URBAN GENERIC FRAMEWORK

D3.4.1 - CESBA MED SNT Generic Framework

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2.1: To raise capacity for better management of energy in public buildings at transnational level
Work package: WP3 TESTING
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Deliverable: 3.4.1 – CESBA MED SNT Generic Framework

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A. Methodology

CESBA MED Generic Framework (CESBA MED SNTool GF) is a transnational generic multicriteria assessment system for rating the sustainability performance of Mediterranean neighbourhoods. “Generic” means that the CESBA MED GF needs to be configured to carry out an assessment on a specific area. The configuration process consists in the contextualization of the CESBA MED GF to local conditions in the way to reflect the regional sustainability priorities and practices. The contextualization takes place through the selection of the active assessment criteria and the assignment of a weight and a performance scale to them.

Local sustainability priorities are set up assigning a regional weight to the assessment criteria. This aspect is in line with a key CESBA principle: it isn’t possible to set transnational weights valid for all regions because the climatic conditions, the sustainability priorities, the social-economic contexts are different.

The CESBA MED GF also allows to reflect the local practice, regulations, standards and level of advancement in the sustainability field through the possibility to define for each assessment criterion a local performance scale. Following the CESBA principles, it is not proper to assign a transnational minimum reference performance because the conditions in the Mediterranean regions are different.

Despite the different weights and benchmarks of local systems that are derived from the CESBA MED GF, the results produced by them are fully compatible because based on the same transnational methodology. The results produced have the same meaning: the score represents how much a neighbourhood is performing with regards to the minimum local acceptable performance. The transitional comparability of assessment results is guaranteed by the CESBA MED Passport and the CESBA MED KPIs.

The use of regional systems based on different methodologies would bring to the same confused situation that today still characterizes the assessment systems at building scale. Only in the European Union there are more than 60 systems in use, all producing scores not comparable. A situation that is still confusing the stakeholders of the building sector.

Through the configuration of the CESBA MED GF, the contextualization process, it is possible to produce local assessment tools for rating the sustainability of any neighbourhoods in the Mediterranean areas. Conventionally, the local systems derived from the CESBA MED GF are named “CESBA SNTool + neighbourhood name” (i.e CESBA SNTool City of Turin_Spina 4, etc.). The CESBA MED GF is not operational and can’t be used as it is. It needs always to be adapted to local conditions.

The advantage of the Generic Framework principle is that it makes possible to transnationally share the same assessment methodology and approach preserving the possibility to adapt the tool to local conditions. The generic framework is a common transnational language. This aspect is an added value because it facilitates the use of assessment tools in transnational policies and the share of best practices.

From the CESBA MED Generic Framework it is possible to derive harmonized local assessment tools through a contextualization process articulated in 3 steps:

- Selection of the active criteria
- Benchmarking
- Weighting

The first step consists in the selection of the criteria that will be used to carry out the assessment. The criteria are selected from the whole list of the Generic Framework. Each applicant, regional authority or third party can freely select the active criteria on the base of its needs and objectives. There isn't a minimum 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, 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 CESBA MED Passport.

The second step, benchmarking, 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 and the one that is considered the best at regional level. Benchmarks can't be the same at transnational level because the local conditions of each region are different (climate, building practice, standards, level of advancement in the sustainability field, etc..). The scoring scale used in the CESBA MED GF ranges from -1 to 5. Where 0 represent the minimum acceptable performance, 5 the excellence, 3 the best practice and -1 a negative performance.

The final step, weighting, consists in the assignment of a weight to each criterion, category and issue. The weight is expressed as a percentage. This process allows to align the assessment tool to local environmental, social and economic priorities. These ones are not the same in all the Mediterranean areas.

Through the CESBA MED Generic Framework all regions in the Mediterranean areas can share common assessment methodologies, criteria and indicators. It means to speak the same language. The results of all local assessments will have the same meaning. This aspect will facilitate the transnational cooperation. In the same time, the assignment of local benchmarks and weight allows to reflect the local conditions.

Basic definitions and structure of the *SBEMethod*

The assessment method adopted in the CESBA MED Generic Framework multicriteria 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 neighbourhood.

The sustainability score of the neighbourhood under assessment is computed through a mathematical procedure (called assessment procedure) which is articulated in 3 main steps:

- characterization: neighbourhood's performances are quantified through indicators in regard of each criterion;
- normalization: indicator values are adimensionalized 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 criteria;
2. a set of indicators, which allow to quantify the 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. In CESBA MED, the CESBA Local Committees act as panel of experts.

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

- **Issues:** describe general themes, recognized as relevant for assessing the sustainability of a neighborhood. For instance, the issues are 7: Built Urban Systems, Economy, Energy, Atmospheric Emissions, Non-Renewable Resources, Environment and Social Aspects.
- **Categories:** concern particular aspects of issues. For instance, the issue "Built Urban Systems" contains 2 categories: urban structure and form, transportation infrastructure.
- **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 "urban structure and form" includes 7 criteria: A1.1 Concentration of land parcels, A1.2 Urban compactness, A1.3 Building plot ratios, A1.4 Residential density, A1.5 Urban street canyons (H/W aspect ratio), A1.6 Homogeneity of the urban fabric and A1.7 Conservation of Land.

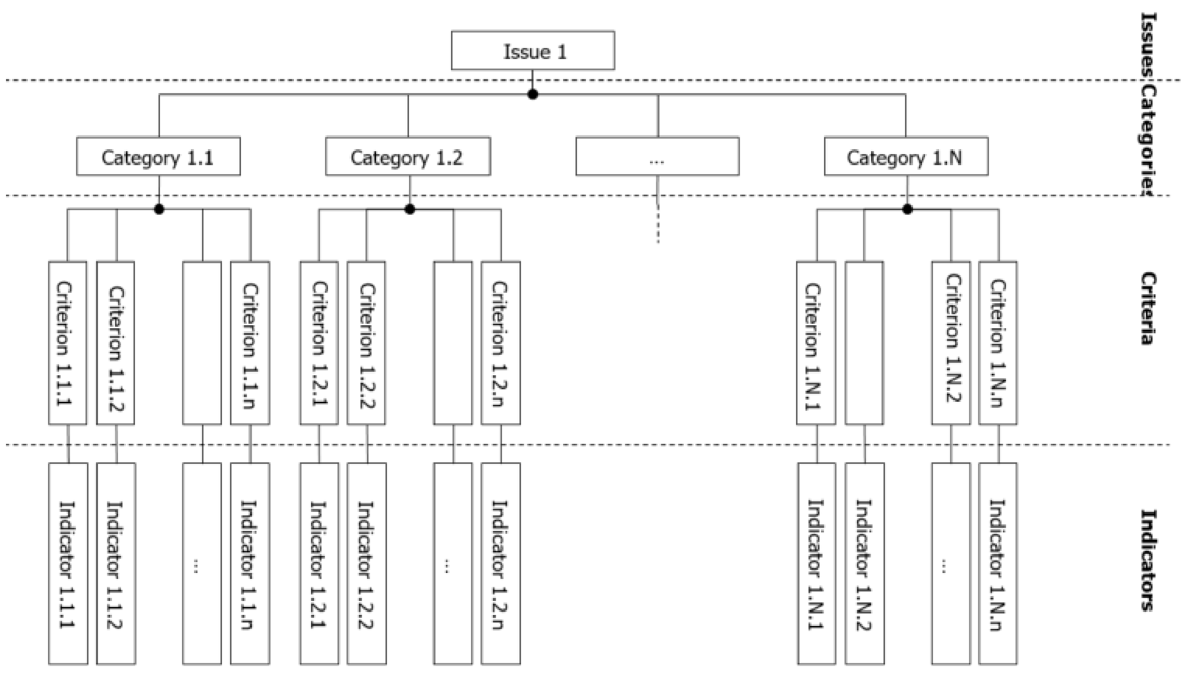
Issues, categories and criteria are linked in the following sense: each issue includes a variable number of categories (depending from issue to issue), each of them describes a particular aspect of the issue whom it belongs to. The total number of categories is 23, divided in the 7 issues: Built Urban Systems (2), Economy (3), Energy (3), Atmospheric Emissions (1), Non-Renewable Resources (3), Environment (3), Social Aspects (8). Categories include different *criteria*, each of them describing a particular aspect of the corresponding category. The total number of criteria is 180.

Each criterion is combined with a (some) physical quantity(ies). These allow to quantify neighborhood'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 neighborhood's performance with respect to the corresponding criterion.

In the *SBEMethod*, qualitative criteria are also present, for which the neighborhood's performance is provided in terms of a comparison with a certain number of reference scenarios defined within the corresponding indicator.

Note that, in principle, several indicators can be associated with the same criterion, as one can define multiple strategies to quantify the neighborhood's performance in regard to a specific criterion.

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



Schematic representation of a generic Issue's structure in the SBEMethod.

A BUILT URBAN SYSTEMS	B ECONOMY	C ENERGY	D ATMOSPHERIC EMISSIONS	E NON-RENEWABLE RESOURCES	F ENVIRONMENT	G SOCIAL ASPECTS
A1- Urban Structure and Form	B1- Economic Structure and Value	C1- Non-renewable energy	D1- Atmospheric emissions	E1- Potable water, storm-water and greywater	F1- Environmental impacts	G1- Safety and Accessibility
A2- Transportation Infrastructure	B2- Economic activity	C2- Renewable and Decarbonised energy		E2- Solid and Liquid Wastes	F2- Outdoor environmental quality	G2- Traffic and Mobility Services
	B3- Cost and Investment	C3- Energy recycling and storage		E3- Resource consumption, retention and maintenance	F3- Ecosystems and landscapes	G3- Communication services
						G4- Public and private facilities and services
						G5- Local Food
						G6- Management and community involvement
						G7- Society, Culture and Heritage
						G8- Perceptual

Structure of the CESBA MED Generic Framework: Issues and Categories.

The 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 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:

Step 1
- **Caracterization**: calculation/evaluation of the indicator's value

Step 2
- **Normalization**: assignement of a score to the indicator's value

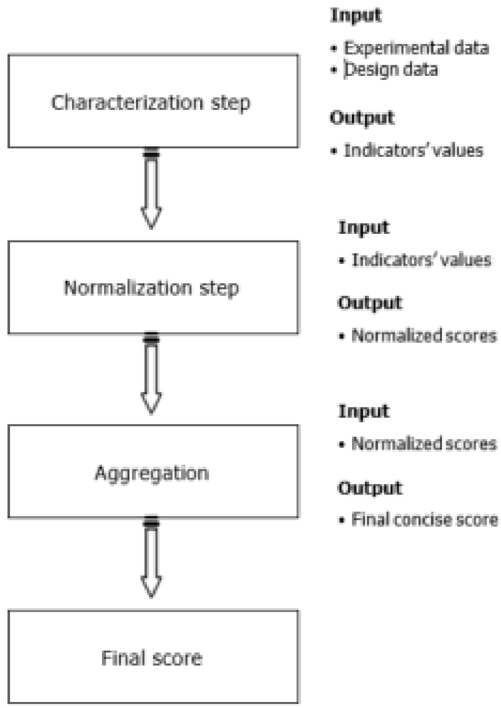
Step 3
- **Aggregation**: weighted sum of criteria's scores to calculate the score of categories, issues and the final score

Characterization step. Neighborhood'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 neighborhood'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 adimensionalized 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 CESBA MED GF is from -1 to +5. The mining 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.

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.



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:

- A_i, the i-th issue, i = 1,….., N_A, and N_A is the total number of issues included in the SBEMethod. E.g: the third issue will be denoted with the symbol A_3.
- $C_{i,j}$, the j-th category in A_i, 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 $C_{3,2}$.
- $c_{i,j,k}$, 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 $C_{i,j}$. E.g: if the second category includes 7 criteria, $N_C^{(3,2)}$= 7, and the fifth criterion in $C_{3,2}$ is denoted with $c_{3,2,5}$.
- $I_{i,j,k}$, 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 $I_{3,2,5}$

- $\hat{s}_{i,j,k}$, the numerical values of $I_{i,j,k}$. E.g: the numerical values of the indicator $I_{3,2,5}$ associated with $c_{3,2,5}$ is denoted with $\hat{s}_{3,2,5}$

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 CESBA MED GF the issues are indicated with a letter in substitution of the number, where 1=A, 2=B, 3=C, 4=D, 5=E. 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 CESBA MED SNTool F, for each indicator a specific assessment method has been defined to calculate/evaluate its value.

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

Normalization step: assignment of a score to indicators' value

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 adimensionalized 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. 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.

H.I.B. Criteria (*Higher Is Better*). All criteria such that the higher the numerical value of the corresponding indicator, the higher the performance level. Since the normalized score must fulfil the requirement "the better the performance, the higher the normalized score", *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*.

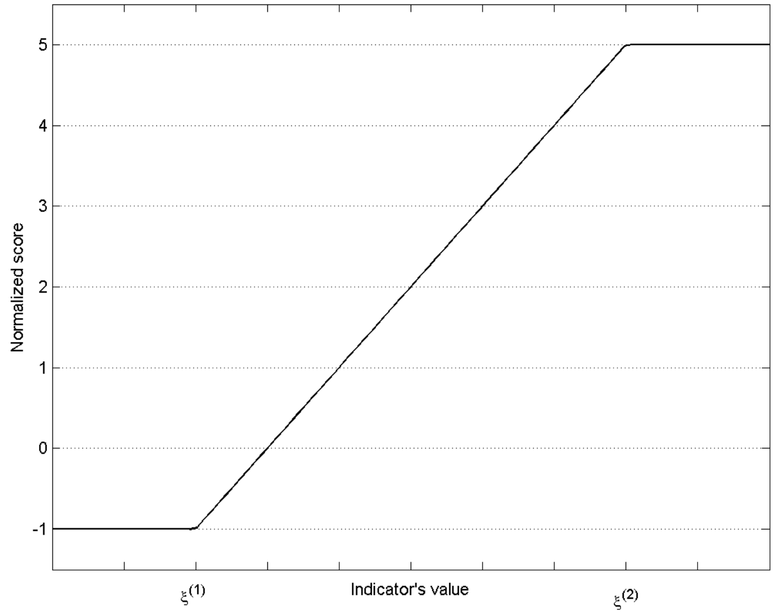
Qualitative criteria. All criteria such that the normalized score can only attain discrete values in the normalization interval, each of them corresponding to a reference scenario defined by the corresponding indicator. Roughly speaking, the normalized score is computed by comparing the neighborhood's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

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

Normalization function of this kind are such that:



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

- 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 in (1) for a general H.I.B criterion is an increasing function.

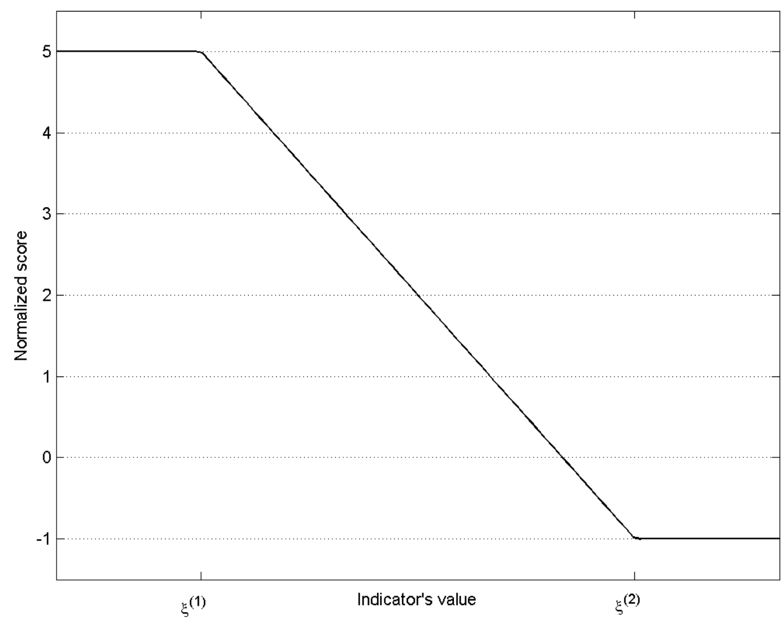
The normalization function depends on two parameters: $\xi^{(1)}_{i,j,k}$ and $\xi^{(2)}_{i,j,k}$ which vary from criterion to criterion. Such parameters are called benchmarks in the sense that they respectively represent the threshold for the worst (-1) and the best (+5) performance.
If the numerical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

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

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.

$$\phi_{i,j,k}\left(\hat{s}_{i,j,k}\right) = \begin{cases} m, & \hat{s}_{i,j,k} \leq \xi_{i,j,k}^{(1)} \\ m - (m-n)\,\dfrac{\hat{s}_{i,j,k} - \xi_{i,j,k}^{(1)}}{\xi_{i,j,k}^{(2)} - \xi_{i,j,k}^{(1)}}, & \xi_{i,j,k}^{(1)} < \hat{s}_{i,j,k} \leq \xi_{i,j,k}^{(2)} \\ n, & \hat{s}_{i,j,k} > \xi_{i,j,k}^{(2)} \end{cases} \tag{3}$$



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

Remark 2. Note that the normalization function defined in (3) is a decreasing function.

The normalization function depends on two parameters: $\xi_{i,j,k}^{(1)}$ and $\xi_{i,j,k}^{(2)}$ 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:

$$\begin{cases} \dfrac{\xi_{i,j,k}^{(1)} - x'}{x'' - x'} = \dfrac{m - y'}{y'' - y'} \\ \dfrac{\xi_{i,j,k}^{(2)} - x'}{x'' - x'} = \dfrac{n - y'}{y'' - y'} \end{cases} \tag{4}$$

Normalization functions for qualitative criteria.

Normalization functions associated with qualitative criteria are defined as follows:

$$\phi\left(\hat{s}_{i,j,k}\right) = \begin{cases} s_0, & x = \xi_{i,j,k}^{(0)} \\ s_1, & x = \xi_{i,j,k}^{(1)} \\ s_2, & x = \xi_{i,j,k}^{(2)} \\ \dots, & \\ s_n, & x = \xi_{i,j,k}^{(n)} \end{cases} \tag{5}$$

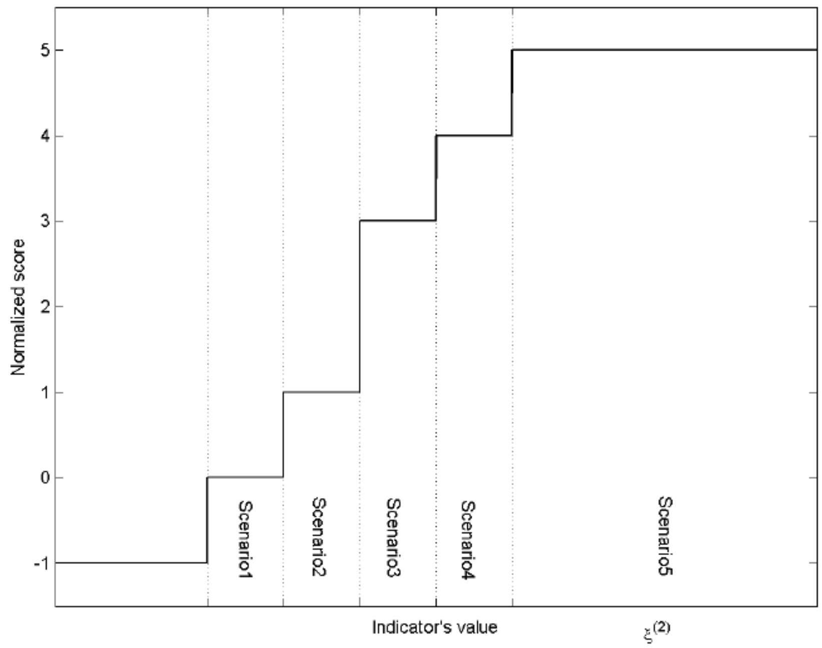
$$s_0, s_1, \dots, s_n \in [n, m]$$

The normalized score can only attain discrete values in the normalization interval, each of them associated with a reference *scenario* (see, fig. 5).

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 s_n 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.



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

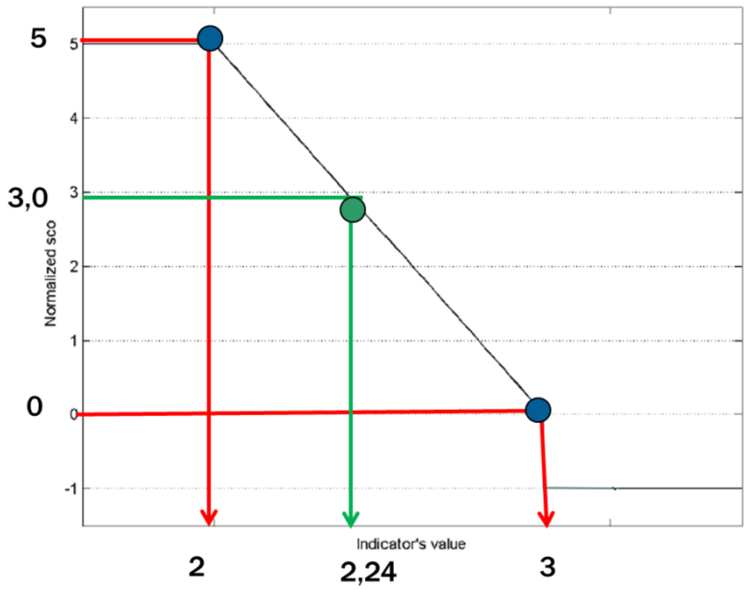
Once all scenarios are defined, normalization functions associated with qualitative criteria only depend on $n + 1$ tunable parameters, which are the normalized score associated with each scenario ($s_0, \ldots, s_n$).

<u>Example:</u>

Criterion "Total GHG Emissions from primary energy used in building operations"

Normalization of the indicator's value:

- CO2 equivalent emissions per useful internal floor area per year = 2,24 kg CO2 eq./m2/yr



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 CO2 eq./m2/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: score of categories

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:

$$S_{i,j} = \sum_{k=1}^{N_c^{(i,j)}} \omega_{i,j,k} \, s_{i,j,k} \tag{6}$$

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

- each weighting factor lies in the interval [0, 1];
- $\sum_{k=1}^{N_c^{(i,j)}} \omega_{i,j,k} = 1$

It follows that (6) can be interpreted as a weighted sum of the performance score obtained by the neighborhood in regard of each criterion, i.e. the performance score computed for a given category represents the 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 category A1 Urban Structure and Form

Code	Criterion	Score	Weight
A1.1	Concentration of land parcels	3,1	14%
A1.2	Urban compactness	2,2	14%
A1.3	Building plot ratios	1,3	12%
A1.4	Residential density	0,5	14%
A1.5	Urban street canyons (H/W aspect ratio)	1,4	12%
A1.6	Homogeneity of the urban fabric	3,0	12%
A1.7	Conservation of Land	3,0	22%

Calculation of the category's score as weighted sum:

Code	Criterion	Score x Weight	Weighted score
A1.1	Concentration of land parcels	3,1x0,14 =	0,4
A1.2	Urban compactness	2,2x0,14 =	0,3
A1.3	Building plot ratios	1,3x0,12 =	0,2
A1.4	Residential density	0,5x0,14 =	0,0
A1.5	Urban street canyons (H/W aspect ratio)	1,4x0,12 =	0,2
A1.6	Homogeneity of the urban fabric	1,4x0,12 =	0,2
A1.7	Conservation of Land	1,4x0,22 =	0,3
	TOTAL	**1,6**	

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

Category score = sum of the weighted scores = 1,6

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:

- $w_{i,j}$: the weighting factors for each category included in the issue A_i;
- S_{ij}: the performance score associated with the A_i.

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

$$S_i = \sum_{j=1}^{N_C^{(i)}} w_{i,j} \, S_{i,j} \tag{7}$$

$w_{i,j}$ 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 fulfill 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 (7) 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 the issue A Built Urban Systems

Code	**Category**	**Score**	**Weight**
A1	Urban Structure and Form	1,6	60%
A2	Transportation Infrastructure	2,2	40%

Calculation of the issue's score as weighted sum:

Code	Category	Score x Weight	Weighted score
A1	Urban Structure and Form	1,6 x 0,6 =	1,0
A2	Transportation Infrastructure	2,2 x 0,4 =	0,9
		TOTAL	**1,9**

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

Issue score = sum of the weighted scores = 1,9

Aggregation through issues: overall score of the neighborhood

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:

$$\Sigma = \sum_{i=1}^{N_{\mathcal{A}}} W_i\, \mathcal{S}_i$$

where W_i 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];

$$\sum_{i=1}^{N_{\mathcal{A}}} W_i = 1$$

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

Example: calculation of the overall score for a neighborhood:

Code	Issue	Score	Weight
A	Built Urban Systems	3,1	15%
B	Economy	0,9	10%
C	Energy	2,3	20%
D	Atmospheric emissions	1,9	20%
E	Non-Renewable Resources	2,1	15%
F	Environment	2,0	10%
G	Social Aspects	3,0	10%

Calculation of the issue's score as weighted sum:

Code	Issue	Score x Weight	Weighted score
A	Built Urban Systems	3,1 x 0,1 =	0,3
B	Economy	0,9 x 0,1 =	0,0
C	Energy	2,3 x 0,2 =	0,5
D	Atmospheric emissions	1,9 x 0,2 =	0,4
E	Non-Renewable Resources	2,1 x 0,1 =	0,2
F	Environment	2,0 x 0,1 =	0,2
G	Social Aspects	3,0 x 0,1 =	0,3
		TOTAL	**1,9**

$$\Sigma = \sum_{i=1}^{N_{\mathcal{A}}} W_i \, \mathcal{S}_i$$

Neighborhood score = sum of the weighted scores = 1,9

B. Contextualisation Process

The contextualisation process is a key aspect for the implementation of the local Sustainable Neighbourhood Tool (SNTool) and Sustainable Building Tool (SBTool). The contextualization coincides with the phase 2. Preparation of the Decision Making Process and is also described in the paragraph E. Decision Making of this document.

The contextualization process consists in three main steps:

- selection of the active parameters;
- benchmarks setting for each active parameter;
- weights setting for issues, categories and criteria.

Selection of the active parameters

In this first step project partners have to describe the structure of their SBTool/SNTool by entering in a specific format, described in the Testing Protocol – Assessment Protocol, the list of the criteria selected from the CESBA MED Generic Framework at Building and Urban scale.
Of course, KPIs are mandatory criteria in the list.

A- BUILT URBAN SYSTEMS	
AX	**Name of the Category**
AX.X	*Name of the Criterion*
Etc.	
B- ECONOMY	
BX	**Name of the Category**
BX.X	*Name of the Criterion*
Etc.	
C- ENERGY	
CX	**Name of the Category**
CX.X	*Name of the Criterion*
Etc.	
D- ATMOSPHERIC EMISSIONS	
DX	**Name of the Category**
DX.X	*Name of the Criterion*
Etc.	
E- NON - RENEWABLE RESOURCES	
EX	**Name of the Category**
EX.X	*Name of the Criterion*
Etc.	
F- ENVIRONMENT	
FX	**Name of the Category**
FX.X	*Name of the Criterion*
Etc.	
G- SOCIAL ASPECTS	
GX	**Name of the Category**
GX.X	*Name of the Criterion*
Etc.	

Project Partners must also motivate the selection of the criteria that have been included in the Tools. The reason of the inclusion could depend on regional policies, targets, specific characteristics of the territory (i.e. touristic area, agricultural area, etc.…).

Benchmarks setting for each active parameter

In this second step partners have to establish the benchmarks taking into account city's context for each active criterion. Benchmark could be defined as a reference objective parameter to look forward to guarantee the basic performance; it is absolutely contextualized and calibrated on the specifics of the city in relation to the goals to which it aims.

There are different methodologies to properly carry on the benchmarking activity:

1. Find a local reference value;
2. Find a regional reference value;
3. Find a national reference value;
4. Find a European/global value;
5. Examine values on scientific publications;
6. Examine historical values in the neighbourhood assessed.

There are different typologies of benchmark, legal limits, scientific documents, statistical data, reference value of the city, etc.

PPs must motivate the value of benchmarks assigned to the different criteria for score zero (minimum acceptable performance) and for score 5 (excellent and ideal performance). The value of indicators corresponding to score zero is usually depends on regulations, standards or a typical performance in the region. It is important to underline that 3 represents a best practice performance. Score 5 is an excellent performance.

A- URBAN STRUCTURE AND FORM				
CRITERION	INDICATOR	UNIT OF MEASURE	BENCHMARK	RATIONALE
Ax.x	*(text)*		*0: value*	*Insert your comment here*
			5: value	*Insert your comment here*
Etc.				
B- ECONOMY				
CRITERION	INDICATOR	UNIT OF MEASURE	BENCHMARK	RATIONALE
Bx.x	*(text)*		*0: value*	*Insert your comment here*
			5: value	*Insert your comment here*
Etc.				

C- ENERGY				
CRITERION	INDICATOR	UNIT OF MEASURE	BENCHMARK	RATIONALE
Cx.x	*(text)*		*0: value*	*Insert your comment here*
			5: value	*Insert your comment here*
Etc.				
D- ATMOSPHERIC EMISSIONS				
CRITERION	INDICATOR	UNIT OF MEASURE	BENCHMARK	RATIONALE
Dx.x	*(text)*		*0: value*	*Insert your comment here*
			5: value	*Insert your comment here*
Etc.				
E- NON-RENEWABLE RESOURCES				
CRITERION	INDICATOR	UNIT OF MEASURE	BENCHMARK	RATIONALE
Ex.x	*(text)*		*0: value*	*Insert your comment here*
			5: value	*Insert your comment here*
Etc.				
F- ENVIRONMENT				
CRITERION	INDICATOR	UNIT OF MEASURE	BENCHMARK	RATIONALE
Ex.x	*(text)*		*0: value*	*Insert your comment here*
			5: value	*Insert your comment here*
Etc.				
G- SOCIAL ASPECTS				
CRITERION	INDICATOR	UNIT OF MEASURE	BENCHMARK	RATIONALE
Ex.x	*(text)*		*0: value*	*Insert your comment here*
			5: value	*Insert your comment here*
Etc.				

Weights setting for issues, categories and criteria

This third step is very crucial because it consists in the definition of the priorities in the hierarchical system of the Tool through the allocation of the weights.

Chronologically PPs have to:

1. Allocate value of weight to the issues;
2. Allocate value of weight to the categories;
3. Allocate value of weight to the criteria.

In this section PPs must also motivate the value of weights assigned keeping in mind that weights should reflect the regional political priorities.

In this section is also required to assign priority factors to each criterion. The priority factors are the following:
B= Impact of the Potential Effect (1-3)
C= Extent of potential effect (1-5)
D= Duration of potential effect (1-5)

These priority factors are very useful to establish the hierarchy relevance of the criteria, defined on the basis of regional policy and specific needs; these factors help also to prioritize indicators in the whole system.

Impact of the potential effect
It can get from 1 to 3 points; it takes into account 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
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
It can get from 1 to 5 points; it measures the durability of the effect evaluated by the criterion. Land consumption criterion confirms that a 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.

