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FINAL D3.1.1

Transnational Indicators and Assessment Methods for Buildings and Urban areas

WP3 Testing

CESBA MED Sustainable MED Cities

Fostering low-carbon strategies and energy efficiency in specific MED territories: cities, islands and remote areas

Priority axis-Investment Priority-Specific Objective 2-1-1

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This report was created with the joint effort of the CESBA MED partners.

Contents

1. Executive Summary

The **objective** of **A.3.1** “**Analysis of existing transnational methods and Key Performance Indicators (KPIs) for the assessment of buildings and urban areas”** is to identify the method and the set of KPIs that are more suitable in energy and sustainability plans for public buildings, in order to increase their impact and effectiveness. This report elaborates deliverable **D.3.1.1** “**Transnational Indicators and assessment methods for buildings and urban areas”**. The work is based on available transnational sets of indicators for the assessment of the sustainability of buildings and small urban areas, which have been developed within the frame of 11 transnational projects and 2 public assessment systems (P.A.S.). The report presents a comprehensive overview of the available information in order to derive a generic list of indicators based on the level of relevance, operability and affordability of the available indicators in the Mediterranean context.

The report is structured into 3 main parts:

Part 1 discusses the available performance indicators under the main issues and categories considered in this work.

Part 2 presents a detailed overview of the existing performance indicators that have been developed within 11 European projects and 2 P.A.S. for the sustainability assessment of buildings and small urban areas.

Part 3 outlines the results from the classification of the existing performance indicators to select two sets of indicators at building and urban scale, presented in the form of a catalogue. It also includes a description of the revised SBTool multi-criteria assessment methodology for the urban scale in the Mediterranean context.

The lead partner of this deliverable is NOA. All project partners have contributed in the different sections in accordance to the work allocation.

2. Introduction

Buildings are the leading energy consuming sector, representing about 40% of the final energy consumption in Europe, and have a major impact on the natural environment. Energy efficiency improvement is a key European strategy to reduce the environmental impact of buildings. However, common energy efficiency plans do not fully exploit the potential for synergies that groups of buildings may offer. The implementation of large scale energy efficiency measures at city, district, neighbourhood or block level (e.g. district heating and cooling, photovoltaics and solar thermal installations) have clearly demonstrated that a building scale is not an optimal approach for reaching significant and cost-effective solutions. On the other hand, decision making processes for the design and assessment of interventions are more complex at larger scales due to the number of the various sustainability themes that need to be addressed (Figure 1).

Figure 1. Sustainability themes at different scales [Barbano et al. 2016].

Indicators are metrics that can be used to determine how well the sustainability objectives are achieved. They can be expressed as

- numerical values (e.g. how much energy is used normalized per unit floor area of the building, so that it is possible to compare different buildings or against other benchmarks; how much water is consumed per building occupant or building occupant) or
- ratios and percentages (e.g. what is the percentage of renewables that cover power or heat demand; what percentage of waste is recycled).

Various performance indicators are available for benchmarking different building and urban attributes or characteristics, facilitating decision making, assessing specific project requirements, or ensuring compliance with regulations and norms. These indicators quantify what one is trying to achieve and thus may need to select and use several of them at different stages of their work or process.

Opinions vary as to which one is the most important since they all depend on the user or the intent. Apparently, different indicators can support the diverse needs of stakeholders and their priorities, to support decision making. For example, in routine building design practice, the first step is to calculate peak power demand (loads) or energy demand, in an effort to minimize system sizing and thus meet building code requirements or minimize first cost. Depending on the opportunities for a given project, efforts may focus on building architecture, selection of different thermal envelope materials and components and then electromechanical (E/M) systems. Other indicators may also be used for the assessment of indoor environmental quality and occupant the well-being. This usually includes indoor thermal comfort conditions under free floating conditions (e.g. minimum and maximum indoor temperature), indoor visual comfort conditions (e.g. daylight) and indoor air quality (e.g. different air flow rates and minimum fresh outdoor requirements).

Simple numeric metrics may be easily associated with a building's energy performance (i.e. lower or higher energy use) as a result of the building's characteristics, design, equipment selection and overall operation. This way, one can compare different design scenarios in order to optimize building construction, operation or assess energy refurbishment scenarios and alternatives, and use these indicators to quantify and substantiate selections to the different stakeholders.

Indicators can be considered at different scales, e.g. Building or District scale. In some cases they share some common indicators, with building scale values contributing to a larger scale, e.g. a neighbourhood or a district scale (Figure 2).

	Number	Name
Environment	B.1	*Energy*
	B.1.1	Operational Primary Energy Demand
	B.1.2	Delivered Energy Demand
	B.1.3	Renewable Energy on Site
	B.2	*Impacts*
	B.2.1	Global Warming Potential
Society	B.5	*Air Quality*
	B.5.1	Indoor Air Quality
	B.6	*Thermal Comfort*
	B.6.1	Summer Comfort without Cooling
	B.6.2	Thermal Comfort in the Heating Season
	B.6.3	Thermal Comfort in the Cooling Season
	B.8	*Acoustic Comfort*
	B.8.1	Acoustic Comfort
Economy	B.10	*Operational Costs*
	B.10.1	Operational Energy Costs

	Number	Name
Environment	D.1	*Energy*
	D.1.1	Operational Primary Energy Demand
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	D.1.3	Renewable Energy on Site
	D.2	*Impacts*
	D.2.1	Global Warming Potential
Society	D.8	*Acoustic Comfort*
	D.8.1	Acoustic Environment
Economy	D.10	*Operational Costs*
	D.10.1	Operational Energy Costs

Figure 2. Breakdown examples of Building (left) and District (right) indicators [Barbano et al. 2016].

Selected indicators may also be targeted for evaluating the district energy status or neighbourhood central systems for small scale areas (e.g. up to 12 buildings). They can be suitable for energy networks analysis [Barbano et al. 2016] and for example may include:

- Evaluation of district energy status, e.g. percentage of energy demand to be covered by renewables, surplus of electricity from renewables, available storage capacity
- Evaluation of neighbourhood readiness for central systems, e.g. central heating, central cooling and smart grids.

One of the most important industry-led initiatives to harmonise environmental performance indicators is that of the Sustainable Building Alliance (**SBA** http://www.sballiance.org). SBA assembled various representatives from major building assessment schemes (e.g. BREEAM, HQE, DGNB, SB Tool, LEED) and developed a harmonised framework of common metrics that focus on four life cycle analysis indicators:

- non-renewable primary energy consumption,
- CO_2 equivalents,
- drinking water consumption and waste production, as well as measures of
- thermal comfort and indoor air quality.

The Common European Sustainable Built Environment Assessment (**CESBA** http://wiki.cesba.eu) has been working to respond to the perceived confusion caused by the proliferation of various building assessment schemes, by bringing together various projects and platforms led by public authorities. A set of KPIs that form the basis for the CESBA 'building signature', include:

- primary energy use,
- CO_2 emissions,
- reused/recycled materials,
- water consumption,

- solid waste,
- building life cycle costs,
- health and wellbeing factors (IAQ and thermal comfort),
- monitoring/optimisation in operation.

Over the past few years, the European Commission has recognized the importance developing a common EU framework of core indicators for the environmental performance of buildings and released the Communication on Resource Efficiency Opportunities in the Building Sector - **COM(2014)445**. This Communication identified the need for a common European approach to assess the environmental performance of buildings throughout their lifecycle, taking into account the use of resources such as energy, materials and water. The six macro objectives that will be translated into indicators include:

- Greenhouse gases from life cycle energy use
- Resource efficient material life cycles
- Efficient use of water resources
- Healthy and comfortable spaces
- Resilience to climate change
- Optimised life cycle cost and value.

The **CESBA MED** work focuses on identifying the most suitable transnational sets of indicators for the integrated assessment of public buildings and urban areas in the Mediterranean context, addressing the main dimensions of sustainability.

2.1 Overview of Issues-Indicators

The emphasis of **CESBA MED** is on the energy use of **public buildings** in the context of their surrounding urban area. This work considers various indicators for **three major issues** (*in alphabetical order*):

- Economic
- Environmental
- Social

and numerous categories of various commonly used indicators that are briefly discussed in the following subsections.

➢ Economic Issue

Most decision making processes are influenced to a great extent by the project's economic aspects. Improving the building's energy performance has a direct impact on first and operational costs. For example, starting with the efforts to minimize loads one can reduce the size of equipment and thus minimize first cost, which includes materials, labour, overhead, VAT etc. Some design options and materials may last for the life time of the building, while others will extend over the life time of the components that may run over several years or decades. For high performance buildings, construction costs average 3 to 10% higher than standard alternatives, but using energy efficient equipment or exploiting renewables will reduce operational costs by up to 40-50% lower than for conventional buildings, with proper operation and maintenance.

Different economic indicators are used for appraising the benefits and financial attractiveness of different design options and scenarios. For example, the simple payback period (PBP) that is commonly used and easily understood in the market. More accurate but more demanding methods are sometimes considered, e.g. accounting rate of return (ROR) or average annual rate of return on investment (RRI) discounted cash flow (e.g. the net present value (NPV) and internal rate of return (IRR) methods). Life cycle costing (LCC) and analysis (LCCA) methodologies can be used to reach cost optimal levels. However, they are not easy to implement since they require information on energy prices, different material/equipment costs, and a number of relevant rates (e.g. variables and cash flow components) that may be difficult to realistically define in uncertain financial times.

Different indicators can be used in order to assess the benefits and financial attractiveness of different design options for new buildings and renovation scenarios for existing buildings. Starting from the simple payback period (PBP) that is commonly used and easily understood in the market, to more accurate but more demanding calculation methods like accounting rate of return (ROR) or average annual rate of return on investment (RRI) discounted cash flow (e.g. net present value (NPV) and internal rate of return (IRR) methods). Progressively the focus is placed on life cycle costing (LCC) and analysis (LCCA) methodologies that can be used to reach cost optimal levels for the entire lifetime of the building. However, these methods are not easy to implement since they require information on energy prices, different material/equipment costs, and a number of relevant rates (e.g. variables and cash flow components) that may be difficult to realistically define in uncertain financial times.

➢ Environmental Issue

Environmental issues that relate to new and existing buildings involve the use of natural resources, various gaseous emissions (that are directly related to greenhouse gases and linked to global warming), waste etc. They can impact the air, land (use, preservation, open available green areas), and water (consumption, pollution, waste). The rational use of fresh water resources, the exploitation of rain water and waste water treatment, are some major environmental priorities, especially in the Mediterranean basin. The area also has a sensitive and significant biodiversity, with numerous indigenous plants that are suitable for landscaping and also have reduced water needs.

The emphasis of CESBA MED is on building energy use. Most commonly used energy related indicators, which quantify a building's energy performance, include the normalized final (site) energy breakdown of different fuels (e.g. renewables, electricity, heating oil, natural gas) and primary (source) energy consumption that facilitates the assessment of environmental impact (e.g. emissions). Although different time steps may be used (e.g. hourly, monthly), the most common is on an annual basis (e.g. annual energy consumption or annual emissions). In addition, indicators can be used for evaluating different scenarios for equipment and system selection that can lower the total building's energy consumption, specific end-use energy consumption, e.g. related to HVAC equipment, lighting, service hot water, major office equipment, appliances and other plug loads, vertical transportation etc. Emissions are then directly related to the specific energy carriers. Environmental emissions are usually expressed in CO_2 emissions (or equivalent) in kg per unit floor area of a building or aggregated as total quantities.

➢ Social Issue

For the social aspects, the indoor environmental quality (IEQ) and well-being of occupants inside the buildings, involves, thermal, visual and acoustical comfort, and proper indoor air quality. Temperature and humidity levels provide helpful insight on the prevailing conditions that effect thermal comfort. Detailed simulation results and monitoring data can be used to assess prevailing conditions and for example, identify overheating conditions in summer (implying thermal discomfort) or even in winter that means energy waste beyond discomfort. The minimum indoor temperature in winter and the maximum indoor temperature in summer can be used as indicators for checking compliance with the desirable indoor conditions and preliminary assessment of peak sensible loads. Similarly, indoor humidity can reveal relevant priorities for humidification in winter or dehumidification in summer and support the preliminary assessment of peak latent loads. On an annual basis, spaces should have no more than 1% of the annual occupied hours over/under the desirable set point temperature. The predictive mean vote (PMV) and percentage people dissatisfied (PPD) are common thermal comfort indicators in order to quantify indoor thermal conditions and further assess the impact on occupancy.

Visual comfort is an integral part of proper IEQ and a critical design parameter in commercial buildings, since it improves productivity and overall functions. In terms of energy consumption, for some building categories, lighting may constitute a major final end-use and may also contribute to internal heat loads.

Another relevant indicator is the indoor air velocity that impacts thermal comfort conditions. Computational fluid dynamics (CFD) simulations can handle the complex phenomena and provide the necessary information in order to optimize the architectural and system design. CFD data visualization of spaces allows users to easily follow path lines and flow mixing resulting from mechanical or natural ventilation in order to evaluate the effectiveness of natural or mechanical ventilation systems. CFD may also be used to assess indoor air quality, outdoor pollution and concentrations of contaminants, which are compared against standards and health regulations.

Air ventilation and circulation plays a dominant role in achieving comfort conditions and securing the necessary amount of fresh (outdoor) air by natural, mechanical and/or hybrid ventilation. Minimum air flow rate of fresh outdoor air is a commonly used indicator, which depends on the building end-use, the number of occupants and the generation of indoor pollutants. Minimum requirements per person (m3/h/person), according to the maximum occupancy (person/m^2 net occupiable floor area) to ensure proper indoor air quality are set by standards and technical regulations.

On an urban scale, transportation infrastructures, including public transport, availability of safe bicycle routes, suitable pedestrian streets etc, are major elements for sustainable urban development. Public safety and security are also important social aspects that influence the well-being of residents and working visitors. Accessibility to public spaces (e.g. community centres and services, parks) and other services (e.g. broadband networks) are also very important social criteria.

2.2 Work Overview

Several European projects and other public or commercial programs and initiatives have addressed these issues and have proposed different methods, tools and indicators. Accordingly, there is an abundance of available knowhow but on the other hand there is a need to collectively look at these outcomes in order to establish a common basis of a methodology and tool set that is suitable for the refurbishment of public buildings in the urban context of the MED area.

CESBA MED exploits available information from 14 transnational projects and public assessment systems. They are critically reviewed in order to develop a **generic list** of CESBA MED **set of indicators at building and urban scale** that will allow the sustainability assessment of public buildings and areas in the context of the Mediterranean area.

CESBA MED will produce an assessment system composed by a generic framework (CESBA MED SN Generic Framework) and the locally contextualized assessment tools (CESBA MED SNTools). The reference assessment methodology adopted by CESBA is the SBTool of iiSBE that gives the possibility of a total contextualization of tools to local conditions. The SBTool assessment methodology, originally developed for the building scale, is adapted for the application at urban scale. Finally, an integrated multi –criteria CEBA MED assessment methodology is developed to connect the assessments at building and urban scale.

3. Transnational Methods & Indicators

The starting point of CESBA MED are the available information and main results from 14 transnational projects and public assessment systems (P.A.S.) dealing with energy efficiency at building and urban scale. They all define and use several indicators in their methods in order to assess sustainability of buildings at different scales. The main projects and P.A.S. considered in this work are outlined next in alphabetical order and they are elaborated in detail in **Appendix A**.

Transnational Projects

- **CABEE** - Capitalizing Alpine Building Evaluation Experiences (ASP ALPINE Space Programme, European Territorial Cooperation, 2013-15) http://www.cabee.eu

  A rating tool at cluster scale that contains criteria based on quantitative and qualitative criteria dealing with environmental, social and economic issues. More information in Appendix A.1.

- **CAT MED** - Platform for Sustainable Urban Models (Interreg MED,2013-15) http://www.catmed.eu

  A common system of urban sustainability indicators to track the evolution of urban systems in time. Different indicators are organized around four main axes: territorial management & urban design, mobility & transport, natural resources management and social and economic cohesion. More information in Appendix A.2.

- **CEC5** - Demonstration of Energy Efficiency and utilization of renewable energy sources trough public buildings (Interreg Central Europe, 2010-12) http://wiki.cesba.eu/wiki/CEC5

  CESBA Tool is a transnational sustainability assessment tool at building scale based on common indicators dealing with process, environmental, social and economic issues. More information in Appendix A.3.

- **CLUE** - Climatic Neutral Urban Districts in Europe (Interreg IVC, 2011-14) http://www.clue-project.eu

  A set of 50 criteria and indicators for sustainability assessment at cluster and neighborhood scale. The indicators are all quantitative and performance based. Similar indicators with ITACA. More information in Appendix A.4.

- **ENERBUILD** - Energy Efficiency and Renewable Energies in the Building sector (ASP ALPINE Space Programme, European Territorial Cooperation, 2010-12) http://www.enerbuild.eu

  A transnational sustainability assessment tool at building scale based on common indicators dealing with process, environmental, social and economic issues. More information in Appendix A.5.

- **EPISCOPE** - Energy Performance Indicator Tracking Schemes for the Continuous Optimisation of Refurbishment Processes in European Housing Stocks (IEE, 2012-14) http://www.episcope.eu

  A scheme of energy performance indicators to access national actions for tracking and assessing refurbishment plans for improving the energy performance of building stocks. More information in Appendix A.6.

- **FASUDIR** - Friendly and affordable sustainable urban districts retrofitting (FP7, 2014-16) http://fasudir.eu

  A set indicators at building and district level for assessing the three issues of sustainability: environmental, economic and social aspects. Calculation methods and benchmarks of KPIs are defined. More information in Appendix A.7.

- **IRH-MED** - Innovative Residential Housing MED (Interreg MED, 2010-12) http://wiki.cesba.eu/wiki/IRH_med

  A common framework for residential building sustainability assessment in MED areas that can be used as a basis for the implementation of future regional initiatives. More information in Appendix A.8.

- **NewTREND** - New integrated methodology and tools for retrofit design towards a next generation of energy efficient and sustainable buildings and districts (H2020, 2015-18) http://newtrend-project.eu

  An efficient collaborative design platform that accounts for current best practices in the design process for energy efficient refurbishment of buildings. More information in Appendix A.9.

- **OpenHouse** - Benchmarking and mainstreaming building sustainability in the EU based on transparency and openness (open source and availability) from model to implementation (FP7, 2010-12) http://www.openhouse-fp7.eu

  A common European methodology to assess the sustainability of buildings based on the existing certification schemes and European standards, using a transnational set of indicators. More information in Appendix A.10.

- **SuPerBuildings** - Sustainability and Performance Assessment and Benchmarking of Buildings (FP7, 2010-12) http://cic.vtt.fi/superbuildings

  A set of sustainability indicators for buildings and methods for the assessment and benchmarking considering the output of the standardization processes, focusing on the validity of indicators, comparability of assessment results, benchmarking criteria. More information in Appendix A.11.

Public Assessment Systems (P.A.S.)

- **Eco-Quartier** - French Label Eco Quartier (Eco-District) http://www.eco-quartiers.fr

  A French label to formalize sustainable development of districts and assess Eco-districts. The approach is compatible with the Reference Framework for Sustainable Cities (http://rfsc.eu). The approach considers 20 commitments of a common charter, covering life quality and users practices; territorial development; environment and climate. More information in Appendix A.12.

- **Protocollo ITACA**- Environmental label (Federal Association of the Italian Regions, with the scientific support of iiSBE and ITC-CNR) http://wiki.cesba.eu/wiki/Protocollo_Itaca

  A voluntary environmental label promoted by the Italian Regions based on the international assessment methodology SBMethod of iiSBE and it has been contextualized at local level by several regions to support specific policies in promoting sustainable buildings. A national version is also under development to create a point of reference for the market stakeholders. Similar indicators with CLUE. More information in Appendix A.4.

- **QDM**- Quartiers Durables Méditerranéens (Sustainable Mediterranean Neighbourhoods) http://www.envirobatbdm.eu/baroque

  A local and contextualised approach to sustainability in neighbourhood planning for local authorities. It is based on a bottom up and participative approach, using 8 themes, 31 criteria and 240 indicators. More information in Appendix A.13.

Table 1. Overview of CESBA MED project partner involvement in preparing the background information and review of existing projects & public assessment systems (P.A.S.)

	Projects											**P.A.S.**		
CESBA MED Partners	**CLUE**	**FASUDIR**	**CABEE**	**CAT-MED**	**EPISCOPE**	**ENERBUILD**	**CEC5**	**OPEN HOUSE**	**IRH-MED**	**SuPerBuildings**	**NewTREND**	**Eco-Quartier**	**Protocollo ITACA**	**QDM**
LP-TO	✓			✓										
PP1-iiSBE		✓									✓		✓	
PP2-UDINE							✓							
PP3-EVBDM														✓
PP4-RAEE			✓			✓						✓		
PP5-Gov of Catalonia									✓					
PP6-SCUGAT														
PP7-UoM								✓						
PP8-NOA					✓									
PP9-CESBA														
PP10-EIHP										✓				
PP11-MPM														

The available indicators are clustered into **three (3) major sustainability Issues** and **nineteen (19) main Categories**, illustrated in Figure 3. The various categories are listed in alphabetical order, not in terms of their importance.

In order to facilitate the organization of the available information and easy cross reference, a common letter coding is introduced as follows:

- Each issue is denoted by a three letter code (the three first letters of the issue's name)
- Each category is denoted by a two letter code: the first letter (in caps) and the second letter of the category's name, in case of category with a single-word name, OR the first letter (in caps) of the first word and the first letter (in caps) of the last word of the category's name, in case of category with a more than one word name.

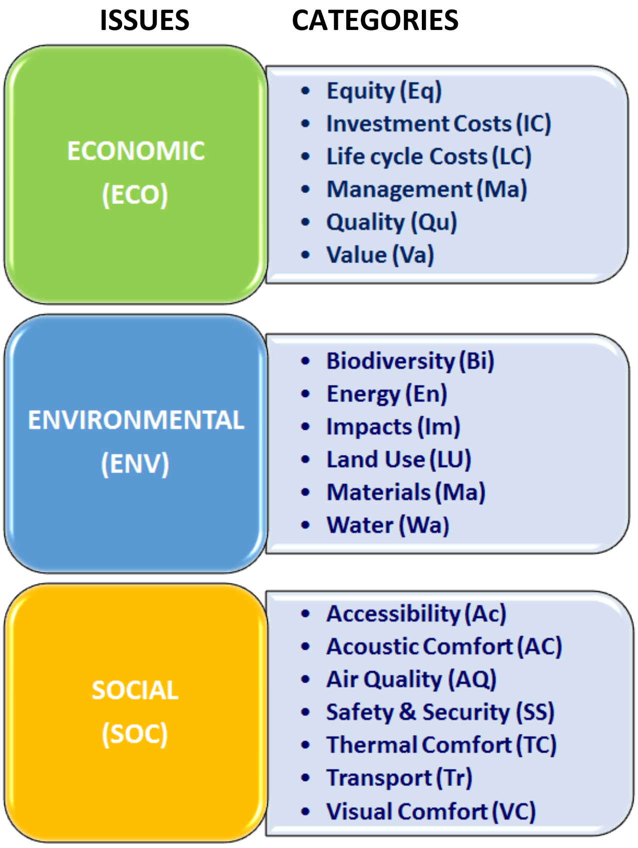


Figure 3. Issues and corresponding Categories (listed in alphabetical order) of indicators.

A complete list of the corresponding indicators for each category and criterion are summarized in Table 2. They are listed in alphabetical order, not in terms of their importance.

Table 2. Indicators and Criteria under the main Issues & Categories (listed in alphabetical order). The spatial coverage is based on the building scale and/or neighbourhood scale.

