SBTool MED

Sustainable Building Tool

Integrated tool and assessment methodology for sustainable buildings in MED cities

Version : 2023-A

ENI CBCMED Cooperating across borders in the Mediterranean

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REGIONE AUTÒNOMA DE SARDIGNA
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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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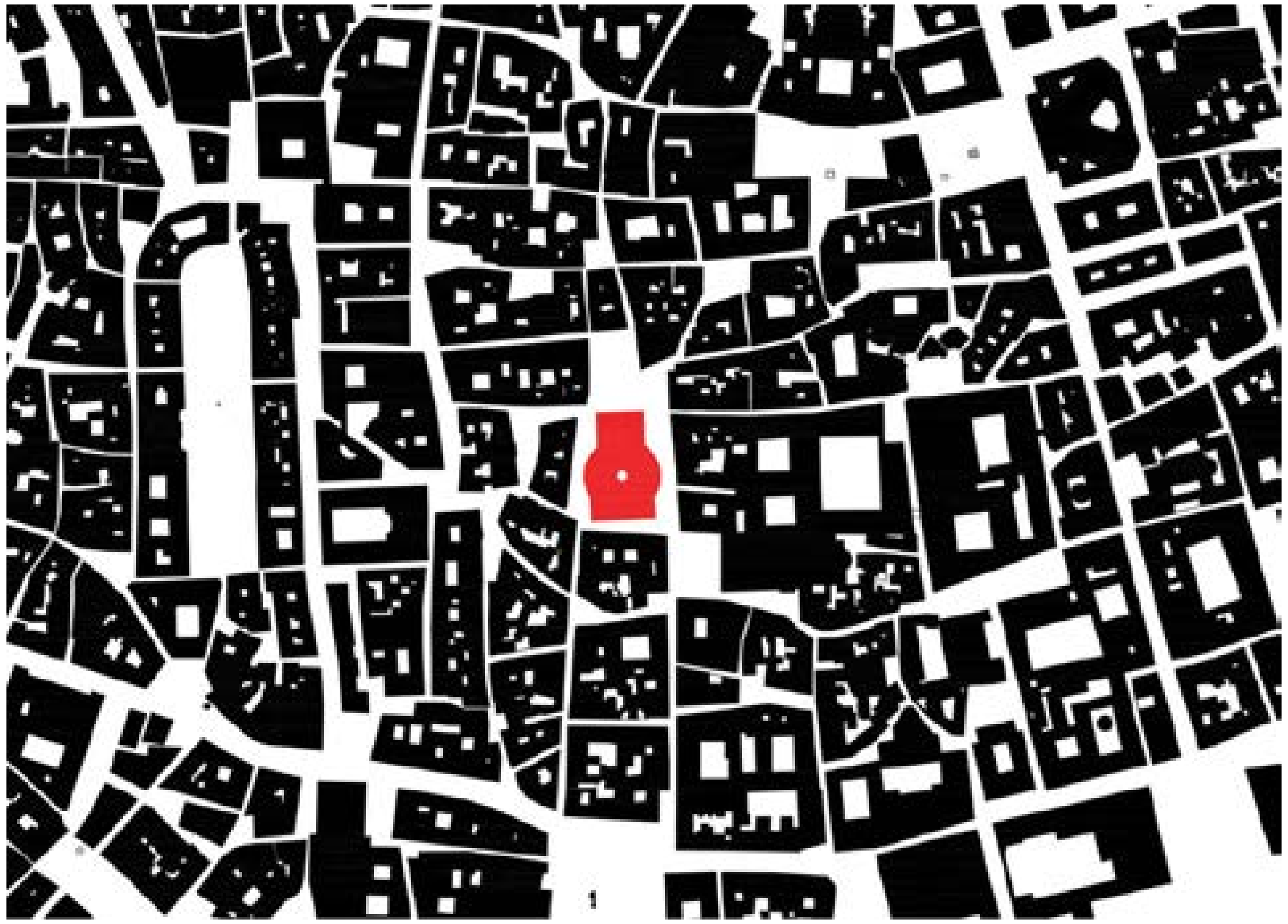

SBTool MED is an assessment system for measuring the sustainability of Mediterranean buildings. It can be used by designers to support integrative design processes and by public authorities to establish verifiable performance targets in policies, programs, and action plans. SBTool MED can be contextualized and adapted to any Mediterranean region and 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 the international version of SBTool on hundreds of buildings 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 using the SBE Method, such as SBTool MED, can be adapted to any context reflecting local priorities and peculiarities. The use of SBTool 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, avoiding the uncertainty and confusion generated using different assessment tools. Any public authority can develop its own SBTool MED version that will provide sustainability assessment results comparable and aggregable with the results of any other local version of the tool. The first version of SBTool for the Mediterranean (SBTool MED) has been developed through the Interreg MED project "CESBA MED: Sustainable Cities", leaded by the City of Torino with the scientific coordination of iiSBE Italia R&D. The other partners of the project were: Government of Catalonia, National Observatory of Athens, AURA-EE, EnvirobatBDM, City of Udine, City of Sant Cugat del Vallés, University of Malta, Energy Institute Hrvoje Požar, CESBA. In the Sustainable MED Cities project, SBTool MED has been updated and upscaled to be applicable to the whole Mediterranean region, taking in account the specific issues of the South and East shores, with the contribution of Greater Irbid Municipality, Municipality of Sousse, Municipality of Moukhtara, UNEP/MAP and MedCities. This publication illustrates the SBE Method, how to contextualise SBTool MED to a specific region or 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 buildings is also explained. SBTool MED is freely available to any public authority in the Mediterranean willing to develop its own sustainability assessment tool at building scale. The use of SBTool contributes to the achievement of the objectives of the Mediterranean Strategy for Sustainable Development.

Andrea Moro

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1. SBE Method

Sustainable Built Environment Method

Mediterranean Buildings 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 buildings overall sustainability.

Main elements:

1. A set of assessment criteria.
2. A set of indicators, which allow to quantify the buildings 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, recognized as relevant for assessing the sustainability of a building. For instance, the issues of SBTool are:

- A - Site Regeneration and Development, Urban Design and Infrastructure
- B - Energy and Resources Consumption
- C - Environmental Loadings
- D - Indoor Environmental Quality
- E - Service Quality
- F - Social, Cultural and Perceptual Aspects
- G - Cost and Economic Aspects
- H - Adaptation to Climate Change

Categories

2

Concern particular aspects of issues. For instance, in the SBTool, the issue E -Service Quality contains 2 categories: E1-Controllability, E2- Optimization and Maintenance of Operating Performance.

- A.1 Site Selection
- A.2 Site development

- B.1 Energy
- B.2 Electrical peak demand
- B.3 Materials
- B.4 Use of potable water, stormwater and greywater

- C.1 Greenhouse Gas Emissions
- C.2 Other Atmospheric Emissions
- C.3 Solid Wastes

- D.1 Indoor Air Quality and Ventilation
- D.2 Air Temperature and Relative Humidity
- D.3 Daylighting and Illumination
- D.4 Noise and Acoustics
- D.5 Noise and Acoustics

- E.1 Controllability
- E.2 Optimization and Maintenance of Operating Performance

- F.1 Social Aspects
- F.2 Perceptual

- G.1 Cost and Economics

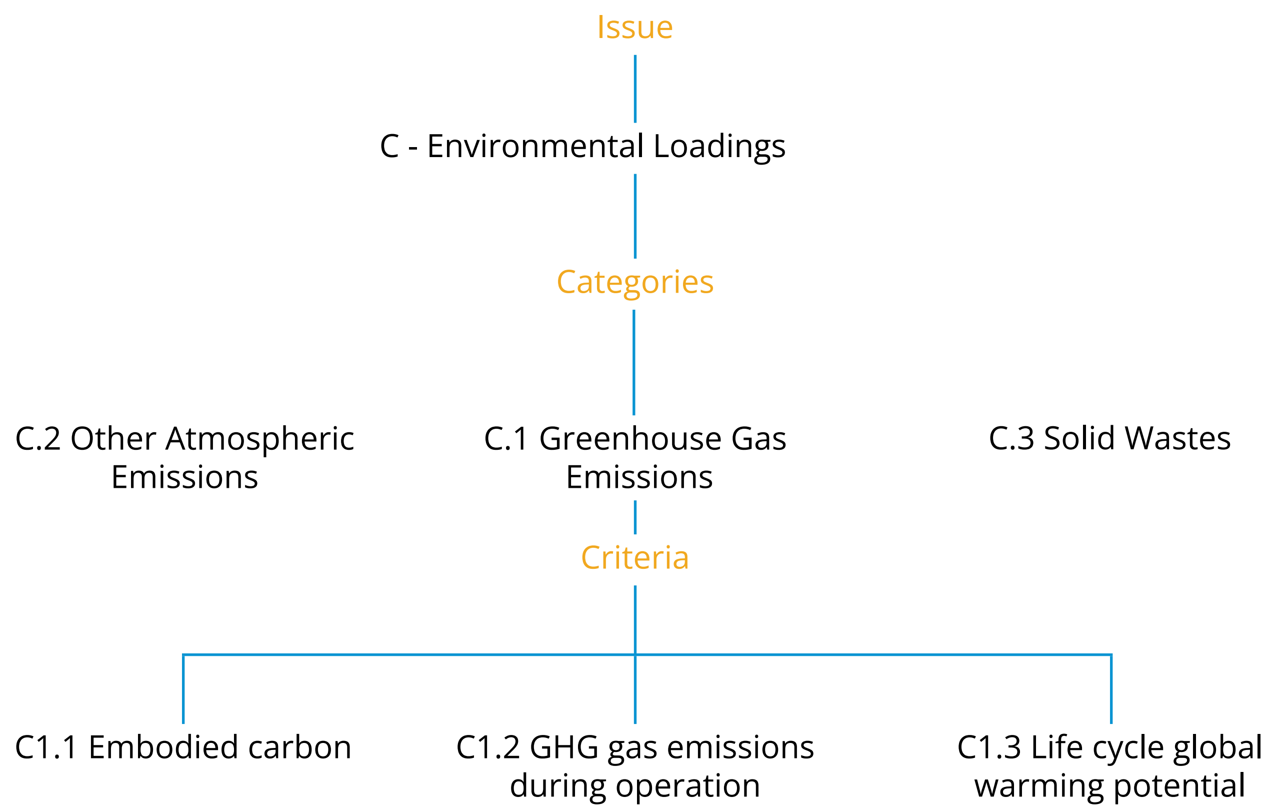
- H.1 Climatic action: increase of temperature
- H.2 Climatic action: pluvial flood
- H.3 Climatic action: fluvial and coastal flood
- H.4 Climatic action: drought
- H.5 Climatic action: fire exposure
- H.6 Climatic action: wind action

Criteria

3

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

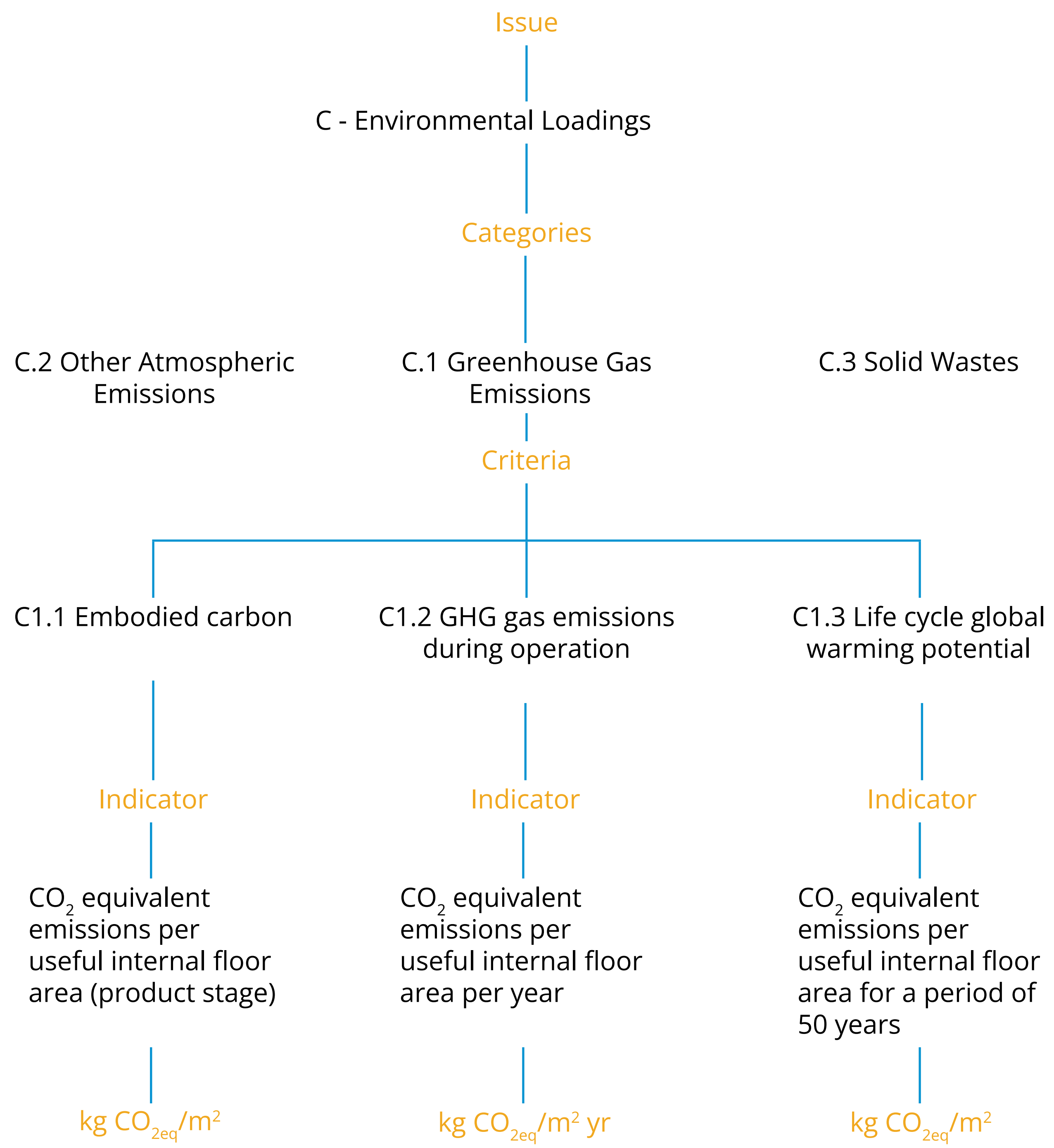
Example:



Indicators

Each criterion is associated to an indicator. They are physical quantities or qualitative scenarios that allow to assess the performance of the buildings 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 summarizes the overall performance of the buildings 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

Assignment 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
Normalized 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 are calculated.

For each criterion, SBTool provides the description of an “Assessment Method” that specifies the calculation procedure.

For the qualitative indicators, the performance of the building is assessed thorough the selection of a reference scenario.

Example:

Code	Criterion	Indicator	Unit of measure	Value
A1.3	Adjacency to existing service infrastructures	Average distance between the site and key existing infrastructures	m	78
B2.1	Electrical peak demand for building operations	Average of peak monthly electrical demand for one year	W/m^2	220
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	%	65
D1.1	Formaldehyde concentration	Formaldehyde concentration in indoor air	$\mu g/m^3$	35
E1.1	Effectiveness of facility management control system	Percentage of control functions within class A	%	78
F1.2	Exposure to sunlight	Hours of sunlight	Hrs	12
G1.3	Maintenance cost	Predicted maintenance cost per useful internal floor area per year	$€/m^2/yr$	50
H4.2	Capacity of greywater collection and storage for non-potable uses	Share of greywater collected and cleaned for reuse	%	38

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.

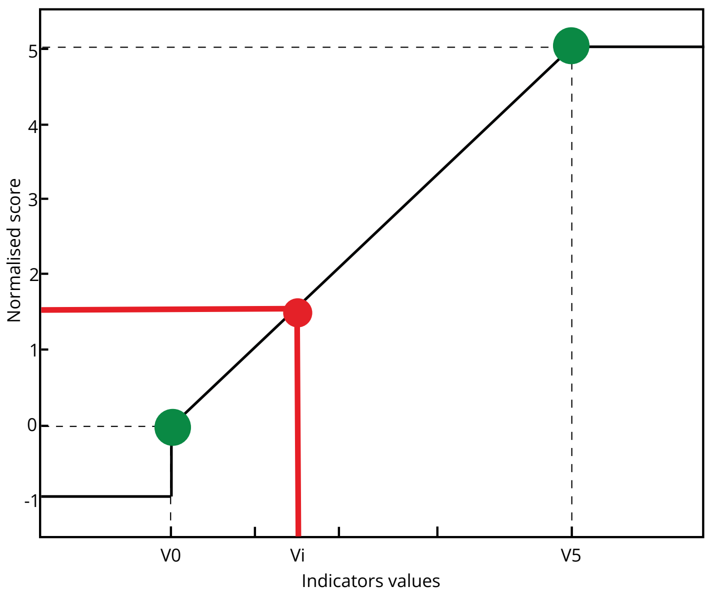
In the other cases, the value of the indicator is normalised through an interpolation.