EXTENT of potential effect	
Block	1
Neighborhood	2
Cluster	3
Urban/Region	4
Global	5
DURATION 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
IMPACT of the Potential Effect	
Minimum	1
Moderate	2
High	3

A- BUILT URBAN SYSTEMS						
Ax-………						
CRITERION	**Weight (%)**	**B**	**C**	**D**	**L.F.**	**L.F. REASON/MOTIVATION**
Ax.x		*X*	*X*	*X*		*Insert your comment here*
Etc.						
TOTAL	100					

B- ECONOMY						
Bx-………						
CRITERION	**Weight (%)**	**B**	**C**	**D**	**L.F.**	**L.F. REASON/MOTIVATION**
Bx.x		*X*	*X*	*X*		*Insert your comment here*
Etc.						
TOTAL	100					

C- ENERGY						
Cx-………						
CRITERION	**Weight (%)**	**B**	**C**	**D**	**L.F.**	**L.F. REASON/MOTIVATION**
Cx.x		*X*	*X*	*X*		*Insert your comment here*
Etc.						
TOTAL	100					

D- ATHMOSPHERIC EMISSIONS						
Dx-………						
CRITERION	**Weight (%)**	**B**	**C**	**D**	**L.F.**	**L.F. REASON/MOTIVATION**
Dx.x		*X*	*X*	*X*		*Insert your comment here*
Etc.						
TOTAL	100					

E- NON-RENEWABLE RESOURCES						
Ex-………						
CRITERION	**Weight (%)**	**B**	**C**	**D**	**L.F.**	**L.F. REASON/MOTIVATION**
Ex.x		*X*	*X*	*X*		*Insert your comment here*
Etc.						
TOTAL	100					

F- ENVIRONMENT						
Fx-………						
CRITERION	**Weight (%)**	**B**	**C**	**D**	**L.F.**	**L.F. REASON/MOTIVATION**
Fx.x		*X*	*X*	*X*		*Insert your comment here*
Etc.						
TOTAL	100					

G- SOCIAL ASPECTS						
Gx-………						
CRITERION	**Weight (%)**	**B**	**C**	**D**	**L.F.**	**L.F. REASON/MOTIVATION**
Gx.x		*X*	*X*	*X*		*Insert your comment here*
Etc.						
TOTAL	100					

C. Criteria List: Urban Scale

A BUILT URBAN SYSTEMS
- A1- Urban Structure and Form
- A2- Transportation Infrastructure

B ECONOMY
- B1- Economic Structure and Value
- B2- Economic activity
- B3- Cost and Investment

C ENERGY
- C1- Non-renewable energy
- C2- Renewable and Decarbonised energy
- C3- Energy recycling and storage

D ATMOSPHERIC EMISSIONS
- D1- Atmospheric emissions

E NON-RENEWABLE RESOURCES
- E1- Potable water, stormwater and greywater
- E2- Solid and Liquid Wastes
- E3- Resource consumption, retention and maintenance

F ENVIRONMENT
- F1- Environmental impacts
- F2- Outdoor environmental quality
- F3- Ecosystems and landscapes

G SOCIAL ASPECTS
- G1- Safety and Accessibility
- G2- Traffic and Mobility Services
- G3- Communication services
- G4- Public and private facilities and services
- G5- Local Food
- G6- Management and community involvement
- G7- Society, Culture and Heritage
- G8- Perceptual

A	**Built Urban Systems**	
A1	**Urban Structure and Form**	
	A1.1	Concentration of land parcels
	A1.2	Urban compactness
	A1.3	Building plot ratios
	A1.4	Residential density
	A1.5	Urban street canyons (H/W aspect ratio)
	A1.6	Homogeneity of the urban fabric
	A1.7	Conservation of Land
A2	**Transportation Infrastructure**	
	A2.1	Walking distance to public transport for area residents
	A2.2	Walking distance to public transport for area workers and students
	A2.3	Extent and connectivity of pedestrian streets and walkways
	A2.4	Extent and connectivity of bicycle paths separated from vehicular traffic
	A2.5	Cyclomatic complexity of the street network
	A2.6	Connectivity of the street network
	A2.7	Street network connection and accessibility
	A2.8	Scale of the street network
	A2.9	On-street and indoor parking spaces relative to local population
	A2.10	Intermodality facilities

B	**Economy**	
B1	**Economic Structure and Value**	
	B1.1	Affordability of housing property
	B1.2	Affordability of housing rental
	B1.3	Long-term risk for capital investments
	B1.4	Impact of land values on adjacent areas
	B1.5	Impact of construction and operations on the local economy
	B1.6	Percent of residential units in the local area that are vacant
B2	**Economic activity**	
	B2.1	Income equity for resident households
	B2.2	Average annual per-capita income of residents
	B2.3	Employment rate
	B2.4	Economic viability of commercial occupancies
	B2.5	Economic contribution from tourism activity
B3	**Cost and Investment**	
	B3.1	Provision of social housing units
	B3.2	Public contribution in residential retrofitting investments
	B3.3	Operating energy costs for public buildings
	B3.4	Levels of total public and private investment

C	**Energy**	
C1	**Non-renewable energy**	
	C1.1	Total final thermal energy consumption for building operations
	C1.2	Total final thermal energy consumption for residential building operations
	C1.3	Total final thermal energy consumption for non residential building operations
	C1.4	Total final electrical energy consumption for building operations
	C1.5	Total final electrical energy consumption for residential building operations
	C1.6	Total final electrical energy consumption for non residential building operations
	C1.7	Total primary energy demand for building operations
	C1.8	Total primary energy demand for residential building operations
	C1.9	Total primary energy demand for non residential building operations
	C1.10	Primary energy for heating for residential buildings
	C1.11	Primary energy for heating for non residential buildings
	C1.12	Primary energy for cooling for residential buildings
	C1.13	Primary energy for cooling for non residential buildings
	C1.14	Primary energy for DHW for residential buildings
	C1.15	Primary energy for DHW for non residential buildings
	C1.16	Primary energy for indoor lighting for residential buildings
	C1.17	Primary energy for indoor lighting for non residential buildings
	C1.18	Electrical peak demand for non-residential building operations
	C1.19	Scheduling of non-residential building operations to reduce peak loads on generating facilities
	C1.20	Energy consumption of public lighting
	C1.21	Energy consumption of local public transport
	C1.22	Consumption of non-renewable energy for demolition or dismantling
C2	**Renewable and Decarbonised energy**	
	C2.1	Share of renewable energy on-site, relative to total final thermal energy consumption for building operations
	C2.2	Share of renewable energy on-site, relative to total final energy consumption for residential building operations
	C2.3	Share of renewable energy on- site, relative to total final energy consumption for non-residential building operations

	C2.4	Share of renewable energy on-site, relative to total primary energy consumption for building operations
	C2.5	Share of renewable energy on-site, relative to total primary energy consumption for residential building operations
	C2.6	Share of renewable energy on-site, relative to total primary energy consumption for non residential building operations
	C2.7	Share of renewable energy on-site, relative to final electric energy consumption
	C2.8	Aggregated electrical energy generation from renewable sources located on public properties
	C2.9	Aggregated electrical energy generation from renewable sources located on private properties
	C2.10	Electrical energy generated from renewable sources that is exported from the local area
	C2.11	Aggregated use of renewable electrical energy
	C2.12	Aggregated thermal energy generation from renewable sources located on public properties
	C2.13	Aggregated thermal energy generation from renewable sources located on private properties
	C2.14	Thermal energy generated from renewable sources that is exported from the local area
C3	**Energy recycling and storage**	
	C3.1	Waste heat re-utilization from building operations
	C3.2	Mid- and long-term storage of geothermal energy
	C3.3	Mid-term storage of electrical energy

D	**Atmospheric emissions**	
D1	**Atmospheric emissions**	
	D1.1	GHG emissions from energy embodied in construction materials used for construction, maintenance or replacement(s)
	D1.2	Total GHG Emissions from primary energy used in building operations
	D1.3	Aggregate emissions of ozone-depleting substances during building operations
	D1.4	Aggregate emissions of acidifying emissions during building operations
	D1.5	Aggregate annual GHG emissions from the use of private vehicles
	D1.6	Aggregate annual GHG emissions from the use of public transport
	D1.7	Total GHG Emissions from buildings, private and public mobility

E	**Non-Renewable Resources**	
E1	**Potable water, stormwater and greywater**	
	E1.1	Availability of a public municipal water supply
	E1.2	Provision of split grey / potable water services
	E1.3	Re-use of rainwater in residential buildings
	E1.4	Re-use of rainwater in non-residential building
	E1.5	Re-use of stormwater
	E1.6	Consumption of potable water for residential population
	E1.7	Consumption of potable water for non-residential building systems
	E1.8	Consumption of potable water for irrigation purposes
	E1.9	Intensity of water purification treatment
E2	**Solid and Liquid Wastes**	
	E2.1	Access to solid waste and recycling collection points
	E2.2	Separate collection and disposal of solid waste and recycling
	E2.3	Solid waste from construction and demolition projects retained in the area for re-use or recycling
	E2.4	Solid waste from residents' activities and facility operations sent out of the area for re-use, recycling or disposal
	E2.5	Composting and re-use of organic sludge
	E2.6	Public wastewater that is disposed or treated
	E2.7	Liquid effluents from building operations that are sent out of the area
	E2.8	Potential for building operations to contaminate nearby bodies of water
	E2.9	Cumulative annual thermal changes to lake water or sub-surface aquifers
E3	**Resource consumption, retention and maintenance**	
	E3.1	Consumption of non-renewable material resources for construction or renovation of buildings
	E3.2	Efficient use of materials for construction of infrastructures
	E3.3	Percent of reused or recycled materials used for construction or renovation
	E3.4	Adaptive re-use of existing buildings and structures
	E3.5	Preservation and maintenance of existing buildings and structures
	E3.6	Maintenance of the heritage value of existing buildings

F	**Environment**	
F1	**Environmental impacts**	
	F1.1	Impact of construction activities on natural features
	F1.2	Impact of construction activities or landscaping on soil stability or erosion
	F1.3	Recharge of groundwater through permeable paving or landscaping
	F1.4	Changes in biodiversity
	F1.5	Heat Island Effect in the local area
	F1.6	Impact on access to daylight or solar energy potential of contiguous buildings.
	F1.7	Impact of local building user population on peak load capacity of public transport system
	F1.8	Impact of private vehicles used by the local population on peak load capacity of the local road system
	F1.9	Degree of atmospheric light pollution caused by exterior lighting systems of buildings
	F1.10	Degree of atmospheric light pollution caused by exterior public lighting systems
	F1.11	Albedo of building and paving surfaces
F2	**Outdoor environmental quality**	
	F2.1	Ambient air quality with respect to particulates <2.5 mu (PM2.5) over a one-year period
	F2.2	Ambient air quality with respect to particulates <2.5 mu (PM2.5) over a one-week period
	F2.3	Ambient air quality with respect to particulates <10 mu (PM10) over a one-year period
	F2.4	Ambient air quality with respect to particulates <10 mu (PM10) over a one-week period
	F2.5	Ambient air quality - carbon monoxide
	F2.6	Ambient air quality - ozone
	F2.7	Olfactory quality in the area
	F2.8	Adverse wind conditions at grade around low-rise buildings
	F2.9	Adverse wind conditions at grade around tall buildings
	F2.10	Ambient daytime noise conditions
	F2.11	Ambient night-time noise conditions
	F2.12	Summer thermal comfort conditions
	F2.13	Winter thermal comfort conditions
F3	**Ecosystems and landscapes**	
	F3.1	Green zones & recreation areas availability
	F3.2	Green zones & recreation areas accessibility
	F3.3	Green zones & recreation areas density
	F3.4	Contamination status of undeveloped land
	F3.5	Surface water management

	F3.6	Tree coverage for shade and management of local ambient temperatures
	F3.7	Green roofs
	F3.8	Vegetated walls and other building surfaces
	F3.9	Presence or potential for wildlife corridors
	F3.10	Ecological diversity in the area
	F3.11	Ecological sensitivity classification of the area
	F3.12	Walking or bicycling nature trails
	F3.13	Condition of surface freshwater systems
	F3.14	Condition of groundwater and subsurface aquifers
	F3.15	Viability of adjacent wetlands and urban marine environments
G	**Social Aspects**	
G1	**Safety and Accessibility**	
	G1.1	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
	G1.3	Barrier-free accessibility in local outdoor public areas
	G1.4	Ease of access to and use of public transport for physically disabled persons
	G1.5	Objective / subjective safety measures
G2	**Traffic and Mobility Services**	
	G2.1	Performance of the public transport system
	G2.2	Availability of car sharing services
	G2.3	Measures to limit traffic of cars and trucks passing through the local area
	G2.4	Quality of pedestrian and bicycle network
	G2.5	Availability of sheltered bicycle parking facilities
G3	**Communication services**	
	D3.1	Availability of a broadband communication network
	D3.2	Access to a broadband communication network
G4	**Public and private facilities and services**	
	G4.1	Availability and proximity of key food and retail services
	G4.2	Availability and proximity of key services
	G4.3	Availability and proximity of a primary school
	G4.4	Availability and proximity of a secondary school
	G4.5	Availability and proximity of childrens' play facilities
	G4.6	Availability and proximity of leisure facilities
	G4.7	Access to indoor gymnastic facilities for winter use.
G5	**Local Food**	
	G5.1	Local production of food
	G5.2	Residents' access to and use of urban agricultural plots
G6	**Management and community involvement**	

	G6.1	Involvement of residents in community affairs
	G6.2	Community management of urban facilities and urban spaces
	G6.3	Community involvement in urban planning activities
	G6.4	Individual access to community facilities and key services during off-hours
G7	**Society, Culture and Heritage**	
	G7.1	Compatibility of urban design with local cultural values
	D7.2	Compatibility of public open space with local cultural values
	D7.3	Compatibility of new building designs with existing streetscapes
	D7.4	Use of traditional local materials and techniques
	D7.5	Maintenance of UNESCO or other protected landscapes
G8	**Perceptual**	
	G8.1	Impact of tall structure(s) on existing view corridors.
	G8.2	Panoramic and scenic routes or view points
	G8.3	Perceived safety of public areas for pedestrians
	G8.4	Impact of commercial signage on the visual environment
	G8.5	Impact of overhead electric distribution system on the visual environment
	G8.6	Perceptual quality of area development
	G8.7	Aesthetic quality of new facility exteriors

A Built Urban Systems

A1 Urban Structure and Form

A.1.1 Concentration of land parcels

Intent:	To assess the concentration of land parcels in the local area
Indicator:	Number of lots in the local area related to the total surface area
Unit of measure:	%
Relevant information:	Concentration of land parcels is a good indication of the efficiency of land use
Assessment method:	1. Identify the cadastral lots in the area using a cadastral map. 2. Calculate the total number of cadastral lots in the area. 3. Calculate the ratio between the number of cadastral lots and the surface area (A).
Urban Scale:	Neighbourhood - Cluster

A.1.2 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 / m²
Relevant information:	Land for development that is used efficiently has little surface area that is not used for a well-defined functional purpose, such as that needed for buildings, parks, streets, parking and pedestrian areas. The most meaningful measure for the efficient development of buildings is their aggregate gross volume related to the net developable area of the locality. Such a measure does not imply that very tall buildings with little open space is desirable, but only that is is one useful metric
Assessment method:	1. Calculate the aggregate gross volume of all buildings in the local area, in m3. 2. 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. 3. Determine the ratio of the aggregate volume of buildings to the net local developable area, expressed as m3/ha
Urban Scale:	Neighbourhood - Cluster

A.1.3 Building plot ratios

Intent:	To evaluate the efficiency of utilization of building lots in the urbanized area
Indicator:	The ratio of total gross floor area above grade of all buildings, relative to the total developed land area within the local area
Unit of measure:	%
Relevant information:	Useful measure of the efficiency of development of individual building lots is to calculate their average gross area related to the average area of building lots
Assessment method:	1. Calculate the average gross area above grade of all buildings in the local area, in m2. 2. Calculate the average lot area by dividing the aggregate lot area by the number of lots used for buildings. 3. Determine the ratio of average gross area of buildings to the average lot area, expressed as m2/m2
Urban Scale:	Neighbourhood - Cluster

A.1.4 Residential density

Intent:	To assess the density of buildings in the local area.
Indicator:	The ratio of total residential population relative to the total land area for all developed residential blocks within the local area
Unit of measure:	Persons / hectare
Relevant information:	Building density, measured as the gross area of a group of buildings above grade, relative to the relevant land area, is a key measure of the efficiency of land use. The most common application of this metric is to assess the density of residential buildings or areas. For single buildings, a more common metric is the Plot Ratio, the total gross area of building divided by the plot area. Measurements of residential density can refer to the number of housing or dwelling units, habitable rooms, or persons per unit area. Some regulatory authorities or researchers include ancillary uses in calculating the land area, such as parking, play areas or garden spaces, so there is much scope for argument. One of the many advantages of a relatively high density (more than 150-200 persons per hectare) is that it facilitates public transport and local shops. However, acceptable densities are related to cultural values.
Assessment method:	1. Determine the scope of analysis (part or all of the Local Area). 2. Identify ground surface area of properties being used for residential purposes. 3. Identify the total residential population for the relevant residential buildings. 4. Calculate the residential density.
Urban Scale:	Neighbourhood - Cluster

A.1.5 Urban street canyons (H/W aspect ratio)

Intent:	To minimize the negative psychological effects that result from urban streets with a very small ratio of street width to height
Indicator:	The ratio of typical building heights compared to the distance between building facades on the other side of the street
Unit of measure:	%
Relevant information:	Certain urban environments can feel oppressive to pedestrians if the height of buildings facing the street is high compared to the width between building faces on opposite sides of the street. Relevant context factors include street orientations and latitude of location
Assessment method:	Calculate the ratio of typical building heights compared to the distance between building facades on the other side of the street
Urban Scale:	Neighbourhood - Cluster

A.1.6 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:	%
Relevant information:	The effective use of valuable urban land requires a minimum of holes in the urban fabric, and this indicator is intended to provide a measure of the homogeneity
Assessment method:	1. Quantify the total length of the perimeter of the area analyzed (A). 2. Evaluate, by quantifying, the linear meters of urban fabric adjacent to urbanized areas (B). 3. 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
Urban Scale:	Neighbourhood - Cluster

A.1.7 Conservation of Land

Intent:	To determine the proportion of land, considered to be of value for ecological or agricultural purposes, that remains undeveloped
Indicator:	Area of undeveloped land with ecological or agricultural value / area of the neighborhood
Unit of measure:	%
Relevant information:	Most urban areas exist in a state of continuing development and re-development, with the building stock and infrastructure undergoing concurrent construction, operation, renovation and demolition activities. In many cases development or re-development is inefficient in terms of the use of land that would otherwise be valuable for ecological or agricultural purpose. In this context, the amount of such land that remains undeveloped is useful information in developing strategies to ensure efficient urban development, while ensuring the integrity of ecological and agricultural services
Assessment method:	To characterize the indicator's value: 1. Determine the area of the neighborhood. 2. Determine the undeveloped area of land that is considered by authorities to be of ecological and agricultural value. 3. Calculate the ratio between the undeveloped area and the area 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. 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.
Urban Scale:	Neighbourhood - Cluster

A2 Transportation Infrastructure

A.2.1 Walking distance to public transport for area residents

Intent:	To identify typical walking distances for local area residents to public transport stops
Indicator:	Percent of residential buildings located within 500m. of a public transport stop
Unit of measure:	%
Relevant information:	Public transport systems are an essential component of a strategy to minimize the use of private vehicles to go to shops, public facilities, or other key facilities within the local area. Bicycles are a good alternative, but some residents, especially the elderly, may prefer to walk to a nearby public transport stop, and therefore close proximity to a stop is important to maximize the use of a public transport system
Assessment method:	1. Identify the location of public transport stops within the local area. 2. Identify major residential buildings and centers of other housing. 3. Calculate the walking distance for a sample of typical routes.
Urban Scale:	Neighbourhood - Cluster

A.2.2 Walking distance to public transport for area workers and students

Intent:	To promote road connectivity, as a key element of spatial accessibility
Indicator:	Percent of workers and students who can reach a public transport stop within a 500m. distance
Unit of measure:	%
Relevant information:	Public transport systems are an essential component of a strategy to minimize the use of private vehicles to go to shops, public facilities, or other key facilities within the local area. Bicycles are a good alternative, but some students or workers, may have limited time available to access public transport, and therefore close proximity to a stop is important to maximize the use of a public transport system
Assessment method:	1. Identify the location of public transport stops within the local area. 2. Identify major education, industrial or office buildings. 3. Calculate the walking distance for a sample of typical routes.
Urban Scale:	Neighbourhood - Cluster

A.2.3 Extent and connectivity of pedestrian streets and walkways

Intent:	To promote road connectivity, as a key element of spatial accessibility
Indicator:	Aggregate area of pedestrian streets and walkways in the local area relative to the total land area
Unit of measure:	%
Relevant information:	The criterion calculates the extent of walkways and streets that are designated for pedestrian use. The purpose is to encourage local residents and workers to walk to local facilities as an alternative to using public transport or private cars. This would lead to health benefits for local pedestrians, a decrease in congestion levels of roads, as well as a reduction in pollution, and improvement in air quality. The criterion takes into account only the total area of walkways that are exclusively reserved to pedestrians or shared with bicycles (pedestrian and cycle path), marked by special signs which indicate it, as well as strips that surround along its way. The area calculated does not include street sidewalks
Assessment method:	For the calculation of the performance indicator proceed as follows: 1. Identify exclusive pedestrian walkways and those shared with bicycles in the area analyzed. 2. Calculate the area of walkways (00 of m2). 3. Relate to the value surface area of the local area being assessed (in 00 m2, converted from ha. area shown in ContextData sheet of File B), as a percent. The value obtained by this calculation should be related to the average reference value of the city or with the surrounding urban areas, in order to assess whether the performance of the area are higher or lower than the average of the urban territory in which it is inserted.
Urban Scale:	Neighbourhood - Cluster

A.2.4 Extent and connectivity of bicycle paths separated from vehicular traffic

Intent:	To assess the extent and connectivity of bicycle paths separated from vehicular traffic in the local area
Indicator:	Aggregate length of bicycle paths separated from vehicular traffic in the local area per 1000 residents
Unit of measure:	km./1000 residents
Relevant information:	The criterion calculates the length of safe cycling routes in the area and relates it to the number of inhabitants of the area. The purpose is to encourage the use of bicycles as an alternative to the private car. This would lead to a decrease in congestion levels of roads, as well as a reduction in pollution, with a significant improvement in air quality. The criterion takes into account only the linear meters of safe cycle path, that is a protected path, exclusively reserved to bicycles or shared with pedestrians (pedestrian and cycle path), marked by special signs which indicate it, as well as strips that surround along its way. This criterion evaluates, without distinctions, cycle paths on reserved lane and the shared with pedestrians one. In additional are also counted cycle paths in the green areas.
Assessment method:	For the calculation of the performance indicator proceed as follows: 1. Identify safe cycle tracks in the area analyzed. 2. Calculate the linear meters of safe cycle tracks (m). 3. Relate the value obtained to the population residing in the area. The criterion evaluates meters of cycle path per capita. The value obtained in the area in question must therefore be put in comparison with the average reference value of the city or with the surrounding urban areas, in order to assess whether the performance of the area are higher or lower than the average of the urban territory in which it is inserted.
Urban Scale:	Neighbourhood - Cluster

A.2.5 Cyclomatic complexity of the street network

Intent:	To assess road connectivity, as a key element of spatial accessibility
Indicator:	Cyclomatic number
Unit of measure:	-
Relevant information:	-
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 area of 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
Urban Scale:	Neighbourhood - Cluster

A.2.6 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/km2
Relevant information:	From Street Networks 101, Congress for the New Urbanism; More compact and connected street networks tend to have significantly higher levels of people walking and biking and fewer vehicle miles traveled as compared to sparser, tree-like designs. However, there appear to be limitations in the application of the concept. From The metrics of street network connectivity: their inconsistencies, Paul L. Knight, May 2014; The concept of street connectivity has been gaining increasing appeal among researchers, planners, and planning authorities. In response, many connectivity metrics have been developed in an effort to understand better street network connectivity. This paper will study the effectiveness and consistency of three mainstream metrics – the Connectivity Index, Intersection Density, and Street Density – with respect to differences in study area and geometry. While these metrics are intended to be applied incrementally, this paper reveals that the metrics often fail to do this successfully.
Assessment method:	The density of street intersections is defined as the total number of intersections per km2 in the local area.
Urban Scale:	Neighbourhood - Cluster

A.2.7 Street network connection and accessibility

Intent:	To measure the actual connection and accessibility of the neighbourhood to the rest of the city
Indicator:	Cul-de-sac roads and path ratio
Unit of measure:	%
Relevant information:	-
Assessment method:	The proportion of cul-de-sac is measured by a percentage. It is the ratio between cul-de-sac streets and the total number of streets.

A.2.8 Scale of the street network

Intent:	To ensure the possibility to move using bicycle or walking for every day movements
Indicator:	Average distance between the intersections of the area
Unit of measure:	m
Relevant information :	Calculated data
Assessment method:	For the calculation of the performance indicator proceeds as follows: 1. Locate in the area the segments (sides L) between successive intersections, quantifying them. 2. Calculate the length of each of sides previously identified. 3. Add together the relative lengths of the sides to obtain a total value. 4. Divide the value obtained for the number of sides in the urban fabric analyzed obtaining an average value of reference relative to the average distance between successive nodes.
Urban Scale:	Neighbourhood - Cluster

A.2.9 On-street and indoor parking spaces relative to local population

Intent:	To determine the amount of on-street and indoor parking relative to the total residential and working population in the local area
Indicator:	On-street and indoor parking spaces relative to local population
Unit of measure:	%
Relevant information:	The amount of total parking available relative to the total population in any area is a major factor in determining the willingness of residents and workers to use public transport or to walk to local destinations. A generous supply of parking spaces will also increase the number of vehicles owned and/or operated within the local area, leading to traffic congestion, increased air pollution, and a more difficult environment for pedestrians. A knowledge of the total parking spaces available is therefore a first step in managing these problems
Assessment method:	1. Determine the number of on-street parking spaces. 2. Determine the number of indoor parking spaces. 3. Determine the ratio of total parking spaces to the total residential and working population in the local area
Urban Scale:	Neighbourhood - Cluster

A.2.10 Intermodality facilities

Intent:	To evaluate the proximity to the intermodal platforms
Indicator:	Proximity to intermodal platforms
Unit of measure:	
Relevant information:	
Assessment method:	
Urban Scale:	Neighbourhood - Cluster

B Economy

B1 Economic Structure and Value

B.1.1 Affordability of housing property

Intent:	To assess the affordability of housing property in the local area
Indicator:	Housing properties in the local area that are financially accessible to the lowest quintile of area population
Unit of measure:	%
Relevant information:	The affordability of housing for middle- and low-income segments of the population is a matter of concern for governments and the general population alike. There are many cases of residential properties (houses or apartments) escalating in price because of outside investment, to a point where local middle-income households cannot afford to get into the housing market.
Assessment method:	The percent of typical annual household income in the area relative to the market value of a local housing unit with two bedrooms that is considered to be modest in area and quality.
Urban Scale:	Neighbourhood - Cluster

B.1.2 Affordability of housing rental

Intent:	To assess the affordability of housing rental property for low-income residents in the local area
Indicator:	Percentage of the average salary of the lowest quintile of the population used for rental payments
Unit of measure:	%
Relevant information:	The affordability of housing for the low-income segment of the population is a matter of concern for governments and the general population alike. If residential rents escalate because of a population influx or outside investment, to a point where local middle-income households cannot afford to find housing at an affordable rent, there may be social unrest.
Assessment method:	The percent of typical annual household income of the lowest income quintile in the area relative to the market rents local housing unit with two bedrooms that is considered to be modest in area and quality.
Urban Scale:	Neighbourhood - Cluster

B.1.3 Long-term risk for capital investments

Intent:	To assess the level of long-term risks for capital investments in the local area
Indicator:	Aggregate average return on investment (ROI) on capital investments made in the local area over a 5-year period.
Unit of measure:	%
Relevant information:	A certain level of external and internal capital investment in the local area is needed to ensure that the property market remains healthy and that business enterprises can function. There is always a risk for and the acceptability of risk can be indicated by historical return on investments.
Assessment method:	Calculate the aggregate return on investment (ROI) on capital investments made in the local area over a 5-year period
Urban Scale:	Neighbourhood - Cluster

B.1.4 Impact of land values on adjacent areas

Intent:	To assess the impact of changes in land values in the local area on land values in adjacent areas
Indicator:	Average annual change in land values of properties immediately adjacent to the urban area, over a 5-year period
Unit of measure:	%
Relevant information:	A certain level of external and internal capital investment in the local area is needed to ensure that the property market remains healthy and that business enterprises can function. There is always a risk for and the acceptability of risk can be indicated by historical return on investments
Assessment method:	Review of a sample of capital investments in areas adjacent to the local area over a five-year period to ascertain the average return on investment
Urban Scale:	Neighbourhood - Cluster

B.1.5 Impact of construction and operations on the local economy

Intent:	To determine the economic impact of the construction of buildings in the local area
Indicator:	Estimated average annual economic impact in the local area, over a 5-year period
Unit of measure:	%
Relevant information:	Construction activity generates employment and the purchase of materials, equipment and fuel or power also has economic impact. Some of the economic benefit accrues to the local area, but it is probable that the urban region, or even other regions, also benefit
Assessment method:	1. Estimate the total value of construction over a five-year period. 2. For a sample of projects, develop estimates of the average aggregate annual local v. regional economic impact.
Urban Scale:	Neighbourhood - Cluster

B.1.6 Percent of residential units in the neighbourhood that are vacant

Intent:	To evaluate the efficiency in the use of residential units in the area
Indicator:	Percentage of vacant residential units
Unit of measure:	%
Relevant information:	A certain level of residential vacancies indicates a healthy market, but an excessively high level may indicate some dysfunction in the market or in the type of units available
Assessment method:	Calculate the percentage of residential units in the local area that are vacant
Urban Scale:	Neighbourhood - Cluster

B2 Economic activity

B.2.1 Income equity for resident households

Intent:	To assess the level of income inequality of resident of the local area.
Indicator:	The GINI index for residents within the local area, relative to the GINI index for the urban area as a whole
Unit of measure:	0 -1
Relevant information:	From Wikipedia: The Gini coefficient is a measure of statistical dispersion ... and is the most commonly used measure of inequality. The Gini coefficient measures the inequality among values of a frequency distribution .... A Gini coefficient of zero expresses perfect equality, where all values are the same. A Gini coefficient of 1 (or 100%) expresses maximal inequality among values...For OECD countries, ... the income Gini coefficient ranged between 0.24 and 0.49, with Slovenia being the lowest and Chile the highest
Assessment method:	1. Obtain data on household income in the Local Area and the larger urban region. 2. Ensuring that the data formats are compatible, and that the number of households in the local area is large enough to be statistically meaningful, calculate the GINI index.
Urban Scale:	Neighbourhood - Cluster

B.2.2 Average annual per-capita income of residents

Intent:	To evaluate the economic well-being
Indicator:	Average per-capita income of residents in the local area relative to that of the urban region as a whole
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the average per-capita income of residents in the local area relative to that of the urban region as a whole
Urban Scale:	Neighbourhood - Cluster

B.2.3 Employment rate

Intent:	To assess the labour market status, the economy development and citizens' quality of life
Indicator:	Percent of working age adults employed or actively looking for work
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the number of people in the labor force compared to the number of working age people and express result as a percentage
Urban Scale:	Neighbourhood - Cluster

B.2.4 Economic viability of commercial occupancies

Intent:	To assess the economic potential of the area
Indicator:	Rate of business failures of commercial occupancies in the local relative to the total urban area, over a 5-year period
Unit of measure:	%
Relevant information:	-
Assessment method:	1. Identify the number of businesses that have failed in the urban area over the period. 2. Identify the number of businesses that have failed in the local area over the period. 3. Calculate the ratio of 2/1
Urban Scale:	Neighbourhood - Cluster

B.2.5 Economic contribution from tourism activity

Intent:	To assess the evolution of the tourist frequency
Indicator:	Estimate of average annual income from tourism activity (overnight stays and local purchases) on a per-resident basis
Unit of measure:	euro/resident
Relevant information:	Depending on the local points of interest, tourism income can be a major contribution to the local economy
Assessment method:	Calculate the average annual income from tourism activity (overnights stays and local purchases) in a per resident basis
Urban Scale:	Neighbourhood - Cluster

B3 Cost and Investment

B.3.1 Provision of social housing units

Intent:	To estimate whether funding for social housing is adequate to meet the housing needs of low-income groups in the local area
Indicator:	Adequacy of annual funding for social housing units in relation to the total investment housing units
Unit of measure:	-
Relevant information:	Funding for social housing units, aimed at the lowest quintile of household income, is an important element in maintaining a balance in housing available for low-income and other income groups in the local area. Such funding may come from public on non-profit sources, and is best assessed over a five-year period
Assessment method:	1. Identify the percent of households in the local area that falls within the lowest quintile of household income within the larger urban area. 2. Identify the percent of the lowest income quintile in the local area that requires social housing units. 3. Assess the adequacy of funding for social housing to meet the needs of the local area.
Urban Scale:	Neighbourhood - Cluster

B.3.2 Public contribution in residential retrofitting investments

Intent:	To evaluate the level of public investments in the area
Indicator:	Funds provided by governments over a 5-year period
Unit of measure:	%
Relevant information:	-
Assessment method:	Investment expenditure of the local authority in the project / total investment cost of the project in euros Excl Taxes
Urban Scale:	Neighbourhood - Cluster

B.3.3 Operating energy costs for public buildings

Intent:	To assess the cost of energy services for public buildings
Indicator:	Aggregated annual operating energy cost per aggregated indoor useful floor area
Unit of measure:	€/m2/year
Relevant information:	The annual operating energy costs are usually a significant part of total operating costs. This criterion provides information on the actual energy costs of public buildings in the urban area
Assessment method:	To characterize the indicator’s value: 1.For each building in the urban area, calculate the annual operating energy (thermal and electric) cost (euro/year). 2.Sum the operating energy costs of each building in the urban area up to an aggregated annual operating energy cost value (euro/year). 3.Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m2). 4.Calculate the indicator as: aggregated annual operating energy cost / aggregated indoor useful area (euro/m2/year)
Urban Scale:	Neighbourhood - Cluster

B.3.4 Levels of total public and private investment

Intent:	To assess the level of public and private investment
Indicator:	The average annual aggregate amount of public and private investment, on a per-resident basis, for new construction, renovation and infrastructure projects in the local area, 00 Euro
Unit of measure:	euro/resident
Relevant information:	-
Assessment method:	Calculate the average annual aggregate amount of public and private investment, on a per-resident basis, for new construction, renovation infrastructure projects in the local area, based on a 3-year period
Urban Scale:	Neighbourhood - Cluster

C Energy

C1 Non-renewable energy

C.1.1 Total final thermal energy consumption for building operations

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/m2/year
Relevant information:	The criterion allows to understand the buildings' final thermal energy consumption in the use stage. Use stage energy consumptions are in general responsible for most of life cycle energy use in the case of buildings constructed before the turn of the millennium
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 (m2). 5.Calculate the indicator's value as: aggregated annual total final thermal energy consumption/ aggregated indoor useful area (kWh/m2/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. 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 (m2). 5.Calculate the indicator's value as: aggregated annual total final thermal energy consumption/ aggregated indoor useful area (kWh/m2/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.
Urban Scale:	Neighbourhood - Cluster

C.1.2 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/m2
Relevant information:	-
Assessment method:	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 Note: Cooling and lighting are also included in order to consider the potential use of, for example, CHP or trigeneration for generating electricity that may then be used for lighting and heat for sorption cooling. In case that the calculation method used is different from C1.1., then it may not be necessary that the values C1.1 = C1.2 + C1.3
Urban Scale:	Neighbourhood - Cluster

C.1.3 Total final thermal energy consumption for non residential building operations

Intent:	To estimate urban thermal energy consumption per gross area for non-residential building operations
Indicator:	Urban thermal energy consumption of non-residential buildings
Unit of measure:	kWh/m2
Relevant information:	-
Assessment method:	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 non-residential building in the local area. Calculate the aggregated annual total final thermal energy consumption for all non-residential buildings. Calculate: Aggregated annual total final thermal energy consumption / Total gross area of all non-residential buildings Note: Cooling and lighting are also included in order to consider the potential use of, for example, CHP or trigeneration for generating electricity that may then be used for lighting and heat for sorption cooling. In case that the calculation method used is different from C1.1., then it may not be necessary that the values C1.1 = C1.2 + C1.3
Urban Scale:	Neighbourhood - Cluster

C.1.4 Total final electrical energy consumption for building operations

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/year
Relevant information:	The criterion allows to understand the buildings' final electric energy consumption in the use stage. Use stage energy consumptions are in general responsible for most of life cycle energy use in the case of buildings constructed before the turn of the millennium.
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). 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 (m2). 5.Calculate the indicator's value as: aggregated annual total final electric energy consumption/ aggregated indoor useful area (kWh/m2/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 (m2). 5.Calculate the indicator's value as: aggregated annual total final electric energy consumption/ aggregated indoor useful area (kWh/m2/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.
Urban Scale:	Neighbourhood - Cluster

C.1.5 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/m2
Relevant information:	-
Assessment method:	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 In case that the calculation method used is different from C1.4., then it may not be necessary that the values C1.4 = C1.5 + C1.6
Urban Scale:	Neighbourhood - Cluster

C.1.6 Total final electrical energy consumption for non residential building operations

Intent:	To estimate urban electrical energy consumption per gross area for non residential building operations
Indicator:	Urban electrical energy consumption of non-residential buildings
Unit of measure:	kWh/m2
Relevant information:	-
Assessment method:	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 non-residential building in the local area. Calculate the aggregated annual total final thermal energy consumption for all non-residential buildings. Calculate: Aggregated annual total final electrical energy consumption / Total gross area of all non-residential buildings In case that the calculation method used is different from C1.4., then it may not be necessary that the values C1.4 = C1.5 + C1.6
Urban Scale:	Neighbourhood - Cluster

C.1.7 Total primary energy demand for building operations

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/m2/year
Relevant information:	The criterion allows to understand the buildings' primary energy consumption in the area. "Primary energy" means energy from renewable and non-renewable sources which has not undergone any conversion or transformation process
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.Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m2). 7.Calculate the indicator's value as: aggregated annual total primary energy consumption / aggregated indoor useful area (kWh/m2/year). Note Calculations are based on EN 13790 using the quasi-steady state monthly method.
Urban Scale:	Neighbourhood - Cluster

C.1.8 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:	%
Relevant information:	-
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for building operations (heating, cooling, domestic hot water and lighting), in kWh/m2 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
Urban Scale:	Neighbourhood - Cluster

C.1.9 Total primary energy demand for non residential building operations

Intent:	To reduce the need of energy for non residential building operations
Indicator:	Ratio of average total primary energy consumption of residential buildings to the local minimum value
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for building operations (heating, cooling, domestic hot water and lighting), in kWh/m2 of gross area for each non-residential building in the local area. Calculate Neighbourhood non-residential total primary energy consumption as the weighted mean value of total primary energy consumption over the floor surfaces of all non-residential buildings in the area. Calculate: (Neighbourhood non-residential total primary energy consumption / local minimum value)* 100
Urban Scale:	Neighbourhood - Cluster

C.1.10 Primary energy for heating for residential buildings

Intent:	To reduce the need of energy for heating for residential buildings
Indicator:	Ratio of average total primary energy consumption for heating of residential buildings to the local minimum value
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for heating, in kWh/m2 of gross area for each residential building in the local area. Calculate Neighbourhood residential total primary energy consumption for heating as the weighted mean value of total primary energy consumption for heating over the floor surfaces of all residential buildings in the area. Calculate: (Neighbourhood residential total primary energy consumption for heating / local minimum value)* 100
Urban Scale:	Neighbourhood - Cluster