ECONOMIC (ECO) ISSUE						
Category	Criterion	Indicator (units)		Building (B) and Neighbourhood (N) scale		
				B	N	B&N
Equity	Housing value	1	Affordability of housing property (m^2)		◆	
		2	Affordability of housing rental (%)		◆	
	Local economy	3	Support to local economy (%)		◆	
	Prevention of prejudice	4	Prevention of prejudice		◆	
	Social & Economic cohesion	5	Future evolution and modularity		◆	
		6	Gentrification index (-)		◆	
		7	Labor force participation (%)		◆	
		8	Potential Employment (%)		◆	
		9	Social housing ratio (%)		◆	
		10	Social mixing and solidarity based economy		◆	
		11	Unemployment rate (%)		◆	
Investment Costs	Capital cost	1	Additional costs for energy efficiency and sustainability (€)			◆
		2	Investment costs (€/m^2)			◆
		3	Investment costs aggregated (€)		◆	
		4	Participation of local authority in the total investment cost (%)		◆	
	Performance	5	Return on investment (%)			◆
Life cycle Costs	Benchmarking & Targeting	1	Verifiable sustainable targets			◆
	Cost benefit	2	Cost benefit analysis focused on sustainability			◆
	Energy cost	3	Operational energy costs (€/m^2)			◆
		4	Operational energy costs aggregated (€)			◆
	Non- Energy cost	5	Operational non-energy costs aggregated (€)		◆	
	Total cost	6	Cost in operational phase (€)			◆
		7 8	Life cycle costs (-) (€)	◆		
		9	Life cycle costs aggregated (€)		◆	
Management	Building operation	1	Communication and information management (%)			◆
		2	Information and participation of users			◆
		3	Synergy management (-)		◆	
		4	User information (-)	◆		
	Social & Economic cohesion	5	Environmental activities in primary school (%)		◆	

ECONOMIC (ECO) ISSUE						
Category	**Criterion**	**Indicator (units)**		Building (**B**) and Neighbourhood (**N**) scale		
Quality	Architectural	1	Aesthetic quality (-)		◆	
		2	Enhance architectural, cultural and landscape patrimony (yes/no)		◆	
	Benchmarking & Targeting	3	Setting verifiable environmental targets (-)	◆		
	Building energy performance	4	Energy optimization during planning (-)	◆		
	Cultural heritage	5	Monument or monumental value / Historical value (-)			◆
	Process & Planning	6	Building works quality control	◆		
		7	Community management (yes/no)		◆	
		8	Community planning (yes/no)		◆	
		9	Finalising the design phase (yes/no)		◆	
		10	Integrated design in the planning process (-)		◆	
		11	Plus 6 (+6) project management (yes/no)		◆	
		12	Process and planning quality (-)			◆
		13	Project management (yes/no)		◆	
		14	Working with skilled professionals (yes/no)		◆	
	Risk management	15	Long term stability of value (€)			◆
		16	Risk management (-)		◆	
	Territorial management & Urban design	17	Urban complexity, Shannon-Wiener index (-)		◆	
Value	Flexibility & Adaptability	1	Flexibility and adaptability, during the life of the project (yes/no)		◆	
		2	Flexibility and adaptability, programming (yes/no)		◆	
	Process & Planning	3	Assessing the current situation (yes/no)		◆	
		4	Competent professional team		◆	
		5	Economic advantage of cluster in comparison to single buildings (-)		◆	
		6	Equipment and services pooling		◆	
	Social & Economic cohesion	7	Tourist frequency trends, seasonality overnight stays (%)		◆	
		8	Tourist frequency trends, seasonality tourists (%)		◆	

ENVIRONMENTAL (ENV) ISSUE						
Category	Criterion	Indicator (units)		Building (B) and Neighbourhood (N) scale		
				B	N	B&N
Biodiversity	Building site	1	Ecological quality of the building site (-)	◆		
	Land preservation	2	During programming, design and before the beginning of the works; the land is maintained through mowings, prunings, maintenance of canals and hedges (yes/no)		◆	
	Public spaces	3	Change in ecological value of the site, species(-)			◆
		4	Connectivity of green spaces (%)		◆	
		5	Diversity (yes/no)		◆	
		6	Ecological corridors and continuity (yes/no)		◆	
		7	Use of local plants (%)		◆	
		8	Vegetal areas (%)		◆	
Energy	Building vertical transportation	1	Escalators and moving walks design and efficiency (-)	◆		
		2	Lift design and efficiency (-)	◆		
		3	Stairs and ramps planning (-)	◆		
	Embodied energy	4	Embodied energy demand (kWh/m^2)	◆		
	Final energy	5	Annual heat generation for space heating and DHW (kWh/m^2)			◆
		6	Cooling demand (kWh/m^2)	◆		
		7	Delivered energy demand (kWh/m^2)			◆
		8	Energy consumption (Toe/inhabitant)		◆	
		9	Heating demand (kWh/m^2)	◆		
		10	Peak energy demand			◆
	Primary energy	11	Abiotic Depletion Potential (kWh/m^2)	◆		
		12	Consumption of non-renewable primary energy (kWh/m^2)			◆
		13	Operational primary energy (kWh/m^2)			◆
		14	Primary energy for cooling (%)		◆	
		15	Primary energy for heating (%)		◆	
		16	Primary energy for public lighting (%)		◆	
		17	Primary energy for public lighting (kWh/yr)		◆	
		18	Total primary energy demand (kWh/m^2)			◆
	Renewables	19	Renewable electricity production (%)		◆	
		20	Renewable energy on site (%)			◆
		21	Share of renewable primary energy in total primary energy demand (kWh/m^2)	◆		
		22	PV-power plant (kWh/a)	◆		
	Virtual power systems	23	Electric energy and Virtual power systems		◆	

ENVIRONMENTAL (ENV) ISSUE						
Category	Criterion	Indicator (units)		Building (**B**) and Neighbourhood (**N**) scale		
				B	N	B&N
Impacts	Eco-mobility	1	Eco-mobility potential of a building in its context (km/unit)			◆
	Effects on surrounding buildings	2	Impacts on surrounding buildings (%)		◆	
	Emissions	3	Acidification potential (kgSO_2-eq/m^2)			◆
		4	Acidifying emissions, Intensity (%)		◆	
		5	Annual CO2 emissions (kgCO_2/m^2)			◆
		6	CO2 emission factor heat supply (kg/kWh)			◆
		7	CO2 emissions (tonnes CO_2-eq/yr)		◆	
		8	Eutrophication potential (kgPO_4-eq/m^{2}yr)			◆
		9	Global Warming Potential (kgCO_2-eq/m^2 yr)			◆
		10	Global Warming Potential (-)		◆	
		11	Global Warming Potential (kgCO_2-eq/m^2 yr)			◆
		12	Intensity of GHG emissions (%)		◆	
		13	Ozone depletion potential (kgR11-eq/m^{2}yr)			◆
		14	Photochemical Ozone creation potential (kgC_2H_4-eq/m^{2}yr)			◆
		15	Photo-oxidants emissions, Intensity (%)		◆	
	Light pollution	16	Light on properties (lx)		◆	
		17 18	Light pollution (-) (%)		◆	
		19	Luminaire intensity (cd)		◆	
		20	Luminance (cd/m^2)		◆	
		21	Upward Light		◆	
	Outdoor conditions	22	Monitoring of air quality (%)		◆	
		23	Thermal comfort of outdoor areas (%)		◆	
	Raw materials	24	Abiotic Depletion Potential elements (kgSB-eq/m^{2}yr)			◆
	Solid waste management	25	Accessibility to differentiated waste collection (%)		◆	
		26	Accessibility to waste sorting facilities (%)			◆
		27	Composting (-)	◆		
		28	Construction and demolition waste generation (kg/m^2)			◆
		29	Recyclable waste storage (m^2)	◆		
	Water pollution	30	Water pollution due to material leaching (mg/m^2 yr)			◆

ENVIRONMENTAL (ENV) ISSUE						
Category	**Criterion**		**Indicator (units)**	Building (**B**) and Neighbourhood (**N**) scale		
				B	**N**	**B&N**
Land Use	**Preservation**	1	Conservation of built environment (%)		◆	
		2	Preservation of land (%)			◆
	Quality	3	Site quality (-)		◆	
	Soil sealing	4	Permeability of site / land (%)			◆
	Spatial planning	5	Change of land use (-)		◆	
		6	Imperviousness change, Imperviousness coefficient (-)		◆	
	Urban design	7	Green zones & recreation areas (m^2/inhabitant)		◆	
		8	Green zones & recreation areas density (%)		◆	
		9	Green zones & recreation areas proximity (%)		◆	
		10	Outdoor space (-)		◆	
		11	Population density (inhabitants/ha)		◆	
		12 13	Urban compactness (dwelling/m^2) (m^3/m^2)		◆	
		14	Urban context (-)		◆	
		15	Urban conversion (%)		◆	
Materials	**ECO materials**	1	Low-pollutant and low-emission materials (-)	◆		
	Emissions	2	Building materials and construction, OI3 index (-)			◆
Water	**Embodied water**	1	Embodied water use (m^3/m^2)			◆
	Freshwater	2	Intensity of water treatment (%)		◆	
		3	Operational water use (m^3)			◆
		4	Water consumption (l/inhabitant day)		◆	
	Rainwater	5	Dedicated network (yes/no)		◆	
		6	Intensity of rainwater usage (%)		◆	
		7	Landscaped and accessible retention ponds and ditches (yes/no)		◆	
		8	Rainwater collection from roofs (%)		◆	
		9	Respecting streaming continuity (yes/no)		◆	
	Total water use	10	Operational water use and waste water (m^3)			◆
	Wastewater	11	Intensity of wastewater treatment (%)		◆	
		12 13	Waste management & removal (l/inhabitant day) (%)		◆	
		14	Wastewater management (%)		◆	
		15	Wastewater management (m^3/m^2)			◆
		16	Water consumption & use of rainwater (-)	◆		

SOCIAL (SOC) ISSUE						
Category	**Criterion**	**Indicator (units)**		Building (**B**) and Neighbourhood (**N**) **scale**		
				B	**N**	**B&N**
Accessibility	**Broadband communication network**	1	Access to a broadband communication network, areas (%)		◆	
		2	Access to a broadband communication network, population (%)		◆	
	Flexibility	3	Flexibility of residential buildings (%)			◆
		4	Flexibility use (%)		◆	
	Public space planning	5	Access to parks and open spaces (-)		◆	
		6	Adaptation to users practices (yes/no)		◆	
		7 8	Availability of green spaces (%) (m^2/inhabitant)		◆	
		9	Barrier-Free accessibility of the district (%)		◆	
		10	Community gardens (yes/no)		◆	
		11	Parks and vegetated spaces network (yes/no)		◆	
		12	Public space quality (yes/no)		◆	
		13	Shared community spaces (yes/no)		◆	
	Services & Leisure facilities	14	Access to services and facilities (%)		◆	
		15	Collective facilities and outsourcing of services (%)		◆	
		16	Community support (yes/no)		◆	
		17	Proximity to leisure facilities (%)		◆	
		18	Proximity to services (%)		◆	
		19	Proximity to services and leisure facilities (%)		◆	
		20	Social gatherings and common cluster activities (-)		◆	
	Street network	21	Cyclomatic complexity of the street network (-)		◆	
	Urban planning	22	Development and integration of land parcels (%)		◆	
		23	Homogeneity of the urban fabric (%)		◆	
		24	Mixing functions (yes/no)		◆	
Acoustic Comfort	**Noise - Indoor**	1	Indoor A-weighted sound pressure level (dBA)			◆
		2	Weighted sound pressure from ventilation (dBA)	◆		
	Noise - Outdoor	3	Building area over noise limit (%)		◆	
		4	Noise pollution, silence quality – day (%)		◆	
		5	Noise pollution, silence quality – night (%)		◆	
	Noise pollution management	6	Accoustics studies (yes/no)		◆	
Air Quality	**Indoor air quality**	1	Concentration of pollutants (µg/m^3)			◆
	Outdoor air quality	2	Number of days with bad air quality (days/yr)		◆	

SOCIAL (SOC) ISSUE						
Category	**Criterion**	**Indicator (units)**		Building (**B**) and Neighbourhood (**N**) scale		
				B	**N**	**B&N**
Safety & Security	**Energy & Management systems**	1	Objective/subjective safety measures (-)		◆	
	Green production	2	Local production of food (m^2/inhabitant)		◆	
	Mobility	3	Pedestrian safety paths (%)		◆	
Thermal Comfort	**Indoor conditions**	1	Predicted Mean Vote (-)			◆
		2	Predicted Percentage Dissatisfied (%)			◆
		3	Thermal comfort in summer (-)	◆		
	Outdoor conditions	4	Exploitation of local resources: sun, daylight, wind (-)		◆	
		5 6	Heat island effect (-) (yes/no)		◆	
		7	Microclimate Index I (-)		◆	
Transport	**Mobility & Alternative transportation**	1	Availability of safe bicycle routes (m)		◆	
		2	Bicycle and pedestrian network quality (-)		◆	
		3	Bicycle facilities (-)		◆	
		4	Car sharing pool/station (yes/no)		◆	
		5	Contiguity of bicycle and car routes (%)		◆	
		6	Pedestrian streets and walkways, area (%)		◆	
		7	Pedestrian streets and walkways, length (%)		◆	
		8	Proximity to bicycle lanes and paths (%)		◆	
		9	Shared mobility (%)			◆
	Parking facilities	10	Parking facilities (number/dwelling)		◆	
		11	Parking facilities, Off-street parking spaces (%)		◆	
		12	Parking places with innovative features (%)		◆	
		13	Bicycle Parking (%)	◆		
	Public transportation	14	Access to public transport nodes, areas (%)		◆	
		15	Access to public transport nodes, population (%)		◆	
		16	Access to public transport, District Accessibility Index (-)		◆	
		17	Accessibility of public transport, stops and frequency (-)	◆		
		18	Accessibility to public transport, Lense index (-)			◆
		19	Dwellings with access to public transport (%)		◆	
	Street network	20	Connectivity of the street network (number/m^2)		◆	
		21	Cul-de-sac roads and path ratio (%)		◆	

SOCIAL (SOC) ISSUE						
Category	**Criterion**	**Indicator (units)**		Building (**B**) and Neighbourhood (**N**) scale		
				B	**N**	**B&N**
		22	Scale of the street network (m)		◆	
		23	Traffic modal split (%)		◆	
Visual Comfort	**Artificial lighting**	1	Illuminance (lx)			◆
	Daylighting	2	Daylight factor (%)			◆

Depending on the amount of information required for the definition of the indicators they can also be grouped into three categories, depending on the **level and complexity of their calculation**:

- **Basic (B)**: using simple parametric calculations, values from literature, benchmark averages,
- **Standard (S)**: using standards, simple tool calculations, simple measurements or utility bills,
- **Advanced (A)**: using advanced software for dynamic simulations

and in some cases based on a combination of calculation approaches, for example, Basic and Advanced (**B&A**).

Furthermore, the available indicators can be categorized according to their spatial coverage (Table 2) based on the **scale** of their application at

- **Building** Scale (**B**)
- **Neighbourhood** Scale (**N**)
- Both (**B&N**)

The **CESBA MED set of indicators** at **building scale** will allow the sustainability assessment of public buildings with different end-uses (e.g. school, offices, residential). At **urban scale** the CESBA MED set of indicators will allow the sustainability assessment of areas at different scales and physical boundaries.

- A **small urban scale** area (Neighbourhood scale, e.g. block/cluster of buildings) includes 5 – 15 buildings with a traditional composition, e.g. few buildings (adjacent or separated) with an internal courtyard.
- A **large urban scale** (e.g. neighbourhood) covers an area of 200-400 m in size that can be crossed in 10-15 min walk and incorporates 200-1500 inhabitants. The CESBA MED set of indicators will also consider different **time scales** to facilitate the sustainability assessment of **existing urban areas**

The **CESBA MED set** of indicators at urban scale will allow the sustainability assessment of an area concerning:

- **Existing** urban areas
  - actual performance assessment in order to take snap shot of the urban area and to identify the sustainability critical issues;
  - potential performance related to retrofit scenarios in order to identify the most cost effective sustainable retrofit scenario;
  - monitoring of urban retrofit actions in order to evaluate the effectiveness of urban retrofit actions and the achievement of the sustainability performance targets.
- **New** urban developments
  - potential performance of alternative planning options in order to identify the most cost effective sustainable development option;
  - monitoring of new urban developments in order to monitor new urban development and the achievement of the performance targets.

The two **CESBA MED sets of indicators** at

- **Building scale** and
- **Neighbourhood (Urban) scale**

are composed by indicators selected from existing sets developed by the previous EU projects and P.A.S. The available indicators are presented in detail for each project and P.A.S. (**Appendix A**). These information sheets (their contents are elaborated in the template in Appendix A.0) include:

- Short description of the project and its objectives
- Short list of indicators used in the specific project
- Detailed presentation of the indicators (e.g. name, units, categorization using the abbreviated codes for issue/category/level/scale, a brief description, the calculation method, and reference sources for more information).

The **code name for each indicator** follows the abbreviated notation from Table 2 as: "*Issue.Category.Number*". For example, "Energy consumption" is denoted as "*ENV.En.8*".

An overview of the available indicators and their association with all the projects and P.A.S. considered in this work are summarized in **Appendix B** (Project List of Indicators_Overview.xlsx). Over **210 indicators** have been identified. As illustrated in the exert in Figure 4, each indicator is identified in terms of the issues (ECO, ENV, SOC), categories, descriptive name and units, the calculation complexity (B, S, A), the spatial coverage (B, N), linked to the specific projects and P.A.S. considered in this work. The counter column indicates the number of times that the specific indicator has been used. The last column is used for supplementary notes to provide clarity on specific processes or approaches.

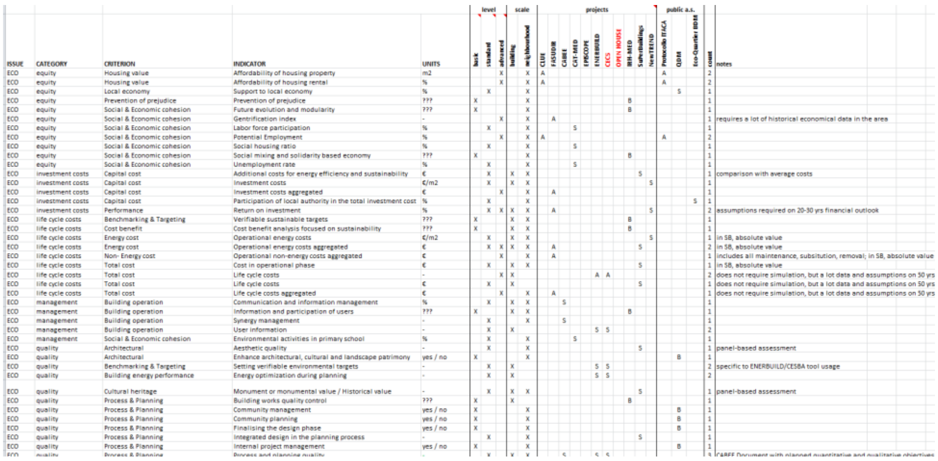


Figure 4. Exert of the overview of available indicators and frequencies in transnational projects and PAS (Appendix B).

4. Analysis

The analysis of the available information provides some useful insight with regard to the most relevant indicators. The goal of the following analysis is to identify from the generic list of indicators used in the transnational projects consider in this work, the ones that are most commonly used under each of the main issues (ECO, ENV, SOC) and specific categories, while at the same time identify common trends, for example, the commonly used calculation approaches. The analysis considers both **Building & Neighbourhood (Urban) scales**. The outcome of this analysis provides the appropriate CESBA MED set of indicators that will then be coupled with a multi-criteria assessment methodology in order to derive the specific CESBA MED key and core performance indicators.

4.1 Generic Indicators

The generic list of indicators from the EU projects and P.A.S. considered in this work include a **total** of **216 indicators** (Table 2). Some of the indicators are expressed with different units. The breakdown of the indicators based on their spatial coverage (Figure 5) is as follows:

- **24 indicators** (11% of the total) at **Building Scale** (only)
- **142 indicators** (66% of the total) **at Neighbourhood (urban) Scale** (only)
- **50 indicators** (23% of the total) are common and apply at both **B&N scale**.

Considering that some indicators are common and used at both building and neighbourhood scales, their breakdown is as follows:

- **74 indicators** (34%) at **Building Scale**
- **192 indicators** (89%) at **Neighbourhood (urban) Scale**

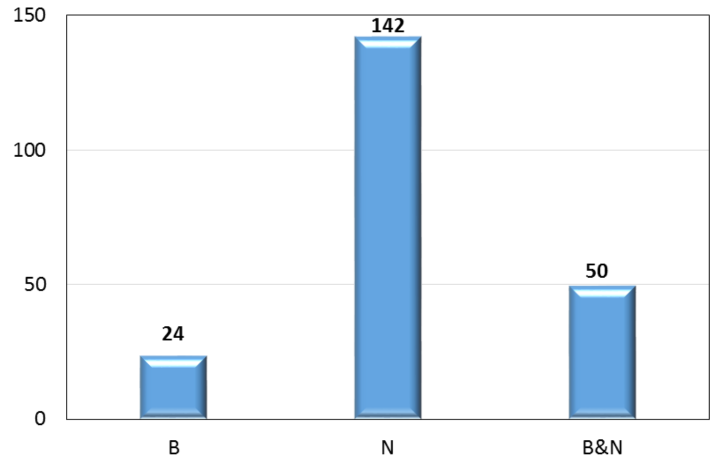


Figure 5. Number of indicators at building (B) scale, neighbourhood (N) scale, and both B&N scale.

In terms of the **level and complexity of their calculation**, the majority of the indicators are derived using standard calculations (Figure 6). A total of **98 indicators** or 45% are based on **standard calculations**, followed by **advanced** (**50 indicators** or 23%), **basic** (**40 indicators** or 19%) and their combinations thereafter (i.e. S&A for 25 indicators or 12%, and only one for B&S, B&A and B&S&A).

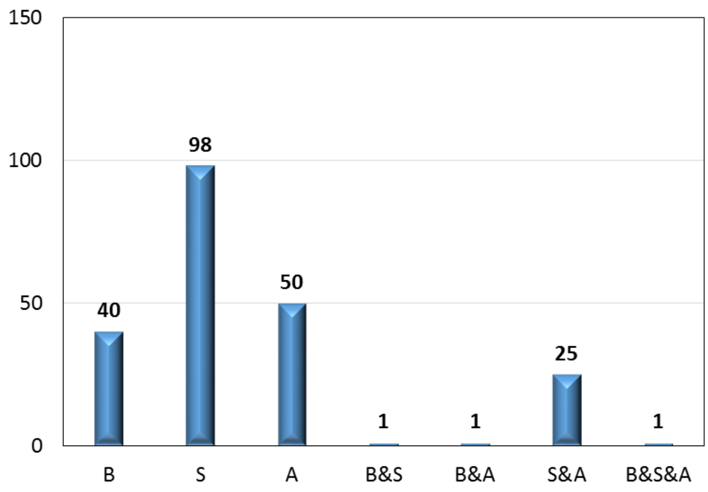


Figure 6. Number of indicators with different levels of calculation complexity (B: Basic, S: Standard, A: Advanced) and their combinations thereafter.

Specifically, for the indicators that use **Basic calculations**, 21 of them are included in the ECO issue, 13 in ENV issue and 9 in SOC issue (Figure 7a). Of the ones using **Standard calculations**, 28 indicators are included in the ECO pillar, 63 in ENV pillar and 34 in SOC pillar (Figure 7b), while for the ones that use **Advanced calculations**, 11 are included in the ECO issue, 35 in ENV issue, 31 and in SOC issue (Figure 7c).

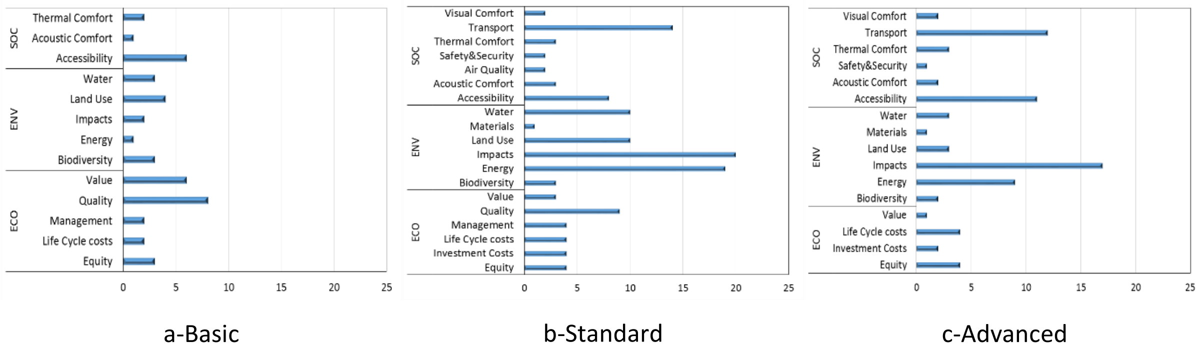


Figure 7. Number of indicators that use a-Basic, b-Standard and c-Advanced level calculations for the main sustainability issues and categories.

The following sections elaborate the most popular indicators under the three main issues.

ECONOMIC (ECO)

A total of 55 indicators (addressed 66 times in total) are assigned under Economic (ECO) issue. The two most popular categories under the specific issue are Quality (Qu) and Equity (Eq).

➢ ECO - Quality (ECO.Qu)

A total of 17 indicators are assigned under «ECO.Qu» amongst the various projects and P.A.S. considered during this work. Specifically, 3 of them address the neighbourhood scale (N), 3 the building scale (B) and 11 both scales (B&N). These indicators have been addressed 21 times in total, following different calculation methodologies. The majority use a "Standard" level calculation approach (53%), followed by "Basic" level approach (47%).

➢ ECO - Equity (ECO.Eq)

A total of 11 indicators are assigned under «ECO.Eq» amongst the various projects and P.A.S. and all of them address the neighbourhood scale (N). These indicators have been addressed 14 times in total, following different calculation methodologies. The majority use a "Standard" level calculation approach (36%), followed by "Advanced" level approach (36%) and 28% use a "Basic" level approach.

