D3.4.2 - CESBA MED KPIs and Passport

BUILDING and URBAN SCALE

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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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Index

KPIs Building Scale 4
B1.1 Primary energy demand 5
B1.2 Delivered thermal energy demand 8
B1.3 Delivered electric energy demand 10
B1.5 Energy from renewable sources in total thermal energy consumption 12
B1.6 Energy from renewable sources in total electric energy consumption 14
B1.11 Embodied non-renewable primary energy 16
B4.5 Potable water consumption for indoor uses 19
C1.3 Global Warming potential 21
C3.2 Solid waste from building operation 23
D1.10 Ventilation rate 25
D2.2 Thermal comfort index 27
G1.4 Use stage energy cost 30
G1.5 Use stage water cost 31

KPIs Urban Scale 32
A1.7 Conservation of Land 333
B3.3 Use stage energy cost for public buildings 334
C1.1 Total final thermal energy consumption for building operations 335
C1.4 Total final electric energy consumption for building operations 337
C1.7 Total primary energy demand for building operations 339
C2.1 Share of renewable energy on-site, relative to total final thermal energy consumption for building operations 40
C2.7 Share of renewable energy on-site, on final electric energy consumptions 42
D1.2 Total GHG Emissions from primary energy used in building operations 44
E1.6 Consumption of potable water for residential population 46
E1.7 Consumption of potable water for public non-residential building systems 47
F1.3 Recharge of groundwater through permeable paving or landscaping 48
F2.3 Ambient air quality with respect to particulates <10 mu (PM10) over a one year period 50
G2.1 Public transport service 51
G2.4 Quality of pedestrian and bicycle network 52

G4.2 Availability and proximity of key services 54
G6.3 Community involvement in urban planning activities 55

Passport Template 60
Certificate Template 64

KPIs BUILDING SCALE

Listed below, the final KPIs selected for the Building Scale.

B1.1 Primary energy demand
B1.2 Delivered thermal energy demand
B1.3 Delivered electric energy demand
B1.5 Energy from renewable sources in total thermal energy consumption
B1.6 Energy from renewable sources in total electric energy consumption
B1.11 Embodied non-renewable primary energy
B4.5 Potable water consumption for indoor uses
C1.3 Global Warming potential
C3.2 Solid waste from building operation
D1.10 Ventilation rate
D2.2 Thermal comfort index
G1.4 Use stage energy cost
G1.5 Use stage water cost

B1.1 Primary energy demand

[LEVELS – Headline indicator]

1. Intent: to minimise the total energy consumptions in the use stage.

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
Primary energy demand per internal useful floor area per year	kWh/m2/yr	Design	Estimation
		Occupation	Metering

2.3 Boundary and scope

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.

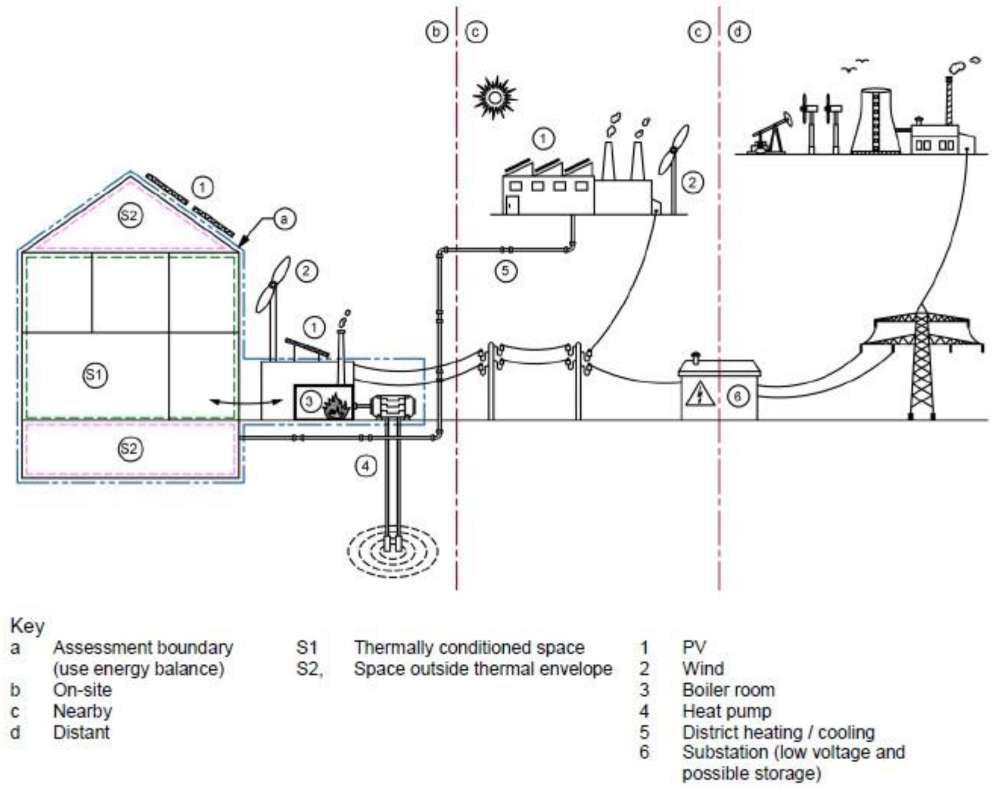

Fig.1:Building assessment boundary and energy balance locations Source: CEN (2017)

2.4 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).