C.1.11 Primary energy for heating for non residential buildings

Intent:	To reduce the need of energy for heating for non residential buildings
Indicator:	Ratio of average total primary energy consumption for heating of non-residential buildings to the local minimum value
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for heating, in kWh/m2 of gross area for each non-residential building in the local area. Calculate Neighbourhood non-residential total primary energy consumption for heating as the weighted mean value of total primary energy consumption for heating over the floor surfaces of all non-residential buildings in the area. Calculate: (Neighbourhood non-residential total primary energy consumption for heating / local minimum value)* 100
Urban Scale:	Neighbourhood - Cluster

C.1.12 Primary energy for cooling for residential buildings

Intent:	To reduce the need of energy for cooling for residential buildings
Indicator:	Ratio of average total primary energy consumption for cooling of residential buildings to the local minimum value
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for coolng, in kWh/m2 of gross area for each residential building in the local area. Calculate Neighbourhood residential total primary energy consumption for cooling as the weighted mean value of total primary energy consumption for cooling over the floor surfaces of all residential buildings in the area. Calculate: (Neighbourhood residential total primary energy consumption for cooling / local minimum value)* 100
Urban Scale:	Neighbourhood - Cluster

C.1.13 Primary energy for cooling for non residential buildings

Intent:	To reduce the need of energy for public lighting
Indicator:	Ratio of average total primary energy consumption for cooling of non-residential buildings to the local minimum value
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for cooling, in kWh/m2 of gross area for each non-residential building in the local area. Calculate Neighbourhood non-residential total primary energy consumption for cooling as the weighted mean value of total primary energy consumption for cooling over the floor surfaces of all non-residential buildings in the area. Calculate: (Neighbourhood non-residential total primary energy consumption for cooling / local minimum value)* 100
Urban Scale:	Neighbourhood - Cluster

C.1.14 Primary energy for DHW for residential buildings

Intent:	To reduce the need of energy for DHW for residential buildings
Indicator:	Ratio of average total primary energy consumption for DHW of residential buildings to the local minimum value
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for DHW, in kWh/m2 of gross area for each residential building in the local area. Calculate Neighbourhood residential total primary energy consumption for DHW as the weighted mean value of total primary energy consumption for DHW over the floor surfaces of all residential buildings in the area. Calculate: (Neighbourhood residential total primary energy consumption for DHW / local minimum value)* 100
Urban Scale:	Neighbourhood - Cluster

C.1.15 Primary energy for DHW for non residential buildings

Intent:	To reduce the need of energy for DHW for non residential building
Indicator:	Ratio of average total primary energy consumption for DHW of non-residential buildings to the local minimum value
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for DHW, in kWh/m2 of gross area for each non-residential building in the local area. Calculate Neighbourhood non-residential total primary energy consumption for DHW as the weighted mean value of total primary energy consumption for DHW over the floor surfaces of all non-residential buildings in the area. Calculate: (Neighbourhood non-residential total primary energy consumption for DHW / local minimum value)* 100
Urban Scale:	Neighbourhood - Cluster

C.1.16 Primary energy for indoor lighting for residential buildings

Intent:	To reduce the need of energy for indoor lighting for residential buildings
Indicator:	Ratio of average total primary energy consumption for indoor lighting of residential buildings to the local minimum value
Unit of measure:	%
Relevant information:	Calculated data
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for indoor lighting, in kWh/m2 of gross area for each residential building in the local area. Calculate Neighbourhood residential total primary energy consumption for indoor lighting as the weighted mean value of total primary energy consumption for indoor lighting over the floor surfaces of all residential buildings in the area. Calculate: (Neighbourhood residential total primary energy consumption for indoor lighting / local minimum value)* 100
Urban Scale:	Neighbourhood - Cluster

C.1.17 Primary energy for indoor lighting for non residential buildings

Intent:	To reduce the need of energy for indoor lighting for non residential buildings
Indicator:	Ratio of average total primary energy consumption for indoor lighting of non-residential buildings to the local minimum value
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the annual total primary energy consumption of non-renewable energy for indoor lighting, in kWh/m2 of gross area for each non-residential building in the local area. Calculate Neighbourhood non-residential total primary energy consumption for indoor lighting as the weighted mean value of total primary energy consumption for indoor lighting over the floor surfaces of all non-residential buildings in the area. Calculate: (Neighbourhood non-residential total primary energy consumption for indoor lighting / local minimum value)* 100
Urban Scale:	Neighbourhood - Cluster

C.1.18 Electrical peak demand for non-residential building operations

Intent:	To assess electrical peak demand for non residential building operations
Indicator:	Aggregated peak demand in the local are
Unit of measure:	MW
Relevant information:	Electrical demand varies over diurnal and longer time periods, according to ambient temperatures, increased use of building equipment and time-of-use variation. Major peaks in demand have to be accommodated by the electric utility, and the difference between the average demand and peak demand is therefore an important factor in avoiding a need for increased generating capacity and emissions.
Assessment method:	Calculate the aggregated peak demand in MW of electrical demand over a one-hour peak load period, for non-residential buildings in the local area. 1. Determine the average base load electric demand for the local area over a one-year period. 2. Determine the average peak demand for the local area over the same period. 3. Calculate the average differential between base load and peak demand as a percent.
Urban Scale:	Neighbourhood - Cluster

C.1.19 Scheduling of non-residential building operations to reduce peak loads on generating facilities

Intent:	To reduce peak loads
Indicator:	Annual time periods of electrical peak loads
Unit of measure:	h
Relevant information:	-
Assessment method:	Calculate the aggregate annual electrical consumption consumed by outdoor public lighting systems, in average kWh or MWh per 1000 m2
Urban Scale:	Neighbourhood - Cluster

C.1.20 Energy consumption of public lighting

Intent:	To reduce the need of energy for public lighting
Indicator:	Annual electrical consumption by outdoor public lighting systems
Unit of measure:	kWh/m2
Relevant information:	-
Assessment method:	Calculate the aggregated annual electrical consumption consumed by outdoor public lighting systems on a per capita basis
Urban Scale:	Neighbourhood - Cluster

C.1.21 Energy consumption of local public transport

Intent:	To reduce the need of energy for public lighting
Indicator:	Energy efficiency of local public transport
Unit of measure:	pax.km/MJ
Relevant information:	-
Assessment method:	Calculate the energy efficiency of local public transport, in aggregated annual passenger-kilometers per MJ of non-renewable energy consumed
Urban Scale:	Neighbourhood - Cluster

C.1.22 Consumption of non-renewable energy for demolition or dismantling

Intent:	To reduce annual final consumption of non-renewable energy
Indicator:	Final consumption of non-renewable energy for building demolition or dismantling
Unit of measure:	kWh/m2
Relevant information:	-
Assessment method:	Calculate the annual aggregate final consumption of non-renewable energy for building demolition or dismantling, as kWh/m2 of gross area of all buildings dismantled in the local area, calculated over a 3-year period.
Urban Scale:	Neighbourhood - Cluster

C2 Renewable and Decarbonised energy

C.2.1 Share of renewable energy on-site, relative to total final thermal energy consumption for building operations

Intent:	To incentive the consumption and production of renewable energy
Indicator:	Annual total thermal energy consumption from on-site renewable energy sources / annual total final thermal energy consumption
Unit of measure:	%
Relevant information:	The criterion al assesses the share of renewable thermal energy in final thermal energy consumptions and, by implication, the degree to which renewable fuels have substituted fossil and/or nuclear fuels and therefore contributed to the decarbonisation of the Mediterranean area economy.
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 with the Directive 2009/28/EC (RES Directive), 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.

Urban Scale:	Neighbourhood - Cluster

C.2.2 Share of renewable energy on-site, relative to total final energy consumption for residential building operations

Intent:	To incentive the consumption and production of renewable energy
Indicator:	Ratio of on-site renewable energy consumption to the total final energy consumption of residential buildings
Unit of measure:	%
Relevant information:	-
Assessment method:	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
Urban Scale:	Neighbourhood - Cluster

C.2.3 Share of renewable energy on- site, relative to total final energy consumption for non-residential building operations

Intent:	To incentive the consumption and production of renewable energy
Indicator:	Ratio of on-site renewable energy consumption to the total final energy consumption of non-residential buildings
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the following: * annual total final energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each non-residential building in the local area including renewables, if applicable, in the existing condition. * aggregated annual total final energy consumption for all non-residential buildings. * annual total final energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each non-residential building in the local area without the installed renewables, if applicable. * aggregated annual total final energy consumption without the renewables for all non-residential buildings. * Aggregated annual total final energy consumption / Aggregated annual total final energy consumption without the renewables
Urban Scale:	Neighbourhood - Cluster

C.2.4 Share of renewable energy on-site, relative to total primary energy consumption for building operations

Intent:	To incentive the consumption and production of renewable energy
Indicator:	Aggregated total annual primary energy consumption from on-site renewable energy sources / aggregated total annual primary energy consumption
Unit of measure:	%
Relevant information:	The criterion assesses the share of renewable energy in primary energy consumptions and, by implication, the degree to which renewable fuels have substituted fossil and/or nuclear fuels and therefore contributed to the decarbonisation of the Mediterranean area economy. It also shows what is the progress towards Europe 2020 target for renewable energies
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
Urban Scale:	Neighbourhood - Cluster

C.2.5 Share of renewable energy on-site, relative to total primary energy consumption for residential building operations

Intent:	To incentivate the consumption and production of renewable energy
Indicator:	Ratio of on-site renewable energy consumption to the total primary energy consumption of residential buildings
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the following: * 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. * aggregated annual total primary energy consumption for residential buildings. * 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. * aggregated annual total primary energy consumption without the renewables for residential buildings. * Aggregated annual total primary energy consumption / Aggregated annual total primary energy consumption without the renewables
Urban Scale:	Neighbourhood - Cluster

C.2.6 Share of renewable energy on-site, relative to total primary energy consumption for non residential building operations

Intent:	To incentivate the consumption and production of renewable energy
Indicator:	Ratio of on-site renewable energy consumption to the total primary energy consumption of non-residential buildings
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the following: * annual total primary energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each non-residential building in the local area including renewables, if applicable, in the existing condition. * aggregated annual total primary energy consumption for non-residential buildings. * annual total primary energy consumption for building operations (heating, cooling, domestic hot water and lighting), in kWh, for each non-residential building in the local area without the installed renewables, if applicable. * aggregated annual total primary energy consumption without the renewables for non-residential buildings. * Aggregated annual total primary energy consumption / Aggregated annual total primary energy consumption without the renewables
Urban Scale:	Neighbourhood - Cluster

C.2.7 Share of renewable energy on-site, on final electric energy consumptions

Intent:	To incentive the consumption and production of renewable energy
Indicator:	Share of renewable electric energy in final electric energy consumptions
Unit of measure:	%
Relevant information:	The criterion assesses the share of renewable electric energy in final electric energy consumptions and, by implication, the degree to which renewable fuels have substituted fossil and/or nuclear fuels and therefore contributed to the decarbonisation of the Mediterranean area economy.
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. <u>Use of estimated data:</u> 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. <u>Use of metered data</u>: 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 with the Directive 2009/28/EC (RES Directive), 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.
Urban Scale:	Neighbourhood - Cluster

C.2.8 Aggregated electrical energy generation from renewable sources located on public properties

Intent:	To promote production of renewable energy sources
Indicator:	Electrical energy generation from renewable sources from public properties
Unit of measure:	MWh/year
Relevant information:	-
Assessment method:	Calculate the aggregated electrical energy generation from renewable sources located on public properties that is exported from the local area, in MWh per year
Urban Scale:	Neighbourhood - Cluster

C.2.9 Aggregated electrical energy generation from renewable sources located on private properties

Intent:	To promote production of renewable energy sources
Indicator:	Electrical energy generation from renewable sources located on private properties
Unit of measure:	MWh/year
Relevant information:	-
Assessment method:	Aggregate use of electric power generated from renewable sources that is consumed in the local area, in MWh per year
Urban Scale:	Neighbourhood - Cluster

C.2.10 Electrical energy generated from renewable sources that is exported from the local area

Intent:	To assess the quote of renewable energy exported
Indicator:	Electrical energy generation from renewable sources that is exported from the local area
Unit of measure:	MWh/year
Relevant information:	-
Assessment method:	Calculate the aggregated electrical energy generation from renewable sources that is exported from the local area, in MWh per year
Urban Scale:	Neighbourhood - Cluster

C.2.11 Aggregated use of renewable electrical energy

Intent:	To assess the autonomy of the area regarding electricity
Indicator:	Share of renewable electricity production
Unit of measure:	%
Relevant information:	-
Assessment method:	Ratio of aggregated electrical energy that is generated on-site or nearby from renewable sources and consumed in the local area, to the total annual electric energy (e.g. buildings, public lighting)
Urban Scale:	Neighbourhood - Cluster

C.2.12 Aggregated thermal energy generation from renewable sources located on public properties

Intent:	To promote production of renewable energy sources
Indicator:	Thermal energy generation from renewable sources from public properties
Unit of measure:	MWh/year
Relevant information:	-
Assessment method:	Calculate the aggregated thermal energy generation from renewable sources located on public properties that is exported from the local area, in MWh per year
Urban Scale:	Neighbourhood - Cluster

C.2.13 Aggregated thermal energy generation from renewable sources located on private properties

Intent:	To promote production of renewable energy sources
Indicator:	Thermal energy generation from renewable sources located on private properties
Unit of measure:	MWh/year
Relevant information:	-
Assessment method:	Calculate the aggregated thermal energy generation from renewable sources located on private properties that is exported from the local area, in MWh per year
Urban Scale:	Neighbourhood - Cluster

C.2.14 Thermal energy generated from renewable sources that is exported from the local area

Intent:	To assess the quote of renewable energy exported
Indicator:	Thermal energy generation from renewable sources that is exported from the local area
Unit of measure:	MWh/year
Relevant information:	-
Assessment method:	Calculate the aggregated thermal energy generation from renewable sources that is exported from the local area, in MWh per year
Urban Scale:	Neighbourhood - Cluster

C3 Energy recycling and storage

C.3.1 Waste heat re-utilization from building operations

Intent:	To reduce waste building operations
Indicator:	Percentage of waste heat from building operations
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of waste heat from building operations that is captured and re-used for other buildings in the local area
Urban Scale:	Neighbourhood - Cluster

C.3.2 Mid- and long-term storage of geothermal energy

Intent:	To assess the capacity of thermal storage from geothermal sources
Indicator:	Seasonal or annual thermal capacity of geothermal energy sinks in the local area
Unit of measure:	%
Relevant information:	Depending on the geotechnical circumstances, geothermal sources can provide considerable thermal energy for use in building heating systems. This energy source can sometimes be used directly, but in other cases requires thermal storage, control and pumping systems
Assessment method:	By means of geotechnical investigations, determine the location and capacity of geothermal sources, if available, and also the possible rate of extraction. If capacity is limited by capacity or exact location, determine suitable extraction locations and requirements for thermal storage systems so that a continuous flow of thermal energy can be provided
Urban Scale:	Neighbourhood - Cluster

C.3.3 Mid-term storage of electrical energy

Intent:	To assess the long-term capacity of electrical storage from renewable sources
Indicator:	Weekly or monthly electrical storage capacity of electrical storage devices in the local area, in gWh
Unit of measure:	%
Relevant information:	Photovoltaic systems can generate considerable electrical energy for use in the building - during the day and when the sun is shining. Unless the energy generated is converted to AC and uploaded to the grid, electrical storage long-term storage will be required to make use of the energy in the building. A source of stored electrical energy can be valuable in reducing period of peak demand. Systems with medium discharge times are more practical than long-term systems. Types of electrical energy storage include pumped hydro storage, compressed air storage, flywheel energy storage, secondary batteries, flow batteries (there are many types of batteries), Hydrogen or synthetic natural gas, double-layer capacitors or superconducting magnetic coil.
Assessment method:	
Urban Scale:	Neighbourhood - Cluster

D Atmospheric emissions

D1 Atmospheric emissions

D.1.1 GHG emissions from energy embodied in construction materials used for construction, maintenance or replacement(s)

Intent:	To reduce GHG emissions from construction materials
Indicator:	Aggregate GHG emissions from energy embodied in construction materials
Unit of measure:	tons CO2/1000 m2
Relevant information:	-
Assessment method:	Calculate the aggregate GHG emissions from energy embodied in construction materials that have been used for construction, maintenance or replacement(s) of buildings and infrastructure, in tons of CO2-e per 1000 m2 of surface area over a 3-year period
Urban Scale:	Neighbourhood - Cluster

D.1.2 Total GHG Emissions from primary energy used in building operations

Intent:	To minimize the total greenhouse gas emissions from buildings' operations
Indicator:	CO2 equivalent emissions per useful internal floor area per year
Unit of measure:	kg CO2 eq./m2/yr
Relevant information:	The criterion measures the contribution of the greenhouse gas (GHG) emissions associated with the building's operational phase on the earth's global warming or climate change. The Global Warming Potential (GWP) was developed to allow for the comparison of the impact on global warming caused by different gases. Specifically, it is a relative measure of how much energy can be trapped in the atmosphere over a set time horizon by a mass of gas in comparison with the same mass of carbon dioxide (CO2). A higher GWP means a larger warming effect in that period of time
Assessment method:	The scope of the indicator comprises the use stage of the building and includes the emissions correlated to the following energy uses: heating, cooling, ventilation, domestic hot water, lighting, auxiliaries. To characterize the indicator's value: For each building in the area calculate the emissions of CO2 eq. with the following formula: $E = \left[\sum \left(Q_{fuel,i} \times LHV_i \times k_{em,i}\right) + \left(Q_{el} \times k_{em,el}\right) + \left(Q_{dh} \times k_{em,dh}\right)\right]$ Qfuel,I = annual quantity of i-th fuel (m3 or Kg) Qel = annual quantity of electric energy from the grid (kWh) Qdh = annual quantity of energy from district heating/cooling (kWh) LHVi = lower heating value of the i-th fuel (kWh/m3 or kWh/Kg) Kem,i = CO2 eq. emission factor of the i-th fuel (Kg CO2/kWh) Kem,i = CO2 eq. emission factor of the electric energy from the grid (Kg CO2/kWh) Kem,i = CO2 eq. emission factor of energy from district heating/cooling (Kg CO2/kWh) Calculate the aggregated annual total CO2 equivalent emissions from all buildings / total useful internal floor area of all buildings.
Urban Scale:	Neighbourhood - Cluster

D.1.3 Aggregate emissions of ozone-depleting substances during building operations

Intent:	To reduce ODS emissions during building operation
Indicator:	Aggregate emissions of ozone-depleting substances
Unit of measure:	tons CO2/1000 m2
Relevant information:	-
Assessment method:	Calculate aggregate emissions of ozone-depleting substances generated by equipment during building operations, in tons of ODS per 1000 m2 of surface area over a 3-year period
Urban Scale:	Neighbourhood - Cluster

D.1.4 Aggregate emissions of acidifying emissions during building operations

Intent:	To reduce per capita SO2 and NOx emissions
Indicator:	Percentage of acidifying emissions over a 5-year period
Unit of measure:	%
Relevant information:	-
Assessment method:	Aggregate emissions of acidifying emissions (Nox, NH3 or SO2) during building operations, in kg. per 1000 m2 of surface area over a 3-year period
Urban Scale:	Neighbourhood - Cluster

D.1.5 Aggregate annual GHG emissions from the use of private vehicles

Intent:	To estimate greenhouse gas (GHG) emissions resulting from the operation of private vehicles in the local area
Indicator:	Aggregate GHG emissions from private transport fuels
Unit of measure:	tons / yr
Relevant information:	Private vehicles have become increasingly fuel-efficient, but the aggregate GHG emissions from the use of private vehicles in the local area remain a strong contribution ti air pollution and climate change. It is difficult to make an accurate estimate of the aggregate GHG emissions, but estimates can be made, based on the number of vehicles of various types, annual distance travelled and their fuel economy. It is assumed that the emission of a typical vehicle is 4.7 tons per year
Assessment method:	1. Estimate the total number of private vehicles being operated in the local area. 2. Estimate the average distance travelled within the local area for each vehicle type. 3. Estimate the average emission by vehicle type. 4. Estimate the total GHG emissions generated by all vehicles over a period of one year
Urban Scale:	Neighbourhood - Cluster

D.1.6 Aggregate annual GHG emissions from the use of public transport

Intent:	To reduce emissions from fuels
Indicator:	Aggregate GHG emissions from public transport fuels
Unit of measure:	Tons per 10,000 passengers
Relevant information:	-
Assessment method:	Aggregate GHG emissions from fuels used for public transport in the local area, in tons per 10,000 passengers per year per year
Urban Scale:	Neighbourhood - Cluster

D.1.7 Total GHG Emissions from buildings, private and public mobility

Intent:	To reduce greenhouse gas (GHG) emissions in all major sectors in the local area
Indicator:	Aggregate GHG emissions from buildings, public and private transport fuels
Unit of measure:	%
Relevant information:	Buildings and mobility systems are two major sources of greenhouse gases. This indicator attempts to estimate the total GHG emitted on an annual basis, averaged over a 3-year period
Assessment method:	Estimate the annual aggregate GHG emissions emitted by all public and private buildings in the local area, averaged over a recent 3-year period. Estimate the annual aggregate GHG emissions emitted by all electric or fuel-powered vehicles operating in the local area Total the above and obtain the result in tons per 1000 residents.
Urban Scale:	Neighbourhood - Cluster

E Non-Renewable Resources

E1 Potable water, stormwater and greywater

E.1.1 Availability of a public municipal water supply

Intent:	To determine the availability of a public water supply system in the local area
Indicator:	Availability of a public municipal water supply to all permanent buildings in the area
Unit of measure:	%
Relevant information:	The availability of a public water supply system, with water purity assured by appropriate purification systems and management, is essential to ensure public health in urban areas. Public water supplies are often free to the end user, or else are supplied at very low cost. A frequent problem is that the availability of cheap or free water leads to potable water being wasted or being used for other purposes, such as irrigation. An essential first step in ensuring that public water supplies are used efficiently and for the purpose intended, is to measure consumption for each household or commercial user.
Assessment method:	1. Identify sections of the local area that are served by a municipal public water supply. 2. Identify residential and non-residential end users. 3. Ensure that each end user is equipped with one or more water meters. 4. Collect data on usage and assess whether water is consumed in an efficient way. 5. Place caps on consumption for various uses, and/or impose user charges to provide incentives for conservation.
Urban Scale:	Neighbourhood - Cluster

E.1.2 Provision of split grey / potable water services

Intent:	To reduce potable water consumption
Indicator:	Permanent buildings provided with split grey / potable water services
Unit of measure:	%
Relevant information:	Calculated data
Assessment method:	Calculate the percentage of permanent buildings in the local area that are provided with split grey / potable water services
Urban Scale:	Neighbourhood - Cluster

E.1.3 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
Unit of measure:	%
Relevant information:	Rainwater collection cam be used as greywater to use for toilet or irrigation purposes. This reduces the demand for potable water which is wasted for such applications
Assessment method:	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
Urban Scale:	Neighbourhood - Cluster

E.1.4 Re-use of rainwater in non-residential buildings

Intent:	To assess the collection of rainwater from roofs in non-residential buildings
Indicator:	Share of rainwater collected from roofs of non-residential buildings
Unit of measure:	%
Relevant information:	Rainwater collection cam be used as greywater to use for toilet or irrigation purposes. This reduces the demand for potable water which is wasted for such applications
Assessment method:	Calculate the percent of demand for greywater that can be used for toilets and irrigation in non-residential buildings that is met by rainwater collected in the local area
Urban Scale:	Neighbourhood - Cluster

E.1.5 Re-use of stormwater

Intent:	To reduce potable water consumption
Indicator:	Percent of annual stormwater that is re-used in the local area
Unit of measure:	%
Relevant information::	-
Assessment method:	Calculate the percentage of annual stormwater that is re-used in the local area
Urban Scale:	Neighbourhood - Cluster

E.1.6 Consumption of potable water for residential population

Intent:	Make efficient use of water resources
Indicator:	Annual potable water consumption per occupant
Unit of measure:	m3/occupant/year
Relevant information:	The criterion measures the potable water consumption of sanitary fittings/devices and water consuming appliances by residential population
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 (m3). 2)Sum the annual potable water consumption of each building up to an aggregated annual total potable water consumption (m3/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.
Urban Scale:	Neighbourhood - Cluster

E.1.7 Consumption of potable water for public non-residential building systems

Intent:	Make efficient use of water resources
Indicator:	Annual potable water consumption per m2
Unit of measure:	m3 /m2
Relevant information:	The criterion measures the potable water consumption of sanitary fittings/devices and water consuming appliances by non-residential public buildings
Assessment method:	The water consumption is calculated based on metered data of 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 dishwasher; -water for cleaning. To characterize the indicator's value: 1)For each non-residential public building, collect the monitored annual water consumptions for building operation. The consumption data must be estimated taking the average over 3 years period (m3). 2)Sum the annual water consumption of each building up to an aggregated annual total water consumption (m3/year). 3)Estimate the area of public buildings considered for the calculation. 4)Calculate the indicator's value as: aggregated annual total water consumption / area of public buildings. Note: The public buildings that must be considered in the calculation are offices and schools (all levels, excluding universities). The consumption of water for dishwasher should not be considered for offices.
Urban Scale:	Neighbourhood - Cluster

E.1.8 Consumption of potable water for irrigation purposes

Intent:	To reduce the consumption of potable water
Indicator:	Potable water used for irrigation purposes
Unit of measure:	m3/1000 m2
Relevant information:	Potable water should not be a first option for use in irrigation systems
Assessment method:	Calculate the estimated consumption of potable water used for irrigation purposes in the local area, in m3/1000 m2
Urban Scale:	Neighbourhood - Cluster

E.1.9 Intensity of water purification treatment

Intent:	To maximize the potential of use of wastewater whenever possible
Indicator:	Energy intensity of purification treatment used for potable water
Unit of measure:	kWh/m3
Relevant information:	-
Assessment method:	Energy intensity of purification treatment used for potable water that is to be supplied to the local area, in kWh/m3
Urban Scale:	Neighbourhood - Cluster

E2 Solid and Liquid Wastes

E.2.1 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:	%
Relevant information:	In many urban areas, the collection of solid waste and recycling material at each address has been replaced by public pick-up points. A critical aspect to ensure success of such a strategy is to ensure that walking distances are minimized. It is assumed that large residential or non-residential buildings will have their own collection points within or near the building.
Assessment method:	For the indicator performance calculation proceeds as follows: 1. Identify the ecological areas or individual bins of differentiated collection of waste present in the area 2. Calculate the actual distance on foot between these nodes and access the buildings. 3. 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.
Urban Scale:	Neighbourhood - Cluster

E.2.2 Separate collection and disposal of solid waste and recycling

Intent:	To determine the extent to which solid waste from households and commercial occupancies are separated and recycled
Indicator:	Separated collection and disposal of solid waste and recycling
Unit of measure:	%
Relevant information:	An important factor in increasing the rate of recycling of solid waste is to ensure that waste material is separated into paper, plastic, metals and other solid wastes. This implies that occupants and building staff maintain separate waste bins in their buildings. It also implies that the municipality has the equipment to recycle these materials, either in the community or by contract in other locations
Assessment method:	1. Identify the total solid waste generated during the operation of key residential and commercial buildings over a 3-year period. 2. Identify how much of this waste was separated into separate waste streams. 3. Obtain data on the percent of waste that was recycled.
Urban Scale:	Neighbourhood - Cluster

E.2.3 Solid waste from construction and demolition projects retained in the area for re-use or recycling

Intent:	To estimate the proportion of solid waste resulting from construction and demolition projects in the area that is re-used or recycled
Indicator:	Volume of materials that will be re-used or recycled from the local area on the total solid waste from construction and demolition of building projects
Unit of measure:	%
Relevant information:	Construction activities for new buildings and for demolition have traditionally resulted in large amounts of waste materials that have to be taken to solid waste sites. Much of this material is bulky and remains, but not useable, for long periods of time. Experience has shown that significant improvements can be made in reducing waste, either by recycling them or by re-using some of these materials in new projects. For re-use applications, testing or on-site certification by structural engineers may be required
Assessment method:	To characterize the value of the indicator: 1. Identify the annual volume of construction/demolition waste generated over a 3-year period. 2. Sample the waste stream to identify the origin (type of building) for each sample and the approximate proportion of materials that will be recycled or re-used. 3. Estimate the volume of material that will be re-used or recycled from future projects of the same type. 4. Aggregate the volume of materials that will be re-used or recycled per year from the local area, based on current rates of construction and demolition. 5. Calculate the volume of materials that will be re-used or recycled from the local area on the total solid waste from construction and demolition projects.
Urban Scale:	Neighbourhood - Cluster

E.2.4 Solid waste from residents' activities and facility operations sent out of the area for re-use, recycling or disposal

Intent:	To incentivate recycling
Indicator:	Percentage of solid waste sent out of the area for re-use
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of solid waste from residents' activities and facility operations sent out of the area for re-use, recycling or disposal
Urban Scale:	Neighbourhood - Cluster

E.2.5 Composting and re-use of organic sludge

Intent:	To incentivate composted and re-used organic sludge
Indicator:	Percentage of organic sludge composted and re-used
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of organic sludge that is composted and re-used within the local area
Urban Scale:	Neighbourhood - Cluster

E.2.6 Public wastewater that is disposed or treated

Intent:	To incentivate the treatment of public wastewater
Indicator:	Percent of public wastewater that is disposed or treated
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of public wastewater that is disposed or treated
Urban Scale:	Neighbourhood - Cluster

E.2.7 Liquid effluents from building operations that are sent out of the area

Intent:	To minimize the interruption and contamination of natural water flows
Indicator:	Percent of liquid effluents from building operations sent out of the area
Unit of measure:	%
Relevant information:	-
Assessment method:	1. Calculate the volume of wastewater for the treatment conferred outside the area (A). 2. Divide the volume for the total production of waste water in the area (B). 3. Calculate the percentage value of wastewater for the treatment conferred outside the area with respect to the total A / B * 100
Urban Scale:	Neighbourhood - Cluster

E.2.8 Potential for building operations to contaminate nearby bodies of water

Intent:	To prevent contamination of water bodies
Indicator:	Presence of hazardous effluents from building operations
Unit of measure:	Score
Relevant information:	-
Assessment method:	Hazardous effluents from building operations that are disposed of so that nearby bodies of water may become contaminated
Urban Scale:	Neighbourhood - Cluster

E.2.9 Cumulative annual thermal changes to lake water or sub-surface aquifers

Intent:	To evaluate thermal changes in lake water
Indicator:	Thermal changes in lake water
Unit of measure:	Score
Relevant information:	-
Assessment method:	1. Carry out annual measurements of temperature changes in lake water or sub-surface aquifers that may be affected by building or infrastructure operations. 2. Analyze the annual temperature changes over at least a 3-year period. 3. Normalize results by comparing to other bodies of water in the region that are not adjacent to built-up areas. 4. Assess the results to determine if thermal regimes have been affected by building or infrastructure operations.
Urban Scale:	Neighbourhood - Cluster

E3 Resource consumption, retention and maintenance

E.3.1 Consumption of non-renewable material resources for construction or renovation of buildings

Intent:	To promote the use of non-renewable material resources
Indicator:	Aggregate consumption of non-renewable material resources for construction or renovation of buildings
Unit of measure:	Tons/1000 m2
Relevant information:	Modern buildings require large amounts of heavy non-renewable materials, such as sand, crushed stone, cement, concrete, glass and steel. Efficiency in the use of these materials is therefore of considerable significance
Assessment method:	Calculate the aggregate consumption of non-renewable material resources for construction or renovation of buildings in the local area over a 3-year period, in tons per 1,000 m2 of built area
Urban Scale:	Neighbourhood - Cluster

E.3.2 Efficient use of materials for construction of infrastructures

Intent:	To promote the use of non-renewable material resources
Indicator:	Quantity of materials from non-renewable material resources for construction or renovation of infrastructures in the local area over a 5-year period
Unit of measure:	Tons/1000 m2
Relevant information:	A non-renewable resource (also called a finite resource) is a resource that does not renew itself at a sufficient rate for sustainable economic extraction in meaningful human time-frames. The criterion estimates the quantity of materials from non-renewable resources that is consumed in the area for the construction of infrastructures in a 5 years period (i.e. bridges, roads, services)
Assessment method:	To characterize the indicator's value: 1. Calculate the aggregate consumption of non-renewable material resources for construction or renovation of infrastructures in the local area over a 5-year period, in tons per 1,000 m2
Urban Scale:	Neighbourhood - Cluster

E.3.3 Percent of reused or recycled materials used for construction or renovation

Intent:	To reduce consumption of new materials
Indicator:	Reused or recycled materials for construction
Unit of measure:	%
Relevant information:	Building and infrastructure projects require large amounts of heavy non-renewable materials, such as sand, crushed stone, cement, concrete, glass and steel. Efficiency in the use of these materials is therefore of considerable significance. Re-use or recycling are two strategies that can considerably reduce the mass of new material required
Assessment method:	Quantity of reused or recycled materials used for construction or renovation in the local area over a 5-year period, as a percent of total materials used
Urban Scale:	Neighbourhood - Cluster

E.3.4 Adaptive re-use of existing buildings and structures

Intent:	To estimate the proportion of buildings that are functionally obsolete but can be adapted to new uses
Indicator:	The percent of existing buildings and structures in the local area not requiring demolition that have been adapted to new uses
Unit of measure:	%
Relevant information:	An unfortunate tradition in the construction industry is to demolish older buildings, some of which are structurally soundl, although functional requirements may have changed. An alternative to demolition is to re-use the structure and to adapt it to the new functions. An impediment to this approach is often the desire of the developer to maximize profits by increasing the building height, but where regulations or other factors can prevent this, adaptive re-use is a good option. There are many examples of old office buildings in central urban locations being converted to residential units, although the reverse is usually not possible because of limited floor-to-floor heights of residential buildings
Assessment method:	1. Identify structurally sound existing commercial and public buildings in the local area that are functionally obsolete but may be prospects for adaptive re-use, considering location, configuration and market demand. This step will require the participation of real estate professionals. 2. Assess the apparent structural condition of the building sample and estimate the feasibility of adapting these to new uses. 3. Calculate the ratio of adaptable buildings to the total stock of existing commercial and public buildings
Urban Scale:	Neighbourhood - Cluster

E.3.5 Preservation and maintenance of existing buildings and structures

Intent:	To determine the degree to which existing buildings and structures in the local area are preserved and maintained
Indicator:	The percent of existing buildings and structures in the local area not requiring demolition, that have been preserved and maintained in full operating condition
Unit of measure:	Score
Relevant information::	Existing buildings and structures include some that are dysfunctional, but most are usually functional or at least adaptable to new functions. Many existing buildings also constitute a valuable historical heritage
Assessment method:	1. Identify key buildings and structure of functional and historical value. 2. Assess the degree of preservation and the extent of on-going maintenance activities of a sample of these
Urban Scale:	Neighbourhood - Cluster

E.3.6 Maintenance of the heritage value of existing buildings

Intent:	To maintain existing building heritage
Indicator:	Preservation of existing buildings with heritage value and key features
Unit of measure:	Score
Relevant information::	-
Assessment method:	Evaluate the degree to which existing buildings with heritage value are maintained and key features preserved
Urban Scale:	Neighbourhood - Cluster

F Environment

F1 Environmental impacts

F.1.1 Impact of construction activities on natural features

Intent:	To reduce impact of construction activities
Indicator:	Preservation of land during and pre construction phase
Unit of measure:	-
Relevant information:	Design of buildings and infrastructure should respect existing land forms to the extent possible. During programming, design and before the beginning of the works, the land should be maintained through mowings, prunings, maintenance of canals and vegetation
Assessment method:	The degree to which construction activities over the last 3 years have had negative effects on natural features of the local area
Urban Scale:	Neighbourhood - Cluster

