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Sustainable MED Cities

Integrated tools and methodologies for sustainable Mediterranean cities

D3.1.1 - Adaptation of CESBA MED assessment system to South and East side of MED

This project has received funding from the
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Executive Summary

The key ending results of this deliverable are two innovative tools for evaluating the sustainability of neighbourhoods and buildings in the whole Mediterranean region, with particular attention to the needs and specificities of the South and East sides of MED. The two innovative assessment tools mentioned before are:

- Sustainable Building Tool (SBTool)
- Sustainable Neighbourhood Tool (SNTool)

Both tools will enhance the capacity of public administration in delivering, implementing and monitoring efficient measures, plans and strategies to improve the sustainability of neighbourhoods and buildings.

Through the drafting of the deliverable, the steps followed to achieve the results are retraced, starting from the capitalisation of the CESBA MED outputs coming to the adaptation of the tools to the South and East side of MED. The major points of this document are of course the tools themselves, composed of several indicators fully described through detailed tables in chapters 3 and 4. To facilitate the promotion and the consequent easy application of the tools, all the indicators described herein, will be implemented on the Collaborative Platform of Sustainable MED Cities project, as mentioned in the conclusion of the deliverable. Furthermore, it’s important to highlight that this deliverable (D3.1.1) has been produced together with “Deliverable 3.1.2 - Sustainable Cities Tool (SCTool)”, since the spatial context addressed by Sustainable MED Cities starts from the building to get to the city level.

ACRONYMS	
SBTool	Sustainable Building Tool
SNTool	Sustainable Neighborhood Tool
SCTool	Sustainable City Tool
MED	Mediterranean
DX.X.X	Deliverable X.X.X
LPC	Local Project Committee
PPs	Project Partners
S.MED.Cities	Sustainable MED Cities project
TL	Task Leader
LP	Lead Partner
GF	Generic Framework

1. Introduction

The document fully describes the steps performed to achieve the results, starting from the kick off meeting of the activity to the end results obtained. It's important to stress the fact that, the entry point of this activity is the end results of CESBA MED, the project capitalised by Sustainable MED Cities.

The path followed has ensured a strong added value of the final results because it has taken into account different technical recommendations, several local hints collected through the Local Project Committee activities and many practical suggestions acquired during the internal consultations among PPs involved in the activity.

The bottom-up approach followed to reach the final results has ensured a valid and consistent adaptation process to the needs and specificities of the South and East side of MED.

In the following chapters of this document, all the steps and the process followed during the implementation activity are described in detail, until reaching the two tools for evaluating the sustainability at building and neighborhood scale.

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2. Adaptation process of the CESBA MED assessment system

2.1. CESBA MED Deliverable: the starting point

The starting point of the activity A3.1.1 of S.MED.Cities is represented by one of the most important final outputs of the Interreg MED project "CESBA MED: Sustainable MED Cities" (https://cesba-med.interreg-med.eu/): a transnational assessment system useful for measuring and rating the sustainability of Mediterranean buildings and neighbourhoods.

The assessment system is composed by the SBTool and the SNTool, instruments useful to support policies and programs for a sustainable built environment. These CESBA MED tools contain many indicators chosen in relation to policies relevant for the cities belonging to the North side of Mediterranean. Since the S.MED.Cities project has partners belonging to the South and East sides of Mediterranean (Jordan, Lebanon and Tunisia), the SBTool and the SNTool need to be adapted to the peculiarities and prerogatives strictly related to that part of the MED area.

Starting from the capitalisation of the CESBA MED SBTool and SNTool, different environmental, social and economic aspects (e.g., slums, availability of potable water, etc.) must be taken into account and, accordingly, new indicators need to be integrated in the frameworks.

Furthermore, other actions need to be carried out for the improvement of the SBTool and SNTool since, for example, some indicators of the CESBA MED Tools must be updated to the latest regulations, others require some adjustments because they are not so practical in the assessment method since they are based on qualitative perception of the issue, and so on.

All activities carried out to achieve the final results developed for the Sustainable MED Cities are shortly described in the image below and fully described in the following paragraphs.

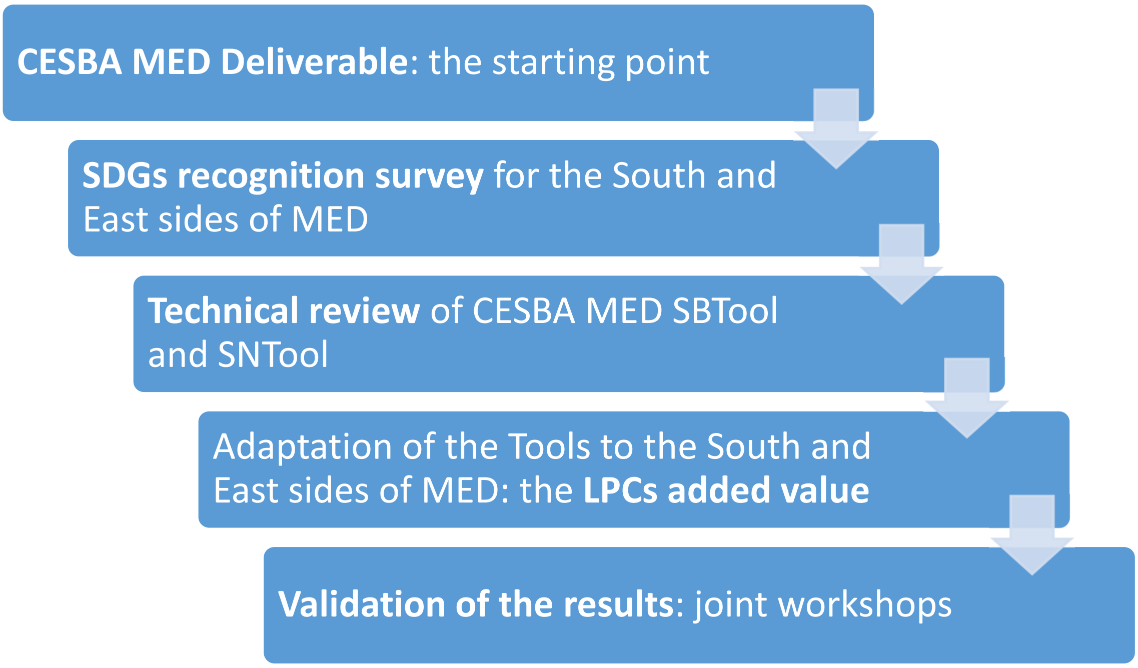

Figure 1: The key steps followed to achieve the results: Sustainable MED Cities SBTool and SNTool.

2.2. SDGs exploratory survey for the South and East sides of MED

The adaptation activity of the SBTool and SNTool to the South and East sides of MED starts with a recognition survey on two fundamental documents:

- The "*Sustainable Development in the Mediterranean Report 2020 - Transformations to achieve the Sustainable Development Goals*[1]", developed by a team of experts of the University of Siena – Santa Chiara Lab, as the hosting institution of the Sustainable Development Solutions Network for the Mediterranean Area (SDSN-Mediterranean). The scope of the report is to facilitate the reading of the Sustainable Development Report 2020 through the optic of Mediterranean countries in order to share knowledge on current trends towards SDGs and drive common action, perfectly in line with the objective of the S.MED.Cities project.

[1] Riccaboni, A., Sachs, J., Cresti, S., Gigliotti, M., Pulselli, R.M. (2020): Sustainable Development in the Mediterranean. Report 2020. Transformations to achieve the Sustainable Development Goals. Siena: Sustainable Development Solutions Network Mediterranean (SDSN Mediterranean).

- The "*Istanbul Environment Friendly City Award - Framework of Assessment Indicators at City Level*[2]", mainly focused on neighborhood and city scale, very useful for the development of the SCTool, as described in D3.1.2. It was funded by the Government of Turkey and created in the framework of the Mediterranean Strategy for Sustainable Development (MSSD) to recognize efforts of local authorities in promoting sustainable development in Mediterranean coastal cities.

Both documents take into account the importance of the Sustainable Development Goals (SDGs), which are an urgent call for action by all countries, developed and developing, in a global partnership. All the main fields of action, mentioned in the image below, must be taken into consideration for the adaptation and the updating of the SBTool and SNTool.

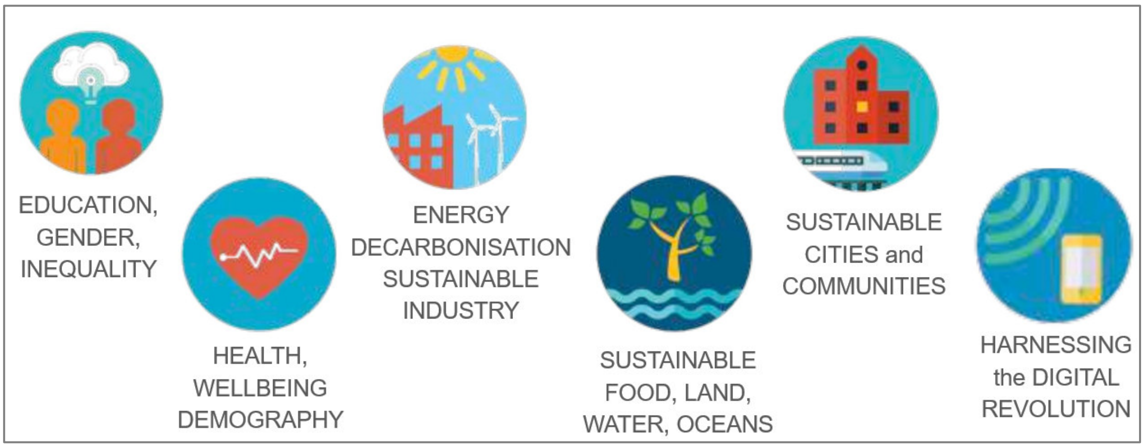

Figure 2: The main fields of action to meet the 17 SDGs in South and East Mediterranean.

Starting from the content of these two reference documents, PPs have identified all the additional sustainable development issues relevant for South and East Mediterranean not yet existing in the CESBA MED version of the Tools. They are requested to fill out an excel table, described in the image below, including all the issues they considered very relevant to be included in the SBTool and SNTool, providing the source of the information and eventually, also the related criterion and indicator.

[2] https://www.unep.org/unepmap/istanbul-environment-friendly-city-award

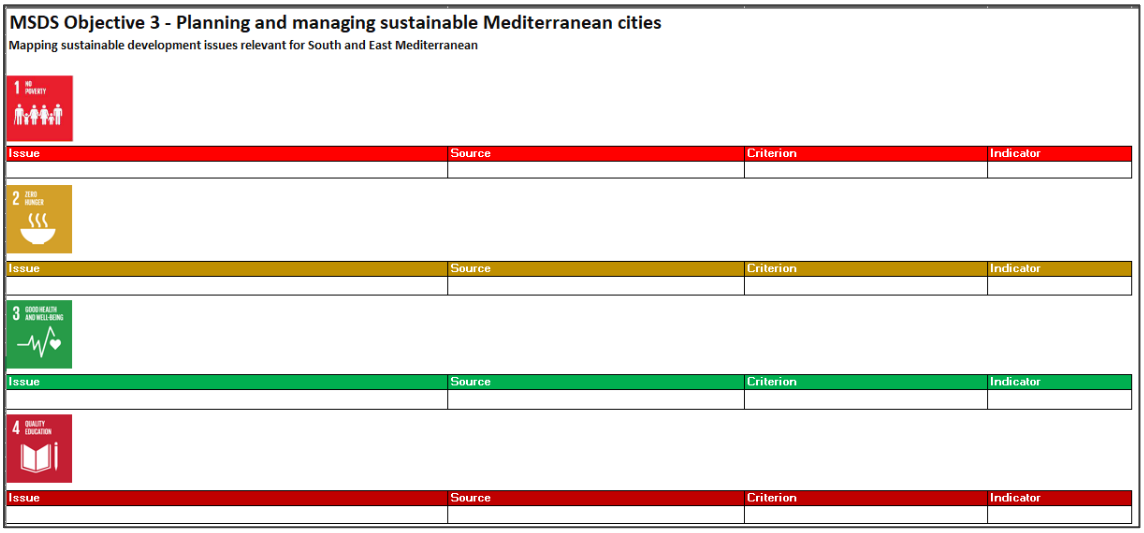

Figure 3: The excel file produced by iiSBE and shared with PPs to collect feedback on additional issues.

During this survey, many other documents have been investigated (e.g. EC in-Depth Report: Indicators for Sustainable Cities, City sustainability Indicators of the World Bank, etc.), in order to produce an exhaustive recognition work for the MED area, including the South and East sides.

iiSBE Italia, as TL, has explained through a ppt presentation, the work to be carried out by PPs, providing them with some examples of potential new issues and related indicators to be included in the frameworks, as showed below.

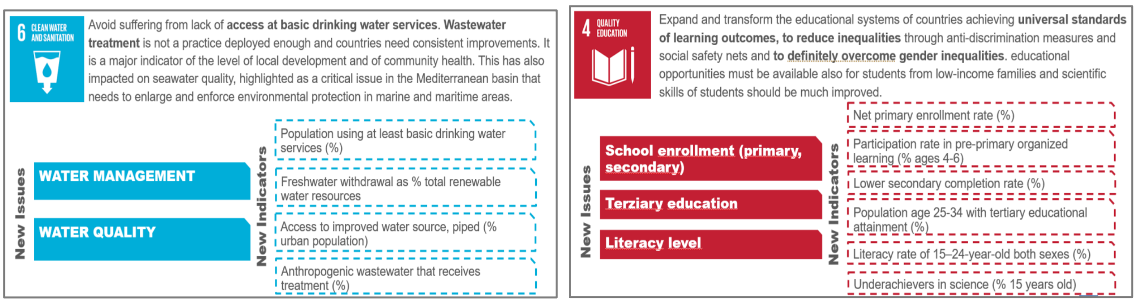

Figure 4: Some inputs provided to PPs to explain the recognition activity to carry on.

Through this recognition survey, many interesting issues for the South and East Mediterranean have been highlighted by PPs and taken into account during the next adaptation steps.

2.3. Technical review of CESBA MED SBTool and SNTool

iiSBE Italia and NOA, technical partners mainly involved in activity A3.1.1, worked together in operating a scientific review of the content of the CESBA MED SBTool and SNTool. Moreover, they were both project partners of CESBA MED project and they know very well the content of the frameworks.

The technical review of the content of CESBA MED SBTool and SNTool consists in an in-depth analysis of all the indicators included in the two frameworks, highlighting, for each of them, if an amendment is required.

The possible modifications are summarized into three main groups of action:

- General (GEN): addressing all the changes related to a reschedule proposal, moving to another category, addition proposal, etc.
- Technical (TEC): addressing all the changes related to the amendment in content of the criterion, to the modification of the calculation method, adaptation to new regulation requirements, etc.
- Editorial (ED): addressing all the changes related to typo or inconsistencies due to editorial issues.

This updating and refining work of the SBTool and SNTool, has been carried out through the use of a word document, elaborated by iiSBE, in which all the changes proposals have been collected, as showed in the image below.

Sustainable MED Cities

SBTool Review Proposal

Applicant	Type	Code	Criterion	Proposed Amendment	Solution Adopted
iiSBE	GEN	A1.2	Protection and restoration of coastal environments	TO EXCLUDE – not appropriate for evaluations at building scale	
NOA	TEC	A1.7	Use of vegetation to provide ambient outdoor cooling.	MOVE to the issue "Adaptation to Climate Change", vulnerability to heatwaves	
NOA	GEN	A1.9	Provision of public open space(s).	TO EXCLUDE – not appropriate for evaluations at building scale	
iiSBE	TEC	A1.10	Provision and quality of children's play area(s).	MODIFY as "Availability of equipped outdoor areas". Indicator: Available outdoor equipment	
iiSBE	TEC	A1.12	Provision and quality of bicycle pathways and parking.	MODIFY as "Provision of bicycle parking spaces". Indicator: number of bicycle parking spaces/number of occupants	
NOA	GEN	A1.13	Provision and quality of walkways for pedestrian use.	TO EXCLUDE – not appropriate for evaluations at building scale	
iiSBE	TEC	A2.2	Reducing need for commuting transport through provision of mixed uses.	MODIFY – Change on the indicator as "Mean distance from 5 key services"	

Figure 5: Extract from the word document used by iiSBE and NOA to propose amendments.

Several technical progress meetings have been carried out between NOA and iiSBE, allowing to get coherent lists of indicators for the SBTool and SNTool, fully revised in content and structure.

2.4. Adaptation of the CESBA MED assessment system to the South and East shores of MED: the LPCs added value

As detailed in “D4.4.1 - Set up of the Local Project Committees”, LPCs are the primary strategy for actively engaging target groups in the Sustainable MED Cities project and they have been established in each participating municipality. Local members involved, represent the different stakeholders interested in the project outcomes and they actively participate in these informal but collective working group. Since the starting point of the CESBA MED Generic Frameworks (GFs) did not consider the needs and specificities of the South and East side of MED, the critical role and contribution of the LPCs focuses in the provision of relevant local criteria to be included in the Tools. Accordingly, the 1st LPC has been organised to present the structures of the CESBA MED Tools and to start a discussion among the stakeholders for the identification of additional issues concerning the south-east area of MED. For that reason, the main stakeholders involved in the activity came from both technical and not technical fields, as for example: professionals in the construction sector, local, regional and national authorities, academic, Small & Medium Enterprises Association, etc.

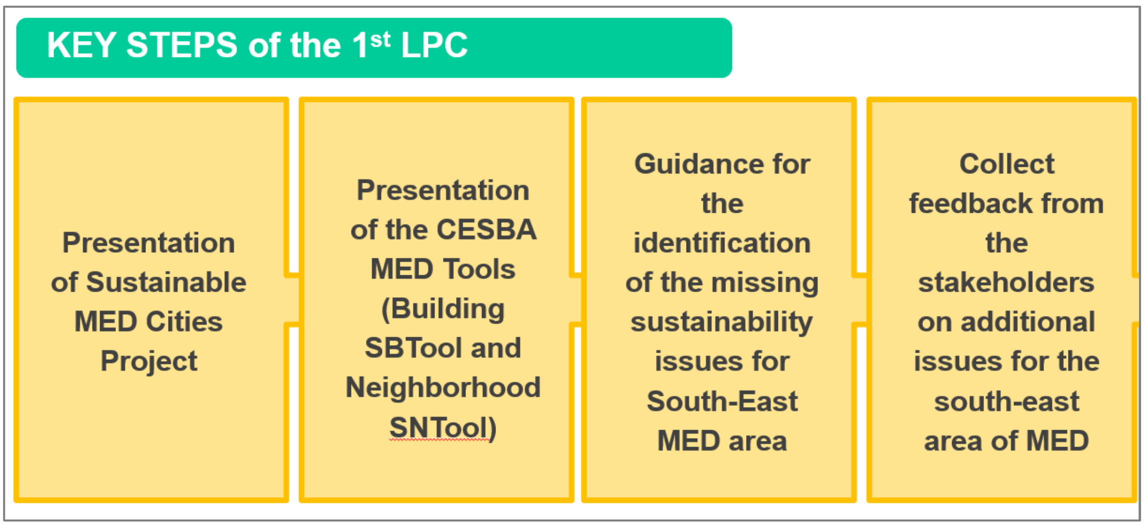

Figure 6: The key steps followed by PPs to perform their 1st LPC.

Some useful and very contextualised feedbacks emerged from the LPCs results. However, some of these comments were expressed more like "recommendations to follow" and not in a structured manner using the necessary technical language that the CESBA MED method prescribes, some considerations were not integrated yet in the Tools. The plan is to consider them once they are further elaborated by the LPCs and their technical experts in a follow-up second stage, during the testing activities in each municipality. During this phase, PPs will be able to better specify their proposed indicators and define the necessary assessment method considering the content and characteristics that were highlighted during the LPC meetings.

2.5. Validation of the results: joint workshops

The final list of the criteria belonging to the SBTool and SNTool, described respectively in chapter 4 and 5 of this Deliverable, is the results of many internal workshops, performed both with the three municipalities providing inputs from their LPCs and with the technical partners involved in the project. The aim of these joint efforts of comparison and exchange of views is to validate the intent, the relevance, the accuracy, the completeness, the possibility of calculation and the applicability of the criteria suggested by the different PPs.

These joint workshops were numerous, always organised by iiSBE on Zoom platform, and they were mainly of three different types:

- Clarification workshops, primarily aiming the three cities involved in the project, requiring information and clarification on the suggested proposals for the inclusion of specific and contextualised indicators, based on local needs;
- Technical workshop, performed together with NOA, based on technical issues discussions, the structure of the frameworks and organisational features;
- Operational workshop, mainly performed together with the LP, addressing the activities time scheduling and any kind of specific problems that could have occurred (delays, difficulties in reception of the material from other PPs, etc.).

This productive synergistic activity made it possible to arrive at defining a quite comprehensive list of criteria addressing the Building and the Neighborhood scale of the

Mediterranean area. As mentioned in the previous paragraph, the list is not static; according to the needs that will arise during the testing activity, other specific indicators can be integrated if deemed useful for the purpose.

3. Sustainability assessment method for the MED built environment

3.1. The SBE Method

The Sustainable MED Cities assessment system is composed by tools that allows to evaluate the sustainability of the built environment at different spatial scales (SBTool, SNTool and SCTool). The assessment system is based on the SBEMethod of iiSBE International. SBTool, SNTool and SCTool are transnational generic multicriteria assessment systems, named Generic Frameworks, useful to evaluate the sustainability of the Mediterranean built environment. To be used, a Generic Framework needs to be contextualised to local conditions. SBTool, SNTool and SCTool can't be used in their transnational versions. The contextualisation process consists in the adaptation of SBTool, SNTool and SCTool to regional priorities and practices. The contextualization takes place through the selection from the Generic Framework of the assessment criteria that will compose the local version of the tool and in the assignment of weights and benchmarks to them. The final result of the contextualisation process is a local version of SBTool SNTool and SCTool ready to be used for assessing buildings, urban areas and cities.

The contextualisation principle is the fundament of the Sustainable MED Cites assessment system. The basic assumption is that it isn't correct to use a unique common sustainability assessment tool the foresees the use of the same criteria, performance thresholds, weights everywhere, independently for the context. In reality, each local context has different priorities, history, climatic conditions, social-economic conditions, and advancement state in relation to sustainability issues that must be reflected in an assessment tool. The contextualisation process of the Generic Frameworks allows to obtain an operational sustainability assessment tool that fits the local needs and useful to measure the level of sustainability of buildings, urban areas and cities with regards to local priorities, practice, regulations, standards, etc.

The principle of contextualisation is showed in the Figure below:

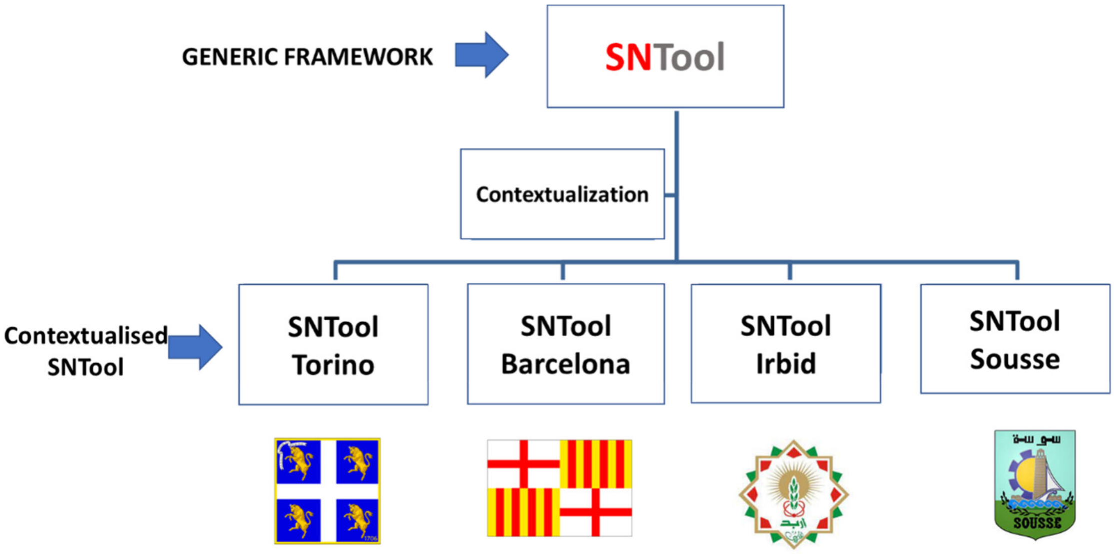

Figure 7: Contextualisation of the SNTool Generic Framework in local versions

Conventionally, the local systems derived from the Sustainable MED Cities GF are named "SMC SNTool/SBTool/SCTool + municipality/region/country name" (e.g. SNTool Sousse, SNTool Irbid, SNTool Barcelona).

Despite the different criteria, weights and benchmarks, deriving from the Generic Frameworks, the results produced by the contextualised versions of SBTool, SNTool and SCTool are compatible because based on the same transnational methodology. The assessments' results have the same meaning: the score represents how well a building or a neighbourhood or a city is performing in relation to the minimum local acceptable sustainability performance. Thus, the Generic Frameworks represent a common transnational language in sustainable built environment assessment, facilitating the transnational cooperation and share of best practices.