2.5 Potential data sources

Data item	Potential source	
	Default EU values	**National, regional or locally specific values**
Conditions of use and occupancy	EN ISO 13790 (Annex G8) ISO/TR 52000-1/2 EN ISO 52016-1	National or regional calculation method
Thermal envelope description	EN ISO 13790 (Annex G) EN ISO 52016-1	National or regional calculation method: certified products and details
Building services description	EN ISO 13790 (Annex G) EN ISO 52016-1	National or regional calculation method: certified products
Reference year climate file	Three climate zones (EN 15265 test cases)	National or regional calculation method Member State Meteorological Offices
Primary energy factors	EN 15603 (Annex E) EN 52000-1 (Annex B.10)	National or regional calculation method
Internal temperature set points	EN ISO 13790 (Annex G) EN ISO 52016-1	National or regional calculation method
Ventilation and infiltration rates	EN 15241 EN 15242	National or regional calculation method
Internal gains as heat flows	EN ISO 13790 (Annex J) EN ISO 52016-1	National or regional calculation method
Heating/cooling system characteristics and capacity	-	National or regional calculation method: certified products

3. References and standards

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

B1.2 Delivered thermal energy demand

[LEVELS – Supporting indicator]

1. Intent: to minimise the total thermal energy consumptions in the use stage.

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
Delivered thermal energy demand per internal useful floor area per year	kWh/m2/yr	Design	Estimation
		Occupation	Metering

2.3 Boundary and scope

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.

2.4 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.

3. References and standards

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

B1.3 Delivered electric energy demand

[LEVELS – Supporting indicator]

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

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
Delivered electric energy demand per internal useful floor area per year	kWh/m2/yr	Design	Estimation
		Occupation	Metering

2.3 Boundary and scope

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.

2.4 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.

3. References and standards

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

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

[LEVELS – Reporting indicator]

1. Intent: to maximize the use of renewable energy sources.

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
Share of renewable energy in final thermal energy consumptions	%	Design	Estimation
		Occupation	Metering

2.3 Boundary and scope

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.

2.4 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.

3. References and standards

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.

B1.6 Energy from renewable sources in total electric energy consumption

[LEVELS – Reporting indicator]

1. Intent: to maximize the use of renewable energy sources.

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
Share of renewable energy in final electric energy consumption	%	Design	Estimation
		Occupation	Estimation

2.3 Boundary and scope

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.

2.4 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 $> 1{,}15 * 1/\eta$ shall be taken into account.

3. References and standards

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.

B1.11 Embodied non-renewable primary energy

[CESBA]

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

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
Embodied primary non-renewable energy	MJ/m2	Design	Estimation
		Occupation	Not applicable

The unit of measurement to be used for reporting on this indicator is MJ /m^2 (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.

2.3 Boundary and scope

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.

The minimum scope of the indicator shall include the following building parts and elements:

Building parts	Related building elements
Shell (substructure and superstructure)	
Foundations (substructure)	Piles Basements Retaining walls
Load bearing structural frame	Frame (beams, columns and slabs) Upper floors External walls Balconies
Non-load bearing elements	Ground floor slab Internal walls, partitions and doors Stairs and ramps
Facades	External wall systems, cladding and shading devices Façade openings (including windows and external doors) External paints, coatings and renders
Roof	Structure Weatherproofing
Parking facilities	Underground

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

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

- Compile the Bill of Quantities: A BoQ is compiled which comprises the building elements accounting for at least 99% of the mass of the building.
- Identify the basic composition of each building element. A breakdown of its **constituent materials** has to be carried out. The mass of each constituent material has to be estimated;
- Aggregation by material: The mass for each **constituent material** should thereafter be aggregated to obtain the total mass for each type of material.

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

3. References and standards

EN 15978 "Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method".

B4.5 Potable water consumption for indoor uses

[LEVELS – Headline indicator]

1. Intent:

To make efficient use of water resources.

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
Potable water consumption per occupant per year	m^3/occupant/year	Design	Estimation
		Occupation	Metering

2.3 Boundary and scope

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.

2.3 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.

3. References and standards

Level(s) Part 1-2 – Beta version.

C1.3 Global Warming potential

[LEVELS – Headline indicator]

1. Intent: to minimise the total greenhouse gas emissions from buildings' operations.

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
CO_2 equivalent emissions per internal useful floor area per year	kg CO_2 eq./m^2/yr	Design	Estimation
		Occupation	Estimation

2.3 Boundary and scope

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.

2.3 Assessment method

To characterize the indicator's value:

$$E = \left[\sum\left(Q_{fuel,i} \times LHV_i \times k_{em,i}\right) + \left(Q_{el} \times k_{em,el}\right) + \left(Q_{dh} \times k_{em,dh}\right)\right] \div S_u$$

$Q_{fuel,I}$ = annual quantity of i-th fuel (m^3 or Kg)
Q_{el} = annual quantity of electrical energy from the grid (kWh)
Q_{dh} = annual quantity of energy from district heating/cooling (kWh)
LHV_i = lower heating value of the i-th fuel (kWh/m3 or kWh/Kg)
$K_{em,i}$ = CO_2 eq. emission factor of the i-th fuel (Kg CO_2/kWh)
$K_{em,i}$ = CO_2 eq. emission factor of the electrical energy from the grid (Kg CO_2/kWh)
$K_{em,i}$ = CO_2 eq. emission factor of energy from district heating/cooling (Kg CO_2/kWh)
S_u = 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.