F.1.2 Impact of construction activities or landscaping on soil stability or erosion

Intent:	To reduce impact of construction activities
Indicator:	Impact degree of construction activities on soil stability
Unit of measure:	-
Relevant information:	-
Assessment method:	Evaluate the degree to which construction activities over the last 5-years have had negative effects on soil stability or erosion in the local area (minor, moderate or major)
Urban Scale:	Neighbourhood - Cluster

F.1.3 Recharge of groundwater through permeable paving or landscaping

Intent:	To improve the permeability of the area
Indicator:	Area of permeable surfaces on total neighborhood area
Unit of measure:	%
Relevant information:	Permeability of land is the capacity to transmit water to the soil. It is a very important issue connected to the water recharging of aquifers and the reduction of effluents. Soil sealing - the covering of the ground by an impermeable material – is one of the main causes of soil degradation in the EU. Soil sealing often affects increases the risk of flooding and water scarcity and contributes to global warming
Assessment method:	To characterize the indicator's value: 1.Calculate the size (Sa) of the urban area (m2). 2.Calculate the size of the surfaces with a different paving or occupied by constructions in the urban area (i.e. green areas, surfaces paved with asphalt, surfaces occupied by buildings, etc.). Include all the surfaces in the urban area so that: $$S_a = \sum_{i=1}^{n} S_{a,1}$$ Sa = total surface of the urban area Sa,i = surface i-th in the area (m2) 3.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 (m2) αi= permeability coefficient of the i-th surface <u>Reference permeability coefficients</u>: 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 4.Calculate the indicator's value as: $\frac{S_{a,perm}}{Sa} \times 100$
Urban Scale:	Neighbourhood - Cluster

F.1.4 Changes in biodiversity in the area

Intent:	To promote the diversity of plants and in public spaces
Indicator:	Diversity of plant structures
Unit of measure:	-
Relevant information:	-
Assessment method:	Changes in plant or animal biodiversity in the local area over the last 3 year period
Urban Scale:	Neighbourhood - Cluster

F.1.5 Heat Island Effect in the local area

Intent:	To estimate the extent of the Urban Heat Island effect in the local area, relative to the larger urban region, and to to identify relevant causal factors
Indicator:	Increasing of local atmospheric heating during summer
Unit of measure:	ºC
Relevant information:	The so-called Urban Heat Island effect (UHI) is a phenomenon whereby the absorption of solar energy by dark and non-reflective surfaces that are close to the horizontal is then re-radiated back out at lower frequency wavelengths to the local atmosphere causing increases in ambient temperatures close to the ground. The increase will vary by season, weather conditions and time of day, but may result in ambient temperature increases as much as 10ºC to 15ºC during the day, and 5ºC to 10ºC at night (U.S. EPA source). Worst cases are in tight urban areas with a high level of re-radiation between buildings that have low-albedo surfaces, under conditions of no wind. Mitigating factors are transpiration from trees and other vegetation, water bodies, wind and cloud cover, as well as permeable, light-colour and reflective road and building surfaces. The major consequence of UHI relevant to sustainability is that higher temperatures lead to more demand for mechanical cooling, which in turn results in increased power demand and GHG emissions.
Assessment method:	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
Urban Scale:	Neighbourhood - Cluster

F.1.6 Impact on access to daylight or solar energy potential of contiguous buildings

Intent:	To promote solar access to the buildings
Indicator:	Percentage of buildings negatively impacted to solar access
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of buildings in the local area that are negatively impacted with respect to access to daylight or solar energy potential by the design or location of contiguous buildings
Urban Scale:	Neighbourhood - Cluster

F.1.7 Impact of local building user population on peak load capacity of public transport system

Intent:	To evaluate the peak load capacity of public transport system
Indicator:	Peak load capacity of public transport system on user population
Unit of measure:	-
Relevant information:	The impact of user populations of buildings in the local area on peak load capacity of public transport system. The load factor is the dimensionless ratio of passenger-kilometers travelled to seat-kilometers available. It should be noted that the environmental performance of any transport mode improves as the load factor increases
Assessment method:	1. Determine the load capacity of public transport systems, in seat-kilometers available. 2. Determine the passenger load at peak periods in passenger-km. 3. Divide 2/1
Urban Scale:	Neighbourhood - Cluster

F.1.8 Impact of private vehicles used by the local population on peak load capacity of the local road system

Intent:	To determine the impact of private vehicles used by the local population on the peak load capacity of the local road system
Indicator:	Impact degree of private vehicles on the population
Unit of measure:	-
Relevant information:	Urban roads must serve the needs of public transport, trucks, cars, bicycles and pedestrians (crossing). Such competing uses usually leave bicycles and pedestrians having the least priority. Facilitating vehicle traffic can lead to the peak load capacity of the urban road system being exceeded, with results such as reduced traffic speed, increased air pollution and a negative environment for pedestrians and adjacent retail shops. Private vehicles are a major part of the problem, because of the large numbers involved. Congestion pricing is one method used in some large cities to reduce vehicle traffic at peak periods.
Assessment method:	1. Identify sections of the urban road network that are representative of the variety of road types in the local area; 2. Identify the designed traffic capacity of each section; 3. Assess current vehicle traffic volumes and typical speeds at peak traffic periods; 4. Assess secondary impacts of high traffic volumes on bicyclists, pedestrians and the function of retail, commercial or residential buildings facing the roads. 5. Summarize the situation by estimating the impact of local vehicle traffic on the peak road capacity.
Urban Scale:	Neighbourhood - Cluster

F.1.9 Degree of atmospheric light pollution caused by exterior lighting systems of buildings

Intent:	To reduce light pollution
Indicator:	Light pollution caused by exterior lighting systems of buildings
Unit of measure:	-
Relevant information:	Many factors play a role in sky glow. One must not only consider the lighting, but also the angular distribution of the light emitted from the luminaire, the light reflected from the ground and its angular distribution, as well as atmospheric effects of humidity and the interaction of light with aerosols (particles in the atmosphere that may be caused by manufactured pollutants, fire, volcanic eruptions, etc.), all of which can change from moment to moment. Light environmentalists identify four types of light pollution. The first is sky glow, which is defined as light wastefully escaping into the night sky. The glows over urban or suburban communities that result as a consequence have considerably changed the clarity of the night sky view and interfere with scientific observation of the stars. The second type is glare, which is light shining dangerously into people's eyes, causing viewing discomfort and reduced night vision that can play a part in roadway accidents. The third type is light trespass, which refers to light from a source directed towards an adjacent property or lighting of an area that would otherwise be dark. The fourth type is energy waste, which refers to inappropriate use of light or appliances that increase the energy demand, and hence, the consumption of fossil fuels to generate electricity.
Assessment method:	Night sky brightness (NSB) is quantified aa the brightness of skyglow. The measured NSB is a combination of the scattered light from artificial lighting sources and natural emissions. Technically, NSB refers to the flux of “anything” coming from the night sky per unit surface per unit solid angle. Typical units of NSB include magnitude per arcsecond square (mag/arcsec2) and candela per meter square (cd/m2).
Urban Scale:	Neighbourhood - Cluster

F.1.10 Degree of atmospheric light pollution caused by exterior public lighting systems

Intent:	To reduce light pollution
Indicator:	Light pollution caused by exterior public lighting systems
Unit of measure:	-
Relevant information:	Many factors play a role in sky glow. One must not only consider the lighting, but also the angular distribution of the light emitted from the luminaire, the light reflected from the ground and its angular distribution, as well as atmospheric effects of humidity and the interaction of light with aerosols (particles in the atmosphere that may be caused by manufactured pollutants, fire, volcanic eruptions, etc.), all of which can change from moment to moment. Light environmentalists identify four types of light pollution. The first is sky glow, which is defined as light wastefully escaping into the night sky. The glows over urban or suburban communities that result as a consequence have considerably changed the clarity of the night sky view and interfere with scientific observation of the stars. The second type is glare, which is light shining dangerously into people's eyes, causing viewing discomfort and reduced night vision that can play a part in roadway accidents. The third type is light trespass, which refers to light from a source directed towards an adjacent property or lighting of an area that would otherwise be dark. The fourth type is energy waste, which refers to inappropriate use of light or appliances that increase the energy demand, and hence, the consumption of fossil fuels to generate electricity.
Assessment method:	Night sky brightness (NSB) is quantified aa the brightness of skyglow. The measured NSB is a combination of the scattered light from artificial lighting sources and natural emissions. Technically, NSB refers to the flux of “anything” coming from the night sky per unit surface per unit solid angle. Typical units of NSB include magnitude per arcsecond square (mag/arcsec2) and candela per meter square (cd/m2).
Urban Scale:	Neighbourhood - Cluster

F.1.11 Albedo of building and paving surfaces

Intent:	To reduce the heat island effect, to reduce the discomfort at ground level during summer
Indicator:	Average albedo of building and paving surfaces exposed to direct sunlight
Unit of measure:	Number
Relevant information:	Albedo is the fraction of solar energy (shortwave radiation) reflected from the Earth back into space. It is a measure of the reflectivity of the earth's surface. An albedo of zero (black body) to 1 (perfectly reflective). In urban areas, dark paving has a low albedo and therefore later re-radiates heat, causing discomfort and adding to the urban heat island effect. Most urban surfaces have albedos ranging from 0.1 to 0.4
Assessment method:	For the indicator of performance calculation proceeds as follows: 1. Calculate the total area of the urban area 2. Calculate the area of each homogeneous surfaces identified in the area. 3. Multiply each previously identified surface for the relative reflection coefficients. 4. Sum the thus obtained weighed surfaces. 5. Divide the total value of the sum of homogeneous areas weighted by the relative reflection coefficients for the urban area total area analyzed. 6. The final figure thus derived is expressed as a dimensionless figure between 0 and 1
Urban Scale:	Neighbourhood - Cluster

F2 Outdoor environmental quality

F.2.1 Ambient air quality with respect to particulates <2.5 mu (PM2.5) over a one year period

Intent:	To evaluate the quality of the air through the exceeded daily limits of pollutants
Indicator:	Number of days exceeding the daily limits in a year
Unit of measure:	days / y
Relevant information:	From Wikipedia: In 2013, a study involving 312,944 people in nine European countries revealed that there was no safe level of particulates and that for every increase of 10 µg/m3 in PM10, the lung cancer rate rose 22%. The smaller PM2.5 were particularly deadly, with a 36% increase in lung cancer per 10 µg/m3 as it can penetrate deeper into the lungs. Major sources of PM2.5 particulates include wood combustion, gasoline-powered motor vehcile and diesel exhaust, meat cooking and road dust.
Assessment method:	Number of days with bad air quality per 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
Urban Scale:	Neighbourhood - Cluster

F.2.2 Ambient air quality with respect to particulates <2.5 mu (PM2.5) over a one-week period

Intent:	To evaluate the quality of the air through the exceeded daily limits of pollutants
Indicator:	Number of days exceeding the daily limits in a year
Unit of measure:	days / y
Relevant information:	From Wikipedia: In 2013, a study involving 312,944 people in nine European countries revealed that there was no safe level of particulates and that for every increase of 10 µg/m3 in PM10, the lung cancer rate rose 22%. The smaller PM2.5 were particularly deadly, with a 36% increase in lung cancer per 10 µg/m3 as it can penetrate deeper into the lungs. Major sources of PM2.5 particulates include wood combustion, gasoline-powered motor vehicle and diesel exhaust, meat cooking and road dust.
Assessment method:	Number of days with bad air quality per 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
Urban Scale:	Neighbourhood - Cluster

F.2.3 Ambient air quality with respect to particulates <10 mu (PM10) over a one year period

Intent:	To assess the long-term ambient air quality with respect to particulates <10 mu (PM10) in the local area
Indicator:	Number of days exceeding the daily limits in a year
Unit of measure:	days/year
Relevant information:	Particulate matter (PM10) pollution consists of very small liquid and solid particles floating in the air. PM10 is a mixture of materials that can include smoke, soot, dust, salt, acids, and metals. Particulate matter also forms when gases emitted from motor vehicles and industry undergo chemical reactions in the atmosphere. PM10 is among the most harmful of all air pollutants. When inhaled these particles evade the respiratory system's natural defences and lodge deep in the lungs. The criterion allows to evaluate the level of exposition of inhabitants to PM10 in the urban area
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.
Urban Scale:	Neighbourhood - Cluster

F.2.4 Ambient air quality with respect to particulates <10 mu (PM10) over a one-week period

Intent:	To assess the long-term ambient air quality with respect to particulates <10 mu (PM10) in the local area
Indicator:	Ambient air quality
Unit of measure:	days/year
Relevant information:	From Wikipedia: In 2013, a study involving 312,944 people in nine European countries revealed that there was no safe level of particulates and that for every increase of 10 μg/m3 in PM10, the lung cancer rate rose 22%.
Assessment method:	Test air samples in accordance with acceptable national procedures, including consideration of condensable emissions. Number of days with bad air quality per year. Number of days with more than 50 μg/m3.
Urban Scale:	Neighbourhood - Cluster

F.2.5 Ambient air quality - carbon monoxide

Intent:	To evaluate the quality of the air through the exceeded daily limits of pollutants
Indicator:	Number of days exceeding the daily limits in a year
Unit of measure:	days / y
Relevant information:	-
Assessment method:	Number of days with bad air quality per 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
Urban Scale:	Neighbourhood - Cluster

F.2.6 Ambient air quality - ozone

Intent:	To evaluate the quality of the air through the exceeded daily limits of pollutants
Indicator:	Number of days exceeding the daily limits in a year
Unit of measure:	days / y
Relevant information:	-
Assessment method:	Number of days with bad air quality per 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
Urban Scale:	Neighbourhood - Cluster

F.2.7 Olfactory quality in the area

Intent:	To evaluate the olfactory quality of air in the area
Indicator:	Frequency of anecdotal reports of poor olfactory conditions
Unit of measure:	Number
Relevant information:	Bad odours are difficult to measure objectively, but annoying to many. Sources may include sewage systems, rubbish that has not been picked up etc.
Assessment method:	Number of anecdotal reports of poor olfactory conditions in the area in one year
Urban Scale:	Neighbourhood - Cluster

F.2.8 Adverse wind conditions at grade around low-rise buildings

Intent:	To reduce the impact of excessive wind conditions at street level for low rise buildings
Indicator:	Qualitative
Unit of measure:	Number
Relevant information:	-
Assessment method:	Anecdotal reports or CFD modeling indicating discomfort from wind gusts or high sustained wind speeds around low-rise buildings at street levels.
Urban Scale:	Neighbourhood - Cluster

F.2.9 Adverse wind conditions at grade around tall buildings

Intent:	To reduce the impact of excessive wind conditions near the ground floor of high buildings.
Indicator:	Qualitative
Unit of measure:	Number
Relevant information:	-
Assessment method:	Anecdotal reports or CFD modeling indicating discomfort from wind gusts or sustained windspeeds around certain buildings at street levels
Urban Scale:	Neighbourhood - Cluster

F.2.10 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:	%
Relevant information:	Excessive ambient noise can be annoying and can disrupt normal activities. Daytime activities are less affected
Assessment method:	This indicator measures the percent of the population living in an area with excessive ambient daytime noise levels
Urban Scale:	Neighbourhood - Cluster

F.2.11 Ambient night-time noise conditions

Intent:	To promote acoustic comfort, for a healthy and safe environment
Indicator:	Proportion of population exposed to not recommended levels of night noise
Unit of measure:	%
Relevant information:	Excessive ambient noise can be annoying and can disrupt normal activities, especially at night when residents may want to sleep with open windows
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.
Urban Scale:	Neighbourhood - Cluster

F.2.12 Summer thermal comfort conditions

Intent:	To evaluate summer thermal comfort conditions
Indicator:	Factors include temperature, relative humidity and wind speeds, or Standard Effective Temperature (SET)
Unit of measure:	SET
Relevant information:	-
Assessment method:	Relevant factors include type of outdoor activity, temperature, relative humidity and wind speeds, or Standard Effective Temperature (SET)
Urban Scale:	Neighbourhood - Cluster

F.2.13 Winter thermal comfort conditions

Intent:	To evaluate winter thermal comfort conditions
Indicator:	Factors include temperature, relative humidity and wind speeds, or Standard Effective Temperature (SET)
Unit of measure:	SET
Relevant information:	-
Assessment method:	Factors include temperature, relative humidity and wind speeds, or Standard Effective Temperature (SET)
Urban Scale:	Neighbourhood - Cluster

F3 Ecosystems and landscapes

F.3.1 Green zones & recreation areas availability

Intent:	To measure the existing green zones and recreation areas as added value for quality of life of inhabitants
Indicator:	Availability of green zones & recreation areas
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate (Green zones & Recreation areas m2 / Number of inhabitants)
Urban Scale:	Neighbourhood - Cluster

F.3.2 Green zones & recreation areas accessibility

Intent:	To reduce negative effects of urbanization
Indicator:	Accessibility of green spaces within the area
Unit of measure:	m
Relevant information:	-
Assessment method:	Calculate the average distance to green zones and recreation area for a sample of key residential buildings in the area. Parks & Open Spaced are defined as: • Public garden (1000m), green spaces (500m), parks and other facilities for pedestrians and cyclists • Outdoor sport facilities with freedom of access (1300m)
Urban Scale:	Neighbourhood - Cluster

F.3.3 Green zones & recreation areas density

Intent:	To measure the existing green zones and recreation areas as added value for quality of life of inhabitants
Indicator:	Density of green spaces within the area
Unit of measure:	%
Relevant information:	
Assessment method:	Calculate (Green zones & Recreation areas m2 / Urban area square meters)
Urban Scale:	Neighbourhood - Cluster

F.3.4 Contamination status of undeveloped land

Intent:	To preserve contamination of undeveloped land
Indicator:	Contamination degree of soil and water courses of undeveloped land
Unit of measure:	-
Relevant information:	-
Assessment method:	Calculate the degree to which subsurface soil or water courses, or undeveloped land parcels within the local area are polluted from natural or human causes
Urban Scale:	Neighbourhood - Cluster

F.3.5 Surface water management

Intent:	To preserve infrastructures or buildings from water
Indicator:	Actions for the protection of infrastructures or buildings from the water
Unit of measure:	-
Relevant information:	-
Assessment method:	Evaluate the degree to excessive surface water is managed, through sinks, channels or other means, to avoid damage to landscaped areas, infrastructure or buildings
Urban Scale:	Neighbourhood - Cluster

F.3.6 Tree coverage for shade and management of local ambient temperatures

Intent:	To reduce ambient temperatures through evapo-transpiration
Indicator:	Reduction of ambient temperatures through evapo-transpiration
Unit of measure:	%
Relevant information:	Deciduous trees can be very effective in shielding people and lower parts of buildings from excessive solar heat gain. This does not apply to seasons when leaves have fallen
Assessment method:	Calculate the area of tree planting in the local area relative to total area, with trees suitable for shading and reduction of ambient temperatures through evapo-transpiration
Urban Scale:	Neighbourhood - Cluster

F.3.7 Green roofs

Intent:	To determine the aggregate area of green roofs on all buildings relative to the total surface area in the locality
Indicator:	Aggregate area of building roofs covered with vegetated material
Unit of measure:	%
Relevant information:	Green roofs may be defined as building roof with slopes no great that 10%, that are covered with vegetation. Green roofs reduce the contribution of buildings to the Urban Heat Island effect. Green roofs can also slow down the drainage of heavy rain into local sewer systems, thereby helping to avoid flooding in local streets. A side benefit is a reduction of ambient noise into the building
Assessment method:	1. Identify all buildings with green roofs and estimate the aggregate net green roof area. 2. Determine the ratio of the aggregate green roof area to the total surface area in the locality
Urban Scale:	Neighbourhood - Cluster

F.3.8 Vegetated walls and other building surfaces

Intent:	To absorb rain water and to stock green effect gazes and to contribute to the freshness and life quality of the area
Indicator:	Aggregate area of building walls and other building surfaces that are covered with vegetation, m2
Unit of measure:	m2
Relevant information:	Vegetated walls (ivy etc.) can provide considerable help in reducing thermal heat gain by walls of buildings that are exposed to mid-day sun during summer conditions
Assessment method:	Calculate the vegetated building surfaces area (m2)
Urban Scale:	Neighbourhood - Cluster

F.3.9 Presence or potential for wildlife corridors

Intent:	To favour the continuity of natural spaces as a core issue for maintaining biodiversity
Indicator:	Continuity of green areas to support small wildlife
Unit of measure:	-
Relevant information:	-
Assessment method:	The continuity of green areas more than 100 m. in width, uninterrupted by structures or infrastructure, and traversing the whole local area, to support small wildlife
Urban Scale:	Neighbourhood - Cluster

F.3.10 Ecological diversity in the area

Intent:	To preserve and enhance the local ecological diversity
Indicator:	Degree of the diversity of the surrounding natural environment
Unit of measure:	-
Relevant information:	-
Assessment method:	The degree to which diversity of surface and aquatic biota in the local area reflects that of the surrounding natural environment
Urban Scale:	Neighbourhood - Cluster

F.3.11 Ecological sensitivity classification of the area

Intent:	To preserve human and biological elements to negative impacts of the built environment
Indicator:	The sensitivity of human and biological elements of the ecosystem to impacts of the built environment or natural events
Unit of measure:	-
Relevant information:	-
Assessment method:	The sensitivity of human and biological elements of the ecosystem to impacts of the built environment (construction, effluents) or natural events (floods or wind)
Urban Scale:	Neighbourhood - Cluster

F.3.12 Walking or bicycling nature trails

Intent:	To incentivate nature trails walking or with bicycle
Indicator:	Length of walking or bicycling nature trails
Unit of measure:	Km/1000 residents
Relevant information:	Calculated data
Assessment method:	Length of walking or bicycling nature trails, in km/1000 residents
Urban Scale:	Neighbourhood - Cluster

F.3.13 Condition of surface freshwater systems

Intent:	To preserve the quality of surface freshwater
Indicator:	The level of pollution of surface freshwater systems within the local area
Unit of measure:	-
Relevant information:	The river Rhine, it is well known, doth wash your city of Cologne: But tell me, nymphs, What power divine shall henceforth wash the river Rhine? Samuel Taylor Coleridge (1772-1834)
Assessment method:	Evaluation of the level of pollution of surface freshwater systems within the local area, including total dissolved solids, salinity, oxygen, BOD, nitrogen, phosphorous, chlorophyll, toxics. The condition of the waterbody should be categorized as Excellent, Good, Fair, Marginal or Poor, reflecting degree of adherence to locally applicable regulations and standards
Urban Scale:	Neighbourhood - Cluster

F.3.14 Condition of groundwater and subsurface aquifers

Intent:	To preserve the quality of groundwater and subsurface aquifers
Indicator:	The capacity and purity of groundwater and subsurface aquifers
Unit of measure:	-
Relevant information:	-
Assessment method:	The capacity and purity of groundwater and subsurface aquifers in the local area
Urban Scale:	Neighbourhood - Cluster

F.3.15 Viability of adjacent wetlands and urban marine environments

Intent:	To preserve the quality of wetlands and urban marine environments
Indicator:	Ability of wetlands and marine environments to withstand impacts of urban development or natural events
Unit of measure:	-
Relevant information:	-
Assessment method:	Estimates of the ability of wetlands and marine environments within or adjacent to the local area to withstand impacts of urban development or natural events
Urban Scale:	Neighbourhood - Cluster

G Social Aspects

G1 Safety and Accessibility

G.1.1 Buildings 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 have physical access to key buildings
Indicator:	Percent of key public, commercial and residential buildings that are accessible for use by physically disabled persons
Unit of measure:	%
Relevant information:	Persons with physical disabilities that require the use of walking aids or wheelchairs, who need access to key public or commercial buildings, often encounter problems in entering these buildings. There are also other physical disabilities, such as visual or auditory problems, that make physical access difficult or impossible. Approaches to address this problem have been under development since the 1970's. the most obvious include the provision of reserved and extra-wide parking spaces, exterior curb cuts, covered ramps, wide exterior doors with electric or hydraulic operation. Other important features include auditory or visual wayfinding clues.
Assessment method:	1. Identify what may be referred to as "key" public, commercial and residential buildings. 2. Assess the accessibility of exterior parking and pedestrian access areas, considering all major disability types. 3. Establish the percent of key buildings that may be considered accessible.
Urban Scale:	Neighbourhood - Cluster

G.1.2 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:	%
Relevant information:	-
Assessment method:	1. Identify key pedestrian paths or other public routes that may be frequently used by persons with physical disabilities. 2. Assess the accessibility of exterior parking and pedestrian routes, considering all major disability types. 3. Establish the percent of public pedestrian routes that may be considered accessible
Urban Scale:	Neighbourhood - Cluster

G.1.3 Barrier-free accessibility in local outdoor public areas

Intent:	To evaluate the accessibility of various urban resources using spatial data analysis
Indicator:	Adequacy of barrier-free accessible public outdoor areas compared to the total public area
Unit of measure:	%
Relevant information:	-
Assessment method:	1. Identify key outdoor public facilities that may be frequently used by persons with physical disabilities. 2. Assess the accessibility of pedestrian routes, considering all major disability types. 3. Establish the percent of public outdoor facilities that may be considered accessible.
Urban Scale:	Neighbourhood - Cluster

G.1.4 Ease of access to and use of public transport for physically disabled persons

Intent:	To facilitate the access to public transport by physically disabled persons
Indicator:	Features of public transport to facilitate access physically disabled persons, such as kneeling buses and wide entries
Unit of measure:	%
Relevant information:	-
Assessment method:	Evaluate the ease of access to and use of public transport for physically disabled persons
Urban Scale:	Neighbourhood - Cluster

G.1.5 Objective/subjective safety measures

Intent:	To provide objective and subjective safety to area users
Indicator:	Adequacy of signage and traffic calming measures
Unit of measure:	-
Relevant information:	-
Assessment method:	Adequacy of signage and traffic calming measures taken to protect pedestrians, cyclists and drivers from traffic dangers
Urban Scale:	Neighbourhood - Cluster

G2 Traffic and mobility services

G.2.1 Performance of the public transport

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:	%
Relevant information:	Most urban areas are serviced by a public transportation service, but the quality of service, including the density of the route network, scheduling to suit the needs of the local population and affordable fares, vary widely
Assessment method:	To characterize the indicator's value: 1. Calculate the percentage of the inhabitants 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 residents and not working people in the area.
Urban Scale:	All

G.2.2 Availability of car sharing services

Intent:	To promote the use of car sharing services
Indicator:	Resident and working population using car sharing services
Unit of measure:	%
Relevant information:	-
Assessment method:	Percent of resident and working population in the local area making use of car sharing services, averaged over a one-year period
Urban Scale:	Neighbourhood - Cluster

G.2.3 Measures to limit traffic of cars and trucks passing through the local area

Intent:	To reduce the volume of transient vehicular traffic in order to reduce air pollution, noise or hazards for bicyclists and pedestrians
Indicator:	The effectiveness of regulations or financial measures designed to limit number of vehicles passing at peak hours
Unit of measure:	-
Relevant information:	Urban roads must serve the needs of public transport, trucks, cars, bicycles and pedestrians (crossing). Excess traffic generated within the local area can lead to problems such as reduced traffic speed, excessive noise, increased air pollution and a negative environment for pedestrians and adjacent retail shops. If the local area is also subjected to a high level of vehicles, especially trucks, passing through the area to other destinations, the peak load capacity of the urban road system may be exceeded and pollution, noise and other problems may become intolerable. Congestion pricing is one method used in some large cities to reduce vehicle traffic at peak periods.
Assessment method:	1. Identify sections of the urban road network that may be used by through traffic; 2. Identify the designed traffic capacity of each section; 3. Assess the proportion of current vehicle traffic volumes generated by local and through traffic at non-peak and peak traffic periods; 4. Assess secondary impacts of high traffic volumes on bicyclists, pedestrians and the function of retail, commercial or residential buildings facing the roads. 5. Summarize the situation by estimating the impact of local vehicle traffic on the peak road capacity.
Urban Scale:	Neighbourhood - Cluster

G.2.4 Quality of pedestrian and bicycle network

Intent:	To promote cycling and walking as an alternative to vehicle use by providing a safe and efficient mobility networks. Travelling by bicycle or by foot means less cars on the roads which reduces traffic congestion. Efficient alternative and environmentally-friendly modes of transport are key to not only improve mobility but the quality of life as well
Indicator:	Total walkway meters of dedicated pedestrian paths and meters of bicycle path and “shared space” per 100 inhabitants
Unit of measure:	m/100 inhabitants
Relevant information:	Increasing zero emission mobility is crucial to lower the carbon footprint of human activities
Assessment method:	To characterize the indicator’s value: 1. Estimation of the number of inhabitants in the area 2. Calculation of the walkway meters of dedicated pedestrian paths in the area (A) 3. Calculation of the meters of bicycle paths in the area (B) 4. Calculation of the meters of “shared space” in the area (C) 5. Calculate the indicator’s value as: (A+B+C) 100 INHABITANTS Note -Pedestrian paths not part of a “shared space” must be safe to be considered (physically separated from traffic roads) -Bicycle paths not part of a “shared space” must be safe to be considered (physically separated from traffic roads) -A “shared space” is an urban design approach that minimizes the segregation between modes of road user (car, pedestrian, bicycle, etc.) in order to make safe space for every type of mobility; the shared space is to be used by anyone. This can be done through minimizing traffic signs, road surface markings, enforcing speed reduction down to 15-20 kmh. Shared space is here understood in a broad definition including the different philosophies and implementation methods in force in Europe. For the calculation it is necessary to evaluate the linear meters of all the streets included in a shared space.
Urban Scale:	Neighbourhood - Cluster

G.2.5 Availability of sheltered bicycle parking facilities

Intent:	To promote cycling and walking as an alternative to vehicle use by providing a safe and efficient mobility networks
Indicator:	Sheltered bicycle parking spaces
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the number of sheltered bicycle parking spaces relative to the total population of the local area
Urban Scale:	Neighbourhood - Cluster

G3 Communication services

G.3.1 Availability of a broadband communication network

Intent:	To evaluate occupant access to broadband communication
Indicator:	Local area with available broadband communication network
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of the local area in which a broadband communication network is available
Urban Scale:	Neighbourhood - Cluster

G.3.2 Access to a broadband communication network

Intent:	To ensure occupants access to high-speed Internet connections
Indicator:	Percentage of population with access to broadband communication
Unit of measure:	%
Relevant information:	-
Assessment method:	Identify all the dwellings that have access to high-speed Internet connection, estimate the occupancy, and divide the value for the overall population of the area
Urban Scale:	Neighbourhood - Cluster

G4 Public and private facilities and services

G.4.1 Availability and proximity of key food and retail services

Intent:	To assess the ability of local residents to have easy access to local key food services
Indicator:	Percent of residential buildings located within a distance of 300 m. of basic food and household goods
Unit of measure:	%
Relevant information:	Access to key local food services within easy walking distance is a factor in residents' choice of walking or using a car to do basic shopping for food or retail facilities such as news, pharmacy, discount stores, restaurants and other small shops
Assessment method:	1. Estimate typical walking distances from centers of residential occupancy to key food and retail services. 2. Estimate the residential population living within 500 m. of shopping facilities and calculate the percent relative to the total residential population in the local area
Urban Scale:	Neighbourhood - Cluster

G.4.2 Availability and proximity of 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:	Percentage of inhabitants that are within 800 meters walking distance of at least 3 key services
Unit of measure:	%
Relevant information:	Convenient locations of key services for access by residents (e.g. schools, sports facilities, supermarket, community buildings, etc.) is a major factor in reducing the use of private vehicles and in ensuring that residents can obtain access to the services they need.
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 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.
Urban Scale:	Neighbourhood - Cluster

G.4.3 Availability and proximity of a primary school

Intent:	To evaluate the percentage of the population near a primary school
Indicator:	Percentage of population near a primary school
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of resident population with access to a primary school within a distance of 500 m
Urban Scale:	Neighbourhood - Cluster

G.4.4 Availability and proximity of a secondary school

Intent:	To evaluate the percentage of the population near a secondary school
Indicator:	Percentage of population near a secondary school
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of resident population with access to a secondary school within a distance of 1 km
Urban Scale:	Neighbourhood - Cluster

G.4.5 Availability and proximity of childrens' play facilities

Intent:	To evaluate the percentage of the population near a childrens' play facilities
Indicator:	Percentage of population near a childrens' play facilities
Unit of measure:	%
Relevant information:	-
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
Urban Scale:	Neighbourhood - Cluster

G.4.6 Availability and proximity of leisure facilities

Intent:	To discourage and reduce the use of private vehicles for transportation to take advantage of these services and facilities
Indicator:	Percent of residential buildings located within a distance of 1 km. of public or commercial leisure facilities
Unit of measure:	%
Relevant information:	-
Assessment method:	For the indicator of performance calculation proceeds as follows: 1. Identify the facilities for leisure in the area, distinguishing in sports and cultural structures. 2. Calculate the actual distance on foot between these nodes and access the buildings. 3. Calculate the percentage of the population that is less than 1km from at least one service for each of the two categories.
Urban Scale:	Neighbourhood - Cluster

G.4.7 Access to indoor gymnastic facilities for winter use

Intent:	To promote the indoor gymnastic facilities
Indicator:	Percent of residential buildings located near an indoor gymnastic facility for winter use
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of resident population of the local area who have access within a distance of 1 km. to an indoor gymnastic facility for winter use
Urban Scale:	Neighbourhood - Cluster

G5 Local Food

G.5.1 Local production of food

Intent:	To encourage the production of fresh fruit and vegetables
Indicator:	Surface of garden areas per capita
Unit of measure:	m² / inhabitant
Relevant information:	-
Assessment method:	Calculate the surface area of vegetable gardens available to the users in the area in relation to the number of inhabitants
Urban Scale:	Neighbourhood - Cluster

G.5.2 Residents' access to and use of urban agricultural plots

Intent:	To promote self food production
Indicator:	Percentage of the population with access to public urban agriculture plots
Unit of measure:	%
Relevant information:	-
Assessment method:	Percent of resident population with access to public urban agriculture plots within a distance of 1 km
Urban Scale:	Neighbourhood - Cluster

G6 Management and community involvement

G.6.1 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:	%
Relevant information:	-
Assessment method:	Calculate the percentage of resident population above 16 years in age having an on-going involvement in community or school associations
Urban Scale:	Neighbourhood - Cluster

G.6.2 Community management of urban facilities and urban spaces

Intent:	To raise awareness about urban spaces management among citizens
Indicator:	Percentage of population playing management roles in public facilities
Unit of measure:	%
Relevant information:	-
Assessment method:	Calculate the percentage of resident population playing management roles in public facilities such as schools, libraries and parks
Urban Scale:	Neighbourhood - Cluster