The transnational direct comparability of assessment results is assured using common Key Performance Indicators (KPIs), always included in all the local versions SBTool, SNTool and SCTool. The value of the KPIs is displayed and communicated through the Sustainable MED Cities Passport (D3.1.4)

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KPIs are a set of assessment criteria that during the contextualisation process must be included in the local versions of SBTool, SNTool and SCTool. They are the Key Performance Indicators. This principle is showed in the Figure below:

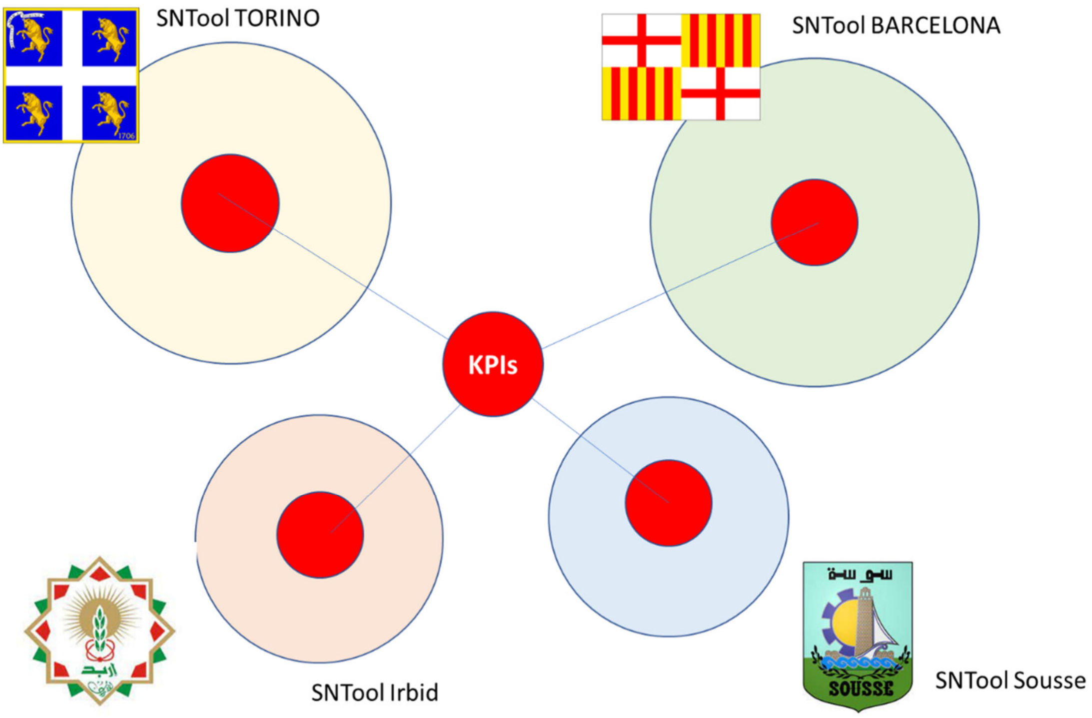

Figure 8: KPIs as a core set of common indicators in the local versions of SNTool

3.2. Description of the *SBEMethod*

The assessment method adopted in Sustainable MED Cities assessment system is the "*SBEMethod*" (Sustainable Built Environment Method) developed by iiSBE (international initiative for a Sustainable Built Environment). In general, the *SBEMethod* is a generic multi-criteria analysis methodology for assessing the sustainability of the built environment. Starting from a set of criteria the *SBEMethod* provides a final score about a building, urban area or territory overall performance. Using this methodology, it is possible to give a sustainability rating to a building or to a neighbourhood.

The sustainability score of the neighbourhood/building under assessment is computed through a mathematical procedure (called "assessment procedure") which is articulated in three main steps:

- characterization: building's/neighbourhood's performances are quantified through indicators in regard of each criterion;
- normalization: indicator values are adimensionalised and rescaled in a suitable interval, called normalization interval. The normalization consists in the assignment of a score to the indicator's value;
- aggregation: normalized scores are combined through weighted sums to produce the final concise score.

The main elements of the *SBEMethod* can be summarized as follows:

1. a set of assessment criteria
2. a set of indicators, which allow to quantify the building's/neighbourhood's performances with respect to each criterion
3. a normalization method (scoring system)
4. an aggregation method
5. a panel of experts who establish and define criteria and indicators

The *SBEMethod* is organized in issues, categories and criteria:

- **Issues:** describe general themes, recognized as relevant for assessing the sustainability of a building/neighbourhood. For instance, the issues of the building scale are: A-Site Regeneration and Development, Urban Design and

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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.

The issues of the neighbourhood scale are: A-Use of land and biodiversity, B-Energy, C-Water, D-Solid Waste, E-Environmental quality, F-Transportation and mobility, G-Social Aspects, H-Economy, I-Climate Change: mitigation and adaptation, L-Governance.

- **Categories:** concern particular aspects of issues. For instance, in the SBTool, the issue A-Site Regeneration and Development, Urban Design and Infrastructure contains two categories: A1-Site Selection and A2-Site development.
- **Criteria:** detail specific aspects of categories. They represent the basic assessment entries used to characterize each area since the very beginning of the assessment process. For instance, the category A1-Site Selection includes 4 criteria: A1.1-Ecological value of land, A1.2-Proximity of site to public transportation, A1.3-Adjacency to existing service infrastructures and A1.4-Proximity to key services.

Issues, categories and criteria are linked in the following sense: each issue includes a variable number of categories (depending on issue to issue), each of them describing a particular aspect of the issue. Categories include different *criteria*, each of them describing a particular aspect of the corresponding category.

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
A1 - Site Selection	B1 - Energy	C1 - Greenhouse Gas Emissions	D1 - Indoor Air Quality and Ventilation	E1 - Controllability	F1 - Social Aspects	G1 - Cost and Economics	H1 - Climatic action: increase of temperature
A2 - Site development	B2 - Electrical peak demand	C2 - Other Atmospheric Emission	D2 - Air Temperature and Relative Humidity	E2 - Optimization and Maintenance of Operating Performance	F2 - Perceptual		H2 - Climatic action: pluvial flood
	B3 - Materials	C3 - Solid Wastes	D3 -Daylighting and Illumination				H3 - Climatic action: fluvial and coastal flood
	B4 - Use of potable water, stormwater and greywater		D4 - Noise and Acoustics				H4 - Climatic action: drought
			D5 - Electromagnetic pollution				H5 - Climatic action: fire exposure
							H6 - Climatic action: wind action

A - Use of land and biodiversity	B - Energy	C - Water	D - Solid Waste	E - Environmental quality	F - Transportation and mobility	G - Social Aspects	H - Economy	I - Climate Change: mitigation and adaptation	L - Governance
A1 - Use of land	B1 - Energy infrastructure	C1 - Water infrastructure	D1 - Solid waste collection infrastructure	E1 - Air quality	F1 - Performance of mobility service	G1 - Accessibility (disabled persons)	H1 - Economic performance	I1 - Climate change mitigation	L1 - Urban Planning
A2 - Green urban areas	B2 - Energy consumptions	C2 - Water consumption	D2 - Solid waste management	E2 - Noise	F2 - Green mobility	G2 - Housing	H2 - Employment	I2 - Adaptation to the climatic action: heatwaves and increase of temperature	L2 - Management and community involvement
A3 - Biodiversity and ecosystems	B3 - Renewable energy	C3 - Effluents management		E3 - EMF exposure	F3 - Safety in mobility	G3 - Availability of public and private facilities and services	H3 - Innovation	I3 - Adaptation to the climatic action: pluvial flood	L3 - Public buildings operation
				E4 - Environmental impacts	F4 - Urban morphology and transportation	G4 - Education	H4 - ICT infrastructure	I4 - Adaptation to the climatic action: fluvial and coastal flood	
						G5 - Social inclusion		I5 - Adaptation to the climatic action: drought	
						G6 - Safety		I6 - Adaptation to the climatic hazard: wildfire	
						G7 - Health		I7 - Climatic hazard: wind	
						G8 - Food security			
						G9 - Culture and Heritage			
						G10 - Perceptual			

Figure 9: Structure of the SBTool (yellow) and SNTool (blue): Issues and Categories.

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Each criterion is combined with a (some) physical quantity(ies). These allow to quantify building/neighbourhood’s performances with regard to each criterion. In the *SBEMethod*, such quantities are called “indicators”. An indicator is a methodology which allows to characterize (not necessarily in numerical terms) the building/neighbourhood’s performance with respect to the corresponding criterion.

In the *SBEMethod*, qualitative criteria are also present, for which the building/neighbourhood’s performance is provided in terms of a comparison with a certain number of reference scenarios defined within the corresponding indicator. In the SBTool and SNTool, qualitative criteria are present in minimum quantity.

In the *SBEMethod* each criterion is associated with a single indicator.

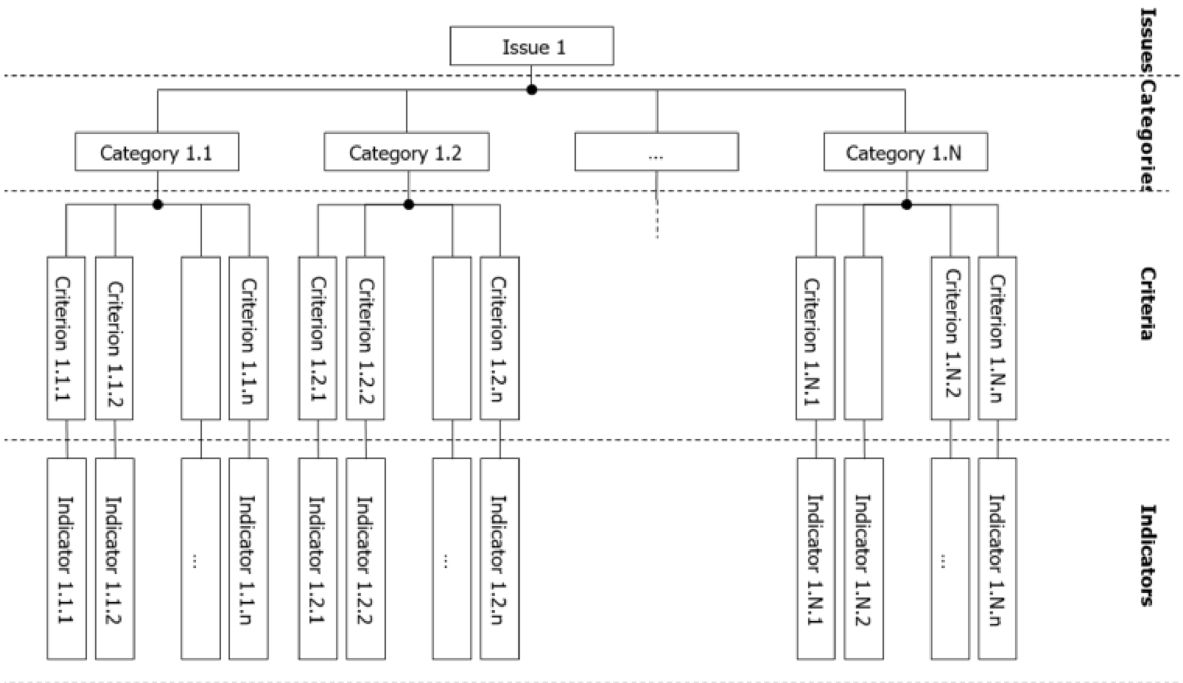

Figure 10: Schematic representation of a generic Issue’s structure in the SBEMethod.

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3.2.1. Assessment procedure in the *SBEMethod*

The main goal of the *SBEMethod* is to provide a final concise score, which summarizes the overall performance of the building and neighborhood with respect to all criteria. Such a score is called "final score" and is computed starting from indicator values.

The mathematical procedure used to compute the final score is called **assessment procedure**, and is articulated in three main steps:

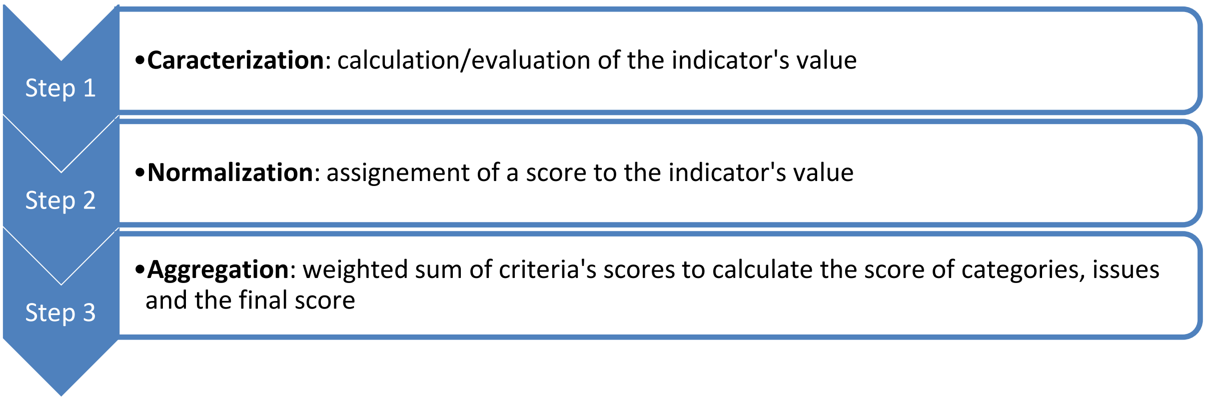

Figure 11: Schematic representation of the SBEMethod assessment process.

Characterization step. Building/Neighbourhood's performances on each criterion are characterized either by means of a numerical value (if the corresponding indicator represents some physical quantity), or by means of a comparison with some reference scenarios defined by the associated indicator (in the case of qualitative criteria). The output of the characterization step is composed by a set of numerical values (the indicators' values), each of them representing the neighbourhood's performances in regard to each criterion. The numerical value could for instance correspond to an energy consumption (i.e. kWh/inhabitant).

Normalization step. Indicators' values are made non-dimensional and rescaled in a suitable interval called *normalization interval*. The output of the normalization step is represented by a set of normalized scores, each of them is associated with a criterion. The normalization interval used in Sustainable MED Cities GF is from -1 to +5.

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The meaning of scores is:

Score	Meaning
-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.

Table 1: performance scale of the SBEMethod.

Aggregation step. Normalized scores are combined together (or *aggregated)* in order to compute the overall performance score. The aggregation step consists in a series of weighted sum.

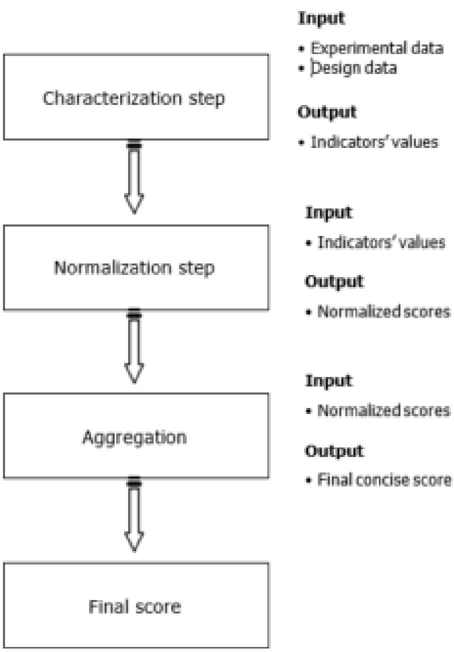

Figure 12: Input / Outputs of the SBEMethod assessment process.

To describe the assessment method in mathematical terms, in the following, these symbols will be used to denote:

- Ai, the i-th issue, i = 1,....., NA, and NA is the total number of issues included in the SBEMethod. E.g: the third issue will be denoted with the symbol A3.
- Ci,j, the j-th category in Ai, j = 1,......,$N_C^{(i)}$, where $N_C^{(i)}$is the number of categories included in the i-th issue. E.g: if the third issue contains 5 categories, $N_C^{(3)}$= 5, and the second category is denoted with the symbol C3,2.
- ci,j,k, the k-th criterion in the j-th category of the i-th issue, k = 1,........ , $N_c^{(i,j)}$, and $N_c^{(i,j)}$is the number of criteria included in Ci,j. E.g: if the second category includes 7 criteria, $N_C^{(3,2)}$= 7, and the fifth criterion in C3,2 is denoted with $c_{3,2,5.}$
- Ii,j,k, the indicator associated with $c_{i,j,k}$, k = 1,....., $N_c^{(i,j)}$. E.g: the indicator associated with the criterion $c_{3,2,5}$ is denoted with the symbol $I_{3,2,5}$
- sˆi,j,k, the numerical values of Ii,j,k. E.g: the numerical values of the indicator $I_{3,2,5}$ associated with $c_{3,2,5}$ is denoted with $sˆ_{3,2,5}$

Note: the symbols above indicated are valid for the mathematical description of the multicriteria assessment system. To improve the understandability of the generic framework, in Sustainable MED Cities GF the issues are indicated with a letter in substitution of the number, where 1=A, 2=B, 3=C, 4=D, 5=E, etc. The consequence is that categories are identified by a letter and a number (i.e. A1, C2, D4) and criteria by a letter and two numbers (i.e. A1.3, C2.4, D4.5).

Characterization step

The first step of the analysis is the characterization step. Characterization is performed by assigning a numerical value to each indicator. Such values are determined starting from design data, experimental measures, and through comparison with reference scenarios (in the case of qualitative criteria).

In the Sustainable MED Cities SBTool and SNTool, for each indicator a specific assessment method has been defined to calculate/evaluate its value.

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The output of the characterization step is represented by the set of data: $\hat{s}_{i,j,k}$, k = 1…$N_c^{(i,j)}$, j = 1,…, $N_C^{(i)}$, i = 1,…., N_A, each of them is associated with a criterion, and represents the numerical values of the corresponding indicator.

Normalization step

The normalization steps consist basically in the assignment of a score to the indicators' value. Due to the diverse nature of criteria, indicator values are characterized by different units of measure and different orders of magnitude. Moreover, indicator values associated with qualitative criteria do not possess any unit of measure as they do not represent any physical quantity. For this reason, indicator values are adimensionalised and rescaled in an interval from -1 to +5 before the aggregation phase. The normalization method fulfills two basic requirements:

1. indicator values are normalized in the interval [-1, +5], where -1 and +5 are integers, called "normalization interval";
2. the better the performance, the higher the normalized score.

Normalized scores are computed by applying suitable functions, called "normalization functions" to indicator values. These modify indicator values and provide normalized scores which fulfill both the previous requirements.

In the following, these symbols will be used to denote:

- $\varphi_{i,j,k}$, the normalization function associated with the indicator $I_{i,j,k}$;
- $s_{i,j,k}$, the normalized score associated with the criterion $c_{i,j,k}$.

Each normalization function is defined in different ways depending on the criterion which it is associated with. In the *SBEMethod* three main kinds of criteria can be distinguished:

- H.I.B. criteria (*Higher is Better*);
- L.I.B. criteria (*Lower is Better*);
- Qualitative criteria.

<u>H.I.B. Criteria (*Higher Is Better*).</u> 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", *normalization functions associated with H.I.B. criteria must be increasing functions*.

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. N*ormalization functions associated with L.I.B. criteria must be decreasing functions*.

Qualitative criteria. All criteria such that the normalized score can only attain discrete values in the normalization interval, each of them corresponding to a reference scenario defined by the corresponding indicator. Roughly speaking, the normalized score is computed by comparing the neighborhood's performance with some reference scenarios which are defined by the indicator associated with the criterion.

Normalization functions for H.I.B. criteria.

In the *SBEMethod*, normalization functions for H.I.B. criteria are piecewise linear functions defined as follows:

$$\phi_{i,j,k}\left(\hat{s}_{i,j,k}\right) = \begin{cases} n, & \hat{s}_{i,j,k} \leq \xi_{i,j,k}^{(1)} \\ n + (m-n)\,\dfrac{\hat{s}_{i,j,k} - \xi_{i,j,k}^{(1)}}{\xi_{i,j,k}^{(2)} - \xi_{i,j,k}^{(1)}}, & \xi_{i,j,k}^{(1)} < \hat{s}_{i,j,k} \leq \xi_{i,j,k}^{(2)} \\ m, & \hat{s}_{i,j,k} > \xi_{i,j,k}^{(2)} \end{cases}$$

Normalization function of this kind are such that:

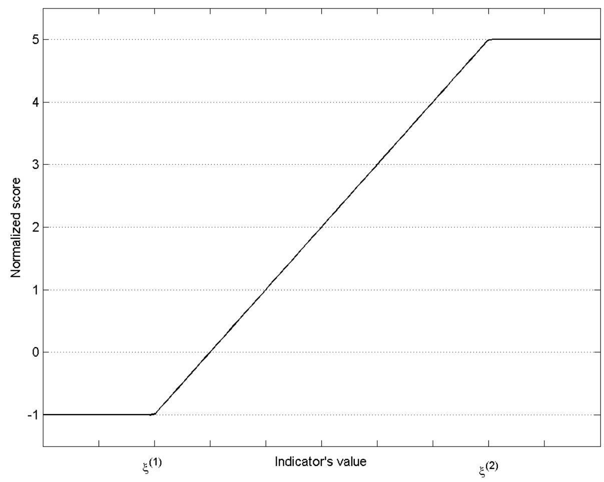

Figure 12: Normalization function for a H.I.B. criterion for the case n = −1 and m = 5.

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- the normalized score is 'n', if the indicator value lies below the threshold $\xi^{(1)}_{i,j,k}$;
- the normalized score is 'm', if the indicator value lies above the threshold $\xi^{(2)}_{i,j,k}$;
- otherwise the normalized score linearly varies in the interval $\left[\xi^{(1)}_{i,j,k}, \xi^{(2)}_{i,j,k}\right]$.

Remark: Note that the normalization function defined for a general H.I.B criterion is an increasing function.

The normalization function depends on two parameters: $\xi^{(1)}_{i,j,k}$ and $\xi^{(2)}_{i,j,k}$ which vary from criterion to criterion. Such parameters are called benchmarks in the sense that they respectively represent the threshold for the worst (-1) and the best (+5) performance.

If the numerical values of benchmarks are not available, they are computed starting from some reference values, i.e. two normalized scores (y' and y'') are associated with two values (x' and x'') of the corresponding indicator, and benchmarks are recovered by linear extrapolation:

$$\begin{cases} \dfrac{\xi^{(1)}_{i,j,k} - x'}{x'' - x'} = \dfrac{n - y'}{y'' - y'} \\ \dfrac{\xi^{(2)}_{i,j,k} - x'}{x'' - x'} = \dfrac{m - y'}{y'' - y'} \end{cases}$$

Normalization functions for L.I.B. criteria.

The same analysis of the previous section can be repeated in the case of normalization function associated with L.I.B. criteria, with the only exception that in this case, the normalization function must be a decreasing function.

$$\phi_{i,j,k}\left(\hat{s}_{i,j,k}\right) = \begin{cases} m, & \hat{s}_{i,j,k} \leq \xi^{(1)}_{i,j,k} \\ m - (m-n)\dfrac{\hat{s}_{i,j,k} - \xi^{(1)}_{i,j,k}}{\xi^{(2)}_{i,j,k} - \xi^{(1)}_{i,j,k}}, & \xi^{(1)}_{i,j,k} < \hat{s}_{i,j,k} \leq \xi^{(2)}_{i,j,k} \\ n, & \hat{s}_{i,j,k} > \xi^{(2)}_{i,j,k} \end{cases}$$

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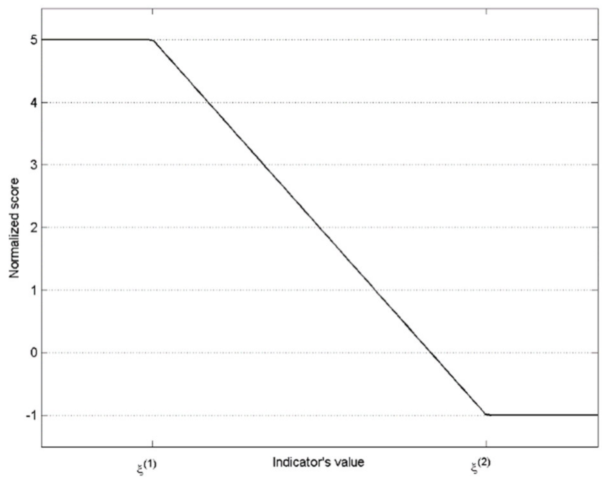

Figure 13: Normalization function for a L.I.B. criterion in the case n = −1 and m= 5.

Normalization functions of this kind are such that:

- the normalized score is 'm', if the indicator value lies below the threshold $\xi^{(1)}_{i,j,k}$;
- the normalized score is 'n', if the indicator value lies above the threshold $\xi^{(2)}_{i,j,k}$;
- otherwise, the normalized score linearly varies in the interval $\left[\xi^{(1)}_{i,j,k}, \xi^{(2)}_{i,j,k}\right]$.

Remark 2. Note that the normalization function defined is a decreasing function.

The normalization function depends on two parameters: $\xi^{(1)}_{i,j,k}$ and $\xi^{(2)}_{i,j,k}$ which vary from criterion to criterion. Such parameters are called benchmarks in the sense that they respectively represent the threshold for the best (+5) and worst performance (-1). Also in the present case, if the benchmarks are not available, they are computed by linear extrapolation:

$$\begin{cases} \dfrac{\xi^{(1)}_{i,j,k} - x'}{x'' - x'} = \dfrac{m - y'}{y'' - y'} \\ \dfrac{\xi^{(2)}_{i,j,k} - x'}{x'' - x'} = \dfrac{n - y'}{y'' - y'} \end{cases}$$

Normalization functions for qualitative criteria.

Normalization functions associated with qualitative criteria are defined as follows:

$$\phi\left(\hat{s}_{i,j,k}\right) = \begin{cases} s_0, & x = \xi_{i,j,k}^{(0)} \\ s_1, & x = \xi_{i,j,k}^{(1)} \\ s_2, & x = \xi_{i,j,k}^{(2)} \\ \ldots, & \\ s_n, & x = \xi_{i,j,k}^{(n)} \end{cases}$$

$$s_0, s_1, \ldots, s_n \in [n, m]$$

The normalized score can only attain discrete values in the normalization interval, each of them associated with a reference *scenario*.

After *n* + 1 scenarios are defined:

- the normalized score *s*0 is associated with the 0-th scenario;
- the normalized score *s*1 is associated with the 1-st scenario;
- ...
- the normalized score *sn* is associated with the *n*-th scenario;

Then the neighborhood's performance is compared with all reference scenarios and the normalized score is assigned depending on the result of such a comparison.