3. References and standards

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

C3.2 Solid waste from building operation

[CESBA]

1. Intent:

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

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
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	%	Design	Estimation
		Occupation	Measure

2.3 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.

D1.10 Ventilation rate

[LEVELS – Headline indicator]

1. Intent:

To ensure an effective air exchange and high local air quality.

2. Assessment methodology

2.1 Description

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.

2.2 Indicator

Description	Unit	Project stage	Data source
Ventilation rate normalized per useful floor area	l/s/m2	Design	Estimation
		Post completion	Measure

2.3 Boundary and scope

The boundary for the criteria is the useful conditioned space. The indicator must be calculated in all the main occupied rooms.

2.3 Assessment method

<u>Project stage: design</u>
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/m^2) 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:

$$Indicator = \frac{\sum V_i \times S_{u,i}}{\sum S_{u,i}}$$

V_i = Ventilation rate calculated in the i-th room (l/s/m^2)
$S_{u,i}$ = useful floor area of the i-th room (m^2)

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.

3. References and standards

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.

D2.2 Thermal comfort index

[CESBA]

1. Intent:

To facilitate the assessment of indoor thermal comfort conditions.

2. Assessment methodology

2.1 Description

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.

2.2 Data requirement

Description	Unit	Project stage	Data source
Predicted Percentage Dissatisfied (PPD)	%	Design	Estimation
		Occupation	Measure

2.3 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
   - Select the design air temperature (dry bulb-db) and relative humidity for the main space function, e.g. for offices 26(20)°C and 45(35)% in summer(winter)
   - Select the design indoor air speed, e.g. 0.15 m/s
   - Calculate the mean radiant temperature of indoor wall surfaces (°C)
   - Determine the main physical activity of the occupants (related to the metabolic rate), e.g. seated office work (1 met)

- Determine the typical type of clothing ensembles, e.g. light indoor summer clothing (0.5 clo)
- 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)]

<u>Calculation in Design stage (naturally conditioned).</u>

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

a) Calculate the running mean of outdoor temperature **(T_{rm})**
b) Calculate the operative temperature (T_o)
c) Select the thermal comfort category and verify the PPD value.

a) Calculate the running mean of outdoor temperature **(T_{rm})**

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

where T_{od} is the daily mean outdoor temperature for the previous day ($T_{od\text{-}1}$), the day before ($T_{od\text{-}2}$) and so on

b) Calculate the operative temperature (T_o) 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

<u>Calculation in Occupancy stage.</u>

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

Thermal environment measurements are made in the building at a representative sample of locations, i.e.

- The center of the room or space
- 1m inward from the center of each of the room's walls and if there are windows, the measurements are taken 1m inward from the center of the largest window

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).

3. References and standards

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.

G1.4 Use stage energy cost

[LEVELS – Sub indicator]

1. Intent:

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

2. Assessment methodology

2.1 Description

The focus of the criteria is on the costs of thermal and electric energy during operation for all uses.

2.2 Indicator

Description	Unit	Project stage	Data source
Energy annual cost per usable floor area	€/m²/yr	Design	Estimation
		Occupation	Energy bills

2.3 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.

3. References and standards

Level(s) Part 1-2 – Beta version.

G1.5 Use stage water cost

[LEVELS – Sub indicator]

1. Intent:

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

2. Assessment methodology

2.1 Description

The focus of the criteria is on the costs of water during operation for all indoor uses.

2.2 Indicator

Description	Unit	Project stage	Data source
Water annual cost per usable floor area	€/m^2/yr	Design	Estimation
		Occupation	Water bills

2.3 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.

3. References and standards

Level(s) Part 1-2 – Beta version.

KPIs URBAN SCALE

Listed below, the final KPIs selected for the Urban Scale.

A1.7 Conservation of Land
B3.3 Use stage energy cost for public buildings
C1.1 Total final thermal energy consumption for building operations
C1.4 Total final electric energy consumption for building operations
C1.7 Total primary energy demand for building operations
C2.1 Share of renewable energy on-site, relative to total final thermal energy consumption for building operations
C2.7 Share of renewable energy on-site, on final electric energy consumptions
D1.2 Total GHG Emissions from primary energy used in building operations
E1.6 Consumption of potable water for residential population
E1.7 Consumption of potable water for public non-residential building systems
F1.3 Recharge of groundwater through permeable paving or landscaping
F2.3 Ambient air quality with respect to particulates <10 mu (PM10) over a one year period
G2.1 Public transport service
G2.4 Quality of pedestrian and bicycle network
G4.2 Availability and proximity of key services
G6.3 Community involvement in urban planning activities

A1.7 Conservation of Land

1. Intent:

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

2. Assessment methodology

2.1 Description

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.

2.2 Data requirement

Indicator	Unit	Data source
Area of undeveloped land with ecological or agricultural value / area of the neighborhood	%	Urban area thematic map

2.3 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.

<u>Specifications</u>:

- 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.