Base representation:

V0 = value of the indicator for benchmark zero

V5 = value of the indicator for benchmark five

Vi = value of the indicator

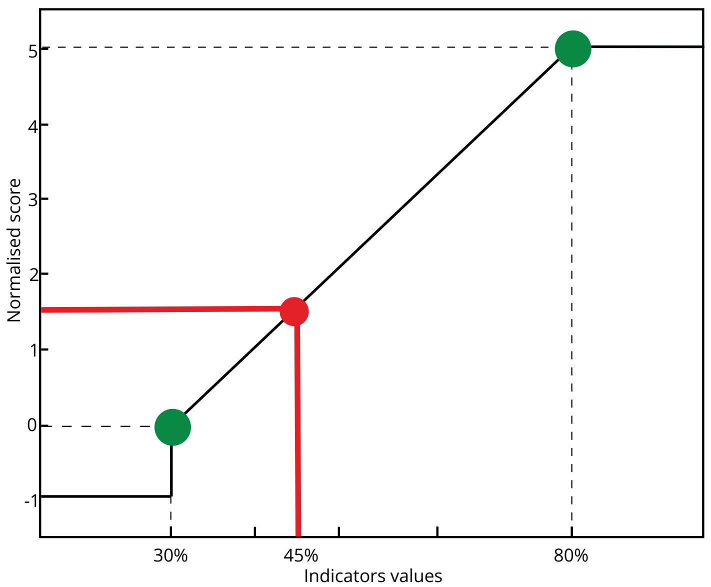


Example:

Criterion:
B2.1- Electrical peak demand for building operation.

Indicator:
Average of peak monthly electrical demand for one year.

Value of the indicator: 45W/m²
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.

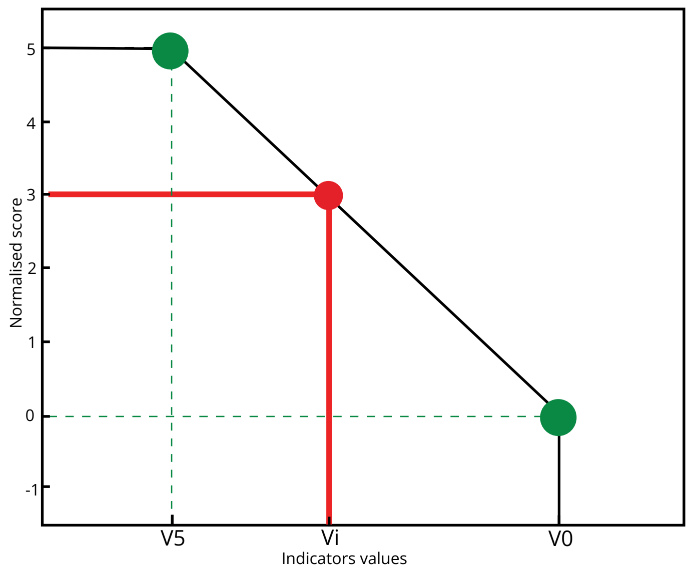
In the other cases, the value of the indicator is normalised through an interpolation.

Base representation:

V0 = value of the indicator for benchmark zero

V5 = value of the indicator for benchmark five

Vi = value of the indicator

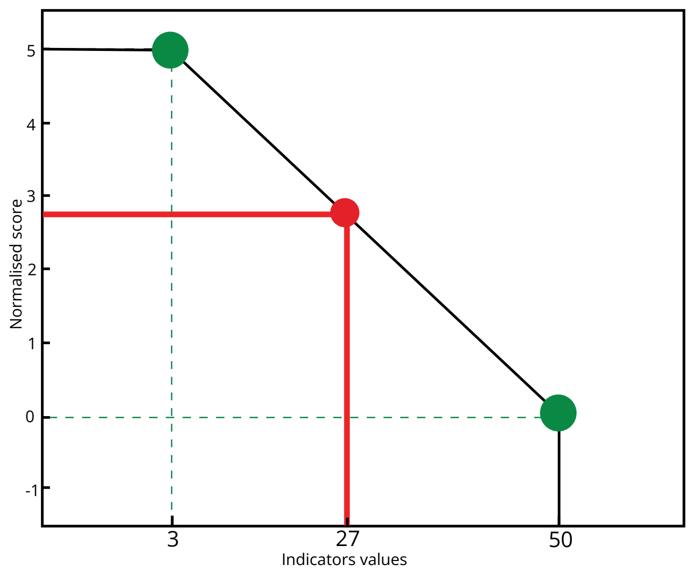


Example:

Criterion:
C3.1 - Construction waste

Indicator:
Weight of waste and materials generated per m² of internal useful floor area.

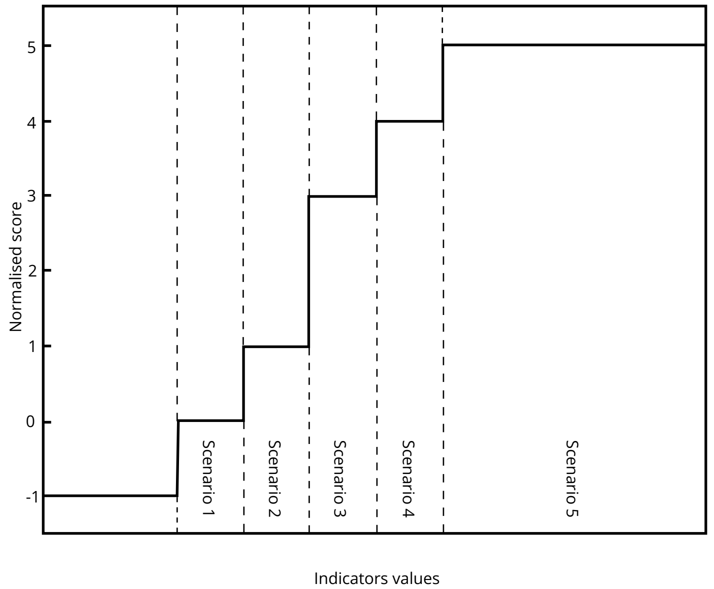
Value of the indicator: 27 kg/m²
Normalised score: 2,7



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 building's performance with reference scenarios which are defined by the indicator associated with the criterion.

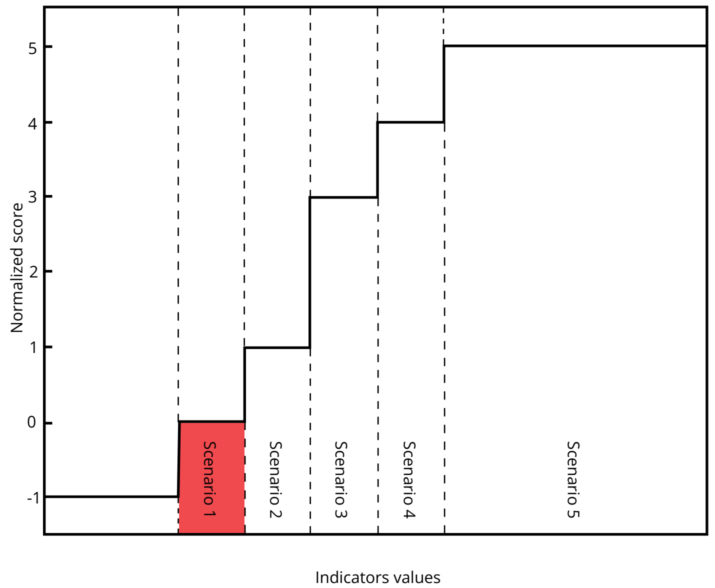


Example:

Criterion:
F2.1 - View out

Indicator:
Quality of view out

Normalisation of the indicator's value: 0



Step 3: Aggregation

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

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 building.

In what follows are used the symbols:

a. Xi the i-th issue. The issues in SBTool are 8, consequently i=1,8. NI is the number of the issues included in SBTool

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.

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

$\omega_{i,j,k}$: 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 SBTool category A1 **Site Selection:**

Code	Criteria	Score	Weight
A1.1	Ecological value of land	3,1	24%
A1.2	Proximity of site to public trans-portation	2,2	34%
A1.3	Adjacency to existing service infrastructures	1,3	16%
A1.4	Proximity to key services	0,5	26%

Calculation of the category's score as weighted sum:

Code	Criteria	Score X Weight	Weighted Score
A1.1	Ecological value of land	3,1*0,24	0,7
A1.2	Proximity of site to public trans-portation	2,2*0,34	0,8
A1.3	Adjacency to existing service infrastructures	1,3*0,16	0,2
A1.4	Proximity to key services	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 SBTool issue A **Site Regeneration and Development, Urban Design and Infrastructure:**

Code	Category	Score	Weight
A1	Site Selection	1,6	30%
A2	Site development	2,6	30%

Calculation of the issue's score as weighted sum:

Code	Category	Score X Weight	Weighted Score
A1	Site Selection	1,6*0,3	0,5
A2	Site development	2,6*0,3	0,8
		Total score of the issue	1,3

Through issues

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

W_i = the weight of each issue included in SBTool

S_i = the score of each issue included in SBTool

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

Example:

Calculation of the first trhee issues overall score for a **building:**

Code	Issue	Score	Weight
A	Site Regeneration and Development, Urban Design and Infrastructure	2,2	8%
B	Energy and Resources Consumption	1,9	13%
C	Environmental Loadings	2,3	10%

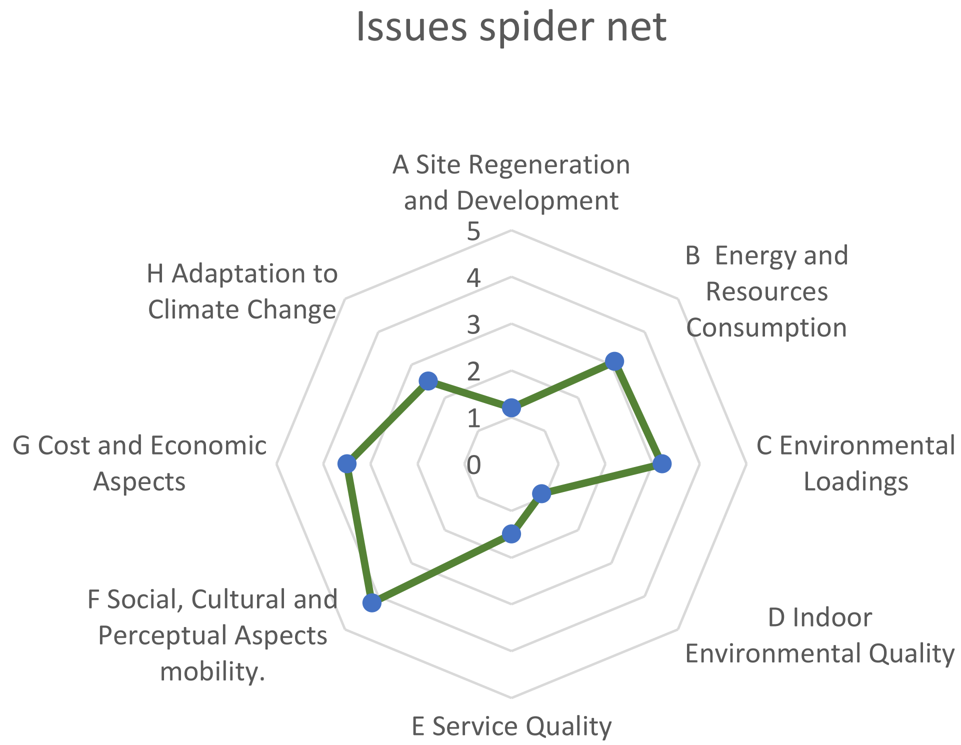
Calculation of the issues overall score as weighted sum:

Code	Issue	Score X Weight	Weighted Score
A	Site Regeneration and Development, Urban Design and Infrastructure	2,2*0,08	0,2
B	Energy and Resources Consumption	1,9*1,3	0,2
C	Environmental Loadings	2,3*0,1	0,2
		Sustainability score	0,6

Assessment`s results

Spider chart:

Easy-to-read representation of the 8 issues score on a scale from 0 (minimum acceptable performance) to 5 (best performance).



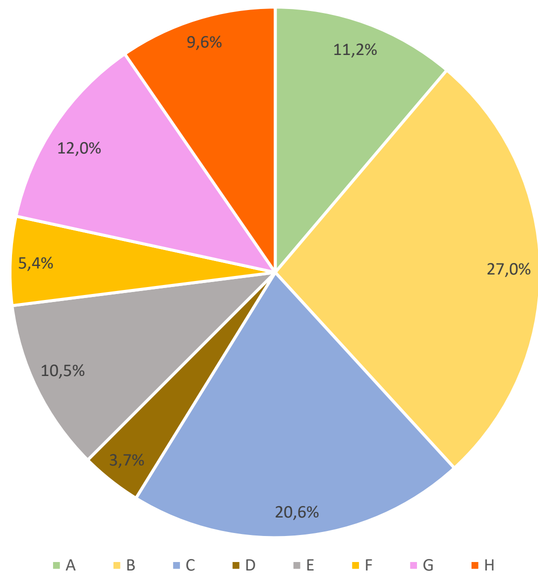
Number of active indicators:

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

The number available criteria is:	80	The number active criteria is:	50

Pie chart:

Percentual contribution weight of each issue to the overall score.



Final score:

Detail of the scores and weights for the 8 issues and overall score.

Issue	Score	Weight	Weighted scores
A Site Regeneration and Development, Urban Design and Infrastructure	1,2	11,2%	0,13
B Energy and Resources Consumption	3,1	27,0%	0,83
C Environmental Loadings	3,2	20,6%	0,66
D Indoor Environmental Quality	0,9	3,7%	0,03
E Service Quality	1,5	10,5%	0,15
F Social, Cultural and Perceptual Aspects	4,2	5,4%	0,22
G Cost and Economic Aspects	3,5	12,0%	0,42
H Adaptation to Climate Change	2,5	9,6%	0,24
		100% Total weight	2,68/5 Total score

Description of the KPIs:

Value of Key performance indicators.

Example:

KPIs Building scale scale		Value	Unit of measurement
B1.1	Primary energy consumption	140	kWh/m²/yr
B1.2	Thermal energy consumption	100	kWh/m²/yr
B1.3	Electrical energy consumption	110	kWh/m²/yr
B1.4	Energy from renewable sources in total thermal energy consumption	42%	%
B1.5	Energy from renewable sources in total electrical energy consumption	53%	%
B1.6	Embodied non-renewable primary energy	5500 MJ/m²	MJ/m²
B3.4	Recycled materials	30%	%
B4.3	Potable water consumption for indoor uses	3000	m³/occupant/yr
C1.1	Embodied carbon	250	kg CO_{2eq}/m²
C1.2	GHG gas emissions during operation	28	kg CO_{2eq}/m² yr
D1.2	TVOC concentration	0.5	µg/m³
D1.7	Mechanical Ventilation	1,2	l/s/m²
D2.3	Thermal comfort index	15%	%
D3.1	Mean Daylight Factor	40	%
E1.2	Smart Readiness Indicator	60	%
G1.4	Energy cost	13,2 €/m²/ yr	€/m²/yr
H1.2	Heat island effect	80	SRI

2. Contextualisation

Definition:

SBTool 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, ready to be used for assessing the sustainability at building scale.

Objectives:

Develop a contextualised version of SBTool 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 SB-Tool. 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 criteria:

A. Site Regeneration and Development, Urban Design and Infrastructure

A1	Site Selection	Justification
A1.2	Proximity of site to public trans-portation	Support the sustainable mo-bility policies and prevent car pollution

B. Energy and Resources Consumption

B2	Electrical peak demand	Justification
B2.1	Total final thermal energy con-sumption for building operations	Achievement of the EU targets and the objectives set by the cov-enant of Mayors

D. Indoor Environmental Quality

D1	Indoor Air Quality and Ventilation	Justification
D1.7	Mechanical Ventilation	Ensuring a constant intake of clean air into the building, regu-lating humidity and, thanks to the heat recovery unit, also ensuring energy savings

F. Social, Cultural and Perceptual Aspects

F1	Social Aspects	Justification
F1.2	Exposure to sunlight	ensuring well-being of the occupants, reducing energy consumption

G. Cost and Economic Aspects

G1	Cost and Economics	Justification
G1.2	Construction cost	avoiding unjustified construc-tion surcharges in relation to standards of Acceptable Prac-tice

H. Adaptation to Climate Change

H1	Climatic action: increase of temperature	Justification
H1.4	Use of vegetation to improve microclimate and cooling during summer	reduction of energy consump-tion for cooling during summer-time, reduction of heat island effect

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

A. Site Regeneration and Development, Urban Design and Infrastructure

Site Selection	A1.2	Unit of measurment	Benchmark	Rationale
A1	Proximity of site to public transportation	index	0 (min): 2,5 5 (max): 20	Protocollo ITACA Nazionale 2011 - Residenziale

B. Energy and Resources Consumption

Electrical peak demand	B2.1	Unit of measurment	Benchmark	Rationale
B2	Electrical peak demand for building operations	W/m²	0 (min): 225,3 5 (max): 9	Min value from typical installed power for heating, cooling, mechanical ventilation, lighting, and equipment for office buildings. Max value based on nZEB buildings

C. Environmental Loadings

Greenhouse Gas Emissions	C1.2	Unit of measurment	Benchmark	Rationale
C1	GHG gas emissions during operation	$kgCO_{2eq}/ m^2$	0 (min): 30 5 (max): 0	technical evaluation Ideal target

D. Indoor Environmental Quality

TVOC concentration in indoor air	D1.4	Unit of measurment	Benchmark	Rationale
D1	Formaldehyde concentration	µg/m³	0 (min): 5000 5 (max): 1000	Measured data operating buildingshttp://www.minerva.unito.it/Chimica&Industria/MonitoraggioAmbientale/A4/Confinati7.htm

E. Service Quality

Optimization and Maintenance of Operating Performance	E2.3	Unit of measurment	Benchmark	Rationale
E1	Retention of as-built documentation	Score	0 (min): 5 (max):	A full set of systems manuals and complete as-built drawings will be been provided. There will be a partial recording, reporting anddocumentation protocol formaintenance.