ENVIRONMENTAL (ENV)

A total of 93 indicators (addressed 133 times in total) are assigned under Environmental (ENV) issue. The two most popular categories under the specific issue are Impacts (Im) and Energy (En).

➢ ENV – Impacts (ENV.Im)

A total of 30 indicators are assigned under «ENV-Im» amongst the various projects and P.A.S. considered during this work. Specifically, 15 of them address the neighbourhood scale, 13 both B&N scales and 2 indicators the building scale. These indicators have been addressed 46 times in total, following different calculation methodologies. The majority use a "Standard" level calculation approach (37%), followed by 30% that use both "Standard" and "Advanced" level approaches, 27% that use an "Advanced" level approach and only 6% use a "Basic" level approach.

➢ ENV – Energy (ENV-En)

The emphasis of CESBA MED is on building energy use. A total of 23 indicators are assigned under «ENV-En» amongst the various projects and P.A.S. considered during this work. Specifically, 9 of them address the building scale, 7 both B&N scales and 7 the neighbourhood scale. These indicators have been addressed 33 times in total, following different calculation methodologies. The majority use a "Standard" calculation approach (57%), 26% use both "Standard" and "Advanced" level approach, 13% use "Advanced" level approaches and only 4% use a "Basic" level approach.

SOCIAL (SOC)

A total of 67 indicators (addressed 94 times in total) are assigned under Social (SOC) issue. The two most popular categories under the specific issue are Accessibility (Ac) and Transport (Tr).

➢ SOC - Accessibility (SOC.Ac)

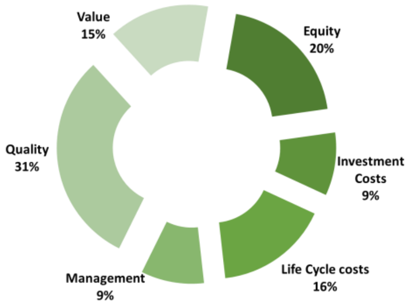
A total of 24 indicators are assigned under «SOC.Ac» amongst the various projects and P.A.S. considered during this work. Specifically, 23 of them address the neighbourhood (N) scale and only 1 both B&N scales. These indicators have been addressed 33 times in total, following different calculation methodologies. The majority use an "Advanced" level calculation approach (42%), followed by "Standard" level approach (29%), "Basic" level approach (25%) , while only 4% use both "Standard" and "Advanced" level approaches.

➢ SOC - Transport (SOC.Tr)

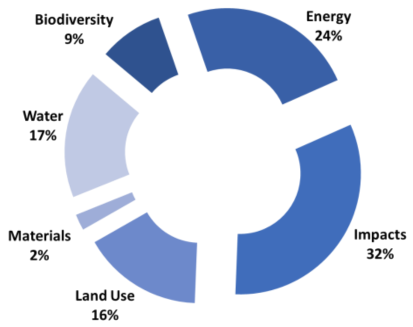
A total of 23 indicators are assigned under «SOC.Tr» amongst the various projects and P.A.S. considered during this work. Specifically, 19 of them address the neighbourhood (N) scale, 2 the building (B) scale, and 2 both B&N scales. These indicators have been addressed 35 times in total following different calculation methodologies. The majority use a "Standard" calculation approach (48%), followed by "Advanced" level approach (39%) and 13% use both "Standard" and "Advanced" level approaches.

TOTAL (215 indicators)

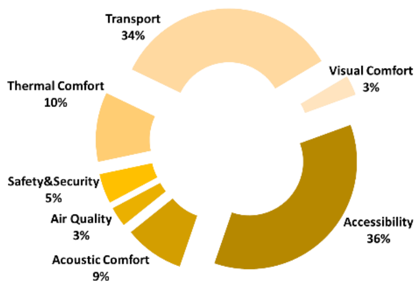
ECONOMIC (55)



ENVIRONMENTAL (90)

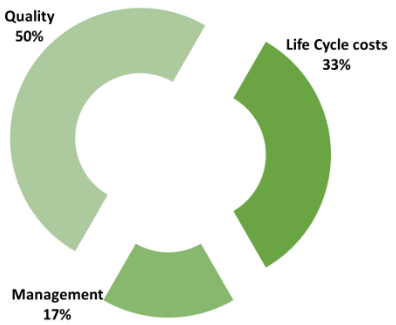


SOCIAL (65)

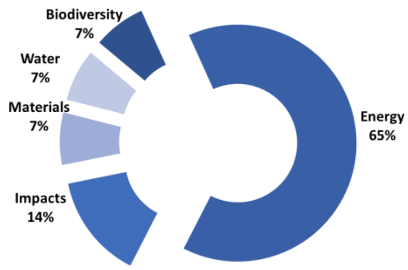


BUILDING SCALE (24 indicators)

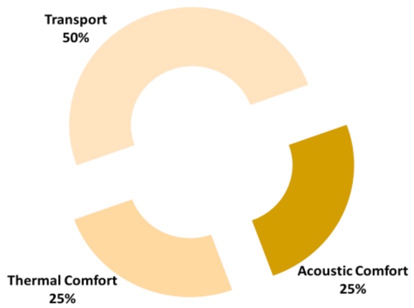
ECONOMIC (6)



ENVIRONMENTAL (14)

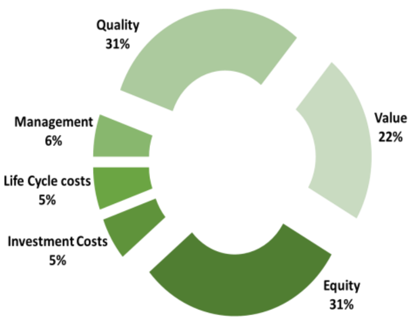


SOCIAL (4)

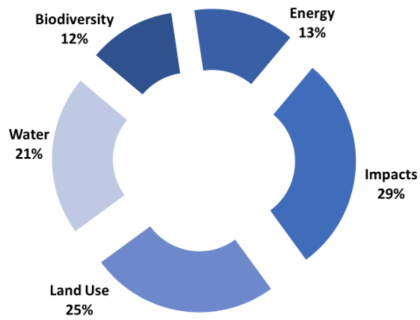


NEIGHBOURHOOD SCALE (142 indicators)

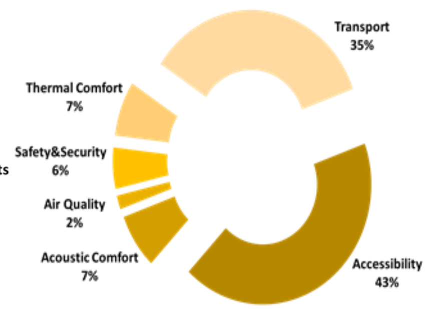
ECONOMIC (36)

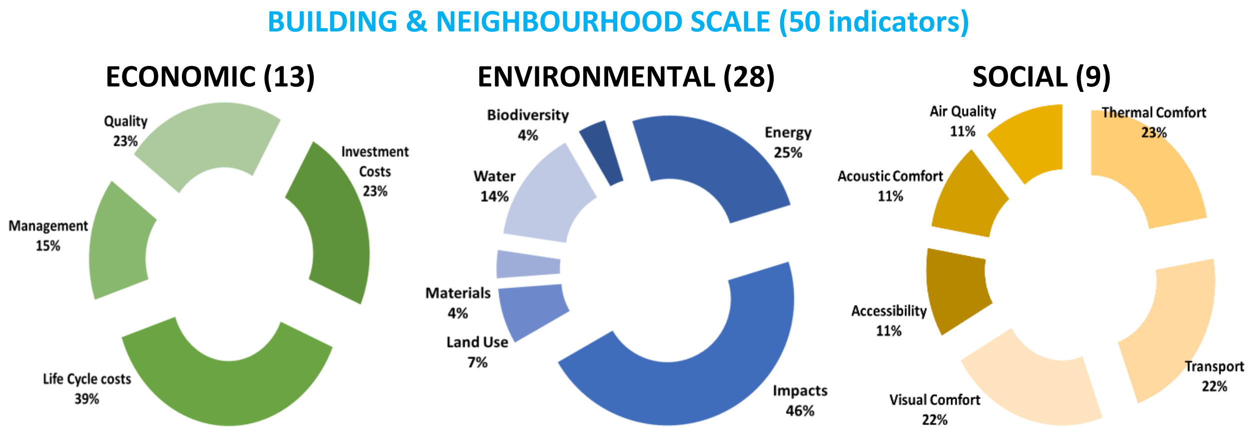


ENVIRONMENTAL (52)



SOCIAL (54)





4.2 CESBA MED Set of Indicators

The practical issues one needs to consider in order to identify a manageable number of indicators should address some general aspects (e.g. stakeholders, clarity and accuracy) and specific items related to energy and environmental aspects (e.g. energy demand and consumption, emissions).

- **Stakeholders**

Different indicators can support the diverse needs and priorities of public authorities, policy makers and other public and private technical stakeholders (e.g. urban planners, investors, SMEs, grant managers, owners, construction companies, solutions providers, users), in their efforts to assess and improve the overall environmental, social and economic performance of buildings. The clarity of the indicators is critical, in order to properly support the decision making process of specific stakeholders, without demanding elaborate training for using them and being able to readily adopt them.

- **Clarity & Accuracy**

Effective indicators should be based on scientifically and robust calculations that provide clear results that can be easily communicated and understood by the stakeholders. Simplicity and reproducibility should not conflict with accuracy. Input uncertainties that may result from increased complexity to determine the necessary data from which they are derived, require time consuming data collection processes or very complicated simulations, will impose unnecessary burdens and may limit the applicability of the indicators.

- **Primary vs Final Energy Consumption & Emissions**

The primary energy, i.e. the source energy that has not been subjected to any conversion or transformation process (e.g. power plant), is used to produce the energy delivered to the building (e.g. electrical energy). Most European and national approaches consider primary (source) instead of final (site) energy consumption. For natural gas and oil, the multiplier to obtain the primary energy is about 5% and 10% higher, respectively. However, for electricity generated from conventional power plants, depending on the MED area this may be about three times higher. From a resource depletion point of view, it is necessary to evaluate the primary energy. However, from an occupant's or owner's perspective, the final energy use is directly related to the operating costs of the building. Final energy consumption is usually retrieved from energy bills and utilities for existing buildings or estimated using appropriate calculation tools.

Energy consumption may be normalized, for example, per unit floor area, unit volume or weather conditions (e.g. using heating- or cooling-degree days) and may even be expressed for different end-uses at either the building scale and/or neighbourhood scale (e.g. for heating or cooling). The definition of the reference floor area (e.g. gross floor area, heated floor area, useful floor area) using internal or external dimensions, should be carefully specified. Energy use per inhabitant is commonly used for comparison at large (national) level.

The use of primary energy is necessary for calculating the environmental impact and CO_2 emissions. Environmental emissions are expressed in CO_2 emissions (or equivalent) in kg per unit floor area of the building and depend on the specific primary fuel. National or even regional conversion factors for calculating the primary energy consumption from calculated or measured final energy consumption depends on the fuel and the fuel mix for generating electricity. Comparing CO_2 emissions one may optimize the selection of different equipment that use different fuels.

- **Total vs Specific end-uses Energy Consumption**

Due to the climate characteristics of the Mediterranean region, cooling energy is of special interest for the scope of CESBA MED. Lighting and plug loads can also be of significant importance in commercial and public buildings. Depending on the specific end-uses (e.g. heating, cooling, ventilation, lighting, etc) and the use of different energy carriers, it is important to consider both total and the breakdown of specific energy use.

Embodied energy (EE) in building materials, equipment and systems, is attracting more attention as buildings' energy consumption continues to decrease as a result of strict regulations, codes, building practices and market advances. It is important for new building constructions or other public works to select materials and equipment with low EE. For building refurbishments one needs to also account for the EE of any materials or equipment that are removed, in addition to the new ones. However, there are several obstacles to consider in order to easily handle this type of analysis, given that there is limited availability of local (national) tools and databases.

The CESBA MED indicators cover:

- All issues (Economic, Environmental, Social) and main sustainability aspects, with an emphasis on environmental-energy related issues
- Both scales: Building (B) and Neighbourhood (N)
- Different stakeholders

taking into account their

- Frequency of use in the existing projects considered during this work (i.e. how frequently used are the indicators – Section 3.1)

and complying with the following requirements

- **Operational**: calculate the indicators on the basis of easily accessible open data and information from existing databases;
- **Affordable**: calculate the indicator through a cost and time effective process;
- **Practical**: support decision making processes for the sustainability improvement of public buildings and urban areas;
- **Suitable**: support certification processes at building and urban scale;
- **Relevant**: for the Mediterranean context.

The **two sets** of **CESBA MED indicators** at **Building Scale** & **Neighbourhood** (urban) **Scale** are defined with the intent to be used in assessment activities for the:

- Evaluation of the actual level of sustainability of urban areas and public buildings;
- Identification of the most cost effective retrofit scenario for sustainable urban areas and public buildings;
- Evaluation of alternative design options for new sustainable urban developments and public buildings;
- Development of target based action plans for sustainable public buildings;
- Sustainability certification of public buildings and urban areas.

Eventually one needs to consider a realistic number of indicators. This is critical in order to secure the practical aspects during implementation, e.g. time constraints, complexity and relevant accuracy for collecting the main input data, etc. This is the trend and current practice within several projects, e.g. ENERBUILD includes 16 KPIs, similar with NewTREND that includes 16 core KPIs, while FADUSIR includes 20 KPIs for building and district level.

Building Scale Indicators

(listed in alphabetical order)

ECONOMIC (ECO) ISSUE			
Category	**Criterion**	**Indicator (units)**	
Investment Costs	Capital cost	1	Additional costs for energy efficiency and sustainability (€)
		2	Investment costs (€/m²)
	Performance	5	Return on investment (%)
Life cycle Costs	Benchmarking & Targeting	1	Verifiable sustainable targets
	Cost benefit	2	Cost benefit analysis focused on sustainability
	Energy cost	3	Operational energy costs (€/m²)
		4	Operational energy costs aggregated (€)
	Total cost	6	Cost in operational phase (€)
		7 8	Life cycle costs (-) (€)
Management	Building operation	1	Communication and information management (%)
		2	Information and participation of users
		4	User information (-)
Quality	Benchmarking & Targeting	3	Setting verifiable environmental targets (-)
	Building energy performance	4	Energy optimization during planning (-)
	Cultural heritage	5	Monument or monumental value / Historical value (-)
	Process & Planning	6	Building works quality control
		12	Process and planning quality (-)
	Risk management	15	Long term stability of value (€)

ENVIRONMENTAL (ENV) ISSUE			
Category	**Criterion**	**Indicator (units)**	
Biodiversity	Building site	1	Ecological quality of the building site (-)
	Public spaces	3	Change in ecological value of the site, species (-)
Energy	Building vertical transportation	1	Escalators and moving walks design and efficiency (-)
		2	Lift design and efficiency (-)
		3	Stairs and ramps planning (-)
	Embodied energy	4	Embodied energy demand (kWh/m²)
	Final energy	5	Annual heat generation for space heating and DHW (kWh/m²)
		6	Cooling demand (kWh/m²)
		7	Delivered energy demand (kWh/m²)
		9	Heating demand (kWh/m²)
		10	Peak energy demand
	Primary energy	11	Abiotic Depletion Potential (kWh/m²)
		12	Consumption of non-renewable primary energy (kWh/m²)
		13	Operational primary energy (kWh/m²)
		18	Total primary energy demand (kWh/m²)
	Renewables	20	Renewable energy on site (%)
		21	Share of renewable primary energy in total primary energy demand (kWh/m²)
		22	PV-power plant (kWh/a)
Impacts	Eco-mobility	1	Eco-mobility potential of a building in its context (km/unit)
	Emissions	3	Acidification potential ($kgSO_2$-eq/m²)
		5	Annual CO2 emissions ($kgCO_2$/m²)
		6	CO2 emission factor heat supply (kg/kWh)
		8	Eutrophication potential ($kgPO_4$-eq/m²yr)
		9 11	Global Warming Potential ($kgCO_2$-eq/m² yr) (kWh/m²)
		13	Ozone depletion potential (kgR11-eq/m²yr)
		14	Photochemical Ozone creation potential (kgC_2H_4-eq/m²yr)
	Raw materials	24	Abiotic Depletion Potential elements (kgSB-eq/m²yr)
	Solid waste management	26	Accessibility to waste sorting facilities (%)
		27	Composting (-)
		28	Construction and demolition waste generation (kg/m²)
		29	Recyclable waste storage (m²)
	Water pollution	30	Water pollution due to material leaching (mg/m² yr)
Land Use	Preservation	2	Preservation of land (%)
	Soil sealing	4	Permeability of site / land (%)
Materials	ECO materials	1	Low-pollutant and low-emission materials (-)
	Emissions	2	Building materials and construction, OI3 index (-)
Water	Embodied water	1	Embodied water use (m³/m²)
	Freshwater	3	Operational water use (m³)
	Total water use	10	Operational water use and waste water (m³)
	Wastewater	15	Wastewater management (m³/m²)
		16	Water consumption & use of rainwater (-)

SOCIAL (SOC) ISSUE			
Category	**Criterion**	**Indicator (units)**	
Accessibility	Flexibility	3	Flexibility of residential buildings (%)
Acoustic Comfort	Noise - Indoor	1	Indoor A-weighted sound pressure level (dBA)
		2	Weighted sound pressure from ventilation (dBA)
Air Quality	Indoor air quality	1	Concentration of pollutants (μg/m³)
Thermal Comfort	Indoor conditions	1	Predicted Mean Vote (-)
		2	Predicted Percentage Dissatisfied (%)
		3	Thermal comfort in summer (-)
	Outdoor conditions	7	Microclimate Index I (-)
Transport	Mobility & Alternative transportation	9	Shared mobility (%)
	Parking facilities	13	Bicycle Parking (%)
	Public transportation	17	Accessibility of public transport, stops and frequency (-)
		18	Accessibility to public transport, Lense index (-)
Visual Comfort	Artificial lighting	1	Illuminance (lx)
	Daylighting	2	Daylight factor (%)

Neighbourhood (urban) Scale Indicators

(listed in alphabetical order)

ENVIRONMENTAL (ENV) ISSUE			
Category	Criterion	Indicator (units)	
Biodiversity	Land preservation	2	During programming, design and before the beginning of the works; the land is maintained through mowings, prunings, maintenance of canals and hedges (yes/no)
	Public spaces	3	Change in ecological value of the site, species(-)
		4	Connectivity of green spaces (%)
		5	Diversity (yes/no)
		6	Ecological corridors and continuity (yes/no)
		7	Use of local plants (%)
		8	Vegetal areas (%)
Energy	Embodied energy Final energy	5	Annual heat generation for space heating and DHW (kWh/m²)
		7	Delivered energy demand (kWh/m²)
		8	Energy consumption (Toe/inhabitant)
		10	Peak energy demand
	Primary energy	12	Consumption of non-renewable primary energy (kWh/m²)
		13	Operational primary energy (kWh/m²)
		14	Primary energy for cooling (%)
		15	Primary energy for heating (%)
		16	Primary energy for public lighting (%)
		17	Total primary energy demand
	Renewables	18	Renewable electricity production (%)
		19	Renewable energy on site (%)
Impacts	Eco-mobility	1	Eco-mobility potential of a building in its context (km/unit)
	Effects on surrounding buildings	2	Impacts on surrounding buildings (%)
	Emissions	3	Acidification potential (kgSO₂-eq/m²)
		4	Acidifying emissions, Intensity (%)
		5	Annual CO2 emissions ($kgCO_2/m^2$)
		6	CO2 emission factor heat supply (kg/kWh)
		7	CO2 emissions (tonnes CO_2-eq/yr)
		8	Eutrophication potential ($kgPO_4$-eq/m²yr)
		9 10 11	Global Warming Potential ($kgCO_2$-eq/m² yr) (-) (kWh/m²)
		12	Intensity of GHG emissions (%)
		13	Ozone depletion potential (kgR11-eq/m²yr)
		14	Photochemical Ozone creation potential (kgC_2H_4-eq/m²yr)
		15	Photo-oxidants emissions, Intensity (%)
	Light pollution	16	Light on properties (lx)
		17 18	Light pollution (-, %)
		19	Luminaire intensity (cd)
		20	Luminance (cd/m²)
		21	Upward Light
	Outdoor conditions	22	Monitoring of air quality (%)
		23	Thermal comfort of outdoor areas (%)
	Raw materials	24	Abiotic Depletion Potential elements (kgSB-eq/m²yr)
	Solid waste management	25	Accessibility to differentiated waste collection (%)
		26	Accessibility to waste sorting facilities (%)
		28	Construction and demolition waste generation (kg/m²)
	Water pollution	30	Water pollution due to material leaching (mg/m² yr)
Land Use	Preservation	1	Conservation of built environment (%)
		2	Preservation of land (%)
	Quality	3	Site quality (-)
	Soil sealing	4	Permeability of site / land (%)
	Spatial planning	5	Change of land use (-)
		6	Imperviousness change, Imperviousness coefficient (-)
	Urban design	7	Green zones & recreation areas (m²/inhabitant)
		8	Green zones & recreation areas density (%)
		9	Green zones & recreation areas proximity (%)
		10	Outdoor space (-)
		11	Population density (inhabitants/ha)
		12 13	Urban compactness (dwelling/m²) (m³/m²)
		14	Urban context (-)
		15	Urban conversion (%)
Materials	Emissions	2	Building materials and construction, OI3 index (-)
Water	Embodied water	1	Embodied water use (m³/m²)
	Freshwater	2	Intensity of water treatment (%)
		3	Operational water use (m³)
		4	Water consumption (l/inhabitant day)
	Rainwater	5	Dedicated network (yes/no)
		6	Intensity of rainwater usage (%)
		7	Landscaped and accessible retention ponds and ditches (yes/no)
		8	Rainwater collection from roofs (%)
	Total water use	9	Respecting streaming continuity (yes/no)
		10	Operational water use and waste water (m³)
	Wastewater	11	Intensity of wastewater treatment (%)
		12 13	Waste management & removal (l/inhabitant day) (%)
		14 15	Wastewater management (%) (m³/m²)

ECONOMIC (ECO) ISSUE			
Category	Criterion	Indicator (units)	
Equity	Housing value	1	Affordability of housing property (m²)
		2	Affordability of housing rental (%)
	Local economy	3	Support to local economy (%)
	Prevention of prejudice	4	Prevention of prejudice
	Social & Economic cohesion	5	Future evolution and modularity
		6	Gentrification index (-)
		7	Labor force participation (%)
		8	Potential Employment (%)
		9	Social housing ratio (%)
		10	Social mixing and solidarity based economy
		11	Unemployment rate (%)
Investment Costs	Capital cost	1	Additional costs for energy efficiency and sustainability (€)
		2	Investment costs (€/m²)
		3	Investment costs aggregated (€)
		4	Participation of local authority in the total investment cost (%)
	Performance	5	Return on investment (%)
Life cycle Costs	Benchmarking & Targeting	1	Verifiable sustainable targets
	Cost benefit	2	Cost benefit analysis focused on sustainability
	Energy cost	3	Operational energy costs (€/m²)
		4	Operational energy costs aggregated (€)
	Non- Energy cost	5	Operational non-energy costs aggregated (€)
	Total cost	6	Cost in operational phase (€)
		9	Life cycle costs aggregated (€)
Management	Building operation	1	Communication and information management (%)
		2	Information and participation of users
		3	Synergy management (-)
	Social & Economic cohesion	5	Environmental activities in primary school (%)
Quality	Architectural	1	Aesthetic quality (-)
		2	Enhance architectural, cultural and landscape patrimony (yes/no)
	Cultural heritage	5	Monument or monumental value / Historical value (-)
	Process & Planning	7	Community management (yes/no)
		8	Community planning (yes/no)
		9	Finalising the design phase (yes/no)
		10	Integrated design in the planning process (-)
		11	Internal project management (yes/no)
		12	Process and planning quality (-)
		13	Project management (yes/no)
		14	Working with skilled professionals (yes/no)
	Risk management	15	Long term stability of value (€)
		16	Risk management (-)
	Territorial management & Urban design	17	Urban complexity, Shannon-Wiener index (-)
Value	Flexibility & Adaptability	1	Flexibility and adaptability, during the life of the project (yes/no)
		2	Flexibility and adaptability, programming (yes/no)
	Process & Planning	3	Assessing the current situation (yes/no)
		4	Competent professional team
		5	Economic advantage of cluster in comparison to single buildings (-)
		6	Equipment and services pooling
	Social & Economic cohesion	7	Tourist frequency trends, seasonality overnight stays (%)
		8	Tourist frequency trends, seasonality tourists (%)