B3.3 Use stage energy cost for public buildings

1. Intent:

To assess the cost of energy services for public buildings.

2. Assessment methodology

2.1 Description

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.

2.2 Data requirement

Indicator	Unit	Data source
Aggregated annual operating energy cost per aggregated indoor useful floor area	Euro/m^2/year	Estimation or energy bills

2.3 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 (m^2).
4. Calculate the indicator as: aggregated annual operating energy cost / aggregated indoor useful area (euro/m^2/year).

Note
The public buildings that must be considered in the calculation are offices and schools (all degree levels, excluding universities).
The operating energy cost is the utility costs associated with occupation of a building, inclusive of communal costs of operating a building and the costs associated with occupier energy use. The operating energy is the one metered by the utilities.
It is the energy per 'carrier' (e.g. thermal or electrical energy) supplied to the building, to satisfy end uses within the building (heating, cooling, ventilation, domestic hot water, lighting, appliances, etc.).
In the calculation it is possible to use real or estimated costs. Their percentage on the total energy costs must be declared in the way to understand the reliability of the result. If both the real energy costs and the estimated one is available, the first one should be used.
The real energy cost is suitable for the indicator's calculation only if the building has been constructed and is occupied for at least 1 year prior to the analysis and preferably 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.

C1.1 Total final thermal energy consumption for building operations

1. Intent:

To estimate urban thermal energy consumption for building operations.

2. Assessment methodology

2.1 Description

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.

2.2 Data requirement

Indicator	Unit	Data source
Aggregated annual total final thermal energy consumption per aggregated indoor useful floor area	$kWh/m^2/year$	Metered or Estimated data

2.3 Assessment method

To characterize the indicator's value there are two options:

- Use of estimated data
  OR
- Use of metered data

Note
To perform the calculation, it is possible to use metered or estimated data.
The source of data must always be clearly declared.
For the evaluation of the actual performance of the urban area it is preferable to use metered data. If metered data aren't available, estimated data shall be used.
Estimated data shall be used for evaluating alternative scenarios in planning and decision-making processes. In reporting the indicator's value, the data source must be indicated.

Use of estimated data:

1. In the calculation of the final thermal energy consumption, the following energy uses must be considered: heating, cooling, domestic hot water.
2. For each building in the local area, calculate the annual final thermal energy consumption in kilowatt hours (kWh/year).
3. Sum the annual final thermal energy consumption of each building up to an aggregated total annual final thermal energy consumption (kWh/year).
4. Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m^2).

5. Calculate the indicator's value as: aggregated annual total final thermal energy consumption/ aggregated indoor useful area (kWh/m^2/year).

Note
Calculations are based on EN 13790 using the quasi-steady state monthly method.

Use of metered data:

1. In the evaluation of the final thermal energy consumption, the following energy uses must be considered: heating, cooling, domestic hot water.
2. For each building in the local area, collect the metered annual final thermal energy consumption) in kilowatt hours (kWh/year).
3. Sum the annual final thermal energy consumption of each building up to an aggregated total annual final thermal energy consumption (kWh/year).
4. Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m^2).
5. Calculate the indicator's value as: aggregated annual total final thermal energy consumption/ aggregated indoor useful area (kWh/m^2/year)

Note
The metered energy consumption is suitable for the indicator's calculation only if the building has been in use for 3-years, in order to ensure that there has been time enough to have building systems reach their normal operating efficiency levels, and also to factor out unusual seasonal variations. This means that the buildings assessed are at least 3 years old.

3. References and standards

EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling).
ec.europa.eu/energy/en/topics/energy-efficiency/buildings.
https://www.iea.org/publications/freepublications/.../buildings_certification.pdf.
www.theicct.org/sites/default/files/.../ICCTupdate_EU-95gram_jan2014.pdf.

C1.4 Total final electric energy consumption for building operations

1. Intent:

To estimate urban electric energy consumption for building operations.

2. Assessment methodology

2.1 Description

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.

2.2 Data requirement

Indicator	Unit	Data source
Aggregated annual total final electric energy consumption per aggregated indoor useful floor area	kWh/m^2/year	Metered or Estimated data

2.3 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 <u>actual</u> 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 (m^2).

5. Calculate the indicator's value as: aggregated annual total final electric energy consumption/ aggregated indoor useful area (kWh/m^2/year)

Note
Calculations are based on EN 13790 using the quasi-steady state monthly method.

Use of metered data:

1. In the evaluation of the final electric energy consumption, the following energy uses must be considered: heating, cooling, ventilation, auxiliaries, domestic hot water and lighting.
2. For each building in the local area, collect the metered annual final electric energy consumption) in kilowatt hours (kWh/year).
3. Sum the annual final electric energy consumption of each building up to an aggregated total annual final electric energy consumption (kWh/year).
4. Sum the indoor useful area of each building in the area up to an aggregated indoor useful area value (m^2).
5. Calculate the indicator's value as: aggregated annual total final electric energy consumption/ aggregated indoor useful area (kWh/m^2/year)

Note
The metered energy consumption is suitable for the indicator's calculation only if the building has been in use for 3-years, in order to ensure that there has been time enough to have building systems reach their normal operating efficiency levels, and also to factor out unusual seasonal variations. This means that the buildings assessed are at least 3 years old.