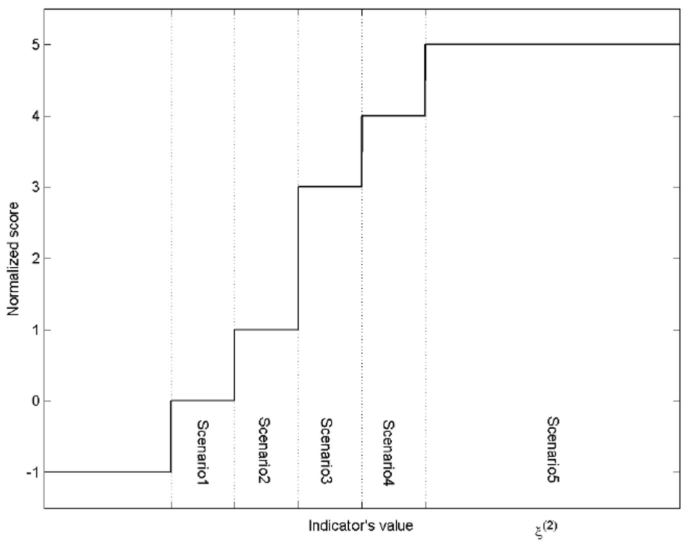

Figure 14: Example of a normalization function for a qualitative criterion in the case n = −1, m = 5.

Once all scenarios are defined, normalization functions associated with qualitative criteria only depend on *n* + 1 tunable parameters, which are the normalized score associated with each scenario (*s*0*, . . . , sn*).

Example:

Criterion "GHG gas emissions during operation"

Normalization of the indicator's value:

- CO_2 equivalent emissions per useful internal floor area per year = 2,24 kg CO_2 eq./m^2/yr

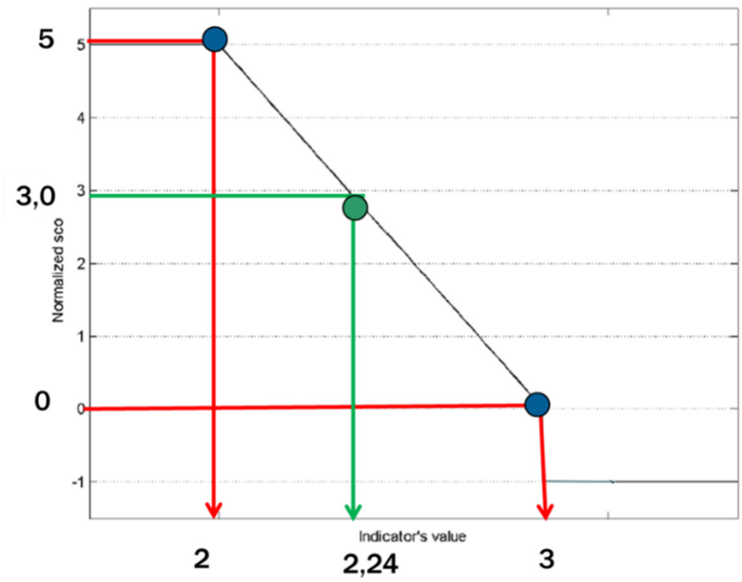

Figure 15: Example of normalisation of a indicator's value

Blue dots: represents the minimum acceptable performance (score zero) and the excellent performance (score +5).

Green dot: represents the value of the indicator on the linear performance scale.

The results of the normalization for a value of the indicator of 2,24 kg CO_2 eq./m^2/yr is a score of 3,0.

Aggregation step

At the end of the normalization step, a new set of data is available, composed of the normalized scores associated with each criterion. Normalized scores are then combined through a series of weighted sums to produce the final score, and this is done in three steps:

- *Aggregation through criteria*: normalized scores associated with all criteria in the same category are aggregated to produce a single score for each category.
- *Aggregation through categories:* normalized score associated with categories in the same issue (these resulting from aggregation through criteria) are further aggregated to produce a single score for each issue.
- *Aggregation through issues*: normalized scores associated with issues (these resulting from aggregation through categories) are aggregated to produce the final concise score.

Aggregation through criteria.

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

Aggregation is performed by linear aggregation of data through some coefficients, called *weighting factors*. These quantify the relative weight of each criterion with respect to all criteria in the same category.

In the following, these symbols will be used to denote:

- $\omega_{i,j,k}$: the weighting factor associated with the criterion $c_{i,j,k}$ in the category $C_{i,j}$;
- $S_{i,j}$: the normalized score resulting from aggregation of criteria included in the category $C_{i,j}$.

The score $S_{i,j}$ is computed as follows:

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

Note that the weighting factors defined by fulfill the following properties:

- each weighting factor lies in the interval [0, 1];

$$\sum_{k=1}^{N_c^{(i,j)}} \omega_{i,j,k} = 1$$

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It can be interpreted as a weighted sum of the performance score obtained by the neighbourhood in regard of each criterion, i.e. the performance score computed for a given category represents the building/neighborhood's average performance with respect to all criteria included in that category.

The result of aggregation through criteria is a set of normalized scores, each of them corresponding to a category.

Example: calculation of the score for the SNTool category A1 Use of land:

Code	**Criterion**	**Score**	**Weight**
A1.1	Population density	3,1	24%
A1.2	Urban compactness	2,2	34%
A1.3	Homogeneity of the urban fabric	1,3	16%
A1.4	Conservation of land	0,5	26%

Calculation of the category's score as weighted sum:

Code	**Criterion**	**Score x Weight**	**Weighted score**
A1.1	Population density	3,1x0,24 =	0,7
A1.2	Urban compactness	2,2x0,34 =	0,8
A1.3	Homogeneity of the urban fabric	1,3x0,16 =	0,2
A1.4	Conservation of land	0,5x0,26 =	0,1
		TOTAL	**1,8**

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

1,8

Category score = sum of the weighted scores = 1,8

Aggregation through categories

Scores obtained in the previous step are further aggregated to produce a single score for each issue.

In the following, these symbols will be used to denote:

- *wi,j:* the weighting factors for each category included in the issue *Ai;*
- *Sij:* the performance score associated with the *Ai.*

Aggregation through categories is performed for each issue, combining the performance scores of all categories in that issue as follows:

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

wi,j are the '*categories weighting factors*' which quantify the relative weight of each category with respect to the others in the same issue.

Weighting factors for categories are established by a panel of experts, and fulfil the following properties:

1. each weighting factor lies in the interval [0, 1];
2. $\sum_{j=1}^{N_C^{(i)}} w_{i,j} = 1$

Therefore, also the aggregation through categories performed for each issue, can be interpreted as a weighted sum, i.e., the final score obtained for each issue represents the average performance of the neighbourhood with respect to all categories included in that issue.

Example: calculation of the score for SNTool issue A-Use of land and biodiversity

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

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Calculation of the issue's score as weighted sum:

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

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

Issue score = sum of the weighted scores = 2,2

Aggregation through issues.

Finally, scores provided by aggregation through categories are further aggregated to produce the final concise score representing the neighborhood overall performance.

The final score is computed as follows:

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

where *Wi* represent the "*weighting factors for all issues*"' and express the relative influence of each issue on the final score.

The weighting factor for each issue is established by a panel of experts and fulfills the following properties:

Each weighting factor lies in the interval [0*,* 1];

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

Therefore, the final score can also be interpreted as the average performance of the neighbourhood with respect to all issues.

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Example: calculation of the overall score for a building/neighborhood:

Code	Issue	Score	Weight
A	Use of land and biodiversity	2,2	8%
B	Energy	1,9	13%
C	Water	2,3	10%
D	Solid Waste	0,9	10%
E	Environmental quality	2,1	10%
F	Transportation and mobility	2,0	8%
G	Social Aspects	1,1	11%
H	Economy	1,3	9%
I	Climate Change: mitigation and adaptation	3,0	13%
L	Governance	2,1	8%

Calculation of the issue's score as weighted sum:

Code	Issue	Score x Weight	Weighted score
A	Use of land and biodiversity	2,2 x 0,08 =	0,2
B	Energy	1,9 x 0,13 =	0,2
C	Water	2,3 x 0,1 =	0,2
D	Solid Waste	0,9 x 0,1 =	0,0
E	Environmental quality	2,1 x 0,1 =	0,2
F	Transportation and mobility	2,0 x 0,08 =	0,2
G	Social Aspects	2,1 x 0,11 =	0,2
H	Economy	1,3 x 0,09 =	0,2
I	Climate Change: mitigation and adaptation	3,0 x 0,13 =	0,4
L	Governance	2,1 x 0,08 =	0,2
		TOTAL	**2,0**

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

Neighborhood score = sum of the weighted scores = 2,0.

3.3. Contextualisation Process of a Generic Framework

From the Sustainable MED Cities MED Generic Frameworks, it is possible to develop contextualised local assessment tools through a process articulated in three steps:

- Selection of the active criteria
- Benchmarking
- Weighting

3.3.1. Selection of the active criteria

The first step consists in the selection of the criteria that will compose the local vision of the tool. The criteria are selected from the whole list of the Generic Framework (SBTool, SNTool, SCTool). There isn't a fixed number of criteria to be selected. The local systems can widely vary from this point of view. Only a core set of criteria, the Key Performance Indicators (KPIs), are mandatory for all. The KPIs represent the priority sustainability transnational issues and they allow to compare the key performances in the Mediterranean areas through the Sustainable MED Cities Passport.

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 tables provided in D5.2.1 Testing Protocol at section 2.1 (SNTool) and 2.5 (SBTool).

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A- USE OF LAND AND BIODIVERSITY		
AX	**Name of the Category**	***Justification***
AX.X	*Name of the Criterion*	*Text*
AX.X	*Name of the Criterion*	*Text*

Table 2: example of table to document and justify the selection of criteria

3.3.1. Benchmarking

The second step consists in the definition of the scoring scale for each selected criterion. The benchmark is a quantification of the indicator's value corresponding to the minimum acceptable performance (score zero) and the one that is considered the best at local level (score 5). To set the benchmarks, it is possible to refer to (listed in a priority order):

- national, regional laws
- national, regional, municipal regulations
- technical standards (national or international9
- statistical data
- scientific literature
- local reference values
- simulations

The selection of benchmarks shall be and justified using the tables provided in D5.2.1 Testing Protocol at section 2.3 (SNTool) and 2.7 (SBTool).

A- USE OF LAND AND BIODIVERSITY				
CRITERION	INDICATOR	UNIT OF MEASURE	BENCHMARK	RATIONALE
Ax.x	*(text)*		*0: value*	*Insert your comment here*
			5: value	*Insert your comment here*

Table 3: example of table to document and justify the selection of benchmarks

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3.3.2. Weighting

The third step consists in the definition of the weight at criterion, category and issue level through the assignment of priorities. 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.

3.3.2.1. 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 level 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.

The weight of each issue is then calculated as:

$$w_i = \frac{P_i}{\sum_{i=1}^{N} P_i} \times 100$$

Where:

- w_i = weight of the issue A_i
- Pi = priority level of the A_i issue

For instance, the table below shows a simulation of priority level assigned to SNTool issues:

ISSUE	Priority Factor (1 to 5)
A- USE OF LAND AND BIODIVERSITY	2
B- ENERGY	5
C- WATER	4
D- SOLID WASTE	2
E- ENVIRONMENTAL QUALITY	2
F- TRANSPORTATION AND MOBILITY	2
G- SOCIAL ASPECTS	4
H - ECONOMY	4
I – CLIMATE CHANGE	5

Table 4: simulation of priority factors assigned to SNTool issues

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The weight of issue A will be:

$$w_A = \sum \frac{2}{28} = 4\%$$

The weight of issue B will be:

$$w_B = \sum \frac{5}{28} \times 100 = 18\%$$

The table below shows the weight for all issues (SNTool):

ISSUE	Priority Factor (1 to 5)	Weight
A- USE OF LAND AND BIODIVERSITY	2	4%
B- ENERGY	5	18%
C- WATER	4	11%
D- SOLID WASTE	2	7%
E- ENVIRONMENTAL QUALITY	2	7%
F- TRANSPORTATION AND MOBILITY	2	7%
G- SOCIAL ASPECTS	4	14%
H - ECONOMY	4	14%
I – CLIMATE CHANGE	5	18%

Table 5: simulation of weights assigned to SNTool issues

3.3.2.2. Weighting of categories

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

The weight of each issue is then calculated as:

$$w_{i,j} = \frac{L_j}{\sum_{j=1}^{N_c^{(i)}} L_j} \quad \text{X } 100$$

Where:

$W_{i,j}$= weight of category $C_{j,k}$ included in issue A_i

L_j = priority factor of category $C_{j,k}$ included in issue A_i

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The priority factors must be assigned to all the categories in the local assessment tool. For istance, the table below shows the priorities assigned to the categories belonging to issue G of a local SNTool:

G	Social Aspects	Priority Factor (1 to 5)
G1	Accessibility (disabled persons)	2
G2	Housing	2
G3	Availability of public and private facilities and services	3
G4	Education	3
G5	Social inclusion	5
G6	Safety	3
G7	Health	5
G8	Food security	1
G9	Culture and Heritage	2
G10	Perceptual	2

Table 6: simulation of priority factors assigned to SNTool categories in Issue G

The resulting weights will be:

G	Social Aspects	Priority Factor (1 to 5)	Weight
G1	Accessibility (disabled persons)	2	7%
G2	Housing	2	7%
G3	Availability of public and private facilities and services	3	11%
G4	Education	3	11%
G5	Social inclusion	5	18%
G6	Safety	3	11%
G7	Health	5	18%
G8	Food security	1	4%
G9	Culture and Heritage	2	7%
G10	Perceptual	2	7%

Table 7: simulation of weights assigned to SNTool categories in Issue G

3.3.2.3. *Weighting of criteria*

To weight the criteria is necessary to assign priority factors to each assessment criterion. The priority factors are the following:

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)

Impact of the potential effect (I_k)

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

Extent of potential effect (E_k)

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

Duration of potential effect (D_k)

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

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

It can get from 1 to 3 points; it is a factor that can be used if there is the need to adjust the priority factor of the criterion in relation to specific local priorities. Maybe in a region

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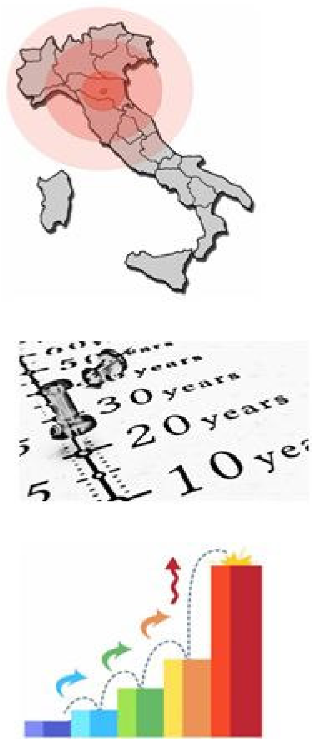
a particular sustainability issue has a dramatic importance in relation to other issues. In this case the adjustment factor can be used to take in account the local context.



<u>EXTENT</u> of potential effect	
Block	1
Neighborhood	2
Cluster	3
Urban/Region	4
Global	5
<u>DURATION</u> of potential effect	
from 1 to 3 years	1
from 3 to 10 years	2
From 10 - 30 years	3
30 - 75 years	4
>75 years	5
<u>IMPACT</u> of the Potential Effect	
Minimum	1
Moderate	2
High	3

Figure 16: Priority factors useful to establish the hierarchy relevance of the criteria

The weight of a criterion in its category is calculated applying the following steps.

- Calculation of the impact level P_k as:

  $Pk = D_k \times E_k \times I_k \times A_k$

- Calculation of the weight of the criterion in its category

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

For instance, considering the criteria in the SNTool category C1 Water infrastructure, possible priority factors are:

C- WATER					
C1 - Water infrastructure					
CRITERION	**Impact P_k *(IxExDxA)***	**I Intensity**	**E Extent**	**D Duration**	**A Adjustment**
C1.1 Availability of a public municipal water supply	60	5	*4*	*3*	*1*
C1.2 Availability of wastewater treatment systems	48	*4*	*4*	*3*	*1*

Table 8: Priority factors and impact of the criteria in the category C1

Consequently, the resulting weights are:

C- WATER	
C1 - Water infrastructure	
CRITERION	**Weight**
C1.1 Availability of a public municipal water supply	56%
C1.2 Availability of wastewater treatment systems	44%

Table 9: weights of the criteria in the category C1

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4. Sustainable MED Cities SBTool

4.1. Sustainable MED Cities SBTool: specifications

The complete list of the criteria which make up the Sustainable MED Cities SBTool, is presented in the following table. the specific table below also includes, for each criterion, the information related to the name of the indicator and the unit of measure. Furthermore, KPIs are marked in the list with a "X" and fully described in "D3.1.4 - MED Passport and KPIs".

Sustainable MED Cities - SBTool Criteria List

A	**Site Regeneration and Development, Urban Design and Infrastructure**			
A1	**Site Selection**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
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 infrastructures	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**	**KPIs**
A2.1	Use of native plantings	The extent of vegetated landscaped area that is planted with native plants	%	
A2.2	Provision of outdoor recreation areas	Number of recreation services offered in outdoor areas of the building	n	
A2.3	Support for bicycle use	Percentage of bicycle parking spaces available	%	
B	**Energy and Resources Consumption**			
B1	**Energy**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
B1.1	Primary energy demand	Primary energy demand per internal useful floor area per year	$kWh/m^2/yr$	X
B1.2	Delivered thermal energy demand	Delivered thermal energy demand per internal useful floor area per year	$kWh/m^2/yr$	X
B1.3	Delivered electrical energy demand	Delivered electrical energy demand per internal useful floor area per year	$kWh/m^2/yr$	X
B1.4	Energy from renewable sources in total thermal energy consumption	Share of renewable energy in final thermal energy consumptions	%	X

B1.5	Energy from renewable sources in total electrical energy consumption	Share of renewable energy in final electric energy consumption	%	X
B1.6	Embodied non-renewable primary energy	Embodied primary non-renewable energy per building's useful internal floor area	MJ/m^2	X
B2	**Electrical peak demand**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
B2.1	Electrical peak demand for building operations	Average of peak monthly electrical demand for one year	W/m^2	
B3	**Materials**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
B3.1	Degree of re-use of suitable existing structure(s)	Percent, by area, of an existing structure that is re-used	%	
B3.2	Materials intensity	Weight of structural and envelope components per useful floor area	kg/m^2	
B3.3	Renewable materials	Weight of renewable materials on total weigh of construction materials	%	
B3.4	Recycled materials	Weight of recycled materials on total weight of materials	%	X
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**	**KPIs**
B4.1	Embodied water	Net fresh water per useful internal floor area	m^3/m^2	
B4.2	Total water consumption	Total consumption of water per building occupant	m^3/occupant/yr	
B4.3	Potable water consumption for indoor uses	Potable water consumption per occupant per year	m^3/occupant/yr	X
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**	**KPIs**
C1.1	Embodied carbon	CO_2 equivalent emissions per useful internal floor area (product stage)	kg CO_2eq/m^2	X
C1.2	GHG gas emissions during operation	CO_2 equivalent emissions per useful internal floor area per year	kg CO_2eq/m^2 yr	X
C1.3	Life cycle global warming potential	CO_2 equivalent emissions per useful internal floor area for a period of 50 years	kg CO_2eq/m^2	
C2	**Other Atmospheric Emissions**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
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	

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C2.2	Emissions of acidifying emissions during facility operations	SO_2 equivalent emissions per year in kg per unit net area	kg/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**	**KPIs**
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**	**KPIs**
D1.1	Formaldehyde concentration	Formaldehyde concentration in indoor air	μg/m³	
D1.2	TVOC concentration	TVOC concentration in indoor air	μg/m³	X
D1.3	CO_2 concentrations	CO_2 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	X
D2	**Air Temperature and Relative Humidity**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
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	%	X
D3	**Daylighting and Illumination**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
D3.1	Daylight	Mean Daylight Factor	%	X
D3.2	Daylight Provision	Level of daylight provision	Level	
D3.3	Protection from Glare	DGP (Daylight Glare Probability)	Number	
D4	**Noise and Acoustics**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
D4.1	Protection from noise: façade 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	

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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**	**KPIs**
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**	**KPIs**
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	%	X
E2	**Optimization and Maintenance of Operating Performance**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
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**			
F1	**Social Aspects**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
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**	**KPIs**
F2.1	View out	Quality of view out	Score	

G	Cost and Economic Aspects			
G1	Cost and Economics			
CODE	CRITERION	INDICATOR	UNIT	KPIs
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	X
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	KPIs
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	X
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	Leaf Area Index: ratio of total vegetated surface area (on ground and on roofs, and including trees), divided by total site area	%	
H2	Climatic action: pluvial flood			
CODE	CRITERION	INDICATOR	UNIT	KPIs
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	KPIs
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	KPIs
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	%	

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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**	**KPIs**
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**	**KPIs**
H6.1	Windproof envelope	Level of use of certified wind resistant materials in the envelope	Score	

After the list of the SBTool criteria, for each of them it is provided a table with all the relevant information, as showed below in the example.

A	**Area**	
A1	**Category**	
A1.1	**Criterion**	
	Intent:	Description of the objective of the criterion
	Indicator:	Indicate the indicator name
	Unit of measure:	Include the unit of measure of the indicator
	Assessment method:	Describe the calculation methodology, step by step, to achieve the indicator result
	Standard:	Indicate, if any, the calculation standard for the criterion
	References:	Indicate the acquiring source

Sustainable MED Cities - SBTool Tables

A	**Site Regeneration and Development, Urban Design and Infrastructure**	
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:	Pre-development ecological value of land
	Unit of measure:	Score
	Project's stage:	Design
	Assessment method:	Calculation steps: - Determine the extension of the area analysed. - Determine the undeveloped area of land that is considered by authorities to be of ecological and agricultural value. - Calculate the ratio between the undeveloped area and the area analysed. Specifications:

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		▪ Only areas with recognized ecological or agricultural value, also in case of reconverted areas, must be taken in account. ▪ Parks and squares are not considered undeveloped land. ▪ Definition of agricultural value: an area that is intended for agricultural objectives (food, forage, etc.). ▪ Definition of ecological value: an area that has an ecological value because provides support to native life forms, making up natural ecosystems.
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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 that the use of private vehicles may be minimized
	Indicator:	Accessibility index to public transportation
	Unit of measure:	Index
	Project's stage:	design/in use
	Assessment method:	Calculation step: - Determine the walking distance from the nodes of the public transport network served by trains, buses and trams and the metro - Determine the frequency of the service for public transport lines accessible from the selected nodes - For each transport line selected according to the procedure indicated in the previous points, calculate the following parameters: • walking time of the building-node journey using a theoretical walking speed of 80 meters per minute, using the formula: $$w_t = \frac{d_n}{v} = \frac{d_n}{80}$$ where: Wt = walking time of the node-building journey, [min]; dn = length of the node-building route, understood as indicated in point 1, [m]; v = theoretical walking speed, equal to 80 meters per minute, [m/min]. • Waiting time for the service using the formula: $S_{wt} = 0{,}5 \cdot \left(\frac{60 \cdot 4}{n}\right) + R_f$ where: Swt = service waiting time, [min];

		n = number of passages of the vehicles of the individual lines in the reference time bands, [-]; Rf = reliability factor, equal to 2 for buses and trams, and equal to 0.75 for trains and metro. • total access time to public transport, adding the previously calculated walking time and waiting time for the service: $$At = Wt + Swt$$ where: At = total service waiting time, [min]; Swt = service waiting time, [min]; Wt = walking time of the node-building journey, in minutes, [min]; • equivalent frequency of access to the service from the building, using the formula: $$FI = \frac{30}{At}$$ where: FI = equivalent frequency of access to the service from the building, [-]; At = total time of access to the service, [min]; - By analysing each type of public transport (bus, tram, train) individually, calculate the accessibility index, using the formula: $$IA_i = FI_{i,max} + 0{,}5\left[\sum(FI_i) - FI_{i,max}\right],$$ where: IAi = accessibility index of the i-th type of transport, [-]; FIi,max = the higher of the FI values relating to the i-th type of transport, [-]; ΣFIi = sum of the FI values relating to the same type of i-th transport, [-]. - Calculate the value of the performance indicator, or the accessibility index IA to public transport, as the sum of the accessibility indices of the different types of public transport calculated in the previous point. $$Indicator = IA_{bus} + IA_{tram} + IA_{train}$$
	Standard:	-

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	References:	CESBA MED Project – SBTool assessment system

A1.3	**Adjacency to existing service infrastructures**	
	Intent:	To discourage the construction of buildings on undeveloped land
	Indicator:	Average distance between the site and key existing infrastructures
	Unit of measure:	m
	Project's stage:	design
	Assessment method:	Calculation steps: - Identify locations of the existing service infrastructures on the site. - Calculate the average distance between the site and the key existing infrastructures.
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Average distance from key services
	Unit of measure:	m
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Identify locations of the key services for local residents on the site. - Calculate the average distance between the site and the key services. Note Key services are: 1. Education (schools, kindergartens, education centers, etc.) 2. Health center (hospitals, medical ward, medical center, etc.) 3. Law enforcement areas (police station, etc.) 4. Sport facilities 5. Food shops 6. Bank 7. Post office 8. Pharmacy 9. Shopping center 10. Culture and leisure. It is possible to consider only one key service from each of the ten categories. Private services can be considered.
	Standard:	-

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	References:	CESBA MED Project – SBTool assessment system

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:	The extent of vegetated landscaped area that is planted with native plants
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - 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 - calculate the total area landscaped (excluding paved areas) (B) – denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

A2.2	**Provision of outdoor recreation areas**	
	Intent:	To provide public space and recreation areas for gathering, relaxation and recreation of the population
	Indicator:	Number of recreation services offered in outdoor areas of the building
	Unit of measure:	n
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the number of recreation services offered in outdoor areas of the building
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

A2.3	**Support for bicycle use**	
	Intent:	To promote the use of the bicycle as an alternative to the car
	Indicator:	Percentage of bicycle parking spaces available
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the number of bicycle parking spaces available in the building (A) - numerator - calculate the number of occupants of the building (B) – denominator - Calculate the value of the indicator as A/B (%)

	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

B	**Energy and Resources Consumption**	
B1	**Energy**	
B1.1	**Primary energy demand**	
KPI	*Intent:*	To minimise the total energy consumptions in the use stage
	Indicator:	Primary energy demand per internal useful floor area per year
	Unit of measure:	kWh/m²/yr
	Project's stage:	design/in use
	Assessment method:	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)
	References:	CESBA MED Project – SBTool assessment system

B1.2	**Delivered thermal energy demand**

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KPI	*Intent:*	To minimise the total thermal energy consumptions in the use stage
	Indicator:	Delivered thermal energy demand per internal useful floor area per year
	Unit of measure:	kWh/m²/yr
	Project's stage:	design/in use
	Assessment method:	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)
	References:	CESBA MED Project – SBTool assessment system

B1.3	**Delivered electrical energy demand**	
KPI	*Intent:*	To minimise the total electric energy consumptions in the use stage
	Indicator:	Delivered electrical energy demand per internal useful floor area per year
	Unit of measure:	kWh/m²/yr
	Project's stage:	design/in use
	Assessment method:	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).
	References:	CESBA MED Project – SBTool assessment system

B1.4	**Energy from renewable sources in total thermal energy consumption**	
KPI	*Intent:*	To maximize the use of renewable energy sources
	Indicator:	Share of renewable energy in final thermal energy consumptions
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	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.