G. Cost and economics aspects

Cost and economics	G1.4	Unit of measurment	Benchmark	Rationale
G1	Use stage energy cost	€/m²	0 (min): 20 5 (max): 10	Linked to energy target consumption

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

Example:

Issue	Priority factor (1 to 5)	Formula	Weight
A. Site Regeneration and Development, Urban Design and Infrastructure	3	W=(3/20)*100	15%
B. Energy and Resources Consumption	3	W=(3/20)*100	15%
C.Environmental Loadings	2	W=(2/20)*100	10%
D. Indoor Environmental Quality	2	W=(2/20)*100	10%
E. Service Quality	3	W=(3/20)*100	15%
F. Social, Cultural and Perceptual Aspects	3	W=(3/20)*100	15%
G. Cost and Economic Aspects	1	W=(1/20)*100	5%
H. Adaptation to Climate Change	3	W=(3/20)*100	15%
			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

Example:

Category: Adaptation to Climate Change

Category	Priority factor(PF)	Formula	Weight
H1. Climatic action: increase of temperature	3	W=(3/24)*100	12.5%
H2. Climatic action: pluvial flood	4	W=(4/24)*100	16.6%
H3. Climatic action: fluvial and coastal flood	4	W=(4/24)*100	16.6%
H4. Climatic action: drought	5	W=(5/24)*100	20.8%
H5. Climatic action: fire exposure	5	W=(5/24)*100	20.8%
H6. Climatic action: wind action	3	W=(3/24)*100	12.5%
			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.

Impact of potential effect

Minimum	1
Moderation	2
High	3

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.

Extent of potential effect

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

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.

Duration of potential effect

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

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.

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

Example step 1: Impact level assignment

B4 Use of potable water, stormwater and greywater

Criterion	Impact (Pk)	Intensity (Ik)	Extent (Ek)	Duration (Dk)	Adjustment (Ak)
B4.1 Embodied water	12	2	3	2	1
B4.2 Total water consumption	12	2	3	2	1
B4.3 Potable water consumption for indoor uses	12	2	3	2	1
B4.4 Potable water consumption for irrigation	24	2	3	4	1

Example step 2: Weights assignment in the category B4

Criterion	Formula	Weight
B4.1 Embodied water	(12/60)*100	20%
B4.2 Total water consumption	(12/60)*100	20%
B4.3 Potable water consumption for indoor uses	(12/60)*100	20%
B4.4 Potable water consumption for irrigation	(24/60)*100	40%
		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 of-fered in outdoor areas of the build-ing	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/m²/yr
B1.2	Thermal energy consumption	Thermal energy consumption per internal useful floor area per year	kWh/m²/yr
B1.3	Electrical energy consumption	Delivered electrical energy con-sumption per internal useful floor area per year	kWh/m²/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/m²

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/m²

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/m²
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/m²
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}/m²
C1.2	GHG gas emissions during operation	CO2 equivalent emissions per useful internal floor area per year	kg CO_{2eq}/m² 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}/m²

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/m² /yr
C2.2	Emissions of acidifying emissions during facility operations	SO2 equivalent emissions per year in kg per unit net area	g/m² /yr
C2.3	Emissions leading to photo-oxidants during facility operations	Ethene equivalent emissions per useful internal floor area per year	g/m² /yr

C3 Solid Wastes

CODE	CRITERION	INDICATOR	UNIT
C3.1	Construction waste	Weight of waste and materials generated per m² of internal useful floor area	kg/m²
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/m³
D1.2	TVOC concentration	TVOC concentration in indoor air	μg/m³
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/m³
D1.6	Relative humidity	Relative humidity in indoor air	%
D1.7	Mechanical Ventilation	Mechanical ventilation rate per useful internal floor area	l/s/m²

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 filed (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	€/m²/yr
G1.2	Construction cost	Predicted construction cost per useful internal floor area	€/m²
G1.3	Maintenance cost	Predicted maintenance cost per useful internal floor area per year	€/m²/yr
G1.4	Energy cost	Annual energy cost per useful internal floor area	€/m²/yr
G1.5	Water cost	Annual water cost per useful internal floor area	€/m²/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 microclimate 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

A.Site regeneration and development

Description of the Information
A: Issue.
Ax: Category.
A1: Site selection.
A2: Site development.

Ax.x: Criterion.

Intent: Description of the objective of the criterion.

Indicator: Name of the indicator to be calculated.

Unit of Measure: Measuring unit of each indicator.

Standard: The calculation standard for the criterion.

References: The acquiring source of information.

★ Key Performance Indicator

A. Site regeneration and development — SBTool

A1 Site Selection
A1.1 Ecological value of land

Intent: To determine the proportion of land, considered to be of value for ecological or agricultural purposes, that remains undeveloped

Indicator	Unit of Measure
Pre-development ecological value of land	Score

Assessment Methodology:

1. Determine the extension of the area analysed.

2. Determine the undeveloped area of land that is considered by authorities to be of ecological and agricultural value.

3. Calculate the ratio between the undeveloped area and the area analysed.

Standard: -

Reference: 1.CESBA MED Project – SBTool assessment system

A. Site regeneration and development — SBTool

A1 Site Selection
A1.2 Proximity of site to public transportation

Intent: To determine the presence and quality of an on-site public or communal transportation system in large projects so the use o f private vehicles may be minimized.

Indicator	Unit of Measure
Accessibility index to public transportation	Index

Assessment Methodology:

1. Determine the walking distance from the nodes of the public transport network served by trains, buses and trams and the metro.

2. Determine the frequency of the service for public transport lines accessible from the selected nodes.

3. For each transport line selected according to the procedure indicated in the previous points, calculate the following parameters: (see anex one)

Standard: -

Reference: 1.CESBA MED Project – SBTool assessment system

A. Site regeneration and development — SBTool

A1 Site Selection
A1.3 Adjacency to existing service infrastructures

Intent: To discourage the construction of buildings on undeveloped land.

Indicator	Unit of Measure
Average distance between the site and key existing infrastructures.	m

Assessment Methodology:

1. Identify locations of the existing service infrastructures on the site.

2. Calculate the average distance between the site and the key existing infrastructures.

Standard: -

Reference: 1. CESBA MED Project – SBTool assessment system

A. Site regeneration and development — SBTool

A1 Site Selection
A1.4 Proximity to key services

Intent: To determine the accessibility and proximity of key services for local residents (e.g. schools, sports facilities, supermarket, community buildings, etc.).

Indicator	Unit of Measure
Average distance from key services.	m

Assessment Methodology:

1. Identify locations of the key services for local residents on the site.

2. Calculate the average distance between the site and the key services.

Standard: -

Reference: 1. CESBA MED Project – SBTool assessment system.

A. Site regeneration and development — SBTool

A2 Site development
A2.1 Use of native plantings

Intent: To assess the use of native plants for landscaping purposes, in order to reduce the need for irrigation.

Indicator	Unit of Measure
The extent of vegetated landscaped area that is planted with native plants.	%

Assessment Methodology:

1. Calculate the extent of the vegetated landscaped area planted with native species that are drought-resistant, or at least that do not require more irrigation than alternatives.

(A) - numerator

2. calculate the total area landscaped (excluding paved areas).

(B) - denominator

3. Calculate the value of the indicator as

A/B

Standard: -

Reference: 1. CESBA MED Project – SBTool assessment system

A. Site regeneration and development — SBTool

A2 Site development
A2.2 Provision of outdoor recreation areas

Intent: To provide public space and recreation areas for gathering, relaxation and recreation of the population.

Indicator	Unit of Measure
Number of recreation services offered in outdoor areas of the building.	n

Assessment Methodology:

1. Identify the outdoor area of the building

2. Find the recreation services existing in the outdoor area of the building

3. Calculate the number of recreation services offered in outdoor areas of the building

Standard: -

Reference: 1. CESBA MED Project – SBTool assessment system

A. Site regeneration and development — SBTool

A2 Site development
A2.3 Support for bicycle use

Intent: To promote the use of the bicycle as an alternative to the car.

Indicator	Unit of Measure
Percentage of bicycle parking spaces available.	%

Assessment Methodology:

1. Calculate the number of bicycle parking spaces available in the building.

(A) - numerator

2. calculate the number of occupants of the building.

(B) - denominator

3. Calculate the value of the indicator as A/B (%)

Standard: -

Reference: 1. CESBA MED Project – SBTool assessment system

B.Energy & Resources Consumption

Description of the Information

B: Issue.

Bx: Category.

- **B1:** Energy.
- **B2:** Electrical peak demand.
- **B3:** Materials.
- **B4:** Use of potable water, stormwater and greywater.

Bx.x: Criterion.

Intent: Description of the objective of the criterion.

Indicator: Name of the indicator to be calculated.

Unit of Measure: Measuring unit of each indicator.

Standard: The calculation standard for the criterion.

References: The acquiring source of information.

★ Key Performance Indicator

B. Energy and Resources Consumption — SBTool

B1 Energy

B1.1 Primary energy consumption

Intent: To minimise the total energy consumptions in the use stage

Indicator	Unit of Measure
Primary energy consumption per internal useful floor area per year	$kWh/m^2/yr$

Assessment Methodology:

The source of data must always be clearly declared. The underlying calculation method for each sub-indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

Standard: EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings)

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption — SBTool

B1 Energy

B1.2 Thermal energy consumption

Intent: To minimise the total thermal energy consumptions in the use stage

Indicator	Unit of Measure
Thermal energy consumption per internal useful floor area per year	$kWh/m^2/yr$

Assessment Methodology:

The source of data must always be clearly declared. The underlying calculation method for each sub-indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

Standard: EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings)

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption — SBTool

B1 Energy

B1.3 Electrical energy consumption

Intent: To minimise the total electric energy consumptions in the use stage.

Indicator	Unit of Measure
Electrical energy consumption per internal useful floor area per year.	$kWh/m^2/yr$

Assessment Methodology:

The source of data must always be clearly declared. The underlying calculation method for each sub-indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

Standard: EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings)

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption — SBTool

B1 Energy

★B1.4 Energy from renewable sources in total thermal energy consumption

Intent: To maximize the use of renewable energy sources.

Indicator	Unit of Measure
Share of renewable energy in final thermal energy consumptions.	%

Assessment Methodology:

The source of data must always be clearly declared. The underlying calculation method for each sub-indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

Standard: EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings)

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption — SBTool

B1 Energy

B1.5 Energy from renewable sources in total electrical energy consumption

Intent: To maximize the use of renewable energy sources.

Indicator	Unit of Measure
Share of renewable energy in final electric energy consumption	%

Assessment Methodology:

The source of data must always be clearly declared. The underlying calculation method for each sub-indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

Standard: EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings)

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption — SBTool

B1 Energy

★B1.6 Embodied non-renewable primary energy

Intent: To promote the use of construction materials with a low embodied energy.

Indicator	Unit of Measure
Embodied primary non-renewable energy per building's useful internal floor area	MJ/m^2

Assessment Methodology:

To calculate the value of the indicator it is necessary to compile a Bill of Materials (BoM) that is a mass-based inventory of the different materials (kg) that compose a building. The BoM is organised according to main elements that a building is composed of.

The starting point is the Bill of Quantities (BoQ) that specifies the elements of a building (e.g. foundations, columns). The BoQ comprises different categories of elements, which can have different functional performance characteristics.

Standard: ISO 14040/44, EN 15804 EN 15978 (Sustainability of construction works.

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption — SBTool

B2 Electrical peak demand

B2.1 Electrical peak demand for building operations

Intent: To predict the peak monthly electrical demand for building operations, especially where the grid is near peak capacity.

Indicator	Unit of Measure
Average of peak monthly electrical demand for one year	W/m^2

Assessment Methodology:

1. Calculate the average of peak monthly electrical demand for one year, W/m^2, as predicted by means of an acceptable method or tool
   A) - numerator

2. Calculate the area of the building
   B) – denominator

3.Calculate the value of the indicator as A/B.

Standard: -

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption

SBTool

B3 Materials

B3.1 Degree of re-use of suitable existing structure(s)

Intent: To determine if sound structure(s) that exist on the site are to be used as part of the new project.

Indicator	Unit of Measure
Percent, by area, of an existing structure that is re-used.	%

Assessment Methodology:

1.Calculate the area of the existing structure that is re-used
(A) - numerator

2. Calculate the total area of the existing structure
(B) – denominator

3. Calculate the value of the indicator as:

A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption

SBTool

B3 Materials

B3.2 Materials intensity

Intent: To evaluate the material intensity of the building for the structure and the envelope.

Indicator	Unit of Measure
Weight of structural and envelope components per useful floor area.	kg/m^2

Assessment Methodology:

1. Calculate the weight (kg) of structural and envelope components
(A) - numerator

2. Calculate the useful floor area of the building (m^2)
(B) – denominator

3. Calculate the value of the indicator as

A/B

Standard: -

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption

SBTool

B3 Materials

B3.3 Renewable materials

Intent: To promote the use of non-renewable material resource.

Indicator	Unit of Measure
Weight of renewable materials on total weigh of construction materials.	%

Assessment Methodology:

1. Calculate the weight of the renewable materials existing in the building
(A) - numerator

2. Calculate the total weight of the construction material in the building
(B) – denominator

3. Calculate the value of the indicator as
A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption

SBTool

B3 Materials

★B3.4 Recycled materials

Intent: To reduce the environmental impact of construction materials.

Indicator	Unit of Measure
Weight of recycled materials on total weight of materials	%

Assessment Methodology:

To calculate the value of the indicator it is necessary to compile a Bill of Materials (BoM) that is a mass-based inventory of the different materials (kg) that compose a building.

The BoM is organised according to main elements that a building is composed of. The starting point is the Bill of Quantities (BoQ) that specifies the elements of a building (e.g. foundations, columns). The BoQ comprises different categories of elements, which can have different functional performance characteristics.

Standard: EN ISO 14021 (Environmental labels and declarations - Type II environmental labelling)

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption

SBTool

B3 Materials

B3.5 Local materials

Intent: To promote the use of local materials and techniques.

Indicator	Unit of Measure
Weight of local materials on total weight of materials.	%

Assessment Methodology:

1. Calculate the weight of the local materials existing in the building
(A) - numerator

2. Calculate the total weight of the construction material in the building
(B) – denominator

3. Calculate the value of the indicator as:

A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption

SBTool

B3 Materials

B3.6 Design for deconstruction

Intent: To ascertain the degree to which components of the building are easy to disassemble so that they can be re-used or recycled at the end of the service life of the components.

Indicator	Unit of Measure
Circularity potential.	Score

Assessment Methodology:

1. Consult the checklist of deconstruction design concepts in section L1.4 of these instructions and read the associated technical guidance and supporting information that appears later in this document.

Optional:
Seek advice from a demolition contractor or waste management expert with relevant knowledge of the building type and the state of the art in deconstruction techniques and local, regional and/or national end-markets.

Standard: -

Reference: Level(s) indicator 2.4: Design for deconstruction

B. Energy and Resources Consumption

SBTool

B3 Materials

B3.7 Design for adaptability

Intent: To ensure a high degree of adaptability of the structure for different uses.

Indicator	Unit of Measure
Adaptability potential.	Score

Assessment Methodology:

Following Level(s) guideline, evaluate the three key concepts that form the basis for the "adaptability design concept checklist, namely adaptation to:

1. Existing and future occupier needs.

2. Changing future demand in the property market.

3. Life changes in the case of residential property.

Standard: -

Reference: Level(s) indicator 2.3: Design for adaptability and renovation

B. Energy and Resources Consumption

SBTool

B4 Use of potable water, stormwater and greywater

B4.1 Embodied water

Intent: To estimate the amount of fresh water for the building.

Indicator	Unit of Measure
Net fresh water per useful internal floor area.	m^3/m^2

Assessment Methodology:

1. Calculate the amount of fresh water for the building
(A) - numerator

2. Calculate the useful internal floor area of the building
(B) – denominator

3. Calculate the value of the indicator as:
A/B

Standard: -

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption

SBTool

B4 Use of potable water, stormwater and greywater

B4.2 Total water consumption

Intent: To evaluate water resources consumption

Indicator	Unit of Measure
Total consumption of water per building occupant.	m^3/occupant/yr

Assessment Methodology:

1. Calculate the total amount of the water consumption in m3 per year.
(A) - numerator

2.Calculate the total number of occupants .
(B) - denominator

3. Calculate the value of the indicator as:
A/B

Standard: -

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption

SBTool

B4 Use of potable water, stormwater and greywater

B4.3 Potable water consumption for indoor uses

Intent: Make efficient use of water resources.