3. References and standards

EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling).

C1.7 Total primary energy demand for building operations

1. Intent:

To reduce the need of primary energy for building operations.

2. Assessment methodology

2.1 Description

The criterion allows to understand the 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

2.2 Data requirement

Indicator	Unit	Data source
Aggregated annual total primary energy consumption per aggregated indoor useful floor area	kWh/m^2/year	Estimated data

2.3 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 (m^2).
7. Calculate the indicator's value as: aggregated annual total primary energy consumption / aggregated indoor useful area (kWh/m^2/year).

Note
Calculations are based on EN 13790 using the quasi-steady state monthly method.

3. References and standards

EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling).

C2.1 Share of renewable energy on-site, relative to total final thermal energy consumption for building operations

1. Intent:

To incentive the consumption and production of renewable energy.

2. Assessment methodology

2.1 Description

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. It also shows what is the progress towards Europe 2020 target for renewable energies.

2.2 Data requirement

Indicator	Unit	Data source
Annual total thermal energy consumption from on-site renewable energy sources / annual total final thermal energy consumption	%	Metered or Estimated data

2.3 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 <u>actual</u> 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 (kWh/year).
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. This means that the buildings assessed are at least 3 years old.

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.

3. References and standards

EN 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling).
Directive 2009/28/EC (RES Directive).
2013/114/EU: Commission Decision of 1 March 2013.

C2.7 Share of renewable energy on-site, on final electric energy consumptions

1. Intent:

To incentive the consumption and production of renewable energy.

2. Assessment methodology

2.1 Description

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. It also shows what is the progress towards Europe 2020 target for renewable energies.

2.2 Data requirement

Indicator	Unit	Data source
Share of renewable electric energy in final electric energy consumptions	%	Metered or estimated data

2.3 Assessment method

To characterize the indicator's value there are two options:

- Use of estimated data

  OR
- Use of metered data

Note

For the evaluation of the actual performance of the urban area it is preferable to use metered data. If metered data aren't available, estimated data shall be used.
Estimated data are used for evaluating retrofit scenarios in planning and decision-making processes.
In reporting the indicator's value, data sources must always be indicated.

Exported energy is the one delivered by technical systems through the system boundary (urban area) and used outside the system boundary. Exported energy is a benefit beyond the system boundary and it has not to be included in the calculation.

Use of estimated data:

1. In the calculation of the final electric energy consumption, the following energy uses must be considered: heating, cooling, ventilation, auxiliaries, domestic hot water and lighting.
2. For each building in the local area, calculate the annual final electric energy consumption in kilowatt hours (kWh/year).
3. Sum the annual final electric energy consumption of each building up to an aggregated total annual final electric energy consumption (kWh/year).
4. For each building in the local area, calculate the annual final electric energy consumption from on-site renewable energy sources in kilowatt hours (kWh/year).

5. Sum the annual final electric energy consumption from on-site renewable sources of each building up to an aggregated total annual final electric energy consumption from on-site renewable sources (kWh/year).
6. Calculate the indicator as: annual total final electric energy consumption from on-site renewable sources / annual total final electric energy consumption.

Note
Calculations are based on EN 13790 using the quasi-steady state monthly method.

Use of metered data:
1. In the evaluation of the final electric energy consumption, the following energy uses must be considered: heating, cooling, ventilation, auxiliaries, domestic hot water and lighting water.
2. For each building in the local area, collect the metered annual final electric energy consumption) in kilowatt hours (kWh/year).
3. Sum the annual final electric energy consumption of each building up to an aggregated total annual final electric energy consumption (kWh/year).
4. For each building in the local area, collect the monitored annual final electric energy consumption from on-site renewable sources in kilowatt hours (kWh).
5. Sum the annual final electric energy consumption from on-site renewable sources of each building up to an aggregated total annual final electric energy consumption from on-site renewable sources (kWh/year).
6. Calculate the indicator as: annual total electric energy generation from on-site renewable energy sources / annual total final electric energy consumption.

Note
The metered energy consumption is suitable for the indicator’s calculation only if the building has been in use for 3-years, in order to ensure that there has been time enough to have building systems reach their normal operating efficiency levels, and also to factor out unusual seasonal variations. This means that the buildings assessed are at least 3 years old.

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.

3. References and standards
EN 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling).
Directive 2009/28/EC (RES Directive).
2013/114/EU: Commission Decision of 1 March 2013.

D1.2 Total GHG Emissions from primary energy used in building operations

1. Intent:

To minimise the total greenhouse gas emissions from buildings' operations.

2. Assessment methodology

2.1 Description

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 (CO_2). A higher GWP means a larger warming effect in that period of time.