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		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
	References:	CESBA MED Project – SBTool assessment system

B1.5	**Energy from renewable sources in total electrical energy consumption**	
KPI	*Intent:*	To maximize the use of renewable energy sources
	Indicator:	Share of renewable energy in final electric energy consumption
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	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.
	References:	CESBA MED Project – SBTool assessment system

B1.6	**Embodied non-renewable primary energy**	
KPI	*Intent:*	To promote the use of construction materials with a low embodied energy
	Indicator:	Embodied primary non-renewable energy per building's useful internal floor area
	Unit of measure:	MJ/m^2
	Project's stage:	design
	Assessment method:	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: - 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. - 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; - 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)
	References:	CESBA MED Project – SBTool assessment system

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:	Average of peak monthly electrical demand for one year
	Unit of measure:	W/m^2
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - 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 - Calculate the area of the building (B) – denominator - Calculate the value of the indicator as A/B. Note: Review of contract documentation and sample equipment specifications by an outside electrical engineer
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Percent, by area, of an existing structure that is re-used
	Unit of measure:	%
	Project's stage:	design
	Assessment method:	Calculation steps: - Calculate the area of the existing structure that is re-used (A) - numerator - Calculate the total area of the existing structure (B) – denominator - Calculate the value of the indicator as A/B (%)

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		Note: the basis of assessment should be a report that provides a structural, functional and economic assessment of the existing structure, carried out by a team of qualified professionals
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

B3.2	**Materials intensity**	
	Intent:	To evaluate the material intensity of the building for the structure and the envelope
	Indicator:	Weight of structural and envelope components per useful floor area
	Unit of measure:	kg/m^2
	Project's stage:	design
	Assessment method:	Calculation steps: - Calculate the weight (kg) of structural and envelope components in relation to the useful floor area (m^2)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

B3.3	**Renewable materials**	
	Intent:	To promote the use of non-renewable material resources
	Indicator:	Weight of renewable materials on total weigh of construction materials
	Unit of measure:	%
	Project's stage:	design
	Assessment method:	Calculation steps: - Calculate the weight of the renewable materials existing in the building (A) - numerator - Calculate the total weight of the construction material in the building (B) – denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

B3.4	**Recycled materials**	
KPI	*Intent:*	To reduce the environmental impact of construction materials
	Indicator:	Weight of recycled materials on total weight of materials
	Unit of measure:	%
	Project's stage:	design
	Assessment method:	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.

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		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: - 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. - 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. - 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). - Identify the recycled content of each constituent material (in mass). - 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. - The indicator's value is calculated as B/A (total mass of recycled materials on the total mass of materials).
	Standard:	EN ISO 14021 (Environmental labels and declarations - Self-declared environmental claims - Type II environmental labelling)
	References:	CESBA MED Project – SBTool assessment system

B3.5	**Local materials**	
	Intent:	To promote the use of local materials and techniques
	Indicator:	Weight of local materials on total weight of materials
	Unit of measure:	%
	Project's stage:	design
	Assessment method:	Calculation steps: - Calculate the weight of the local materials existing in the building (A) - numerator - Calculate the total weight of the construction material in the building (B) – denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-

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	References:	CESBA MED Project – SBTool assessment system

B3.5	**Local materials**	
	Intent:	To promote the use of local materials and techniques
	Indicator:	Weight of local materials on total weight of materials
	Unit of measure:	%
	Project's stage:	design
	Assessment method:	Calculation steps: - Calculate the weight of the local materials existing in the building (A) - numerator - Calculate the total weight of the construction material in the building (B) – denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Circularity potential
	Unit of measure:	Score
	Project's stage:	design
	Assessment method:	- Following Level(s) guideline: 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. 2. *Optional step*: 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 (as relevant to the bill of quantities and materials). 3. *Optional step*: Consider the availability of building components and parts with building material passports and seek advice from experts familiar with the Buildings As Material Banks (BAMB) concept. 4. Within the design team, review and identify how the deconstruction design concepts could be introduced into the design process. 5. Once the design concept is finalised with the client, record the deconstruction design concepts that were taken into account using the L1 reporting format at the end of these instructions (L1.5).
	Standard:	-

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

B3.7	**Design for adaptability**	
	Intent:	To ensure a high degree of adaptability of the structure for different uses
	Indicator:	Adaptability potential
	Unit of measure:	Score
	Project's stage:	design
	Assessment method:	- Following Level(s) guideline, evaluate the three key concepts that form the basis for the "adaptability design concept checklist, namely adaptation to: • Existing and future occupier needs. • Changing future demand in the property market. • Life changes in the case of residential property. In this way, users can obtain a better understanding of why adaptability is important to address and how it can influence the useful service life of a building in the medium to long term.
	Standard:	-
	References:	Level(s) indicator 2.3: Design for adaptability and renovation

B4	**Use of potable water, stormwater and greywater**	
B4.1	**Embodied water**	
	Intent:	To estimate the amount of fresh water for the building
	Indicator:	Net fresh water per useful internal floor area
	Unit of measure:	m^3/m^2
	Project's stage:	design
	Assessment method:	Calculation steps: - Calculate the amount of fresh water for the building (A) - numerator - Calculate the useful internal floor area of the building (B) – denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

B4.2	**Total water consumption**	
	Intent:	To evaluate water resources consumption
	Indicator:	Total consumption of water per building occupant
	Unit of measure:	m^3/occupant/yr
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the total amount of the water consumption in m^3 per year (A) - numerator

		- Calculate the total number of occupants (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

B4.3	**Potable water consumption for indoor uses**	
KPI	*Intent:*	Make efficient use of water resources
	Indicator:	Potable water consumption per occupant per year
	Unit of measure:	m^3/occupant/yr
	Project's stage:	design/in use
	Assessment method:	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: $Total\ consumption\ \left(\frac{L}{occupant.d}\right) = Consumption\ rate\ \left(\frac{L}{min}\right) x\ Usage\ factor\ \left(\frac{min}{occupant.d}\right)$ $Total\ consumption\ \left(\frac{m^3}{ocucpant.year}\right) = Total\ consumption\ \left(\frac{L}{occupant.d}\right) x\ 0.001 \left(\frac{m^3}{L}\right) x\ occupancy\ rate\ \left(\frac{d}{year}\right)$ 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: $Total\ consumption\ \left(\frac{L}{year}\right) = Consumption\ rate\ \left(\frac{L}{m^2}\right) x\ area\ (m^2)\ x\ no.cleans\ per\ year\ (year^{-1})$ $Total\ consumption\ \left(\frac{m3}{occupant.year}\right) = Total\ consumption\ \left(\frac{L}{year}\right) x\ 0.001 \left(\frac{m^3}{L}\right) \div full\ time\ eqivt.ocucpancy\ (occupant)$ 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
	References:	CESBA MED Project – SBTool assessment system

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:	Potable water consumption / standardised potable water consumption
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the total amount of the water consumption in m^3 for irrigation purposes (A) - numerator - Calculate the standardised potable water consumption in m^3 (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

C	**Environmental Loadings**	
C1	**Greenhouse Gas Emissions**	
C1.1	**Embodied carbon**	
KPI	*Intent:*	Promote the use of construction materials with a low embodied carbon
	Indicator:	Embodied carbon dioxide equivalents per building's useful internal floor area
	Unit of measure:	kg CO_2eq/m^2
	Project's stage:	design
	Assessment method:	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 ($kgCO_2eq/m^2$) 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.

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		IEA Evaluation of Embodied Energy and CO_2eq 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)
	References:	CESBA MED Project – SBTool assessment system

C1.2	**GHG gas emissions during operation**	
KPI	*Intent:*	To minimise the total greenhouse gas (GHG) emissions from buildings' operations
	Indicator:	CO_2 equivalent emissions per useful internal floor area per year
	Unit of measure:	kg CO_2 eq/m^2 /yr
	Project's stage:	design/in use
	Assessment method:	To characterize the indicator's value: 1. Calculate the total emissions of CO_2 eq. related to building operations, using the following formula: $$E = \frac{\sum_1^i (Q_{fuel,i} \cdot LHV_i \cdot k_{em,i}) + (Q_{el} \cdot k_{em}) + (Q_{dhc} \cdot k_{em.dhc})}{A_u}$$ Where: $Q_{fuel,i}$ = total quantity of annual fuel consumption of i-th fuel (e.g. m^3 for gas or lt for oil) LHV_i = lower heating value of the i-th fuel (e.g. kWh_{th}/m^3 or kWh_{th}/lt) $k_{em,i}$ = LCA CO_2 eq. emission factor of the i-th fuel (kg CO_2 eq./kWh_{th}) Q_{el} = total quantity of annual electrical energy from the grid (kWh_e) k_{em} = LCA CO_2 eq. emission factor of the electrical energy from the grid (kg CO_2 eq./kWh_e) Q_{dhc} = total quantity of annual energy from district heating/cooling (kWh_{th}) $k_{em,dhc}$ = LCA CO_2 eq. emission factor of energy from district heating/cooling (kg CO_2eq./kWh_{th}) A_u = useful internal floor area (m^2) 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.
	References:	CESBA MED Project – SBTool assessment system

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:	CO_2 equivalent emissions per useful internal floor area for a period of 50 years
	Unit of measure:	kg CO_2eq/m^2
	Project's stage:	design
	Assessment method:	Following Level(s) guideline, proceed as follow: 1. Consult the checklist of life cycle design concepts in section L1.4 and read the background descriptions in Level 1 supporting guidance later in this document. 2. *Optional step*: make a review of relevant LCA/whole life carbon studies of similar building types in the same country and, preferably, the same region or locality. 3. *Optional step*: Interpret and identify 'hot spots' and recommendations for improvements along the building life cycle from the studies reviewed. 4. Within the design team, review and identify options for using the life cycle design concepts and for addressing the hot spots identified from previous studies. 5. Once the design concept is finalised with the client, record the life cycle design concepts that were taken into account using the L1 reporting format.
	Standard:	EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings). Level(s) Part 1-2 – Beta version.
	References:	Level(s) indicator 1.2: Life cycle Global Warming Potential (GWP)

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:	CFC-11 equivalent emissions per useful internal floor area per year
	Unit of measure:	g/m^2 per yr
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the amount of CFC-11 equivalent, in grams per m^2 per year
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	SO_2 equivalent emissions per year in kg per unit net area

	Unit of measure:	kg/m² / yr
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the amount of SO_2 equivalent, in kg per unit net area, per year
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Ethene equivalent per year in grams per net unit area
	Unit of measure:	g/m² /yr
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the amount of ethene equivalent per year in grams per net unit area per year
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

C3	**Solid Wastes**	
C3.1	**Construction waste**	
	Intent:	To minimize the production of construction waste
	Indicator:	Weight of waste and materials generated per m² of internal useful floor area
	Unit of measure:	kg/m²
	Project's stage:	design
	Assessment method:	Calculation steps: - Calculate the weight of waste and materials generated per m² of internal useful floor area
	Standard:	Level(s) Part 1-2 – Beta version. EN 15978 (Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method)
	References:	CESBA MED Project – SBTool assessment system

C3.2	**Solid waste from building operations**	
	Intent:	To facilitate the separate collection and recycle of solid waste from building operation
	Indicator:	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
	Unit of measure:	%
	Project's stage:	in use
	Assessment method:	Calculation steps:

		- Identify the availability and position of bins and containers for each of the seven solid waste categories. - Calculate the walking distance (m) from the building's main entrance to each identified bin or container. - 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). - Calculate the value of the indicator as: A/7. The seven reference categories of solid waste are: ▪ Paper ▪ Plastic ▪ Metal ▪ Glass ▪ Wet waste ▪ Textiles ▪ Special hazardous waste Note: if a single bin is used to collect different types of waste that will be later separated at the waste facility, each type of waste counts as a separate category in the indicator's calculation. For instance, if a single bin is used to collect glass and metal and the two wastes will be later separated at waste facility, the single bin counts for 2 waste categories.
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

D	**Indoor Environmental Quality**	
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:	Formaldehyde concentration in indoor air
	Unit of measure:	µg/ m^3
	Project's stage:	As built/in use
	Assessment method:	**Assessment approach (as built):** After the completion of a building, it is important to evaluate the internal air formaldehyde concentration, in order to ensure the health of future occupants. The measurement could be performed both in case of only natural ventilation and in case of mechanical ventilation. 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. The reference values for the formaldehyde concentration in indoor air are highlighted in the WHO guidelines and in the AFSSET document. **Assessment approach (in-use):** The measurement of the formaldehyde concentration in use phase is the same of the as-built stage (see above). The additional thing that must be considered is the fact that, since the building is in use, 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.*
	References:	CESBA MED Project – SBTool assessment system

D1.2	**TVOC concentration**	
KPI	*Intent:*	To facilitate the assessment of indoor air quality
	Indicator:	TVOC concentration in indoor air
	Unit of measure:	µg/ m^3
	Project's stage:	As built/in use
	Assessment method:	**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.
	References:	CESBA MED Project – SBTool assessment system

D1.3	**CO_2 concentrations**	
	Intent:	To assess the predicted or actual carbon dioxide concentrations in typical primary occupancy areas
	Indicator:	CO_2 concentration in indoor air
	Unit of measure:	ppm
	Project's stage:	As built/in use
	Assessment method:	**Assessment approach (as built and in-use):** 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. Thanks to these two measures, it will be easy evaluate the increase in CO_2 of indoor air compared to outdoor air for each main room. The measurement should be made in building rooms in which its known that users spend most of their time in and cover various representative periods of time. The measurement is performed using carbon dioxide detectors.
	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 15251: 2007 Indoor Environmental Criteria. EN 16798: 2019 Energy performance of buildings - Ventilation for buildings.
	References:	CESBA MED Project – SBTool assessment system

D1.4	**Low emitting materials**	
	Intent:	To evaluate the emission class of finishing materials, promoting low emitting material
	Indicator:	Mean emission class of finishing materials
	Unit of measure:	index
	Project's stage:	Design
	Assessment method:	Calculation steps: - Calculate the extension (m^2) of the internal finishing materials of the building, identifying each of them; - For each finishing material identified, check its class of emission and the related index; - Make a weighted average for each finishing material, as described in the formula below: $$Z_m = \frac{\sum(Z_{p,i} \cdot S_{p,i})}{\sum S_{p,i}}$$ - Get the final score, based on the weighted average.
	Standard:	UNI EN ISO 16000-9:2006 UNI EN ISO 16000-10:2006 UNI EN ISO 16000-11:2006
	References:	CESBA MED Project – SBTool assessment system

D1.5	**Radon**	
	Intent:	To reduce radon concentration in indoor air
	Indicator:	Radon concentration in indoor air
	Unit of measure:	Bq/m^3
	Project's stage:	In use
	Assessment method:	**Assessment approach (as built and in-use):** 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: - at a height from the floor of about 1,5 m possibly hanging on the walls; - away from windows and doors; - away from heat sources and direct light; - 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) indicator 4.1: Indoor air quality. Document

		developed by European Commission - Joint Research Centre, January 2021.
	References:	-

D1.6	**Relative humidity**	
	Intent:	To assess indoor thermal comfort conditions in relation to the relative humidity
	Indicator:	Relative humidity in indoor air
	Unit of measure:	%
	Project's stage:	As built/in use
	Assessment method:	**Assessment approach (as built):** 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. **Assessment approach (in-use):** During the occupation of the building (in-use phase), the verification of the relative humidity must be performed in all the main rooms of the building in order to be able to characterise the way in which the user manages the installations establishing, therefore, the user profile of the building. The relative humidity measurement must be carried out also for the external air. It is recommended to perform the measurement for a period sufficient to establish a complete time profile of internal thermo-hygrometric conditions, using a datalogger for data collection (better with stand-alone power supply and with adequate storage capacity). For the measurement it is necessary the use of hygrometric sensors (psychrometric, dew point, capacitive type) with the following minimal requirements: • range: 10 ÷ 90 % • uncertainty: ±3% • resolution: 0.1% Furthermore, the measurement of the relative humidity is an indirect measure that allows to understand if the mechanical ventilation works properly and if there are anomalies not identified at the design stage.
	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 15251: 2007 Indoor Environmental Criteria.

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		EN 16798: 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.
	References:	CESBA MED Project – SBTool assessment system

D1.7	**Mechanical Ventilation**	
KPI	*Intent:*	To assess indoor thermal comfort conditions in relation to the mechanical ventilation rate
	Indicator:	Mechanical ventilation rate per useful internal floor area
	Unit of measure:	$l/s/m^2$
	Project's stage:	Design/as built/in use
	Assessment method:	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.
	References:	CESBA MED Project – SBTool assessment system

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:	Percentage of the time out of the range of defined interior maximum and minimum temperatures during the heating season
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	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. Alternatively, if a dynamic method is used, the results shall be validated according to EN ISO 52016-1 or the criteria and test cases in EN 15265. The indicator has to be evaluated in all main living rooms and all bedrooms. In the case of assessment of multiple apartments, each distinctive configuration and orientation shall be assessed.
	Standard:	EN 15251 EN ISO 13790
	References:	CESBA MED Project – SBTool assessment system

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D2.2	Time outside of the thermal comfort range (cooling season)	
	Intent:	To assess indoor thermal comfort conditions
	Indicator:	Percentage of the time out of the range of defined interior maximum and minimum temperatures during the cooling season
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	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. Alternatively, if a dynamic method is used, the results shall be validated according to EN ISO 52016-1 or the criteria and test cases in EN 15265. The indicator has to be evaluated in all main living rooms and all bedrooms. In the case of assessment of multiple apartments, each distinctive configuration and orientation shall be assessed.
	Standard:	EN 15251 EN ISO 13790
	References:	CESBA MED Project – SBTool assessment system

D2.3	Thermal comfort index	
KPI	*Intent:*	To facilitate the assessment of indoor thermal comfort conditions during the cooling season
	Indicator:	Predicted Percentage of Dissatisfied in cooling season
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	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,

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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
- Select the design indoor air speed
- Calculate the mean radiant temperature of indoor wall surfaces (°C)
- Determine the main physical activity of the occupants (related to the metabolic rate)
- Determine the typical type of clothing ensembles
- 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
$PPD = 100 – 95 * exp[-(0.03353 * PMV^4 + 0.2179 * PMV^2)]$

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.

a) Calculate the running mean of outdoor temperature (Trm)

$$T_{rm} = \frac{(T_{od-1}+0.8T_{od-2}+0.6T_{od-3}+0.5T_{od-4}+0.4T_{od-5}+0.3T_{od-6}+0.2T_{od-7})}{3.8}$$

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

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

	Upper Limit $T_{i,max}$ (°C)	Lower Limit $T_{i,max}$ (°C)	T_o Variance (Adaptive method)	PPD(%)	PMV
Category I	$0.33\ T_{rm} + 18.8 + 2$	$0.33\ T_{rm} + 18.8 - 2$	±2	≤6	$-0.2 \le PMV \le 0.2$
Category II	**$0.33\ T_{rm} + 18.8 + 3$**	$0.33\ T_{rm} + 18.8 - 3$	±3	≤10	$-0.5 \le PMV \le 0.5$
Category III	$0.33\ T_{rm} + 18.8 + 4$	$0.33\ T_{rm} + 18.8 - 4$	±4	≤15	$-0.7 \le PMV \le 0.7$

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: - The center of the room or space; - 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. . 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.
	References:	CESBA MED Project – SBTool assessment system

D3	**Daylighting and Illumination**	
D3.1	**Daylight**	
KPI	*Intent:*	To ensure an adequate level of daylighting in all primary occupied spaces
	Indicator:	Mean Daylight Factor
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	**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.

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		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 D_T and D_{TM} - Ensure that the daylight factors equal or exceed the target values (D_{TM} and D_T). 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*.

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	References:	CESBA MED Project – SBTool assessment system

D3.2	**Daylight Provision**	
	Intent:	To evaluate if the level of daylight provision is sufficient to carry out the task
	Indicator:	Level of daylight provision
	Unit of measure:	Level
	Project's stage:	design/in use
	Assessment method:	Following what stated in EN 17037 (Section 5 Assessment of Daylight in Interior Spaces): - Calculate the level of daylight provision necessary to perform the task, also taking into account: - External obstruction - Glazing transmittance - Thickness of walls and roofs - Internal partition and surface reflectance.
	Standard:	CEN European Daylight Standard EN 17037 – Daylighting in buildings
	References:	CESBA MED Project – SBTool assessment system

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:	DGP (Daylight Glare Probability)
	Unit of measure:	Number
	Project's stage:	in use
	Assessment method:	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. Recommendations for glare protection is given in Table A.7 and calculation methods and pre-calculated tables are described in Annex E (Informative). The shading material properties and glare protection classes are according to prEN 14501 Blinds and shutters - Thermal and Visual comfort - Performance characteristics and classification.
	Standard:	CEN European Daylight Standard EN 17037 – Daylighting in buildings
	References:	CESBA MED Project – SBTool assessment system

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:	$D_{2m,nT,w}$ - Weighted standardized level difference for traffic noise (sound insulation)
	Unit of measure:	dB
	Project's stage:	Design/in use
	Assessment method:	Following what stated in Level(s): - 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. Check the content of the "L1.4. Checklist of acoustic and noise protection design aspects" in Level(s) indicator 4.4. Use the "L1.5. Reporting format", to complete the reporting format for the indicator.
	Standard:	Level(s) indicator 4.4: Acoustics and protection against noise
	References:	EN 12354-3

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:	R'w - Weighted apparent sound reduction index
	Unit of measure:	dB
	Project's stage:	Design/in use
	Assessment method:	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. Check the content of the "L1.4. Checklist of acoustic and noise protection design aspects" in Level(s) indicator 4.4.

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		Use the “L1.5. Reporting format”, to complete the reporting format for the indicator.
	Standard:	Level(s) indicator 4.4: Acoustics and protection against noise
	References:	EN 12354-1

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:	L’n,w - Weighted normalized impact sound pressure level
	Unit of measure:	dB
	Project's stage:	-
	Assessment method:	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. Check the content of the “L1.4. Checklist of acoustic and noise protection design aspects” in Level(s) indicator 4.4. Use the “L1.5. Reporting format”, to complete the reporting format for the indicator.
	Standard:	Level(s) indicator 4.4: Acoustics and protection against noise
	References:	EN 12354-2

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:	$LA_{eq,nT}$ - A-weighted standardized continuous sound pressure level
	Unit of measure:	dB
	Project's stage:	-
	Assessment method:	Following what stated in Level(s): - 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. Check the content of the "L1.4. Checklist of acoustic and noise protection design aspects" in Level(s) indicator 4.4. Use the "L1.5. Reporting format", to complete the reporting format for the indicator.
	Standard:	Level(s) indicator 4.4: Acoustics and protection against noise
	References:	EN 12354-5

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:	T - Reverberation time
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - 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. Check the content of the "L1.4. Checklist of acoustic and noise protection design aspects" in Level(s) indicator 4.4. Use the "L1.5. Reporting format", to complete the reporting format for the indicator.
	Standard:	Level(s) indicator 4.4: Acoustics and protection against noise
	References:	EN 12354-6

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:	Strategies adopted to minimise the exposition to ELF magnetic fields
	Unit of measure:	Score
	Project's stage:	design

	Assessment method:	Evaluate the typologies of strategies adopted to minimise the exposition to ELF magnetic fields during the design stage
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

D5.2	**Level of ELF magnetic fields**	
	Intent:	To minimise the exposure to the ELF magnetic fields
	Indicator:	Mean level of magnetic induction (50/60 Hz)
	Unit of measure:	µt
	Project's stage:	In use
	Assessment method:	**Assessment procedure (in-use):** - Check for the presence and location of industrial frequency magnetic field sources inside or in the immediate proximity of the building - 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 - Check the impact value of the power frequency magnetic field sources according to the exposure levels described in the following table:
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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

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:	Strategies adopted to minimise the exposition to High Frequency Electromagnetic fields
	Unit of measure:	Score
	Project's stage:	design
	Assessment method:	Evaluate the typologies of strategies adopted to minimise the exposition to High Frequency Electromagnetic fields
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

D5.4	**Level of High Frequency Electromagnetic Fields**

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	Intent:	To minimise the level of exposure to High Frequency Electromagnetic fields
	Indicator:	Mean level of electric filed (100 kHz- 3GHz)
	Unit of measure:	V/m
	Project's stage:	In use
	Assessment method:	**Assessment procedure (in-use):** - Check for the presence and location of radio frequency electromagnetic field sources and microwaves inside or in the proximity of the building - Measure the electric field level in all main rooms - On the basis of the measurements made, check the impact value of the electromagnetic field sources according to the following table:
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

Exposure Level	impact
Mean value < 0.8 V/m in all the main 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

E	**Service Quality**	
E1	**Controllability**	
E1.1	**Effectiveness of facility management control system**	
	Intent:	To evaluate the effectiveness of facility management control system within the building
	Indicator:	Percentage of control functions within class A
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the number of control functions within class A (A) - numerator - Calculate the total number of control functions (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

E1.2	**Smart Readiness Indicator**	
KPI	*Intent:*	Reach more energy efficient, environmentally friendly, healthy and comfortable indoor environments. Assesses the smartness of a building.