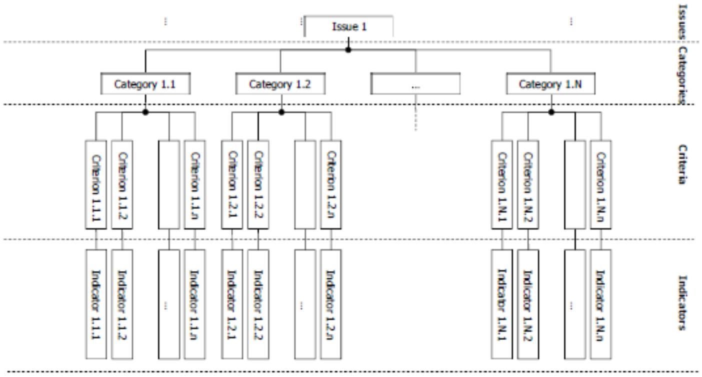
SOCIAL (SOC) ISSUE			
Category	Criterion	Indicator (units)	
Accessibility	Broadband communication network	1	Access to a broadband communication network, areas (%)
		2	Access to a broadband communication network, population (%)
	Flexibility	3	Flexibility of residential buildings (%)
		4	Flexibility use (%)
	Public space planning	5	Access to parks and open spaces (-)
		6	Adaptation to users practices (yes/no)
		7 8	Availability of green spaces (%, m²/inhabitant)
		9	Barrier-Free accessibility of the district (-)
		10	Community gardens (yes/no)
		11	Parks and vegetated spaces network (yes/no)
		12	Public space quality (yes/no)
		13	Shared community spaces (yes/no)
	Services & Leisure facilities	14	Access to services and facilities (%)
		15	Collective facilities and outsourcing of services (%)
		16	Community support (yes/no)
		17	Proximity to leisure facilities (%)
		18	Proximity to services (%)
		19	Proximity to services and leisure facilities (%)
		20	Social gatherings and common cluster activities (-)
	Street network	21	Cyclomatic complexity of the street network(-)
	Urban planning	22	Development and integration of land parcels (%)
		23	Homogeneity of the urban fabric (%)
Acoustic Comfort	Noise - Indoor	1	Indoor A-weighted sound pressure level (dBA)
	Noise - Outdoor	3	Building area over noise limit (%)
		4	Noise pollution, silence quality – day (%)
		5	Noise pollution, silence quality – night (%)
	Noise pollution management	6	Acoustics studies (yes/no)
Air Quality	Indoor air quality	1	Concentration of pollutants (µg/m³)
	Outdoor air quality	2	Number of days with bad air quality (days/yr)
Safety & Security	Energy & Management systems	1	Objective/subjective safety measures (-)
	Green production	2	Local production of food (m²/inhabitant)
	Mobility	3	Pedestrian safety paths (%)
Thermal Comfort	Indoor conditions	1	Predicted Mean Vote (-)
		2	Predicted Percentage Dissatisfied (%)
	Outdoor conditions	4	Exploitation of local resources: sun, daylight, wind (-)
		5 6	Heat island effect (-) (yes/no)
		7	Microclimate Index I (-)
Transport	Mobility & Alternative transportation	1	Availability of safe bicycle routes (m)
		2	Bicycle and pedestrian network quality (-)
		3	Bicycle facilities (-)
		4	Car sharing pool/station (yes/no)
		5	Contiguity of bicycle and car routes (%)
		6	Pedestrian streets and walkways, area (%)
		7	Pedestrian streets and walkways, length (%)
		8	Proximity to bicycle lanes and paths (%)
		9	Shared mobility (%)
	Parking facilities	10	Parking facilities (number/dwelling)
		11	Parking facilities, Off-street parking spaces (%)
		12	Parking places with innovative features (%)
	Public transportation	14	Access to public transport nodes, areas (%)
		15	Access to public transport nodes, population (%)
		16	Access to public transport, District Accessibility Index (-)
		18	Accessibility to public transport, Lense index(-)
		19	Dwellings with access to public transport (%)
	Street network	20	Connectivity of the street network (number/m²)
		21	Cul-de-sac roads and path ratio (%)
		22	Scale of the street network (m)
		23	Traffic modal split (%)
Visual Comfort	Artificial lighting	1	Illuminance (lx)
	Daylighting	2	Daylight factor (%)

4.3 SBTool Multi-Criteria Assessment

The CESBA MED Generic Framework for Sustainable Neighborhoods is based on the "SBEMethod" (Sustainable Built Environment Method) developed by iiSBE (international initiative for a Sustainable Built Environment). The SBEMethod is a generic multi-criteria analysis methodology for assessing the sustainability of the built environment. Starting from a set of assessment entries (criteria), the SBEMethod provides a final concise score about a building, urban area or territory overall performance. The SBEMethod [Moro 2017] constitutes the reference assessment methodology for the CESBA MED SN Generic Framework.

The SBEMethod [Moro 2017] is organized in:

- Issues (describe general themes for sustainability assessment)
- Categories (address particular aspects of issues)
- Criteria (detail specific aspects of categories).



Each issue includes a different number of categories, each one of them describing a specific aspect of the issue that it belongs to. Categories include different criteria, each of them describing a particular aspect of the corresponding category. Criteria represent the basic assessment entries used to characterize an urban area from the very beginning of the assessment process. The indicators quantify the performance with respect to each criterion. In principle, several indicators can be associated with the same criterion, since one can define multiple strategies to quantify the urban area performance with regard to a specific criterion. However, in most cases, each criterion is generally associated with a single indicator. A final concise score summarizes the overall performance of an urban area with respect to all criteria. The score is computed starting from indicator values following an assessment procedure that is based on three main steps, i.e. characterization, normalization and aggregation step. The relevant procedures are detailed in D3.3.1 [Moro 2017].

5. References

Barbano G., N. Eßig, P. Mittermeier, M. Orova, P. Beagon, L. Claudi, J.F. Gómez-Salcedo, F. Kiedaisch (2016). Definition of sustainable Key Performance Indicators, NEWTREND Project, H2020 Program, European Commission. http://newtrend-project.eu/wp-content/uploads/2015/11/NewTREND_WP2_D2.2_KPI_GB04_V5.2.pdf

Moro A. (2017). CESBA MED D3.3.1 Testing Protocol, CESBA MED Consortium, Marsaille.

CABEE http://www.cabee.eu

CAT MED http://www.catmed.eu

CEC5 http://wiki.cesba.eu/wiki/CEC5

CLUE http://www.clue-project.eu

ENERBUILD http://www.enerbuild.eu

EPISCOPE http://www.episcope.eu

FASUDIR http://fasudir.eu

IRH-MED http://wiki.cesba.eu/wiki/IRH_med

NewTREND http://newtrend-project.eu

OpenHouse http://www.openhouse-fp7.eu

SuPerBuildings http://cic.vtt.fi/superbuildings

Eco-Quartier http://www.eco-quartiers.fr

Protocollo ITACA http://wiki.cesba.eu/wiki/Protocollo_Itaca

QDM http://www.envirobatbdm.eu/baroque

Appendix A

OVERVIEW OF

PROJECTS & ASSOCIATED INDICATORS

A.0 - Template for Project/Indicator presentations

Project funding source (logo)

PROJECT ACRONYM

Full project name

Project website

Project logo

Provide a short general project description (less than 200 words). Outline objectives and achieved results, state period and source of funding.

INDICATORS

<table>
<tr><td rowspan="3">XXX.XX.XX</td><td colspan="6">Performance indicator name (units)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">e.g. Environment</td><td colspan="2">e.g. Energy</td><td>B-Basic / S-Standard / A-Advanced</td><td>B-Building N-Neighborhood</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Provide a general description of the indicator, explain what it represents and how it is used</td></tr>
<tr><td>Background</td><td colspan="6">State whether this indicator has been adopted from a previous project; in such a case name the project and give a valid reference for it</td></tr>
<tr><td>References</td><td colspan="6">Give valid references for English speaking readers to get further insight on the indicator. Supply references as numbers in brackets. The corresponding full reference will be supplied in the section “REFERENCES”.</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from
(Check – X - as appropriate)</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Provide details to justify the “Level” characterization (basic/standard/advanced) of the indicator given in the appointed space above. Provide information regarding the complexity of the methodology that is followed in order to derive the indicator. If it is a software tool output, describe the complexity of the tool and refer to its cross-national availability.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Highlight the main areas that are covered by the indicator and those that are not. Give the necessary information (areas covered/limitations) to highlight the added value of the indicator approach under the specific project, and if known, as opposed to the one(s) proposed in other projects
This information will be helpful especially if there are more than one projects proposing different approaches for the same indicator,</td></tr>
<tr><td>Barriers</td><td colspan="6">Discuss the difficulties encountered while assessing/applying the indicator. Refer to its transnational applicability.</td></tr>
<tr><td>Rating</td><td colspan="6">Provide information on existing rating schemes for the indicator</td></tr>
<tr><td>References</td><td colspan="6">Give valid references for English speaking readers to get further insight on the methodology that is followed to derive the indicator. Include reference numbers here. Provide full references under “REFERENCES” section.</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Provide the range of existing examples from the application of the indicator to justify its classification as small (building) or large (neighbourhood) scale.</td></tr>
<tr><td>Details</td><td colspan="6">Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.</td></tr>
<tr><td>Multiscale</td><td colspan="6">Discuss whether it is possible or not to extrapolate the indicator result from single building to a group of buildings of similar function</td></tr>
<tr><td>References</td><td colspan="6">Give valid references for English speaking readers to get further insight on existing applications of the indicator in pilot studies. Supply references as numbers in brackets. The corresponding full reference will be supplied in the section “REFERENCES”.</td></tr>
<tr><td colspan="7">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="6">Publication reference (see example A.6 for format style) Provide web source(if available): http://....</td></tr>
<tr><td>[2]</td><td colspan="6"></td></tr>
</table>

A.1 - CABEE

CABEE

Capitalizing Alpine Building Evaluation Experiences

http://www.cabee.eu/

CABEE was a transnational Alpine project to create and implement an Alpine-wide guideline for definition, procurement, production, assessment and promotion as well as learning about new and refurbished Nearly-Zero-Emission-Buildings (NZEB) and their neighbourhoods.

CABEE capitalized information from finished and ongoing EU-projects but also projects from the Alpine Space program. It focused on a mass oriented approach with low entry barriers and an on-going Open-Source support. Pilot activities were settled on public tendering, users' behaviour and toward a 100% eco-assessment approach. The integration of micro smart energy grids was explored.

Furthermore, markets for NZEBs have been prepared, especially in cooperation with public authorities and SMEs.

CABEE harmonized existing tools and policies and formulated a common transnational Alpine-wide Guideline - CESBA - for buildings and a Knowledge-Hub, which has exceed the project life time, the CESBA Wiki. All results of CABEE can be downloaded from the CESBA wiki.

In the CABEE pilot projects, only 15 'must' indicators have been tested on all the pilots. The others have been tested only on some pilot depending on the contextualization.

Then, we only give here details of the 15 'Must' indicators that have really been tested and 9 indicators that are not in other projects/tools.

ISSUE/Category	criterion name	indicator
ENV-En 4	Electric energy and Virtual power systems (VPS)	percentage of appliances connected to the VPS
ENV-En 12	Primary Energy for Heating	percentage of PE compared to law limit
ENV-En 11	Primary Energy for Cooling	percentage of PE compared to law limit
ENV-En 13	Primary Energy for Public Lighting	percentage of PE compared to law limit
ENV-Im 14	Intensity of GHG emissions	percentage of GHG emissions over the average
ENV-Im 3	Access to waste sorting facilities	users within walking distance from sorting facilities
ENV-Im 13	Impact on surrounding Buildings	quality reduction of neighbouring buildings and areas
ENV-LU 6	Preservation of land	Ratio of previously used land over

		total
ENV-Wa 2	Intensity of Rainwater Usage	ratio of collected and consumed rainwater
SOC-TR 7	Internal Accessibility (public transport)	district accessibility index
SOC-Tr 13	Shared mobility	inhabitants with access to shared mobility
SOC-Ac 11	Proximity to services	ratio of inhabitants within 300 m over total
SOC-Ac 8	Collective facilities and outsourcing of services	inhabitants within 50 m of communal housing services
SOC-Ac 9	Flexibility of residential buildings	percentage of living surface with flexible floor plans
SOC-Ac 1	Access to a broadband communication network	ratio of inhabitants with broadband access
SOC-Ac 13	Social gatherings and common cluster activities	established services and social gatherings
SOC-TC 3	Exploitation of local resources: sun, daylight, wind	points for outdoor numerical simulations present
SOC-SS 3	Local production of food	surface of garden areas per capita
SOC-SS 5	Objective/subjective safety measures	number of established safety measures
FIN-Va 2	Economic advantage of cluster in comparison to single buildings	cost reduction through common strategies
FIN-Qu 5	Process and planning quality	points depending on planning activity report
FIN-Qu 6	Risk management	synergies with risk management plan
FIN-Ma 1	Communication and information management	ratio of informed/trained adult inhabitants
FIN-Ma 4	Synergy management	synergies with management plan

INDICATORS

ENV.En.23	Electric energy and Virtual power systems (%)					
	ISSUE	CATEGORY		LEVEL	SCALE	
	Environmental	Energy		S	N	
GENERAL						
Description	Intent: Optimize electric energy management within the building cluster. Indicator: Percentage of electric appliances connected to the virtual power system Unit of measure: %					
Background	CABEE Cluster Tool					
References	This indicator was experimented in CABEE project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	Assessment method: A virtual power system integrates two existing concepts of Virtual Power Plant (VPP) and Virtual Power Load (VPL). It combines load, storages and generations into a single aggregation. For the documentation of the VPS use the template from Alpenergy project (www.alpenergy.net).					
Areas covered	VPS concerns all types of building and all sizes of areas.					
Barriers	Two main barriers for this indicator : - Only few areas have a VPS system - It's very difficult to evaluate the existing appliances and more over wich ones are connected to the VPS					
Rating	Score: The score for this indicator is 20. Assign 20 points if all the electric appliances are connected to the VPS and 0 points if none of them is connected. Determine the other scores proportionally.					
References	This indicator was experimented in CABEE project [1], [2] and Alpenergy project{3]					
SCALE						
Application	This indicator can be used for buildings but is more adapted for building clusters or wider areas.					
Details	The interest of the indicator is to evaluate the capacity to share production and adapt it to the consumption. For this, you need to have various production plants and also various types of consumption that you can manage to create a virtual load.					
Multiscale	The calculation can be done at building level if power plants exists but a real efficiency need different power plants and different consumptions profile.					
References	[1], [2]], [3]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf
[3]	http://alpenergy.net/images/stories/White_Book_VPS.pdf

ENV.En.14	Primary energy for cooling (%)					
	ISSUE	CATEGORY		LEVEL		SCALE
	Environmental	Energy		S		N
GENERAL						
Description	Intent: Reduce the need of energy for cooling. Indicator: Percentage of primary energy under the limit. Unit of measure: %					
Background	CABEE Cluster Tool					
References	This indicator was experimented in CABEE project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	Assessment method: To assess this criterion, estimate (via project assumptions, or via actual data if available) the cooling primary energy requirement of every building in the cluster [kWh/m2]. Aggregate these values through a weighted mean over the floor surfaces, to obtain a cluster value. Divide the cluster heating primary energy requirement by the local limit and multiply by 100 to obtain the performance as a percentage ratio.					
Areas covered	Cluster composed of the same types of buildings. The values are different for each type of building and thus the building group must be composed of only one type of building. Concerning the different thermal regulations and calculations in different countries, the absolute values are not comparable but the ratio is comparable.					
Barriers	Two main barriers for this indicator : - the consumption calculation and requirement available includes not only cooling demand. Thus it could be complicated to find just the cooling demand and the corresponding requirement. - the requirements are different for each type of building and then if the cluster is composed of different types of buildings, the ratio cannot be compared with any requirement To solve this problem, an average requirement can be established for the Cluster or the indicator can be the average of the % of each building.					
Rating	Score: The score for this indicator is 40. Assign 40 points if the result, evaluated through the assessment method, is equal or less than the 25% of the local limit. For example, if the limit is 100 kWh/m2 to reach the maximum score, the cluster energy performance has to be equal or lower than 25 kWh/m2. Assign 0 points if the cluster energy performance is equal or higher than the local limit. Determine the other scores proportionally.					
References	This indicator was experimented in CABEE project [1], [2]					
SCALE						
Application	This indicator is specific for building clusters even if it is based on individual building values.					
Details	The interest of the indicator is to evaluate not the efficiency of each building but the global efficiency of the group of buildings.					
Multiscale	The calculation is based on the performance of each building but the interest of the global performance is to have an average value. For example, some new buildings can be very efficient and some old buildings not so efficient but the result is that the cluster can be more efficient (or not !) than the requirement even if all the buildings don't reach the requirement.					
References	[1], [2]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

<table>
<tr><td rowspan="3">ENV.En.15</td><td colspan="4">Primary energy for heating (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Energy</td><td>S</td><td>N</td></tr>
</table>

GENERAL	
Description	Intent: Reduce the need of energy for heating. Indicator: Percentage of primary energy under the limit. Unit of measure: %
Background	The target percentage for the cluster energy performances is set according to the objectives promoted by the European Commission within the Program Horizon 2020
References	This indicator was experimented in CABEE project [1], [2]
LEVEL	

Derived from						
	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	Assessment method: To assess this criterion, estimate (via project assumptions, or via actual data if available) the heating primary energy requirement of every building in the cluster [kWh/m2]. Aggregate these values through a weighted mean over the floor surfaces, to obtain a cluster value. Divide the cluster heating primary energy requirement by the local limit and multiply by 100 to obtain the performance as a percentage ratio.
Areas covered	Cluster composed of the same types of buildings. The values are different for each type of building and then the building group must be composed of only one type of building. Concerning the different thermal regulations and calculations in different countries, the absolute values are not comparable but the ratio is comparable.
Barriers	Two main barriers for this indicator : - the consumption calculation and requirement available includes mostly not only heating demand. Then it could be complicated to find just the heating demand and the corresponding requirement. - the requirements are different for each type of building and then if the cluster is composed of different types of buildings, the ratio cannot be compared with any requirement To solve this problem, an average requirement can be established for the Cluster or the indicator can be the average of the % of each building.
Rating	Score: The score for this indicator is 40. Assign 40 points if the result, evaluated through the assessment method, is equal or less than the 25% of the local limit. For example, if the limit is 100 kWh/m2 to reach the maximum score, the cluster energy performance has to be equal or lower than 25 kWh/m2. Assign 0 points if the cluster energy performance is equal or higher than the local limit. Determine the other scores proportionally.
References	This indicator was experimented in CABEE project [1], [2]
SCALE	
Application	This indicator is specific for building clusters even if it is based on individual building values.
Details	The interest of the indicator is to evaluate not the efficiency of each building but the global efficiency of the group of buildings.
Multiscale	The calculation is based on the performance of each building but the interest of the global performance is to have an average value. For example, some new buildings can be very efficient and some old buildings not so efficient but the result is that the cluster can be more efficient (or not !) than the requirement even if all the buildings don't reach the requirement.
References	[1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

<table>
<tr><td rowspan="3">ENV.En.16</td><td colspan="6">Primary energy for public lighting (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Energy</td><td>S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Intent: Reduce the need of energy for public lighting.
Indicator: Percentage of primary energy over the limit.
Unit of measure: %</td></tr>
<tr><td>Background</td><td colspan="6">CABEE Cluster Tool</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td>X</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Assessment method: To assess this criterion, estimate (via project assumptions, or via actual data if available) the public lighting primary energy requirement of all public areas in the cluster [kWh/m2]. Aggregate these values through a weighted mean over the floor surfaces, to obtain a cluster value.
Divide the cluster public lighting primary energy requirement by the local limit and multiply by 100 to obtain the performance as a percentage ratio.</td></tr>
<tr><td>Areas covered</td><td colspan="6">All types of building cluster areas.</td></tr>
<tr><td>Barriers</td><td colspan="6">Estimating the public lighting consumptions is not so easy. If the number of lighting points is quite easy to find, the estimation of the consumption needs to know the power of each lighting points and the average lighting hours.</td></tr>
<tr><td>Rating</td><td colspan="6">Score: The score for this indicator is 40. Assign 40 points if the result, evaluated through the assessment method, is equal or less than the 25% of the local limit.
For example, if the limit is 100 kWh/m2 to reach the maximum score, the cluster energy performance has to be equal or lower than 25 kWh/m2. Assign 0 points if the cluster energy performance is equal of higher than the local limit. Determine the other scores proportionally.</td></tr>
<tr><td>References</td><td colspan="6">[1], [2]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">This indicator is specific for building clusters.</td></tr>
<tr><td>Details</td><td colspan="6">This indicator is specific for building clusters as it concerns the areas between the buildings and not the buildings themselves.</td></tr>
<tr><td>Multiscale</td><td colspan="6">-</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
</table>

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

ENV.Im.26	**Accessibility to waste sorting facilities (%)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Environmental	Impacts		S		B / N
GENERAL						
Description	Intent: It aims to increase recycling quota and raise residents' awareness of source separation and recycling. Indicator: Percentage of users located at less than 50 m from waste sorting facilities. Unit of measure: %					
Background	CABEE Cluster Tool					
References	This indicator was experimented in CABEE project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	Assessment method: To assess this criterion, calculate the amount of users who have access to waste sorting facilities in the same building or in its immediate vicinity. Consider only waste sorting facilities which are connected to a waste management plan at cluster scale or wider. Quantify also efforts relating to waste avoidance and recycling through information and educational campaigns.					
Areas covered	All types of building groups.					
Barriers	The access to waste sorting facilities has not the same signification/influence for enterprises (mostly the waste management is included in a 'cleaning service') and for housing (people are directly involved. So if you have a group of building composed of tertiary and housing building, the result will be difficult to compare to a housing or a tertiary building cluster ratio. It can also be complicated to calculate the number of users for each building especially for the tertiary buildings or for example for shops or public services.					
Rating	Score: The score for this indicator is 15. Assign 15 points if the result of the evaluation is equal to 100% and 0 points if none of the inhabitants has easy access to waste sorting. Determine the other scores proportionally.					
References	This indicator was experimented in CABEE project [1], [2]					
SCALE						
Application	This indicator is not specific for building clusters. It can be calculated for each building.					
Details	This indicator is just the sum or the average value of all the building that composed the building group. The interest of the indicator is to evaluate on one side the efficiency for each building and the global efficiency of the group of buildings.					
Multiscale	The interest of the indicator is to evaluate on one side the efficiency for each building and the global efficiency of the group of buildings.					
References	This indicator was experimented in CABEE project [1], [2]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

ENV.Im.02	Impacts on surrounding buildings (%)						
	ISSUE		CATEGORY		LEVEL		SCALE
	Environmental		Impacts		S / A		N
GENERAL							
Description	Intent: Quantify the impact on surrounding buildings. Indicator: Percentage of quality reduction of neighbouring buildings and areas. Unit of measure: -						
Background	CABEE Cluster Tool						
References	This indicator was experimented in CABEE project [1], [2]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements		
	Simple Calculations	X	Empirical/Literature		Other (specify)		
Details	Assessment method: Environmental measures should not have negative effects on surrounding buildings and clusters. The impacts of shading, wind, vegetation, transport through established synergies should not influence negatively neighbouring buildings and areas outside the cluster boundary.						
Areas covered	Cluster composed of the same types of buildings.						
Barriers	This indicator can be based on standard calculation only if the impact is define as qualitative evaluation and not quantitative. The quantitative evaluation of the impact of surrounding building is complicated because it needs studies for different types of impacts which can be complicated to do. For example impact of shading or ventilation is difficult to calculate (see indicator Soc TC 3)						
Rating	Score: The maximum score for this indicator is 15. Assign: 15 if the cluster does not affect the comfort of surrounding area 7 if the cluster slightly affects the comfort of surrounding area 0 if the cluster influences negatively the existing surroundings						
References	This indicator was experimented in CABEE project [1], [2]						
SCALE							
Application	This indicator is specific for building clusters.						
Details	The interest of the indicator is to evaluate not the impact of each single building but the global impact of the group of buildings.						
Multiscale	-						
References	This indicator was experimented in CABEE project [1], [2]						