Indicator	Unit of Measure
Potable water consumption per occupant per yea	m^3/occupant/yr

Assessment Methodology:

The source of data must always be clearly declared. The user must include in the calculation the sanitary devices/fittings (i.e. toilets, taps and showers) and water using appliances (i.e dishwashers and washing machines).

Consumption rates for different sanitary devices and fittings are determined through specific data from suppliers.

Standard: Level(s) Part 1-2 – Beta version

Reference: CESBA MED Project – SBTool assessment system

B. Energy and Resources Consumption

SBTool

B4 Use of potable water, stormwater and greywater

B4.4 Potable water consumption for irrigation

Intent: To predict the amount of water that will be used for irrigation purposes during building operations.

Indicator	Unit of Measure
Potable water consumption standardised potable water consumption.	%

Assessment Methodology:

1. Calculate the total amount of the water consumption in m^3 for irrigation purposes.
(A) - numerator

2. Calculate the standardised potable water consumption in m^3
(B) - denominator

3. Calculate the value of the indicator as:
A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

C.Environmental Loadings

Description of the Information

C: Issue.

Cx: Category.

- **C1:** Greenhouse Gas Emissions.
- **C2:** Other Atmospheric Emissions.
- **C3:** Solid Wastes.

Cx.x: Criterion.

- **Intent:** Description of the objective of the criterion.
- **Indicator:** Name of the indicator to be calculated.
- **Unit of Measure:** Measuring unit of each indicator.
- **Standard:** The calculation standard for the criterion.
- **References:** The acquiring source of information.

★ Key Performance Indicator

C. Environmental loadings — SBTool

C1 Greenhouse Gas Emissions

★C1.1 Embodied carbon

Intent: Promote the use of construction materials with a low embodied carbon

Indicator	Unit of Measure
Embodied carbon dioxide equivalents per building's useful internal floor area	kg CO_2eq/m^2

Assessment Methodology:

1. Identify the basic composition of each building element. The mass of each constituent material has to be estimated.
2. Each material should thereafter be aggregated to obtain the total mass for each type of material.
3. Calculate the embodied carbon of each material by multiplying the specific mass with its corresponding carbon coefficient.
4. Calculate the total useful internal floor area.
5. Calculate the indicator's value as: total embodied carbon of the building / total useful internal floor area.

Standard: EN 15978 "Sustainability of construction works - Assessment of environmental buildings.

Reference: CESBA MED Project – SBTool assessment system

C. Environmental loadings — SBTool

C2 Other Atmospheric Emissions

C2.1 Emissions of ozone-depleting substances during facility operations

Intent: To assess Ozone Depletion from leakage of CFC-11 equivalent

Indicator	Unit of Measure
CFC-11 equivalent emissions per useful internal floor area per year	g/m^2 per yr

Assessment Methodology:

Calculate the amount of CFC-11 equivalent, in grams per m^2 per year

Standard: -

Reference: CESBA MED Project – SBTool assessment system

C. Environmental loadings — SBTool

C2 Other Atmospheric Emissions

C2.2 Emissions of acidifying emissions during facility operations

Intent: To assess the production of atmospheric emissions from building operations that may result in acidification

Indicator	Unit of Measure
SO^2 equivalent emissions per year in kg per unit net area.	kg /m^2 / yr

Assessment Methodology:

Calculate the amount of SO^2 equivalent, in kg per unit net area, per year

Standard: -

Reference: CESBA MED Project – SBTool assessment system

C. Environmental loadings — SBTool

C1 Greenhouse Gas Emissions

★C1.2 GHG gas emissions during operation

Intent: To minimise the total greenhouse gas (GHG) emissions from buildings' operations

Indicator	Unit of Measure
CO2 equivalent emissions per useful internal floor area per year	kg CO_2eq/m^2 /yr

Assessment Methodology:

1. Calculate the total emissions of CO^2 eq. related to building operations.

2. Calculate the useful internal floor area of the building.

3. Calculate the indicator's value as the ratio of the total emissions of CO^2 eq. related to building operations to the useful internal floor area.

Standard: EN 15603 (Energy performance of buildings)

Reference: CESBA MED Project – SBTool assessment system

C. Environmental loadings — SBTool

C1 Greenhouse Gas Emissions

C1.3 Life cycle global warming potential

Intent: To minimise the total greenhouse gas (GHG) emissions from buildings for a period of 50 years.

Indicator	Unit of Measure
CO_2equivalent emissions per useful internal floor area for a period of 50 years.	kg CO_2eq/m^2

Assessment Methodology:

1. Consult the checklist of life cycle design concepts in section L1.4.
2. Make a review of relevant LCA/whole life carbon studies of similar building types in the same country.
3. Interpret and identify 'hot spots' and recommendations for improvements along the building.
4. Review and identify options for using the life cycle design concepts and for addressing the hot spots identified from previous studies.
5. Record the life cycle design concepts that were taken into account using the L1 reporting format.

Standard: EN 15603 (Energy performance of buildings).

Reference: Level(s) indicator 1.2: Life cycle Global Warming Potential (GWP)

C. Environmental loadings — SBTool

C2 Other Atmospheric Emissions

C2.3 Emissions leading to photo-oxidants during facility operations

Intent: To minimize the production of atmospheric emissions from building operations that may result in photo-oxidants

Indicator	Unit of Measure
Ethene equivalent per year in grams per net unit area	g /m^2/ yr

Assessment Methodology:

Calculate the amount of ethene equivalent per year in grams per net unit area per year

Standard: -

Reference: CESBA MED Project – SBTool assessment system

C. Environmental loadings — SBTool

C3 Solid Wastes

C3.1 Construction waste

Intent: To minimize the production of construction waste

Indicator	Unit of Measure
Weight of waste and materials generated per m^2 of internal useful floor area	kg/m^2

Assessment Methodology:

1. Calculate the weight (kg) of waste and materials generated

(A) - numerator

2. Calculate the useful floor area of the building (m^2)

(B) – denominator

3. Calculate the value of the indicator as

A/B

Standard: EN 15978 (Sustainability of construction works)

Reference: CESBA MED Project – SBTool assessment system

C. Environmental loadings

SBTool

C3 Solid Wastes

C3. 2 Solid waste from building operations

Intent: To facilitate the separate collection and recycle of solid waste from building operation

Indicator	Unit of Measure
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	%

Assessment Methodology:

1. Identify the availability and position of bins and containers for each of the seven solid waste categories.
2. Calculate the walking distance (m) from the building's main entrance to each identified bin or container.
3. Evaluate how many of the 7 categories of solid waste is possible to collect within a 100 m walking distance from the building's entrance (A).

4. Calculate the value of the indicator as: A/7.

Standard: -

Reference: CESBA MED Project – SBTool assessment system

D.Indoor Environmental Quality

Description of the Information

D: Issue.

Dx: Category.

- D1: Indoor Air Quality and Ventilation.
- D2: Air Temperature and Relative Humidity.
- D3: Daylighting and Illumination.
- D4: Noise and Acoustics.
- D5: Electromagnetic pollution.

Dx.x: Criterion.

Intent: Description of the objective of the criterion.

Indicator: Name of the indicator to be calculated.

Unit of Measure: Measuring unit of each indicator.

Standard: The calculation standard for the criterion.

References: The acquiring source of information.

★ Key Performance Indicator

D. Indoor Environmental Quality

SBTool

D1 Indoor Air Quality and Ventilation

D1.1 Formaldehyde concentration

Intent: To assess the risk of occupants being exposed to hazardous levels of mold spores

Indicator	Unit of Measure
Formaldehyde concentration in indoor air	$\mu g/m^3$

Assessment Methodology:

The measures must be performed within the longer permanence rooms and in the main areas of the building. At least 3 measures must be performed in the selected rooms, for a minimum duration of 30 minutes.
To properly conduct the measurement, the absorbing material tester for formaldehyde is located on a tripod, at a height of 1.5 metres. To assess the level of formaldehyde concentration, it must be evaluated the average concentration based on the sum of the individual measurements carried out.

Standard: EN 16516: Assessment of release of dangerous substances.Determination of emissions into indoor air.

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality

SBTool

D1 Indoor Air Quality and Ventilation

★D1.2 TVOC concentration

Intent: To facilitate the assessment of indoor air quality.

Indicator	Unit of Measure
TVOC concentration in indoor air	$\mu g/m^3$

Assessment Methodology:

The indicator value for the building is then calculated as a weighted average of the corresponding measurements. For each pollutant measured, is to be checked the quantitative increase of the indoor air value in relation to the external air value.
The instruments to be utilised for the measurement may vary in relation to what pollutant is necessary to assess, in most cases VOCs detectors are used, located on tripod at a height of 1.5 metres.
It is recommended to perform the measurement for a period sufficient to establish the TVOCs concentration level trend (not less than a week)

Standard: EN 16516: Assessment of release of dangerous substances.Determination of emissions into indoor air.

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality

SBTool

D1 Indoor Air Quality and Ventilation

D1.3 CO^2 concentrations

Intent: To assess the predicted or actual carbon dioxide concentrations in typical primary occupancy areas

Indicator	Unit of Measure
CO^2concentration in indoor air.	ppm

Assessment Methodology:

The measurement of the CO^2 concentration must be performed in all the main rooms with full occupancy of the building, measuring at the same time the CO^2 concentration in indoor air and the CO^2 concentration in outdoor air.

The measurement is performed using carbon dioxide detectors.

Standard: EN 16798: 2019 Energy performance of buildings - Ventilation for buildings.

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality

SBTool

D1 Indoor Air Quality and Ventilation

D1.4 Low emitting materials

Intent: To evaluate the emission class of finishing materials, promoting low emitting material

Indicator	Unit of Measure
Mean emission class of finishing materials.	index

Assessment Methodology:

1. Calculate the extension (m²) of the internal finishing materials of the building, identifying each of them.

2. For each finishing material identified, check its class of emission and the related index.

3. Make a weighted average for each finishing material, as described in the formula below:

$$Z_m = \frac{\sum(Zpj \; x \; Spj)}{\sum S_{pj}}$$

Standard: UNI EN ISO 16000-9:2006 UNI EN ISO 16000-10:2006 UNI EN ISO 16000-11:2006

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality

SBTool

D1 Indoor Air Quality and Ventilation

D1.5 Radon

Intent: To reduce radon concentration in indoor air

Indicator	Unit of Measure
Radon concentration in indoor air	Bq/m³

Assessment Methodology:

The measurement of the radon concentration must be performed in all the main rooms with full occupancy of the building, using a dosimeter that must be located:
1. At a height from the floor of about 1,5 m possibly hanging on the walls;
2. Away from windows and doors;
3. Away from heat sources and direct light;
4. Not inside cabinets or drawers.

Measurement duration can vary from 1 month up to 6 months.

Standard: Level(s) (the European framework for sustainable buildings)

Reference: -

D. Indoor Environmental Quality

SBTool

D1 Indoor Air Quality and Ventilation

D1.6 Relative humidity

Intent: To assess indoor thermal comfort conditions in relation to the relative humidity

Indicator	Unit of Measure
Relative humidity in indoor air	%

Assessment Methodology:

After the completion of a building, it is important to evaluate the internal air relative humidity in order to check the level of drying of construction materials.
The measurement of the internal air relative humidity could be performed using a datalogger, by evaluating also the thermohygrometric conditions in the area considered within the measurement.

Standard: EN 15251: 2007 Indoor Environmental Criteria. EN 16798: 2019 Energy buildings

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality

SBTool

D1 Indoor Air Quality and Ventilation

D1.7 Mechanical Ventilation

Intent: To assess indoor thermal comfort conditions in relation to the mechanical ventilation rate

Indicator	Unit of Measure
Mechanical ventilation rate per useful internal floor area	l/s/m²

Assessment Methodology:

The standard defines three different methods for the assessment of the air quality.
Method 1: based on perceived air quality.
Method 2: based on the use of limit values for the concentration of pollutants.
Method 3: based on pre-defined ventilation flow rates.
In term of accuracy of the final result, method 1 is the one to be preferred and the calculation methodology is described in short below.
The ventilation rate is calculated by combining the share of ventilation to dilute and/or remove pollutants produced by occupants with the share of ventilation to dilute and/or remove pollutants produced by buildings (materials, components, etc.) and by the installations.

Standard: EN 16798-1: 2019 EN 12599: 2012 CEN/TR 16798-2

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality
SBTool

D2 Air Temperature and Relative Humidity

D2.1 Time outside of the thermal comfort range (heating season)

Intent: To assess indoor thermal comfort conditions

Indicator	Unit of Measure
Percentage of the time out of the range of defined interior maximum and minimum temperatures during the heating season	%

Assessment Methodology:

Calculation of the reported performance shall be in accordance with the method described in Annex F of EN 15251 and/or an overheating assessment that forms part of a National Calculation Method.

Buildings with and without mechanical cooling shall be assessed.

The quasi-steady state and simplified hourly methods described in EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling) may be used.

Standard: EN 15251, EN ISO 13790

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality
SBTool

D2 Air Temperature and Relative Humidity

D2.2 Time outside of the thermal comfort range (cooling season)

Intent: To assess indoor thermal comfort conditions

Indicator	Unit of Measure
Percentage of the time out of the range of defined interior maximum and minimum temperatures during the cooling season	%

Assessment Methodology:

Calculation of the reported performance shall be in accordance with the method described in Annex F of EN 15251 and/or an overheating assessment that forms part of a National Calculation Method.

Buildings with and without mechanical cooling shall be assessed.

The quasi-steady state and simplified hourly methods described in EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling) may be used.

Standard: EN 15251, EN ISO 13790

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality
SBTool

D2 Air Temperature and Relative Humidity

★D2.3 Thermal comfort index

Intent: To facilitate the assessment of indoor thermal comfort conditions during the cooling season

Indicator	Unit of Measure
Predicted Percentage of Dissatisfied in cooling season	%

Assessment Methodology:

The indicator can be calculated both at the design and at the in use stage, calculation steps are the following:
a) Estimate or Measure PMV
b) Calculate PPD
Calculations are performed in all spaces with characteristic functions of the building (e.g. office spaces, meeting room, cafeteria), different orientations (e.g. on the side of a façade facing the street), and floors (e.g. first, middle and last floor). Calculations are also performed in spaces where the most extreme values of the thermal parameters are observed or anticipated (e.g. occupied areas near windows, diffuser outlets, corners, entries). The indicator value for the building is then calculated as a weighted average of the corresponding values.

Standard: EN ISO 7730, EN 16798-1:2017

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality
SBTool

D3 Daylighting and Illumination

D3.1 Daylight

Intent: To ensure an adequate level of daylighting in all primary occupied spaces

Indicator	Unit of Measure
Mean Daylight Factor	%

Assessment Methodology:

The daylight provision is calculated in new buildings and under major renovation buildings accordingly to EN 17037. Paragraph 5.1.3 fully describes the two possible calculation methods:
Method 1) Calculation method using daylight factors on the reference plane.
1. Identify the grid of points on the plane
2. Predict the daylight factors across the plane
3. Calculate the target daylight factor DT and DTM
4. Ensure that the daylight factors equal or exceed the target values (DTM and DT).

Standard: CEN European Daylight Standard EN 17037

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality
SBTool

D3 Daylighting and Illumination

D3.2 Daylight Provision

Intent: To evaluate if the level of daylight provision is sufficient to carry out the task

Indicator	Unit of Measure
Level of daylight provision	Level

Assessment Methodology:

Following what stated in EN 17037 (Section 5 Assessment of Daylight in Interior Spaces):
1. Calculate the level of daylight provision necessary to perform the task, also taking into account:
2. External obstruction.
3. Glazing transmittance.
4. Thickness of walls and roofs.
5. Internal partition and surface reflectance.

Standard: CEN European Daylight Standard EN 17037 – Daylighting in buildings

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality
SBTool

D3 Daylighting and Illumination

D3.3 Protection from Glare

Intent: To ensure that glare conditions are minimized in main occupancy areas during periods of maximum exterior brightness, through the use of exterior or interior shading

Indicator	Unit of Measure
DGP (Daylight Glare Probability)	Number

Assessment Methodology:

Following what stated in EN 17037 (Section 5.4 Assessment of Daylight in Interior Spaces):

Glare shall be measured by the contrast between window areas and adjacent wall areas, as seen from the interior.

Standard: CEN European Daylight Standard EN 17037 – Daylighting in buildings

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality
SBTool

D4 Noise and Acoustics

D4.1 Protection from noise: façade insulation

Intent: Ensure that noise attenuation through the wall facing the noisiest site boundary is adequate to provide interior noise levels that will not interfere with normal tasks

Indicator	Unit of Measure
$D_{2m,nT,w}$ - Weighted standardized level difference for traffic noise	dB

Assessment Methodology:

Evaluate the protection from noise coming from the outside using the calculation method described in EN 12354-3.