2.2 Data requirement

Indicator	Unit	Data source
CO_2 equivalent emissions per useful internal floor area per year	kg CO_2 eq./m2/yr	Estimation

2.3 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:

1. For each building in the area calculate the emissions of CO_2 eq. with the following formula:

$$E = \left[\sum \left(Q_{fuel,i} \times LHV_i \times k_{em,i}\right) + \left(Q_{el} \times k_{em,el}\right) + \left(Q_{dh} \times k_{em,dh}\right)\right]$$

$Q_{fuel,I}$ = annual quantity of i-th fuel (m^3 or Kg)
Q_{el} = annual quantity of electric energy from the grid (kWh)
Q_{dh} = annual quantity of energy from district heating/cooling (kWh)
LHV_i = lower heating value of the i-th fuel (kWh/m3 or kWh/Kg)
$K_{em,i}$ = CO_2 eq. emission factor of the i-th fuel (Kg CO_2/kWh)
$K_{em,i}$ = CO_2 eq. emission factor of the electric energy from the grid (Kg CO_2/kWh)
$K_{em,i}$ = CO_2 eq. emission factor of energy from district heating/cooling (Kg CO_2/kWh)

Calculate the aggregated annual total CO_2 equivalent emissions from all buildings / total useful internal floor area of all buildings.

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.

3. References and standards

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

E1.6 Consumption of potable water for residential population

1. Intent:

Make efficient use of water resources.

2. Assessment methodology

2.1 Description

The criterion measures the potable water consumption of sanitary fittings/devices and water consuming appliances by residential population.

2.2 Data requirement

Indicator	Unit	Data source
Annual potable water consumption per occupant	m^3/occupant/year	Metered data

2.3 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 (m^3).
2) Sum the annual potable water consumption of each building up to an aggregated annual total potable water consumption (m^3/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.

E1.7 Consumption of potable water for public non-residential building systems

1. Intent:

Make efficient use of water resources.

2. Assessment methodology

2.1 Description

The criterion measures the potable water consumption of sanitary fittings/devices and water consuming appliances by non-residential public buildings.

2.2 Data requirement

Indicator	Unit	Data source
Annual water consumption per m^2	m^3/m^2	Metered

2.3 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 (m^3).
2) Sum the annual water consumption of each building up to an aggregated annual total water consumption (m^3/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.

F1.3 Recharge of groundwater through permeable paving or landscaping

1. Intent:

To improve the permeability of the area.

2. Assessment methodology

2.1 Description

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.

2.2 Data requirement

Indicator	Unit	Data source
Area of permeable surfaces on total neighborhood area	%	Thematic map – Geographic Information System.

2.3 Assessment method

To characterize the indicator's value:

1. Calculate the size (S_a) of the urban area (m^2).
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:

$$S_a = \sum_{i=1}^{n} S_{a,1}$$

S_a = total surface of the urban area
$S_{a,i}$ = surface i-th in the area (m^2)

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

$$S_{a,perm} = \sum_{i=1}^{n} (S_{a,i} \times \alpha_i)$$

$S_{a,i}$ = i-th surface in the area (m^2)
α_i= permeability coefficient of the i-th surface

Reference permeability coefficients:

Grass = 1

Gravel = 0,9

Sand = 0,9

Plastic gratings filled with land/grass = 0,8

Concrete gratings leaning on the grass = 0,6

Concrete gratings leaning on gravel = 0,6

Interlocking elements leaning on sand = 0,3

Interlocking elements leaning on gravel = 0,3

Interlocking elements leaning on concrete pavement = 0

Continuous pavements leaning on concrete = 0

Asphalt = 0

4. Calculate the indicator's value as: $\frac{S_{a,perm}}{Sa} \times 100$

3. References and Standards

http://download.acca.it/Files/Scheda/Itacus/SCHEDE-PROTOCOLLO-ITACA-RESIDENZIALE/C.4.3-Permeabilita-del-suolo-Protocollo-ITACA-Residenziale.pdf

F2.3 Ambient air quality with respect to particulates <10 mu (PM10) over a one year period

1. Intent

To assess the long-term ambient air quality with respect to particulates <10 mu (PM10) in the local area.

2. Assessment methodology

2.1 Description

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.

2.2 Data requirement

Indicator	Unit	Data source
Number of days exceeding the daily limits in a year	days/year	Estimation

2.3 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.

G2.1 Public transport service

1. Intent

To determine the performance of the public transportation system.

2. Assessment methodology

2.1 Description

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.

2.2 Data requirement

Indicator	Unit	Data source
Percentage of inhabitants that are within 400 meters walking distance of at least one public transportation service stop	%	Estimation

2.3 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.

3. References and Standards

Global Platform for Sustainable Cities – Urban Sustainability Frame

G2.4 Quality of pedestrian and bicycle network

1. 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.

2. Assessment methodology

2.1 Description

Increasing zero emission mobility is crucial to lower the carbon footprint of human activities.

2.2 Data requirement

Information/Attribute	Unit	Data source
Total walkway meters of dedicated pedestrian paths and meters of bicycle path and “shared space” per 100 inhabitants.	m/100 inhabitants	Estimation

2.3 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: $\frac{(A+B+C)}{100\ \mathrm{INHABITANTS}}$

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.

3. References and standards

Global Platform for Sustainable Cities – Urban Sustainability Framework.
The pedestrian and the City- Carmen Hass-Klau.

G4.2 Availability and proximity of key services

1. Intent:

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

2. Assessment methodology

2.1 Description

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.

2.2 Data requirement

Indicator	Unit	Data source
Percentage of inhabitants that are within 800 meters walking distance of at least 3 key services.	%	Estimation

2.3 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.

3. References and standards

Global Platform for Sustainable Cities – Urban Sustainability Framework.

G6.3 Community involvement in urban planning activities

1. 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?