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

<table>
<tr><td rowspan="3">ENV.Im.12</td><td colspan="6">Intensity of GHG emissions (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Impacts</td><td>S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Intent: Reduce the per capita emission of CO2.
Indicator: Percentage of GHG emissions over the average.
Unit of measure: %</td></tr>
<tr><td>Background</td><td colspan="6">CABEE Cluster Tool</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td>X</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Assessment method: To assess this criterion, estimate (via project assumptions, or via actual data if available) the overall energy demand of the cluster as per the previous criteria. Associate each component to the CO2 emission factor corresponding to its vector [kg CO2 / kWh]. For each component, multiply the energy demand [kWh / m2] for its emission factor, to obtain the amount of CO2 emissions [kg CO2/ m2]. Sum all emissions from all components to obtain the overall CO2 emissions of the cluster.
To obtain a relative performance, calculate the comparison metric as the average CO2 emissions as follows:
Consider as energy demands the local limits as defined by laws, and define a credible scenario for the energy vectors (as the common choices available in the region).
Calculate as average the amount of CO2 emissions the cluster would have if its energy demands corresponded to the limits, using the common energy vectors (and their emission factors), as above.
The relative performance is thus calculated by dividing the actual performance by the emissions of the average scenario, and multiplying by 100 to obtain a percentage value.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Cluster composed of the same types of buildings. The values are different for each type of building and thus the building group must be composed of only one type of building. Concerning the different thermal regulations and calculations in different countries, the absolute values are not comparable but the ratio is comparable.</td></tr>
<tr><td>Barriers</td><td colspan="6">The requirements are different for each type of building and thus if the cluster is composed of different types of buildings, the ratio cannot be compared with any requirement.
To solve this problem, an average requirement can be established for the Cluster or the indicator can be the average of the % of each building.</td></tr>
<tr><td>Rating</td><td colspan="6">Score: The score for this indicator is 40. Assign 40 points if the result, evaluated through the assessment method, is equal or less than the 25% of the local limit.
For example, if the limit is 100 kWh/m2 to reach the maximum score, the cluster energy performance has to be equal or lower than 25 kWh/m2. Assign 0 points if the cluster energy performance is equal of higher than the local limit. Determine the other scores proportionally.</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">This indicator is specific for building clusters even if it is based on individual building values.</td></tr>
<tr><td>Details</td><td colspan="6">The interest of the indicator is to evaluate not the efficiency of each building but the global efficiency of the group of buildings.</td></tr>
<tr><td>Multiscale</td><td colspan="6">The calculation is based on the performance of each building but the interest of the global performance is to have an average value. For example, some new buildings can be very efficient and some old buildings not so efficient but the result is that the cluster can be more efficient (or not !) than the requirement even if all the buildings don’t</td></tr>
</table>

	reach the requirement.
References	This indicator was experimented in CABEE project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

ENV.LU.02	**Preservation of land and soil (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Land Use	B	B / N

GENERAL	
Description	Intent: Reduce land consumption by using already contaminated or occupied areas for building construction. Indicator: Re-use of previously occupied and contaminated land for buildings and infrastructure.
Background	CABEE Cluster Tool
References	This indicator was experimented in CABEE project [1], [2]
LEVEL	

Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	Assessment method: To assess this criterion, assign to each homogeneous part of the cluster a weight as follows undisturbed land weight = -1 agricultural land weight = 0 occupied land weight = 3 contaminated land weight = 5 Multiply each surface area by its weight and sum the weighted values. Divide the weighted sum by the total area of the cluster. The result will be a number between -1and 5.
Areas covered	This criteria can be used for all types of buildings.
Barriers	There are no barriers to use this criteria in all countries and situations.
Rating	Rating was not in the scope of the CABEE project. A scoring has been used just based on partners' agreement Score: The maximum score for this indicator is 15. Assign 15 points if the calculated value is equal or higher than 4 and 0 points if it is equal or less than 1. Determine the other scores proportionally.
References	This indicator was experimented in CABEE project [1], [2]
SCALE	
Application	The use of land can be used as much for building and for a group of building.
Details	The scoring as a % makes it comparable at both scale.
Multiscale	It is possible to extrapolate from building level to building cluster level. You just have to sum the weighted areas for each building and divide them by the total surface.
References	This indicator was experimented in CABEE project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

ENV.Wa.06	**Intensity of rainwater usage (%)**						
	ISSUE		**CATEGORY**		**LEVEL**		**SCALE**
	Environmental		Water		S		N
GENERAL							
Description	Intent: Maximize the use of rainwater. Indicator: Rainwater collected in the zone for landscape irrigation and WC flushing and laundry. Unit of measure: %						
Background							
References	This indicator was experimented in CABEE project [1], [2]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements		
	Simple Calculations	X	Empirical/Literature		Other (specify)		
Details	Assessment method: To assess this criterion, calculate the volume of rain water storage tanks (as a project estimate or through actual data, if available). Divide this amount by the maximal storage tank volume for all cluster necessities.						
Areas covered	All types of building groups.						
Barriers	The water consumption is different for each type of building use and the estimation of the maximal storage tank volume can be sometimes complicated.						
Rating	Score: The score for this indicator is 15.Assign 15 points if the result of the evaluation is equal to 100%, and if it is equal to 0%, assign 0 points. Determine the other scores proportionally.						
References	This indicator was experimented in CABEE project [1], [2]						
SCALE							
Application	This indicator is specific for building clusters even if it is based on individual building values.						
Details	The interest of the indicator is to evaluate not the efficiency of each building but the global efficiency of the group of buildings.						
Multiscale	The calculation is based on the water consumption of each building but the interest of the global performance is to have an average value. For example, some buildings with big roofs can collect more water than they use and some old buildings cannot collect any water but the result is that the cluster can be more efficient (or not !) than the requirement even if all the buildings don't reach the requirement.						
References	This indicator was experimented in CABEE project [1], [2]						

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
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<table>
<tr><td rowspan="3">SOC.Ac.02</td><td colspan="4">Access to a broadband communication network (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Accessibility</td><td>S</td><td>N</td></tr>
</table>

<table>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Intent: To ensure occupants access to high-speed Internet connections.
Indicator: Percentage of population with access to broadband communication.
Unit of measure: %</td></tr>
<tr><td>Background</td><td colspan="6">CABEE Cluster Tool</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td>X</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Assessment method: To assess this criterion, 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 cluster.</td></tr>
<tr><td>Areas covered</td><td colspan="6">This criteria is for housing buildings.</td></tr>
<tr><td>Barriers</td><td colspan="6">The estimation of the occupancy can be complicated. In a first level of calculation the % of connected dwellings can be used.</td></tr>
<tr><td>Rating</td><td colspan="6">Score: The score for this indicator is 20. Assign 20 points if all the population in the cluster has access to broadband communication and 0 points if none of them has the access. Assign the other scores proportionally.</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">This indicator is specific for building groups.</td></tr>
<tr><td>Details</td><td colspan="6">The high speed internet connection is for one whole building and the interest of the indicator is to evaluate the buildings and their users that are connected.</td></tr>
<tr><td>Multiscale</td><td colspan="6">One building is connected or not. Then the % of access is the sum of the users of the connected buildings.</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
</table>

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

<table>
<tr><td rowspan="3">SOC.Ac.15</td><td colspan="6">Collective facilities and outsourcing of services (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Social</td><td colspan="2">Accessibility</td><td>S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Intent: To reduce housing costs for all users, and to maximize resource consumption in the cluster.
Indicator: Percentage of users located at less than 50 m from communal housing services.
Unit of measure: %</td></tr>
<tr><td>Background</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td>X</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Assessment method: Several household services can be moved from the private dwellings to communal areas, in order to reduce the square footage needed by the inhabitants and to optimize the consumption of soil, energy, and water in the cluster. This criterion allows verify the amount of users who have access to communal facilities in the same building or in its immediate vicinity.
Some example facilities include: laundry, meeting rooms, co-working office space, leisure time areas, dining hall, kitchen and gym.</td></tr>
<tr><td>Areas covered</td><td colspan="6">All types of building clusters can be evaluated.</td></tr>
<tr><td>Barriers</td><td colspan="6">The indicators just assess the presence of at least one of the services and don't give additional points to multiple services. The evaluation of the proximity of the dwellings seems to be easier than the evaluation of the inhabitants that needs to know the number of inhabitants per dwelling.</td></tr>
<tr><td>Rating</td><td colspan="6">Score: The score for this indicator is 20. Assign 20 points if all the inhabitants have communal housing services located at less than 50 m, assign 0 points if none of them has easy access to common facilities. Determine the other scores proportionally.</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">This indicator is specific for building groups as it concerns common services established for the group of buildings</td></tr>
<tr><td>Details</td><td colspan="6"></td></tr>
<tr><td>Multiscale</td><td colspan="6">Basically, because of the calculation based on a distance, the calculation has to be done for each building and the result is the sum of the building results.</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
</table>

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

SOC.Ac.03	**Flexibility of residential buildings (%)**					
	ISSUE	**CATEGORY**		**LEVEL**	**SCALE**	
	Social	Accessibility		S	B / N	
GENERAL						
Description	Intent: Provide functional flexibility for residential buildings, in order to adapt them to living changes and to age of inhabitants. Growing and shrinking of families as well as multigenerational living arrangements should be taken into account. Indicator: Percentage of living surface with flexible floor plans and foreseen adaptable spaces. Unit of measure: %					
Background	CABEE Cluster Tool					
References	This indicator was experimented in CABEE project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature	*X*	Other (specify)	
Details	Assessment method: When dealing with major interventions (new construction and refurbishment), functional flexibility has to be taken into account. Floor plans with multi-generational concepts (i.e. adaptation of floor plan depending on family size, separate access for apartments, barrier free accesses and sanitary installation) allow a long term usage of apartments and contribute to a sustainable living concept. To assess this criterion, identify residential areas with adaptable floor plans and calculate the percentage of the total living area.					
Areas covered	Housing buildings					
Barriers	The type of activities concerned by the indicator is not very detailed and then the evaluation of the number of activities will not be very objective.					
Rating	Score: The score for this indicator is 20. Assign 20 points if all the residential areas have adaptable floor plans and 0 points if there are no spaces with adaptable plan. Determine the other scores proportionally.					
References	This indicator was experimented in CABEE project [1], [2]					
SCALE						
Application	This indicator is for building groups but it can also be used for buildings.					
Details						
Multiscale	Basically, the calculation can be done for each building and the result is the weighted sum of the building results.					
References	This indicator was experimented in CABEE project [1], [2]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

<table>
<tr><td rowspan="3">SOC.Ac.19</td><td colspan="6">Proximity to services and leisure facilities (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Social</td><td colspan="2">Accessibility</td><td>S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Intent: To reduce the need for vehicular transport outside the cluster.
Indicator: Percentage of users located at less than 300 m from the main services. For rural cluster villages, the score is assigned according to the available services and facilities within the cluster boundaries.
Unit of measure: %</td></tr>
<tr><td>Background</td><td colspan="6">CABEE Cluster Tool</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td>X</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Assessment method: To assess this criterion, it is necessary to identify all the main services located in the cluster and outside of it (only the nearest instance). Graphically, overlay to each of these services a circle with a 300 m radius. Calculate how many users are served by these services, by verifying which buildings are included in the radius of all the services.
Possible services include: primary schools, health facilities (primary care, emergency services and chemist’s), grocery shopping, public services (post office, libraries)
Possible leisure facilities include: theatres, museums, port halls. Calculate the percentage of service users of all the considered services
For rural village cluster consider all the services within the analysed boundary and assign a score according to the classes reported in the following table.
Class 19 — Class 2
Local food shop — Children's play area
Primary school — Postal facility
Outdoor public access area — Bank/cash machine
Leisure centre/sport centre — Chemist’s
Medical centre/doctor</td></tr>
<tr><td>Areas covered</td><td colspan="6">This criteria can be calculated for all type of building cluster.</td></tr>
<tr><td>Barriers</td><td colspan="6">The graphical determination of the buildings included in the services area is quite complicated and implies to identify and locate all services you want to include. Some services include in the building Cluster are not always dedicated for it.
It can also be complicated to calculate the number of users for each building especially for the tertiary buildings or for example for shops or public services.</td></tr>
<tr><td>Rating</td><td colspan="6">Score: The maximum score for this indicator is 20. If the considered service supplies all of the cluster inhabitants assign:
? 8 points for each service belonging to Class 1
? 6 points for each service belonging to Class 2
Class 19 — Class 2
Local food shop — Children's play area
Primary school — Postal facility
Outdoor public access area — Bank/cash machine
Leisure centre/sport centre — Chemist’s
Medical centre/doctor</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
</table>

SCALE	
Application	This indicator is specific for building clusters.
Details	The indicator is based on the services included in the building cluster and not on the buildings themselves.
Multiscale	-
References	This indicator was experimented in CABEE project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

<table>
<tr><td rowspan="3">SOC.Ac.20</td><td colspan="4">Social gatherings and common cluster activities (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Accessibility</td><td>S</td><td>N</td></tr>
</table>

GENERAL						
Description	Intent: Establish common services and social gatherings. Indicator: Number of established services and social gatherings. Unit of measure: -					
Background						
References	This indicator was experimented in CABEE project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	*X*	Other (specify)	
Details	Assessment method: The criterion evaluates the number of services and activities which have been established for the cluster. Mobility concepts like car sharing, bike sharing are taken into account, sustainable food acquisition, time bank activities for providing cooperation between neighbours.					
Areas covered	All types of building clusters can be evaluated.					
Barriers	The type of activities concerned by the indicator is not very detailed and then the evaluation of the number of activities will not be very objective.					
Rating	Score: The score for this indicator is 25. Assign 5 points for each service and activity.					
References	This indicator was experimented in CABEE project [1], [2]					
SCALE						
Application	This indicator is specific for building groups as it concerns common services established for the group of buildings					
Details						
Multiscale						
References	This indicator was experimented in CABEE project [1], [2]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

SOC.SS.02	**Local production of food (m²/inhabitant)**						
	ISSUE		**CATEGORY**		**LEVEL**	**SCALE**	
	Social		Safety and Security		S	N	
GENERAL							
Description	Intent: Encourage the production of fresh fruit and vegetables Indicator: Surface of garden areas per capita. Unit of measure: m²/inhabitant						
Background	CABEE Cluster Tool						
References	This indicator was experimented in CABEE project [1], [2]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements		
	Simple Calculations	X	Empirical/Literature	*X*	Other (specify)		
Details	Assessment method: To assess this criterion, calculate the surface of vegetable gardens available to the users in the clusters and divide it by the number of inhabitants.						
Areas covered	Only for housing building clusters						
Barriers							
Rating	Score: The score for this indicator is 25. Assign 25 points if the surface of the vegetable garden area is 10 m2 for each family unit and 0 if the there are no green area. Determine the other scores proportionally.						
References	This indicator was experimented in CABEE project [1], [2]						
SCALE							
Application	This indicator is specific for building groups as it concerns common gardens for the group of buildings						
Details							
Multiscale							
References	This indicator was experimented in CABEE project [1], [2]						

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

SOC.SS.01	**Objective/ subjective safety measures (-)**					
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**		
	Social	Safety and Security	S	N		
GENERAL						
Description	Intent: Provide objective and subjective safety to cluster users. Indicator: Number of established safety measures. Unit of measure: -					
Background						
References	This indicator was experimented in CABEE project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	*X*	Other (specify)	
Details	Assessment method: To assess this criterion, count established safety measures which can be related to autonomous energy supply, fire alarm systems, alarm system with presence detectors.					
Areas covered	All types of building clusters can be evaluated.					
Barriers						
Rating	Score: The score for this indicator is 25. Assign 5 points for each safety measure.					
References	This indicator was experimented in CABEE project [1], [2]					
SCALE						
Application	The indicator concerns collective measures for the building cluster.					
Details	The interest of the indicator is not to sum the measures in each building but to evaluate the common measures at building cluster level.					
Multiscale						
References	This indicator was experimented in CABEE project [1], [2]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

SOC.TC.04	Exploitation of local resources: sun, daylight, wind (-)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Thermal Comfort	A	N

GENERAL	
Description	Overheating of buildings can be avoided by detailed planning and appropriate dimensions of transparent surface, glazing properties and shading systems. Within a building cluster the erection of new buildings, enlargements of buildings or demolition of building parts can change the solar radiation on surrounding buildings. Trees can provide shading on buildings and should be planned in accordance with the whole building cluster. Vegetation can alleviate the urban heat island effect, and reduce functioning of air-conditioning and energy consumption. Energy refurbishments and extension can have influences on daylight availability of neighbouring buildings too. Mostly daylight is reduced when new construction is erected, but also positive effect can be reached. Thus, for example, application of an external thermal insulation on a building with application of a new light colored plaster can increase light reflection on neighbouring buildings and allow better daylight conditions. When new buildings are erected, based on the local dominant wind direction, ventilation corridors or ventilation barriers can appear. The artificial surfaces affect urban natural ventilation and the formation of urban wind environment. Therefore, observations of the local climate conditions should be done, the wind direction and wind speed in planning considered. Natural ventilation is a simple and way to alleviate urban heat island effect. Intent: Exploit the local resources and predict the effects interventions into the building cluster. Indicator: Numerical simulation of cluster for urban interventions and building design. Unit of measure: -
Background	CABEE Cluster Tool
References	This indicator was experimented in CABEE project [1], [2]

LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	

Details	Assessment method: Elaboration of a digital model of the building cluster with analysis of shadings, daylight, natural ventilation, and effects of interventions like erections of new buildings or planting trees.
Areas covered	All types of building clusters can be assessed
Barriers	The elaboration of a digital model needs specific tools and skills that only few people have especially for ventilation effects. The price of such a simulation is therefore high.
Rating	Score: The score for this indicator is 25. Assign points if a numerical simulation model of the building cluster was elaborated: 10 points for daylighting and shadings model 10 points for natural ventilation simulation 5 points for simulations related to the effects of interventions If there is no simulation, assign 0 points.
References	This indicator was experimented in CABEE project [1], [2]
SCALE	
Application	As the indicator is related to the influence of the buildings on the others, it's specific for building clusters
Details	The indicator is a global analyse of the influence of each building on all other buildings.

Multiscale	-
References	This indicator was experimented in CABEE project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

<table>
<tr><td rowspan="3">SOC.Tr.18</td><td colspan="6">Accessibility to public transport, Lense index (-)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Social</td><td colspan="2">Transport</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Intent: Reduce the use of private vehicles.
Indicator: Accessibility to public transport index.
Unit of measure: -
This indicator uses an index called Lense index to evaluate the accessibility of public transport taking into account the walk distance to nodes and the frequency of the buses/train/tram.</td></tr>
<tr><td>Background</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2], [3]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td>X</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Assessment method: For each building in the cluster, calculate the accessibility index as follows [LEnSE methodology]. Then, calculate the average accessibility index of the cluster as a weighted average on the number of users per building.

Step 1: Walking distance to public transport nodes
Determine the walking distance from the building's main entrance to each public transport node served by rail, bus or tram. Use a notional walking speed of 80 meters per minute. Do not consider nodes that are further than a 500 m radius of the building for bus/tram and 1000 m for rail.
Note:
1. For nodes within the radius that are served by the same service/route consider only the closest node, i.e. do not consider multiple nodes which are on the same route.
2. The distance must be measured as it would be travelled on foot, i.e. do not measure in a straight line over inaccessible objects such as buildings or rivers.

Step 2: Frequency of service at each node
 For each node that meets the requirements in step 1, determine the total number of services departing/arriving at each node in the following periods for a typical weekday: AM 08.00 – 10.00 PM 17.00 – 19.00
 For domestic buildings, consider the number of services departing/arriving at each node in the following periods for a typical weekday and on a Saturday: Weekday: AM 08.00 – 10.00 PM 17.00 – 19.00, Saturday: 08.00AM – 19.00PM

Note:
1. For nodes that have multiple routes, determine the frequency of service for each route and not a collective nodal frequency.
2. It is likely that each route at a node will be bi-directional, consider only the route in the direction with the highest frequency of service.
3. For trains consider only those routes that have at least two stops within a 20 km radius of the development (Including the stop nearest to the building).

Step 3: Calculating the accessibility index
For each node and route:
1. Determine the walk time = Distance to node (m) / notional walk speed (80 m/min)
2. Determine the service waiting time= 0.5*(60/(No. of services during peak time/4))
3. Add a reliability factor to the service waiting time: Bus/trams=2,Train = 0.75
4. Determine total access time = walk time + service wait time
5. Determine the Equivalent Building Entrance (EBE) frequency = 30/ total access time.</td></tr>
</table>

	Then; 6. For each public transport type calculate the accessibility index = EBEmax + (0.5* all other EBE). 7. Then; Sum the accessibility index.
Areas covered	All areas but housing buildings index has not the same calculation as tertiary buildings.
Barriers	The graphical evaluation of the distance and the determination of the transports nodes and frequency can be complicated. The index has to be calculated for each building and each transport type. As the calculation is different for housing buildings, the results between two different districts composed of different building types are hardly comparable.
Rating	Score: The maximum score for this indicator is 20. Assign the score according to the benchmark reported in the following table.
References	
SCALE	
Application	Basically, this indicator is a building scale indicator but it can also be used for building clusters.
Details	The building cluster scale indicator is obtained by adding the building scale index of all buildings within the building cluster.
Multiscale	Yes the large level is an extrapolation of the building level.
References	This indicator was experimented in CABEE project [1], [2], [3]

Public transport accessibility index - benchmark

Points	Capital/regional center or inner city	Capital/regional city district center or district town/city	Small/medium town or city suburb	Rural
20	22.5	13.5	9.0	4.5
0	2.5	1.5	1.0	0.5

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf
[3]	Project LENSE – Stepping Stone 2 - Methodology Development towards a Label for Environmental, Social and Economic Buildings.

<table>
<tr><td rowspan="3">SOC.Tr.09</td><td colspan="4">Shared mobility (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Transport</td><td>S</td><td>B/ N</td></tr>
</table>

<table>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Intent: Enhance shared mobility concepts.
Indicator: Percentage of people who have access to shared mobility initiatives.
Unit of measure: %</td></tr>
<tr><td>Background</td><td colspan="6">CABEE Cluster Tool</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Survey</td><td>X</td></tr>
<tr><td>Details</td><td colspan="6">Assessment method: To assess this criterion, calculate the amount of people who have access to shared mobility initiatives (car-sharing, bike-sharing, e-bike sharing, e-car sharing).</td></tr>
<tr><td>Areas covered</td><td colspan="6">Only for housing buildings.</td></tr>
<tr><td>Barriers</td><td colspan="6">The evaluation implies to list all providers of shared access mobility (bikes, cars…) and to ask them the number of users within the building Cluster. This evaluation seems impossible for tertiary buildings because the users address declared to share mobility providers is the private address of the employees and not the professional one.
It is also impossible to list all car sharing providers (because there are too much) and obtain from them the number of their subscribers living in the building cluster. One other way can be to make survey or specific studies but it is in many cases too costly.</td></tr>
<tr><td>Rating</td><td colspan="6">Score: The score for this indicator is 20. Assign the maximum score if the percentage of inhabitants who have access to shared-mobility is 100% and 0 points if the percentage is equal to 0%. Determine the other scores proportionally.</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">This indicator can be established at building or building cluster level.</td></tr>
<tr><td>Details</td><td colspan="6">The building cluster scale indicator can be evaluated directly or obtained by adding the building scale of all buildings within the building cluster.</td></tr>
<tr><td>Multiscale</td><td colspan="6">Yes the large level is an extrapolation of the building level.</td></tr>
<tr><td>References</td><td colspan="6">This indicator was experimented in CABEE project [1], [2]</td></tr>
</table>

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

ECO.Ma.01	Communication and information management (%)			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Economic	Management	S	B / N

GENERAL	
Description	**Intent**: Ensure communication and information exchange to ensure correct operation of the buildings and functioning of synergies within the cluster. **Indicator**: Percentage of trained users with access to information
Background	CABEE Cluster Tool
References	The use of this indicator for the neighbourhood was experimented in CABEE project [1], [2]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X	Other (specify)	

Details	Assessment method: Inhabitants should continuously be informed on on-going activities and on taken decisions. Identified needs by the inhabitants should be discussed and future actions adjusted accordingly. As the actual performance of the cluster depends heavily on the users' behaviour, a distributed information grid should provide users with content, tailored for their needs and responsibilities. In order to ensure the functioning of this information system, users need to be trained on its features, and on how to act when interventions are necessary.
Areas covered	This indicator covers all types of buildings. It can also be used for building Cluster in addition or to replace a building approach. The indicator is based on training and is for this reason focused on the people 'using' the buildings every day (enough to justify to be trained).
Barriers	The problem for this district/building cluster level is the time scale of the project often more than 5 years separate the first and the last building. That makes the trainings complicated to organize, the total number of users difficult to evaluate and then the assessment complicated.
Rating	Rating was not in the scope of the CABEE project. A scoring has been used just based on partners' agreement: The maximum score for this indicator is 25. Assign 25 points if all the adult inhabitants (100%) are trained or have access to the important Information of the building cluster and 0 points if no inhabitants are informed (0%). Determine the other scores proportionally. Within the 8 CABEE pilot projects 3 projects had a null, 3 project less than 15 and 2 projects between 15 and 20.
References	This indicator was experimented in CABEE project [1], [2]
SCALE	
Application	As said before, this indicator is easier to measure and assess at building level. It can also be used for neighbourhood assessment but it is more complicated.
Details	At district or building cluster level, buildings are mostly not built or renovated at the same time and thus the trainings at district/building cluster level are organised during a long period of time and are therefore not easy to evaluate.
Multiscale	It is not possible to extrapolate the indicator from building level to group of building level because the content of information/trainings is not the same at both level but trainings can be organised including both level of information at the same time.
References	This indicator was experimented in CABEE project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