It is necessary to be aware of the design aspects and the related factors that influence the incorporation of design features and material selection to address acoustic performance. Each aspect informs what is required to ensure that the right decisions are made at concept design stage and in order to achieve better outcomes at later stages.

Standard: Level(s) indicator 4.4: Acoustics and protection against noise

Reference: References: EN 12354-3

D. Indoor Environmental Quality
SBTool

D4 Noise and Acoustics

D4.2 Protection from airborne noise within adjacent spaces

Intent: To ensure that measures have been taken to reduce airborne noise impacts between all tenancies and occupancy types

Indicator	Unit of Measure
R'w - Weighted apparent sound reduction index	dB

Assessment Methodology:

Following what stated in Level(s):
- Evaluate the protection from airborne noise within adjacent rooms and spaces or buildings following the EN 12354-1.

It is necessary to be aware of the design aspects and the related factors that influence the incorporation of design features and material selection to address acoustic performance. Each aspect informs what is required to ensure that the right decisions are made at concept design stage and in order to achieve better outcomes at later stages.

Standard: Level(s) indicator 4.4: Acoustics and protection against noise

Reference: EN 12354-1

D. Indoor Environmental Quality

SBTool

D4 Noise and Acoustics

D4.3 Protection from the sound of impacts within adjacent spaces

Intent: To ensure that measures have been taken to reduce noise impacts between all tenancies and occupancy types

Indicator	Unit of Measure
L'n,w - Weighted normalized impact sound pressure level	dB

Assessment Methodology:

Following what stated in Level(s):
- Evaluate the protection from the sound of impacts within adjacent spaces or on an adjacent floor or wall following the EN 12354-2.

It is necessary to be aware of the design aspects and the related factors that influence the incorporation of design features and material selection to address acoustic performance. Each aspect informs what is required to ensure that the right decisions are made at concept design stage and in order to achieve better outcomes at later stages.

Standard: Level(s) indicator 4.4: Acoustics and protection against noise

Reference: EN 12354-2

D. Indoor Environmental Quality

SBTool

D4 Noise and Acoustics

D4.4 Protection from noise generated by service equipment

Intent: To ensure that measures have been taken to reduce noise impacts generated by service equipment

Indicator	Unit of Measure
LAeq,nT - A-weighted standardized continuous sound pressure level	dB

Assessment Methodology:

Evaluate the protection from noise generated by service equipment following the EN 12354-5.

It is necessary to be aware of the design aspects and the related factors that influence the incorporation of design features and material selection to address acoustic performance. Each aspect informs what is required to ensure that the right decisions are made at concept design stage and in order to achieve better outcomes at later stages.

Standard: Level(s) indicator 4.4: Acoustics and protection against noise

Reference: EN 12354-5

D. Indoor Environmental Quality

SBTool

D4 Noise and Acoustics

D4.5 Reverberation time

Intent: To evaluate the time required for the sound in a room to decay over a specific dynamic range when a source is suddenly interrupted

Indicator	Unit of Measure
T - Reverberation time	%

Assessment Methodology:

Calculate the time required for the sound pressure level in a room to decrease by 60dB after the sound source has stopped.

It is necessary to be aware of the design aspects and the related factors that influence the incorporation of design features and material selection to address acoustic performance. Each aspect informs what is required to ensure that the right decisions are made at concept design stage and in order to achieve better outcomes at later stages

Standard: Level(s) indicator 4.4: Acoustics and protection against noise

Reference: EN 12354-6

D. Indoor Environmental Quality

SBTool

D5 Electromagnetic pollution

D5.1 *Minimisation of exposition to ELF magnetic fields*

Intent: To evaluate the strategies adopted to minimise the exposition to ELF magnetic fields

Indicator	Unit of Measure
Strategies adopted to minimise the exposition to ELF magnetic fields	Score

Assessment Methodology:

Evaluate the typologies of strategies adopted to minimise the exposition to ELF magnetic fields during the design stage

Standard: -

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality

SBTool

D5 Electromagnetic pollution

D5.2 Level of ELF magnetic fields

Intent: To minimise the exposure to the ELF magnetic fields

Indicator	Unit of Measure
Mean level of magnetic induction (50/60 Hz)	μt

Assessment Methodology:

1. Check for the presence and location of industrial frequency magnetic field sources inside or in the immediate proximity of the building
2. Measure the level of magnetic induction in all the main rooms adjacent to internal sources of industrial frequency magnetic field and in those close to external sources of industrial frequency magnetic field.

Exposure Level	Impact
> 2 μt in one or more rooms	-10
> 1 μt in one or more rooms	-5
< 1 μt in one or more rooms	0
< 0,5 μt in one or more rooms	+5
< 0,2 μt in one or more rooms	+10

Standard: -

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality

SBTool

D5 Electromagnetic pollution

D5.3 Minimisation of exposition to High Frequency Electromagnetic Fields

Intent: To evaluate the strategies adopted to minimise the exposition to High Frequency Electromagnetic Fields

Indicator	Unit of Measure
Strategies adopted to minimise the exposition to High Frequency Electromagnetic fields	Score

Assessment Methodology:

Evaluate the typologies of strategies adopted to minimise the exposition to High Frequency Electromagnetic fields

Standard: -

Reference: CESBA MED Project – SBTool assessment system

D. Indoor Environmental Quality

SBTool

D5 Electromagnetic pollution

D5.4 Level of High Frequency Electromagnetic Fields

Intent: To minimise the level of exposure to High Frequency Electromagnetic fields

Indicator	Unit of Measure
Mean level of electric filed (100 kHz- 3GHz)	V/m

Assessment Methodology:

1. Check for the presence and location of radio frequency electromagnetic field sources and microwaves inside or in the proximity of the building
2. Measure the electric field level in all main rooms
3. On the basis of the measurements made, check the impact value of the electromagnetic field sources according to the following table:

Exposure Level	Impact
Mean value < 0,8 V/m in one or more rooms	-10
Mean value between 0,8 and 1,9 V/m in one or more rooms	-5
Mean value between 2 and 4,5 V/m in one or more rooms	+5
Mean value > 4,5 V/m in one or more rooms	+10

Standard: -

Reference: CESBA MED Project – SBTool assessment system

E.Service Quality

Description of the Information

E: Issue.

Ex : Category.

- **E1: Controllability.**
- **E2: Optimization and Maintenance of Operating Performance**

Ex.x : Criterion.

Intent: Description of the objective of the criterion.

Indicator: Name of the indicator to be calculated.

Unit of Measure: Measuring unit of each indicator.

Standard: The calculation standard for the criterion.

References: The acquiring source of information.

★ Key Performance Indicator

E. Service Quality

SBTool

E1 Controllability

E1. 1 Effectiveness of facility management control system

Intent: To evaluate the effectiveness of facility management control system within the building

Indicator	Unit of Measure
Percentage of control functions within class A	%

Assessment Methodology:

1. Calculate the number of control functions within class A

   (A) - numerator

2. Calculate the total number of control functions

   (B) - denominator

3. Calculate the value of the indicator as

   A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

E. Service Quality

SBTool

E1 Controllability

★E1. 2 Smart Readiness Indicator

Intent: Reach more energy efficient, environmentally friendly, healthy and comfortable indoor environments. Assesses the smartness of a building.

Indicator	Unit of Measure
Total smart readiness of buildings for responding to the needs of occupants, optimizing energy performance, and interacting with energy grids	%

Assessment Methodology:

Method A - Simplified method (e.g. Existing buildings with low complexity)
1. Use with a simplified service catalogue (Verbeke et al. 2020) that includes only 27 pre-defined services for existing residential buildings or small non-residential buildings that have low complexity

2. Use a check-list

3. Complete assessment in less than an hour

4. Suitable for a self-assessment of a building

Standard: Adopted by the revised Energy Performance of Buildings Directive 2018 EPBD and its subsequents

Reference: European Commission in response to an EPBD mandate

E. Service Quality

SBTool

E2 Optimization and Maintenance of Operating Performance

E2. 1 Existence and implementation of a maintenance management plan

Intent: To ensure the availability and implementation of a plan for the long-term maintenance and efficient operation of the facility

Indicator	Unit of Measure
The availability of a comprehensive and long-term plan at the end of Design phase, and evidence of its implementation during Operations phase	Score

Assessment Methodology:

Check the availability and the content of the maintenance management plan of the building

Standard: -

Reference: CESBA MED Project – SBTool assessment system

E. Service Quality

SBTool

E2 Optimization and Maintenance of Operating Performance

E2. 2 On-going monitoring and verification of performance

Intent: To ensure the ongoing optimization of building energy and water consumption performance over time

Indicator	Unit of Measure
The provision of energy sub-metering systems and water consumption monitoring systems, according to design documentation	Score

Assessment Methodology:

Check the availability and the content of the building documentation, with special emphasis on the capability of the computerized building management system to manage the gathering and analysis of data from many dispersed locations

Standard: -

Reference: CESBA MED Project – SBTool assessment system

E. Service Quality

SBTool

E2 Optimization and Maintenance of Operating Performance

E2. 3 Retention of as-built documentation

Intent: Ensure that as-built architectural, mechanical and electrical drawings, and equipment manuals are available to operating staff and owners

Indicator	Unit of Measure
The scope and quality of design documentation retained for use by building operators, according to design documentation	Score

Assessment Methodology:

Check the availability and the content of the building documentation especially the availability of the as-built architectural, mechanical and electrical drawings and equipment manuals, to operating staff and owners, so that they will be able to operate the building efficiently

Standard: -

Reference: CESBA MED Project – SBTool assessment system

F. Social, Cultural and Perceptual Aspects

Description of the Information

F: Issue.

Fx : Category.

- **F1: Social aspects.**
- **F2: Perceptual .**

Fx.x : Criterion.

Intent: Description of the objective of the criterion.

Indicator: Name of the indicator to be calculated.

Unit of Measure: Measuring unit of each indicator.

Standard: The calculation standard for the criterion.

References: The acquiring source of information.

★ Key Performance Indicator

F. Social, Cultural and Perceptual Aspects — SBTool

F1 Social Aspects

F1. 1 Universal access on site and within the building

Intent: To assess the relative ease of access and use of facilities for persons with mobility or perceptual disabilities

Indicator	Unit of Measure
The scope and quality of design measures planned to facilitate access and use of building facilities by persons with disabilities	Score

Assessment Methodology:

Check the documentation content of the building in relation to the design features that impair or support the use of the building and its systems by persons with physical impairments, including mobility, visual or auditory types

Standard: -

Reference: CESBA MED Project – SBTool assessment system

F. Social, Cultural and Perceptual Aspects — SBTool

F1 Social Aspects

F1. 2 Exposure to sunlight

Intent: To assess the extent to which principal daytime living areas of dwelling units in the building have direct sunlight

Indicator	Unit of Measure
Hours of sunlight	Hrs

Assessment Methodology:

Calculate the number of hours of dwelling units whose principal daytime living areas have direct sunlight

Standard: -

Reference: CESBA MED Project – SBTool assessment system

F. Social, Cultural and Perceptual Aspects — SBTool

F2 Perceptual

F2. 1 View out

Intent: To assess the quality of view out of the building

Indicator	Unit of Measure
Quality of view out	Score

Assessment Methodology:

Following what stated in EN 17037 (Section 5 Assessment of Daylight in Interior Spaces, Annex C):

Evaluate the quality of view out taking into account that view to the outside provides visual connection with the surroundings to supply information about the local environment, weather changes and the time of day. This information can relieve the fatigue associated with long periods of being indoors. A view is considered to comprise three distinct layers:

1. A layer of sky;
2. A layer of landscape;
3. A layer of ground.

Standard: CEN European Daylight Standard EN 17037 – Daylighting in buildings

Reference: CESBA MED Project – SBTool assessment system

G. Cost and Economic Aspects

Description of the Information

G: Issue.

Gx : Category.

G1: Cost and economics.

Gx.x : Criterion.

Intent: Description of the objective of the criterion.

Indicator: Name of the indicator to be calculated.

Unit of Measure: Measuring unit of each indicator.

Standard: The calculation standard for the criterion.

References: The acquiring source of information.

★ Key Performance Indicator

G. Cost and Economic Aspects — SBTool

G1 Cost and Economics

G1.1 Life-cycle cost

Intent: To assess the level of total Life Cycle Cost of the building

Indicator	Unit of Measure
Life cycle cost (production and construction, use and end of life) per useful internal floor area per year	€/m²/yr

Assessment Methodology:

1. Calculate the life cycle cost related to the production, construction, use and end of life of the building (€) per year
2. Calculate the useful internal floor area (m²)
3. Calculate the value of the indicator as €/m²/year

Standard: -

Reference: CESBA MED Project – SBTool assessment system

G. Cost and Economic Aspects — SBTool

G1 Cost and Economics

G1.2 Construction cost

Intent: To assess the difference between the capital cost of the Design with that of a reference building designed according to standards of Acceptable Practice

Indicator	Unit of Measure
Predicted construction cost per useful internal floor area	€/m²

Assessment Methodology:

Calculation steps:

1. Evaluate the predicted construction cost of the building (€)
2. Calculate the useful internal floor area (m²)
3. Calculate the value of the indicator as €/m²

Standard: -

Reference: CESBA MED Project – SBTool assessment system

G. Cost and Economic Aspects — SBTool

G1 Cost and Economics

G1.3 Maintenance cost

Intent: To assess the difference between the operating and maintenance cost of the Design with that of a reference building designed according to standards of Acceptable Practice

Indicator	Unit of Measure
Predicted maintenance cost per useful internal floor area per year	€/m²/yr

Assessment Methodology:

1. Evaluate the predicted maintenance cost of the building (€) per year
2. Calculate the useful internal floor area (m²)
3. Calculate the value of the indicator as €/m²/year

Standard: -

Reference: CESBA MED Project – SBTool assessment system

G. Cost and Economic Aspects — SBTool

G1 Cost and Economics

★ G1.4 Energy cost

Intent: To optimize the operating cost of buildings to reflect the potential for long term performance

Indicator	Unit of Measure
Annual energy cost per useful internal floor area	€/m²/yr

Assessment Methodology:

Calculation steps:

1. Estimate the annual energy cost of the building (€)
2. Calculate the useful internal floor area (m²)
3. Calculate the value of the indicator as €/m²/year

Standard: Level(s) Part 1-2 – Beta version

Reference: CESBA MED Project – SBTool assessment system

G. Cost and Economic Aspects — SBTool

G1 Cost and Economics

G1.5 Water cost

Intent: To optimize the operating cost of buildings to reflect the potential for long term performance

Indicator	Unit of Measure
Annual water cost per useful internal floor area	€/m²/yr

Assessment Methodology:

Calculation steps:

1. Estimate the water annual cost of the building (€)
2. Calculate the useful internal floor area (m²)
3. Calculate the value of the indicator as €/m²/year

Standard: Level(s) Part 1-2 – Beta version

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change

Description of the Information

H: Issue.

Hx: Category.

H1: Climatic action: increase of temperature.
H2: Climatic action: pluvial flood.
H3: Climatic action: fluvial and coastal flood.
H4: Climatic action: drought.
H5: Climatic action: fire exposure.
H6: Climatic action: wind action.

Hx.x: Criterion.

Intent: Description of the objective of the criterion.
Indicator: Name of the indicator to be calculated.
Unit of Measure: Measuring unit of each indicator.
Standard: The calculation standard for the criterion.
References: The acquiring source of information.

★ Key Performance Indicator

H. Adaptation to climate change — SBTool

H1 Climatic action: increase of temperature

H1.1 Time outside of the thermal comfort range – 2050

Intent: To assess indoor thermal comfort conditions over the long term

Indicator	Unit of Measure
Percentage of the time out of range from defined maximum temperatures during the cooling seasons	%

Assessment Methodology:

Calculation of the reported performance shall be in accordance with the method described in Annex F of EN 15251 and/or an overheating assessment that forms part of a National Calculation Method.

Buildings with and without mechanical cooling shall be assessed. The quasi-steady state and simplified hourly methods described in EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling) may be used.

Standard: EN 15251, EN ISO 13790

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change — SBTool

H1 Climatic action: increase of temperature

★ H1.2 Heat island effect

Intent: To reduce the heat island effect, to reduce the discomfort at ground level during summer

Indicator	Unit of Measure
Mean Solar Reflectance Index of paved surfaces and roofs in the area	SRI

Assessment Methodology:

Calculation steps:

1. Identify the boundaries of the building being assessed.
2. Identify all the horizontal surfaces and roofs in the area.
3. Calculate the extension (m²) of each surface identified and classify them in relation to the cover material.
4. Multiply each surface previously identified by the corresponding solar reflectance index.
5. Sum the weighed surfaces obtained.
6. Calculate the weighted value of the index for the building as the ratio of the sum of products to the total area of all horizontal surfaces and roofs.