2. Assessment methodology

2.1 Description

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 (figure 2).

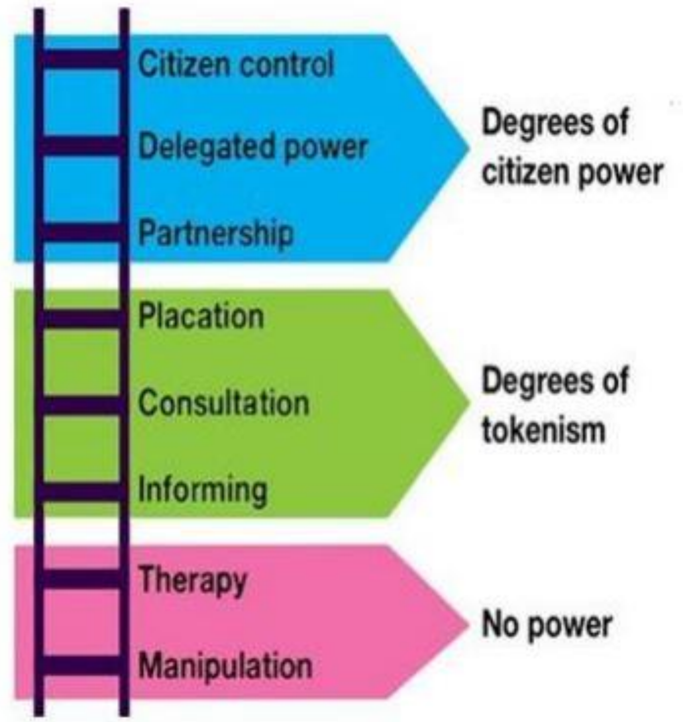

Figure 1: Original Arnstein ladder, with 8 rungs and 3 categories.

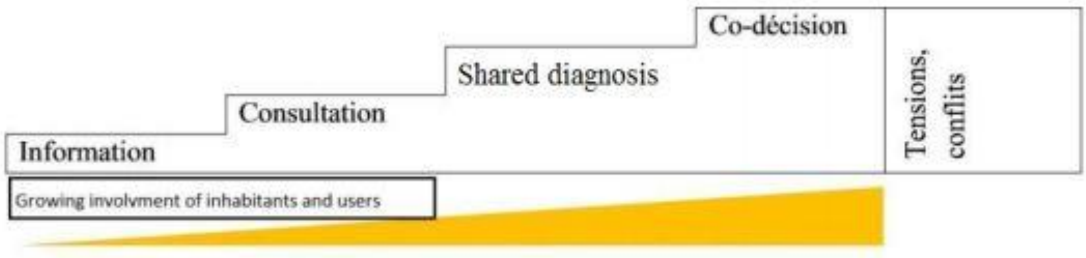

Figure 2: Assessing inhabitants involvment, Hélène Chelzen and Anne Jégou , from Arnstein and Beuret.

2.2 Data requirement

Indicator	Unit	Data source
Level of involvement of users in urban planning	Level (score)	Process documentation

2.3 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.

<u>Levels for assessment:</u>
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.

Issue	What to highlight	Data source (indicative)
information	Number and variety of information media (panels on site, documents including all studies, programs and calendar on website, dedicated communication materials leaflets, articles in the city magazine, information meetings, a project house with models of the planned project…)	Documents Weblinks Pictures
Information and consultation	Scheduling of public meetings including duration, number and dates. (does the scheduling allow the attendance of the many? when is it planned : day or evening or both? Working time or holydays or both ? Where : known community location, changing location?	Schedule of the information and concertation meetings
Consultation (about the project program) to co-decision	How is it done (pubic registry, survey)? When is it done? (this should highlight the potential for integrating people's suggestion)? Are the results shared?	Consultancy contract Survey if applicable
Shared diagnosis	Process for shared diagnosis, Existing dedicated consultancy, Survey done to users, Workshops to build and confirm the diagnosis collectively	Consultancy contract, Workshop minutes, Pictures, Final diagnosis
Co-decision	Process for co-decision Existing dedicated consultancy? Workshops? Existing scenarios presented to users? Evolution of scenario to integrate citizens feedback	Consultancy contract Workshops minutes, Pictures, Ground plans

3. References and standards

Arnstein S., 1969, "A Ladder Of Citizen Participation", Journal of the American Institute of Planners 35 (4), p. 216-24.

Chelzen Hélène and Jégou Anne, « À la recherche de l’habitant dans les dispositifs participatifs de projets urbains durables en région parisienne : les éclairages de l’observation participante », Développement durable et territoires [En ligne], Vol. 6, n°2 | Septembre 2015, mis en ligne le 30 septembre 2015.

Quartiers Durables Méditerranéens (Sustainable Mediterranean Neighbourhood) , an approach towards sustainable Mediterranean neighbourhoods in the Provence-Alpes-Côte d’Azur Region, envirobatBDM.

Passport Template

Passport Template is a graphical visualisation of the main information concerning the neighbourhood assessed. It is produced starting from the results of the evaluation activities carried out in the pilot area and it is made up of two different pages.
The first one contains all the general information related to the location, dimension and historical origins of the area; in this section there is the possibility to add maps and significant images, in order to better represent the features of the neighbourhood analysed. Some important information are required for demography aspects, climate, building stocks, morphology and use of land. Applicants are free to include data they consider more meaningful for the pilot area.
The second page of the Passport Template contains the list of the Key Performance Indicators, together with their code, criterion, unit of measure and value. Applicants have to enter the value achieved for each KPIs in the relevant section. These values are also contained in the CESBA MED SNTool.