ECO.Ma.03	**Synergy Management (-)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Economic	Management		S		N
GENERAL						
Description	Intent: Provide maintenance of operation of established services and synergies. Indicator: Maintenance plan Unit of measure: -					
Background	CABEE Cluster Tool					
References	The use of this indicator for the neighbourhood was experimented in CABEE project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	*X*	Other (specify)	
Details	Assessment method: Different services may need a management for being initiated, maintained and closed. Maintenance of operation in most cases will take the biggest effort and should therefore be organized in a structured way. For each synergy operational requirements are established and responsible persons named.					
Areas covered	This indicator covers all types of buildings.					
Barriers						
Rating	Rating was not in the scope of the CABEE project. A scoring has been used just based on partners' agreement : Score: The maximum score for this indicator is 25. Assign 25 points if all the synergies have a management plan, and 0 points if none of the synergies has a management plan. Determine the other scores proportionally.					
References	This indicator was experimented in CABEE project [1], [2]					
SCALE						
Application	This indicator concerns synergies at building cluster level.					
Details						
Multiscale	O&M must be planned at building level but this indicator only concerns the management of the synergies at building cluster level.					
References	This indicator was experimented in CABEE project [1], [2]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

ECO.Qu.12	**Process and planning quality (-)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Economic	Quality	S	B / N

GENERAL	
Description	For the improvement of the sustainability of a building cluster, a diagnosis of the situation succeeded by an evaluation of the performance is necessary. During the conception of the project objectives and measurable goals have to be defined for future interventions and planning phases (planned-versus actual-comparison). They can concern refurbishments and new constructions within the cluster boundary as well as services during the operational phase of the cluster. The development of scenarios of the area can help to identify short-term, medium-term and long-term priorities to enhance social, environmental and economic quality of the cluster. As user acceptance is a highly important issue, the participation of the inhabitants and users during the planning phase and implementation of actions should be boost. Awareness-raising and participation should be facilitated by giving the possibility in participation in the decision-making process. The effects and consequences of planned measures should be transparent for cluster members. Economic, social and environmental benefits should become understandable i.e. by explaining effects on basis of the indicators calculation. Indicator: Document with planned quantitative and qualitative objectives, as a result of a participative planning process.
Background	CABEE Cluster Tool
References	This indicator is used in many sustainable building assessment systems but the use for the neighbourhood was experimented in CABEE project [1], [2]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	*X*	Other (specify)	

Details	Assessment method: As a basis, a detailed program should be elaborated by distinguishing environmental, social, economic improvements with goals tailored to the respective cluster. Life time of the buildings and users types (occupant, tenant, resident, commercial user) should be taken into account. Urgent interventions should become visible and become priority. Constraints, information on sustainability, awareness-raising of the users, consultation of the inhabitants, negotiation with the inhabitants, cooperation of the users are important processes which lead to common objectives and a project which is supported by the cluster inhabitants. Incentive schemes from national and regional programs (renovation of building stock, use of renewable energies and optimization of mobility) should be pointed out and made accessible for the cluster community. Clusters should attract the interest of buildings outside of the boundary and facilitated their integration into the cluster.
Areas covered	This indicator covers all building types and all the neighbourhood scale.
Barriers	This indicator is quite simple to assess for new projects. For existing districts or buildings, it mainly does not exist any documents.
Rating	Rating was not in the scope of the CABEE project. A scoring has been used just based on partners' agreement: The maximum score for this indicator is 25. Assign: 10 points if a documentation of the decision making process exists and it is available; 15 points if planning variants were considered. 0 points otherwise

References	This indicator is used in many sustainable building assessment system but the use for the neighbourhood was experimented in CABEE project [1], [2]
SCALE	
Application	This indicator is used in many sustainable building assessment systems but the use for the neighbourhood was experimented in CABEE project on 8 pilot projects.
Details	For big renovation or new buildings, the management is very important to reach the sustainability goals. A good programme is the base for sharing objectives at building cluster level.
Multiscale	It is not possible to extrapolate a sustainable building programme at cluster level because the sum of the buildings quality is less than a real common sustainable programme. Evaluation has to be done for the Cluster and for each building.
References	This indicator is used in many sustainable building assessment system but the use for the neighbourhood was experimented in CABEE project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

<table>
<tr><td rowspan="3">ECO.Qu.16</td><td colspan="7">Risk management (-)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Economic</td><td colspan="2">Quality</td><td colspan="2">S</td><td>N</td></tr>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td>Description</td><td colspan="7">Risk Management is an important requirement for all planning activities. Often planning and execution is not in line, because of changed framework conditions, which can be related to timelines, founding, conflicting interest of stakeholders, executional works. The cluster should not fall into difficulties, when such unforeseeable circumstances occur.
Intent: Limit the risk to achieve the established objectives
Indicator: Risk management plan for each synergy with long time prediction during lifecycle
Unit of measure: -</td></tr>
<tr><td>Background</td><td colspan="7">CABEE Cluster Tool</td></tr>
<tr><td>References</td><td colspan="7">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="8">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td>X</td><td>Other (specify)</td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="7">Assessment method: A risk management plan should be elaborated for each planned improvement and each planned synergy within the cluster. Alternative solutions should limit the risk of losing important synergies.</td></tr>
<tr><td>Areas covered</td><td colspan="7">This indicator covers all building types.</td></tr>
<tr><td>Barriers</td><td colspan="7"></td></tr>
<tr><td>Rating</td><td colspan="7">Rating was not in the scope of the CABEE project.
A scoring has been used just based on partners agreement
Score: The maximum score for this indicator is 25. Assign 25 points if 100% of the synergies have a risk management plan and 0 points if none of the synergies has a risk management plan. Determine the other scores proportionally.</td></tr>
<tr><td>References</td><td colspan="7">This indicator was experimented in CABEE project [1], [2]</td></tr>
<tr><td colspan="8">SCALE</td></tr>
<tr><td>Application</td><td colspan="7">This indicator is specific for building clusters.</td></tr>
<tr><td>Details</td><td colspan="7">For big renovation or new buildings, the management is very important to reach the sustainability goals. A good risk management is specifically necessary because the time duration of a building cluster project is 5 to 10 years and many changes can occur.</td></tr>
<tr><td>Multiscale</td><td colspan="7">The risk concerns here the building cluster and not the buildings by themselves.</td></tr>
<tr><td>References</td><td colspan="7">[], [2]</td></tr>
</table>

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

<table>
<tr><td rowspan="3">ECO.Va.05</td><td colspan="4">Economic advantage of cluster in comparison to single buildings (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Value</td><td>B / S / A</td><td>N</td></tr>
</table>

GENERAL						
Description	Intent: Evaluation of economic advantages of the building cluster Indicator: Cost reduction through common investments and usage of common facilities. Unit of measure: -					
Background	CABEE Cluster Tool					
References	This indicator was experimented in CABEE project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	Assessment method: Assess the cost benefit gathered through common actions in process quality, environmental and social quality.					
Areas covered	The indicator can be calculated for different types of buildings.					
Barriers	The first difficulty is to define common actions that can be taken into account for the evaluation. The second difficulty is to calculate the cost benefit of these common actions because such a calculation implies to calculate the cost for each building without the common action and this cost has not been calculated in most cases.					
Rating	Score: The score for this indicator is 25. Assign 25 points if the cost reduction accounts for the 40% and 0 points if there is no cost reduction. Assign the other scores proportionally.					
References	This indicator was experimented in CABEE project [1], [2]					
SCALE						
Application	This indicator is specific for building clusters as it is dedicated to common actions at cluster level.					
Details	-					
Multiscale	-					
References	This indicator was experimented in CABEE project [1], [2]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.1-Booklet-intro-synergy-grids.pdf
[2]	http://wiki.cesba.eu/wiki/File:CABEE-WP6.2-booklet-studies-synergy-grids.pdf

A.2 – CAT-MED

CAT-MED

Mediterranean Metropolis Change Around Time

www.catmed.eu

CAT-MED (2011-2014) was a European MED project that aims to limit emissions of greenhouse gases (GHG) by identifying practical solutions in the dynamics of cities to reduce urban impact, through strategies shared by the 11 participating cities in Spain, France, Italy and Greece. The main aim of CAT-MED was to develop sustainable urban models based on the classical Mediterranean city; compact, complex and where the proximity of public services is determined by people's ability to access them on foot. The project developed a system of common indicators and carried out pilot experiences called the «Green Apple» with the objective of showing the main characteristics of the proposed urban model, both at a planning and building level.

INDICATORS

ENV.En.08	Energy consumption (Toe / inhabitant yr)					
	ISSUE		CATEGORY		LEVEL	SCALE
	Environmental		Energy		S	N
GENERAL						
Description	This indicator estimates the urban energy consumption per inhabitant, considering both the energy and fuel consumption. Excessive energy consumption has a negative effect from a global point of view, depleting natural resources and contributing to increasing the effects of climate change. A more sustainable management of urban energy is necessary, including reducing consumption and the promotion of renewable energy sources, amongst the main policies implemented to mitigate the effects of climate change.					
Background	--					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	**Methodology** Once the yearly energy consumption data has been determined, all of the different energy type consumption values must be converted into tonnes of oil equivalent following the existing conversion equivalence (for example, 1 MWh of electricity equals 0.086 toe), so the consumptions can be compared. The number of inhabitants can be obtained as the sum of all the existing population census records. For this indicator, it is also important to consider the sectorial disaggregation, as the percentage of energy consumption by each sector (residential, commercial, industrial and transport) over the total energy consumption. **Calculation** Energy consumption = (Electricity + Natural gas + Hidrocarbon + LP Gas Consumption) / Number of inhabitants. **Measurement unit** Toe (tonnes of oil equivalent) per inhabitant per year.					
Areas covered	Urban areas					
Barriers	Need for: – Energy consumption data per year (electricity, natural gas, hydrocarbon and liquefied petrol gas consumption) – Population census (number of inhabitants)					
Rating	As for the previous indicator, we could establish a reduction of 20% by 2020 as the desirable range for cities.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

ENV.Wa.04	Water consumption (l/inhabitant day)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Environmental	Water	S	N

GENERAL	
Description	This indicator measures the water consumption (litres) per inhabitant and per day. Water scarcity is one of the biggest hazards related to climate change in Mediterranean cities. This indicator shows the rational usage of one of the most necessary vital natural resources
Background	--
References	[1]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	**Methodology** Once the daily domestic water consumption data has been obtained, the indicator can be simply calculated by dividing the water consumption values by the number of inhabitants. **Calculation** Water consumption per inhabitant = Domestic water consumption volume / Number of inhabitants * 365 **Measurement unit** Litres per inhabitant per day
Areas covered	Urban areas
Barriers	Need for: − Domestic and total water consumption annual data − Population census (number of inhabitants)
Rating	Following the recommendations set out by WHO, 100 litres per inhabitant per day is the desirable level for the domestic water consumption.
References	

SCALE	
Application	Urban scale
Details	--
Multiscale	--
References	--

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

<table>
<tr><td rowspan="3">ENV.Wa.12
ENV.Wa.13</td><td colspan="6">Waste management & removal (kg/inhabitant day)
Waste management & removal (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Water</td><td>S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">This indicator measures the solid urban waste volume generated per inhabitant and per day, and the percentage of selective solid urban waste. Promoting the reduction, reuse and recycling of waste generated in a city is one of the most necessary policies in order to achieve a positive impact on the natural environment. The increase in the amount of waste generated per inhabitant causes both health and environmental issues thus, in addition to an appropriate management and removal policy, reducing and recycling are essential habits for each citizen to practice.</td></tr>
<tr><td>Background</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Methodology
Based on the solid urban waste management data that can be provided by the municipal waste management department, it is possible to determine the total waste volume per year and the selective solid urban waste volume. Once obtained, the indicators can be calculated applying the corresponding formula for the solid urban waste volume per inhabitant per day and the recycled solid urban waste percentage.

Calculation
Urban solid waste volume = Total urban solid waste volume per year / Number of inhabitants * 365
Selective urban solid waste % = Selective urban solid waste volume per year / Total urban solid waste volume per year * 100

Measurement unit
Kilograms per inhabitant per day
Percentage of selective solid urban waste</td></tr>
<tr><td>Areas covered</td><td colspan="6">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="6">Need for:
− Total amount of solid urban waste
− Amount of selective solid urban waste
− Population census (number of inhabitants)</td></tr>
<tr><td>Rating</td><td colspan="6">The interval at around 1.2 to 1.4 kg per capita per day and the selective collection rate at around 50% are the desirable level</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Urban scale</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
</table>

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

ENV.Im.07	**CO_2 Emissions (tonnes CO_2-eq/yr)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Impacts	S	N
GENERAL				
Description	This indicator measures the CO_2 equivalent emissions produced within the local area. CO_2 emissions attributable to the energy and transport sectors are by far the most important factor responsible for the greenhouse effect (industrialized countries' contribution to total emissions is about 80% of the total). The energy and transport sector, together with the waste management sector, represent the main focus for action by the local authority.			
Background	--			
References	[1]			
LEVEL				
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	**Methodology & Calculation** This indicator corresponds to the European Common Indicator number two, local contribution to global climate change. Local activities which include the use of fossil fuels (coal, petroleum, natural gas) for energy purposes (including transport) and local waste management have to be considered. The sectorial disaggregation suggested for the CO2 equivalent indicator includes residential, commercial, industrial and transport. The methodology and calculation process for this indicator can be found at: http://ec.europa.eu/environment/urban/common_indicators.htm **Measurement unit** Tonnes per year			
Areas covered	Urban areas			
Barriers	Need for: consumptions, emission factors (tonnes of CO2 per unit of energy) and emission data.			
Rating	According to the proposals set out by the European Commission in the Energy/Climate package, a 20% reduction in emissions per capita and per year by 2020 is the desirable level for cities			
References				
SCALE				
Application	Urban scale			
Details	--			
Multiscale	--			
References	--			

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

ENV.LU.11	**Population density (inhabitants/ha)**						
	ISSUE		**CATEGORY**		**LEVEL**	**SCALE**	
	Environmental		Land Use		S	N	
GENERAL							
Description	Population density is defined as the number of inhabitants per hectare, calculated only within the consolidated urban area. The population density indicator provides an initial understanding of the configuration and territorial organization of the city. Its analysis gives rise to a first assessment of the extent of urban sprawl throughout the territory and helps in the definition of organized urban planning.						
Background	--						
References	[1]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements		
	Simple Calculations	X	Empirical/Literature		Other (specify)		
Details	A georeferenced population census allows to quantify the indicator for the specific parts of the city or city boroughs						
Areas covered	Urban areas						
Barriers	Need for a georeferenced population census						
Rating	For a city with an average surface area for public space and green areas, CAT-MED project establishes a benchmark of 120 inhabitants per hectare						
References							
SCALE							
Application	Urban scale						
Details	--						
Multiscale	--						
References	--						

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

<table>
<tr><td rowspan="3">ENV.LU.13</td><td colspan="4">Urban compactness (m^3 /m^2)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Land Use</td><td>S</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The level of compactness can be defined as the relation between the usable space of the buildings (volume) and the urban space (area).
The compact building expresses the idea of urban proximity, increasing the contact and interchange possibilities. It also optimizes the management of one of the most important natural resources, land.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] Operational data [ ] In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] Empirical/Literature [ ] Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">Methodology
From the raw digital cadastral data, extract the parcels that do not correspond to buildings (still not included in the urban consolidated area, technical and communications infrastructure, parks and green zones…). For each building, estimate the usable space (volume) multiplying the number of floors of each polygon by an agreed constant that represents the height per floor (for example, 3 meters).
Finally, calculate the sum of the whole building volume and the whole urban area that are necessary to apply the formula.
To calculate the corrected compactness, the public space for pedestrian areas can be obtained as the sum of the area of the polygons included in the public space layer (pedestrian priority public spaces and green zones and recreation areas). Georeferenced population census allows to quantify the indicator for the specific parts of the city or city boroughs.

Urban compactness (absolute)=∑ Building volume/∑ Urban area

Urban compactness (corrected)=∑ Building volume/∑ Pedestrians public space area

Measurement unit
Meters (Cubic meters per square meter)</td></tr>
<tr><td>Areas covered</td><td colspan="4">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="4">Need for:
− Digital cadastral data of the buildings, including the area and number of floors for each polygon corresponding to each building.
− Public space digitalization and classification data: pedestrian priority public space (pedestrian streets, walkways, boulevards, promenades, wide sidewalks) and green zones and recreation areas (squares, little squares, gardens, parks and promenades).</td></tr>
<tr><td>Rating</td><td colspan="4">Closely related to the previous indicator, in general there is a correlation between urban compactness and population density. The compactness can be measured over the gross surface area that includes public space and the remaining urban area, or referring to the building surface which is equivalent to the net lot surface. This correlation between density and compactness mentioned above could represent a desirable level of minimum urban compactness (absolute compactness) equal to 5 meters. Nevertheless, it is important to highlight that the range of the indicator is more relevant when we carry out a more detailed analysis of the different areas of the city. This is due to the presence of large areas without buildings such as the land dedicated to communications infrastructures or the green areas, meaning that when the indicator is calculated as a single value (e.g. the whole city), it can generate some results that can be misleading and fall out of the desired range. This is something which has been observed when calculating the indicator for the different territories defined in the city. On the other hand, for corrected compactness the range could be set from 10 to 50 meters as the desirable level.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Urban scale</td></tr>
</table>

Details	--
Multiscale	--
References	--

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

ENV.LU.07 ENV.LU.08	Green zones & recreation areas (m^2 /inhabitant) Green zones & recreation areas density (%)					
	ISSUE	CATEGORY		LEVEL		SCALE
	Environmental	Land Use		S		N
GENERAL						
Description	This indicator measures the existing green zones and recreation areas and the relation with the number of inhabitants. Thus, this relation is obtained by the proportion of green zones square meters per inhabitant. Green zones play an important role in the urban environment. They improve the inhabitants' quality of life, especially the air quality. Apart from being places where citizens can enjoy leisure time, squares, gardens and parks help to make up a well balanced city, where the natural spaces mitigate the building and pollution effects.					
Background	--					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	**Methodology** Using municipal maps and with the help of orthophotograph or urban planning maps, the useful and existing green zones and recreation area boundaries can be edited in the GIS. The number of inhabitants can be obtained as the sum of all the records existing in the population census. The consolidated urban area boundaries can be obtained with the help of already existing urban planning layers and documents (the already developed urban area plus the new zones that have been allocated), and the comparison with orthophotography or aerial photographs. **Calculation** Green zones per inhabitant = Green zones & Recreation areas m^2 / Number of inhabitants Green zones density = Green zones & Recreation areas m^2 / Urban area square meters **Measurement unit** Square meters per inhabitant Percentage of green zones					
Areas covered	Urban areas					
Barriers	Need for: − Green zones and recreation areas polygons − Census of population (number of inhabitants) − Urban area limits					
Rating	According to WHO recommendations, cities must have at least 10 to 15 square meters of green areas per capita, equally distributed in relation to population density. It is desirable for this ratio to reach values between 15 and 20 square meters of useful green zone per inhabitant.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

ENV.LU.09	Green zones & recreation areas proximity (%)					
	ISSUE	CATEGORY		LEVEL		SCALE
	Environment	Land Use		S		N
GENERAL						
Description	This indicator measures the percentage of population that lives next to at least one green zone or recreation area. The presence of green zones and recreation areas in a big city is not enough, their location is also important. The benefits yielded by green zones are less relevant if most of them are located on the outskirts of the cities. Thus, natural spaces must be integrated into the consolidated urban area, close to the population, so that people can easily gain access to them.					
Background	--					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	**Methodology** Using municipal maps and with the help of orthophotograph or urban planning maps, the useful and existing green zones and recreation area boundaries can be edited in the GIS. The georeferenced population census can be obtained by a traditional relational database join process that relates inhabitants with their address in the georeferenced municipal street guide. The result will be a point layer in which each point represents one person's place of residence. Therefore, there would be as many points as there are inhabitants. Once both layers, green zones & recreation areas polygons and georeferenced population, are included in the GIS, proximity buffers of the green zones & recreation areas can be created with the help of the GIS buffer geo-process. Finally, the population that live near a green zone or recreation area are those that are contained in the buffer layer, which can be obtained by a spatial selection. **Calculation** Green zones proximity = Inhab. that live next to a green zone / Total number of inhab. * 100 **Measurement unit** Percentage of population					
Areas covered	Urban areas					
Barriers	–					
Rating	For the buffer definition, the following criteria will be followed: · 1000 - 5000 square meters area: 300 meters distance · 5000 - 10000 square meters area: 500 meters distance · More than 1 hectare area: 900 meters distance.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

SOC.Tr.23	**Traffic modal split (%)**					
	ISSUE		CATEGORY		LEVEL	SCALE
	Social		Transport		S	N
GENERAL						
Description	The modal split indicator shows which type of transport people use and its proportion to the total number of trips. The distribution of journeys by mode of transport in the urban area is an indicator of the quality of mobility and has a clear relation to the status of air pollution, traffic being a major cause of poor air quality in cities. According to the existing data on the use of public and private transport, the traffic modal split is a basic indicator for the definition of transport policies. The sustainable balance of mobility and the promotion of public transport is one of the main objectives in big cities.					
Background	--					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	**Methodology** To obtain the modes of transport used by citizens to travel to their place of work, study or leisure, it is necessary to carry out surveys to collect data in strategic locations in the city. These kinds of analysis are normally carried out by private or municipal companies for their inclusion in mobility and transport studies and planning. **Calculation** % of trips by car = Trips made by car / Total numbers of trips * 100 % of trips by public transport = Trips made by public transport / Total numbers of trips * 100 % of trips by bicycle = Trips made by bicycle / Total numbers of trips * 100 % of walk trips = Walk trips / Total numbers of trips * 100 **Measurement unit** Percentage of trips					
Areas covered	Urban areas					
Barriers	–					
Rating	The desirable interval for the use of private vehicles could be set below 20%, so that the rest of the trips in the city are made with other modes of transport (public transport, walking/cycling).					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

SOC.Tr.15	**Access to public transport nodes (%)**						
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**	
	Social	Transport		S		N	
GENERAL							
Description	This indicator measures the percentage of population that can find a public transport stop near their place of residence. Proximity to public transport is one of the most important factors to encourage people to reduce their use of private vehicles. A good quality public transport system, frequent and near the inhabitants place of residence can be an alternative to the mass use of private vehicles.						
Background	--						
References	[1]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements		
	Simple Calculations	X	Empirical/Literature		Other (specify)		
Details	**Methodology** The bus & tube stops can be represented as point entities in a graphic layer to be included in the GIS, according to their location. The georeferenced population census can be obtained by a traditional relational database join process that relates inhabitants with their address in the georeferenced municipal street guide. The result will be a point layer in which each point represents one person's place of residence. Therefore, there would be as many points as there are inhabitants. Once both layers, bus & tube stops and georeferenced population, are included in the GIS, proximity buffers of the bus & tube stops entities can be created with the help of the GIS buffer geoprocess. Finally, the populations that live next to bus or tube stops are those that are contained in the buffer layer, which can be obtained by a spatial selection. For the buffer definition, the following criteria will be followed: · Bus stops: 300 meters distance · Tube stops: 500 meters distance **Calculation** Bus & tube stop proximity = Inhabitants that live next to a bus or tube stop / Total number of inhabitants **Measurement unit** Percentage of population						
Areas covered	Urban areas						
Barriers	Need for: − Location of bus & tube stops − Georeferenced population census (census of population and georeferenced municipal street guide)						
Rating	Intervals at around 90%-100% are 7the desirable level of proximity						
References							
SCALE							
Application	Urban scale						
Details	--						
Multiscale	--						
References	--						

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

SOC.Tr.08	**Proximity to bicycle lanes and paths (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Transport	S	N

GENERAL	
Description	This indicator measures the length of existing bicycle lanes and paths and their proximity to population. Bike lanes are spaces that act as special lanes dedicated exclusively to bicycles. They are normally marked on the pavement and include symbols with a bicycle and arrow. Their presence, and especially their interconnection, results in a better sharing of road and street space and enhances the quality of life for residents, providing an alternative, healthier and more sustainable form of transport over short distances.
Background	--
References	[1]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	**Methodology** Based on the municipal cartography and with the help of orthophotographs, the useful and existing cycle lanes and paths can be edited in the GIS, according with the transport plan definition. The georeferenced population census can be obtained by a traditional relational database join process that relates inhabitants with their address in the georeferenced municipal street guide. The result will be a point layer in which each point represents one person's place of residence. Therefore, there would be as many points as there are inhabitants. Once both layers, cycle lanes & paths and georeferenced population, are included in the GIS, proximity buffers of the cycle lanes & paths entities can be created with the help of the GIS buffer geoprocess. Finally, the populations that live near the cycle lane network are those that are contained in the buffer layer, which can be obtained by a spatial selection. For the buffer definition, the following criteria will be followed: · Bicycle lanes and paths network: 300 meters distance for buffer definition **Calculation** Bicycle lanes proximity= Inhabitants that live next to the cycle lanes network / Total number of inhabitants * 100 **Measurement unit** Percentage of population
Areas covered	Urban areas
Barriers	Need for: − Cycle lanes and paths, length and itinerary − Georeferenced population census (census of population and georeferenced municipal street guide)
Rating	The intervals at around 90%-100% are the desirable level of proximity
References	

SCALE	
Application	Urban scale
Details	--
Multiscale	--
References	--

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

<table>
<tr><td rowspan="3">SOC.Tr.06
SOC.Tr.07</td><td colspan="8">Pedestrian streets and walkways, area (%)
Pedestrian streets and walkways, length (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td colspan="2">SCALE</td></tr>
<tr><td colspan="2">Social</td><td colspan="2">Transport</td><td colspan="2">S</td><td colspan="2">N</td></tr>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td>Description</td><td colspan="8">This indicator measures the percentage of pedestrian streets over the total length and area of city streets and roads. Pedestrian streets and walkways provide people with space to travel that is separated from roadway vehicles. Such facilities also improve mobility for pedestrians and provide access for all types of pedestrian travel: to and from home, work, parks, schools, shopping areas, etc. They also provide places for children to walk and play.</td></tr>
<tr><td>Background</td><td colspan="8">--</td></tr>
<tr><td>References</td><td colspan="8">[1]</td></tr>
<tr><td colspan="9">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="2">Software tool</td><td></td><td>Operational data</td><td></td><td colspan="2">In situ measurements</td><td></td></tr>
<tr><td colspan="2">Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td colspan="2">Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="8">Methodology
Using municipal maps and with the help of orthophotographs or existing information about the roads and streets network, the useful and existing pedestrian streets and walkways can be edited in the GIS, according with the mobility & transport plan definition. Secondly, the total length and area of streets and roads can be obtained as the sum of all the shape records existing in the georeferenced municipal street guide.