G.6.3 Community involvement in urban planning activities

Intent:	To raise the level of community involvement in planning through the redistribution of power. The assessment is therefore about: - how much citizens (inhabitants and users) are integrated to the planning process? - how much their opinion is taken into consideration? - how much they drive the planning agenda? - Are people “planned for” by external experts or are they part of the decision-making process? - Is there a dichotomy between the planners holding power (and supposedly knowledge) and citizens?
Indicator:	Percentage of residents active in public urban planning
Unit of measure:	LEVEL
Relevant information:	The Arnstein ladder, built by Sherry Arnstein (SA), is the reference for community planning assessment. Her work remains the basis of current research on citizen involvement in planning. The hereby proposed assessment process is therefore based on the SA ladder (figure1) and further development from Hélène Chelzen and Anne Jégou in 20152 which tends to take into consideration recent evolution in practices.
Assessment method:	To characterize the indicator’s value: 1- 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. Specifications: The criterion may be applied only during the implementation of a planning process for an area of the city, in which there is the involvement of the community in urban planning activities. A shared diagnosis can be made after delivery for corrective actions to be implemented. As a supportive

	introduction to identification of the level of citizen involvement, the method provides the definition of the main rungs from SA ladder and steps from Chelzen and Jegou, classified in the 3 categories: 1/Non participation ; 2/Degrees of tokenism ; 3/Degrees of citizen power, including shared diagnosis and co-decision. **1/ "Non-participation" or "No power" category including rungs "Manipulation" and "Therapy" (in the Arnstein ladder).** The description of the 2 rungs of the "Non-participation / No power" category i.e "Manipulation" and "Therapy" provided by SA encompasses complete external expertise for realizing the urban project on the neighborhood and a lack of transparency in the program information. **2 / "Degrees of tokenism" category including rungs "Information", "Consultation" and "Placation" (in the Arnstein ladder).** In the "Degrees of tokenism" category, the level of information transparency is good, but the redistribution of power is low and involvement remain symbolic. The reason is the goal for the communication. Here, the goal of "Information" is to explain the project and gain support. There is no option or scenario to discuss upon with citizens. There is very little opportunity for people to influence the program designed by external experts. Information is a one-way flow from project owner/developer to users. Here, "Consultation" means collecting the opinion of inhabitants and users. Still it is not a guaranty it will be taken into consideration. There is no follow-through assurance. The scope for taking into consideration citizen concerns and ideas is often marginal. Consultation would only lead to a degree of citizen power if the consultation results are taken into account. **3 / "Degrees of citizen power" category including rungs "Partnership", "Delegated power" and "Citizen power" (in the Arnstein ladder) and "Shared diagnosis" and "Co-decision" (from Chelzen and Jégou).** The main point of this category is the recognition of inhabitants and users expertise, and its integration within the project. Here "Partnership" refers to redistribution of power, shared between citizens and power holders in planning and decision-making responsibilities. This can be done notably in the diagnosis phases, upstream of the project definition or after the delivery. A shared diagnosis (or shared state of the art) consists in understanding spatial practices on the urban territory and pointing out dysfunctions based on users' experience and expertise. In this approach, users do not have decision power, but they are recognised/admitted as indispensable in the development of the diagnosis. This means they are more likely to influence the agenda pointing out their needs and concerns. In the planning process, the shared diagnosis can happen upstream to be the base of the project. It can also be made once the project is completed to assess the results and to consider corrective action consequently. It leads to "Co-decision", if users are then involved in the co- construction and/or choice of planning scenario based on this shared diagnosis. Levels for assessment: Level 0 : Non participation Level 1 : Degrees of tokenism (information and consultation) Level 2 : Shared diagnosis Level 3 : Co-decision Assessing levels of involvement: The following table aims at supporting the assessment of the different levels.
Urban Scale:	Neighbourhood - Cluster

D.6.4 Individual access to community facilities and key services during off-hours

Intent:	To guarantee the individual access to community facilities and key services during off-hours
Indicator:	Individual access to community facilities and key services during off-hours
Unit of measure:	%
Relevant information:	-
Assessment method:	Evaluate the level of individual access to community facilities and key services during off-hours
Urban Scale:	Neighbourhood - Cluster

G7 Society, Culture and Heritage

G.7.1 Compatibility of urban design with local cultural values

Intent:	To evaluate compatibility of urban design with local cultural values
Indicator:	Compatibility with local area traditional values of street layouts and the character of urban spaces
Unit of measure:	Qualitative data
Relevant information:	-
Assessment method:	Evaluate the compatibility of street layouts and the character of urban spaces in the local area with traditional cultural values in the region
Urban Scale:	Neighbourhood - Cluster

G.7.2 Compatibility of public open space with local cultural values

Intent:	To evaluate compatibility of public open space with local cultural values
Indicator:	Compatibility with local area traditional values of local public open spaces, including major uses, dimensions and adjacent uses
Unit of measure:	Qualitative data
Relevant information:	-
Assessment method:	Evaluate the compatibility of public open spaces in the local area with traditional cultural values in the region
Urban Scale:	Neighbourhood - Cluster

G.7.3 Compatibility of new building designs with existing streetscapes

Intent:	To determine the compatibility of new building designs with existing buildings in the local area
Indicator:	Compatibility of the design of new buildings with local area traditional types of building configurations, window types, materials, textures and colours
Unit of measure:	Qualitative data
Relevant information:	There may always be some conflict between the design characteristics of new projects inserted into an existing local area with those of existing buildings and streetscapes. The relevant variables include configuration, forms, floor heights, window types, materials and colours, and the issues become especially important when there are old or historical buildings that have become valued by the local culture.
Assessment method:	1. Establish a panel of local architects and lay people to assess potential areas of design conflict. 2. Prepare a report on the results and disseminate to relevant local actors
Urban Scale:	Neighbourhood - Cluster

G.7.4 Use of traditional local materials and techniques

Intent:	To promote the use of local materials and techniques
Indicator:	Compatibility with local area traditional values of construction techniques and types of materials
Unit of measure:	Qualitative data
Relevant information:	-
Assessment method:	Evaluate the compatibility with local area traditional values of construction techniques and types of materials
Urban Scale:	Neighbourhood - Cluster

G.7.5 Maintenance of UNESCO or other protected landscapes

Intent:	To preserve and maintain landscape heritage
Indicator:	Preventive maintenance and protection of UNESCO or other protected landscapes
Unit of measure:	Qualitative data
Relevant information:	-
Assessment method:	Evaluate the preventive maintenance and protection of UNESCO or other protected landscapes
Urban Scale:	Neighbourhood - Cluster

G8 Perceptual

G.8.1 Impact of tall structure(s) on existing view corridors

Intent:	To avoid visual obstruction on important view corridors
Indicator:	Preservation of the view corridors
Unit of measure:	Qualitative data
Relevant information:	-
Assessment method:	Evaluate the degree to which buildings greater than 6 floors in height block important view corridors in the local area
Urban Scale:	Neighbourhood - Cluster

G.8.2 Panoramic and scenic routes or view points

Intent:	To evaluate interesting natural or urban scenery
Indicator:	Presence and quality of scenic routes and places
Unit of measure:	Qualitative data
Relevant information:	-
Assessment method:	Calculate the presence and quality of scenic routes and places that provide views of interesting natural or urban vistas
Urban Scale:	Neighbourhood - Cluster

G.8.3 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:	Qualitative data
Relevant information:	-
Assessment method:	Evaluate the perceived safety of public places and pedestrian routes, as determined by a sample of residents
Urban Scale:	Neighbourhood - Cluster

G.8.4 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:	Qualitative data
Relevant information:	-
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
Urban Scale:	Neighbourhood - Cluster

G.8.5 Impact of overhead electric distribution system on the visual environment

Intent:	To avoid visual environment obstruction caused by overhead electric distribution system
Indicator:	Visual impact of above-grade electrical distribution systems
Unit of measure:	Qualitative data
Relevant information:	-
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
Urban Scale:	Neighbourhood - Cluster

G.8.6 Perceptual quality of area development

Intent:	To improve the perception of residents about quality of the urban area
Indicator:	Perceived quality of the urban area and natural development
Unit of measure:	Qualitative data
Relevant information:	-
Assessment method:	Evaluate the perceived quality of area urban and natural development, as determined by a sample of residents
Urban Scale:	Neighbourhood - Cluster

G.8.7 Aesthetic quality of new facility exteriors

Intent:	To improve quality of the exteriors new buildings
Indicator:	Perceived quality of the exteriors of new buildings
Unit of measure:	Qualitative data
Relevant information:	-
Assessment method:	Evaluate the perceived quality of the exteriors of new buildings in the local area, as determined by a sample of residents
Urban Scale:	Neighbourhood - Cluster

D. Criteria List: Building Scale

A SITE REGENERATION AND DEVELOPMENT, URBAN DESIGN AND INFRASTRUCTURE	B ENERGY AND RESOURCE CONSUMPTION	C ENVIRONMENTAL LOADINGS	D INDOOR ENVIRON-MENTAL QUALITY	E SERVICE QUALITY	F SOCIAL, CULTURAL AND PERCEPTUAL ASPECTS	G COST AND ECONOMIC ASPECTS
A1- Site Regeneration and Development	B1- Total Life Cycle Non-Renewable Energy	C1- Greenhouse Gas Emissions	D1- Indoor Air Quality and Ventilation	E1- Safety and Security	F1- Social Aspects	G1- Cost and Economics
A2- Urban Design	B2- Electrical peak demand	C2- Other Atmospheric Emissions	D2- Air Temperature and Relative Humidity	E2- Functionality and efficiency	F2- Culture and Heritage	
A3- Project Infrastructure and Services	B3- Use of Materials	C3- Solid and Liquid Wastes	D3- Daylighting and Illu-mination	E3- Controllability	F3- Perceptual	
	B4- Use of potable water, stormwater and greywater	C4- Impacts on Project Site	D4- Noise and Acoustics	E4- Flexibility and Adaptability		
		C5- Other Local and Regional Impacts		E5- Optimization and Maintenance of Operating Performance		

A	**Site Regeneration and Development, Urban Design and Infrastructure**	
A1	**Site Regeneration and Development**	
	A1.1	Protection and restoration of wetlands.
	A1.2	Protection and restoration of coastal environments.
	A1.3	Reforestation for carbon sequestration, soil stability and biodiversity.
	A1.4	Development or maintenance of wildlife corridors.
	A1.5	Remediation of contaminated soil, groundwater or surface water.
	A1.6	Shading of building(s) by deciduous trees.
	A1.7	Use of vegetation to provide ambient outdoor cooling.
	A1.8	Use of native plant types.
	A1.9	Provision of public open space(s).
	A1.10	Provision and quality of children's play area(s).
	A1.11	Facilities for small-scale food production for residential occupants.
	A1.12	Provision and quality of bicycle pathways and parking.
	A1.13	Provision and quality of walkways for pedestrian use.
A2	**Urban Design**	
	A2.1	Maximizing efficiency of land use through development density.
	A2.2	Reducing need for commuting transport through provision of mixed uses.
	A2.3	Impact of orientation on the passive solar potential of building(s).
	A2.4	Building morphology, aggregate measure.
	A2.5	Impact of site and building orientation on natural ventilation of building(s) during warm season(s).
	A2.6	Impact of site and building orientation on natural ventilation of building(s) during cold season(s).
A3	**Project Infrastructure and Services**	
	A3.1	Supply, storage and distribution of surplus thermal energy amongst groups of buildings.
	A3.2	Supply, storage and distribution of surplus photovoltaic energy amongst groups of buildings.
	A3.3	Supply, storage and distribution of surplus hot water amongst groups of buildings.
	A3.4	Supply, storage and distribution of surplus rainwater and greywater amongst groups of buildings.
	A3.5	Provision of facility to produce energy from solid waste.
	A3.6	Provision of solid waste collection and sorting services.
	A3.7	Composting and re-use of organic sludge.
	A3.8	Provision of split grey / potable water services.
	A3.9	Provision of surface water management system.
	A3.10	On-site treatment of rainwater, stormwater and greywater.
	A3.11	On-site treatment of liquid sanitary waste.

	A3.12	Provision of on-site communal transportation system(s).
	A3.13	Provision of on-site parking facilities for private vehicles.
	A3.14	Connectivity of roadways.
	A3.15	Provision of access roads and facilities for freight or delivery.
	A3.16	Provision and quality of exterior lighting.
B	**Energy and Resource Consumption**	
B1	**Total Life Cycle Non-Renewable Energy**	
	B1.1	Primary energy demand.
	B1.2	Delivered thermal energy demand.
	B1.3	Delivered electrical energy demand.
	B1.4	Energy from renewable sources in total primary energy consumption.
	B1.5	Energy from renewable sources in total thermal energy consumption.
	B1.6	Energy from renewable sources in total electrical energy consumption.
	B1.7	Consumption of renewable energy for all building operations.
	B1.8	Consumption of non-renewable energy for all building operations.
	B1.9	Consumption of non-renewable energy for project-related transport.
	B1.10	Consumption of non-renewable energy for demolition or dismantling process.
	B1.11	Embodied non-renewable primary energy.
B2	**Electrical peak demand**	
	B2.1	Electrical peak demand for building operations.
	B2.2	Scheduling of building operations to reduce peak loads on generating facilities.
B3	**Use of Materials**	
	B3.1	Degree of re-use of suitable existing structure(s) where available.
	B3.2	Protection of materials during construction phase.
	B3.3	Material efficiency of structural and building envelope components.
	B3.4	Use of virgin non-renewable materials.
	B3.5	Recycled materials
	B3.6	Efficient use of finishing materials.
	B3.7	Ease of disassembly, re-use or recycling.
B4	**Use of potable water, stormwater and greywater**	
	B4.1	Embodied water in original construction materials.
	B4.2	Water consumption for indoor uses.
	B4.3	Use of water for irrigation purposes.
	B4.4	Use of water for building systems.
	B4.5	Potable water consumption for indoor uses.

C	Environmental Loadings	
C1	**Greenhouse Gas Emissions**	
	C1.1	GHG emissions from energy embodied in original construction materials.
	C1.2	GHG emissions from energy embodied in construction materials used for maintenance or replacement(s).
	C1.3	Global Warming Potential
C2	**Other Atmospheric Emissions**	
	C2.1	Emissions of ozone-depleting substances during facility operations.
	C2.2	Emissions of acidifying emissions during facility operations.
	C2.3	Emissions leading to photo-oxidants during facility operations.
C3	**Solid and Liquid Wastes**	
	C3.1	Construction and demolition waste.
	C3.2	Solid waste from building operations.
	C3.3	Liquid effluents from building operations that are sent off the site.
	C3.4	Hazardous waste resulting from facility operations.
C4	**Impacts on Project Site**	
	C4.1	Recharge of groundwater through permeable paving or landscaping.
	C4.2	Changes in biodiversity on the site.
	C4.3	Adverse wind conditions at grade around tall buildings.
C5	**Other Local and Regional Impacts**	
	C5.1	Impact of building on access to daylight or solar energy potential of adjacent property.
	C5.2	Impact of construction process on local residents and commercial facility users.
	C5.3	Impact of building user population on peak load capacity of public transport system.
	C5.4	Impact of private vehicles used by building population on peak load capacity of local road system.
	C5.5	Potential for project operations to contaminate nearby bodies of water.
	C5.6	Cumulative (annual) thermal changes to lake water or sub-surface aquifers.
	C5.7	Contribution to Heat Island Effect from roofing, landscaping and paved areas.
	C5.8	Degree of atmospheric light pollution caused by project exterior lighting systems.

D	**Indoor Environmental Quality**	
D1	**Indoor Air Quality and Ventilation**	
	D1.1	Pollutant migration between occupancies.
	D1.2	Pollutants generated by facility maintenance.
	D1.3	Formaldehyde concentration.
	D1.4	TVOC concentration in indoor air.
	D1.5	CO2 concentrations in indoor air.
	D1.6	Effectiveness of ventilation in naturally ventilated occupancies during cooling seasons.
	D1.7	Effectiveness of ventilation in naturally ventilated occupancies during intermediate seasons.
	D1.8	Effectiveness of ventilation in naturally ventilated occupancies during heating seasons.
	D1.9	Air movement in mechanically ventilated occupancies.
	D1.10	Ventilation rate.
D2	**Air Temperature and Relative Humidity**	
	D2.1	Time outside of the thermal comfort range
	D2.2	Thermal comfort index
	D2.3	Appropriate air temperature and relative humidity in mechanically cooled occupancies.
	D2.4	Appropriate air temperature in naturally ventilated occupancies.
D3	**Daylighting and Illumination**	
	D3.1	Appropriate daylighting in primary occupancy areas.
	D3.2	Control of glare from daylighting.
D4	**Noise and Acoustics**	
	D4.1	Noise attenuation through the exterior envelope.
	D4.2	Transmission of facility equipment noise to primary occupancies.
	D4.3	Noise attenuation between primary occupancy areas.
E	**Service Quality**	
E1	**Safety and Security**	
	E1.1	Construction safety.
	E1.2	Risk to occupants and facilities from fire - to be developed.
	E1.3	Risk to occupants and facilities from flooding.
	E1.4	Risk to occupants and facilities from earthquake - to be developed
	E1.5	Risk to occupants from incidents involving biological or chemical substances - to be developed.
	E1.6	Maintenance of core building functions during power outages.
	E1.7	Personal security for building users during normal operations.
E2	**Functionality and efficiency**	
	E2.1	Appropriateness of type of facilities provided for tenant or occupant needs.

	E2.2	Suitability of layout(s) for required functions.
	E2.3	Appropriateness of space provided for required functions.
	E2.4	Provision of exterior access and unloading facilities for freight or delivery.
	E2.5	Service quality and efficiency of vertical or horizontal transportation systems in building.
	E2.6	Spatial efficiency.
	E2.7	Volumetric efficiency.
E3	**Controllability**	
	E3.1	Effectiveness of facility management control system.
	E3.2	Capability for partial operation of facility technical systems.
	E3.3	Degree of local control of lighting systems.
	E3.4	Degree of personal control of technical systems by occupants.
E4	**Flexibility and Adaptability**	
	E4.1	Ability for building operator or tenant to modify facility technical systems.
	E4.2	Potential for horizontal or vertical extension of structure.
	E4.3	Adaptability constraints imposed by structure or floor-to-floor heights.
	E4.4	Adaptability constraints imposed by building envelope and technical systems.
	E4.5	Adaptability to future changes in type of energy supply.
E5	**Optimization and Maintenance of Operating Performance**	
	E5.1	Operating functionality and efficiency of key facility systems.
	E5.2	Adequacy of the building envelope for maintenance of long-term performance.
	E5.3	Durability of key materials.
	E5.4	Existence and implementation of a maintenance management plan.
	E5.5	On-going monitoring and verification of performance.
	E5.6	Retention of as-built documentation.

F	**Social, Cultural and Perceptual Aspects**	
F1	**Social Aspects**	
	F1.1	Universal access on site and within the building.
	F1.2	Access to direct sunlight from living areas of dwelling units.
	F1.3	Visual privacy in principal areas of dwelling units.
	F1.4	Access to private open space from dwelling units.
F2	**Culture and Heritage**	
	F2.1	Compatibility of urban design with local cultural values.
	F2.2	Provision of public open space compatible with local cultural values.
	F2.3	Impact of the design on existing streetscapes.

	F2.4	Use of traditional local materials and techniques.
	F2.5	Maintenance of the heritage value of the exterior of an existing facility.
	F2.6	Maintenance of the heritage value of the interior of an existing facility.
F3	**Perceptual**	
	F3.1	Impact of tall structure(s) on existing view corridors.
	F3.2	Quality of views from tall structures.
	F3.3	Sway of tall buildings in high wind conditions.
	F3.4	Perceptual quality of site development.
	F3.5	Aesthetic quality of facility exterior.
	F3.6	Aesthetic quality of facility interior.
	F3.7	Access to exterior views from interior.

G	**Cost and Economic Aspects**	
G1	**Cost and Economics**	
	G1.1	Construction cost.
	G1.2	Operating and maintenance cost.
	G1.3	Life-cycle cost.
	G1.4	Use stage energy cost.
	G1.5	Use stage water cost.
	G1.6	Investment risk.
	G1.7	Affordability of residential rental or cost levels.

A Site Regeneration and Development, Urban Design and Infrastructure

A1 Site Regeneration and Development

A.1.1 Protection and restoration of wetlands

Intent:	To assess the degree of preservation or restoration of wetlands on the site
Indicator:	Expert assessment of the degree to which measures have been or are being taken to restore or maintain the full functionality of the wetlands
Unit of measure:	score
Relevant information:	Wetlands are lands in which water saturation is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the surrounding environment. Other common names for wetlands are bogs, ponds, estuaries, and marshes. Functions of wetlands include local climate regulation, timing and magnitude of water runoff, flooding and aquifer recharge; they can also filter out and decompose organic wastes (Millenium Ecosystem Assessment). In 1995, the EEA estimated that around 25 percent of the most important wetlands in Europe were threatened by groundwater overexploitation.
Assessment method:	Assessment by ecologists, biologists and civil engineers.
Standard or references:	-

A.1.2 Protection and restoration of coastal environments

Intent:	To assess the degree of protection or restoration of the coastal environment on the site, where applicable
Indicator:	Expert assessment of the degree to which measures have been or are being taken to restore or maintain the full functionality of the coastal environment
Unit of measure:	score
Relevant information:	The viability of coastal areas is vulnerable to contamination from pollution and excess nutrification, caused by agriculture and urban development pressures. Nitrogen levels increase by widespread loss of natural interceptors such as coastal wetlands, coral reefs and mangrove forests. Sea level rise caused by climate change will cause further damage.
Assessment method:	Assessment by ecologists and marine biologists.
Standard or references:	-

A.1.3 Reforestation for carbon sequestration, soil stability and biodiversity

Intent:	To assess the degree of preservation or restoration of forested areas on the site
Indicator:	Expert assessment of the degree to which measures have been or are being taken to restore or maintain the full functionality of forested areas on the site
Unit of measure:	score
Relevant information:	Stands of trees or forested areas play valuable roles in sequestering carbon dioxide, in maintaining soli stability (especially in sloped areas) and in supporting biodiversity
Assessment method:	Assessment by ecologists, soil and forestry experts
Standard or references:	

A.1.4 Development or maintenance of wildlife corridors

Intent:	To assess the existence and adequacy of urban wildlife corridors that are intended, in very large projects, to provide natural habitat connections from one side of the site to another
Indicator:	The long-term presence of urban fauna
Unit of measure:	score
Relevant information:	Although many wildlife corridors are large in scale, even narrow corridors can be useful in allowing small fauna to maintain their habitat. According to Wikipedia: Habitat corridors can be categorized according to their width. Typically the wider the corridor, the more use it will get from species. However, the width to length ratio, as well as design and quality play just as important of a role in creating the perfect corridor (Fleury 1997). The strip of land will suffer less from edge effects such as weeds, predators, and chemicals if it is constructed properly.... A Local wildlife corridor can be <50m and could connect remnant patches of gullies, wetlands, ridgelines, etc. In any case, such a feature is suited only to large projects. Required information includes pre- and post-construction ecological status, including an assessment of the viability of habitat for urban wildlife.
Assessment method:	Analysis of reports by biologist
Standard or references:	-

A.1.5 Remediation of contaminated soil, groundwater or surface water

Intent:	To assess the success of remediation of contaminated soil, groundwater, or surface water in the project
Indicator:	Status of soil, groundwater, or surface water after treatment
Unit of measure:	score
Relevant information:	Type and intensity of original contamination, methods of remediation, final levels of contamination and assessment of long-term human health or ecological risks. Frequent causes are surface water contaminated by parking lots, or soils contaminated by previous industrial activity
Assessment method:	Review of pre- and post-remediation site analysis report by a geophysical and soils chemistry specialist
Standard or references:	-

A.1.6 Shading of building(s) by deciduous trees

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:	Native trees retained or planted, according to landscaping plans and specifications; measured as percent of building frontage facing the equator, at a height of 5 m. that will be covered by foliage during the warm season within 5 years
Unit of measure:	%
Relevant information:	Deciduous trees fulfill several valuable functions if they are located on the side of the building most exposed to solar gain during the warm season (South and West in the northern hemisphere, North and West in the southern). Benefits include shading of people, reduction of heat gains into the building, CO2 sequestration and aesthetic enhancement. Note that benefits are maximised for low-rise buildings and may be negligible for high-rise buildings. From "The Potential of Vegetation in Reducing Summer Cooling Loads in Residential Buildings"; by Huang, Y.J. et al; in Journal of Applied Meteorology, Vol. 26, Issue 9, pp. 1103-1116, Sep. 1987: "Parametric analysis reveals that most of the savings can be attributed to the effects of increased plant evapotranspiration, and only 10% to 30% to shading.
Assessment method:	Review of site plan by an outside landscape architect or botanist
Standard or references:	-

A.1.7 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:	Ratio of total vegetated surface area (on ground and on roofs, and including trees), divided by total site area. The result is known as or Leaf Area Index
Unit of measure:	Number
Relevant information:	From Bréda: Leaf area index (LAI) is the total one-sided area of leaf tissue per unit ground surface area. It is a key parameter in ecophysiology, especially for scaling up the gas exchange from leaf to canopy level... It is one of the most difficult to quantify properly, owing to large spatial and temporal variability. Many methods have been developed to quantify LAI from the ground and some of them are also suitable for describing other structural parameters of the canopy. Note that the LAI provides only part of the answer to how much ambient cooling can be provided.
Assessment method:	Desk analysis
Standard or references:	"Ground-based measurements of leaf area index: a review of methods, instruments and current controversies"; Nathalie Bréda, in J. Exp. Bot. 54 (392): 2403-2417. "The Potential of Vegetation in Reducing Summer Cooling Loads in Residential Buildings"; by Huang, Y.J. et al; in Journal of Applied Meteorology, Vol. 26, Issue 9, pp. 1103-1116, Sep. 1987: "Parametric analysis reveals that most of the savings can be attributed to the effects of increased plant evapotranspiration, and only 10% to 30% to shading. "The cooling effect of green spaces as a contribution to the mitigation of urban heat: A case study in Lisbon"; Building and Environment, Volume 46, Issue 11, November 2011, Pages 2186-2194; Sandra Oliveira, Henrique Andrade, Teresa Vaz.

A.1.8 Use of native plant types

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:	%
Relevant information:	Total area landscaped (excluding paved areas), percent of vegetated landscaped area planted with native species that are drought-resistant, or at least that do not require more irrigation than alternatives
Assessment method:	Assessment by landscape architect.
Standard or references:	-

A.1.9 Provision of public open space(s)

Intent:	To provide public space for gathering, relaxation and recreation of the population within the project and neighbourhood
Indicator:	The provision of land within the site suitable as public open space because of its location, area or other characteristics
Unit of measure:	score
Relevant information:	Spaces for public gathering, relaxation and recreation become feasible in larger projects and plays an important role in creating and maintaining social cohesion
Assessment method:	Review of site plan
Standard or references:	-

A.1.10 Provision and quality of children's play area(s)

Intent:	To determine the existence and to assess the quality of play facilities for children living in the project
Indicator:	In projects with residential accommodation for families, the existence and type of facilities for children's play and the quality of service provided
Unit of measure:	score
Relevant information:	The type, number and area of facilities for children's play, current and projected residential population and age mix, ability to modify the facilities to suit future needs, accessibility of the facilities by children and supervising adults, and measures for adult supervision
Assessment method:	Analysis of information by child play specialist
Standard or references:	-

A.1.11 Facilities for small-scale food production for residential occupants

Intent:	To assess the extent to which occupants of residential buildings have access to facilities that support the growth of some common food products
Indicator:	Location, dimensions, access to sun and water
Unit of measure:	score
Relevant information:	Accessible small-scale food production is defined as an area on site that is accessible either individually or communally, that has unimpeded access to at least three hours of sun per day during warm seasons and that provides facilities for soil, water and drainage. An ability to prevent theft and trespass is desirable
Assessment method:	Review of all unit designs
Standard or references:	-

A.1.12 Provision and quality of bicycle pathways and parking

Intent:	To assess the extent and quality of provisions to facilitate the use of bicycles, including bicycle pathways and parking facilities
Indicator:	Type and extent of bicycle paths in the project, connectivity with off-site bicycle paths, amount of sheltered and unsheltered bicycle parking, location of bicycle parking facilities relative to building entrances
Unit of measure:	score
Relevant information:	Type and extent of bicycle paths in the project, number of connections with off-site bicycle paths, sheltered and unsheltered bicycle parking spaces, average distance of bicycle parking facilities from main building entrances
Assessment method:	Desk analysis
Standard or references:	-

A.1.13 Provision and quality of walkways for pedestrian use

Intent:	To assess the extent and quality of walkways for occupants and users
Indicator:	Type and extent of walkways in the project, extent of walkways sheltered from rain, snow or excess sunshine
Unit of measure:	score
Relevant information:	Well-located and designed walkways on the site encourage walking, which promotes human health. Relevant information includes type and extent of walkways in the project, precautions against vehicle traffic hazards, percent of walkway length that is sheltered from rain or snow and that is sheltered from excess sunshine
Assessment method:	Desk analysis
Standard or references:	-

A2 Site Regeneration and Development

A.2.1 Maximizing efficiency of land use through development density

Intent:	To encourage the efficient use of urban land, within the context of an urban development plan
Indicator:	Development density of the project, expressed as the ratio of gross floor area above grade of the Design relative to the maximum permitted gross floor area on the site
Unit of measure:	%
Relevant information:	The application of this criterion assumes that the urban development plan follows a logical framework. If so, then it is desirable to fully utilize the permissible density to make efficient use of urban land
Assessment method:	Review of site and development plan by an outside planner or urban designer
Standard or references:	-

A.2.2 Reducing need for commuting transport through provision of mixed uses

Intent:	To encourage a diversity of major uses within the project
Indicator:	Number of major uses within the project, related to a threshold area
Unit of measure:	score
Relevant information:	A diversity of uses may reduce the need for commuting transport, and can also support an active streetscape. The purpose of the threshold area is to recognize the fact that mixed uses may not be economical or rational in small projects, but becomes of considerable importance in larger ones
Assessment method:	Review of development plans by an outside urban planner
Standard or references:	-

A.2.3 Impact of orientation on the passive solar potential of building(s)

Intent:	To assess the impact that the orientation of the building may have on its passive solar potential in order to encourage a passive solar approach
Indicator:	Deviation, in degrees (º) of main building axis from East-West (to ensure a maximum possible insolation)
Unit of measure:	score
Relevant information:	The simplest case is a building with a rectangular footprint with its long axis oriented as much as possible in an East-West orientation. More complex cases occur with more compact buildings, or projects with multiple buildings or blocks
Assessment method:	Desk study of schematic design and site plan
Standard or references:	-

A.2.5 Impact of site and building orientation on natural ventilation of building(s) during warm season(s)

Intent:	To assess the degree to which the location, topography and vegetation of the site and the orientation and massing of the building encourages or impedes natural ventilation under warm season(s)
Indicator:	Predicted differential wind pressures in Pascals (Pa) during warm season(s) at key points of the building envelope where windows or other openings exist or are likely to be provided
Unit of measure:	Pa
Relevant information:	Natural ventilation reduces the need for mechanical ventilation and cooling. The warm season reduces the driving forces due to temperature differentials, and is therefore a critical test of the concept. Relevant factors include the micro-climate, topography and vegetation of the site; location, orientation and massing of the building. Note that although location, size and type of openings (windows and ventilation stacks) is of critical importance, those features are considered in D1.6 to D1.8
Assessment method:	Computational fluid dynamics or other acceptable method to predict the seasonal velocity of winds around the building during warm season(s), which is usually the period of lowest wind velocities.
Standard or references:	-

A.2.6 Impact of site and building orientation on natural ventilation of building(s) during cold season(s)

Intent:	To assess the degree to which the location, topography and vegetation of the site and the orientation and massing of the building encourages or impedes natural ventilation under cold season(s)
Indicator:	Predicted differential wind pressures in Pascals (Pa) during cold season(s) at key points of the building envelope where windows or other openings exist or are likely to be provided
Unit of measure:	Pa
Relevant information:	Natural ventilation reduces the need for mechanical ventilation and cooling. The cold season maximizes the driving forces due to temperature differentials. Relevant factors include the micro-climate, topography and vegetation of the site; location, orientation and massing of the building. Note that although location, size and type of openings (windows and ventilation stacks) is of critical importance, those features are considered in D1.6 to D1.8
Assessment method:	Computational fluid dynamics or other acceptable method to predict the seasonal velocity of winds around the building during cold season(s), which is usually the period of greatest wind velocities
Standard or references:	-

A3 Project Infrastructure and Services

A.3.1 Supply, storage and distribution of surplus thermal energy amongst groups of buildings

Intent:	To ensure the optimization of supply, storage and distribution of thermal energy for space heating amongst groups of buildings
Indicator:	Total thermal energy capacity from solar and conventional sources, total storage capacity, total thermal energy demand from all buildings, and percent utilization of surplus thermal energy
Unit of measure:	%
Relevant information:	Some building types, such as office buildings with large interior zones or combined heat and power (CHP) systems, may generate more thermal energy than required, while others, such as multi-family residential, have a deficit of thermal energy, especially during cold seasons. Relevant information includes total thermal energy generating capacity from solar, CHP and conventional sources, total storage capacity, total thermal energy demand from all buildings, control systems and percent utlisation
Assessment method:	Analysis of data by mechanical engineer
Standard or references:	-

A.3.2 Supply, storage and distribution of surplus photovoltaic energy amongst groups of buildings

Intent:	To ensure the optimisation of supply, storage and distribution of electrical energy generated by means of photovoltaic systems amongst groups of buildings
Indicator:	Total DC and AC electrical generating capacity from photovoltaic sources, total storage capacity, total electrical energy demand from all buildings, and percent utlisation
Unit of measure:	%
Relevant information:	Some building types, such as low-rise buildings with large roof areas, can generate more PV output than required, while others, such as high-rise buildings, may have a deficit of electrical energy. Relevant information includes total DC and AC electrical generating capacity from photovoltaic sources, total storage capacity, total electrical energy demand from all buildings, control systems, and percent utlisation
Assessment method:	Analysis of data by electrical engineer
Standard or references:	-

A.3.3 Supply, storage and distribution of surplus hot water amongst groups of buildings

Intent:	To ensure the optimisation of supply, storage and distribution of hot water amongst groups of buildings
Indicator:	Total hot water capacity from solar and conventional sources, total storage capacity, total hot water demand from all buildings, and percent utlisation
Unit of measure:	%
Relevant information:	Some building or systems types, such as office buildings or combined heat and power (CHP) systems, may generate more hot water than required, while others, such as multi-family residential buildings, may have a deficit of hot water. Relevant information includes total hot water generating capacity from solar, CHP and conventional sources; total storage capacity, total hot water demand from all buildings, control systems and percent utlisation
Assessment method:	Analysis of data by mechanical engineer
Standard or references:	-

A.3.4 Supply, storage and distribution of surplus rainwater and greywater amongst groups of buildings

Intent:	To ensure the optimisation of supply, storage and distribution of hot water amongst groups of buildings
Indicator:	Total hot water capacity from solar and conventional sources, total storage capacity, total hot water demand from all buildings, and percent utlisation
Unit of measure:	%
Relevant information:	Some building types, such as low-rise buildings with large roof areas or multi-family residential buildings, can generate more rainwater and greywater than required, while others, such as high-rise buildings, may have a deficit. Relevant information includes total rain- and grey-water generating capacity from roofs, paved areas or sanitary waste sources; total storage capacity, total greywater demand from all buildings, control systems and percent utlisation
Assessment method:	Analysis of data by mechanical engineer
Standard or references:	-

A.3.5 Provision of facility to produce energy from solid waste

Intent:	To assess the presence and effectiveness of a facility to produce energy from bio-waste produced in a large project
Indicator:	Presence of the facility, its output, energy effectiveness and minimization of harmful emissions
Unit of measure:	score
Relevant information:	Technical characteristics of the facility
Assessment method:	Analysis by mechanical engineer
Standard or references:	-