Set out below, the empty Passport Template.

CESBA
Common European Sustainable Built Environment Assessment

FULL NAME OF THE PILOT AREA

NEIGHBORHOOD PASSPORT

Name ....Put here your text........................

Surface (Km²) ....

City ....

General location ....

Historical origin of the area ....

Urban area description

Put here your text..

Put here your images

Put here your map

Demography

Residential population in the area	..... inhab.
Urban residential density	...... persons/ha
Daytime population working in the area	number
Other relevant info	

Building stock

Number of buildings in the area	number
Aggregate gross area in m² of housing units	.... m²
Aggregate gross area in m² of office buildings	.... m²
Aggregate gross area of retail commercial buildings	.... m²
Total gross area of all buildings	.... m²
Total gross area of buildings constructed before 1975	.... m²
Average building density (total m² / land surface in m²)	number

Climate

Annual precipitation	.... mm
Solar irradiance on horizontal surface	.....kWh/m²year
Winter design temperature	........°C
Summer design temperature	........°C
Other relevant info	

Use of land and morphology

Percentage of consumed land area	..... %
Aggregate length of urban streets with sidewalks	...... km
Density of street intersections	number
Other relevant info	

FULL NAME OF THE PILOT AREA

NEIGHBORHOOD PASSPORT

SUSTAINABILITY KEY PERFORMANCE INDICATORS

CODE	CRITERION	INDICATOR	VALUE	UNIT
A1.7	Conservation of land	Area of undeveloped land with ecological or agricultural value / area of the neighbourhood	???	%
B3.3	Use stage energy cost for public buildings	Aggregated annual operating energy cost per aggregated indoor useful floor area	???	Euro/m²/year
C1.1	Total final thermal energy consumption for building operations	Aggregated annual total final thermal energy consumption per aggregated indoor useful floor area	???	kWh/m²/year
C1.4	Total final electric energy consumption for building operations	Aggregated annual total final electric energy consumption per aggregated indoor useful floor area	???	kWh/m²/year
C1.7	Total primary energy demand for building operations	Aggregated annual total primary energy consumption per aggregated indoor useful floor area	???	kWh/m²/year
C2.1	Share of renewable energy on-site, relative to total final thermal energy consumption for building operations	Annual total thermal energy consumption from on-site renewable energy sources / annual total final thermal energy consumption	???	%
C2.7	Share of renewable energy on-site, on final electric energy consumptions	Share of renewable electric energy in final electric energy consumptions	???	%
D1.2	Total GHG Emissions from primary energy used in building operations	CO_2 equivalent emissions per useful internal floor area per year	???	kgCO2 eq./m²/yr
E1.6	Consumption of potable water for residential population	Annual potable water consumption per occupant	???	m³/occupant/year
E1.7	Consumption of potable water for public non-residential building systems	Annual water consumption per m²	???	m³/m²
F1.3	Recharge of groundwater through permeable paving or landscaping	Area of permeable surfaces on total neighbourhood area	???	%
F2.3	Ambient air quality with respect to particulates <10 mu (PM10) over a one year period	Number of days exceeding the daily limits in a year	???	Days/year
G2.1	Public transport service	Percentage of inhabitants that are within 400 meters walking distance of at least one public transportation service stop	???	%
G2.4	Quality of pedestrian and bicycle network	Total walkway meters of dedicated pedestrian paths and meters of bicycle path and shared space per 100 inhabitants	???	m/100inhabitants
G4.2	Availability and proximity of key services	Percentage of inhabitants that are within 800 meters walking distance of at least 3 key services	???	%
G6.3	Community involvement in urban planning activities	Level of involvement of users in urban planning	???	LEVEL (score)

Certificate Template

Together with the Passport, it is also produced the Certificate Template of the neighbourhood assessed. It's a graphic label which allows, in a visual way, to understand the performance obtained by the neighbourhood. The pilot area analysed will get the quality label whose level depends on the score obtained. This graphical recognition is called CESBA MED Certificate Template.
In this document are summarized the scores achieved by the neighbourhood in each area of the assessment system, giving than a final score of the sustainability of the pilot area.
Scores are than graphed through a tachometer with a graduated scale which goes from the -1 (negative performance) to the 5 points (best performance).

Set out below, an example of the Certificate Template.


CESBA
Common European Sustainable Built Environment Assessment
FULL NAME OF THE PILOT AREA
NEIGHBORHOOD CERTIFICATE
SCORES
0,4 A - BUILT URBAN SYSTEMS
0,1 B - ECONOMY
1 C - ENERGY
-0,6 D - ATMOSPHERIC EMISSIONS
0,9 E - NON-RENEWABLE RESOURCES
-0,6 F - ENVIRONMENT
2,6 G – SOCIAL ASPECTS
FINAL SCORE
0,15
BEST 5
EXCELLENT 4
GOOD 3
FAIRLY GOOD 2
PASS 1
MINIMUM 0
NEGATIVE -1