Calculation
Pedestrian streets percentage (length) = Pedestrian streets & walkaway length / Total streets and roads length * 100

Pedestrian streets percentage (area) = Pedestrian streets & walkaway area / Total streets and roads area * 100

Measurement unit
Percentage of pedestrian streets in terms of length (%)
Percentage of pedestrian streets in term of area (%)</td></tr>
<tr><td>Areas covered</td><td colspan="8">Urban area</td></tr>
<tr><td>Barriers</td><td colspan="8">Need for:
− Location of pedestrian streets and walkways
− Georeferenced municipal street guide (line and polygon features)</td></tr>
<tr><td>Rating</td><td colspan="8">The minimum percentage of space for pedestrians could be set at 75% as a desirable level</td></tr>
<tr><td>References</td><td colspan="8"></td></tr>
<tr><td colspan="9">SCALE</td></tr>
<tr><td>Application</td><td colspan="8">Urban scale</td></tr>
<tr><td>Details</td><td colspan="8">--</td></tr>
<tr><td>Multiscale</td><td colspan="8">--</td></tr>
<tr><td>References</td><td colspan="8">--</td></tr>
</table>

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

<table>
<tr><td rowspan="3">SOC.AQ.02</td><td colspan="8">Number of days with bad air quality (-)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td colspan="2">SCALE</td></tr>
<tr><td colspan="2">Social</td><td colspan="2">Air Quality</td><td colspan="2">S</td><td colspan="2">N</td></tr>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td>Description</td><td colspan="8">This indicator can be defined as the number of days per year in which a bad quality of air has been recorded, considering the most relevant contaminants. That is, the number of days in which the daily limits set by the European regulations have been exceeded for each of these pollutants.</td></tr>
<tr><td>Background</td><td colspan="8">--</td></tr>
<tr><td>References</td><td colspan="8">[1]</td></tr>
<tr><td colspan="9">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td><td colspan="2"></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td><td colspan="2"></td></tr>
<tr><td>Details</td><td colspan="8">Methodology
Based on the available information on levels recorded for each pollutant, select the number of days per year with a bad air quality, according to the following criteria:
SO_2: Number of days with more than 125 μg/m3
CO: Number of days with more than 10 mg/m3
NO_x: Number of days with more than 50 μg/m3
O_3: Number of days with more than 120 μg/m3
PM10: Number of days with more than 50 μg/m3

Calculation
Air quality (for each contaminant) = Number of days with bad air quality

Measurement unit
Days per year</td></tr>
<tr><td>Areas covered</td><td colspan="8">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="8">Need for recorded levels of contaminants data (SO_2, CO, NO_x, O_3, PM10)</td></tr>
<tr><td>Rating</td><td colspan="8">The desirable levels in this set of indicators are defined at European Community level.
SO_2: Daily limit value: 125 μg/m3. This value should not be exceeded more than 3 times per year.
CO: Daily limit value: 10 mg/m3. This value should not be exceeded on any occasion.
NO_x: Hourly limit value: 200 μg/m3. This value should not be exceeded more than 18 times per year. Annual limit value: 40 μg/m3.</td></tr>
<tr><td>References</td><td colspan="8"></td></tr>
<tr><td colspan="9">SCALE</td></tr>
<tr><td>Application</td><td colspan="8">Urban scale</td></tr>
<tr><td>Details</td><td colspan="8">--</td></tr>
<tr><td>Multiscale</td><td colspan="8">--</td></tr>
<tr><td>References</td><td colspan="8">--</td></tr>
</table>

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

SOC.AC.04 **SOC.AC.05**	**Noise Pollution, Silence quality - day (%)** **Noise Pollution, Silence quality - night (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Acoustic Comfort	S	N
GENERAL				
Description	Noise pollution can be measured as the proportion of population exposed to non-recommended levels of noise, considering both day noise and night noise. According to the World Health Organization, noise seriously harms human health, both from a physical and psychological point of view. The noise caused by traffic, industrial or entertainment activities, is one of the major environmental problems in Europe. The source of noise is associated with the processes of urbanization and the development of transport and industry. While it is a problem mainly in urban areas, in some places it may also affect rural areas. Preserving silence is one of the most important challenges in big cities.			
Background	--			
References	[1]			

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	**Methodology** Thanks to the information existing in the georeferenced noise map, it is possible to identify the streets and city areas with noise level bigger than 65 dB during the day and 55 dB during the night. Once this information has been processed, with the help of the georeferenced census of population it is possible to know the number of people exposed to non recommended noise levels. **Calculation** Silence quality (day) = Number of people exposed to more than 65 dB during the day / Total number of inhabitants * 100 Silence quality (night) = Number of people exposed to more than 55 dB during the night / Total number of inhabitants * 100 **Measurement unit** Percentage of population
Areas covered	Urban areas
Barriers	Need for: − Georeferenced noise map − Georeferenced municipal street guide − Georeferenced population census
Rating	Intervals at around 25% of the population during the day and 15% of the population during the night are the desirable levels
References	
SCALE	
Application	Urban scale
Details	--
Multiscale	--
References	--

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

<table>
<tr><td rowspan="3">SOC.Ac.18</td><td colspan="4">Proximity to basic services (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Accessibility</td><td>S</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">This indicator measures the percentage of population that lives close to basic services, considering the following classification: supply of food and everyday products, education centers, health centers, social centers, sports centers, cultural centers, entertainment centers and selective waste collection points. Accessibility to basic services in town is essential for the citizens’ quality of life. A balanced distribution of basic services (schools, health centers, sport facilities, etc.) allows the population to identify with their closest urban space, increasing the social cohesion and the interrelation between the city and its inhabitants.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | Other (specify) | </td></tr>
<tr><td>Details</td><td colspan="4">Methodology : For each type of basic service, the corresponding point layer is created by georeferencing the centers using a relational database join process that relates each center with its address in the georeferenced municipal street guide. Once all the layers are included in the GIS, proximity buffers are created for each of them with the help of the GIS buffer geoprocess. Finally, the population that lives close to the basic services centers are those that are contained in each buffer layer, which can be obtained by a spatial selection.
Calculation:
For each basic service considered:
Basic services proximity =(Inhabitants that live near a basic service center / Total number of inhabitants)*100
Measurement unit:
Percentage of population</td></tr>
<tr><td>Areas covered</td><td colspan="4">-</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">CAT-MED project sets the intervals at around 90% and 100% of the population as the desirable proximity levels for the Mediterranean cities participating.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Urban scale</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
</table>

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

<table>
<tr><td rowspan="3">ECO.Qu.17</td><td colspan="4">Urban complexity, Shannon-Wiener index (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Quality</td><td>S</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The urban complexity is a measure of the urban system organization. It captures the diversity of mixed uses and services. Urban complexity can be obtained by the application of the Shannon-Wiener index that is one of the several indices used to measure diversity in information theory.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] | Empirical/Literature [ ] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">Methodology
First identify the different activity types that will correspond with the Shannon number of species (species richness). This species richness must be the same for all the cities and will be based on the standard European NACE codes classifications.
Then, group all the existing entities into this classification based on its similarity. For each entity, assign one of the species or activity types based on its type and description.
Apply Shannon index (see calculation formula) where:
· n is the number of different activity types (species richness).
· Pi is the relative abundance of each species, the proportion of entities of a given species or activity type to the total number of activities existing.
· Log2(Pi) is the binary logarithm of the relative abundance of each species.

Calculation
Urban complexity= $-\sum_{n}^{i=1} Pi * \log_2(PI)$

Measurement unit
Entropy (Shannon index H)</td></tr>
<tr><td>Areas covered</td><td colspan="4">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="4">Need for the census of economic activities, including the necessary fields about type and description of the activities to classify them and apply the Shannon index</td></tr>
<tr><td>Rating</td><td colspan="4">The availability of a georeferenced census of economic activities and institutions and associations makes it possible to obtain this indicator, allowing us to calculate the indicator for specific parts of the city, as long as they are small enough and similar in size. In the particular case of this indicator, the possibility of calculating the diversity of the city in a more detailed way is especially needed in order to be able to compare between different city areas (allows us to detect areas with a lack of activities or with a predominant activity).</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Urban scale</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
</table>

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

<table>
<tr><td rowspan="3">ECO.Eq.09</td><td colspan="6">Social housing ratio (%)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td colspan="2">Equity</td><td colspan="2">S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">This indicator measures the social housing percentage in relation with the total number of houses existing in the urban area. The existence of social housing, i.e. housing managed by the government, the main objective of which is to provide housing for citizens for a limited cost. The presence of sufficient social housing provides improved access to housing for lower-income citizens. This indicator shows a first understanding of the municipal commitment to improving social cohesion.</td></tr>
<tr><td>Background</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Methodology : The number of social houses can be obtained as the sum of the records corresponding to social housing, according to its type in the housing census. The total number of houses can be obtained as the sum of all the records existing in the housing census.
Calculation:
Social houses ratio =(Number of social houses / Total number of houses)*100
Measurement unit:
Percentage of social housing</td></tr>
<tr><td>Areas covered</td><td colspan="6">-</td></tr>
<tr><td>Barriers</td><td colspan="6">Need for availability of data from census of housing (number and type of houses)</td></tr>
<tr><td>Rating</td><td colspan="6">CAT-MED project sets the minimum desirable value equal to 20% for the Mediterranean cities participating.</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Urban scale</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
</table>

<table>
<tr><td rowspan="3">ECO.Eq.07
ECO.Eq.11</td><td colspan="4">Labour force participation (%)
Unemployment rate (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Equity</td><td>S</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The labor force participation rate is the percentage of working-age people within an economy who are employed or unemployed but looking for a job. The unemployment rate is the percentage of people in the labor force who are unemployed. This indicator provides information about the labor market status, as well as the economy development and citizens' quality of life. Separation by age or gender is also important for this indicator in order to detect potentially vulnerable groups.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | Other (specify) | </td></tr>
<tr><td>Details</td><td colspan="4">Methodology : The assessment of this indicator is done using existing statistical data on labor force and unemployment. The labor force participation rate is calculated as the proportion between the number of people willing to work (employed and jobseekers) and the number of working-age people, while the unemployment rate is the proportion between unemployed people and the people in the labor force.
Calculation:
Labor force participation rate =(Number of people in the labor force / Number of working age people)*100
Unemployment rate =(Number of Unemployment people / Number of people in the labor force)*100
Measurement unit:
Percentage of population</td></tr>
<tr><td>Areas covered</td><td colspan="4">-</td></tr>
<tr><td>Barriers</td><td colspan="4">Need for availability of labor force participation & unemployment statistics</td></tr>
<tr><td>Rating</td><td colspan="4">CAT-MED project sets the interval at below 10% as the desirable level.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Urban scale</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
</table>

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

<table>
<tr><td rowspan="3">ECO.Va.07
ECO.Va.08</td><td colspan="4">Tourist frequency trends, seasonality overnight stays (%)
Tourist frequency trends, seasonality tourists (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Value</td><td>S</td><td>N</td></tr>
</table>

GENERAL	
Description	This indicator measures the evolution of the tourist frequency, in relation to the number of tourists and overnight stays per year and tourism seasonality. Relevance Tourism is one of the most dynamic sectors of the economy in most Mediterranean cities. The positive impact of tourism on the economy can provide a solution for job creation and economic development within territories. However, it is necessary to promote an ordered and sustainable tourism in order to contribute to mitigating pollution generated in the cities, to balancing water and energy consumption during the summer period, to reducing CO2 emissions and consequently the impacts on climate change.
Background	--
References	[1]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	**Methodology** : Based on the tourists registration or hotel occupancy data, which can be obtained from the municipal or regional tourism office, it is possible to identify the number of tourists and overnight stays per year and its seasonality. **Calculation**: Percent seasonality (tourists) =(Number of tourists in each month/ Total number of tourist)*100 Percent seasonality (overnight stays)=(Number of overnight stays in each month/ Total number of overnight stays)*100 **Measurement unit:** Number of tourists and overnight stays per month and per year. Percentage of seasonality per month
Areas covered	-
Barriers	Need for data availability on number of tourists and overnight stays data per month and year.
Rating	CAT-MED project established the percentage ranges of tourists and overnight stays per month at between 6% and 11% as the desirable levels.
References	

SCALE	
Application	Urban scale
Details	--
Multiscale	--
References	--

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

ECO.Ma.05	Environmental activities in primary school (%)					
	ISSUE	CATEGORY	LEVEL	SCALE		
	Economic	Management	S	N		
GENERAL						
Description	This indicator shows the proportion of primary school children that participate in environmental educational activities aimed at building awareness around eco-citizenship. One of the most important tasks of local governments is to raise awareness among citizens, and especially the children, about the environmental problems cities are currently facing. Therefore, it is important to monitor the environmental education initiatives carried out in schools. Environmental education is one of the best ways to ensure a reduction in the environmental impact and to mitigate climate change effects in the future.					
Background	--					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	**Methodology**: Once the number of students participation in extracurricular environmental educational activities have been obtained, the indicator can be calculated as the proportion between this number of students data and the total number of students in primary school. **Calculation:** Environmental education= (Pupil participating in environmental activities /Total number of primary school pupils) * 100 **Measurement unit** Percentage of primary school children					
Areas covered	Urban areas					
Barriers	Need for: – Data availability on: – Number of educational activities related to urban environment in primary schools and number of pupils participating. – Total number of primary school pupils.					
Rating	CAT-MED project sets the intervals at about 75% and 100% of the students as the desirable level for the Mediterranean cities participating.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	CAT-MED project, Sustainable urban models, Work methodology and results http://www.catmed.eu/archivos/desc9_CatMed%20Ita-Eng.pdf

A.3 – CEC5

CEC5

Demonstration of energy efficiency and utilisation of renewable energy sources through public buildings

http://www.projectcec5.eu

CEC5 applies energy efficiency and use of RES in public buildings as examples for others to follow. CEC5 also developed an approach that allows for a harmonized assessment to making buildings more sustainable. Demonstrating the benefits of low-emission buildings, energy efficiency and RES is not the responsibility of the construction sector. Instead, the public sector needs to lead the way. Organizations engaged in developing sustainable buildings joined CEC5 and formed a consortium uniting cities and regions that are the owners of buildings. The project strives to establish energy efficient public buildings that serve as examples for others, to find a common framework for assessing sustainable buildings and to contribute to the European Union ambitious climate targets. To encourage the use of best practices in making buildings energy-efficient, CEC5 cooperated with a group of transnational projects supported by DG Environment in developing an approach called the Common European Sustainable Building Assessment (CESBA). Together these projects identified key indicators for assessing a building's energy efficiency. CESBA is adaptable, open-source and provides one easy-to-use benchmark and assessment method. CEC 5 was financed by Interreg Central Europe Programme 2007-13 and lasted from 2011 till 2014.

INDICATORS

<table>
<tr><td rowspan="3">SOC.Tr.17</td><td colspan="4">Accessibility of public transport</td></tr>
<tr><td>PILLAR</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Transport</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">This indicator is used to facilitate the choice of sites which easily accessible for public transport networks to reduce the use of private vehicles. This indicator uses the real distance and time spent by pedestrians to reach stops of public transportation network from the main pedestrian entrance of the building to the stops e to calculate the accessibility index of public transportation for each line, for then compare the calculated values to the performance scale benchmarks and attribute the score.</td></tr>
<tr><td>Background</td><td colspan="4">This indicator has been adopted in a previous project called “ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.</td></tr>
<tr><td>References</td><td colspan="4">This indictor was experimented in Project CEC5 [1] [2]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
</table>

<table>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="6">Evaluation is based on the following criteria:
• The stop of each bus or train line is evaluated as a single stop in both directions.
• Bus lines are evaluated only if they work on weekdays, between 7:00 am and 7:00 pm, with a minimum frequency of each hour and not more than 300 m from the ground.
• Railway lines are evaluated only if they work on weekdays, between 7:00 and 19:00, with a minimum passing time of no less than 500 m from the ground.
• The stop of each line counts as a single stop. If the same stop is used by multiple lines, the number of lines is counted.
• If there are two or more stops on a line in the above mentioned radius, only one is counted.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Once identified public transportation network type, stops (with special attentions to interchange nodes about urban and suburban bus transportation lines) and timetable, the main area that cover this indicator comprehends a radial distance of 300 meters for bus service and a radial distance of 500 meters for train service, from the main pedestrian entrance of the building.
Service timetables of public transportations must be referring to weekday in the following time bands: 7:00-9:00, 17:00-19:00.</td></tr>
<tr><td>Barriers</td><td colspan="6">It is necessary to precisely identify the borders of the area you want to calculate the accessibility of, to estimate number of users of public transports and to identify which bus stops are included in the area</td></tr>
<tr><td>Rating</td><td colspan="6">maximum value criteria of 30 points</td></tr>
</table>

	<table><tr><td>Criteria</td><td>Max. points</td></tr><tr><td>Points for each bus-station in a radius of 300 m with hourly frequency or shorter frequency</td><td>6</td></tr><tr><td>Points for each bus-station in a radius of 300 m with half-hourly frequency or shorter frequency</td><td>10</td></tr><tr><td>Points for each railway station in a radius of 500 m with hourly frequency or shorter frequency</td><td>6</td></tr><tr><td>Points for each railway station in a radius of 500 m with half-hourly frequency or shorter frequency</td><td>8</td></tr></table>
References	This indictor was experimented in Project CEC5 [1] [2]
SCALE	
Application	This indicator can be used for buildings but it can be adapted for building clusters or wider areas.
Details	..
Multiscale	--
References	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project" "CEC5 Tool – New Buildings"

REFERENCES	
[1]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"
[2]	"CEC5 Tool – New Buildings"

<table>
<tr><td rowspan="3">SOC.Tr.13</td><td colspan="4">Bicycle Parking (%)</td></tr>
<tr><td>PILLAR</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Transport</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">This indicator shows the percentage between numbers of bicycles, parked in a functional and safe way, and the numbers of users in the building for facilitate the installation of bicycle slots.

The aim is a shift from individual car traffic to bicycle and pedestrian traffic for short and medium distances. As a result, energy demand and CO2 emissions decrease, and the impact of emissions and noise on people's health and the environment get reduced. However, a pre-condition for the regular use of bicycles in everyday traffic, is a sufficient number of bike sheds or/and slots, that should be close to entrances, roofed and protected against theft. The aim is to provide users the fastest possible and barrier-free access to their bicycles and must be in close proximity (<30 meters) of the entrance area.</td></tr>
<tr><td>Background</td><td colspan="4">FASUDIR - Friendly and affordable sustainable urban districts retrofitting. Indicators set at building and district level for assessing the three pillars of sustainability: environmental, economic and social aspects.</td></tr>
<tr><td>References</td><td colspan="4">This indictor was experimented in Project CEC5 [1] [2]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
</table>

Derived from	Software tool		Operational data		In situ measurements	X
	Simple Calculations		Empirical/Literature			

<table>
<tr><td>Details</td><td>Points are awarded based on the number of available parking spaces of the quality and the required number of parking spaces depends on the type of building. The criterion is met if a sufficient number of user-friendly bicycles slots/areas of the quality is available.

Quality of bicycles slots/areas:

- All bicycles parking spaces for users of longer parking times (> 30 minutes)

- The location of the bicycles slots/area must be accessible by cycling, must have good lighting and must be in close proximity (<30 meters) of the entrance area.

- Bicycle underground parking spaces or in underground car parks must be easily accessible by cycling, may be separated from the outside by only one door at maximum and must have direct access to the building.

- Bicycle parking spaces for visitors / short-term parking must be accessible at ground level and not be in lockable rooms.</td></tr>
<tr><td>Areas covered</td><td>Parkings do not have to be necessarily located in peripheral areas, such as in fixed bike racks or dedicated spaces, but can also be located in others common areas easily accessible from the building, such as lobby and garage.</td></tr>
<tr><td>Barriers</td><td>It is not clear the way through which you assign the maximum points.</td></tr>
<tr><td>Rating</td><td>Referenced the maximum value criteria of 25 points, the points are assigned on the base of the presence of dedicated bicycle parking space, referred to the occupant s of the building, or the inhabitants of the area</td></tr>
<tr><td>References</td><td>--</td></tr>
</table>

SCALE	
Application	This indicator can be used for buildings but it can be adapted for building clusters or wider areas
Details	--
Multiscale	--
References	“CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project” “CEC5 Tool – New Buildings”

REFERENCES	
[1]	“CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project”
[2]	“CEC5 Tool – New Buildings”

<table>
<tr><td rowspan="3">ENV.Ma.01</td><td colspan="4">Low pollutant and low emission materials (-)</td></tr>
<tr><td>PILLAR</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Materials</td><td>S</td><td>B</td></tr>
</table>

GENERAL	
Description	A building is like a third skin. Over 90% of our lives are spent in buildings. In so far the quality of the buildings and of the air strongly affects our quality of life. The quality of indoor air in rooms is not only determined by the user, but also by the used construction material and the chemicals it contains. Solvents, formaldehyde or pesticides can escape from the construction material and so pollute rooms and make them hazardous for people's health possibly for weeks. Under consideration of the technical requirements, the "pollutant content" in building materials and therefore also in the air can be reduced by up to 95%. Goal-oriented planning (e.g. constructive protection instead of chemical protection, maintenance-free and easy-to-clean constructions, choice of material suitable for use) as well as a tendering that aims at emission-reduction, leads to both better quality of work at the construction site and better indoor-climate for the users.
Background	This indicator has been adopted in a previous project called "ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.
References	This indictor was experimented in Project CEC5 [1] [2]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		

Details	Before the start of the work, together with the responsible building company a list of building products is drafted ("Agreed building products"). In addition, the materials suppliers, at least within two weeks since the beginning of the work, must submit a complete list of all the products used for construction and any documentation that may be necessary to ensure the minimum ecological quality. All construction products used must be controlled and authorized by an external consultant or by an independent internal specialist. At the same time as the mandatory controls of the work direction, at least three inspections of the yard must be carried out. Only construction products on the list can be used. Concrete construction products can only be found in the site in their original packaging. At the conclusion of the project, the client receives a final report on the measurements employed with documentation value.
Areas covered	--
Barriers	Even if the score is assigned in a qualitative way, by testing the presence of below elements, it is not easy to obtain the basic data to calculate the score. The most difficult elements to obtain are the materials certifications
Rating	Referenced the maximum value criteria of 60 points.

Criteria	Max points

	Does exist a documentation of the ecological optimization of the materials during the planning phase?	10
	The tender for all craftworks have been declared ecologically?	
	100 % of works 90 % of works 70 % of works	20 15 10
	Have all products of all craftworks been declared ecologically?	
	100 % of works 90 % of works 70 % of works	30 20 10
	Does an ecological building supervision exist? Did the supervisor do regularly inspections on the building site?	
	Total construction process Parts of the construction process	20 10
	Total	60
References	--	
SCALE		
Application	This indicator can be used for buildings but it can be adapted for building clusters or wider areas	
Details		
Multiscale	--	
References	"CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"	

REFERENCES	
[1]	CEC5 Tool – New Buildings"
[2]	CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

ECO.Qu.12	**Process and planning quality (-)**			
	PILLAR	**CATEGORY**	**LEVEL**	**SCALE**
	Economic	Quality	S	B/ N
GENERAL				
Description	Building has to be useful and built to answer a specific need. This adaptation to the needs has to be evaluated through adaptation to the use and users and sustainability. One efficient method is to launch competition to select the conception team.			
Background	This indicator has been adopted in a previous project called "ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.			
References	This indictor was experimented in Project CEC5-[1] [2]			
LEVEL				

Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			
Details						
Areas covered	--					
Barriers	--					
Rating	Maximum value criteria of 25 points.					