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change — SBTool

H1 Climatic action: increase of temperature

H1.3 Shading of building envelope by vegetation

Intent: To encourage the use of trees for sequestration of carbon dioxide, and to reduce energy use for cooling of the building, by providing evapotranspiration and shading of the building during the hot season

Indicator	Unit of Measure
Percent of building envelope with orientation between West and South-East that will be covered by vegetation during the warm season	%

Assessment Methodology:

1. Calculate the area of building envelope with orientation between West and South-East that will be covered by vegetation during the warm season (m²)
(A) - numerator

2. Calculate the total area of the building envelope (m²)
(B) - denominator

3. Calculate the value of the indicator as
A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change — SBTool

H1 Climatic action: increase of temperature

H1.4 Shading of building envelope by vegetation

Intent: To assess the role of vegetation on the site and on roofs in cooling ambient conditions through evapotranspiration

Indicator	Unit of Measure
Leaf Area Index: ratio of total vegetated surface area (on ground and on roofs, and including trees), divided by total site area	%

Assessment Methodology:

1. Calculate the total vegetated surface area (on ground and on roofs, and including trees) (m²)

(A) - numerator

2. Calculate the total area of the site (m²)

(B) - denominator

3. Calculate the value of the indicator as

A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change — SBTool

H2 Climatic action: pluvial flood

H2.1 Stormwater retention capacity on site

Intent: To evaluate the level of retention capacity of the building

Indicator	Unit of Measure
Share of the onsite stormwater retention capacity in relation to the optimal retention capacity	%

Assessment Methodology:

1. Calculate the amount of onsite stormwater retention capacity of the building

(A) - numerator

2. Calculate the optimal retention capacity of the building
(B) - denominator

3. Calculate the value of the indicator as

A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change — SBTool

H2 Climatic action: pluvial flood

H2.2 Permeability of land

Intent: To improve the permeability of the area

Indicator	Unit of Measure
Share of the site that is permeable to water	%

Assessment Methodology:

1. Calculate the size (Sa) of the area where the building is located (m²).

2. Calculate the size of the surfaces with a different paving or occupied by the building (i.e. green areas, surfaces paved with asphalt, surfaces occupied by buildings, etc.). Include all the surfaces in the area.

3.Calculate the real permeability of soil considering the permeability coefficient of each surface.

4.Calculate the indicator's value.

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change — SBTool

H3 Climatic action: fluvial and coastal flood

H3.1 Risk to occupants and facilities from flooding

Intent: To assess the vulnerability of the building to flood risk

Indicator	Unit of Measure
Strategies to reduce the vulnerability of occupants and facilities to floods	Score

Assessment Methodology:

Evaluate the strategies to reduce the vulnerability of occupants and facilities to floods

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change

SBTool

H4 Climatic action: drought

H4.1 Capacity of rainwater collection and storage for non-potable uses

Intent: To promote rainwater collection and storage for re-use

Indicator	Unit of Measure
Share of rainwater collected and stored for reuse from roofs and plot's paved area	%

Assessment Methodology:

1. Calculate the quantity of rainwater collected and stored for reuse from roofs and plot's paved area

(A) - numerator

2. Calculate the maximum rainwater collectable from roofs and plot's paved area

(B) - denominator

3. Calculate the value of the indicator as

A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change

SBTool

H4 Climatic action: drought

H4.2 Capacity of greywater collection and storage for non-potable uses

Intent: To promote greywater collection for re-use

Indicator	Unit of Measure
Share of greywater collected and cleaned for reuse	%

Assessment Methodology:

1. Calculate the quantity of greywater collected and cleaned in the building

(A) - numerator

2. Calculate the maximum greywater collectable in the building

(B) - denominator

3. Calculate the value of the indicator as

A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change

SBTool

H5 Climatic action: fire exposure

H5.1 Fire-resistance of the envelope

Intent: To assess wildfire risk of the building

Indicator	Unit of Measure
Level of use of certified fire-retardant materials in the envelope	Score

Assessment Methodology:

Calculate the share of certified fire-retardant materials used for the envelope of the building

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change

SBTool

H5 Climatic action: fire exposure

H5.2 Fireproof ground

Intent: To assess wildfire risk of the building

Indicator	Unit of Measure
Level of use of certified fire-retardant materials for paving	Score

Assessment Methodology:

Calculate the share of certified fire-retardant materials used for the paving of the building

Standard: -

Reference: CESBA MED Project – SBTool assessment system

H. Adaptation to climate change

SBTool

H6 Climatic action: wind action

H6.1 Windproof envelope

Intent: To assess windproof risk of the building envelope

Indicator	Unit of Measure
Level of use of certified wind resistant materials in the envelope	%

Assessment Methodology:

1. Calculate the weight (kg) of certified wind resistant materials used for the envelope of the building

(A) - numerator

2. Calculate the total weight (kg) of materials used for the envelope of the building

(B) – denominator

3. Calculate the value of the indicator as

A/B (%)

Standard: -

Reference: CESBA MED Project – SBTool assessment system

4.Key performance indicators

Definition:

KPIs are a set of assessment criteria that during the contextualisation process must be included in the local versions of the SBTool MED.

There are 17 key performance indicators :

A. Site Regeneration and Development : 0
B. Energy and Resources Consumption: 8
C. Environmental Loadings: 2
D. Indoor Environmental Quality: 4
E. Service Quality: 1
F. Social, Cultural and Perceptual Aspects: 0
G. Cost and Economic Aspects: 1
H. Adaptation to Climate Change: 1

B1 Energy

B1.1 Primary energy consumtion

Intent: To minimise the total energy consumptions in the use stage

Indicator	Unit of Measure
Primary energy consumption per internal useful floor area per year	$kWh/m^2/yr$

Assessment Methodology:

To perform the calculation, it is possible to use:

metered or estimated data.

The source of data must always be clearly declared. The underlying calculation method for each sub-indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

The CEN standards series that currently forms the basis for most of national calculation methods includes EN 15603 (Energy performance of buildings. Overall energy use and definition of energy ratings) and EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling).

This means that most national calculation methods that are required to be used to meet performance requirements or to complete Energy Performance Certificates (EPCs), and which are aligned with the EN standards series, can be used.

In-built lighting may not be specifically covered in all national or regional calculation methods. As a result, either the omission from the calculations, or a separate calculation method if used, shall be noted in the reporting. The reference standard for lighting estimates shall be EN 15193.

The unit of measure is kilowatt hours per square metre per year. The reference unit is one square meter of useful internal floor area (Level(s) Part 3 – 1.3.1).

Standard:
Level(s) Part 1-2 – Beta version.
EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings)

Reference:
CESBA MED Project - SBTool Assessment System

B1 Energy

B1.2 Thermal energy consumption

Intent: To minimise the total thermal energy consumptions in the use stage

Indicator	Unit of Measure
Thermal energy consumtion per internal useful floor area per year	$kWh/m^2/yr$

Assessment Methodology:

To perform the calculation, it is possible to use:

metered or estimated data.

The source of data must always be clearly declared. The underlying calculation method for estimating each sub-indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

The CEN standards series that currently forms the basis for most of national calculation methods includes EN 15603 (Energy performance of buildings. Overall energy use and definition of energy ratings) and EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling).

This means that most national calculation methods that are required to be used to meet performance requirements or to complete Energy Performance Certificates (EPCs), and which are aligned with the EN standards series, can be used. The unit of measure is kilowatt hours per square meter per year. The reference unit is one square meter of useful internal floor area (Level(s) Part 3 – 1.3.1).

In case of existing buildings, the delivered thermal energy should be evaluated using data from metering. The metered delivered thermal energy demand (i.e. fuel consumption data) has to be calculated taking the average value over 3 years period.

Standard:
Level(s) Part 1-2 – Beta version.
EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings).

Reference:
CESBA MED Project - SBTool Assessment System

B1 **Energy**

★B1.3 **Electrical energy consumption**

Intent: To minimise the total electric energy consumptions in the use stage

Indicator	Unit of Measure
Electrical energy consumtion per internal useful floor area per year	kWh/m²/yr

Assessment Methodology:

To perform the calculation, it is possible to use:

metered or estimated data.

The source of data must always be clearly declared. The underlying calculation method for estimating the indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

The CEN standards series that currently forms the basis for most of national calculation methods includes EN 15603 (Energy performance of buildings. Overall energy use and definition of energy ratings) and EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling).

This means that most national calculation methods that are required to be used to meet performance requirements or to complete Energy Performance Certificates (EPCs), and which are aligned with the EN standards series, can be used. The unit of measure is kilowatt hours per square meter per year. The reference unit is one square meter of useful internal floor area (Level(s) Part 3 – 1.3.1).

In case of existing buildings, the delivered electrical energy should be evaluated using data from metering. The metered delivered electric energy demand (i.e. electricity consumption data) has to be calculated taking the average value over 3 years period bills.

Standard:
Level(s) Part 1-2 – Beta version.
EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings).

Reference:
CESBA MED Project - SBTool Assessment System

B1 **Energy**

★B1.4 **Energy from renewable sources in total thermal energy consumption**

Intent: To maximize the use of renewable energy sources

Indicator	Unit of Measure
Share of renewable energy in final thermal energy consumptions	%

Assessment Methodology:

To perform the calculation, it is possible to use:

metered or estimated data.

The source of data must always be clearly declared. The underlying calculation method for the indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

The CEN standards series that currently forms the basis for most of national calculation methods. In case of existing buildings, the share of renewable energy in total final thermal energy consumptions should be evaluated by energy metering.

Note: According to the Renewables Energy Directive (RED 2018),energy from renewable sources means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases. Heat pumps enabling the use of aerothermal, geothermal or hydrothermal heat at a useful temperature level need electricity or other auxiliary energy to function. The energy used to drive heat pumps should therefore be deducted from the total usable heat. Only heat pumps for which SPF > 1,15 * 1/η shall be taken into account.

Standard:
Level(s) Part 1-2 – Beta version.
EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings).
Directive 2009/28/EC (RES Directive).
2013/114/EU: Commission Decision of 1 March 2013

Reference:
CESBA MED Project - SBTool Assessment System

B1 **Energy**

★B1.5 **Energy from renewable sources in total electrical energy consumption**

Intent: To maximize the use of renewable energy sources

Indicator	Unit of Measure
Share of renewable energy in final electrical energy consumption	%

Assessment Methodology:

To perform the calculation, it is possible to use:

metered or estimated data.

The source of data must always be clearly declared. The underlying calculation method for the indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

The CEN standards series that currently forms the basis for most of national calculation methods. In case of existing buildings, the share of renewable energy in total final electric energy consumption should be evaluated by energy metering.

Note: According to the Renewables Energy Directive (RED 2018), energy from renewable sources means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases. Heat pumps enabling the use of aerothermal, geothermal or hydrothermal heat at a useful temperature level need electricity or other auxiliary energy to function. The energy used to drive heat pumps should therefore be deducted from the total usable heat. Only heat pumps for which SPF > 1,15 * 1/η shall be taken into account.

Standard:
Level(s) Part 1-2 – Beta version.
EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings).
Directive 2009/28/EC (RES Directive).
2013/114/EU: Commission Decision of 1 March 2013.

Reference:

CESBA MED Project - SBTool Assessment System

B1 **Energy**

★B1.6 **Embodied non-renewable primary energy**

Intent: To promote the use of construction materials with a low embodied energy

Indicator	Unit of Measure
Embodied primary non-renewable energy per building's useful internal floor area	MJ/m²

Assessment Methodology:

To calculate the value of the indicator it is necessary to compile a Bill of Materials (BoM) that is a mass-based inventory of the different materials (kg) that compose a building. The BoM is organised according to main elements that a building is composed of. The starting point is the Bill of Quantities (BoQ) that specifies the elements of a building (e.g. foundations, columns).
The BoQ comprises different categories of elements, which can have different functional performance characteristics. BoM differs from a BoQ in that it describes the different materials (e.g. concrete, steel, aluminium) that are contained in the various building elements. Once the BoM has been compiled, it is possible to calculate the value of the indicator.

The following steps should be followed in order to compile the BoM:

1. Compile the Bill of Quantities: A BoQ is compiled which comprises the building elements accounting for at least 99% of the mass of the building.

2. Identify the basic composition of each building element. A breakdown of its constituent materials has to be carried out. The mass of each constituent material has to be estimated.

3. Aggregation by material: The mass for each constituent material should thereafter be aggregated to obtain the total mass for each type of material.

Once the BoM has been compiled, it is possible to calculate the indicator associating to each constituent material the relative embodied primary non-renewable energy by multiplying the specific mass (i.e. kg) with its corresponding embodied energy coefficient (i.e. MJ/kg).

The total value of embodied primary non-renewable energy is finally normalized by the internal useful floor area of the building.

Standard:
ISO 14040/44, EN 15804 (Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products)
EN 15978 (Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method)

Reference:

CESBA MED Project - SBTool Assessment System

B3 Materials

B3.4 Recycled materials

Intent: To reduce the environmental impact of construction materials

Indicator	Unit of Measure
Weight of recycled materials on total weight of materials	%

Assessment Methodology:

To calculate the value of the indicator it is necessary to compile a Bill of Materials (BoM) that is a mass-based inventory of the different materials (kg) that compose a building.

The BoM is organised according to main elements that a building is composed of. The starting point is the Bill of Quantities (BoQ) that specifies the elements of a building (e.g. foundations, columns). The BoQ comprises different categories of elements, which can have different functional performance characteristics.

A BoM differs from a BoQ in that it describes the different materials (e.g. wood, steel, aluminium) that are contained in the various building elements. Once the BoM has been compiled, it is possible to calculate the value of the indicator.

The following steps should be followed in order to characterize the indicator:

1. Compile the Bill of Quantities: A BoQ is compiled which comprises the building elements accounting for at least 99% of the mass of the building.

2. Identify the basic composition of each building element. A breakdown of its constituent materials has to elaborated. The mass of each constituent material has to be estimated.

3. Aggregation by material: the mass of all constituent material should thereafter be aggregated to obtain the total mass of materials used in the building (A).

4. Identify the recycled content of each constituent material (in mass).

5. Aggregation by material: the recycled mass of all constituent materials should thereafter be aggregated to obtain the total recycled mass of materials (B) used in the building.

6. The indicator's value is calculated as B/A (total mass of recycled materials on the total mass of materials).

Standard:
ISO 14040/44, EN 15804 (Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products)
EN 15978 (Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method)

Reference:
CESBA MED Project - SBTool Assessment System

B4 Use of potable water, stormwater and greywater

B4.3 Potable water consumption for indoor uses

Intent: Make efficient use of water resources

Indicator	Unit of Measure
Potable water consumption per occupant per year	m^3/occupant/yr

Assessment Methodology:

To perform the calculation, it is possible to use metered or estimated data.

The source of data must always be clearly declared. The user must include in the calculation the sanitary devices/fittings (i.e. toilets, taps and showers) and water using appliances (i.e dishwashers and washing machines). Consumption rates for different sanitary devices and fittings are determined through specific data from suppliers. The specific usage factors have to be established. The number of days that the building is expected to be occupied per year has to be defined by the user.

The principle of the per occupant potable water consumption calculation for taps and showers is as follows:

$$\text{Total consumption} \left(\frac{L}{occupant.d}\right) = \text{consumption rate} \left(\frac{L}{min}\right) \text{ x usage factor} \left(\frac{min}{occupant.d}\right)$$

$$\text{Total consumption} \left(\frac{m^3}{occupant.year}\right) = \text{total consumption} \left(\frac{L}{occupant.d}\right) \text{ x } 0.001\left(\frac{m^3}{L}\right) \text{ X occupancy rate} \left(\frac{d}{year}\right)$$

The exact same principle applies for calculations for toilets (except that flushes are used instead of minutes).

For cleaning, the basis of the calculation is as follows:

$$\text{Total consumption} \left(\frac{L}{year}\right) = \text{consumption rate} \left(\frac{L}{m^2}\right) \text{ X area } (m^2) \text{ X no. cleans per year } (year^{-1})$$

$$\text{Total consumption} \left(\frac{m^3}{occupant.year}\right) = \text{Total consumption} \left(\frac{L}{year}\right) \text{ X } 0.001 \left(\frac{m^3}{L}\right) \div \text{full time eqivt. Occupancy}$$

In case of existing buildings, the potable area water consumptions should be evaluated using data from metering. The metered consumptions have to be estimated taking the average value over 3 years period bills.

Standard:
Level(s) Part 1-2 – Beta version

Reference:
CESBA MED Project - SBTool Assessment System

C1 Greenhouse Gas Emissions

★C1.1 Embodied carbon

Intent: Promote the use of construction materials with a low embodied carbon.

Indicator	Unit of Measure
Embodied carbon dioxide equivalents per building's useful internal floor area	kg CO^2eq/m^2

Assessment Methodology:

The calculation steps are:

1. Identify the basic composition of each building element. A breakdown of its constituent materials has to be carried out. The mass of each constituent material has to be estimated.

2. Aggregate by material: The mass for each constituent material should thereafter be aggregated to obtain the total mass for each type of material.

3. Calculate the embodied carbon of each material by multiplying the specific mass with its corresponding carbon coefficient (use national coefficients, if available or international data bases, for example, (ICE Database). The coefficients are quantified in kilograms of CO^2 equivalent (kgCO^2eq) per unit mass (kg) of the material or sometimes also expressed per unit area of material (kgCO^2eq/m2).