	Indicator:	Total smart readiness of buildings for responding to the needs of occupants, optimizing energy performance, and interacting with energy grids
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	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: $I(d,ic) = \sum_{i=1}^{Nd} I_{ic}(FL(S_{i,d}))$ 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, $S_{i,d}$ is function i of technical domain d, $FL(S_{i,d})$ is the functionality level of function $S_{i,d}$ as available in the building or building unit, $I_{ic}(FL(S_{i,d}))$ is the score of function $S_{i,d}$ 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 $I_{max}(d,ic)$ is determined, as follows: $I_{max}(d,ic) = \sum_{i=1}^{Nd} I_{ic}(FL_{max}(S_{i,d}))$ Where: $FL_{max}(S_{i,d})$ is the highest functionality level that function $S_{i,d}$ could have according to the smart-ready service catalogue, $I_{ic}(FL_{max}(S_{i,d}))$ is the score of function $S_{i,d}$ for its highest functionality level, which means the maximum score of function $S_{i,d}$ for impact criterion number ic. The smart readiness score is calculated as a percentage for each of the impact criterion SR_{ic} using the weighting factors as follows: $$SR_{ic} = \frac{\sum_{d=1}^{N} W_{d,ic}\, I(d,ic)}{\sum_{d=1}^{N} W_{d,ic}\, I_{mx}(d,ic)} \cdot 100$$ Where:

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		d is the number of the major building service (domain) under assessment, N is the total number of technical domains, $W_{d,ic}$ 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: $SR_f = \sum_{ic=1}^{M} W_f\,(ic) \cdot SR_{ic}$ Where: M is the total number of impact criteria, $W_f(ic)$ is the weighting factor expressed in percentage of impact criterion number ic for key functionality f, SR_{ic} 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: $SRI = \sum W_f \cdot SR_f$ Where: SR_f is the smart readiness score for key functionality f, W_f is the weight of key functionality f in the calculation of the total smart readiness scores, with $\Sigma W_f = 1$.
	Standard:	Adopted by the revised Energy Performance of Buildings Directive 2018 EPBD and its subsequent regulations (Delegated Regulation and Implementing Regulation). Verbeke S., Aerts D., Reynders G., Ma Y., Waide P. 2020. Final Report on the Technical Support to the Development of a Smart Readiness Indicator for Buildings, Directorate-General for Energy, European Commission, Brussels.
	References:	The underlying calculation method for the Smart Readiness Indicator (SRI) was developed for the European Commission in response to an EPBD mandate.

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

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	Project's stage:	design/in use
	Assessment method:	Calculation steps: Check the availability and the content of the maintenance management plan of the building
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	The provision of energy sub-metering systems and water consumption monitoring systems, according to design documentation
	Unit of measure:	Score
	Project's stage:	design/in use
	Assessment method:	Calculation steps: 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:	-
	References:	CESBA MED Project – SBTool assessment system

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:	The scope and quality of design documentation retained for use by building operators, according to design documentation
	Unit of measure:	Score
	Project's stage:	design/in use
	Assessment method:	Calculation steps: 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:	-
	References:	CESBA MED Project – SBTool assessment system

F	**Social, Cultural and Perceptual Aspects**
F1	**Social Aspects**
F1.1	**Universal access on site and within the building**

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	Intent:	To assess the relative ease of access and use of facilities for persons with mobility or perceptual disabilities
	Indicator:	The scope and quality of design measures planned to facilitate access and use of building facilities by persons with disabilities
	Unit of measure:	Score
	Project's stage:	design/in use
	Assessment method:	Calculation steps: 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:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Hours of sunlight
	Unit of measure:	Hrs
	Project's stage:	design/in use
	Assessment method:	Calculation steps: Calculate the number of hours of dwelling units whose principal daytime living areas have direct sunlight
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

F2	**Perceptual**	
F2.1	**View out**	
	Intent:	To assess the quality of view out of the building
	Indicator:	Quality of view out
	Unit of measure:	Score
	Project's stage:	design/in use
	Assessment method:	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: - a layer of sky; - a layer of landscape;

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		- a layer of ground.
	Standard:	CEN European Daylight Standard EN 17037 – Daylighting in buildings
	References:	CESBA MED Project – SBTool assessment system

G	**Cost and Economic Aspects**	
G1	**Cost and Economics**	
G1.1	**Life-cycle cost**	
	Intent:	To assess the level of total Life Cycle Cost of the building
	Indicator:	Life cycle cost (production and construction, use and end of life) per useful internal floor area per year
	Unit of measure:	€/m^2/yr
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the life cycle cost related to the production, construction, use and end of life of the building (€) per year - Calculate the useful internal floor area (m^2) - Calculate the value of the indicator as €/m^2/year
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Predicted construction cost per useful internal floor area
	Unit of measure:	€/m^2
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Evaluate the predicted construction cost of the building (€) - Calculate the useful internal floor area (m^2) - Calculate the value of the indicator as €/m^2
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Predicted maintenance cost per useful internal floor area per year
	Unit of measure:	€/m^2/yr
	Project's stage:	design/in use

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	Assessment method:	Calculation steps: - Evaluate the predicted maintenance cost of the building (€) per year - Calculate the useful internal floor area (m^2) - Calculate the value of the indicator as €/m^2/year
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

G1.4	**Energy cost**	
KPI	*Intent:*	To optimize the operating cost of buildings to reflect the potential for long term performance
	Indicator:	Annual energy cost per useful internal floor area
	Unit of measure:	€/m^2/yr
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Estimate the annual energy cost of the building (€) - Calculate the useful internal floor area (m^2) - Calculate the value of the indicator as €/m^2/year
	Standard:	Level(s) Part 1-2 – Beta version
	References:	CESBA MED Project – SBTool assessment system

G1.5	**Water cost**	
	Intent:	To optimize the operating cost of buildings to reflect the potential for long term performance
	Indicator:	Annual water cost per useful internal floor area
	Unit of measure:	€/m^2/yr
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Estimate the water annual cost of the building (€) - Calculate the useful internal floor area (m^2) - Calculate the value of the indicator as €/m^2/year
	Standard:	Level(s) Part 1-2 – Beta version
	References:	CESBA MED Project – SBTool assessment system

H	**Adaptation to climate change**	
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:	Percentage of the time out of range from defined maximum temperatures during the cooling seasons
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	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. Alternatively, if a dynamic method is used, the results shall be validated according to EN ISO 52016-1 or the criteria and test cases in EN 15265. The indicator has to be evaluated in all main living rooms and all bedrooms. In the case of assessment of multiple apartments, each distinctive configuration and orientation shall be assessed.
	Standard:	EN 15251 EN ISO 13790
	References:	CESBA MED Project – SBTool assessment system

H1.2	**Heat island effect**	
KPI	*Intent:*	To reduce the heat island effect, to reduce the discomfort at ground level during summer
	Indicator:	Mean Solar Reflectance Index of paved surfaces and roofs in the area
	Unit of measure:	SRI
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Identify the boundaries of the building being assessed; - Identify all the horizontal surfaces and roofs in the area; - Calculate the extension (m^2) of each surface identified and classify them in relation to the cover material; - Multiply each surface previously identified by the corresponding solar reflectance index; - Sum the weighed surfaces obtained; - 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:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Percent of building envelope with orientation between West and South-East that will be covered by vegetation during the warm season (June 12st)
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the area of building envelope with orientation between West and South-East that will be covered by vegetation during the warm season (m^2) (A) - numerator - Calculate the total area of the building envelope (m^2) (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Leaf Area Index: ratio of total vegetated surface area (on ground and on roofs, and including trees), divided by total site area
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the total vegetated surface area (on ground and on roofs, and including trees (m^2) (A) - numerator - Calculate the total area of the site (m^2) (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

H2	**Climatic action: pluvial flood**	
H2.1	**Stormwater retention capacity on site**	
	Intent:	To evaluate the level of retention capacity of the building
	Indicator:	Share of the onsite stormwater retention capacity in relation to the optimal retention capacity
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the amount of onsite stormwater retention capacity of the building (A) - numerator - Calculate the optimal retention capacity of the building (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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H2.2	Permeability of land	
	Intent:	To improve the permeability of the area
	Indicator:	Share of the site that is permeable to water
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: Calculation steps: - Calculate the size (Sa) of the area where the building is located (m^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 so that: $S_a = \sum_{i=1}^{n} S_{a,1}$ Sa = total surface of the area Sa,i = surface i-th in the area (m^2) - Calculate the real permeability of soil considering the permeability coefficient of each surface. $S_{a,perm} = \sum_{i=1}^{n} (S_{a,i} \times \alpha_i)$ Sa,i = i-th surface in the area (m^2) αi= permeability coefficient of the i-th surface - Calculate the indicator's value as: $\frac{S_{a,perm}}{Sa} \times 100$ Note: • Reference permeability coefficients: - Grass = 1 - Gravel = 0,9 - Sand = 0,9 - Plastic gratings filled with land/grass = 0,8 - Concrete gratings leaning on the grass = 0,6 - Concrete gratings leaning on gravel = 0,6 - Interlocking elements leaning on sand = 0,3 - Interlocking elements leaning on gravel = 0,3 - Interlocking elements leaning on concrete pavement = 0 - Continuous pavements leaning on concrete = 0 - Asphalt = 0
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Strategies to reduce the vulnerability of occupants and facilities to floods
	Unit of measure:	Score
	Project's stage:	design/in use
	Assessment method:	Calculation steps: Evaluate the strategies to reduce the vulnerability of occupants and facilities to floods
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

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:	Share of rainwater collected and stored for reuse from roofs and plot's paved area
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the quantity of rainwater collected and stored for reuse from roofs and plot's paved area (A) - numerator - Calculate the maximum rainwater collectable from roofs and plot's paved area (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

H4.2	**Capacity of greywater collection and storage for non-potable uses**	
	Intent:	To promote greywater collection for re-use
	Indicator:	Share of greywater collected and cleaned for reuse
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculation steps: - Calculate the quantity of greywater collected and cleaned in the building (A) - numerator - Calculate the maximum greywater collectable in the building (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

H5	**Climatic action: fire exposure**	
H5.1	**Fire-resistance of the envelope**	
	Intent:	To assess wildfire risk of the building
	Indicator:	Level of use of certified fire-retardant materials in the envelope

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	Unit of measure:	Score
	Project's stage:	design/in use
	Assessment method:	Calculate the share of certified fire-retardant materials used for the envelope of the building
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

H5.2	**Fireproof ground**	
	Intent:	To assess wildfire risk of the building
	Indicator:	Level of use of certified fire-retardant materials for paving
	Unit of measure:	Score
	Project's stage:	design/in use
	Assessment method:	Calculate the share of certified fire-retardant materials used for the paving of the building
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

H6	**Climatic action: wind action**	
H6.1	**Windproof envelope**	
	Intent:	To assess windproof risk of the building envelope
	Indicator:	Level of use of certified wind resistant materials in the envelope
	Unit of measure:	%
	Project's stage:	design/in use
	Assessment method:	Calculate the share of certified wind resistant materials used for the envelope of the building
	Standard:	-
	References:	CESBA MED Project – SBTool assessment system

5. Sustainable MED Cities SNTool

5.1. Sustainable MED Cities SNTool: specifications

As done for the SBTool in the previous paragraph, the complete list of the criteria which make up the Sustainable MED Cities SNTool are described below. The table also includes for each criterion, the information related to the name of the indicator and the unit of measure. Furthermore, KPIs are marked in the list with a "X" and fully described in "D3.1.4 - MED Passport and KPIs".

Sustainable MED Cities - SNTool Criteria List

A	Use of land and biodiversity			
A1	**Use of land**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
A1.1	Population density	Population density in built-up areas (neighbourhood area minus green and blue)	Inhabitants / km^2	
A1.2	Urban compactness	Relation between the usable space of the buildings (volume) and the urban space (area)	m^3 / m^2	
A1.3	Homogeneity of the urban fabric	Percentage of the perimeter of the area directly adjacent to urbanized areas	%	
A1.4	Conservation of land	Pre-development ecological value of land	Score	
A2	**Green urban areas**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
A2.1	Availability of green urban areas	Proportion of all vegetated areas within the neighborhood boundaries in relation to the total area	%	
A2.2	Green areas in relation to the neighborhood population	Total area of green in the neighborhood divided by neighborhood's total population	m^2/inhabitant	
A2.3	Green Area Accessibility	Percentage of inhabitants with accessibility to green areas	%	
A2.4	Green zones density	Density of green spaces within the area	%	
A2.5	Green zones and ecosystemic services	Share of natural green areas on total green areas	%	
A3	**Biodiversity and ecosystems**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
A3.1	Connectivity measures for natural areas	Share of natural areas that are connected	%	
A3.2	Biodiversity in green zones	Number of plants on number of vegetal species	%	
B	**Energy**			

B1	Energy infrastructure			
CODE	CRITERION	INDICATOR	UNIT	KPIs
B1.1	Access to electrical service	Percentage of households with authorized access to electricity	%	
B2	Energy infrastructure			
CODE	CRITERION	INDICATOR	UNIT	KPIs
B2.1	Total final thermal energy consumption for building operations	Aggregated annual total final thermal energy consumption per aggregated indoor useful floor area	kWh/m^2/yr	X
B2.2	Total final thermal energy consumption for residential building operations	Aggregated annual final thermal energy consumption of residential buildings per aggregated internal useful floor area	kWh/m^2/yr	
B2.3	Total final thermal energy consumption for public office/ educational building operations	Aggregated annual final thermal energy consumption of public office and educational buildings per aggregated internal useful floor area	kWh/m^2/yr	
B2.4	Total final electrical energy consumption for building operations	Aggregated annual total final electric energy consumption per aggregated internal useful floor area	kWh/m^2/yr	X
B2.5	Total final electrical energy consumption for residential building operations	Aggregated annual final electrical energy consumption of residential buildings per aggregated indoor useful floor area	kWh/m^2/yr	
B2.6	Total final electric energy consumption for public office/ educational building operations	Aggregated annual final electric energy consumption of public office and educational buildings per aggregated internal useful floor area	kWh/m^2/yr	
B2.7	Total primary energy demand for building operations	Aggregated annual total primary energy consumption per aggregated indoor useful floor area	kWh/m^2/yr	X
B2.8	Total primary energy demand for residential building operations	Ratio of average total primary energy consumption of residential buildings to the local minimum value	%	
B2.9	Total primary energy demand for public office/educational building operations	Ratio of average total primary energy consumption of public office/educational buildings to the local minimum value	%	
B2.10	Energy consumption of public lighting	Total electricity consumption of public street lighting divided by the total distance of streets where street lights are present	kWh/κm/ yr	
B3	Renewable energy			
CODE	CRITERION	INDICATOR	UNIT	KPIs
B3.1	Share of renewable energy on-site, relative to total final	Total consumption of final thermal energy generated from renewable sources on-site divided	%	X

	thermal energy consumption for building operations	by total final thermal energy consumption		
B3.2	Share of renewable energy on-site, relative to total final thermal energy consumption for residential building operations	Total consumption of final thermal energy generated from renewable sources on-site divided by total final thermal energy consumption of residential buildings	%	
B3.3	Share of renewable energy on-site, relative to total final thermal energy consumption for public office/educational building operations	Total consumption of final thermal energy generated from renewable sources on-site divided by total final thermal energy consumption of public office/educational buildings	%	
B3.4	Share of renewable energy on-site, relative to final electric energy consumption	Total consumption of final electric energy generated from renewable sources on-site divided by total final electric energy consumption	%	X
B3.5	Share of renewable energy on-site, relative to total final electric energy consumption for residential building operations	Total consumption of final electric energy generated from renewable sources on-site divided by total final electric energy consumption of residential buildings	%	
B3.6	Share of renewable energy on-site, on final electric energy consumptions for public office/educational building operations	Total consumption of final electric energy generated from renewable sources on-site divided by total final electric energy consumption of public office/educational buildings	%	
B3.7	Share of renewable energy on-site, relative to total primary energy consumption for building operations	Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption	%	X
B3.8	Share of renewable energy on-site, relative to total primary energy consumption for residential building operations	Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption of residential buildings	%	
B3.9	Share of renewable energy on-site, on total primary energy consumptions for public office/ educational building operations	Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption of public office/educational buildings	%	
C	**Water**			
C1	**Water infrastructure**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
C1.1	Availability of a public municipal water supply	Percentage of the buildings within the neighborhood that are served by a municipal water supply	%	

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CODE	CRITERION	INDICATOR	UNIT	KPIs
C1.2	Availability of wastewater treatment systems	Percentage of buildings within the neighbourhood that are served by wastewater collection	%	
C2	**Water consumption**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
C2.1	Total water consumption	Total amount of the neighborhood's water consumption in litres per day divided by the total neighborhood population	l/day/occupant	
C2.2	Efficiency in water use	Volume of water supplied minus the volume of utilized water divided by the total volume of water supplied	%	
C2.3	Consumption of potable water in residential buildings	Annual potable water consumption per occupant	L/occupant/yr	X
C2.4	Consumption of potable water in public offices	Annual potable water consumption per occupant	L/occupant/yr	
C2.5	Consumption of potable water in educational buildings	Annual potable water consumption per occupant	L/occupant/yr	
C2.6	Re-use of rainwater in residential buildings	Share of rainwater collected from roofs of residential buildings for reuse	%	
C2.7	Consumption of potable water in public green spaces	Potable water used for irrigation purposes in public green spaces	m^3/m^2	
C2.8	Solar powered water desalinisation	Percentage of water acceptable for human consumption or agriculture from solar desalination	%	
C3	**Effluents management**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
C3.1	Water treatment	Total volume of wastewater collected for at least secondary treatment in centralized wastewater treatment facilities divided by the total volume of wastewater produced in the neighborhood	%	
C3.2	Public wastewater (from outdoor areas) that is disposed or treated	Percent of public wastewater that is disposed or treated	%	
C3.3	Household sanitation	Percentage of households with access to basic sanitation facilities	%	
D	**Solid Waste**			
D1	**Solid waste collection infrastructure**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
D1.1	Availability of solid waste collection	Percentage of buildings with regular solid waste collection	%	
D2	**Solid waste management**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
D2.1	Access to solid waste and recycling collection points	Proximity of the resident population to the solid waste and recycling collection point	%	

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D2.2	Access to solid waste and recycling collection points	Percentage of inhabitants with access to solid waste and recycling collection points within 400 meters walking distance	%	X
E	**Environmental quality**			
E1	**Air quality**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
E1.1	Fine particulate matter ($PM_{2.5}$) concentration	Number of days within a year that $PM_{2.5}$ concentration exceeds the daily limit	days / yr	
E1.2	Particulate matter (PM_{10}) concentration	Number of days within a year that PM_{10} concentration exceeds the daily limit	days / yr	X
E1.3	Nitrogen Dioxide concentration (NO2)	Number of days within a year that NO_2 concentration exceeds the daily limit	μg/m^3	
E1.4	Sulfur Dioxide concentration (SO2)	Number of days within a year that SO_2 concentration exceeds the daily limit	μg/m^3	
E1.5	Ozone concentration (O3)	Number of days within a year that O_3 concentration exceeds the daily limit	μg/m^3	
E2	**Noise**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
E2.1	Ambient daytime noise conditions	Percentage of building area over noise limit	%	
E2.2	Ambient night-time noise conditions	Percentage of building area over noise limit	%	
E3	**EMF exposure**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
E3.1	Exposure to high frequency electromagnetic fields	Percentage of mobile network antenna sites in compliance with EMF exposure guidelines	%	
E3.2	Percentage of buildings exposed to ELF magnetic fields	Percentage of buildings in the area located not respecting the safety distance from high voltage lines	%	
E4	**Environmental impacts**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
E4.1	Degree of atmospheric light pollution caused by exterior public lighting systems	Percentage of lighting fixtures with upward luminous emission coefficient equal to 0%	%	
F	**Environmental quality**			
F1	**Air quality**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
F1.1	Performance of the public transport system	Percentage of inhabitants that are within 400 meters walking distance of at least one public transportation service stop	%	X
F1.2	Walking distance to public transport for area workers and students	Percent of workers and students who can reach a public transport stop within a 400 meters distance	%	
F2	**Green mobility**			

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CODE	CRITERION	INDICATOR	UNIT	KPIs
F2.1	Shared vehicles	Number of shared vehicles per 1.000 inhabitants	n/1.000 inhabitants	
F2.2	Electric-vehicle infrastructure (charging stations)	Electric vehicle charging stations per inhabitant	n/inhabitant	
F2.3	Bicycle network	Total length of bicycle paths in the neighborhood per inhabitant	m/inhabitant	X
F2.4	Shared bicycles	Number of shared bicycles per 1.000 inhabitants	n/1.000 inhabitants	
F2.5	Availability of bicycle parking facilities	Bicycle parking spaces per inhabitant	n/inhabitant	
F3	**Safety in mobility**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
F3.1	Pedestrian infrastructure	Percentage of the neighborhood designated as a pedestrian/car free zone	%	
F3.2	Availability of sidewalks	Percentage of roads' length that has dedicated sidewalks	%	
F3.3	Safety of bicycle lines	Percentage of bicycle paths physically separated from traffic roads	%	
F3.4	Traffic fatalities	Traffic fatalities per 1.000 inhabitants	n/1000 inhabitants	
F4	**Urban morphology and transportation**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
F4.1	Cyclomatic complexity of the street network	Cyclomatic number	number	
F4.2	Connectivity of the street network	Number of intersections related to the overall surface area	number/km^2	
G	**Social Aspects**			
G1	**Accessibility (disabled persons)**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
G1.1	Public buildings that are accessible for use by physically disabled persons	Percent of key public buildings that are accessible for use by physically disabled persons	%	
G1.2	Sidewalks and other pedestrian paths that are accessible for use by physically disabled persons	Percent of sidewalks and other pedestrian ways that are accessible for use by physically disabled persons	%	
G1.3	Barrier-free accessibility in local outdoor public areas	Adequacy of barrier-free accessible public outdoor areas compared to the total public area	%	
G2	**Housing**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
G2.1	Affordability of housing property	Housing properties in the local area that are financially accessible to the lowest quintile of area population	%	
G2.2	Affordability of housing rental	Percentage of the average salary of the lowest quintile of the population used for rental payments	%	

G2.3	Vacant residential units in the neighborhood	Percentage of vacant residential units	%	
G2.4	Informal settlements	Percentage of inhabitants living in slums, informal settlements or inadequate housing	%	
G3	**Availability of public and private facilities and services**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
G3.1	Availability and proximity of key services	Percentage of inhabitants that are within 800 meters walking distance of at least 3 key services	%	X
G3.2	Availability and proximity of a public primary school	Percentage of population near a public primary school	%	
G3.3	Availability and proximity of a public secondary school	Percentage of population near a public secondary school	%	
G3.4	Availability and proximity of childrens' play facilities	Percentage of population near a childrens' play facilities	%	
G3.5	Open space for public use	Average share of the built-up area of the neighborhood that is open space for public use	%	
G4	**Education**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
G4.1	Primary enrollment rate	Net primary enrollment rate	%	
G4.2	Rate of female scholarship	Ratio of female to male mean years of education received of population age 25+	%	
G4.3	Secondary school enrollment	Lower secondary completion rate	%	
G4.4	Tertiary education	Population age 25-34 with tertiary educational attainment	%	
G5	**Social inclusion**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
G5.1	Energy poverty of households	Percentage of households unable to afford the most basic levels of energy (more than 10% of the income spent on energy bills)	%	
G5.2	Population at risk of poverty or exclusion	Share of persons with an equivalised disposable income below 60 % of the national median income	%	
G6	**Safety**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
G6.1	Police service	Number of police officers per 1.000 inhabitants	n/1.000 inhabitants	
G6.2	Fire service	Number of firefighters per 1.000 inhabitants	n/1.000 inhabitants	
G6.3	Population living in disaster prone areas	Percentage of inhabitants living in a zone subject to natural hazards	%	
G7	**Health**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
G7.1	In-Patient Hospital Beds	Number of in-patient public hospital beds per 1.000 inhabitants	n/1.000 inhabitant	
G8	**Food security**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**

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G8.1	Urban agricultural land	Area of urban agricultural land on total neighborhood area	%	
G9	**Culture and Heritage**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
G9.1	Compatibility of urban design with local cultural values	Compatibility with local area traditional values of street layouts and the character of urban spaces	Score	
G9.2	Compatibility of public open space with local cultural values	Compatibility with local area traditional values of local public open spaces, including major uses, dimensions and adjacent uses	Score	
G10	**Perceptual**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
G10.1	Perceived safety of public areas for pedestrians	Perceived safety of public places and pedestrian routes, as determined by a sample of pedestrians	Score	
G10.2	Impact of commercial signage on the visual environment	Visual impact of exterior commercial signage	Score	
G10.3	Impact of overhead electric distribution system	Visual impact of above-grade electrical distribution systems	Score	
H	**Economy**			
H1	**Economic performance**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
H1.1	Average annual per-capita income of residents	Percentage of average per-capita income	%	
H2	**Employment**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
H2.1	Unemployment rate	Percentage of working age adults unemployed or actively looking for work	%	
H2.2	Youth unemployment rate	Percentage of unemployed youth	%	
H3	**Innovation**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
H3.1	New business registration rate	Proportion of business registrations per 10.000 inhabitants aged 16 and above	n	
H4	**ICT infrastructure**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
H4.1	Fixed Broadband Subscriptions	Percentage of households with fixed (wired) broadband	%	
H4.2	Wireless Broadband Coverage	Percentage of the neighborhood area served by wireless broadband (3G, 4G, 5G)	%	
H4.3	Availability of WIFI in Public Areas	Number of public WIFI hotspots in the neighborhood per 1000 inhabitants	n/1.000 inhabitants	
H4.4	Mobile phone subscriptions	Total number of mobile phone subscriptions in the area divided by one 1000th of the area's total population	n/1.000 inhabitants	

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I	Climate Change: mitigation and adaptation			
I1	**Climate change mitigation**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
I1.1	Greenhouse gas emissions	Total amount of greenhouse gases (equivalent carbon dioxide units) generated from building operations over a calendar year per inhabitant	t CO_2 eq. / inhabitant/yr	X
I1.2	Embodied carbon for construction and renovation of infrastructures	Aggregated total embodied carbon per aggregated linear area	kg CO_2 eq / m^2	
I1.3	Embodied carbon for construction/renovation of residential buildings	Aggregated total embodied carbon per aggregated indoor useful floor area	kg CO_2 eq / m^2	
I1.4	Embodied carbon for construction/renovation of public offices/educational buildings	Aggregated total embodied carbon per aggregated indoor useful floor area	kg CO_2 eq / m^2	
I1.5	CO_2 sequestration	Potential CO_2 sequestraion in the neighborhood per hectare	tepCO_2/he	
I2	**Adaptation to the climatic action: heatwaves and increase of temperature**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
I2.1	Albedo	Mean Solar Reflectance Index of paved surfaces and roofs in the neighborhood	SRI	
I2.2	Use of vegetation to provide ambient outdoor cooling	Leaf Area Index: ratio of total vegetated surface area (on ground and on roofs, and including trees), divided by total site area	Index	
I2.3	Green roofs	Aggregate area of building roofs covered with vegetated material	%	
I3	**Adaptation to the climatic action: pluvial flood**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
I3.1	Stormwater retention capacity on site by buildings	Share of the attenuation storage capacity by buildings in relation to the optimal volume	%	
I3.2	Sustainable Urban Drainage	Share of the optimal capacity of sustainable urban drainage systems	%	
I3.3	Permeability of land	Percentage of weighted ground permeability	%	X
I4	**Adaptation to the climatic action: fluvial and coastal flood**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
I4.1	Flood risk	Percentage of population exposed to flood risk	%	
I4.2	Protection of vulnerable zones	Share of land in vulnerable areas protected by flooding barriers	%	
I4.3	Protection of buildings from flooding	Share of buildings with elevated ground floor in vulnerable sites	%	
I5	**Adaptation to the climatic action: drought**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**

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I5.1	Rainwater collection and storage from buildings for non-potable uses	Share of buildings in the neighborhood with a rainwater collection system	%	
I5.2	Rainwater collection and storage from outdoor areas	Share of rainwater collected from paved (not permeable) surfaces in the neighborhood (excluding buildings' roofs and plots)	%	
I5.3	Greywater collection in buildings for non-potable uses	Share of buildings in the neighborhood with a greywater collection system	%	
I5.4	Local vegetation	Share of landscape (green areas) plated with local vegetation	%	
I6	**Adaptation to the climatic hazard: wildfire**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
I6.1	Wildfire risk	Percentage of population exposed to wildfire risk	%	
I6.2	Fire protection	Share of wildfire vulnerable areas protected by fire barriers	%	
I6.3	Fireproof ground	Share of ground cover materials (excluding buildings' plots) in vulnerable areas that are fire resistant	%	
I7	**Climatic hazard: wind**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
I7.1	Windproof urban form	Strategies to minimise the impact of wind	Score	
L	**Governance**			
L1	**Urban Planning**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
L1.1	Community involvement in urban planning activities	Percentage of residents active in public urban planning	Level	
L2	**Management and community involvement**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
L2.1	Involvement of residents in community affairs	Percentage of resident population above 16 years having an involvement in community affairs	%	
L3	**Public buildings operation**			
CODE	**CRITERION**	**INDICATOR**	**UNIT**	**KPIs**
L3.1	Public buildings sustainability	Percentage area of public buildings with recognized sustainability certifications for ongoing operations	%	
L3.2	Operating energy costs for public buildings	Aggregated annual operating energy cost per aggregated indoor useful floor area	€/m^2/yr	
L3.3	Energy consumption of public buildings	Total end use of energy in public buildings within a neighborhood divided by total indoor useful area of these buildings	kWh/m^2	

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After the list of the SNTool criteria, for each of them it is provided a table with all the relevant information, as showed below in the example.