A.3.6 Provision of solid waste collection and sorting services

Intent:	To determine the existence and service quality of non-organic solid waste collection and sorting services in the project
Indicator:	Solid non-organic waste generation during operations, excluding amounts used for energy production, capacity and location of communal (multi-building) non-organic solid waste and sorting facilities, and provision of appropriate management and staffing
Unit of measure:	score
Relevant information:	Solid non-organic waste generation during operations, excluding amounts used for energy production, capacity and location of communal solid waste and sorting facilities, and type of management and level of staffing
Assessment method:	Desk analysis
Standard or references:	-

A.3.7 Composting and re-use of organic sludge

Intent:	To determine the existence and service quality of an on-site service to compost and re-use organic sludge in the project
Indicator:	Presence of the service and suitable facilities, estimated output of organic waste and sludge produced, level of service
Unit of measure:	score
Relevant information:	In large projects with considerable levels of organic waste, such waste may economically be composted and re-used as fertilizer in landscaping. Relevant information includes estimated output of organic waste and sludge produced, suitable facilities, level of service
Assessment method:	Assessment by services engineer
Standard or references:	-

A.3.8 Provision of split grey / potable water services

Intent:	To determine the presence and service quality of a split grey / potable water supply system for building(s) in the project, with the aim of reducing the use of potable water
Indicator:	Presence of a split supply system and percent of individual building occupancies serviced
Unit of measure:	%
Relevant information:	A split grey / potable water system can greatly reduce the volume of potable water needed, by using grey water for toilets and other water-using equipment that does not require potable water. The number and type of individual occupancies must be identified, with public washrooms on separate floors counting as separate occupancies. Note that use of greywater for irrigation is not included in this benchmark
Assessment method:	Desk analysis, calculation of percent of individual occupancies served
Standard or references:	-

A.3.9 Provision of surface water management system

Intent:	To determine the existence and quality of service of a surface water management system that will provide adequate flood control and remove pollutants from storm runoff
Indicator:	Predicted or actual capacity of the surface water management system to successfully cope with 100-year precipitation and flood events so that disruption to activities on the site or physical damage to structures or contents is avoided
Unit of measure:	score
Relevant information:	Surface water management systems are essential in minimizing water runoff off the site, erosion of soil and pollution of sub-surface soil or groundwater. Relevant information includes site area, topography and surface soil types, local precipitation patterns, volume of surface water to be managed under 100-year precipitation and flood events, type of pollutants carried by storm water, type of filtration and temporary storage. Surface water management or drainage systems may contain permeable paving, storm drains, street gutters, weirs, sluice gates, dams, pumps, swales, French drains (a.k.a. exfiltration trenches), culverts, drainage wells, dry retention areas, and storm runoff treatment ponds or wetlands
Assessment method:	Assessment by civil engineer
Standard or references:	-

A.3.10 On-site treatment of rainwater, stormwater and greywater

Intent:	To determine the availability and service quality of on-site treatment of rain, storm and greywater, with the aim of reducing the use of potable water
Indicator:	Existence of an on-site wastewater treatment system and the percent of total rain, storm and greywater waste treated
Unit of measure:	score
Relevant information:	Rainwater collection area, storage volume and filtration; stormwater sources and treatment method; greywater sources, storage volume and treatment method
Assessment method:	Desk analysis of systems available and their capacities; identification of relative purity of effluents and potential uses
Standard or references:	-

A.3.11 On-site treatment of liquid sanitary waste

Intent:	To determine the availability and service quality of on-site treatment for sewage, to reduce the impact on municipal sewage treatment systems
Indicator:	Existence of an on-site sewage treatment system and the percent of sewage treated
Unit of measure:	%
Relevant information:	Sewage volume, treatment method and purity of resulting effluent
Assessment method:	Desk analysis of systems available and their capacities; identification of relative purity of effluents and potential uses
Standard or references:	-

A.3.12 Provision of on-site communal transportation system(s)

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:	Existence and type of an on-site public or communal transportation system in a large project, percentage of buildings that have access to the system, and frequency of service
Unit of measure:	score
Relevant information:	Existence and type of an on-site public or communal transportation system in a large project, percentage of buildings that have access to the system, and frequency of service
Assessment method:	Desk analysis
Standard or references:	-

A.3.13 Provision of on-site parking facilities for private vehicles

Intent:	To determine the extent and type of parking facilities for private vehicles on the site in order to discourage the use of private vehicles by occupants and users
Indicator:	The ratio of parking spaces for private vehicles per dwelling unit, plus the ratio of parking spaces for private vehicles per 100 m2 of usable area (ua) of non-residential occupancies
Unit of measure:	%
Relevant information:	Number of exterior and interior parking spaces, the total number of dwelling units and the total usable area of non-residential occupancies in m2
Assessment method:	Desk analysis
Standard or references:	-

A.3.14 Connectivity of roadways

Intent:	To maximize the connectivity of streets in a large project, to provide users with a choice of routes and to create a more active community life
Indicator:	Mean distance between intersections of roadways or streets
Unit of measure:	m
Relevant information:	Type and layout of roadways and pedestrian walkways, mean distance in m. between intersections
Assessment method:	Desk analysis by planner or architect
Standard or references:	-

A.3.15 Provision of access roads and facilities for freight or delivery

Intent:	To determine the existence and quality of access roads and facilities for freight or delivery to occupied buildings to maximize the service quality for this function
Indicator:	The degree to which building(s) in the project are serviced by access roads and facilities for freight or delivery
Unit of measure:	score
Relevant information:	Road layout, location and design of loading docks
Assessment method:	Desk analysis
Standard or references:	-

A.3.16 Provision and quality of exterior lighting

Intent:	To determine the provision and quality of exterior lighting for purposes of night-time wayfinding and security of pedestrians
Indicator:	Provision of exterior lighting systems, coverage of roadways, walkways and building entries, and directional efficiency to limit light pollution
Unit of measure:	score
Relevant information:	Coverage of roadways and walkways, building entries by exterior lighting systems, luminaire types and efficiency, and directional efficiency
Assessment method:	Assessment by lighting engineers
Standard or references:	-

B Energy and Resource Consumption

B1 Total Life Cycle Non-Renewable Energy

B.1.1 Primary energy demand

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
Relevant information:	The indicator provides an understanding of a building's primary energy consumptions in the use stage. Primary energy is defined by Article 2(5) of the Energy Performance of Buildings Directive 6 as 'the energy that has not undergone any conversion in the transformation process, calculated by energy carrier using a primary energy factor'. It is the energy that is required to generate the electricity, heating and cooling used by a building. This is a calculation of the overall system efficiency of the building's technical systems (HVAC installation, heat and power generation, domestic hot water supply, built-in lighting installation) and the fuels and energy carriers used. The scope of the indicator includes the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water, (built-in) lighting, auxiliaries. In a life cycle approach, these uses are referred to as operational energy consumption. The assessment boundary is the building. Energy can be imported or exported through the assessment boundary (the building) from/to on-site, nearby and distant locations – as illustrated by Figure 1. Inside the assessment boundary, the system losses are taken into account explicitly in the conversion factor applied to the energy carrier, also referred to as a primary energy factor.
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 or references:	Level(s) Part 1-2 – Beta version. EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings)

B.1.2 Delivered thermal energy demand

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
Relevant information:	The indicator provides an understanding of a building's thermal energy demand in the use stage. Use stage energy demand is in general responsible for the majority of life cycle energy use in the case of buildings constructed before the turn of the millennium. Delivered thermal energy is the energy delivered to the building in the form of heat and fuel. It is the energy per 'carrier' supplied to the building, to satisfy uses within the building (heating, cooling, ventilation, domestic hot water). The ‘delivered energy’ is the one metered by the utilities. The scope of the indicator includes the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water. In a life cycle approach, these uses are referred to as operational energy consumption. The assessment boundary is the building.
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 metre 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 or references:	Level(s) Part 1-2 – Beta version. EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings)

B.1.3 Delivered electrical energy demand

Intent:	To minimise the total electric energy consumptions in the use stage
Indicator:	Delivered electric energy demand per internal useful floor area per year
Unit of measure:	kWh/m2/yr
Relevant information:	The indicator provides an understanding of a building's electric energy demand in the use stage. Use stage energy demand is in general responsible for the majority of life cycle energy use in the case of buildings constructed before the turn of the millennium. Delivered electric energy is the energy delivered to the building in the form of electricity. It is the energy supplied to the building, to satisfy uses within the building (heating, cooling, ventilation, domestic hot water, lighting, appliances). The 'delivered energy' is generally the one metered by the utilities. The scope of the indicator includes the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water, lighting, auxiliaries. In a life cycle approach, these uses are referred to as operational energy consumption. The assessment boundary is the building.
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 metre 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 or references:	Level(s) Part 1-2 – Beta version. EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings).

B.1.4 Energy from renewable sources in total primary energy consumption

Intent:	To assess the predicted or actual proportion of the total primary energy consumption of the building that is met by renewable energy during the use phase
Indicator:	Primary energy demand of the building that is met by renewable sources on total primary energy demand
Unit of measure:	%
Relevant information:	The indicator assesses the share of primary energy demand that is met by renewable sources, without accounting for any export of renewable energy generated on site (such as from solar PV). This is because the CESBA MED Generic Framework takes a life cycle approach and, according to reference standard EN 15978, exported energy is reported as a benefit beyond the building's system boundary. The scope of the indicator includes the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water, lighting, auxiliaries. In a life cycle approach, these uses are referred to as operational energy consumption. The assessment boundary is building.
Assessment method:	The calculation method 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).
Standard or references:	Level(s) Part 1-2 – Beta version EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings)

B.1.5 Energy from renewable sources in total thermal energy consumption

Intent:	To maximize the use of renewable energy sources
Indicator:	Share of renewable energy in final thermal energy consumptions
Unit of measure:	%
Relevant information:	This indicator assesses the share of renewable energy in final thermal energy consumptions and, by implication, the degree to which renewable fuels have substituted fossil and/or nuclear fuels and therefore contributed to the decarbonisation of the Mediterranean space economy. It also shows what is the progress towards Europe 2020 target for renewable energies. The scope of the indicator includes the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water. In a life cycle approach, these uses are referred to as operational energy consumption.
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. Note According with the Directive 2009/28/EC (RES Directive), 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 or references:	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.

B.1.6 Energy from renewable sources in total electrical energy consumption

Intent:	To maximize the use of renewable energy sources
Indicator:	Share of renewable energy in final electric energy consumption
Unit of measure:	%
Relevant information:	This indicator assesses the share of renewable energy in final electric energy consumptions and, by implication, the degree to which renewable sources have substituted fossil and/or nuclear fuels and therefore contributed to the decarbonisation of the Mediterranean space economy. The scope of the indicator includes the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water, lighting, auxiliaries. In a life cycle approach, these uses are referred to as operational energy consumption.
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 with the Directive 2009/28/EC (RES Directive), 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 or references:	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.

B.1.7 Consumption of renewable energy for all building operations

Intent:	To estimate the amount of on-site renewable energy used annually for building operations
Indicator:	Average annual kWh of renewable energy, including power produced by photovoltaics or wind turbines, per m2 of net area as predicted by means of an acceptable method or tool
Unit of measure:	Tot.kWh/m2*yr
Relevant information:	Note that the amount of renewable energy produced on site and consumed in the building is subtracted from the gross amount of electrical energy used, as defined in B1.4 below and then converted to emissions in TrgC 1.3)
Assessment method:	During early design stages a screening tool may be used, but in later stages an hour-by-hour simulation program that is asuited for use with PV or wind turbine technologies should be used. Benchmarks for Operations should be derived from operational data for the relevant occupancy types, after a period of occupancy of at least one year
Standard or references:	See IEA.org for data and case studies.

B.1.8 Consumption of non-renewable energy for all building operations

Intent:	To estimate the amount of non-renewable energy (not including on-site renewable energy) used annually for building operations, commensurate with functional needs
Indicator:	Annual kWh of delivered energy per m2 of net area, including fuel and electrical use, as predicted by means of an acceptable method or tool. Total is to include energy for space heating and cooling, vertical transport and all fixed equipment
Unit of measure:	kWh/m2 *yr
Relevant information:	This criterion is based on the annual use of delivered energy, since that is the most feasible way of gathering building-specific data. The delivered electrical consumption is grossed up by a factor shown in the Emission spreadsheet, and added to the non-renewable fuel used on site, to result in the total primary non-renewable energy used. The fuel used on site does not include renewable energy used on site.
Assessment method:	During early design stages a screening tool may be used, but in later stages an hour-by-hour simulation program should be used. Benchmarks for Operations should be derived from operational data for the relevant occupancy types, after a period of occupancy of at least one year. Note that benchmarks should be set using Delivered energy data, since this is what is commonly available. SBTool applies a conversion factor to these values to convert them to primary energy for the Results.
Standard or references:	See IEA.org for data and case studies

B.1.9 Consumption of non-renewable energy for project-related transport

Intent:	To estimate the amount of non-renewable energy (not including on-site renewable energy) used annually for building-related commuting transport
Indicator:	Estimated annual primary energy use per unit area, kWh/m2 per year
Unit of measure:	kWh/m2 per yr.
Relevant information:	There are two types of transport of concern related to building type and location: commuting transportation, related to the need for to go to or from all occupancy types; and the need for freight re-supply by delivery vans, which is related to delivery or moving activities in residential occupancies, and goods delivery to commercial occupancies, especially retail or supermarket types. Actual vehicle use intensity and vehicle types.
Assessment method:	Identification annual energy consumption for the actual mix of vehicles used by the user population, as determined in sample surveys
Standard or references:	-

B.1.11 Embodied non-renewable primary energy

Intent:	To promote the use of construction materials with a low embodied energy
Indicator:	Embodied primary non-renewable energy
Unit of measure:	MJ/m2
Relevant information:	This indicator measures the embodied non-renewable primary energy of materials used for the building construction. The embodied energy is the energy consumed by all the processes associated with the production of construction materials, from the raw materials supply to manufacturing (cradle-to-gate) energy used for the acquisition of raw materials, processing, manufacturing and assembling building construction materials at the factory gate. Cradle to Gate: energy used for the acquisition of raw materials, processing, manufacturing and assembling building construction materials at the factory gate. The unit of measurement to be used for reporting on this indicator is MJ /m2 (MJ = mega joules). The area for the calculation of the indicator is the gross area of the building. This is a commonly specified environmental impact category indicator used in Life Cycle Assessment. The criterion is only applicable at design stage. In case of new construction, the indicator must be calculated taking in account all the materials used for the building construction. In case of an existing building, the indicator must be calculated taking in account only the materials used for its renovation and not the ones pre-existent. The scope comprises the product stage of the building (Module A1-3) i.e. from raw material supply to manufacturing. The scope encompasses the building materials excluding the technical installations. All the elements of the construction are taken in account: foundations, bearing structure, envelope, slabs.
Assessment method:	The main reference standards for the indicator are ISO 14040/44, EN 15804 (Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products) and EN 15978 (Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method). To calculate the value of the indicator it is necessary to compile a Bill of Materials (BoM) that is a massbased 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 nonrenewable energy is finally normalized by the gross area of the building.
Standard or references:	-

B2 Electrical peak demand

B.2.1 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, W/m2, as predicted by means of an acceptable method or tool
Unit of measure:	W/m2
Relevant information:	Excessive peak demand (e.g. for cooling during hot summer periods), will often lead power utilities to add generating capacity in the form of fossil-fuel based generation, which adds to generation of GHG and particulates. At some point, completely new generating facilities will have to be added which may only be run (inefficiently) to meet the short peak periods of demand.
Assessment method:	Review of contract documentation and sample equipment specifications by an outside electrical engineer.
Standard or references:	-

B.2.2 Scheduling of building operations to reduce peak loads on generating facilities

Intent:	To reduce electrical demand for building operations during periods of the week or the day when the grid is near peak capacity
Indicator:	Average predicted reduction of weekly electrical demand for one year, W/m2, as simulated by means of an acceptable method or tool
Unit of measure:	W/m2
Relevant information:	A management technique to reduce peak loads in certain occupancies is to schedule operations that are heavy consumers of electricity to days and/or times of day when the overall load on the electricity grid and generating facilities are low. This tends to be on weekends and/or night-time.
Assessment method:	Review of contract documentation and sample equipment specifications by an outside electrical engineer.
Standard or references:	-

B3 Use of Materials

B.3.1 Degree of re-use of suitable existing structure(s) where available

Intent:	To determine if sound structure(s) that exist on the site are to be used as part of the new project
Indicator:	The development of an inventory and the percent, by area, of an existing structure that is re-used or recycled, where the structures are in usable condition
Unit of measure:	%
Relevant information:	The re-use of an existing structure on the site, to meet all or part of the new functional needs, is an effective way of reducing embodied energy for new construction. Such an approach will often also reduce construction costs. Conditions to be met include the structural soundness of the existing structure, its ability to be adapted to the new use(s), and the feasibility of integrating the design of new and existing. Physical survey report on characteristics and condition of existing structure, functional program for new requirements.
Assessment method:	If there is an existing structure on the site, 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 or references:	-

B.3.2 Protection of materials during construction phase

Intent:	To ensure that materials stored on site before and during construction are not damaged by weather conditions
Indicator:	Measures taken to protect materials on site
Unit of measure:	score
Relevant information:	Type of materials stored on site, expected type of weather hazards, specific measures to protect them
Assessment method:	Desk analysis of damage reports
Standard or references:	-

B.3.3 Material efficiency of structural and building envelope components

Intent:	To assess the extent to which structural and building envelope components make efficient use of physical resources
Indicator:	The combined weight in kg. of building structural and building envelope components relative to the gross volume of the structure
Unit of measure:	Kg/m3
Relevant information:	Regardless of the embodied energy of construction materials, using a minimum of materials to achieve the functional needs of building components is a way of reducing total embodied energy and cost of the building. Relevant information includes data on weight by material type of structural and building envelope components.
Assessment method:	Review of design team analysis by an outside materials specialist
Standard or references:	-

B.3.4 Use of virgin non-renewable materials

Intent:	To estimate the use of virgin non-renewable materials in the project, where functionally appropriate, in order to minimize the depletion of non-renewable materials
Indicator:	The estimated percentage of total mass of the building that consists of virgin non-renewable materials
Unit of measure:	%
Relevant information:	Relevant information includes the total weight of all structural and permanent non-structural materials used in the building, the proportion of this represented by virgin, non-renewable, materials
Assessment method:	Review of design team analysis by an outside materials specialist
Standard or references:	-

B.3.5 Recycled materials

Intent:	To reduce the environmental impact of construction materials
Indicator:	Weight of recycled materials on total weight of materials
Unit of measure:	%
Relevant information:	This indicator assesses the amount of recycled materials used in the building with regards to the total amount of building materials. The use of recycled materials allows to reduce the use and depletion of new materials. The scope encompasses the building materials excluding the technical installations. All the elements of the construction are taken in account: foundations, load bearing structure, envelope, slabs. The criterion is only applicable at design stage. In case of new construction, the indicator must be calculated taking in account all the materials used for the building construction. In case of an existing building, the indicator must be calculated taking in account only the materials used for the renovation and not the ones pre-existent. It is possible to take in account both the postconsumer and pre-consumer recycled content of a material. It is possible to include the pre-consumer content in the calculation only if it isn't reused in the same industrial process. The reference standard for the definition of pre-consumer and postconsumer content is the EN ISO 14021 (Environmental labels and declarations - Self-declared environmental claims - Type II environmental labelling).
Assessment method:	To calculate the value of the indicator it is necessary to compile a Bill of Materials (BoM) that is a massbased inventory of the different materials (kg) that compose a building. The BoM is organised according to main elements that a building is composed of. The starting point is the Bill of Quantities (BoQ) that specifies the elements of a building (e.g. foundations, columns). The BoQ comprises different categories of elements, which can have different functional performance characteristics. A BoM differs from a BoQ in that it describes the different materials (e.g. wood, steel, aluminium) that are contained in the various building elements. Once the BoM has been compiled, it is possible to calculate the value of the indicator. The following steps should be followed in order to characterize the indicator: - 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 or references:	EN ISO 14021 (Environmental labels and declarations - Self-declared environmental claims - Type II environmental labelling)

B.3.6 Efficient use of finishing materials

Intent:	To estimate the amount of materials used for interior finishes, where functionally appropriate, in order to minimize the direct or indirect consumption of resources
Indicator:	The percent of above-grade interior floor, wall or ceiling surface areas in which structural elements are left exposed
Unit of measure:	%
Relevant information:	The elimination or reduction in use of finishing materials, whether virgin, re-used or recycled, is an effective way of reducing the depletion of resources and the use of embodied energy for the production of new materials. It should be noted that special care will be needed to minimize acoustic problems in such an approach.
Assessment method:	Review of design team analysis
Standard or references:	-

B.3.7 Ease of disassembly, re-use or recycling

Intent:	To ascertain the degree to which components of the building are easy to dis-assemble so that they can be re-used or recycled at the end of the service life of the components
Indicator:	Measures taken to facilitate future disassembly and re-use or recycling
Unit of measure:	score
Relevant information:	Use of composite materials, design of joints, size and weight of panels and components
Assessment method:	Review of contract documentation by an outside deconstruction specialist
Standard or references:	-

B4 Use of potable water, stormwater and greywater

B.4.1 Embodied water in original construction materials

Intent:	To estimate the amount of water embodied in the production of materials used in the construction of the building
Indicator:	Potable water used in the production of original materials and products, in m3/m3 of gross area. This criterion is not applicable to the Operations phase, due to the difficulty in obtaining valid historical data
Unit of measure:	l/m3
Relevant information:	Water embodied in various type of materials
Assessment method:	Analysis of data on water embodied in materials, type and volume or weight of materials used
Standard or references:	-

B.4.2 Water consumption for indoor uses

Intent:	To predict the amount of water that will be used for occupant needs during building operations
Indicator:	Estimates made during the design phase focus on use of water-efficient sanitary fixtures equipment, to predict the gross water volume needed; and also plans for the use of stored rainwater or recycled (grey) water, to estimate what the net water consumption may be
Unit of measure:	m3/m2 yr
Relevant information:	Typical water requirements for the type and number of sanitary fixtures to be used; availability of rainwater and greywater that may be used. Note that if food facilities are present, there may be a need to also to include kitchen equipment in the analysis. Benchmarks are expressed as m3 / m2 gross area per year. Stored rainwater or greywater used is subtracted in the assessment process from these gross amounts.
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. 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 or references:	-

B.4.3 Use of water for irrigation purposes

Intent:	To predict the amount of water that will be used for irrigation purposes during building operations
Indicator:	Estimates made during the design phase focus on use of amount of landscaped area, plans for the use of drought-resistant planting and the use of stored rainwater or recycled (grey) water, to estimate what the net water consumption may be
Unit of measure:	m3/m2 yr
Relevant information:	Typical water requirements in the area for the type of planting to be used based on evapotranspiration factors, density of planting, soil type and depth; availability of rainwater and greywater that may be used. Landscaped areas on upper floors or on roof is part of total. Stored rainwater or greywater used is subtracted in the assessment process from these gross amounts. Benchmarks are expressed as m3 / m2 gross area per year.
Assessment method:	Review of landscaping plans and equipment by landscape architect
Standard or references:	-

B.4.4 Use of water for building systems

Intent:	To estimate the amount of potable water to be used for the requirements of building equipment, excluding sanitary fixtures
Indicator:	Use of water-efficient building equipment and the use of stored rainwater or recycled (grey) water where possible
Unit of measure:	m3/m2 yr
Relevant information:	Typical water requirements for the type of HVAC and other water-using equipment to be used; availability of rainwater and greywater that may be used. Benchmarks are expressed as m3 / m2 gross building area per year. Stored rainwater or greywater used is subtracted in the assessment process from these gross amounts
Assessment method:	Review of building equipment by mechanical engineer
Standard or references:	-

B.4.5 Potable water consumption for indoor uses

Intent:	To make efficient use of water resources
Indicator:	Potable water consumption per occupant per year
Unit of measure:	m3/occupant/year
Relevant information:	The “Water consumption” criterion estimates or measures the potable water consumption of sanitary fittings/devices and water consuming appliances that are relevant to the building. This indicator can be applied to new, renovated or existing buildings in order to understand, and ultimately decrease, the water demand. The water use measured by the indicator relates to life cycle module B7 'operational water use' in the reference standard EN 15978. The scope of the term "operational water use" includes the use of potable water for: - drinking water; - water for sanitation; - water for cleaning; - water for washing machine; - water for dishwasher; - domestic hot water. The boundary covers the time period from the handover of the construction works to the point in time when the building is deconstructed/demolished.
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 or references:	Level(s) Part 1-2 – Beta version

C Environmental Loadings

C1 Greenhouse Gas Emissions

C.1.1 GHG emissions from energy embodied in original construction materials

Intent:	To minimize the amount of CO2-equivalent emissions from primary non-renewable energy used in the extraction, fabrication and transportation of materials and components in the building
Indicator:	CO2-equivalent emissions per Kg. per m2 of gross area, as determined by calculations based on design documents and fuel emission values plus process-related emissions related to the region of production, and annualized according to the predicted lifespan of the building
Unit of measure:	GJ/m2
Relevant information:	Based on embodied energy required for various key materials, and the emissions related to those energy inputs
Assessment method:	We recommend that this analysis be carried out only with new or recent projects, since there are likely to be insurmountable difficulties in obtaining data on materials in an existing building that is more than 5 years old.
Standard or references:	-

C.1.2 GHG emissions from energy embodied in construction materials used for maintenance or replacement(s)

Intent:	To minimize the GHG emissions due to embodied primary energy used for periodic maintenance or replacement of materials in the building, annualized over the estimated lifespan of the building
Indicator:	Estimate of GHG emissions due to embodied primary energy annualized over the entire lifespan of the building (see F12) used for structure, envelope (excl. glazing), and major interior components for periodic maintenance or replacement, as determined by a program designed to estimate embodied energy and emissions through Life Cycle Analysis; also, estimate of replacement cycles
Unit of measure:	GJ/m2
Relevant information:	Based on embodied energy required for various key materials, and the emissions related to those energy inputs
Assessment method:	Use an embodied energy estimating system, based on LCA (Life Cycle Assessment), based on the assumptions made of replacement cycles shown at the right. Alternatively, use the crude estimating method provided in this system
Standard or references:	-

C.1.3 Global Warming Potential

Intent:	To minimise the total greenhouse gas emissions from buildings' operations
Indicator:	CO_2 equivalent emissions per internal useful floor area per year
Unit of measure:	kg CO_2 eq./m2/yr
Relevant information:	This indicator measures the contribution of the greenhouse gas (GHG) emissions associated with the building's operational phase on the earth's global warming. The Global Warming Potential (GWP) was developed to allow for the comparison of the impact on global warming caused by different gases. Specifically, it is a relative measure of how much energy can be trapped in the atmosphere over a set time horizon by a mass of gas in comparison with the same mass of carbon dioxide (CO_2). A higher GWP means a larger warming effect in that period of time. The scope of the indicator comprises the use stage of the building and includes the emissions correlated to the following energy uses: heating, cooling, ventilation, domestic hot water, lighting, auxiliaries.
Assessment method:	To characterize the indicator's value: $E = \left[\sum (Q_{fuel,i} \times LHV_i \times k_{em,i}) + (Q_{el} \times k_{em,el}) + (Q_{dh} \times k_{em,dh})\right] \div S_u$ Qfuel,I = annual quantity of i-th fuel (m3 or Kg) Qel = annual quantity of electrical energy from the grid (kWh) Qdh = annual quantity of energy from district heating/cooling (kWh) LHVi = lower heating value of the i-th fuel (kWh/m3 or kWh/Kg) Kem,i = CO_2 eq. emission factor of the i-th fuel (Kg CO_2/kWh) Kem,i = CO_2 eq. emission factor of the electrical energy from the grid (Kg CO_2/kWh) Kem,i = CO_2 eq. emission factor of energy from district heating/cooling (Kg CO_2/kWh) Su = useful internal floor area Note In the calculation, the annual quantity of fuels, electric energy from the grid, energy from district heating/cooling can be metered or estimated. The source of data must always be clearly declared.
Standard or references:	EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings). Level(s) Part 1-2 – Beta version.

C2 Other Atmospheric Emissions

C.2.1 Emissions of ozone-depleting substances during facility operations

Intent:	To assess Ozone Depletion from leakage of CFC-11 equivalent
Indicator:	CFC-11 equivalent, in gm per m2 per yr
Unit of measure:	gm / m2 per yr
Relevant information:	-
Assessment method:	Review of contract documents and equipment specifications
Standard or references:	-

C.2.2 Emissions of acidifying emissions during facility operations

Intent:	To assess the production of atmospheric emissions from building operations that may result in acidification
Indicator:	SO2 Equiv. per year in kg. per unit net area
Unit of measure:	Kg. / m2 per yr.
Relevant information:	Manufacturers specs on annual SO2 equivalent emissions
Assessment method:	Review of contract documents and equipment specifications
Standard or references:	Contract documents and equipment specifications, or EPD

C.2.3 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 equiv. per year in gm per net unit area
Unit of measure:	gm./m2 per yr.
Relevant information:	Manufacturers specs on annual SO2 equivalent emissions
Assessment method:	Review of contract documents and equipment specifications
Standard or references:	Contract documents and equipment specifications, or EPD

C3 Solid and Liquid Wastes

C.3.1 Construction and demolition waste

Intent:	To minimize the production of construction and demolition waste
Indicator:	Weight of waste and materials generated per 1 m2 of useful floor area demolished or constructed
Unit of measure:	kg/m2/life cycle stage
Relevant information:	The focus of the criterion is on waste that may arise in the life cycle of a building. The demolition of buildings can typically generate between 664 and 1637 kg/m2 of waste. Major renovations can generate between 20 and 326 kg/m2 of waste and construction sites can generate a further 48 – 135 kg/m2 of waste. Consequently, there are significant opportunities to reduce waste by moving to a more circular economy-based approach that focuses on deconstruction instead of demolition, and on reuse and recycling instead of disposal. The criterion is only applicable at design stage. The common performance assessment focuses on gathering data to report on the total waste disposed of and waste diverted. This requires confirmation of the waste types and whether the data is estimated or from a site. The reporting is at a basic level, making a distinction between waste disposed of and waste diverted.
Assessment method:	For each of the defined stages in the life cycle of a building, and as relevant to the nature of the building project being reported on, the following categories of output flows shall be reported on, with the option to disaggregate each flow by material stream: - Waste disposed of: hazardous and non-hazardous waste streams. This shall include waste disposed of to landfill and by incineration. - Components for re-use: This shall include all materials recovered for re- use either on or off site, with a focus on encouraging the reuse of structural elements. - Materials for recycling: This shall include all materials recovered for recycling either on or off site. Waste materials used in backfilling operations on or off site are excluded. - Materials for other material recovery operations: This shall include backfilling and processes that meet the EU definition of energy recovery. - Waste generated during the prefabrication or assembly of parts or elements off site that would otherwise take place on site shall be included within reporting on waste disposed of. This is to ensure that any burden shifting in order to reduce on-site waste is accounted for. The flows reported on under the scope of this indicator reflect those defined 'indicators describing additional environmental information' in the reference standards EN 15978 (Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method).
Standard or references:	Level(s) Part 1-2 – Beta version. EN 15978 (Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method)

C.3.2 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:	%
Relevant information:	Landfills are an increasingly pressing problem. Less and less land is available to deposit refuse, but the volume of waste is growing continuously. As a result, segregating waste is a priority because this practice gives the possibility to reuse and recycle the solid waste produced from buildings operation reducing the pressure on landfills.
Assessment method:	The seven reference categories of solid waste are: □ Paper □ Plastic □ Metal □ Glass □ Wet waste □ Textiles □ Special hazardous waste. 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 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 or references:	-

C.3.3 Liquid effluents from building operations that are sent off the site

Intent:	To assess the volume of waste water, including effluent, sent off the site annually for treatment.
Indicator:	The volume of liquid waste per m2 of gross area that is sent off the site for treatment. Note that units for residential occupancies are M3 / pp*yr, and M3 / m2*yr for non-residential.
Unit of measure:	m3/yr
Relevant information:	Annual total volume of black and grey water sent off the site for treatment in an external plant.
Assessment method:	Review of contract documents to assess potential maximum, minimum and typical wastewater flows. During use phase, sampling results are used.
Standard or references:	-

C4 Impacts on Project Site

C.4.1 Recharge of groundwater through permeable paving or landscaping

Intent:	To assess the extent to which natural groundwater in the site is recharged
Indicator:	The predicted percentage of precipitation that is available to recharge groundwater through permeable paving or landscaping
Unit of measure:	%
Relevant information:	Adapted from Wikipedia: Groundwater recharge is an important process for sustainable groundwater management, since the volume-rate abstracted from an aquifer in the long term should be less than or equal to the volume-rate that is recharged. Groundwater is recharged naturally by rain and snow melt and to a smaller extent by surface water (rivers and lakes). Recharge may be impeded by areas of paving or hard landscaping which can result in excessive surface runoff and reduction in recharge. These factors underline the importance of ensuring that all available rain and stormwater is returned to the ground, after suitable treatment. Predicted type and severity of impacts according to construction management plan.
Assessment method:	Review of construction management plans by a civil engineer, or on-site measurement during use phase.
Standard or references:	-

C.4.2 Changes in biodiversity on the site

Intent:	To ensure that neither the construction process nor the operations of the building will result in significant soil erosion on the site or adjacent lands
Indicator:	The existence and quality of contents of a plan to minimize ecological damage to the site due to the construction process
Unit of measure:	score
Relevant information:	Characteristics of existing soil and slope stability, planned changes in landscaping features, proposed surface water management
Assessment method:	Review of construction and operations management plans by a solid expert or landscape architect.
Standard or references:	-

C.4.3 Adverse wind conditions at grade around tall buildings

Intent:	To assess the impact of excessive wind conditions near the ground floor of high buildings
Indicator:	Design-phase modelling predictions or results of operations-phase field measurements.
Unit of measure:	score
Relevant information:	Height of building, and height, location and form of adjacent buildings. Design-phase information on height of building, and height, location and form of adjacent buildings, coupled with predicted modelling of wind behaviour using extablished predictive algorithms. During use phase, field measurements should be carried out on the site, near building exterior, especially at entries.
Assessment method:	Analysis by landscaping and/or geophysical specialist
Standard or references:	-

C5 Other Local and Regional Impacts

C.5.1 Impact of building on access to daylight or solar energy potential of adjacent property

Intent:	To assess the degree to which the height, bulk or location on the site of the Design does not significantly degrade the access to direct daylight of an existing or future building on adjacent properties
Indicator:	Percentage of nearest face of an existing building, or a future building designed on an adjacent site in accordance with existing regulations that will be shaded by the subject building
Unit of measure:	%
Relevant information:	Design and contract documentation and information on massing and fenestration of adjacent buildings that will be shaded by the subject property.
Assessment method:	Review of schematic plans and design team analysis
Standard or references:	-

C.5.2 Impact of construction process on local residents and commercial facility users

Intent:	To assess the extent to which noise, pollution, traffic disruption and other effects of the construction process may have a negative effects on local residents or users of local commercial facilities
Indicator:	During design phase, expert prediction of likely disruption levels; during and after construction phase, results of local random surveys
Unit of measure:	score
Relevant information:	-
Assessment method:	-
Standard or references:	-

C.5.3 Impact of building user population on peak load capacity of public transport system

Intent:	To assess the impact of large building populations on the operational efficiency of public transport systems used by the building occupants and visitors
Indicator:	Projected impact of building population and visitors on public transport capacity during morning and evening rush hours
Unit of measure:	%
Relevant information:	Load factor of public transport vehicles during morning and evening rush hours and projected building population
Assessment method:	Forecast of proportion of building population that is likely to use public transport during rush hours
Standard or references:	-

C.5.4 Impact of private vehicles used by building population on peak load capacity of local road system