4. Calculate the total useful internal floor area .

5. Calculate the indicator's value as:
total embodied carbon of the building / total useful internal floor area.

Standard:

EN 15978 "Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method".
European Platform on Life Cycle Assessment, European Commission. https://eplca.jrc.ec.europa.eu/?page_id=86
ICE Database, Inventory of Carbon and Energy, Circular Ecology.
IEA Evaluation of Embodied Energy and CO2eq for Building Construction (Annex 57), International Energy Agency.
ISO 14040/44, EN 15804 (Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products).

Reference:

CESBA MED Project - SBTool Assessment System

C1 Greenhouse Gas Emissions

★C1. 2 GHG gas emissions during operation

Intent: To minimise the total greenhouse gas (GHG) emissions from buildings' operations

Indicator	Unit of Measure
CO^2 equivalent emissions per useful internal floor area per year	kg CO^2 eq/m² /yr

Assessment Methodology:

To characterize the indicator's value:
1. Calculate the total emissions of CO^2 eq. related to building operations, using the following formula:

$$E=\frac{\sum_1^i(Qfuel,i\ x\ LHVi)+(Qel\ x\ Kem)+(Qdhc\ x\ Kem.dhc)}{A_u}$$

Where:
Qfuel,i = total quantity of annual fuel consumption of i-th fuel (e.g. m3 for gas or lt for oil)
LHVi = lower heating value of the i-th fuel (e.g. kWhth/m³ or kWhth/lt)
kem,i = LCA CO^2 eq. emission factor of the i-th fuel (kg CO^2 eq./kWhth)
Qel = total quantity of annual electrical energy from the grid (kWhe)
kem = LCA CO^2 eq. emission factor of the electrical energy from the grid (kg CO^2 eq./kWhe)
Qdhc = total quantity of annual energy from district heating/cooling (kWhth)
kem,dhc = LCA CO^2 eq. emission factor of energy from district heating/cooling (kg CO^2eq./kWhth)
Au = useful internal floor area (m²)

2. Calculate the useful internal floor area of the building.

3. Calculate the indicator's value as the ratio of the total emissions of CO^2 eq. related to building operations to the useful internal floor area.

Standard:

EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings).
Level(s) Part 1-2 – Beta version.

Reference:

CESBA MED Project - SBTool Assessment System

D1 Indoor Air Quality and Ventilation

★D1.2 TVOC concentration

Intent: To facilitate the assessment of indoor air quality

Indicator	Unit of Measure
TVOC concentration in indoor air	µg/ m^3

Assessment Methodology:

Assessment approach (as built/in-use):

After the completion of a building, it is important to evaluate the internal air TVOCs concentration level for the health of future occupants.

The measurement of the TVOCs in as built phase could be performed both in presence of mechanical ventilation and in case of natural ventilation.

The measurements of the TVOCs concentration levels must be performed in all spaces with characteristic functions of the building (e.g. office spaces, meeting room, cafeteria), different orientations (e.g. on the side of a façade facing the street), and floors (e.g. first, middle and last floor). The indicator value for the building is then calculated as a weighted average of the corresponding measurements. For each pollutant measured, is to be checked the quantitative increase of the indoor air value in relation to the external air value.

The reference values for the TVOCs in indoor air are highlighted in the WHO guidelines.

The instruments to be utilised for the measurement may vary in relation to what pollutant is necessary to assess, in most cases VOCs detectors are used, located on tripod at a height of 1.5 metres.

It is recommended to perform the measurement for a period sufficient to establish the TVOCs concentration level trend (not less than a week).

Note: in the in-use phase, all the variants that may affect the measure must be noticed, as for example: number of occupants, smoking habit, typology of the furniture, etc.

Standard:

Level(s) (the European framework for sustainable buildings) indicator 4.1: Indoor air quality. Document developed by European Commission - Joint Research Centre, January 2021.
EN 16516: construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air.
ISO 16000-6:2021 - Indoor air — Part 6: Determination of organic compounds (VVOC, VOC, SVOC) in indoor.

Reference:

CESBA MED Project - SBTool Assessment System

D1 Indoor Air Quality and Ventilation

★D1.7 Mechanical Ventilation

Intent: To assess indoor thermal comfort conditions in relation to the mechanical ventilation rate

Indicator	Unit of Measure
Mechanical ventilation rate per useful internal floor area	l/s/m^2

Assessment Methodology:

Calculation method (design):

The underlying calculation method for the ventilation rate at the detailed design phase is provided by the "EN 16798-1 - Energy performance of buildings - Ventilation for buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics".
The standard defines three different methods for the assessment of the air quality.

Method 1: based on perceived air quality.
Method 2: based on the use of limit values for the concentration of pollutants.
Method 3: based on pre-defined ventilation flow rates.

In term of accuracy of the final result, method 1 is the one to be preferred and the calculation methodology is described in short below.
The ventilation rate is calculated by combining the share of ventilation to dilute and/or remove pollutants produced by occupants with the share of ventilation to dilute and/or remove pollutants produced by buildings (materials, components, etc.) and by the installations.

Assessment approach (as built and in-use):

The metering strategies for the measurement of the ventilation rate in as-built performance and in-use phase are different but all useful to evaluate the real performance of the building. The reference standardto be used is the EN 12599: 2012 which provides test methods and measuring instruments to assess the air flow injected by the terminals of a mechanical ventilation system measuring the velocity of the outgoing air using different methodologies (different kind of anemometers could be used)

The standard applies to ventilation and air conditioning systems designed for the maintenance of comfort conditions in buildings.

Testing during occupation captures any additional impacts on IAQ caused by the activities of occupants and the installation of furniture and equipment.

Standard:

Level(s) (the European framework for sustainable buildings) indicator 4.1: Indoor air quality. Document developed by European Commission - Joint Research Centre, January 2021.
EN 16798-1: 2019 Energy performance of buildings - Ventilation for buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.
EN 12599: 2012 - Ventilation for buildings.
CEN/TR 16798-2, is the reference for the identification of the four categories of indoor environmental quality.

Reference:

CESBA MED Project - SBTool Assessment System

D2 Air Temperature and Relative Humidity

D2.3 Thermal comfort index

Intent: To facilitate the assessment of indoor thermal comfort conditions during the cooling season rate

Indicator	Unit of Measure
Predicted Percentage of Dissatisfied in cooling season	%

Assessment Methodology:

The indicator can be calculated both at the design and at the in use stage, calculation steps are the following:

a) Estimate or Measure PMV
b) Calculate PPD

Calculations are performed in all spaces with characteristic functions of the building (e.g. office spaces, meeting room, cafeteria), different orientations (e.g. on the side of a façade facing the street), and floors (e.g. first, middle and last floor). Calculations are also performed in spaces where the most extreme values of the thermal parameters are observed or anticipated (e.g. occupied areas near windows, diffuser outlets, corners, entries). The indicator value for the building is then calculated as a weighted average of the corresponding values.

Calculation in Design stage (mechanically conditioned).

The calculation steps are the following for all main occupied room:

a) Estimate PMV Select the design air temperature (dry bulb-db) and relative humidity for the main space function:

1. Select the design indoor air speed.

2. Calculate the mean radiant temperature of indoor wall surfaces (oC).

3. Determine the main physical activity of the occupants (related to the metabolic rate).

4. Determine the typical type of clothing ensembles.

5. Calculate the PMV value using the equation described in EN ISO 7730 standard.

b) On the base of the PMV value, estimate PPD using the equation described in EN ISO 7730 standard
PPD = 100 – 95 * exp[-(0.03353 * PMV4 + 0.2179 * PMV2)]

Assessment Methodology:

Calculation in Design stage (naturally conditioned).

The calculation steps are the following for all occupied main rooms:

a) Calculate the running mean of outdoor temperature (Trm)
b) Calculate the operative temperature (To)
c) Select the thermal comfort category and verify the PPD value.
d) Calculate the running mean of outdoor temperature (Trm)

$$T_{rm} = \frac{(Tod-1+0.8Tod-2+0.6Tod-3+0.5Tod-4+0.4Tod-5+0.3Tod-6+0.2Tod)}{3.8}$$

where Tod is the daily mean outdoor temperature for the previous day (Tod-1), the day before (Tod-2) and so on

e) Calculate the operative temperature (To) using building simulations to predict indoor conditions.
f) Verify the thermal comfort category and the associated PPD value.

	Upper Limit $T_{i,max}$ (ºC)	Lower Limit $T_{i,max}$ (ºC)	T_0 Variance (adaptive method)	PPD (%)	PMV
Category I	0.33 T_{rm}+18.8+2	0.33 T_{rm}+18.8-2	±2	≤6	-0.2≤PMV≤ 0.2
Category II	0.33 T_{rm}+18.8+3	0.33 T_{rm}+18.8-3	±3	≤10	-0.5≤PMV≤ 0.5
Category III	0.33 T_{rm}+18.8+4	0.33 T_{rm}+18.8-4	±4	≤15	-0.7≤PMV≤ 0.7

Calculation in Occupancy stage:

Measure the PPD in the case of operating buildings in all main occupied rooms. Use a PMV/PPD meter to record indoor conditions and predict the prevailing thermal comfort conditions.
Thermal environment measurements are made in the building at a representative sample of locations, i.e:

1. The center of the room or space.
2. 1m inward from the center of each of the room's walls and if there are windows, the measurements are taken 1m inward from the center of the largest window.
3. Measurement periods cover several hours, representative of total occupancy (e.g. season, typical day).

Note: The indicator is calculated for summer or winter periods considering different prevailing conditions, clothing etc. This is based on the main priorities in terms of thermal discomfort conditions during summer or winter. Accordingly, the time period (summer or winter) considered in the calculations must be clearly stated and considered during the analysis. In addition, this KPI must be cautiously used during cross comparisons between different cities or regions with different priorities, at least in terms of the seasonal nature of the issue for thermal discomfort.

Standard:

EN ISO 7730 – Ergonomics of the thermal environment – Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria.
EN 16798-1:2017 - Energy performance of buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - Module M1-6 (revision of EN 15251). Brussels: European Committee for Standardization.
Level(s) Part 1-2 – Beta version. Brussels: European Commission.

Reference:

CESBA MED Project - SBTool Assessment System

D3 Daylighting and Illumination

D3.1 Daylight

Intent: To ensure an adequate level of daylighting in all primary occupied spaces

Indicator	Unit of Measure
Mean Daylight Factor	%

Assessment Methodology:

Calculation method (design stage):
The indicator must be calculated in all spaces with characteristic functions of the building (e.g. office spaces, meeting room, cafeteria), different orientations (e.g. on the side of a façade facing the street), and floors (e.g. first, middle and last floor). The indicator value for the building is then calculated as a weighted average of the corresponding values.

The daylight provision is calculated in new buildings and under major renovation buildings accordingly to EN 17037. Paragraph 5.1.3 fully describes the two possible calculation methods:
Method 1) Calculation method using daylight factors on the reference plane.
Identify the grid of points on the plane
Predict the daylight factors across the plane
Calculate the target daylight factor DT and DTM
Ensure that the daylight factors equal or exceed the target values (DTM and DT).

Method 2) Calculation method of illuminance levels on the reference plane using climatic data for the given site and an adequate time step.
Simulate illuminance values on the reference plane based on hourly internal daylight illuminance values
Ensure that the targeted illuminance levels are achieved or exceeded.
Annex A gives values for target illuminances and minimum target illuminances to be achieved.
Annex B describes recommendations for the daylight calculations using the two methods.

Assessment approach (as built and in-use):
After the completion of a building, it is important to verify the compliance of the as built performance with what stated in the design phase for the daylight provision. Steps to be followed are described below:
Identify several measuring points in each main room of the building
Conduct the measurements with a luxmeter
At the same time measure the external values (best in overcast conditions with no direct solar radiation). In addition to the luxmeter and if necessary, a shadow ring could be used.
Calculate the average daylight factor making a ratio between the average indoor values measured and the average outdoor values.

In case of the in-use building, some adjusting must be adopted to obtain an accurate measurement (curtains drawn, obstruction resulting from the furniture, absence of occupants, etc.).

Standard:
CEN European Daylight Standard EN 17037 – Daylighting in buildings, paragraph 5.1.2 Criteria for daylight provision and paragraph 5.1.3 Daylight Provision Calculation Methods.

Reference:
CESBA MED Project - SBTool Assessment System

E1 Daylighting and Illumination

E1.2 Smart Readiness Indicator

Intent: Reach more energy efficient, environmentally friendly, healthy and comfortable indoor environments. Assesses the smartness of a building.

Indicator	Unit of Measure
Total smart readiness of buildings for responding to the needs of occupants, optimizing energy performance, and interacting with energy grids	%

Assessment Methodology:

To characterize the indicator's value may follow one of the two assessment methods that focus on qualitative approaches of various building services based on an expert assessment.
The calculation steps are:

Method A - Simplified method (e.g. Existing buildings with low complexity)
1. Use with a simplified service catalogue (Verbeke et al. 2020) that includes only 27 pre-defined services for existing residential buildings or small non-residential buildings that have low complexity
2. Use a check-list .
3. Complete assessment in less than an hour.
4. Suitable for a self-assessment of a building.

Method B – Detailed method (e.g. New buildings with high complexity)
1. Use with a detailed service catalogue that includes 54 pre-defined services for new buildings and non-residential buildings that have a higher complexity.
2. On-site inspection and walk-through audit .
3. Complete in about a day.
4. Need an expert and engage building's facility manager.

The methodology for calculating the SRI is based on the assessment of smart-ready services present or planned at design stage in a building or building unit, and of smart-ready services that are considered relevant for that building or building unit.
The SRI is expressed as a percentage that represents the ratio between the smart readiness of the building or building unit compared to the maximum smart readiness that it could reach. The calculation relies on the assessment of the smart-ready services that are present, or planned at design stage, and on their functionality level.
The smart-ready services that can be present in a building are listed in a pre-defined smart-ready service catalogue that is used by experts as the basis for identifying and assessing smart-ready features, and are organised in nine pre-defined technical services (domains), i.e. heating, cooling, ventilation, domestic hot water, lighting, dynamic building envelope, electricity, electric vehicle charging, monitoring and control.

The calculation of smart readiness scores is made in accordance with the following protocol:
(a) each smart-ready service that is present in a building is assessed and the functionality level is determined according to the various features included in the predefined catalogue
(b) for each smart readiness impact criterion, the individual score I(d,ic) of each major building service (domain) is determined, as follows:

$$I\,(d.ic) = \sum_{i=1}^{Nd} I_{ic}(FL(S_{i,d}))$$

Assessment Methodology:

Where:
d is the number of the major building service (domain) under assessment,
ic is the number of the impact criterion under consideration,
Nd is the total number of the different functions in a technical domain d,
Si,d is function i of technical domain d,
FL(Si,d) is the functionality level of function Si,d as available in the building or building unit,
Iic(FL(Si,d)) is the score of function Si,d for impact criterion number ic, according to the service's functionality level.

In accordance with the predefined catalogue of smart-ready functions, the maximum score of each technical domain for each impact criterion Imax(d,ic) is determined, as follows:

$$I_{max}\,(d.ic) = \sum_{i=1}^{Nd} I_{ic}(FL_{max}(S_{i,d}))$$

Where:
FLmax(Si,d) is the highest functionality level that function Si,d could have according to the smart-ready service catalogue, Iic(FLmax(Si,d)) is the score of function Si,d for its highest functionality level, which means the maximum score of function Si,d for impact criterion number ic.

The smart readiness score is calculated as a percentage for each of the impact criterion SRic using the weighting factors as follows:

$$SR_{ic} = \frac{\sum_{d=1}^{N} w_{di,c}^{I(d,ic)}}{\sum_{d=1}^{N} w_{d,ic}\, I_{mx}\,(d,ic)}\, 100$$

Where:
d is the number of the major building service (domain) under assessment,
N is the total number of technical domains, Wd,ic is the weighting factor expressed as a percentage of the major building service number d for impact criterion number ic.

The smart readiness scores along the three major building functionalities are determined using the corresponding weighting factors, as follows:

$$SR_{f} = \sum_{ic=1}^{M} w_f\,(ic) SR_{ic}$$

Where:
M is the total number of impact criteria, Wf(ic) is the weighting factor expressed in percentage of impact criterion number ic for key functionality f,
SRic is the smart readiness score for impact criterion number ic.

The total smart readiness score is calculated as a weighted sum of the key functionalities' smart readiness scores, as follows:

$$SRI = \sum w_f \;\; SR_f$$

Where:
SRf is the smart readiness score for key functionality f, Wf is the weight of key functionality f in the calculation of the total smart readiness scores, with ΣWf = 1.

Standard:

CEN European Daylight Standard EN 17037 – Daylighting in buildings, paragraph 5.1.2 Criteria for daylight provision and paragraph 5.1.3 Daylight Provision Calculation Methods.