A	Area	
A1	**Category**	
A1.1	**Criterion**	
	Intent:	Description of the objective of the criterion
	Indicator:	Indicate the indicator name
	Unit of measure:	Include the unit of measure of the indicator
	Assessment method:	Describe the calculation methodology, step by step, to achieve the indicator result
	Standard:	Indicate, if any, the calculation standard for the criterion
	References:	Indicate the acquiring source

Sustainable MED Cities - SNTool Tables

A	Built Urban Systems	
A1	**Urban Structure and Form**	
A1.1	**Population density**	
	Intent:	To evaluate the increase of the proximity between residents and local goods and services
	Indicator:	Population density in built-up areas (neighborhood area minus green and blue)
	Unit of measure:	Inhabitants / km^2
	Assessment method:	Calculation steps: - Calculate the total neighborhood population (A) - numerator - Calculate the total area of the neighborhood (neighborhood area minus green and blue) (B) - denominator - Calculate the value of the indicator as A/B The result shall be expressed as number of persons per square kilometre.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

A1.2	Urban compactness	
	Intent:	To maximize efficiency in the use of land used for buildings
	Indicator:	Relation between the usable space of the buildings (volume) and the urban space (area)
	Unit of measure:	m^3 / m^2
	Assessment method:	Calculation steps: - Calculate the aggregate gross volume of all buildings in the local area, in m^3. - Calculate the net developable area by subtracting the surface area used for parks, streets, parking and

		pedestrian areas from the gross surface area of the locality. - Determine the ratio of the aggregate volume of buildings to the net local developable area, expressed as m^3/ha.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

A1.3	**Homogeneity of the urban fabric**	
	Intent:	To identify voids in the urban fabric and at the same time to contain the peripheral expansion
	Indicator:	Percentage of the perimeter of the area directly adjacent to urbanized areas
	Unit of measure:	%
	Assessment method:	Calculation steps: - Quantify the total length of the perimeter of the area analysed (A) - Evaluate, by quantifying, the linear meters of urban fabric adjacent to urbanised areas (B). - Calculate the percentage ratio between the length of the urban fabric perimeter adjacent to urbanized areas and the overall length of the perimeter of the area: (B / A) * 100
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

A1.4	**Conservation of land**	
	Intent:	To determine the proportion of land, considered to be of value for ecological or agricultural purposes, that remains undeveloped
	Indicator:	Pre-development ecological value of land
	Unit of measure:	Score
	Assessment method:	Calculation steps: - Determine the area of the neighborhood. - Determine the undeveloped area of land that is considered by authorities to be of ecological and agricultural value. - Calculate the ratio between the undeveloped area and the area of the neighborhood. Specifications: ▪ Only areas with recognized ecological or agricultural value, also in case of reconverted areas, must be taken in account. ▪ The area of the neighborhood is the area included within the perimeter selection.

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		▪ Parks and squares are not considered undeveloped land. ▪ Definition of agricultural value: an area that is intended for agricultural objectives (food, forage, etc.). ▪ Definition of ecological value: an area that has an ecological value because provides support to native life forms, making up natural ecosystems.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

A2	**Green urban areas**	
A2.1	**Availability of green urban areas**	
	Intent:	To improve the permeability of the area and to benefit from green spaces availability (capturing pollutants, reducing the “heat island” effect, providing recreational spaces, etc.)
	Indicator:	Proportion of all vegetated areas within the neighborhood in relation to the total area
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the amount of vegetated areas (in hectares) in the neighborhood (A) - numerator - Calculate the total area of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

A2.2	**Green areas in relation to the neighborhood population**	
	Intent:	To improve the urban environment helping regulate air quality and climate, recharging groundwater supplies and protecting lakes and streams from polluted runoff.
	Indicator:	Total area of green in the neighborhood divided by neighborhood’s total population
	Unit of measure:	m^2/inhabitant
	Assessment method:	Calculation steps: - Calculate the total area (in m^2) of green in the neighborhood (A) - numerator - Calculate the neighborhood’s total population (B) - denominator - Calculate the value of the indicator as A/B (m^2/inhabitants)
	Standard:	-
	References:	IEFCA 2019 edition – Calculation Guideline

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A2.3	Green Area Accessibility	
	Intent:	To go towards a higher quality of life for the neighborhood's inhabitants and to reduce negative effects of urbanisation
	Indicator:	Percentage of inhabitants with accessibility to green areas
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of inhabitants living with 300m of a publicly accessible green space of at least 0.5ha (A) - numerator - Calculate the neighborhood's total population (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities.

A2.4	Green zones density	
	Intent:	To measure the existing green zones as added value for quality of life of inhabitants
	Indicator:	Density of green spaces within the area
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the green zones in the area (m^2) (A) - numerator - Calculate the total area of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

A2.5	Green zones and ecosystemic services	
	Intent:	To improve the benefits from green zones availability (capturing pollutants, reducing the "heat island" effect, providing recreational spaces, etc.)
	Indicator:	Share of natural green areas on total green areas
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the amount of natural green areas (in hectares) in the neighborhood (A) - numerator - Calculate the total green area of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	-

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A3	Biodiversity and ecosystems	
A3.1	**Connectivity measures for natural areas**	
	Intent:	To maximise the connectivity measures for natural areas
	Indicator:	Share of natural areas that are connected
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the amount of natural connected areas (in hectares) in the neighborhood (A) - numerator - Calculate the total amount of natural area in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%) Note: connected areas are the ones at less than 100 meters away from each other
	Standard:	-
	References:	Reference Framework for Sustainable Cities - RFSC

A3.2	Biodiversity in green zones	
	Intent:	To protect and maintain biodiversity
	Indicator:	Number of plants on number of vegetal species
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of plants in the neighborhood (A) - numerator - Calculate the number of vegetal species in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	Reference Framework for Sustainable Cities - RFSC

B	Energy	
B1	**Energy infrastructure**	
B1.1	**Access to electrical service**	
	Intent:	To evaluate electrical service as a contributing indicator of sustainability, resilience and economic productivity
	Indicator:	Percentage of households with authorized access to electricity
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of people in the neighborhood with authorized electrical service (A) - numerator - Calculate the total population of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

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B2	Energy consumptions	
B2.1	**Total final thermal energy consumption for building operations**	
KPI	*Intent:*	To estimate urban thermal energy consumption for building operations
	Indicator:	Aggregated annual total final thermal energy consumption per aggregated indoor useful floor area
	Unit of measure:	kWh/m^2/yr
	Assessment method:	To characterize the indicator's value there are two options: -Use of estimated data OR -Use of metered data Note: To perform the calculation, it is possible to use metered or estimated data. The source of data must always be clearly declared. For the evaluation of the actual performance of the urban area it is preferable to use metered data. If metered data aren't available, estimated data shall be used. Estimated data shall be used for evaluating alternative scenarios in planning and decision-making processes. In reporting the indicator's value, the data source must be indicated. **Use of estimated data:** 1.In the calculation of the final thermal energy consumption, the following energy uses must be considered: heating, cooling, domestic hot water. 2.For each building in the local area, calculate the annual final thermal energy consumption in kilowatt hours (kWh/year). 3.Sum the annual final thermal energy consumption of each building up to an aggregated total annual final thermal energy consumption (kWh/year). 4.Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m^2). 5.Calculate the indicator's value as: aggregated annual total final thermal energy consumption/ aggregated indoor useful area (kWh/m^2/year). Note: Calculations are based on EN 13790 using the quasi-steady state monthly method. **Use of metered data:** 1.In the evaluation of the final thermal energy consumption, the following energy uses must be considered: heating, cooling, domestic hot water.

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		2.For each building in the local area, collect the metered annual final thermal energy consumption) in kilowatt hours (kWh/year). 3.Sum the annual final thermal energy consumption of each building up to an aggregated total annual final thermal energy consumption (kWh/year). 4.Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m^2). 5.Calculate the indicator's value as: aggregated annual total final thermal energy consumption/ aggregated indoor useful area (kWh/m^2/year). Note: The metered energy consumption is suitable for the indicator's calculation only if the building has been in use for 3-years, in order to ensure that there has been time enough to have building systems reach their normal operating efficiency levels, and also to factor out unusual seasonal variations. This means that the buildings assessed are at least 3 years old.
	Standard:	EN 13790
	References:	CESBA MED Project – SNTool assessment system

B2.2	**Total final thermal energy consumption for residential building operations**	
	Intent:	To estimate urban energy consumption per gross area of all residential buildings
	Indicator:	Urban thermal energy consumption of residential buildings
	Unit of measure:	kWh/m^2/yr
	Assessment method:	Calculation steps: - Calculate the annual total final thermal energy consumption of non-renewable energy for the building use stage (heating, cooling, domestic hot water and lighting), in kWh, for each residential building in the local area. - Calculate the aggregated annual total final thermal energy consumption for all residential buildings. - Calculate: Aggregated annual total final thermal energy consumption / Total gross area of all residential buildings.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B2.3	**Total final thermal energy consumption for public office/educational building operations**	
	Intent:	To estimate urban thermal energy consumption per gross area for public office/ educational building operations
	Indicator:	Urban thermal energy consumption of public office/educational buildings

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	Unit of measure:	kWh/m²/yr
	Assessment method:	Calculation steps: - Calculate the annual total final thermal energy consumption of non-renewable energy for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each public office/educational building in the neighborhood. - Calculate the aggregated annual total final thermal energy consumption for all public office/educational buildings. - Calculate: Aggregated annual total final thermal energy consumption / Total gross area of all public office/educational buildings.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B2.4	**Total final electrical energy consumption for building operations**	
KPI	*Intent:*	To estimate urban electric energy consumption for building operations
	Indicator:	Aggregated annual total final electric energy consumption per aggregated internal useful floor area
	Unit of measure:	kWh/m²/yr
	Assessment method:	To characterize the indicator's value there are two options: -Use of estimated data OR -Use of metered data Note: To perform the calculation, it is possible to use metered or estimated data. The source of data must always be clearly declared. For the evaluation of the actual performance of the urban area it is preferable to use metered data. If metered data aren't available, estimated data shall be used. Estimated data are used for evaluating retrofit scenarios in planning and decision-making processes. In reporting the indicator's value, data sources must always be indicated. **Use of estimated data:** 1.In the calculation of the final electric energy consumption, the following energy uses must be considered: heating, cooling, ventilation, auxiliaries, domestic hot water and lighting. 2.For each building in the local area, calculate the annual final electric energy consumption in kilowatt hours (kWh/year).

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		3.Sum the annual final electric energy consumption of each building up to an aggregated total annual final electric energy consumption (kWh/year). 4.Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m^2). 5.Calculate the indicator's value as: aggregated annual total final electric energy consumption/ aggregated indoor useful area (kWh/m^2/year). Note: Calculations are based on EN 13790 using the quasi-steady state monthly method. **Use of metered data:** 1.In the evaluation of the final electric energy consumption, the following energy uses must be considered: heating, cooling, ventilation, auxiliaries, domestic hot water and lighting. 2.For each building in the local area, collect the metered annual final electric energy consumption) in kilowatt hours (kWh/year). 3.Sum the annual final electric energy consumption of each building up to an aggregated total annual final electric energy consumption (kWh/year). 4.Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m^2). 5.Calculate the indicator's value as: aggregated annual total final electric energy consumption/ aggregated indoor useful area (kWh/m^2/year). Note: The metered energy consumption is suitable for the indicator's calculation only if the building has been in use for 3-years, in order to ensure that there has been time enough to have building systems reach their normal operating efficiency levels, and also to factor out unusual seasonal variations. This means that the buildings assessed are at least 3 years old.
	Standard:	EN 13790
	References:	CESBA MED Project – SNTool assessment system

B2.5	**Total final electrical energy consumption for residential building operations**	
	Intent:	To estimate urban electrical energy consumption per gross area for residential building operations
	Indicator:	Urban electrical energy consumption of residential buildings
	Unit of measure:	kWh/m^2/yr
	Assessment method:	Calculation steps: - Calculate the annual total final electrical energy consumption of non-renewable energy for building

		operations (heating, cooling, domestic hot water and lighting), in kWh, for each residential building in the local area. - Calculate the aggregated annual total final thermal energy consumption for all residential buildings. - Calculate: Aggregated annual total final electrical energy consumption / Total gross area of all residential buildings.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B2.6	**Total final electric energy consumption for public office/ educational building operations**	
	Intent:	To estimate urban electrical energy consumption per gross area for public office/ educational building operations
	Indicator:	Urban electrical energy consumption of public office/ educational buildings
	Unit of measure:	kWh/m^2/yr
	Assessment method:	Calculation steps: - Calculate the annual total final electrical energy consumption of non-renewable energy for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each public office/ educational building in the local area. - Calculate the aggregated annual total final thermal energy consumption for all public office/ educational buildings. - Calculate: Aggregated annual total final electrical energy consumption / Total gross area of all public office/ educational buildings.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B2.7	**Total primary energy demand for building operations**	
KPI	*Intent:*	To reduce the need of primary energy for building operations
	Indicator:	Aggregated annual total primary energy consumption per aggregated indoor useful floor area
	Unit of measure:	kWh/m^2/yr
	Assessment method:	To characterize the indicator’s value: 1.In the calculation of the primary energy consumption, the following energy uses must be considered: heating, cooling, ventilation, auxiliaries, domestic hot water and lighting.

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		2.For each building in the local area, calculate the annual final (thermal and electric) energy consumption per energy carrier in kilowatt hours (kWh/year) 3.Sum the annual final energy consumption of each building up to an aggregated annual final energy consumption per energy carrier (kWh/year). 4.Using the national conversion factors, convert the aggregated annual final energy consumption per energy carrier in annual primary energy consumption per energy carrier (kWh/year). 5.Sum the annual primary energy consumption per energy carrier up to an aggregated annual total primary energy consumption (kWh/year). 6.Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m^2). 7.Calculate the indicator's value as: aggregated annual total primary energy consumption / aggregated indoor useful area (kWh/m^2/year). Note: Calculations are based on EN 13790 using the quasi-steady state monthly method.
	Standard:	EN 13790
	References:	CESBA MED Project – SNTool assessment system

B2.8	**Total primary energy demand for residential building operations**	
	Intent:	To reduce the need of energy for residential building operations
	Indicator:	Ratio of average total primary energy consumption of residential buildings to the local minimum value
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the annual total primary energy consumption of non-renewable energy for building operations (heating, cooling, domestic hot water and lighting), in kWh/m^2 of gross area for each residential building in the local area. - Calculate Neighbourhood residential total primary energy consumption as the weighted mean value of total primary energy consumption over the floor surfaces of all residential buildings in the area. - Calculate: (Neighbourhood residential total primary energy consumption / local minimum value)* 100.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B2.9	**Total primary energy demand for public office/educational building operations**

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	Intent:	To reduce the need of energy for public office/educational building operations
	Indicator:	Ratio of average total primary energy consumption of public office/educational buildings to the local minimum value
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the annual total primary energy consumption of non-renewable energy for building operations (heating, cooling, domestic hot water and lighting), in kWh/m^2 of gross area for each public office/educational buildings in the local area. - Calculate Neighbourhood public office/educational buildings total primary energy consumption as the weighted mean value of total primary energy consumption over the floor surfaces of all public office/educational buildings in the area. Calculate: (Neighbourhood public office/educational buildings total primary energy consumption / local minimum value) * 100.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B2.10	**Energy consumption of public lighting**	
	Intent:	To improve the efficiency of street lighting for cost-effective steps and energy efficiency
	Indicator:	Total electricity consumption of public street lighting divided by the total distance of streets where streetlights are present
	Unit of measure:	kWh/km /yr
	Assessment method:	Calculation steps: - Calculate the total electricity consumption of public street lighting kWh (A) - numerator - Calculate the length of streets where streetlights are present in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B.
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

B3	**Renewable energy**	
B3.1	**Share of renewable energy on-site, relative to total final thermal energy consumption for building operations**	
KPI	*Intent:*	To incentive the consumption and production of renewable energy

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	Indicator:	Total consumption of final thermal energy generated from renewable sources on-site divided by total final thermal energy consumption
	Unit of measure:	%
	Assessment method:	To characterize the indicator's value there are two options: Use of estimated data OR Use of metered data Note: For the evaluation of the actual performance of the urban area it is preferable to use metered data. If metered data aren't available, estimated data shall be used. Estimated data are used for evaluating retrofit scenarios in planning and decision-making processes. In reporting the indicator's value, data sources must always be indicated. Exported energy is the one delivered by technical systems through the system boundary (urban area) and used outside the system boundary. Exported energy is a benefit beyond the system boundary and it has not to be included in the calculation. **Use of estimated data:** 1. In the calculation of the final thermal energy consumption, the following energy uses must be considered: heating, cooling, domestic hot water. 2. For each building in the local area, calculate the annual final thermal energy consumption in kilowatt hours (kWh/year). 3. Sum the annual final thermal energy consumption of each building up to an aggregated total annual final thermal energy consumption (kWh/year). 4. For each building in the local area, calculate the annual final thermal energy consumption from on-site renewable energy sources in kilowatt hours. 5. Sum the annual final thermal energy consumption from on-site renewable sources of each building up to an aggregated total annual final thermal energy consumption from on-site renewable sources (kWh/year). 6. Calculate the indicator as: annual total final thermal energy consumption from on-site renewable sources / annual total final thermal energy consumption. Note: Calculations are based on EN 13790 using the quasi-steady state monthly method. **Use of metered data:**

		1. In the evaluation of the final thermal energy consumption, the following energy uses must be considered: heating, cooling, domestic hot water. 2. For each building in the local area, collect the metered annual final thermal energy consumption) in kilowatt hours (kWh/year). 3. Sum the annual final thermal energy consumption of each building up to an aggregated total annual final thermal energy consumption (kWh/year). 4. For each building in the local area, collect the monitored annual final thermal energy consumption from on-site renewable sources in kilowatt hours (kWh). 5. Sum the annual final thermal energy consumption from on-site renewable sources of each building up to an aggregated total annual final thermal energy consumption from on-site renewable sources (kWh/year). 6. Calculate the indicator as: annual total thermal energy generation from on-site renewable energy sources / annual total final thermal energy consumption. Note: The metered energy consumption is suitable for the indicator's calculation only if the building has been in use for 3-years, in order to ensure that there has been time enough to have building systems reach their normal operating efficiency levels, and also to factor out unusual seasonal variations. 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:	EN 13790
	References:	CESBA MED Project – SNTool assessment system

B3.2	**Share of renewable energy on-site, relative to total final thermal energy consumption for residential building operations**	
	Intent:	To incentive the consumption and production of renewable energy
	Indicator:	Total consumption of final thermal energy generated from renewable sources on-site divided by total final thermal energy consumption of residential buildings

	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the annual total final energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each residential building in the local area including renewables, if applicable, in the existing condition. - Calculate the aggregated annual total final energy consumption for all residential buildings. - Calculate the annual total final energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each residential building in the local area without the installed renewables, if applicable. - Calculate the aggregated annual total final energy consumption without the renewables for all residential buildings. - Calculate: Aggregated annual total final energy consumption / Aggregated annual total final energy consumption without the renewables.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B3.3	**Share of renewable energy on- site, relative to total final thermal energy consumption for public office/educational building operations**	
	Intent:	To incentive the consumption and production of renewable energy
	Indicator:	Total consumption of final thermal energy generated from renewable sources on-site divided by total final thermal energy consumption of public office/educational buildings
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the annual total final energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each public office/educational buildings in the local area including renewables, if applicable, in the existing condition. - Calculate the aggregated annual total final energy consumption for all public office/educational buildings. - Calculate the annual total final energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each public office/educational buildings in the local area without the installed renewables, if applicable. - Calculate the aggregated annual total final energy consumption without the renewables for all public office/educational buildings.

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		- Calculate the ratio: Aggregated annual total final energy consumption / Aggregated annual total final energy consumption without the renewables.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B3.4	**Share of renewable energy on-site, relative to final electric energy consumption**	
KPI	*Intent:*	To incentive the consumption and production of renewable energy
	Indicator:	Total consumption of final electric energy generated from renewable sources on-site divided by total final electric energy consumption
	Unit of measure:	%
	Assessment method:	To characterize the indicator's value there are two options: Use of estimated data OR Use of metered data Note: For the evaluation of the actual performance of the urban area it is preferable to use metered data. If metered data aren't available, estimated data shall be used. Estimated data are used for evaluating retrofit scenarios in planning and decision-making processes. In reporting the indicator's value, data sources must always be indicated. Exported energy is the one delivered by technical systems through the system boundary (urban area) and used outside the system boundary. Exported energy is a benefit beyond the system boundary and it has not to be included in the calculation. **Use of estimated data:** 1.In the calculation of the final electric energy consumption, the following energy uses must be considered: heating, cooling, ventilation, auxiliaries, domestic hot water and lighting. 2.For each building in the local area, calculate the annual final electric energy consumption in kilowatt hours (kWh/year). 3.Sum the annual final electric energy consumption of each building up to an aggregated total annual final electric energy consumption (kWh/year). 4.For each building in the local area, calculate the annual final electric energy consumption from on-site renewable energy sources in kilowatt hours 5.Sum the annual final electric energy consumption from on-site renewable sources of each building up to an

		aggregated total annual final electric energy consumption from on-site renewable sources (kWh/year). 6.Calculate the indicator as: annual total final electric energy consumption from on-site renewable sources / annual total final electric energy consumption. Note: Calculations are based on EN 13790 using the quasi-steady state monthly method. **Use of metered data:** 1.In the evaluation of the final electric energy consumption, the following energy uses must be considered: heating, cooling, ventilation, auxiliaries, domestic hot water and lighting water. 2.For each building in the local area, collect the metered annual final electric energy consumption) in kilowatt hours (kWh/year). 3.Sum the annual final electric energy consumption of each building up to an aggregated total annual final electric energy consumption (kWh/year). 4.For each building in the local area, collect the monitored annual final electric energy consumption from on-site renewable sources in kilowatt hours (kWh). 5.Sum the annual final electric energy consumption from on-site renewable sources of each building up to an aggregated total annual final electric energy consumption from on-site renewable sources (kWh/year). 6.Calculate the indicator as: annual total electric energy generation from on-site renewable energy sources / annual total final electric energy consumption. Note: The metered energy consumption is suitable for the indicator's calculation only if the building has been in use for 3-years, in order to ensure that there has been time enough to have building systems reach their normal operating efficiency levels, and also to factor out unusual seasonal variations. 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
	Standard:	EN 13790
	References:	CESBA MED Project – SNTool assessment system

B3.5	Share of renewable energy on-site, relative to total final electric energy consumption for residential building operations	
	Intent:	To incentive the consumption and production of renewable energy
	Indicator:	Total consumption of final electric energy generated from renewable sources on-site divided by total final electric energy consumption of residential buildings
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the annual total final electric energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each residential building in the local area including renewables, if applicable, in the existing condition. - Calculate the aggregated annual total primary energy consumption for residential buildings. - Calculate the annual total final electric energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each residential building in the local area without the installed renewables, if applicable. - Calculate the aggregated annual total final electric energy consumption without the renewables for residential buildings. - Calculate the ratio: Aggregated annual total final electric energy consumption / Aggregated annual total final electric energy consumption without the renewables.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B3.6	Share of renewable energy on-site, on final electric energy consumptions for public office/educational building operations	
	Intent:	To incentive the consumption and production of renewable energy
	Indicator:	Total consumption of final electric energy generated from renewable sources on-site divided by total final electric energy consumption of public office/educational buildings
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the annual total final electric energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each public office/educational building in the local area including renewables, if applicable, in the existing condition. - Calculate the aggregated annual total final electric energy consumption for public office/educational buildings.