Intent:	To assess the impact of private vehicles used by the building population on the operational efficiency on local road systems
Indicator:	For the design phase, the projected impact of building population on local road capacity during morning and evening rush hours. For the use phase field measurements should be used
Unit of measure:	%
Relevant information:	Number of parking spaces planned for the project, provision of management policies to reduce private vehicle use and local road usage and capacity
Assessment method:	Projection of likely private vehicle use, modelling of road capacity under conditions of additional vehicle population.
Standard or references:	-

C.5.5 Potential for project operations to contaminate nearby bodies of water

Intent:	To assess the risk of building operations causing pollution of adjacent water bodies or acquirers
Indicator:	Distance of the building from water body, acquifer or wetland as defined in official documentation or assessment by competent authorities. During use phase, field measurements of water quality should be taken
Unit of measure:	m
Relevant information:	The nature and volume of building effluents, distance of the building from water body, acquifer or wetland as defined in official documentation or assessment by competent authorities. During use phase, field measurements of water quality should be taken
Assessment method:	Review of site analysis report
Standard or references:	-

C.5.6 Cumulative (annual) thermal changes to lake water or sub-surface aquifers

Intent:	To assess the extent to which building operations involving ground-source or ground-water heat pumps change the average annual temperature of sub-surface aquifers
Indicator:	Predictions of changes in the average annual temperature of sub-surface aquifers, determined by simulation studies or, during use phase, on-site measurements of water temperatures
Unit of measure:	Deg. C
Relevant information:	-
Assessment method:	Review of mechanical drawings, specifications and equipment by geophysical engineer. During use phase, on-site measurements should be used.
Standard or references:	-

C.5.7 Contribution to Heat Island Effect from roofing, landscaping and paved areas

Intent:	To assess the degree to which project features such as open areas of the site and horizontal building surfaces increase or decrease local ambient temperatures related to the local urban heat island effect
Indicator:	During design phase, a building morphology and layout that permits free air circulation, reflectance and area of horizontal surfaces of paved or constructed elements, and the area and type of landscaped areas, as indicated by drawings and specifications. During use phase, on-site measurements should be used
Unit of measure:	Variance in ºC
Relevant information:	The urban heat island effect can add from 6 to 12 deg.C to the normal summer temperatures of surrounding areas; When ambient summer temperatures increase due to climate change, all buildings will have to be cooled for health reasons; In such circumstances, action to reduce the urban heat island effect must become a priority. Mitigation measures can include reducing heat rejection from buildings and vehicles, greening roofs, planting trees, using paving materials with high albedo and improving air circulation between buildings;
Assessment method:	For the design phase, review of landscaping plans and building design. During use phase, longitudinal measurements during summer periods of on-site ambient temperatures should be related to records available in the urban area.
Standard or references:	-

C.5.8 Degree of atmospheric light pollution caused by project exterior lighting systems

Intent:	To assess the spillage of light into the atmosphere from ground-level sources related to the building
Indicator:	Percentage of total exterior light output that lies outside a vertical 120 degree cone, as indicated by drawings and specifications
Unit of measure:	%
Relevant information:	-
Assessment method:	Review of building and site illumination plans and design team analysis
Standard or references:	-

D Indoor Environmental Quality

D1 Indoor Air Quality and Ventilation

D.1.1 Pollutant migration between occupancies

Intent:	Ensure that areas that contain equipment or activities generating chemical pollutants, are separately ventilated and isolated from other occupied spaces. Examples include copier rooms, waste storage areas and janitorial rooms
Indicator:	Measures taken to isolate areas or rooms where pollutants may be generated, as indicated by drawings and specifications
Unit of measure:	score
Relevant information:	-
Assessment method:	Review of contract documents and mechanical system by an outside mechanical engineer
Standard or references:	-

D.1.3 Formaldehyde concentration

Intent:	To assess the risk of occupants being exposed to hazardous levels of mold spores
Indicator:	Formaldehyde concentration in indoor air, µg/ m3
Unit of measure:	µg/ m3
Relevant information:	This indicator for source control of target air pollutants measure one of the most significant potential hazards to human health that can impact indoor air quality, the formaldehyde. In an air tight, modern home or office, the most significant direct emissions sources related to building construction material & products and other building finish materials that may originate from: - paints and varnishes, - textile furnishings, - floor coverings, - associated adhesives and sealants, - finish materials that incorporate particle board.
Assessment method:	Review of contract documents and mechanical system by an outside mechanical engineer. The indicator's value has to be characterized trough in situ measurements prior to occupation (post-completion phase). Testing shall be carried out for a minimum of 10% of the apartments and be representative of any significant variations in the house or apartment typologies, configurations and materials. Samples shall be taken in the living room and the smallest bedroom of each property selected. Sampling devices shall be placed in the centre of a room so as not to be influenced by doors, windows or heating/cooling inputs. Sampling and detection method: 30 minutes average in accordance with ISO 16000-3 (Indoor air -- Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air -- Active sampling method) In the design stage product testing shall to be used as a mean of source control. Test results showing the emissions after 28 days shall be reported for each material or finish to be installed that falls within the identified scope. The determination of emissions shall be in conformance with CEN/TS 16516 (Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air). Test data is therefore required from manufacturers/suppliers of the selected building products, as defined in the scope. All testing shall be on the as-finished product.
Standard or references:	-

D.1.4 TVOC concentration in indoor air

Intent:	To facilitate the assessment of indoor air quality
Indicator:	TVOC concentration in indoor air
Unit of measure:	µg/ m3
Relevant information:	This indicator for source control of target air pollutants measure one of the most significant potential hazards to human health that can impact indoor air, the Total Volatile Organic Compounds (TVOC). In an air tight, modern home or office, the most significant direct emissions sources related to building construction material & products and other building finish materials that may originate from: - paints and varnishes, - textile furnishings, - floor coverings, - associated adhesives and sealants, - finish materials that incorporate particle board. The boundary for the criteria is the useful conditioned volume and the related indoor air conditions as experienced by occupants of a building within those zones of the building. The indicator shall to be evaluated in the post completion phase, prior to occupation. For buildings in the design phase, product testing shall to be used as a mean of source control
Assessment method:	The criterion it's only applicable in post completion phase in a not occupied building. The indicator's value shall to be characterized trough in situ measurements prior to occupation (postcompletion phase). Testing shall be carried out for a minimum of 10% of the apartments and be representative of any significant variations in the house or apartment typologies, configurations and materials. Samples shall be taken in the living room and the smallest bedroom of each property selected. Sampling devices shall be placed in the centre of a room so as not to be influenced by doors, windows or heating/cooling inputs. Sampling and detection method shall to be in accordance with ISO 16000-6 or equivalent. In the design stage product testing shall to be used as a mean of source control. Test results showing the emissions after 28 days shall be reported for each material or finish to be installed that falls within the identified scope. The determination of emissions shall be in conformance with CEN/TS 16516 (Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air). Test data is therefore required from manufacturers/suppliers of the selected building products, as defined in the scope. All testing shall be on the as-finished product.
Standard or references:	EN 15251 (Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics). Level(s) Part 1-2 – Beta version.

D.1.5 CO2 concentrations in indoor air

Intent:	To assess the predicted or actual carbon dioxide concentrations in typical primary occupancy areas
Indicator:	Designs for HVAC systems that conform to ASHRAE, CIBSE or other acceptable protocol during design phase; actual monitoring results during use phase
Unit of measure:	ppm
Relevant information:	The indicator measures the indoor concentration level of CO2 which indicates if a healthy and comfortable indoor air is supplied to occupants. The boundary for the criterion is the useful conditioned space and the related indoor air conditions as experienced by occupants of a building within those zones of the building
Assessment method:	Design-stage predictions of CO2 levels may be obtained by simplified steady state calculation or a dynamic simulations, in accordance with EN 15242. The two methods differ in how accurately they are able to simulate the occupied performance of a building, particularly in terms of how air movements and the interaction of occupants are accounted for within a simulation. Priority has to be given to the dynamic simulation. The measure of CO2 concentration upon occupation of the building is carried out to check whether the design conditions are being achieved. Internal spaces within a building shall be tested and inspected on-site and upon full occupation of the building after a minimum of one year. In residential occupancies. testing shall be carried out for a minimum of 10% of the dwelling units and be representative of any significant variations in the dwelling typologies and configurations. Samples shall be taken in the living room and in the bedrooms of each property selected. The direct sampling of the air in rooms shall to be carried out over 1 week or 7 working days
Standard or references:	EN 15242

D.1.6 Effectiveness of ventilation in naturally ventilated occupancies during cooling seasons

Intent:	To assess air quality and ventilation during summer conditions in a naturally-ventilated building
Indicator:	Air changes per hour in typical occupancy areas, predicted by modelling or measured on site
Unit of measure:	ach
Relevant information:	Cross-ventilation is defined as spaces where openable windows are located on at least two separate walls
Assessment method:	Review of contract documents and mechanical system by an outside mechanical engineer with specific knowledge of natural ventilation issues
Standard or references:	-

D.1.7 Effectiveness of ventilation in naturally ventilated occupancies during intermediate seasons

Intent:	To assess air quality and ventilation during Spring/Fall conditions in a naturally-ventilated building
Indicator:	Air changes per hour in typical occupancy areas, predicted by modelling or measured on site
Unit of measure:	ach
Relevant information:	Cross-ventilation is defined as spaces where openable windows are located on at least two separate walls
Assessment method:	Review of contract documents and mechanical system by an outside mechanical engineer with specific knowledge of natural ventilation issues
Standard or references:	-

D.1.8 Effectiveness of ventilation in naturally ventilated occupancies during heating seasons

Intent:	To assess if occupants in a naturally-ventilated building can be provided with a high level of air quality and ventilation during Winter conditions
Indicator:	Air changes per hour in typical occupancy areas, predicted by modelling or measured on site
Unit of measure:	ach
Relevant information:	Cross-ventilation is defined as spaces where openable windows are located on at least two separate walls
Assessment method:	Review of contract documents and mechanical system by an outside mechanical engineer with specific knowledge of natural ventilation issues
Standard or references:	

D.1.9 Air movement in mechanically ventilated occupancies

Intent:	To assess if air movement in mechanically ventilated occupancies is sufficient to satisfy requirements for human comfort
Indicator:	Predicted air speed in m/s, as indicated by an analysis of proposed HVAC system characteristics or by post-occupancy monitoring
Unit of measure:	m/s
Relevant information:	-
Assessment method:	Review of contract documents and mechanical system by an outside mechanical engineer
Standard or references:	-

D.1.10 Ventilation rate

Intent:	To ensure an effective air exchange and high local air quality
Indicator:	Ventilation rate normalized per useful floor area
Unit of measure:	l/s/m2
Relevant information:	The rate of air change is an important measure of the rate at which stale air is replaced with clean intake air. The rate of air exchange also controls the build-up of other chemical and biological pollutants. The boundary for the criteria is the useful conditioned space. The indicator must be calculated in all the main occupied rooms.
Assessment method:	Project stage: design A design simulation of the building's ventilation strategy in accordance with EN 16798-7 (Energy performance of buildings - Ventilation for buildings - Part 7: Calculation methods for the determination of air flow rates in buildings including infiltration) shall be used to calculate the ventilation rate. According to Directive 2010/31/EU for the Energy Performance of buildings, a ventilation system is part of the technical building system. The simulation shall therefore always form part of the performance assessment for the typical use of a building as a whole. The ventilation rate (l/s/m2) must be calculated in all the main rooms, excluding circulation spaces and service rooms (i.e. toilets). The indicator must be calculated as weighted sum all the calculated ventilation rates: $Indicator = \frac{\sum V_i \times S_{u,i}}{\sum S_{u,i}}$ Vi = Ventilation rate calculated in the i-th room (l/s/m2) Su,i = useful floor area of the i-th room (m2) Project stage: post completion The ventilation rate shall be tested as part of the commissioning process on site according to the methods described in Annex D of EN 12599. The average ventilation rate shall be reported. Measurements can be taken at a number of points in a system. The measurements shall be made for the related ducts and/or air terminals that supply air to the internal spaces as identified according to the guidance in section 2.1.2.2 of the reference standard. Note The criterion is active only if there are ventilation systems in the building.
Standard or references:	EN 16798-7 - Energy performance of buildings - Ventilation for buildings - Part 7: Calculation methods for the determination of air flow rates in buildings including infiltration. EN 12599 - Ventilation for buildings - Test procedures and measurement methods to hand over air conditioning and ventilation systems. Level(s) Part 1-2 – Beta version.

D2 Air Temperature and Relative Humidity

D.2.1 Time outside of the thermal comfort range

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 and cooling seasons
Unit of measure:	%
Relevant information:	-
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 bed rooms. In the case of assessment of multiple apartments, each distinctive configuration and orientation shall be assessed.
Standard or references:	-

D.2.2 Thermal comfort index

Intent:	To facilitate the assessment of indoor thermal comfort conditions
Indicator:	Predicted Percentage Dissatisfied (PPD)
Unit of measure:	%
Relevant information:	The thermal comfort index PPD (Predicted Percentage Dissatisfied) allows to predict the general thermal sensation and degree of discomfort (thermal dissatisfaction) of people exposed to moderate thermal environments. It enables the analytical determination and interpretation of indoor thermal comfort, giving the environmental conditions considered acceptable for general thermal comfort as well as those representing local discomfort.

Assessment method:	The Predicted Percentage Dissatisfied (PPD) value is estimated or measured in accordance to EN 16798 both in summer and winter conditions. PPD has to be evaluated in all main occupied rooms. Spaces in each distinctive configuration and orientation shall be assessed.

The calculation steps are the following:
a) Estimate or Measure PMV
b) Calculate PPD

Calculation in Design stage (mechanically conditioned).
The calculation steps are the following for all main occupied room:
a) Estimate PMV
o Select the design air temperature (dry bulb-db) and relative humidity for the main space function, e.g. for offices 26(20)oC and 45(35)% in summer(winter)
o Select the design indoor air speed, e.g. 0.15 m/s
o Calculate the mean radiant temperature of indoor wall surfaces (oC)
o Determine the main physical activity of the occupants (related to the metabolic rate), e.g. seated office work (1 met)
o Determine the typical type of clothing ensembles, e.g. light indoor summer clothing (0.5 clo)
o 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 ≤ PMV ≤ 0.2
Category II	**0.33 T_{rm} + 18.8 + 3**	0.33 T_{rm} + 18.8 - 3	±3	≤10	-0.5 ≤ PMV ≤ 0.5
Category III	0.33 T_{rm} + 18.8 + 4	0.33 T_{rm} + 18.8 - 4	±4	≤15	-0.7 ≤ PMV ≤ 0.7

Calculation in Occupancy stage.

Measure the PPD in the case of operating buildings in all main occupied rooms. Use a PMV/PPD meter to record indoor conditions and predict the prevailing thermal comfort conditions

Thermal environment measurements are made in the building at a representative sample of locations, i.e.
o The center of the room or space
o 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

Measurements are also taken in locations where the most extreme values of the thermal parameters are observed or anticipated (e.g. occupied areas near

	windows, diffuser outlets, corners, entries) Measurement periods cover several hours, representative of total occupancy (e.g. season, typical day).
Standard or references:	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

D.2.3 Appropriate air temperature and relative humidity in mechanically cooled occupancies

Intent:	To assess temperature and humidity control within established ranges per climate zone To ensure acceptable temperature and humidity control within established ranges per climate zone, and to provide on-going monitoring of thermal comfort performance and the effectiveness of humidification and/or dehumidification system.
Indicator:	During design phase, assessment of compliance of mechanical ventilation systems with recognized design standards such as ASHRAE or CIBSE.
Unit of measure:	score
Relevant information:	Compliance with relevant and recognized standards such as ASHRAE or CIBSE is an important first step. Monitoring of actual conditions is critical suring operations, and this requires a permanent monitoring system.
Assessment method:	Review of contract documents and mechanical system by an outside mechanical engineer
Standard or references:	-

D.2.4 Appropriate air temperature in naturally ventilated occupancies

Intent:	To assess if temperatures fall within established ranges per climate zone in naturally ventilated occupancies
Indicator:	Predicted ability of natural ventilation systems to maintain temperatures within an acceptable range, as indicated by drawings and specifications
Unit of measure:	score
Relevant information:	ASHRAE 55-1992, Addenda 1995 or equivalent CIBSE or other recognized standard
Assessment method:	Review of contract documents and mechanical system by a third-party mechanical engineer with specific knowledge of natural ventilation issues
Standard or references:	-

D3 Daylighting and Illumination

D.3.1 Appropriate daylighting in primary occupancy areas

Intent:	To ensure an adequate level of daylighting in all primary occupied spaces
Indicator:	The predicted Daylight Factor in a typical occupancy area located on the ground floor of the building, as indicated by drawings and specifications
Unit of measure:	Daylighting Factor (%)
Relevant information:	-
Assessment method:	Review of contract documents by an illumination specialist
Standard or references:	-

D.3.2 Control of glare from daylighting

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:	The predicted maximum ratio of contrast in illuminance between windows and adjacent wall areas in a typical occupancy area, as indicated by design characteristics
Unit of measure:	Ratio
Relevant information:	Glare shall be measured by the contrast between window areas and adjacent wall areas, as seen from the interior
Assessment method:	Review of contract documents by an illumination specialist
Standard or references:	-

D4 Noise and Acoustics

D.4.1 Noise attenuation through the exterior envelope

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:	The predicted noise attenuation performance of the exterior wall most exposed to potential sources of noise, as indicated by design characteristics
Unit of measure:	STC
Relevant information:	-
Assessment method:	Review of design team analysis by a noise specialist
Standard or references:	-

D.4.2 Transmission of facility equipment noise to primary occupancies

Intent:	To ensure that HVAC systems and equipment rooms are designed to minimize noise transmission to primary occupancies
Indicator:	Noise Reduction Criteria ratings of mechanical equipment and equipment rooms, as indicated by design characteristics
Unit of measure:	NRC
Relevant information:	-
Assessment method:	Review of contract documents and mechanical system by an outside mechanical engineer
Standard or references:	-

D.4.3 Noise attenuation between primary occupancy areas

Intent:	To ensure that measures have been taken to reduce noise impacts between all tenancies and occupancy types
Indicator:	Minimum Sound Transmission Class of partitions between primary occupancy areas, as indicated by design characteristics
Unit of measure:	STC
Relevant information:	-
Assessment method:	Review of design team analysis
Standard or references:	-

E Service Quality

E1 Safety and Security

E.1.2 Risk to occupants and facilities from fire

Intent:	To assess the risk exposure of occupants and users of the building from fire and smoke
Indicator:	Risk level for occupants in the most vulnerable part of the building
unit of measure:	score
Relevant information:	Provision for fire fighters to access key parts of the building from exterior and interior points; adequacy of means of egress; fire rating of key systems
Assessment method:	Analysis of design documentation
Standard or references:	-

E.1.3 Risk to occupants and facilities from flooding

Intent:	To assess the risk to lives and property of potential flooding incidents
Indicator:	Probability of injury or death or major property damage in case of 100-year flood event or other foreseeable flood risk
Unit of measure:	score
Relevant information:	Height of lowest occupied floor above 100-year flood level; landscaping or building design features that could mitigate or aggravate flooding risks and consequences
Assessment method:	Analysis of documents, discussion with flood control experts in local government and with insurance experts
Standard or references:	-

E.1.4 Risk to occupants and facilities from earthquake

Intent:	To assess the risk to lives and property of potential earthquake events
Indicator:	Probability of injury or death or major property damage in case of earthquake event foreseeable within a 100-year time frame
Unit of measure:	score
Relevant information:	Predicted ability of building structure and key elements to withstand the effects of foreseeable earthquake events and the extent of death or injury to occupants and damage to the building elements and contents. Relevant factors include the typical type and intensity of earthquakes in the location (see ContextA C107), specific geological characteristics of the site, height and type of building structure, isolation of the structure from foundations, strength and flexibility of the superstructure.
Assessment method:	Analysis of documents, discussion with emergency measures experts and with insurance experts
Standard or references:	-

E.1.5 Risk to occupants from incidents involving biological or chemical substances

Intent:	To assess the risk to lives and property of an accidental or willful biological or chemical release in or near the building
Indicator:	Probability of injury or death in case of an accidental or willful biological or chemical release in or near the building
Unit of measure:	score
Relevant information:	Predicted ability of building structure and key elements to withstand the effects of foreseeable biological or chemical release, and for occupants to avoid death or injury
Assessment method:	Analysis of documents, discussion with emergency measures experts and with insurance experts
Standard or references:	-

E.1.6 Maintenance of core building functions during power outages

Intent:	To encourage the provision of features, such as back-up systems and thermal mass, that will allow the building to function outside of anticipated design conditions for temperature, rainfall, power and fuel supply
Indicator:	Predictions of the number of days that ventilation, temperature, lighting, sanitation and internal transportation systems continue to provide minimally acceptable service, under conditions of temperature, rainfall, power and fuel supply that fall outside of anticipated design conditions
Unit of measure:	Days
Relevant information:	Thermal performance of building envelope, characteristics of back-up generation facility and utility data on power interruption history
Assessment method:	Analysis of documents, discussion with emergency measures experts and with insurance experts
Standard or references:	-

E.1.7 Personal security for building users during normal operations.

Intent:	To assess the extent to which building users are relatively secure in accessing and using the building
Indicator:	Measures that are likely to assure adequate levels of actual and perceived personal security, according to design documentation
Unit of measure:	score
Relevant information:	Detailed site and building floor plans, lighting plans, local police reports. Actual and perceived security is related to conditions in the neighbourhood, such as condition of sidewalks, street lighting, and presence of pedestrian traffic; within the building it is linked to the design of building and dwelling entries, and building passenger lifts with respect to ease of use and security
Assessment method:	Analysis of documents, discussion with emergency measures experts and with insurance experts
Standard or references:	-

E2 Functionality and efficiency

E.2.1 Appropriateness of type of facilities provided for tenant or occupant needs

Intent:	Assessment of the appropriateness of the facility relative to the defined needs of tenancies or individual occupants
Indicator:	Factors include location, distance to relevant support facilities, surrounding environment (noise, traffic etc.)
Unit of measure:	score
Relevant information:	The type of facilities provided for various specific functional requirements
Assessment method:	Review of analysis provided by design team
Standard or references:	-

E.2.2 Suitability of layout(s) for required functions

Intent:	To assess the appropriateness of interior layouts to functional requirements of tenancies or occupants
Indicator:	Goodness of fit of provided layouts (shape, ease of access) with functional requirements
Unit of measure:	score
Relevant information:	The location and adjacency characteristics of space provided for various specific functional requirements.
Assessment method:	Review of analysis provided by design team
Standard or references:	-

E.2.3 Appropriateness of space provided for required functions

Intent:	To assess the adequacy of floor area provided for required functions
Indicator:	Goodness of fit of provided area with functional requirements
Unit of measure:	score
Relevant information:	The floor area provided for various specific functional requirements
Assessment method:	Review of analysis provided by design team
Standard or references:	-

E.2.4 Provision of exterior access and unloading facilities for freight or delivery

Intent:	Assessment of access and unloading facilities for delivery and removal of goods and waste material
Indicator:	Adequacy of the facility unloading and temporary storage capacity and measures to prevent excessive noise and visual pollution from disturbing occupants
Unit of measure:	score
Relevant information:	Location and design of facility and access road(s) and measures to isolate facility from occupied areas
Assessment method:	Desk analysis
Standard or references:	-

E.2.5 Service quality and efficiency of vertical or horizontal transportation systems in building

Intent:	To assess the service quality and functional efficiency of vertical and horizontal transportation systems within a building
Indicator:	Availability of lifts for occupant use, taking into account down-time for service and moving needs, and the time required to travel from the ground floor to the top floor (or vice versa) during peak periods; provision, capacity and speed of horizontal passenger conveying systems
Unit of measure:	score
Relevant information:	Identify provision of back-up generation, estimates of floor by floor population and peak arrivel and departure times. For horizontal passenger conveying systems (e.g. air terminals, shopping centres), capacity and speed. Note that energy consumption of systems should be included in the overall energy consumption of the occupancy or building (seeB1.3)
Assessment method:	Review of analysis provided by design team
Standard or references:	-

E.2.6 Spatial efficiency

Intent:	To assess the efficiency of space utilization within buildings
Indicator:	The ratio of directly functional net areas to total net area in each occupancy. Total Net Areas exclude only structure and building envelope areas; Net Functional Areas (NFA) exclude interior garages, vertical circulation and building mechanical rooms
Unit of measure:	%
Relevant information:	Net areas for all floors with varying net areas
Assessment method:	Calculation of net to gross areas for all floors of varying net area
Standard or references:	-

E.2.7 Volumetric efficiency

Intent:	To encourage the efficient utilization of space within buildings
Indicator:	The ratio of directly functional net areas to total net area in each occupancy. Total Net Areas exclude only structure and building envelope areas; Net Functional Areas (NFA) exclude interior garages, vertical circulation and building mechanical rooms
Unit of measure:	%
Relevant information:	Net areas for all floors with varying net areas
Assessment method:	Calculation of net to gross areas for all floors of varying net area.
Standard or references:	-

E3 Controllability

E.3.1 Effectiveness of facility management control system

Intent:	To ensure that a building management control system is provided to maximize the operational efficiency of building systems, such as HVAC, lighting and vertical transportation systems
Indicator:	The presence of a computerized building management control system whose capability is consistent with the complexity of building systems
Unit of measure:	score
Relevant information:	Characteristics of computerized building management control system; number and type of control points for all electrical and mechanical systems
Assessment method:	Review of contract documents and specifications of proposed system(s)
Standard or references:	-

E.3.2 Capability for partial operation of facility technical systems

Intent:	To ensure that a building management control system is provided to partial operation by area or time of use of building systems, such as HVAC, lighting and vertical transportation systems
Indicator:	The predicted ability of building systems to provide partial heating, ventilation, cooling or lighting services, according to design documentation
Unit of measure:	score
Relevant information:	Area of lighting and HVAC control zones, control types and locations
Assessment method:	Review of contract documents and specifications of proposed system(s), and review of analysis provided by design team
Standard or references:	-

E.3.3 Degree of local control of lighting systems

Intent:	To ensure that lighting control system zones in non-residential occupancies are sufficiently small to ensure a satisfactory level of occupant control over lighting conditions
Indicator:	The area of typical lighting control zones in perimeter areas in m2, as shown in design documentation
Unit of measure:	m2
Relevant information:	Area of lighting control zones, control types and locations
Assessment method:	Review of contract documents and specifications of proposed system(s)
Standard or references:	-

E.3.4 Degree of personal control of technical systems by occupants

Intent:	To ensure a maximum degree of personal control over heating, ventilation and illumination systems
Indicator:	The degree of control over key indoor environment systems that can be exercised by occupants, according to design documentation
Unit of measure:	score
Relevant information:	Type of mechanical and electrical equipment accessible by occupants, and the extent to which local systems can be operated and modulated by occupants
Assessment method:	Review of contract documents and specifications of proposed system(s)
Standard or references:	-

E4 Flexibility and Adaptability

E.4.1 Ability for building operator or tenant to modify facility technical systems

Intent:	To extend building life by ensuring that the relocation of HVAC delivery systems, lighting and associated control systems, and modifications to cabling and telecom systems can be accomplished with a minimum of effort and collateral damage
Indicator:	The level of renovation work necessary to alter technical systems to suit new requirements
Unit of measure:	score
Relevant information:	Design features of systems that will facilitate operator or occupant efforts to modify location or other characteristics of lighting and HVAC systems
Assessment method:	Review of contract documents and specifications of proposed system(s), and review of analysis provided by design team
Standard or references:	-

E.4.2 Potential for horizontal or vertical extension of structure

Intent:	To assess the potential of the structure for future vertical or horizontal expansion of the building
Indicator:	Degree of technical and design difficulty and capital cost requirements linked to expansion possibilities
Unit of measure:	score
Relevant information:	For horizontal expansion, site availability and configuration of existing building; for vertical expansion, bearing capacity of structure and issues related to extension of vertical services. For both, the configuration of the existing building may constrain expansion design solutions
Assessment method:	Review of contract documents and specifications of proposed system(s), and review of analysis provided by design team.
Standard or references:	-

E.4.3 Adaptability constraints imposed by structure or floor-to-floor heights

Intent:	To ensure that the location of core and columns and the bearing capacity of the structure offer a degree of adaptability for new uses
Indicator:	Structural load capacity and layout
Unit of measure:	score
Relevant information:	Structural bay spacing and floor load capacity that may support or hinder adaptation to the requirements of a new occupancy type. Although this criterion is applicable to all occupancies, experience indicates that Residential occupancies provide the greatest degree of constraint to changes in use. Load is Sustained Load in kN/m2
Assessment method:	Review of contract documents and specifications of proposed system(s), and review of analysis provided by design team
Standard or references:	-

E.4.4 Adaptability constraints imposed by building envelope and technical systems

Intent:	To ensure that the building envelope, HVAC and electrical systems of the original occupancy offer a degree of flexibility that will allow occupancies to be changed with a reasonable level of renovation work
Indicator:	The ease or difficulty in altering the building envelope or technical systems to suit a new occupancy type
Unit of measure:	score
Relevant information:	Characteristics of building envelope that may support or hinder changes in fenestration or door locations or sizes to suit a new occupancy type
Assessment method:	Review of contract documents and specifications of proposed system(s), and review of analysis provided by design team
Standard or references:	-

E.4.5 Adaptability to future changes in type of energy supply

Intent:	To ensure that the building can, in the future, be adapted to run on a different fuel from that originally anticipated, or to install photovoltaic systems
Indicator:	The ease or difficulty in installing heating or cooling equipment that require a different fuel, or to install photovoltaic systems
Unit of measure:	score
Relevant information:	Characteristics of roofs and walls that may support or hinder the installation and/or operation of photovoltaic or solar thermal systems
Assessment method:	Review of contract documents and specifications of proposed system(s), and review of analysis provided by design team
Standard or references:	-

E5 Optimization and Maintenance of Operating Performance

E.5.1 Operating functionality and efficiency of key facility systems

Intent:	To ensure that all key building or facility systems operate according to the design intent
Indicator:	Commissioning plans developed and/or implemented and commissioning staff assigned
Unit of measure:	score
Relevant information:	Design intent and performance goals related to major building systems
Assessment method:	Review of commissioning plan
Standard or references:	-

E.5.2 Adequacy of the building envelope for maintenance of long-term performance

Intent:	To ensure that detailed design minimizes the risk of moisture accumulating in the building envelope, where it is likely to short the lifespan of building Occupancies, especially if constructed of wood in areas where temperatures can fall to below 0 deg.C
Indicator:	In areas where applicable, the existence of a report that describes and details the measures taken to ensure long-term integrity of the building envelope
Unit of measure:	score
Relevant information:	Results of air depressurization results
Assessment method:	Review of contract documents and engineering analysis of performance during winter conditions
Standard or references:	-

E.5.3 Durability of key materials

Intent:	To encourage the use of materials that have a long service life, where this is appropriate
Indicator:	Materials and components conforming to accepted standards for durability
Unit of measure:	score
Relevant information:	-
Assessment method:	Validated data on functional durability in years.
Standard or references:	-

E.5.4	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
Relevant information:	Maintenance management plan, if one exists
Assessment method:	Review of operations and maintenance management plan
Standard or references:	-

E.5.5	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
Relevant information:	Scope of monitoring plan, if one exists, including number and type of systems monitored, frequency of readings, provision for data analysis
Assessment method:	Review of contract 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 or references:	-

E.5.6	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, so that they will be able to operate the building efficiently
Indicator:	The scope and quality of design documentation retained for use by building operators, according to design documentation
Unit of measure:	score
Relevant information:	Location of information, mode of preservation, instructions for access
Assessment method:	Check to ascertain compliance
Standard or references:	-

F Social, Cultural and Perceptual Aspects

F1 Social Aspects

F.1.1 Universal access on site and within the building

Intent:	To assess the relative ease of access and use of facilities for persons with mobility or perceptual disabilities
Indicator:	The scope and quality of design measures planned to facilitate access and use of building facilities by persons with disabilities
Unit of measure:	score
Relevant information:	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
Assessment method:	Review of construction documents by a specialist in universal access design
Standard or references:	-

F.1.2 Access to direct sunlight from living areas of dwelling units

Intent:	To assess the extent to which principal daytime living areas of dwelling units in the building have direct sunlight
Indicator:	The percentage of dwelling units whose principal daytime living areas have direct sunlight. for at least 2 hours per day at 12 noon on Winter Solstice, according to design documentation
Unit of measure:	%
Relevant information:	Analysis of solar access through computer or manual calculations
Assessment method:	Review of analysis prepared by design team
Standard or references:	-

F.1.3 Visual privacy in principal areas of dwelling units

Intent:	To assess the level of privacy in bedroom and living areas of dwelling units in the building
Indicator:	The percentage of dwelling units whose bedroom and living areas are open to horizontal or downward views from a point within 20 m of the exterior windows
Unit of measure:	%
Relevant information:	Location of windows or private open spaces in subject building that may reveal private activities to persons located in adjacent properties
Assessment method:	Review of analysis prepared by the design team
Standard or references:	-

F.1.4 Access to private open space from dwelling units

Intent:	To assess the extent to which occupants of dwelling units have easy access to private outdoor space meeting functional criteria
Indicator:	Minimum area and dimensions, in m2 and m. and adequate protection from excessive solar exposure
Unit of measure:	%
Relevant information:	Private outdoor space is defined for apartment units as balconies or terraces having a minimum area of 6 m2 and a minimum dimension of 2m, and for ground-level units as having a minimum area of 16 m2 and a minimum dimension of 4m. Adequate protection from excessive solar exposure is to be provided
Assessment method:	Review of all unit designs.
Standard or references:	-

F2 Culture and Heritage

F.2.1 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:	Expert assessment of the degree to which new features, systems and materials are consistent with local cultural values related to urban design and architecture, including both functional and aesthetic aspects
Unit of measure:	score
Relevant information:	Relevant issues include building uses, degree of access by public to site and to interior, degree of design openness
Assessment method:	Subjective assessment by an experienced third-party design professional and/or sociologist
Standard or references:	-

F.2.2 Provision of public open space compatible with local cultural values

Intent:	To ensure that public open space compatible with local cultural values is provided in large projects
Indicator:	Expert assessment of the degree to which public open space provided in the project is consistent with local cultural values
Unit of measure:	score
Relevant information:	Relevant issues include local traditions of open space usage and building uses
Assessment method:	Subjective assessment by an experienced third-party design professional and/or sociologist
Standard or references:	-

F.2.3 Impact of the design on existing streetscapes

Intent:	To assess the degree to which the architectural design of the building exterior is harmonious relative to adjacent buildings
Indicator:	Expert assessment of the harmony of the Design with adjacent existing buildings, in features such as height, bulk, set-back from the street, window size and height, colour or type of materials
Unit of measure:	score
Relevant information:	Visual character of existing streetscape and subject building, especially height, materials, treatment of pedestrian use at ground level
Assessment method:	Review by an outside design team of an analysis prepared by the design team
Standard or references:	-

F.2.4 Use of traditional local materials and techniques

Intent:	To assess the extent to which traditional local materials and construction techniques will used in the execution of the project
Indicator:	Architect's estimate of the percent of the non-structural elements of the building will be constructed using traditional local materials and construction techniques
Unit of measure:	%
Relevant information:	Estimate of percentage of traditional local materials to be used relative to total non-structural materials, by value
Assessment method:	Review by an outside design team of an analysis prepared by the design team
Standard or references:	-