Reference:

CESBA MED Project - SBTool Assessment System

G1 Cost and Economics

★G1.4 Energy cost

Intent: To optimize the operating cost of buildings to reflect the potential for long term performance

Indicator	Unit of Measure
Annual energy cost per useful internal floor area	€/m²/yr

Assessment Methodology:

1. Estimate the annual energy cost of the building (€)
2. Calculate the useful internal floor area (m²)
3. Calculate the value of the indicator as €/m²/year

Standard:

Level(s) Part 1-2 – Beta version

Reference:

CESBA MED Project - SBTool Assessment System

H1 Climatic action: increase of temperature

H1.2 Heat island effect

Intent: To reduce the heat island effect, to reduce the discomfort at ground level during summer

Indicator	Unit of Measure
Mean Solar Reflectance Index of paved surfaces and roofs in the area	SRI

Assessment Methodology:

1. Identify the boundaries of the building being assessed.

2. Identify all the horizontal surfaces and roofs in the area.

3. Calculate the extension (m2) of each surface identified and classify them in relation to the cover material.

4. Multiply each surface previously identified by the corresponding solar reflectance index.

5. Sum the weighed surfaces obtained.

6. Calculate the weighted value of the index for the building as the ratio of the sum of products to the total area of all horizontal surfaces and roofs.

Standard:

-

Reference:

CESBA MED Project - SBTool Assessment System

5.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 The third page shows the sustainability results achieved by the neighbourhood using the contextualised version of SBTool.

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 Building

Name: ....

Building use: ....

General location: ....

City: ....

MAP

SMC Passport Building

Short Description

....

....

....

....

IMAGE

Demography

Total plot area	.............Inhab
Grass floor area	.......Inhab/ha
Useful floor area	........Persons
Other info	....

Climate

Annual precipitation	..................mm
Solar irradiance on horizontal	........kWh/m²y
Winter / summer design temperature	.......................°C
Heating degree days (base 18°C)	...................HDD

Envelope

U- Value of external walls	.......W/m²K
U - Value of roof	.......W/m²K
U - Value of floor	.......W/m²K
U - Valuer of windows	.......W/m²K
Othe info	....

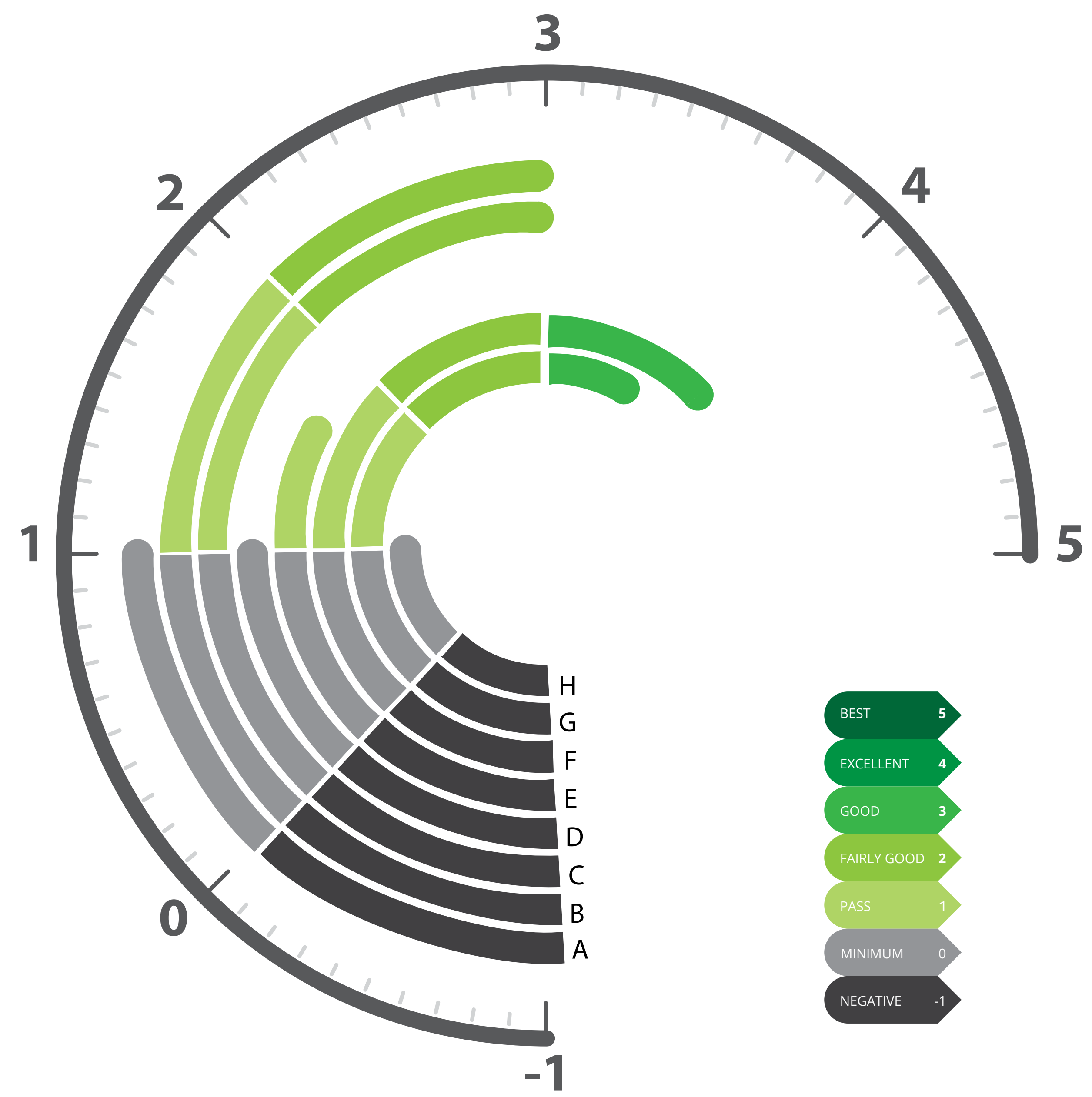
HVAC & RES

Heating system	....
Cooling system	....
DHW system	....
Lighting system	....
Ventilation	....
RES	....

SMC Key Performance Indicators

CODE	CRITERIA	INDICATOR	VALUE	UNIT
B1.1	Primary energy consumption	Primary energy consumption per internal useful floor area per year	....	kWh/m²/yr
B1.2	Thermal energy consumption	Thermal energy consumtion per internal useful floor area per year	....	kWh/m²/yr
B1.3	Electrical energy consumption	Electrical energy consumption per internal useful floor area per year	....	kWh/m²/yr
B1.4	Energy from renewable sources in total thermal energy consumption	Share of renewable energy in final thermal energy consumption	....	%
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 internal useful floor area	....	MJ/m²
B3.4	Recycled materials	Weight of recycled materials on total weight of materials	....	%
B4.3	Potable water consumption for indoor uses	Potable water consumption per occupant per year	....	m³/occupant/yr
C1.1	Embodied carbon	Embodied carbon dioxide equivalents per internal useful floor area	....	kg CO_{2eq}/m²
C1.2	GHG gas emissions during operation	CO2 equivalent emissions per useful internal floor area per year	....	kg CO_{2eq}/m²/yr
D1.2	TVOC concentration	TVOC concentration in indoor air	....	µg/m³
D1.7	Mechanical Ventilation	Mechanical ventilation rate per useful internal floor area	....	l/s/m²
D2.3	Thermal comfort index	Predicted Percentage of Dissatisfied (PPD)	....	%
D3.1	Daylight	Mean Daylight Factor	....	%
E1.2	Smart Readiness Indicator	Total smart readiness of buildings in terms of three key functionalities, i.e. responding to the needs of occupants, optimizing energy performance, interacting with energy grids	....	%
G1.4	Energy cost	Annual energy cost per useful internal floor area	....	€/m²/yr
H1.2	Heat island effect	Mean Solar Reflectance Index of paved surfaces and roofs in the area	....	SRI

Visualisation of the sustainability assessment results



FINAL SCORE 2,68

	Score	Weight	
A Site Regeneration and Development, Urban Design and Infrastructure	1,2	11,2%	0,13
B Energy and Resources Consumption	3,1	27%	0,83
C Environmental Loadings	3,2	20,6%	0,66
D Indoor Environmental Quality	0,9	3,7%	0,03
E Service Quality	1,5	10,5%	0,15
F Social, Cultural and Perceptual Aspects	4,2	5,4%	0,22
G Cost and Economic Aspects	3,5	12%	0,42
H Adaptation to Climate Change	2,5	9,6%	0,24
		100%	2,68

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 buildings.

6. References

CESBA MED – Sustainable MED Cities
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Istanbul Environment Friendly City Award
https://www.unep.org/unepmap/istanbul-environment-friendly-city-award.

Arnstein, Sherry R. "A Ladder of Citizen Participation," JAIP, Vol. 35, No. 4, July 1969.

Anex 1: Benchmarks

A	Site Regeneration and Development, Urban Design and Infrastructure				
A1	Site Selection				
CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
A1.1	Ecological value of land	Pre-development ecological value of land	Score	0	5
A1.2	Proximity of site to public transportation	Accessibility index to public transportation	index	1,5	12
A1.3	Adjacency to existing service infrastructures	Average distance between the site and key existing infrastructures	m	100	25
A1.4	Proximity to key services	Average distance from key services	m	500	200
A2	Site development				
CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
A2.1	Use of native plantings	The extent of vegetated landscaped area that is planted with native plants	%	50	100
A2.2	Provision of outdoor recreation areas	Number of recreation services offered in outdoor areas of the building	n	3	5
A2.3	Support for bicycle use	Percentage of bicycle parking spaces available	%	4	20
B	Energy and Resources Consumption				
B1	Energy				
CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
B1.1	Primary energy consumption	Primary energy consumption per internal useful floor area per year	kWh/m²/yr	155	80
B1.2	Thermal energy consumption	Thermal energy consumption per internal useful floor area per year	kWh/m²/yr	30	15
B1.3	Electrical energy consumption	Delivered electrical energy consumption per internal useful floor area per year	kWh/m²/yr	120	90

B1.4	Energy from renewable sources in total thermal energy consumption	Share of renewable energy in final thermal energy consumptions	%	20	100
B1.5	Energy from renewable sources in total electrical energy consumption	Share of renewable energy in final electrical energy consumption	%	20	100
B1.6	Embodied non-renewable primary energy	Embodied primary non-renewable energy per building's useful internal floor area	MJ/m^2	432	400

B2 Electrical peak demand

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
B2.1	Electrical peak demand for building operations	Average of peak monthly electrical demand for one year	W/m^2	100	20

B3 Materials

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
B3.1	Degree of re-use of suitable existing structure(s)	Percent, by area, of an existing structure that is re-used	%	10	30
B3.2	Materials intensity	Weight of structural and envelope components per useful floor area	kg/m^2	50	20
B3.3	Renewable materials	Weight of renewable materials on total weigh of construction materials	%	0	35
B3.4	Recycled materials	Weight of recycled materials on total weight of materials	%	15	50
B3.5	Local materials	Weight of local materials on total weight of materials	%	80	30
B3.6	Design for deconstruction	Circularity potential	score	0	50
B3.7	Design for adaptability	Adaptability potential	score	20	99

B4 Use of potable water, stormwater and greywater

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
B4.1	Embodied water	Net fresh water per useful internal floor area	%	20	5
B4.2	Total water consumption	Total consumption of water per building occupant	kg/m^2	120	50
B4.3	Potable water consumption for indoor uses	Potable water consumption per occupant per year	%	100	30
B4.4	Potable water consumption for irrigation	Potable water consumption / standardised potable water consumption	%	80	0

C Environmental Loadings

C1 Greenhouse Gas Emissions

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
C1.1	Embodied carbon	CO2 equivalent emissions per useful internal floor area (product stage)	kg CO_{2eq}/m^2	3,1	2,2
C1.2	GHG gas emissions during operation	CO2 equivalent emissions per useful internal floor area per year	kg CO_{2eq}/m^2 yr	54	28
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	10	3

C2 Other Atmospheric Emissions

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
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	3	0
C2.2	Emissions of acidifying emissions during facility operations	SO2 equivalent emissions per year in kg per unit net area	g/m^2 /yr	0,4	0,15
C2.3	Emissions leading to photo-oxidants during facility operations	Ethene equivalent emissions per useful internal floor area per year	g/m^2 /yr	0,25	0,11

C3 Solid Wastes

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
C3.1	Construction waste	Weight of waste and materials generated per m^2 of internal useful floor area	kg/m^2	54	28

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	%	80	100

D Indoor Environmental Quality

D1 Indoor Air Quality and Ventilation

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
D1.1	Formaldehyde concentration	Formaldehyde concentration in indoor air	μg/m³	0,08	0,05
D1.2	TVOC concentration	TVOC concentration in indoor air	μg/m³	0,5	0,1
D1.3	CO2 concentrations	CO2 concentration in indoor air	ppm	500	450
D1.4	Low emitting materials	Mean emission class of finishing materials	Index	0	5
D1.5	Radon	Radon concentration in indoor air	Bq/m³	148	100
D1.6	Relative humidity	Relative humidity in indoor air	%	60	30
D1.7	Mechanical Ventilation	Mechanical ventilation rate per useful internal floor area	l/s/m²	0,6	1,2

D2 Air Temperature and Relative Humidity

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
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	%	10	8
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	%	10	8
D2.3	Thermal comfort index	Predicted Percentage of Dissatisfied	%	20	10

D3 Daylighting and Illumination

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
D2.1	Daylight	Mean Daylight Factor	%	2	4
D2.1	Daylight Provision	Level of daylight provision	Level	1	3
D2.1	Protection from Glare	DGP (Daylight Glare Probability)	Number	50	5

D4 Noise and Acoustics

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
D4.1	Protection from noise: facade insulation	D2m,nT,w - Weighted standardized level difference for traffic noise (sound insulation)	dB	27,5	38,5
D4.2	Protection from air-borne noise within adjacent spaces	R'w - Weighted apparent sound reduction index	dB	25	35
D4.3	Protection from the sound of impacts within adjacent spaces	L'n,w - Weighted normalized impact sound pressure level	dB	45	56
D4.4	Protection from noise generated by service equipment	LAeq,nT - A-weighted standardized continuous sound pressure level	dB	37	25
D4.5	Reverberation time	T - Reverberation time	%	0,8	0,5

D5 Noise and Acoustics

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
D5.1	Minimisation of exposition to ELF magnetic fields	Strategies adopted to minimise the exposition to ELF magnetic fields	Score	0	5
D5.2	Level of ELF magnetic fields	Mean level of magnetic induction (50/60 Hz)	μt	200	150
D5.3	Minimisation of exposition to High Frequency Electromagnetic Fields	Strategies adopted to minimise the exposition to High Frequency Electromagnetic fields	Score	0	5
D5.4	Level of High Frequency Electromagnetic Fields	Mean level of electric filed (100 kHz-3GHz)	V/m	20	6

E Service Quality

E1 Controllability

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
E1.1	Effectiveness of facility management control system	Percentage of control functions within class A	%	50	100
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	%	40	100

E2 Optimization and Maintenance of Operating Performance

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
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	0	5

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	0	5
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	0	5

F Social, Cultural and Perceptual Aspects

G1 Performance of mobility services

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
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	0	5
F1.2	Exposure to sunlight	Hours of sunlight	Hrs	3	6

F2 Perceptual

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
F2.1	View out	Quality of view out	Score	25	75

G Cost and Economic Aspects

G1 Economic performance

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
G1.1	Life-cycle cost	Life cycle cost (production and construction, use and end of life) per useful internal floor area per year	€/m²/yr	4	3
G1.2	Construction cost	Predicted construction cost per useful internal floor area	€/m²	3500	2500
G1.3	Maintenance cost	Predicted maintenance cost per useful internal floor area per year	€/m²/yr	300	200
G1.4	Energy cost	Annual energy cost per useful internal floor area	€/m²/yr	20	5
G1.5	Water cost	Annual water cost per useful internal floor area	€/m²/yr	5	1

H Adaptation to Climate Change

H1 Climatic action: increase of temperature

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
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	%	10	5
H1.2	Heat island effect	Mean Solar Reflectance Index of paved surfaces and roofs in the area	SRI	50	100
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)	%	20	50
H1.4	Use of vegetation to improve microclimate and cooling during summer	Mean Solar Reflectance Index of paved surfaces and roofs in the area	%	20	50

H2 Climatic action: pluvial flood

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
H2.1	Stormwater retention capacity on site	Share of the onsite stormwater retention capacity in relation to the optimal retention capacity	%	20	80
H2.2	Permeability of land	Share of the site that is permeable to water	%	50	100

H3 Climatic action: fluvial and coastal flood

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
H3.1	Risk to occupants and facilities from flooding	Strategies to reduce the vulnerability of occupants and facilities to floods	Score	0	5

H4 Climatic action: drought

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
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	%	50	100
H4.2	Capacity of greywater collection and storage for non-potable uses	Share of greywater collected and cleaned for reuse	%	50	70

H5 Climatic action: fire exposure

CODE	CRITERION	INDICATOR	UNIT	BENCHMARK 0	BENCHMARK 5
H5.1	Fire-resistance of the envelope	Level of use of certified fire-retardant materials in the envelope	Score	0	5

H5.2	Fireproof ground	Level of use of certified fire-retardant materials for paving	Score	0	5
H6	Climatic action: wind action				
I3.3	Windproof envelope	Level of use of certified wind resistant materials in the envelope	Score	75	100

SBTool MED

Sustainable Buildings Tool

https://www.enicbcmed.eu/projects/sustainable-med-cities