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		- Calculate the annual total final electric energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each public office/educational building in the local area without the installed renewables, if applicable. - Calculate the aggregated annual total final electric energy consumption without the renewables for public office/educational buildings. - Calculate the ratio: Aggregated annual total final electric energy consumption / Aggregated annual total final electric energy consumption without the renewables.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B3.7	**Share of renewable energy on-site, relative to total primary energy consumption for building operations**	
KPI	*Intent:*	To incentive the consumption and production of renewable energy
	Indicator:	Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption
	Unit of measure:	%
	Assessment method:	To characterize the indicator's value: 1. In the calculation of the primary energy consumption, the following energy uses must be considered: heating, cooling, ventilation, auxiliaries, domestic hot water and lighting. 2. For each building in the local area, calculate the annual final (thermal and electric) energy consumption per energy carrier in kilowatt hours (kWh/year) 3. Sum the annual final energy consumption of each building up to an aggregated annual final energy consumption per energy carrier (kWh/year). 4. Using the national conversion factors, convert the aggregated annual final energy consumption per energy carrier in annual primary energy consumption per energy carrier (kWh/year). 5. Sum the annual primary energy consumption per energy carrier up to an aggregated annual total primary energy consumption (kWh/year). 6. For each building in the local area, calculate the annual final (thermal and electric) energy consumption per on-site renewable energy source in kilowatt hours (kWh/year) – i.e. P.V, solar thermal panels, etc. 7. Sum the annual final energy consumption from on-site renewable energy sources of each building up to an aggregated annual final energy consumption per on-site renewable energy source (kWh/year).

		8. Using the national conversion factors, convert the aggregated annual final energy consumption per on-site renewable energy source in annual primary energy consumption per on-site renewable energy source (kWh/year). 9. Sum the annual primary energy consumption per on-site renewable energy source up to an aggregated annual total primary energy consumption from on-site renewable energy sources (kWh/year). 10. Calculate the indicator's value as: aggregated total annual primary energy consumption from on-site renewable energy sources / aggregated total annual primary energy consumption. Note Calculations are based on EN 13790 using the quasi-steady state monthly method. Exported energy is the one delivered by technical systems through the system boundary (urban area) and used outside the system boundary. Exported energy is a benefit beyond the system boundary and it has not to be included in the calculation
	Standard:	EN 13790
	References:	CESBA MED Project – SNTool assessment system

B3.8	**Share of renewable energy on-site, relative to total primary energy consumption for residential building operations**	
	Intent:	To incentive the consumption and production of renewable energy
	Indicator:	Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption of residential buildings
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the annual total primary energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each residential building in the local area including renewables, if applicable, in the existing condition. - Calculate the aggregated annual total primary energy consumption for residential buildings. - Calculate the annual total primary energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each residential building in the local area without the installed renewables, if applicable. - Calculate the aggregated annual total primary energy consumption without the renewables for residential buildings.

		- Calculate the ratio: Aggregated annual total primary energy consumption / Aggregated annual total primary energy consumption without the renewables.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

B3.9	**Share of renewable energy on-site, on total primary energy consumptions for public office/ educational building operations**	
	Intent:	To incentive the consumption and production of renewable energy
	Indicator:	Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption of public office/educational
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the annual total primary energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each public office/educational building in the local area including renewables, if applicable, in the existing condition. - Calculate the aggregated annual total primary energy consumption for public office/educational buildings. - Calculate the annual total primary energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each public office/educational building in the local area without the installed renewables, if applicable. - Calculate the aggregated annual total primary energy consumption without the renewables for public office/educational buildings. - Calculate the ratio: Aggregated annual total primary energy consumption / Aggregated annual total primary energy consumption without the renewables.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

C	Water	
C1	**Water infrastructure**	
C1.1	**Availability of a public municipal water supply**	
	Intent:	To evaluate neighborhood health and quality of life
	Indicator:	Number of people within the neighborhood who are served by a municipal water supply divided by the neighborhood population
	Unit of measure:	%
	Assessment method:	Calculation steps:

		- Calculate the number of people within the neighborhood who are served by a municipal water supply (A) - numerator - Calculate the total neighborhood population (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

C1.2	**Availability of wastewater treatment systems**	
	Intent:	To evaluate neighborhood health, cleanliness and quality of life
	Indicator:	Number of people within the neighborhood who are served by wastewater collection divided by the neighborhood population
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of people within the neighborhood who are served by wastewater collection (A) - numerator - Calculate the total neighborhood population (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

C2	**Water consumption**	
C2.1	**Total water consumption**	
	Intent:	To evaluate water resources in the neighborhood
	Indicator:	Total amount of the neighborhood's water consumption in litres per day divided by the total neighborhood population
	Unit of measure:	L/day/occupant
	Assessment method:	Calculation steps: - Calculate the total amount of the neighborhood's water consumption in litres per day (A) - numerator - Calculate the total neighborhood population (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

C2.2	**Efficiency in water use**

	Intent:	To make efficient use of water resources
	Indicator:	Volume of water supplied minus the volume of utilized water divided by the total volume of water supplied
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the total volume of water supplied in the neighborhood (A) - numerator - Calculate the volume of utilised water (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	IEFCA 2019 edition – Calculation Guideline

C2.3	**Consumption of potable water in residential buildings**	
KPI	*Intent:*	Make efficient use of water resources
	Indicator:	Annual potable water consumption per occupant
	Unit of measure:	L/occupant/yr
	Assessment method:	The potable water consumption is calculated based on metered data for water consuming appliances and sanitary fittings in the buildings. The scope of the criterion includes the use of potable water for: -drinking water; -water for sanitation; -domestic hot water; -water for washing machine; -water for dishwasher; -water for cleaning. To characterize the indicator's value: 1) For each residential building, collect the monitored annual potable water consumptions for building operation. The consumption data must be estimated taking the average over 3 years period (litres). 2)Sum the annual potable water consumption of each building up to an aggregated annual total potable water consumption (litres/year). 3)Estimate the number of residential buildings' occupants. 4)Calculate the indicator's value as: aggregated annual total potable water consumption / number of occupants.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

C2.4	**Consumption of potable water in public offices**	
	Intent:	Make efficient use of water resources
	Indicator:	Annual potable water consumption per occupant
	Unit of measure:	L/occupant/yr

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	Assessment method:	To characterize the indicator’s value: 1) For each public office building, collect the monitored annual potable water consumptions for building operation. The consumption data must be estimated taking the average over 3 years period (litres). 2)Sum the annual potable water consumption of each office building up to an aggregated annual total potable water consumption (litres/year). 3)Estimate the number of public office buildings’ occupants. 4)Calculate the indicator’s value as: aggregated annual total potable water consumption / number of occupants.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

C2.5	**Consumption of potable water in educational buildings**	
	Intent:	Make efficient use of water resources
	Indicator:	Annual potable water consumption per occupant
	Unit of measure:	L/occupant/yr
	Assessment method:	To characterize the indicator’s value: 1) For each educational building, collect the monitored annual potable water consumptions for building operation. The consumption data must be estimated taking the average over 3 years period (litres). 2)Sum the annual potable water consumption of each educational building up to an aggregated annual total potable water consumption (litres/year). 3)Estimate the number of educational buildings’ occupants. 4)Calculate the indicator’s value as: aggregated annual total potable water consumption / number of occupants.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

C2.6	**Re-use of rainwater in residential buildings**	
	Intent:	To assess the collection of rainwater from roofs in residential buildings
	Indicator:	Share of rainwater collected from roofs of residential buildings for reuse
	Unit of measure:	%
	Assessment method:	Calculation steps: Calculate the percent of demand for greywater that can be used for toilets and irrigation in residential buildings that is met by rainwater collected in the area
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

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C2.7	Consumption of potable water in public green spaces	
	Intent:	To reduce the consumption of potable water
	Indicator:	Potable water used for irrigation purposes in public green spaces
	Unit of measure:	m^3/m^2
	Assessment method:	Calculation steps: Calculate the estimated consumption of potable water used for irrigation purposes in the local area, in $m^3/1000\ m^2$
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

C2.8	Solar powered water desalinisation	
	Intent:	Alleviate water stress, maximize the use of solar energy to reduce production cost for removing salts from brackish or saline water in order to render it acceptable for human consumption or agriculture
	Indicator:	Percentage of water acceptable for human consumption or agriculture from solar-desalination
	Unit of measure:	%
	Assessment method:	To perform the calculation, it is possible to use metered or estimated data for producing fresh water from direct (thermal) or indirect (electrical) solar-desalination systems. Calculation steps: - Calculate the annual water production from all solar-desalination facilities (m3/year) serving the city (A) - Calculate the annual total water consumption (m3/year) of the city (B) - Calculate the value of the indicator as a percentage ratio of the average annual water production divided by the annual total water consumption (%) as A/B
	Standard:	-
	References:	WHO/HSE/WSH/11.03 Safe Drinking-water from Desalination, World Health Organization, 2011. https://www.who.int/publications/i/item/WHO-HSE-WSH-11.03 Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption (recast). http://data.europa.eu/eli/dir/2020/2184/oj EurEau. 2021. Europe's Water in Figures, The European Federation of National Associations of Water Services. https://www.eureau.org/resources/publications/eureau-publications/5824-europe-s-water-in-figures-2021/file

C3	Effluents management	
C3.1	Water treatment	
	Intent:	To reduce the incidence of a variety of waterborne diseases
	Indicator:	Total volume of wastewater collected for at least secondary treatment in centralized wastewater treatment facilities divided by the total volume of wastewater produced in the neighborhood
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the total volume of wastewater collected for at least secondary treatment in centralized wastewater treatment facilities (A) - numerator - Calculate the total volume of wastewater produced in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

C3.2	Public wastewater (from outdoor areas) that is disposed or treated	
	Intent:	To reduce the incidence of a variety of waterborne diseases
	Indicator:	Percent of public wastewater that is disposed or treated
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the total volume of public wastewater from outdoor areas disposed or treated in the neighborhood (A) - numerator - Calculate the total volume of public wastewater produced from outdoor areas in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

C3.3	Household sanitation	
	Intent:	To maintain certain levels of hygiene
	Indicator:	Percentage of households with access to basic sanitation facilities
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the total number of neighborhood households with access to basic sanitation and facilities (A) - numerator

		- Calculate the total number of neighborhood households (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities
D	**Solid Waste**	
D1	**Solid waste collection infrastructure**	
D1.1	**Availability of solid waste collection**	
	Intent:	To evaluate neighborhood health, cleanliness and quality of life
	Indicator:	Percentage of population with regular solid waste collection
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of neighborhood households that are served by solid waste collection (A) - numerator - Calculate the total number of neighborhood households (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

D2	**Solid waste management**	
D2.1	**Access to solid waste and recycling collection points**	
	Intent:	To assess the proportion of potential residential households and non-residential users with access to nearby collection points for solid waste and recycling
	Indicator:	Proximity of the resident population to the solid waste and recycling collection point
	Unit of measure:	%
	Assessment method:	Calculation steps: - Identify the ecological areas or individual bins of differentiated collection of waste present in the area - Calculate the actual distance on foot between these nodes and access the buildings. - Calculate the percentage of the population that is located more than 50 meters from the waste collection points, compared to the main entrances of the dwellings.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

D2.2	**Access to solid waste and recycling collection points**	
KPI	*Intent:*	To improve separate collection disposal, avoiding to burn waste

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	Indicator:	Percentage of inhabitants with access to solid waste and recycling collection points within 400 meters walking distance
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the share of inhabitant living with 400m access to the solid waste and recycling collection points in the neighborhood (A) - numerator - Calculate the neighborhood's population (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

E	**Environmental quality**	
E1	**Air quality**	
E1.1	**Fine particulate matter ($PM_{2.5}$) concentration**	
	Intent:	To evaluate the quality of the air through the exceeded daily limits of pollutants
	Indicator:	Number of days within a year that $PM_{2.5}$ concentration exceeds the daily limit
	Unit of measure:	days / yr
	Assessment method:	Number of days with bad air quality per year. Evaluate the number of days exceeding the daily limits in a year. Select the number of days per year with a bad air quality, according to the following criteria: SO2: Number of days with more than 125 µg/m3 CO: Number of days with more than 10 mg/m3 NOx: Number of days with more than 50 µg/m3 O3: Number of days with more than 120 µg/m3 PM10: Number of days with more than 50 µg/m3
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

E1.2	**Particulate matter (PM_{10}) concentration**	
KPI	*Intent:*	To assess the long-term ambient air quality with respect to particulates <10 mu (PM_{10}) in the neighborhood
	Indicator:	Number of days within a year that PM_{10} concentration exceeds the daily limit
	Unit of measure:	days / yr
	Assessment method:	To characterize the indicator's value: 1. Daily test air samples in accordance with national or regional procedures over a period of one year. 2. Evaluate the number of days exceeding the daily limits in a year.

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	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

E1.3	**Nitrogen Dioxide concentration (NO2)**	
	Intent:	To evaluate the quality of the air through the exceeded daily limits of pollutants (NO2)
	Indicator:	Number of days within a year that NO_2 concentration exceeds the daily limit
	Unit of measure:	μg/m^3
	Assessment method:	Calculation steps: - Calculate the mass of pollutant collected NO2 (μg) (A) - numerator - Calculate the volume of air sampled in standard cubic metres (μg/m^3) (B) - denominator - The result shall be expressed as the concentration of NO2 in micrograms per standard cubic metre (μg/m^3)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

E1.4	**Sulfur Dioxide concentration (SO2)**	
	Intent:	To evaluate the quality of the air through the exceeded daily limits of pollutants (SO_2)
	Indicator:	Number of days within a year that SO_2 concentration exceeds the daily limit
	Unit of measure:	μg/m^3
	Assessment method:	Calculation steps: - Calculate the mass of pollutant collected SO_2 (μg) (A) - numerator - Calculate the volume of air sampled in standard cubic metres (μg/m^3) (B) - denominator - The result shall be expressed as the concentration of SO_2 in micrograms per standard cubic metre (μg/m^3)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

E1.5	**Ozone concentration (O3)**	
	Intent:	To evaluate the quality of the air through the exceeded daily limits of pollutants (O3)
	Indicator:	Number of days within a year that O_3 concentration exceeds the daily limit
	Unit of measure:	μg/m^3
	Assessment method:	Calculation steps:

		- Calculate the mass of pollutant collected O3 (µg) (A) - numerator - Calculate the volume of air sampled in standard cubic metres (µg/m^3) (B) - denominator - The result shall be expressed as the concentration of O3 in micrograms per standard cubic metre (µg/m^3)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

E2	**Noise**	
E2.1	**Ambient daytime noise conditions**	
	Intent:	To promote acoustic comfort, for a healthy and safe environment
	Indicator:	Percentage of building area over noise limit
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of people living in the neighborhood with excessive ambient daytime noise levels (A) - numerator - Calculate the total number of people living in that neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

E2.2	**Ambient night-time noise conditions**	
	Intent:	To promote acoustic comfort, for a healthy and safe environment
	Indicator:	Percentage of building area over noise limit
	Unit of measure:	%
	Assessment method:	Estimated percentage of total residential population in the local area that is exposed to ambient noise exceeding 40 dBA during periods from 22:00 to 07:00. Calculation steps: - Calculate the number of people living in the neighborhood that is exposed to ambient noise exceeding 40 dBA during periods from 22:00 to 07:00. (A) - numerator - Calculate the total number of people living in that neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

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E3	EMF exposure	
E3.1	**Exposure to high frequency electromagnetic fields**	
	Intent:	To evaluate the exposure to high frequency electromagnetic fields
	Indicator:	Percentage of mobile network antenna sites in compliance with EMF exposure
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of mobile network antenna sites in compliance with EMF exposure (A) - numerator - Calculate the total number mobile network antenna sites in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

E3.2	Exposure to high frequency electromagnetic fields	
	Intent:	To assess the quantity of buildings exposed to ELF magnetic fields
	Indicator:	Percentage of buildings in the area located not respecting the safety distance from high voltage lines
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the buildings located in the neighborhood not respecting the safety distance from high voltage lines (A) - numerator - Calculate the total number of buildings in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

E4	Environmental impacts	
E4.1	**Degree of atmospheric light pollution caused by exterior public lighting systems**	
	Intent:	To reduce light pollution
	Indicator:	Percentage of lighting fixtures with upward luminous emission coefficient equal to 0%
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of lighting fixtures installed in the neighborhood with upward luminous emission coefficient equal to 0% (A) - numerator - Calculate the total number of lighting fixtures installed in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)

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	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

F	**Transportation and mobility**	
F1	**Performance of mobility service**	
F1.1	**Performance of the public transport system**	
KPI	*Intent:*	To determine the performance of the public transportation system
	Indicator:	Percentage of inhabitants that are within 400 meters walking distance of at least one public transportation service stop
	Unit of measure:	%
	Assessment method:	The calculation steps are: - Locate the public/municipal transport stops with daily total service frequency of at least 20 trips, that serve the neighborhood - Locate all the residential buildings in the neighborhood with a walking distance from their entrance to at least one of the located stops up to 400 meters. - Calculate the occupants of the selected buildings. - Calculate the total population of the neighborhood - Calculate the indicator's value as the percentage of the occupants of the selected buildings to the total population of the neighborhood For the calculation of the indicator the following are considered: - only residents of the neighborhood and not working people in the area - a stop must have a daily total service frequency of at least 20 trips
	Standard:	Global Platform for Sustainable Cities – Urban Sustainability Frame
	References:	CESBA MED Project – SNTool assessment system

F1.2	**Walking distance to public transport for area workers and students**	
	Intent:	To determine the performance of the public transportation system.
	Indicator:	Percentage of workers and students that are within 400 meters walking distance of at least one public transportation service stop
	Unit of measure:	%
	Assessment method:	To characterize the indicator's value: Calculate the percentage of workers and students in the area that are within 400 meters walking distance of at

		least one public transportation service stop (bus, tram, metro). Note: To be considered valid for the calculation, a stop must have a daily total service frequency of at least 20 trips. For the calculation of the indicator are considered only students and working people in the neighborhood.
	Standard:	Global Platform for Sustainable Cities – Urban Sustainability Frame
	References:	CESBA MED Project – SNTool assessment system

F2	**Green mobility**	
F2.1	**Shared vehicles**	
	Intent:	To promote an alternative form of transportation
	Indicator:	Number of shared vehicles per 1000 inhabitants
	Unit of measure:	n/1000 inhabitants
	Assessment method:	Calculation steps: - Calculate the number of shared vehicles (A) - numerator - Calculate the one 1.000th of the neighborhood's population (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

F2.2	**Electric-vehicle infrastructure (charging stations)**	
	Intent:	To promote the use of electric vehicles
	Indicator:	Electric vehicle charging stations per inhabitant
	Unit of measure:	n/inhabitant
	Assessment method:	Calculation steps: - Calculate the number of charging stations for electric vehicles (A) - numerator - Calculate the neighborhood's population (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

F2.3	**Bicycle network**	
KPI	*Intent:*	To emphasise the use of bicycles as method to reduce traffic congestion and pollution
	Indicator:	Total length of bicycle paths in the neighborhood per inhabitant
	Unit of measure:	m/inhabitant
	Assessment method:	Calculation steps:

		- Calculate the total length of bicycle paths/lanes in the neighborhood (A) - numerator - Estimate/Calculate the total number of inhabitants in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

F2.4	**Shared bicycles**	
	Intent:	To emphasise the use of bicycles as method to reduce traffic congestion and pollution
	Indicator:	Number of shared bicycles per 1.000 inhabitants
	Unit of measure:	n/1000 inhabitants
	Assessment method:	Calculation steps: - Calculate the number of shared bicycles available (A) - numerator - Calculate the one 1.000 of the neighborhood's population (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

F2.5	**Availability of bicycle parking facilities**	
	Intent:	To promote cycling as an alternative to vehicle use by providing a safe and efficient mobility network
	Indicator:	Bicycle parking spaces per inhabitant
	Unit of measure:	n/inhabitant
	Assessment method:	Calculation steps: - Calculate the number of bicycles parking available in the neighborhood (A) - numerator - Calculate the neighborhood's population (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

F3	**Safety in mobility**	
F3.1	**Pedestrian infrastructure**	
	Intent:	To improve the neighborhood in terms of liveability and safety for pedestrians
	Indicator:	Percentage of the neighborhood designated as a pedestrian/car free zone
	Unit of measure:	%
	Assessment method:	Calculation steps:

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		- Calculate the total area of pedestrian/car free zones (A) - numerator - Calculate the total area of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

F3.2	**Availability of sidewalks**	
	Intent:	To promote road connectivity, as a key element of spatial accessibility
	Indicator:	Percentage of roads' length that has dedicated sidewalks
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the roads' length that has dedicated sidewalks (A) - numerator - Calculate the total length of the roads in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

F3.3	**Safety of bicycle lines**	
	Intent:	To promote bicycle as alternative vehicle from car
	Indicator:	Percentage of bicycle paths physically separated from traffic roads
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the length of bicycle paths physically separated from traffic roads (A) - numerator - Calculate the total length of bicycle paths in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

F3.4	**Traffic fatalities**	
	Intent:	To assess road safety
	Indicator:	Traffic fatalities per 1000 inhabitants
	Unit of measure:	n/1000 inhabitants
	Assessment method:	Calculation steps: - Calculate the number of traffic fatalities (A) - numerator - Calculate one 1.000 of the neighborhood's population (B) - denominator - Calculate the value of the indicator as A/B (%)

	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

F4	**Urban morphology and transportation**	
F4.1	**Cyclomatic complexity of the street network**	
	Intent:	To assess road connectivity, as a key element of spatial accessibility
	Indicator:	Cyclomatic number
	Unit of measure:	number
	Assessment method:	To assess this indicator, it is necessary to add up all the roads links and subtract them the number of intersections. Links - Nodes + 1 For the calculation of the performance indicator proceeds as follows: 1. Locate in the neighborhood the intersections (nodes N), quantifying them. 2. Find in the area segments (sides L) between successive intersections, quantified. 3. Apply the formula L - N + 1.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

F4.2	**Connectivity of the street network**	
	Intent:	To determine the connectivity of the local street network
	Indicator:	Number of intersections related to the overall surface area
	Unit of measure:	number/km^2
	Assessment method:	Calculation steps: - Calculate the number of street intersection in the neighborhood (A) - numerator - Calculate the area of the neighborhood in km^2 (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G	**Social Aspects**	
G1	**Accessibility (disabled persons)**	
G1.1	**Public buildings that are accessible for use by physically disabled persons**	
	Intent:	To assess the ability of residents, workers or visitors with physical disabilities to be able to have physical access to key buildings
	Indicator:	Percent of public buildings that are accessible for use by physically disabled persons

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	Unit of measure:	%
	Assessment method:	Calculation steps: -Identify what may be referred to as "key" public, commercial and residential buildings - Assess the accessibility of exterior parking and pedestrian access areas, considering all major disability types - Establish the percent of key buildings that may be considered accessible.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G1.2	**Sidewalks and other pedestrian paths that are accessible for use by physically disabled persons**	
	Intent:	To assess the ability of local residents, workers or visitors with physical disabilities to be able to make use of public outdoor facilities in the local area
	Indicator:	Percent of sidewalks and other pedestrian ways that are accessible for use by physically disabled persons
	Unit of measure:	%
	Assessment method:	Calculation steps: - Identify key pedestrian paths or other public routes that may be frequently used by persons with physical disabilities. - Assess the accessibility of exterior parking and pedestrian routes, considering all major disability types. - Establish the percent of public pedestrian routes that may be considered accessible.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G1.3	**Barrier-free accessibility in local outdoor public areas**	
	Intent:	To evaluate the accessibility of various urban resources using spatial data analysis
	Indicator:	Percentage of accessible public outdoor areas that are barrier-free compared to the total public area
	Unit of measure:	%
	Assessment method:	Calculation steps: -Identify key outdoor public facilities that may be frequently used by persons with physical disabilities. - Assess the accessibility of pedestrian routes, considering all major disability types - Establish the percent of public outdoor facilities that may be considered accessible.
	Standard:	-

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	References:	CESBA MED Project – SNTool assessment system

G2	**Housing**	
G2.1	**Affordability of housing property**	
	Intent:	To assess the affordability of housing property in the neighborhood
	Indicator:	Housing properties in the neighborhood that are financially accessible to the lowest quintile of area population
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of housing properties in the neighborhood that are financially accessible to the lowest quintile of area population (A) - numerator - Calculate the total number of housing properties in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G2.2	**Affordability of housing rental**	
	Intent:	To assess the affordability of housing rental property for low-income residents in the neighborhood
	Indicator:	Percentage of the average salary of the lowest quintile of the population used for rental payments
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of housing rental property in the neighborhood that are financially accessible to low-income residents (A) - numerator - Calculate the total number of housing rental property in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G2.3	**Vacant residential units in the neighborhood**	
	Intent:	To understand the current and future housing needs in the neighborhood
	Indicator:	Percentage of vacant residential units
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of unoccupied dwellings (A) - numerator - Calculate the total number of dwellings in the neighborhood (B) - denominator

		- Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

G2.4	**Informal settlements**	
	Intent:	To evaluate the extent of the challenges for the reporting neighborhood in meeting shelter needs and demand
	Indicator:	Percentage of inhabitants living in slums, informal settlements or inadequate housing
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the area of informal settlements within the neighborhood boundary (in square kilometres) (A) - numerator - Calculate the neighborhood area in square kilometres (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

G3	**Availability of public and private facilities and services**	
G3.1	**Availability and proximity of key services**	
KPI	*Intent:*	To determine the accessibility and proximity of key services for local residents (e.g. schools, sports facilities, supermarket, community buildings, etc.)
	Indicator:	Percentage of inhabitants that are within 800 meters walking distance of at least 3 key services
	Unit of measure:	%
	Assessment method:	To characterize the indicator's value: 1. Identify locations of key services in the local area. 2. Calculate the percentage of the inhabitants that are within 800 meters walking distance from at least 3 key services coming from the nine categories below. Note Key services are: 1. Education (schools, kindergartens, education centers, etc.) 2. Health center (hospitals, medical ward, medical center, etc.) 3. Law enforcement areas (police station, etc.) 4. Sport facilities 5. Food shops 6. Bank 7. Post office

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		8. Pharmacy 9. Shopping center 10. Culture and leisure It is possible to consider only one key service from each of the ten categories. Private services can be considered.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G3.2	**Availability and proximity of a public primary school**	
	Intent:	To evaluate the percentage of the population near a primary school
	Indicator:	Percentage of population near a public primary school
	Unit of measure:	%
	Assessment method:	Calculate the percentage of resident population with access to a primary school within a distance of 500 m.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G3.3	**Availability and proximity of a public secondary school**	
	Intent:	To evaluate the percentage of the population near a secondary school
	Indicator:	Percentage of population near a public secondary school
	Unit of measure:	%
	Assessment method:	Calculate the percentage of resident population with access to a secondary school within a distance of 1 km.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G3.4	**Availability and proximity of children's' play facilities**	
	Intent:	To evaluate the percentage of the population near a children's' play facilities
	Indicator:	Percentage of population near a children's' play facilities
	Unit of measure:	%
	Assessment method:	Calculate the percentage of residential dwelling units more than two bedrooms having access a play facility designed for young children within a distance of 300 m.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G3.5	**Outdoor public spaces**	
	Intent:	To ensure that public open space compatible with local cultural values is provided in large projects
	Indicator:	Average share of the built-up area of the neighborhood that is open space for public use

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	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the share of the built-up area of the neighborhood that is open space for public use (A) - numerator - Calculate the total area of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G4	**Education**	
G4.1	**Primary enrollment rate**	
	Intent:	To expand and transform the educational systems of countries achieving universal standards of learning outcomes, reducing inequalities
	Indicator:	Net primary enrolment rate
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the net primary enrolment rate of people in the neighborhood (A) - numerator - Calculate the total number of people of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G4.2	**Rate of female scholarship**	
	Intent:	To monitor woman rights
	Indicator:	Ratio of female to male mean years of education received of population age 25+
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of females mean years of education received of population age 25+ in the neighborhood (A) - numerator - Calculate the number of male mean years of education received of population age 25+ in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	Sustainable Development in the Mediterranean Report

G4.3	**Secondary school enrollment**

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	Intent:	To expand and transform the educational systems of countries achieving universal standards of learning outcomes, reducing inequalities
	Indicator:	Lower secondary completion rate
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the secondary enrolment rate of people in the neighborhood (A) - numerator - Calculate the total number of people of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	Sustainable Development in the Mediterranean Report

G4.4	**Tertiary education**	
	Intent:	To expand and transform the educational systems of countries achieving universal standards of learning outcomes, reducing inequalities
	Indicator:	Population age 25-34 with tertiary educational attainment
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the population age 25-34 with tertiary educational attainment in the neighborhood (A) - numerator - Calculate the total number of population age 25-34 of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	Sustainable Development in the Mediterranean Report

G5	**Social inclusion**	
G5.1	**Energy poverty of households**	
	Intent:	To assess poverty risk
	Indicator:	Percentage of households unable to afford the most basic levels of energy (more than 10% of the income spent on energy bills)
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of households unable to afford the most basic levels of energy (more than 10% of the income spent on energy bills) (A) - numerator - Calculate the total number of households in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	-

G5.2	Population at risk of poverty or exclusion	
	Intent:	To assess poverty risk
	Indicator:	Share of persons with an equivalised disposable income below 60 % of the national median income
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of persons with an equivalised disposable income below 60 % of the national median income (A) - numerator - Calculate the total number of persons in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	Sustainable Development in the Mediterranean Report

G6	Safety	
G6.1	Police service	
	Intent:	To assess the overall crime prevention in place in the neighborhood
	Indicator:	Number of police officers per 1.000 inhabitants
	Unit of measure:	n/1000 inhabitants
	Assessment method:	Calculation steps: - Calculate the number of permanent full-time (or FTE) sworn-in police officers (A) - numerator - Calculate one 1.000 of the neighborhood's total population (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

G6.2	Fire service	
	Intent:	To assess the overall fire security/prevention in place in the neighborhood
	Indicator:	Number of firefighters per 1.000 inhabitants
	Unit of measure:	n/1.000 inhabitants
	Assessment method:	Calculation steps: - Calculate the number of permanent full-time (or FTE) sworn-in firefighters (A) - numerator - Calculate one 1.000 of the neighborhood's total population (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

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G6.3	Population living in disaster prone areas	
	Intent:	To assess population living in areas subject to significant risk of death or damage caused by prominent hazards: cyclones, drought, floods, earthquakes, volcanoes and landslides
	Indicator:	Percentage of inhabitants living in a zone subject to natural hazards
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the total number of neighborhood inhabitants living in areas subject to significant risk of death or damage caused by prominent hazards (A) - numerator - Calculate total number of neighborhood inhabitants (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

G7	Health	
G7.1	**In-Patient Hospital Beds**	
	Intent:	To monitor the level of a health service delivery
	Indicator:	Number of in-patient public hospital beds per 1.000 inhabitants
	Unit of measure:	n/1.000 inhabitants
	Assessment method:	Calculation steps: - Calculate the total number of in-patient hospital beds (public and private) (A) - numerator - Calculate one 1.000 of the neighborhood's population (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

G8	Food security	
G8.1	**Urban agricultural land**	
	Intent:	To promote inclusion of areas devoted to urban agriculture and also plans of new urban development projects with the goal of producing food through reutilization of urban resources
	Indicator:	Area of urban agricultural land on total neighborhood area
	Unit of measure:	%
	Assessment method:	Calculation steps:

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		- Calculate the total designated urban agricultural area used for food production located within neighborhood boundaries (A) - numerator - Calculate the total extension of the neighborhood area (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G9	**Culture and Heritage**	
G9.1	**Compatibility of urban design with local cultural values**	
	Intent:	To ensure that the urban design and architecture of buildings is compatible with local cultural values
	Indicator:	Compatibility with local area traditional values of street layouts and the character of urban spaces
	Unit of measure:	Score
	Assessment method:	Subjective assessment by an experienced third-party design professional and/or sociologist
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G9.2	**Compatibility of public open space with local cultural values**	
	Intent:	To ensure that public open space compatible with local cultural values is provided in large projects
	Indicator:	Compatibility with local area traditional values of local public open spaces, including major uses, dimensions and adjacent uses
	Unit of measure:	Score
	Assessment method:	Subjective assessment by an experienced third-party design professional and/or sociologist
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G10	**Perceptual**	
G10.1	**Perceived safety of public areas for pedestrians**	
	Intent:	To improve safety of public places and pedestrian routes
	Indicator:	Perceived safety of public places and pedestrian routes, as determined by a sample of pedestrians
	Unit of measure:	Score
	Assessment method:	Evaluate the perceived safety of public places and pedestrian routes, as determined by a sample of residents
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

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G10.2	Impact of commercial signage on the visual environment	
	Intent:	To avoid visual environment obstruction through the integration of commercial signage
	Indicator:	Visual impact of exterior commercial signage
	Unit of measure:	Score
	Assessment method:	Aggregate visual impact of exterior commercial signage, based on degree of integration with building exteriors, diversity in signage dimensions and illumination; as determined by a sample of the local area population.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

G10.3	Impact of overhead electric distribution system	
	Intent:	To avoid visual environment obstruction caused by overhead electric distribution system
	Indicator:	Visual impact of above-grade electrical distribution systems
	Unit of measure:	Score
	Assessment method:	Aggregate visual impact of above-grade electrical distribution systems, based on degree of visual clutter; as determined by a sample of the local area population.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

H	Economy	
H1	Economic performance	
H1.1	Average annual per-capita income of residents	
	Intent:	To evaluate the economic well-being
	Indicator:	Percentage of average per-capita income
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the per-capita income of residents in the neighborhood (A) - numerator - Calculate the per-capita income of the whole urban region (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

H2	Employment	
H2.1	Unemployment rate	
	Intent:	To assess the labour market status, the economy development and citizens' quality of life
	Indicator:	Percentage of working age adults unemployed or actively looking for work
	Unit of measure:	%

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	Assessment method:	Calculation steps: - Calculate the working age adults unemployed or actively looking for work in the neighborhood (A) - numerator - Calculate the number of working age people in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

H2.2	**Youth unemployment rate**	
	Intent:	To quantify and analyse the current labour market trends and challenges of young people
	Indicator:	Percentage of unemployed youth
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the total number of a neighborhood's unemployed youth (A) - numerator - Calculate the neighborhood's youth labour force (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

H3	**Innovation**	
H3.1	**New business registration rate**	
	Intent:	To assess neighborhood's level of economic activity and economic performance
	Indicator:	Proportion of business registrations per 10.000 inhabitants aged 16 and above
	Unit of measure:	n
	Assessment method:	Calculation steps: - Calculate the number of business registrations per 10.000 inhabitants aged 16 and above
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

H4	**ICT infrastructure**	
H4.1	**Fixed Broadband Subscriptions**	
	Intent:	To assess the access to information and technology connectivity
	Indicator:	Percentage of households with fixed (wired) broadband
	Unit of measure:	%
	Assessment method:	Calculation steps:

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		- Calculate the number of fixed broadband subscriptions in the neighborhood (A) - numerator - Calculate the total number of households in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

H4.2	**Wireless Broadband Coverage**	
	Intent:	To assess the access to information and technology connectivity
	Indicator:	Percentage of the neighborhood served by wireless broadband (3G, 4G, 5G)
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the area of the neighborhood area covered by mobile services (km^2) (A) - numerator - Calculate the Total area of the neighborhood (km^2) (B) - denominator - Calculate the value of the indicator as A/B (%) Note: each service should be reported on separately (3G and 4G)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

H4.3	**Availability of WIFI in Public Areas**	
	Intent:	To increase access to internet at little or no cost
	Indicator:	Number of public WIFI hotspots in the neighborhood per 1.000 inhabitants
	Unit of measure:	n/1000 inhabitants
	Assessment method:	Calculation steps: - Calculate the total number of WIFI hotspots provided by the neighborhood administration (A) - numerator - Calculate the one 1.000 of the neighborhood's total population (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

H4.4	**Mobile phone subscriptions**	
	Intent:	To evaluate the levels of telecommunication technology, information, communication technology and innovation

	Indicator:	Total number of mobile phone subscriptions in the area divided by one 1.000th of the area's total population
	Unit of measure:	n/1.000 inhabitants
	Assessment method:	Calculation steps: - Calculate the total number of mobile phone connections in the neighborhood (A) - numerator - Calculate the one 1.000th of the neighborhood's total population (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

I	**Climate Change: mitigation and adaptation**	
I1	**Climate change mitigation**	
I1.1	**Greenhouse gas emissions**	
KPI	*Intent:*	To assess the adverse contribution the neighborhood is making to climate change
	Indicator:	Total amount of greenhouse gases (equivalent carbon dioxide units) generated from building operations over a calendar year per inhabitant
	Unit of measure:	t CO_2 eq. / inhabitant /yr
	Assessment method:	Calculation steps: - Calculate the total amount of greenhouse gases in tonnes (equivalent carbon dioxide units) generated over a calendar year by all activities within the neighborhood, including indirect emissions outside neighborhood boundaries (A) - numerator - Calculate the current population of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	ISO 37120: Sustainable cities and communities - Indicators for city services and quality of life

I1.2	**Embodied carbon for construction and renovation of infrastructures**	
	Intent:	Promote the use of construction materials for infrastructures with a low embodied carbon
	Indicator:	Aggregated total embodied carbon per aggregated linear area
	Unit of measure:	kg CO_2 eq / m^2
	Assessment method:	Calculation steps: 1. Identify the basic composition of each infrastructure element. A breakdown of its constituent materials has to be carried out. The mass of each constituent material has to be estimated;

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		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 ($kgCO_2eq/m^2$) 4. Calculate the total linear area of the infrastructures considered 5. Calculate the indicator's value as: total embodied carbon of the building / total linear area
	Standard:	EN 15978 "Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method"
	References:	CESBA MED Project – SNTool assessment system

I1.3	**Embodied carbon for construction/renovation of residential buildings**	
	Intent:	Promote the use of construction materials with a low embodied carbon
	Indicator:	Aggregated total embodied carbon per aggregated indoor useful floor area
	Unit of measure:	kg CO_2 eq / m^2
	Assessment method:	Calculation steps: 1. Identify the basic composition of each building element for all the residential buildings of the neighborhood. 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 ($kgCO_2eq/m^2$) 4. Calculate the total useful internal floor area for all the residential buildings of the neighborhood 5. Calculate the indicator's value as: total embodied carbon of the building / total useful internal floor area of residential buildings.

	Standard:	EN 15978 "Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method"
	References:	CESBA MED Project – SNTool assessment system

I1.4	**Embodied carbon for construction/renovation of public offices/educational buildings**	
	Intent:	Promote the use of construction materials with a low embodied carbon
	Indicator:	Aggregated total embodied carbon per aggregated indoor useful floor area
	Unit of measure:	kg CO_2 eq / m^2
	Assessment method:	Calculation steps: 1. Identify the basic composition of each building element for all the offices/educational buildings of the neighborhood. 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/m^2) 4. Calculate the total useful internal floor area for all the offices/educational buildings of the neighborhood 5. Calculate the indicator's value as: total embodied carbon of the building / total useful internal floor area of offices/educational buildings.
	Standard:	EN 15978 "Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method".
	References:	CESBA MED Project – SNTool assessment system

I1.5	**CO_2 sequestration**	
	Intent:	To promote the CO_2 sequestration in the neighborhood
	Indicator:	Potential CO_2 sequestration in the neighborhood per he
	Unit of measure:	tepCO_2/he
	Assessment method:	Calculation steps: - Calculate the amount of CO_2 sequestration in the neighborhood (A) - numerator

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		- Calculate the area of the neighborhood (he) (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I2	**Adaptation to the climatic action: heatwaves and increase of temperature**	
I2.1	**Albedo**	
	Intent:	To estimate the extent of the Urban Heat Island effect in the neighborhood
	Indicator:	Mean Solar Reflectance Index of paved surfaces and roofs in the neighborhood
	Unit of measure:	SRI
	Assessment method:	Calculation steps: 1. Identify the boundaries of the area being assessed 2. Obtain records of local ambient temperatures and wind speeds during summer conditions over a 3-year period 3. Obtain similar data for the larger urban region 4. Identify differences between the local and regional UHI effects 5. Identify factors in configuration of buildings, vegetation, surface albedo and other local factors that may explain the differences.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I2.2	**Use of vegetation to provide ambient outdoor cooling**	
	Intent:	To assess the role of vegetation on the site and on roofs in cooling ambient conditions through evapotranspiration
	Indicator:	Leaf Area Index: ratio of total vegetated surface area (on ground and on roofs, and including trees), divided by total site area
	Unit of measure:	Index
	Assessment method:	Desk analysis
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I2.3	**Green roofs**	
	Intent:	To determine the aggregate area of green roofs on all buildings relative to the total surface area in the neighborhood
	Indicator:	Aggregate area of building roofs covered with vegetated material
	Unit of measure:	%
	Assessment method:	Calculation steps:

		- Identify all buildings with green roofs and estimate the aggregate net green roof area. - Determine the ratio of the aggregate green roof area to the total surface area in the neighborhood.
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I3	**Adaptation to the climatic action: pluvial flood**	
I3.1	**Stormwater retention capacity on site by buildings**	
	Intent:	To evaluate the level of retention capacity of the buildings
	Indicator:	Share of the onsite stormwater retention capacity in relation to the optimal retention capacity
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the amount of onsite stormwater retention capacity of the buildings (A) - numerator - Calculate the optimal retention capacity of the buildings (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	-

I3.2	**Sustainable Urban Drainage**	
	Intent:	To ensure urban drainage
	Indicator:	Share of the optimal capacity of sustainable urban drainage systems
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the share of the optimal capacity of sustainable urban drainage systems (A) - numerator - Calculate the optimal capacity of sustainable urban drainage systems (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	-

I3.3	**Permeability of land**	
KPI	*Intent:*	To improve the permeability of the area
	Indicator:	Percentage of weighted ground permeability
	Unit of measure:	%
	Assessment method:	Calculation steps: Calculation steps: - Calculate the size (Sa) of the neighborhood area (m^2) - Calculate the size of the surfaces with a different paving or occupied by constructions in the neighborhood area

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		(i.e. green areas, surfaces paved with asphalt, surfaces occupied by buildings, etc.). Include all the surfaces in the neighborhood area so that: $S_a = \sum_{i=1}^{n} S_{a,1}$ Sa = total surface of the neighborhood area Sa,i = surface i-th in the neighborhood area (m^2) - Calculate the real permeability of soil considering the permeability coefficient of each surface. $S_{a,perm} = \sum_{i=1}^{n} (S_{a,i} \times \alpha_i)$ Sa,i = i-th surface in the neighborhood area (m^2) αi= permeability coefficient of the i-th surface - Calculate the indicator's value as: $\frac{S_{a,perm}}{Sa} \times 100$ Note: • Reference permeability coefficients: - Grass = 1 - Gravel = 0.9 - Sand = 0.9 - Plastic gratings filled with land/grass = 0.8 - Concrete gratings leaning on the grass = 0.6 - Concrete gratings leaning on gravel = 0.6 - Interlocking elements leaning on sand = 0.3 - Interlocking elements leaning on gravel = 0.3 - Interlocking elements leaning on concrete pavement = 0 - Continuous pavements leaning on concrete = 0 - Asphalt = 0
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I4	**Adaptation to the climatic action: fluvial and coastal flood**	
I4.1	**Flood risk**	
	Intent:	To assess flood risk of the neighborhood
	Indicator:	Percentage of population exposed to flood risk
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of inhabitants exposed to a flood risk with medium probability in the neighborhood (A) - numerator - Calculate the total population of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	Reference Framework for Sustainable Cities - RFSC

I4.2	Protection of vulnerable zones	
	Intent:	To assess vulnerable zones to flood risk
	Indicator:	Share of land in vulnerable areas protected by flooding barriers
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the amount of land in vulnerable areas protected by flooding barriers (A) - numerator - Calculate the total extension of land in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I4.3	Protection of buildings from flooding	
	Intent:	To assess flood risk in the neighborhood
	Indicator:	Share of buildings with elevated ground floor in vulnerable sites
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of buildings with elevated ground floor exposed to flood risk in the neighborhood (A) - numerator - Calculate the total number of buildings of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I5	Adaptation to the climatic action: drought	
I5.1	Rainwater collection and storage from buildings for non-potable uses	
	Intent:	To promote rainwater collection for re-use
	Indicator:	Share of buildings in the neighborhood with a rainwater collection system
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of buildings in the neighborhood with a rainwater collection system (A) - numerator - Calculate the total number of buildings in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I5.2	Rainwater collection and storage from outdoor areas

	Intent:	To ensure the optimisation of supply, storage and distribution of rainwater
	Indicator:	Share of rainwater collected from paved (not permeable) surfaces in the neighborhood (excluding buildings' roofs and plots)
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the amount of rainwater collected from paved (not permeable) surfaces in the neighborhood (excluding buildings' roofs and plots) (A) - numerator - Calculate the maximum amount of rainwater collectable from paved (not permeable) surfaces in the neighborhood (excluding buildings' roofs and plots) (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I5.3	**Greywater collection in buildings for non-potable uses**	
	Intent:	To reduce potable water consumption
	Indicator:	Share of buildings in the neighborhood with a greywater collection system
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the number of buildings in the neighborhood with a greywater collection system (A) - numerator - Calculate the total number of buildings in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I5.4	**Local vegetation**	
	Intent:	To promote the use of local vegetation
	Indicator:	Share of landscape (green areas) plated with local vegetation
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the extent of green areas planted with local vegetation in the neighborhood (A) - numerator - Calculate the total extent of green areas in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I6	Adaptation to the climatic hazard: wildfire	
I6.1	**Wildfire risk**	
	Intent:	To assess wildfire risk of the neighborhood
	Indicator:	Percentage of population exposed to wildfire risk
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the amount of population exposed to wildfire risk in the neighborhood (A) - numerator - Calculate the total population of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I6.2	Fire protection	
	Intent:	To assess the protection level of vulnerable zones to fire risk
	Indicator:	Share of wildfire vulnerable areas protected by fire barriers
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the amount of wildfire vulnerable areas protected by fire barriers (A) - numerator - Calculate the total extension of wildfire vulnerable areas in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I6.3	Fireproof ground	
	Intent:	To assess the risk exposure to fire
	Indicator:	Share of ground cover materials (excluding buildings' plots) in vulnerable areas that are fire resistant
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the share of ground cover materials (excluding buildings' plots) in vulnerable areas that are fire resistant (A) - numerator - Calculate the total extension of ground cover materials (excluding buildings' plots) in vulnerable areas in the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

I7	Climatic hazard: wind

I7.1	**Windproof urban form**	
	Intent:	To minimise the impact of wind in urban context
	Indicator:	Strategies to minimise the impact of wind
	Unit of measure:	Score
	Assessment method:	Evaluate the strategies adopted in the neighborhood to minimise the impact of wind
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

L	**Governance**	
L1	**Urban Planning**	
L1.1	**Community involvement in urban planning activities**	
	Intent:	To raise the level of community involvement in planning through the redistribution of power
	Indicator:	Percentage of residents active in public urban planning
	Unit of measure:	Level
	Assessment method:	To characterize the indicator's value: Use of the Sherry Arnstein ladder on citizen participation. Rate the level of users' involvement on planning. SCORE -1 (LEVEL 1) Non-participation or manipulation and therapy (in the Arnstein ladder). SCORE 0 (LEVEL 2) Degrees of tokenism: Information / Consultation / Placation (in the Arnstein ladder). SCORE 3 (LEVEL 3) Degrees of citizen power: Partnership, delegated power and citizen power (in the Arnstein ladder) in one phase, like diagnosis or after delivery. SCORE 5 (LEVEL 4) Degrees of citizen power: Partnership, delegated power and citizen power (in the Arnstein ladder), at every stages.
	Standard:	Sherry Arnstein
	References:	CESBA MED Project – SNTool assessment system

L2	**Management and community involvement**	
L2.1	**Involvement of residents in community affairs**	
	Intent:	To promote involvement of citizens in community affairs
	Indicator:	Percentage of resident population above 16 years having an involvement in community affairs
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the amount of resident population above 16 years having an involvement in community affairs (A) - numerator - Calculate the total population above 16 years of the neighborhood (B) - denominator - Calculate the value of the indicator as A/B (%)

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	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

L3	**Public buildings operation**	
L3.1	**Public buildings sustainability**	
	Intent:	To evaluate the number of buildings with a certification label
	Indicator:	Percentage area of public buildings with recognized sustainability certifications for ongoing operations
	Unit of measure:	%
	Assessment method:	Calculation steps: - Calculate the floor area of public buildings with certification to a recognized standard for ongoing building operation (m^2) (A) - numerator - Calculate the total floor area of public buildings (m^2) (B) - denominator - Calculate the value of the indicator as A/B (%)
	Standard:	-
	References:	UNECE - Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

L3.2	**Operating energy costs for public buildings**	
	Intent:	To evaluate the operational energy costs amount for public buildings
	Indicator:	Aggregated annual operating energy cost per aggregated indoor useful floor area
	Unit of measure:	€/m^2/yr
	Assessment method:	Calculation steps: - Calculate the aggregated annual operating energy cost per aggregated indoor useful floor area (m^2)
	Standard:	-
	References:	CESBA MED Project – SNTool assessment system

L3.3	**Energy consumption of public buildings**	
	Intent:	To evaluate the energy efficiency of public buildings
	Indicator:	Total end use of energy in public buildings within a neighborhood divided by total indoor useful area of these buildings
	Unit of measure:	kWh/m^2
	Assessment method:	Calculation steps: - Calculate the total end use of energy in public buildings within the neighborhood (kWh) (A) - numerator - Calculate the total indoor useful area of these buildings (m^2) (B) - denominator - Calculate the value of the indicator as A/B
	Standard:	-

	References:	CESBA MED Project – SNTool assessment system

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6. Conclusions

The final result of this deliverable can be considered a **living improvement process** which, over the coming crucial months of S. MED Cities, may undergo improvements and implementation of new indicators. It is not a static document because, as mentioned in different sections of this document, most likely during the testing activity expected in the coming months, PPs might face the need to include other important criteria for their territories which are not yet present. This is exactly in line with the adaptation and contextualisation process that characterises the testing phase.

The **Sustainable MED Cities SBTool and SNTool**, developed starting from the capitalisation of the CESBA MED results, **are the results of a bottom-up approach** that has been based on the interactions of different key stakeholders and on specific technical activities. This approach has allowed to obtain assessments **Tools reliable, comprehensive, contextualised to the European guidelines and adapted also to the South and East side of MED**.

Furthermore, a fundamental next improvement concerning the SBTool and the SNTool will be represented by **the online implementation of all the indicators described herein**; indeed, they will be fully uploaded on the Collaborative Platform of Sustainable MED Cities project, in order to have practical and operational building and neighborhood tools available online.

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