F.2.5 Maintenance of the heritage value of the exterior of an existing facility

Intent:	To encourage the preservation of heritage value of existing buildings
Indicator:	Expert assessment of the degree to which new features, systems and materials are consistent with the character of the original design of the heritage building
Unit of measure:	score
Relevant information:	Degree to which the renovation will impair or support the original design characteristics, including issues of window and door sizes and, locations and design, materials used
Assessment method:	Review of characteristics of existing structure and design documents by a heritage expert
Standard or references:	-

F.2.6 Maintenance of the heritage value of the interior of an existing facility

Intent:	To assess the extent to which interior elements of a heritage building is preserved
Indicator:	Expert assessment of the degree to which new interior features, systems and materials are consistent with the character of the original design of the heritage building
Unit of measure:	score
Relevant information:	Degree to which the renovation will impair or support the original interior design characteristics, including issues of window and door sizes and, locations and design, materials used
Assessment method:	Review of characteristics of existing structure and design documents by a heritage expert
Standard or references:	-

F3 Perceptual

F.3.1 Impact of tall structure(s) on existing view corridors

Intent:	To assess the extent to which a new tall structure may impair existing view corridors from key positions in the urban area
Indicator:	Expert or public opinion regarding impairment of existing view corridors
Unit of measure:	score
Relevant information:	Prediction of impact of new structure on view corridors using physical or CAD models, and/or reactions of expert or lay panels
Assessment method:	Review of design by an expert panel or by public survey
Standard or references:	-

F.3.2 Quality of views from tall structures

Intent:	Assessment of quality of views provided by new tall structure
Indicator:	Expert or public opinion regarding impairment of existing view corridors
Unit of measure:	score
Relevant information:	Simulation of views from various floor levels of the new structure
Assessment method:	Review of design by an expert panel or by public survey
Standard or references:	-

F.3.3 Sway of tall buildings in high wind conditions

Intent:	To assess the lateral displacement on the top floors of tall buildings that might cause discomfort for occupants
Indicator:	Lateral displacement from vertical under high wind conditions, in cm
Unit of measure:	sway in m.
Relevant information:	Lateral displacement will be related to the height of the building
Assessment method:	Review of analysis provided by design team
Standard or references:	-

F.3.4 Perceptual quality of site development

Intent:	To assess the perceptual quality of site development, including aesthetic, olfactory, auditory and symbolic aspects
Indicator:	Views of an expert panel
Unit of measure:	score
Relevant information:	Various aspects of site development that affect perceptions, including visual, olfactory, auditory and psychological
Assessment method:	Review of design or completed site work by an expert panel
Standard or references:	-

F.3.5 Aesthetic quality of facility exterior

Intent:	To assess the aesthetic quality of the building exterior
Indicator:	-
Unit of measure:	score
Relevant information:	-
Assessment method:	Review of design or actual exterior by an expert panel
Standard or references:	-

F.3.6 Aesthetic quality of facility interior

Intent:	To assess the aesthetic quality of the building interior
Indicator:	-
Unit of measure:	score
Relevant information:	-
Assessment method:	Review of design or actual interior by an expert panel
Standard or references:	-

F.3.7 Access to exterior views from interior

Intent:	To assess the quality of exterior views available to an observer located in an interior space of a main occupancy
Indicator:	Visual quality of exterior artifacts or natural objects and their distance from the viewer
Unit of measure:	score
Relevant information:	-
Assessment method:	Review of analysis prepared by the design team
Standard or references:	-

G Cost and Economic Aspects

G1 Cost and Economics

G.1.1 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 unit area, according to design documentation
Unit of measure:	Euro/m2
Relevant information:	Land acquisition costs, contractor and subcontractor costs, revisions
Assessment method:	Review of cost analysis by a qualified cost consultant
Standard or references:	-

G.1.2 Operating and 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:	Operating cost per unit area for energy, water & maintenance, according to design documentation
Unit of measure:	Euro/m2
Relevant information:	The operating cost of a high-performance building should be substantially less than Acceptable Practice, primarily because of reduced energy, water and equipment maintenance costs
Assessment method:	Review of operating cost projections by a cost consultant and a person knowledgeable in building operations
Standard or references:	-

G.1.3 Life-cycle cost

Intent:	To assess the level of total Life Cycle Cost of the project
Indicator:	Predicted Life Cycle Cost over a 25-year period, with calculations carried out in accordance with recognized procedures
Unit of measure:	Euro/m2
Relevant information:	Capital cost, projected operating and maintenance cost, projections of future energy costs, discount rate
Assessment method:	Review of LCC analysis by a qualified cost consultant
Standard or references:	-

G.1.4 Use stage energy cost

Intent:	To optimize the operating cost of buildings to reflect the potential for long term performance
Indicator:	Energy annual cost per usable floor area
Unit of measure:	€/m2/yr
Relevant information:	The focus of the criteria is on the costs of thermal and electric energy during operation for all uses
Assessment method:	Reporting can be based on estimated performance at the design stage and after monitoring of performance during normal building occupancy. This means they can be used by a range of project actors, including during the design stage, to estimate future performance and performance following occupation so as to check how the building is actually performing against projected short, medium and long-term cost schedules. In case of existing buildings, the total annual cost of actual thermal and electrical energy use from energy bills should be calculated taking the average energy cost over 3 years period. The source of data must always be declared.
Standard or references:	Level(s) Part 1-2 – Beta version

G.1.5 Use stage water cost

Intent:	To optimize the operating cost of buildings to reflect the potential for long term performance
Indicator:	Water annual cost per usable floor area
Unit of measure:	€/m2/yr
Relevant information:	The focus of the criteria is on the costs of water during operation for all indoor uses
Assessment method:	Reporting can be based on estimated performance at the design stage and after monitoring of performance during normal building occupancy. This means they can be used by a range of project actors, including during the design stage, to estimate future performance and performance following occupation so as to check how the building is actually performing against projected short, medium and long-term cost schedules. In case of existing buildings, the total annual cost of water use from water bills should be calculated taking the average water cost over 3 years period. The source of data must always be declared.
Standard or references:	Level(s) Part 1-2 – Beta version

G.1.6 Investment risk

Intent:	To assess the extent to which the construction of the project has affected nearby property values and the investment risk
Indicator:	Percent change in market value of properties within 200 m of the project boundaries, 12 months after the start of construction
Unit of measure:	score
Relevant information:	An increase in adjacent property values may be seen as desirable if the area is to be upgraded, but may be seen as negative if increases are likely to harm the market viability of existing properties. These considerations will affect the setting of benchmark values. Risk is defined as the probability of failing to reach financial objectives because of technical or social failures, factored by the potential investment loss
Assessment method:	Economic evaluation
Standard or references:	-

G.1.7 Affordability of residential rental or cost levels

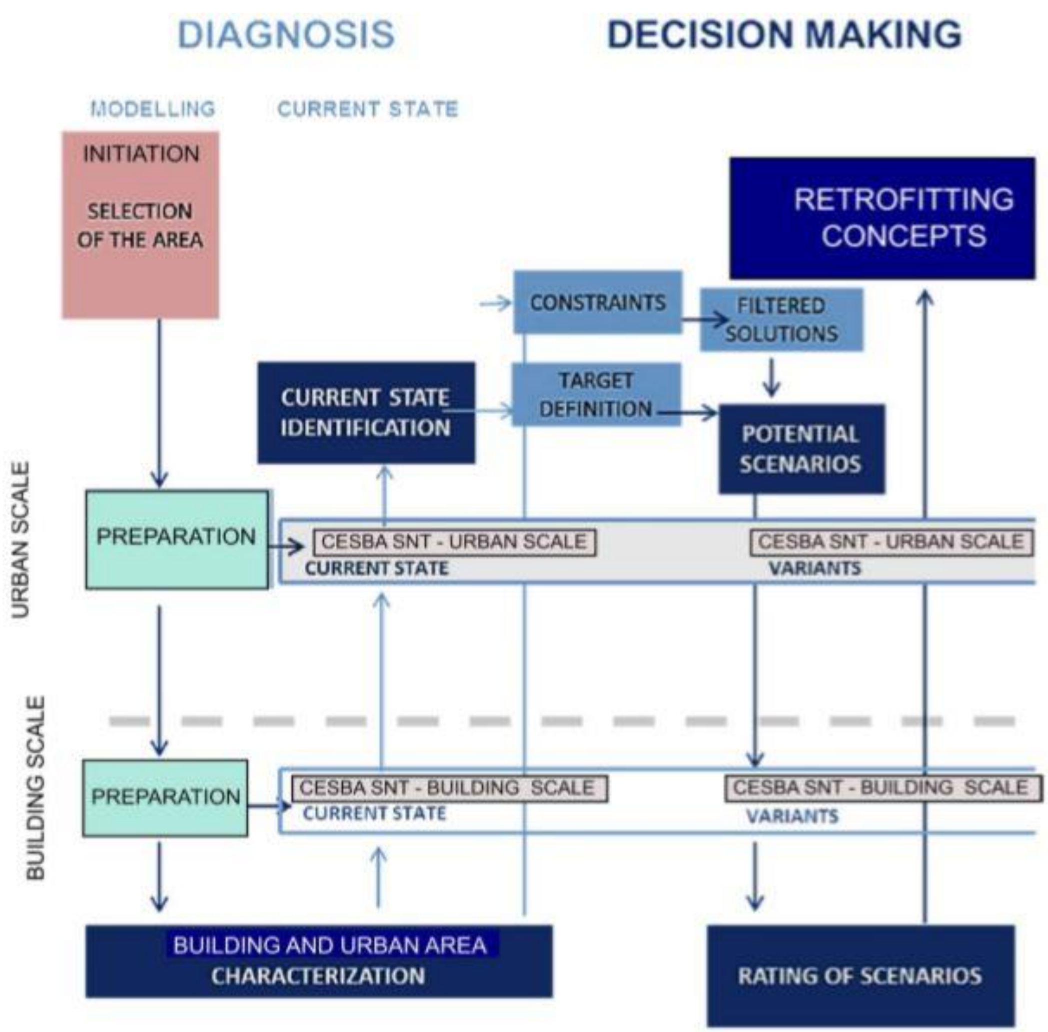
Intent:	To assess whether rents or costs of residential units in the Design will be affordable for the target market
Indicator:	The gross housing cost, including rent or financing costs plus basic utilities, as a percentage of median gross income
Unit of measure:	%
Relevant information:	Modal and mean incomes of residential population in urban area, anticipated or actual rental or purchase and carrying costs
Assessment method:	Review of analysis prepared by design team, with special review of household incomes in the neighbourhood
Standard or references:	-

E. Decision Making

The model of decision making process is intended to support public administrations in the definition of the best sustainability retrofit concept for small urban areas and public buildings.

The process is based on the use of multicriteria assessment tools, SNTool (urban scale) and SBTool (building scale), that will provide the necessary information to optimize the decision-making process. This decision-making process is articulated in 6 phases:

1. Initiation
2. Preparation
3. Diagnosis
4. Strategic definition
5. Decision making
6. Retrofit/New development concept



Initiation

Each PPs must select an existing small urban area and two public buildings that are included in the area. It is necessary to set clearly the physical boundaries of the urban area and to decide which of the surrounding infrastructures are of relevance (i.e. district heating).

Physical boundaries of the urban area may be derived using the following criteria:

- Geographical proximity
- Property ownership / occupier
- Social and Economic context
- Legal /administrative boundary lines
- Period of construction
- Energy supply infrastructure

The urban area can have a neighborhood or cluster size.

The reference parameters for a neighborhood size are:

- Square with a 200-400 m size
- Area that can be crossed in 10-15 min walk
- 200-1500 inhabitants

The reference parameters for a block/cluster size are:

- 5 – 1 5 buildings
- Traditional composition: few buildings (adjacent or separated), internal courtyard

The relevant stakeholders that can have an influence on the project have to be identified. All involved stakeholders in the district retrofitting project shall be grouped into the main roles. For instance:

- Project Manager/Coordinator (e.g. the responsible for the study)
- Planning and Design Team (urban planners, municipality, architects, engineers, etc.)
- End-User (e.g. inhabitants, occupants)
- External Parties (e.g. Banks, Neighbors)

Preparation

The preparation phase is the beginning of each urban retrofitting concept development. The preparation phase must provide the necessary information to create a sufficient working basis for the use of the decision-making methodology.

Contextualisation

The first step of the preparation phase consists in the contextualization of the CESBA MED Generic Framework to produce the local SNTool and SBTool. The contextualization process consists in the selection of the active parameters, the weights setting for issues, categories and criteria and the benchmarks setting for each active parameter.

In the generic framework "CESBA MED GF-U" (urban scale) each PP:
- Selects the active criteria
- Establishes the benchmarks taking in the account the city's context for each active criterion;
- Assigns the priority factor to the Issues.

In the SNTool file (urban scale) each PP:
- Deselect the criteria not applicable to the specific urban area;
- Adjusts the weight of the single criteria on the base of the local context;
- Adjusts the benchmarks on the base of the specific context.

In the generic framework file SBTool A (building scale) each PP:
- Selects the active criteria;
- Establishes the benchmarks for each active criterion;
- Assigns the priority factor to the Issues.

Identification

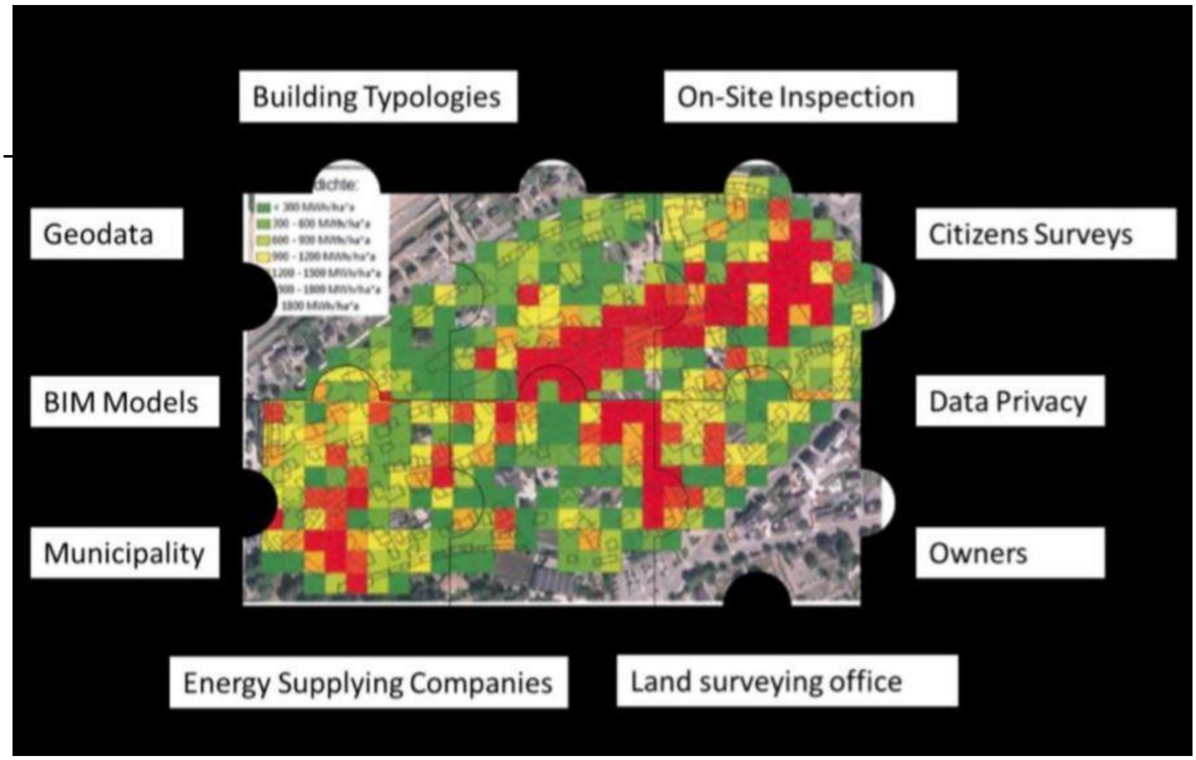
The assessment method associated to each indicator of CESBA MED SNTool and SBTool requires specific information and data. It is necessary to identify, preliminary to the assessment activities, the sources of this information.

High quality and significance of the retrofitting concept can only be achieved if it is planned on a solid database. Collecting the data together from several data providers is comparable with putting together a puzzle and needs a structured process to be followed. PPs shall define all needed data at building and urban level for the assessment activities. Potential data providers, data sources and most promising strategies have to be identified to gather all the needed data

The use of software tools (GIS, energy simulation, cloud-based applications) may accelerate the collection and processing of the data collection process significantly Main data providers for district projects may be as followed:

- Administrative bodies of the municipalities and federal states (e.g. Building authorities, land surveying office, etc.)

- B
uilding owners / tenants
- Existing Energy Performance Certificates
- Energy Supplying Companies
- Public accessible free source (e.g. Google Earth, Open Street Map)
- On-site inspection by the planners
- Default Data Sources and databases (databases from R&D projects, etc.)



Diagnosis

The diagnosis phase consists in the evaluation of the actual performance and relative level of sustainability of the pilot urban area and the buildings by the SNTool and SBTool.

The objective of the diagnosis is to:

- Set the basis for the definition of the performance targets for the retrofitting project of the urban area and public buildings
- Identify the strengths and key weaknesses of the whole urban area and public buildings in terms of sustainability
- Explore the potentials for renewable energies
- Analyze and evaluate the energy infrastructure as well as existing synergies and interactions between buildings within the district
  o Heat demand density map
  o Connected heat density
  o District heat load profiles
  o Duration curves
  o Hours of operation
  o District electricity load profile
  o District electricity balance

In the diagnosis phase the CESBA MED Committees should be involved by having access to the results of the diagnosis phase. Therefore, they will be able to view the results of the KPIs for the whole district and single buildings. Especially the municipalities as well as the owners and tenants will participate in this phase.

Since the data entry process as well the description of the detailed energetic state of the buildings and the district is a complex task that requires expert knowledge, only educated planners and experts in the fields of energy efficiency of buildings and sustainability assessment should have access to change the data in the building and district records. Otherwise the risk of operating errors and misuse would be too high.

At urban level the information provided by the assessment systems allows to develop a SWOT analysis. A SWOT analysis is a study undertaken to identify its strengths, weaknesses, available opportunities, and possible threats. The analysis is based on a quadrant matrix, in which strengths and weaknesses (internal factors) are presented above the x-axis, and opportunities and threats (external factors) are presented below. Typically, strengths and opportunities (positive factors) are listed on the left of the y-axis, while weaknesses and threats (negative factors) are listed on the right.

Strategic Definition

The strategic definition phase is articulated in two steps: setting targets and setting constraints and restrictions. In the first one, following the diagnosis' outcomes, the performance targets for the urban area and the two public buildings retrofitting projects are defined. In the second one, the constraints that could limit the range of possible retrofit strategies are identified.

Setting Targets

Before starting to create a sustainability retrofitting scenario for the urban area and the buildings it is necessary to define clear and measurable targets that should be achieved by the retrofitting concept. Already the Roman Stoic philosopher Lucius Annaeus Seneca said 2000 years ago "*If one does not know to which port one is sailing, no wind is favorable*".
Targets must address all fields of sustainability like environment, economy and social aspects.

Environmental targets may address the following fields:

- o Improve the energetic performance
- o Reduce Green House Gas emissions
- o Increase the share of renewable energies used in the district
- o Foster the use of sustainable materials
- o Reduce soil sealing and increase available green spaces

Social targets may address the following fields:

- o Avoid gentrification caused by energy retrofitting of buildings
- o Improve district surroundings (green spaces, accessibility, heat island)
- o Improve transport infrastructure and mobility
- o Support participation and local activities (vs "dormitory" district)
- o Improve safety and security

Economic targets may address the following fields:

- o Increase the return on investment
- o Minimize the payback period
- o Fostering value conservation o Increase in property value

Targets need to be S.M.A.R.T. which means:

- o Specific – target must be clearly defined (not vague but as specific as possible)
- o Measurable – targets must be quantifiable
- o Attainable – target must be realistic and achievable
- o Relevant – are the targets relevant for energy retrofitting of urban districts
- o Time-bound – specify when the result(s) can be achieved

To get a clear direction in which the sustainability retrofitting projects for the urban area and the buildings should be developed, the target issues have to be transformed into measurable performance targets.
This means that each partner must establish a target value for each indicator in its SNTool and SBTool to reflect the environmental, social and economic targets.

Setting Constraints and Restrictions

Since each urban area and even each building in a district is an individual case a lot of available retrofitting technologies cannot be implemented due to constraints and restrictions in different fields. The main constraints that occur in district and building energy retrofitting projects can be defined and structured into the following categories:

- Legal constraints (e.g. Building Codes, Cultural Heritage Protection)
- Technical constraints (e.g. Architecture, Systems)
- Financial constraints (e.g.Investment Cost, ROI)
- Environmental condition constraints (e.g. Climatic conditions, morphology of the district)
- Stakeholder based restrictions
- For each pilot neighborhood and public building the specific constraints and restrictions have to be identified.

<u>Legal constraints</u> are mainly caused by European or national laws, regulations and standards which settle the process of energy retrofitting of buildings and districts. For example, in most of the European countries regulations for energy savings in buildings exist currently. They were initiated by the European Building Directive (EPBD). Planners therefore have to consider the national energy saving ordinances in their projects. The planning concepts for energy retrofitting projects also are often affected by laws on cultural heritage protections or national and European standards which give guidelines for the planners. Therefore, planners of district retrofitting concepts have to be aware of all legal constraints in their countries before starting to plan the concept. Those legal constraints may give restrictions to many retrofitting technologies that are theoretically available on the market. For example, in some cases keeping the cultural value of the buildings and districts could be a restriction that will not allow the achievement of improvements to insulation of the building envelope or to installations of photovoltaics that in theory could be technically feasible. Also, certain thicknesses of insulation materials may be restricted as their insulation effectiveness (max. u-values) is too low according to the national energy saving ordinances

<u>Technical constraints</u> are setting the main restrictions for the use of technologies in building energy retrofitting projects. Each retrofitting technology needs special requirements for its implementation which may not always be given by each building or the district. For example, if the planners want to use a geothermal heat pump with ground collectors the property on which the building is located must have enough space for laying the ground collectors. According to the needed output of the heat pump the space may not be available in dense urban areas. Moreover, the use of renewable energy supply systems like biomass boilers needs enough space to store the biomass. The feasibility of solar energy systems on roofs and facades is also dependent on the solar radiation exposure of the area. For example, in a district some roof areas can be shaded by other buildings or trees and the sun exposure can be lower even if the global solar radiation is high. Furthermore, there are often many unforeseeable technical constraints in energy retrofitting projects like the load capacity of the building structure or structural damages

<u>Financial constraints</u> are often the largest obstacles in energy retrofitting projects on building and district level. Planners often have to consider the financial situation of the building owners as well

as the tenants in order to avoid negative social impacts like gentrification.
Depending on the type of the owners (private, public) also the economic efficiency of the retrofitting technologies is a big issue. Therefore, the financial constraints are setting main restrictions to the application of different retrofitting technologies. Compared to legal or technical constraints financial constraints cannot be generalized for different building types or a country. Instead they are always depending on the financial situation and the individual willingness of building owners to invest in energy retrofitting measures. Therefore, the special financial constraints of a project must be given by the stakeholders and entered by the planners themselves.

Environmental constraints are often restricting the use of retrofitting technologies as they are depending on proper environmental conditions in the district. Most common are climatic conditions which are not suitable for the use of certain technologies like solar energy systems or wind power. The urban morphology or the condition of the ground also can set restrictions on the use of geothermal systems. The availability of biomass sources near the district can also be a limiting factor for the use of biomass boilers. The environmental conditions are mostly related to the whole district as they are not changing from building to building. Although in certain cases like solar energy potential they may be different for each single building.

Decision Making

This phase consists in the study of possible alternative retrofit scenarios for the pilot urban area and the two public buildings and in the identification of the best one in terms of cost-efficiency.
It is articulated in two steps:

- Creation of retrofitting scenarios
- Retrofit concepts assessment and raking

Creation of retrofitting scenarios

The main challenge for planners in creating sustainability retrofitting variants for urban areas is to estimate the impacts of different retrofitting solutions onto the buildings and the energy supplying infrastructure in the district.

The goal of each concept is to optimize the performance of the urban area as a whole considering all buildings as connected global system by the following process:

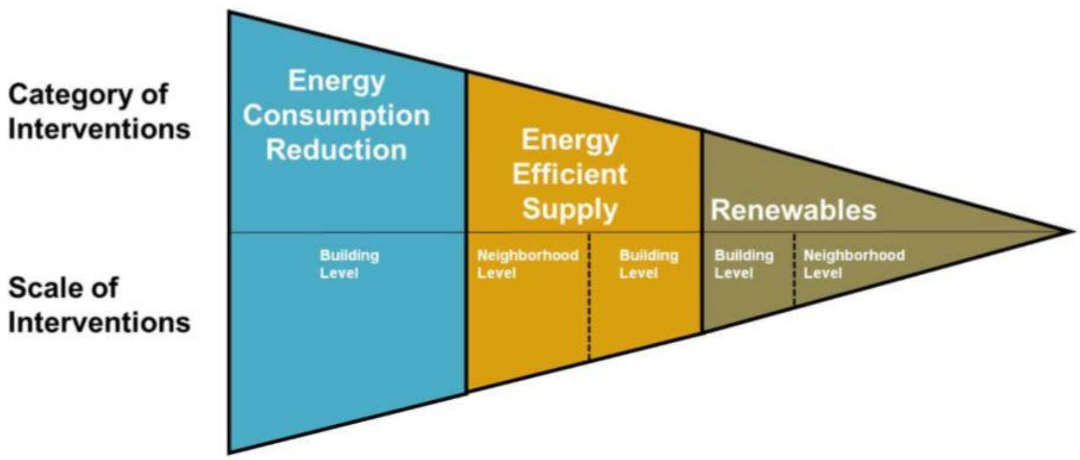
- o Selection and optimization of energy intervention package at urban level
- o Selection and optimization of energy intervention package on building level
- o Addition of non-energy related interventions (Traffic / Mobility, Green Spaces, Infrastructure)
- o Inclusion of business models and financing schemes
- o Approval of design variant

To ensure the right chronological sequence to create a complete energy retrofitting concept, planners initially should apply strategies in the following order:

1. Reduction of energy consumption (consumer-driven)
The reduction of the energy consumption is the basis for the creation of sustainable energy concepts and to achieve the set sustainability goals. For that reason, the reduction of the energy consumption must be the priority for planners. Keeping the order is also important as potential newly-constructed heat networks should be operated efficient in the long-term.

2. Increasing the efficiency of the energy supply
After applying energy consumption reduction measures the next step will be to increase the efficiency of the energy supply in the district. Then, according to the general efficiency increasing potential the district solutions should be preferred over individual solutions.

3. Inclusion of renewable energy production
After increasing the efficiency of the energy supply the energy supply should be further improved using climate neutral and renewable energy sources. By increasing the share of climate-neutral and renewable electricity in a district the primary energy consumption can be reduced significantly. Moreover, the energy balance between energy production and energy consumption must be optimized to achieve the best results for a variant.



Setting up an urban energy retrofitting concept the following analysis and evaluations need to be conducted by the planners in order to find the most optimum concepts for the district:

1. Assessing the energetic weak points of buildings
To prioritize different retrofitting measures to reduce the energy consumption and to increase the energy efficiency of a building it is necessary to know which represent from an energy view the weakest points of buildings. This means identifying the building components or systems which cause the highest energy losses and therefore, have with high probability the greatest energy saving potential.

2. Assessing the feasibility of energy networks
The use of synergies between buildings is one of the most promising and useful key strategies for urban district retrofitting projects. One of the main advantages of the district approach compared to individual retrofitting measures on single buildings is the use of heat-related synergies by the

connection of buildings. The key to evaluate heat-related synergies and interactions between buildings and their surrounding energy infrastructure is having knowledge about the heat demand of all defined groups and their containing buildings.

3. Assessment of electricity related synergies and interactions between buildings
One of the main factors which limits the exploitation of the use of renewable energies in the production of electricity is the fact that renewable energy sources are climate dependent, and the electrical consumption is not. Thus, more often a mismatch between the supply and demand occurs and the generated energy can't be fully used when the demand is there, which in turn has a negative effect on the reliability and the efficiency of the whole network. To overcome this challenge, planners need to be able to predict the electrical demand and production by renewables energy systems for the investigated district, so to introduce appropriate energy storage systems and/or smart grids.

4. Financial Planning and selection of financing mechanisms for implementation
For each retrofitting concept, adequate business models and financing have to be selected in order to implement it in practice. Moreover, financial metrics like investment cost, Return on Investment and Payback need to be calculated to ensure the financial feasibility of each concept.

The following financing opportunities have to be considered:
<u>Grants</u>
Grants may be available at all stages for feasibility studies, proposal development, capital investment and maintenance expenses. They offer a subsidy to the total costs but exist only because governments or other altruistic organizations wish to see particular innovations develop that would otherwise not be economically attractive. They will usually only cover part of the costs.

<u>Loans</u>
Loans imply debts that must ultimately be repaid, and on-going interest charges. Retail and commercial banks will generally lend, but at a price that depends upon perceived risks. They will want to see a business model that shows adequate "debt coverage", i.e. a plan that shows how interest charges and debt repayment will be covered under normal and risky scenarios. Hence, lenders will often want to see co-funding by the owners and other stakeholders in the project. Furthermore, in order to borrow at a reasonable rate, the lender may require collateral security, i.e. financial recourse to stakeholder assets in the case of default. In contrast, pure project finance, without any recourse to the stakeholder assets, but secured only against the anticipated savings is sometime known as "nonrecourse financing" and will be more expensive. Finally, for energy efficiency, preferential loans may be available at a lower cost. This is where governments or NGOs make funds available to retail and commercial banks under a scheme to incentivise particular initiatives.

<u>Loan Guarantees</u>
This is an ancillary financial product that can reduce the cost of debt finance. Essentially it involves another stakeholder to the project investment team, namely a loan guarantor. The loan guarantor is usually a public body created to lower the cost of energy efficiency loans, back acting as a final guarantee that defaults will be avoided.

Energy Performance Contracting

Energy Performance Contracting is usually undertaken by an ESCO, through a contractual obligation to implement the energy savings initiatives in return for a flow of payments from the building owner or end-user. To the extent that this flow of payments is less than the savings, it is attractive to the owner. Evidently the owner / end user is passing on some of the investment returns to the ESCO, but is avoiding the initial capital outlay. A variety of financial arrangements may be undertaken with the ESCO taking on some, none or all of the debt and collateral obligations, and performance risk may also be split in flexible ways.

Co-Investment

There are several initiatives around the world whereby municipalities or energy utilities assume the capital cost of retrofitting and place the charge on the property, to be recovered through the regular property tax-, or utility bill assessment and collection. Evidently, this is simply transferring the debt, but it may be an incentive for several reasons. Owners may not want, or be able, to accumulate more bank debt, or the bank terms may be unfavourable. For commercial owners, this is an easy way to transfer the cost to the tenants. Municipalities, furthermore, may have access to lower cost funds through bonds, specialist cleantech funds or related initiatives, and may be willing to spread the cost over a longer term.

Embedded revenue contributions

Many countries now encourage residential, commercial and industrial consumers to install solar, wind, biomass, micro-hydro and other renewable sources of electricity generation to reduce consumption of grid supplied energy and for sale back to the local distribution company, or, in the case of larger industrial units, to the wholesale market. These feed-in tariff (FiT) arrangements vary according to technologies, vintage, length of term and size of connection. District level solutions have a lot to offer here as there are economies of scale in the provision of generating facilities and transaction costs. “Smart” districts offer further revenue possibilities through the possibility of endusers of electricity “selling” demand reduction options to the distribution utilities. In some countries, there are also “white certificate” trading schemes for energy efficiency which are intended to parallel what green certificates have achieved for renewable technologies. The idea is very similar, having a volume based target for energy savings, earning credits to the extent that they are achieved, and being able to trade credits so that those who are able to achieve it more efficiently do more and profit by selling to others who face higher marginal costs of energy saving. In Europe, Italy has been the only country to have some trading, although Belgium, France, Denmark, Poland and the UK have limited schemes. Rental increases are sometimes anticipated following retrofitting and can be built into the financing model.

Tax benefits

Fiscal measures are an important class of support and can relate to a reduced rate of tax for the owners, properties and / or contracting organisations, as well as specific tax and VAT benefits on the various cost or revenue elements. Evidently, they are idiosyncratic to individual EU member states, but are widely used as part of the business models.

Retrofit scenarios assessment and raking

The CESBA MED assessment system is a tool to support planners in the complex decision-making process for the sustainable retrofit of urban areas and public buildings. Providing the necessary objective and reliable information, CESBA MED assessment system allows the planners to compare the different retrofitting scenarios that have been created and to find the best suiting one for the local preferences.
CESBA assessment system has to be applied to each retrofitting scenario at urban scale and, interactively, at building scale to evaluate the performances reached.

On the base of the assessments' outcomes (scores) provided by the CESBA MED assessment system, it will be possible to rank the different retrofitting scenarios according to the preferences of different stakeholders and decision-makers. CESBA MED assessment system will provide an overall score for the current state as well as all the created concepts and it will allow to rank the scenarios according to their overall suitability and performance.

CESBA MED assessment system using the common CESBA KPIs will also allow to compare the performance of urban areas and public buildings in different MED cities.

	Current state	Scenario 1	Scenario 2
TOTAL SCORE	0,0	2,1	1,4
A – Built Urban Systems	0,2	0,5	0,3
B – Economy	0,8	1,2	1,0
C – Energy	-1	3,2	1,5
D – Atmospheric	-1	2,5	2,0
E – Non-renewable sources	0,8	2,2	1,8
F - Environment	0,5	2,4	1,9
G – Social aspects	1	3,5	2,0

In the selection of the best scenario, the possible financial mechanism to implement it should be taken into consideration. The final chose should combine the best scenario in terms of performance and financial sustainability.

This phase consists in the description of the retrofit concept for the pilot urban area and the two public buildings based on the best ranked scenarios. The concept will further specify the solutions taken in account by the best scenario. The concept will be ready to be implemented in future when the conditions will allow to transform in a project.

The concept will mainly illustrate the retrofit strategies, the performance improvement that will be achieved and the cost benefit analysis.

Retrofit Concept

Urban Regeneration Concepts are composed of a variety of single regeneration concepts in different thematic fields. The main fields among others for instance are energy, climate protection, infrastructure and mobility, architecture and design, socio-cultural condition, spatial development. Urban Regeneration Concepts therefore are created on behalf of many different urban planning departments of cities and municipalities. All contributing departments have special teams of internal or external experts in the related thematic fields. All departments are considering the results of other departments and thematic fields in order to create their own strategies. Hence, an overall Urban Regeneration Concept is divided into different chapters which represent the different thematic fields of urban regeneration processes.

The CESBA MED Assessment System therefore will focus on supporting urban planners in the thematic fields of sustainability retrofitting concepts for small urban areas. Urban district regeneration interventions in the field of energy retrofitting are influencing other thematic urban regeneration fields like socio-cultural issues, architecture and design or spatial development. Thus, CESBA MED will evaluate the impacts of sustainability retrofitting interventions on further related sustainability issues to foster an integral planning process between the different urban planning departments.

However, the CESBA assessment system will not be suitable to cover all fields that are reflected in urban regeneration concepts as this will not be the scope of the project. Therefore, CESBA MED will provide deep support to planners of urban district sustainability retrofitting concepts. Furthermore, CESBA MED assessment system will be capable of evaluating the impacts of sustainability retrofitting interventions on the whole sustainability of the urban district.