Criteria	Points (max. 25)
Is there any documentation on the decision-making process?	10
Have variants been verified and evaluated?	5
Is verification and confirmation of variant 0?	5
Is there a documented evaluation scheme for checking variants?	4
It contains: city planning Accessibility and increased traffic Exploitation of land - soil quality energy efficiency Use of ecological materials	 2 2 2 2 2

References	--
SCALE	
Application	This indicator can be used for buildings but it can be adapted for building clusters or wider areas
Details	--
Multiscale	--
References	"CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

ECO.Ma.04	User information			
	PILLAR	CATEGORY	LEVEL	SCALE
	ECO	Management	B	B

GENERAL						
Description	Users have a significant influence on the energy consumption of buildings. The goal is to provide useful information to users for manage the building in an efficiently way, from an energy point of view and without compromising comfort.					
Background	This indicator has been adopted in a previous project called "ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.					
References	This indictor was experimented in Project CEC5 [1] [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		
Details	User information is provided through a manual. It should include the main aspects of the topics such as: room temperature (heating / cooling regulation), mechanical ventilation and ventilation through the windows, sun and reverb protection, general lighting and workplace lighting, efficient use of energy-consuming appliances (PCs, printers, etc.) Verify that technical documentation relating the construction is archived and that such documentation is accessible to the operator in order to optimize its management and maintenance. In particular, check which of the following documents are, or will be, archived: - General report - Specialist reports - Technical drawings - Maintenance plans - "As-Built" drawings - Documentation concerning the construction phase of the building (such as photographic or/and video documentation, technical reports, etc.)					
Areas covered	--					
Barriers	--					
Rating	Maximum value criteria of 25 points.					
References	--					
SCALE						
Application	This indicator can be used for buildings but it can be adapted for building clusters or wider areas					
Details	--					

Multiscale	--
References	"CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

ENV.En.09	Heading demand (kWh/m2 yr)					
	PILLAR		CATEGORY		LEVEL	SCALE
	Environmental		Energy		A	B
GENERAL						
Description	Reducing energy demand for heating is a long-term solution that can be estimated in advance and aimed at reducing the use of energy and all emissions of harmful substances. A well-insulated building with low-emissivity glass allow to reduce energy consumption for heating environments, offering a high degree of comfort. The high temperature of inner surfaces of the building, in an identical external temperature condition, causes that the perceived temperature results to be higher.					
Background	This indicator has been adopted in a previous project called "ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.					
References	This indictor was experimented in Project CEC5 [1] [2]					
LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature			
Details	Calculation of the thermal energy parameter for heating with PHPP version 6.1 (2012). The calculation must be performed on the microclimate.					
Areas covered	--					
Barriers	--					
Rating	Maximum value of 100 points. Scoring is based on the heating energy parameter required for PHPP. The minimum requirements by Heating Energy Parameter are based on the Area/Volume ratio. - For buildings with an A/V ratio of 0.8 or higher the minimum parameter is 50 kWh/m2 of Effective energy related area in sm - For buildings, while for buildings with an A/V ratio of 0.2 or less the minimum parameter is 3 kWh/sm of Effective energy related area in sm. The intermediate values of the minimum requirements are derived from linear interpolation. The maximum score is assigned regardless of the A/V ratio for Heating Energy Parameter <15 kWh / sm of Effective energy related area in sm The minimum score of 25 is assigned when the heating energy parameter for the PHPP of the building reaches 50 kWh / m2 of Effective energy related area in sm (only for buildings with A / V over 0.8) . For buildings with an Low A / V ratio, rigorous minimum requirements applies. The maximum score of 100 is assigned in the presence of a heating energy parameter of max. 15 kWh / m2 of Effective energy related area in sm. The intermediate values result from linear interpolation.					

References	--
SCALE	
Application	This indicator can be used for buildings
Details	--
Multiscale	--
References	"CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

ENV.En.06	Cooling demand (kWh/m2 yr)					
	PILLAR	CATEGORY		LEVEL	SCALE	
	Environmental	Energy		A	B	
GENERAL						
Description	In last years the active cooling of buildings, (kindergartens, municipalities and gyms) played a secondary role. However in the last few years more and more buildings are growing at an active cooling rate with a large number of windows. General optimization of energy consumption, cooling energy must be avoided or minimized.					
Background	This indicator has been adopted in a previous project called "ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.					
References	This indictor was experimented in Project CEC5 [1] [2]					
LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature			
Details	Calculation of the thermal energy parameter for cooling with PHPP version 6.1 (2012).					
Areas covered	--					
Barriers	--					
Rating	maximum value of 100 points. Score assignment is based on the PHPP power useful heat parameter. The basis for calculation in PHPP on the "summer" sheet should be the 25°C over temperature limit. The criterion for assignment of the score is the implementation of systems to reduce the cooling load and limit solar emissions (window size, quality and window orientation, temporary sun protection, reduction of internal heat sources, activation of a thermal mass for cooling, etc.). These systems are evaluated on the basis of the following reference values: - overpass the overcurrent temperature of 25°C max. 10% (PHPP sheet "summer") - cooling load per specific area max. 5 W/m2 (PHPP Sheet "Cooling Load") The minimum score of 10 is assigned when the energy cooling parameter has a maximum value of 15 kWh/m2 EBFa. The maximum score of 100 is assigned when the energy cooling parameter value is equal to of 5 kWh/m2 EBFa. The intermediate values of the minimum requirements are derived from linear interpolation.					
References	--					
SCALE						

Application	This indicator can be used for buildings
Details	--
Multiscale	--
References	Publication reference: "CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

ENV.En.13	Operational Primary energy demand (kWh/m2 yr)			
	PILLAR	CATEGORY	LEVEL	SCALE
	Environmental	Energy	A	B / N

GENERAL	
Description	The goal is to reduce the overall energy consumption of buildings in all areas, considering the chain processes from the beginning
Background	This indicator has been adopted in a previous project called "ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.
References	this indictor was experimented in Project CEC5 [1] [2]

LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature			
Details	Calculation of the primary energy demand with PHPP program - version 6.1 (2012)-, aligned to draft ISO 52000 Operational primary energy demand.					
Areas covered	--					
Barriers	--					
Rating	Maximum value of 125 points. Primary energy factors apply in PHPP program referred to all energy consumptions including heating systems, cooling systems, hot water-production systems, lighting systems and other power application. The minimum score of 25 points is assigned when a primary energy parameter of 240 kWh/m2 of Effective energy related area in sm per year is reached. The maximum score of 125 is assigned when a primary energy parameter of max. 120 kWh/m2 of Effective energy related area in sm per year is reached. The intermediate values result from linear interpolation.					
References	--					

SCALE	
Application	This indicator can be used for buildings
Details	--
Multiscale	--
References	Publication reference: "CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

ENV.Im.11	Global Warming Potential (kgCO2-eq/m2 yr)			
	PILLAR	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Impacts	S / A	B / N

GENERAL						
Description	The goal is to reduce CO_2-equivalent emissions during building life cycle.					
Background	This indicator has been adopted in a previous project called "ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.					
References	This indictor was experimented in Project CEC5 [1] [2]					
LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature			
Details	Calculation of primary energy parameter with PHPP program -version 6.1 (2012)-.					
Areas covered	--					
Barriers	--					
Rating	Maximum value of 75 points. The CO2-equivalent factors are applied in PHPP program referred to all energy consumptions including heating systems, cooling systems, hot water-production systems, lighting systems and other power application. The minimum score of 10 points is assigned when maximum value of 60 kWh/m2 of Effective energy related area in sm per year is reached. The maximum score of 75 points is assigned when maximum value of 26 kWh/m2 of Effective energy related area in sm per year is reached.					
References	--					
SCALE						
Application	This indicator can be used for buildings, but it can be adapted to neighborhoods					
Details	--					
Multiscale	--					
References	Publication reference: "CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"					

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

SOC.TC.03	**Thermal comfort in summer (-)**			
	PILLAR	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Thermal Comfort	A	B

GENERAL

Description	In our modern architecture and change destination uses make possible that summer energy consumption reaches or even exceeds winter one, even in our latitudes. For guarantee thermal comfort, the main aspect is represented to solar emissions that, if not consider, bring to a thermal comfort loss or to a high energy consumption. Creation of a pleasant indoor climatic condition essentially contributes to user wellness, and better concentration especially for office buildings which require a high internal thermal loads therefore pose a special planning challenge. Thermal comfort is an important factor for user satisfaction on workplaces. The relative regulations on workplaces stipulate limits value that must be respected and guaranteed. An optimal combination between window area ratio, heating and cooling systems, sun systems protection, heat insulations and other influentially factors, ensure a comfortable indoor temperature every season. For reasons of energy efficiency, passive systems (such as night cooling, gravity ventilation in combination with efficient shading systems - as required by the relevant emission areas), are generally preferred to active cooling systems (such as surface, and air cooling). The use of active cooling systems requires a detailed proof that the comfort goals according to EN ISO ÖN 7730 were achieved, by simulating the most critical areas. With active systems the planned room temperatures (and partly also the desired room humidity) can be better reached. Still, in addition to the increased energy use, further parameters, such as draft and radiation asymmetries, play a substantial role for the actual comfort conditions.
Background	This indicator has been adopted in a previous project called “ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.
References	This indictor was experimented in Project CEC5 [1] [2]

LEVEL

Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature			

Details	For buildings with a glass surface area below 35% of the total facade and without excessive internal loads (normal use of offices, classes, gyms, etc.), the test of summer efficiency can be provided with methods Stationary or semi-stationary. (ÖNORM B8110-3, KB * according to OIB RL-6 or PHPP) For buildings with a high percentage of glass surface, over 35% of the total, or buildings / environments with special internal loads (conference rooms, exhibition areas, computer rooms, etc.), it is necessary to provide dynamic simulations of ambient temperatures Which demonstrate the cooling loads and energy used for cooling. For Buildings without installed cooling capacities or with free-cooling systems: dynamic cooling load calculation / simulation under defined climatic conditions, evidence that comfort conditions are maintained for critical areas.

	For Buildings with active cooling: Cooling load calculation according to OEN H 6040 or VDI 2078, cooling demand according to. OEN B 8110-6, installed cooling capacity, indication of the type of cooling (surface cooling, air cooling: Displacement ventilation, air swirl, mixed ventilation, combination systems, etc.)
Areas covered	--
Barriers	--
Rating	maximum value of 150 points.

Criteria	Max points
Building with less than 35% windows surfaces and without active cooling system	
Analysis based on ON B8110-3	50
or analysis based on OIB RL-6; KB* < 0,4 kWh/m^3a	50
or analysis based on OIB RL-6; KB* < 0,6 kWh/m^3a [1]	35
or analysis PHPP exceeding 26 °C < 5 %	65
Dynamical building simulation (at least for critical rooms) considerating the local climate, flexible shading systems and the respected usage of the building	
Exceeding 26°C<5% without active cooling systems (e.b. free night cooling)	150
Exceeding 26°C < 10% without active cooling system	50
Exceeding 26°C < 3% without active cooling system. It is possible to choose between 26°C and 27 °C, to be indicated in the report	75
Analysis to prevent air currents (v < 0,1 m/s, ΔT < 2K at the domicile)	75

References

ÖN EN ISO 7730:2006	Ergonomie der thermischen Umgebung – Analytische Bestimmung und Interpretation der thermischen Behaglichkeit des PMV- und PPD-Indexes und Kriterien der lokalen thermischen Behaglichkeit [ISO 7730: 2005]
ÖN EN 15251:2007	Eingangsparameter für das Raumklima zur Auslegung und Bewertung der Energieeffizienz von Gebäuden – Raumluftqualität, Temperatur, Licht und Akustik
AStV	Arbeitsstättenverordnung (AStV): Verordnung des Bundesministeriums für Arbeit, Gesundheit und Soziales, mit der Anforderungen an Arbeitsstätten und an Gebäude auf Baustellen festgelegt und die Bauarbeiterschutzverordnung geändert wird, 1999
CFD	CFD (Computional Fluid Dynamics) – Software Fluid

SCALE	
Application	This indicator can be used for buildings
Details	
Multiscale	--
References	Publication reference: "CEC5 Tool – New Buildings"

	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

SOC.AC.02	Comfort ventilation - hygiene and soundproofing (dBA)			
	PILLAR	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Acoustic Comfort	S	B

GENERAL

Description	Controlled ventilation must contribute to improving air quality and overall improvement in the quality of environments and, even for this reason, sound input system is also has been considered. The goal is to avoid exceeding the maximum noise level value of 1dB when the ventilation system is activated, that means system will not disturb you during normal use of the room.
Background	This indicator has been adopted in a previous project called "ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.
References	This indictor was experimented in Project CEC5 [1] [2]

LEVEL

Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature			

Details	The objective is reached when standard acoustic intensity (evaluated "A") caused by activity of the system should not exceed the expected background noise level and low frequency acoustic emissions are considered and separately evaluated. While standard acoustic intensity (evaluated "C) should not exceed the expected background noise level by more than 20 dB, considering the octave bandwidth of more than 63 .
Areas covered	--
Barriers	--
Rating	maximum value of 40 points.

Criteria	Max points
Sound transmission calculation (depending on the room use), prognostic of expected sound presser level	
LA,nT < 30 dB e LC(50-4000),nT < 50 dB	20
Sound emission measurement (calculation?) on most exposed working place	
LA,nT < 30 dB e LC(50-4000),nT < 50 dB	30
Sound emission measurement (calculation?) on most exposed working place	
LA,nT < 30 dB e LC(50-4000),nT < 50 dB	40

References	--

SCALE

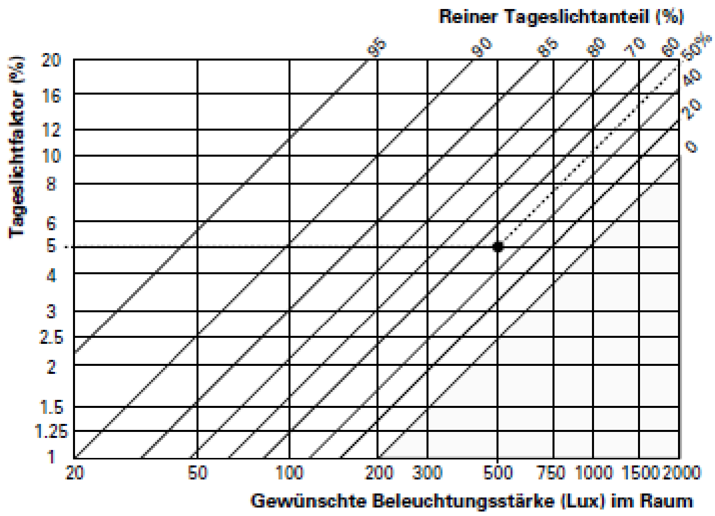
Application	This indicator can be used for buildings

Details	
Multiscale	--
References	"CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

SOC.VC.02	**Availability of Daylight (%)**			
	PILLAR	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Visual Comfort	S / A	B

GENERAL	
Description	This indicator provides the calculation procedure for mid daylight factor. The factor is calculated separately for the building and it's an integrant part of the assessment of category B "Energy and Supply"in PHPP. If daytime light is correctly used, we can reduce energy consumption for artificial lightning in all the building. The goal is reaching a daylight factor of 5%, while a factor below 2% is considered negative. The table below shows the daylight requirements through daylight intensity on the respective daylight factor. These values consider an annual working hours from 7:00 to 17:00 in winter, and from 8:00 to 18:00 in summer, in cloudy atmosphere conditions.



Background	This indicator has been adopted in a previous project called "ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.
References	This indictor was experimented in Project CEC5 [1] [2]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			
Details	It's extremely difficult evaluate light intensity of a room exposed to direct sunlight exposition because there's a constantly variation of sun position and of direct irradiation. For these reasons is preferred to define cloudy atmosphere conditions					
Areas covered	--					

Barriers	--
Rating	maximum value of 40 points. The calculation is the relation between available external daylight and indoor light intensity of room. This ratio is called Daylight Factor (D) and is expressed as a percentage. E_p = daylight intensity on work surface E_{hz}= horizontal daylight intensity (see table below) Technical measurements of mid daylight value should be calculated in at least 5 different points evenly distributed in usual living places of the building. The mid daylight value is the resulting arithmetic calculation of other values
References	--
SCALE	
Application	This indicator can be used for buildings
Details	
Multiscale	--
References	Normative reference: ÖNORM EN 15193: 2008 01 01. Energetische Bewertung von Gebäuden – Energetische Anforderungen an die Beleuchtung. Österreichisches Normungsinstitut, Wien. “CEC5 Tool – New Buildings” “CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project”

D values	Points
< 2 %	0
2-3 %	10
3-4 %	30
5 %	40

REFERENCES	
[1]	“CEC5 Tool – New Buildings”
[2]	“CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project”

<table>
<tr><td rowspan="3">ENV.En.22</td><td colspan="4">PV-power plant (kWh/a)</td></tr>
<tr><td>PILLAR</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Energy</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Networked photovoltaic systems are considered in this indicator as a measure to enhance use of RES. No free installations are considered, but only installations connected with the building or with annexed buildings (Integrated in the roof, in the facades, on flat roofs).

Scenario assumption is the design of the plant with the aid of a suitable calculation program.

The points assignment is based on the annual performance of the plant</td></tr>
<tr><td>Background</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">This indictor was experimented in Project CEC5 [1] [2]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">

Software tool	X	Operational data		In situ measurements	
Simple Calculations		Empirical/Literature			

</td></tr>
<tr></tr>
<tr><td>Details</td><td colspan="4">The goal of this measure is the increase in the percentage of solar energy production..</td></tr>
<tr><td>Areas covered</td><td colspan="4">buildings</td></tr>
<tr><td>Barriers</td><td colspan="4">--</td></tr>
<tr><td>Rating</td><td colspan="4">The minimum requirement is an annual output of 3.5 kWh of photovoltaic energy for sm This corresponds to a photovoltaic surface of approx. 0,035 sm of Effective energy related area in sm

If this minimum requirement is reached, 10 points are awarded.

The maximum score of 50 is assigned if an annual output of 14 kWh of photovoltaic energy is achieved at m2. This corresponds to a photovoltaic surface of approx. 0.14 sm of Effective energy related area in sm

The intermediate values result from linear interpolation.</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">This indicator can be used for buildings but it can be adapted for building clusters or wider areas.</td></tr>
<tr><td>Details</td><td colspan="4">The interest of the indicator is to evaluate the capacity of buildings and areas to produce energy from RES.

Customer Documentation

• Calculation of photovoltaic efficiency with a suitable program containing regional climatic data, taking into account local shading.

• Module data sheet / components selected</td></tr>
</table>

	• Graphic design of the position and surface of the solar panels
Multiscale	--
References	"CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

ENV.Wa.16	Water consumption & use of rainwater (-)					
	PILLAR	CATEGORY		LEVEL	SCALE	
	Environmental	Water		S	B	
GENERAL						
Description	The goal is to reduce the drinking water consumption on the one hand and, on the other hand, in the event of heavy precipitation, to ensure water retention through specific measures.					
Background						
References	This indictor was experimented in Project CEC5 [1] [2]					
LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	X
	Simple Calculations		Empirical/Literature			
Details	Measures are taken to reduce the consumption of drinking water and, in the event of heavy rainfall, ensure retention.					
Areas covered	--					
Barriers	--					
Rating	Projects are assigned points based on the performance performed below to a maximum value of 20 points.					
References	--					

Rating table:

Parameter	description	points
Use of taps that allows rational use of water	Reduction of water consumption by at least 50% compared to standard taps	5
Use taps with sensors	Using taps with infrared sensor	5
Double water flush (2 stop buttons)	Maximum water quantity: 6 liters, or 3 liters for urinals	5
Use of waterless urinals	Exclusively use of urinals without water	5
Use of rainwater in the outdoor areas	Use of rainwater (eg through tanks) for outdoor areas	5
Realization of a green roof	Creating a green roof (or terracing at least > 50% of the roof surface), minimum substrate thickness: 7 cm	10

SCALE	
Application	This indicator can be used for buildings but it can be adapted for building clusters or wider areas .
Details	--
Multiscale	--
References	"CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

<table>
<tr><td rowspan="3">ENV.Bi.01</td><td colspan="4">Ecological quality of the building site (-)</td></tr>
<tr><td>PILLAR</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Biodiversity</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The goal is to encourage the selection of sites that have low ecological value or that are ecologically stable.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">This indictor was experimented in Project CEC5 [1] [2]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
</table>

Derived from	Software tool		Operational data		In situ measurements	X
	Simple Calculations		Empirical/Literature			

Details

Assessment method

1. Analysis of the pre-development range of flora existing on the site;
2. For each kind of flora identified, it has to be defined the area occupied and the relative extension (m2);

At each area it has to be assigned a code (from a1 to a6) on the base of the following table:

Code	Ecologic conditions	Typologies
a1 – area with zero ecological value	Autochthon flora destroyed. Natural regenerative dynamics absent. No elements of the local potential flora.	Rubbles, buildings, infrastructures, road borders.
a2 – area with very low ecological value	Autochthon flora substituted. Natural regenerative dynamics absent.	Agricultural fields, orchards, wineries, grass lawns (extensive).
a3 – area with low ecological value	Autochthon flora degraded. Natural regenerative dynamics present.	Artificial woods, abandoned agricultural fields and grass lawns, pasture land (low extensive)
a4 – area with medium ecological value	Autochthon flora - simple structure. Dominant presence of the local potential flora.	Pasture lands, natural grassland prairies, reforestation of autochthon vegetation.
a5 – area with high ecological value	Autochthon flora – secondary character.	Structured secondary woods and shrubs.
a6 – area with very high ecological value	Stable autochthon flora, undisturbed.	Primary woods and shrubs, grass lawns (height).

3. The overall extension (m2) of the areas with the same code (from a1 to a6) has to be calculated;
4. The Indicator's value is calculated as a weighted sum:

$$\frac{s1\times1+s2\times2+s3\times3+s4\times5+s5\times7+s6\times10}{s1+s2+s3+s4+s5+s6}$$

Where:
s1 = total extension of the areas with code a1 - zero ecological value [m2]

	a2 = total extension of the areas with code a2 - very low ecological value [m2] a3 = total extension of the areas with code a3 - low ecological value [m2] a4 = total extension of the areas with code a4 - medium ecological value [m2] a5 = total extension of the areas with code a5 - high ecological value [m2] a6 = total extension of the areas with code a6 - very high ecological value [m2] 5. On the base of the indicator's value , the performance score ranging from -1 up to 5 (interpolation must be applied) is calculated on the base of the following linear scale:
Areas covered	--
Barriers	--
Rating	the performance score ranging from -1 up to 5 (interpolation must be applied) is calculated on the base of the following linear scale. By applying the "Land ecological value calculator" you calculate the performance score up to 30 points.
References	--

Performance score	Calculated Ecological value of land
-1 – negative	>5
0 – standard	5
3 – good	2.6
5 - excellent	1

SCALE	
Application	This indicator can be used for buildings but it can be adapted for building clusters or wider areas .
Details	---
Multiscale	--
References	"CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

<table>
<tr><td rowspan="3">ENV.Ma.02</td><td colspan="4">Building materials and construction, OI3 index</td></tr>
<tr><td>PILLAR</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Materials</td><td>A</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The ecological production costs for a building at the current building standard are about equally high as the ecological costs for heating a passive house for 100 years. Therefore, the ecological optimization of the expenditures in the construction-phase is an important part of ecological building.

Ecological optimization is defined by minimization of material flow, energy demand and emissions in the production process of the building and the used building materials.</td></tr>
<tr><td>Background</td><td colspan="4">This indicator has been adopted in a previous project called “ENERBUILD - ENERgy Efficiency and Renewable Energies in the BUILDing Sector in the Alpine Space.</td></tr>
<tr><td>References</td><td colspan="4">This indictor was experimented in Project CEC5</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="4">This optimization process can be carried out using Ökoindex 3 which encompasses 3 environmental parameters: the non-renewable primary energy requirement, the global warming potential and the acidity potential.

A score per square meter of constructive element is calculated from 0 to 100. The OI3 value of the building is lower if the use of non-renewable energies is reduced and if during the production of building materials and the construction of the building Less greenhouse gases or other substances are emitted.

More use of reproducible raw materials and the use of ecological production processes normally provide a better building Ökoindex 3</td></tr>
<tr><td>Areas covered</td><td colspan="4">--</td></tr>
<tr><td>Barriers</td><td colspan="4">--</td></tr>
<tr><td>Rating</td><td colspan="4">maximum value of 200 points.
The manufacturing ecological cost of a building results from the production process has an immediate effect, while ecological cost of exploitation arises only during use. Therefore, ecological manufacture optimization is directly relevant to environment protection (e.g. CO2 building industry certificates).
Buildings are best valued if their manufacturing cost is in accordance with Ökoindex OI3.
The points for evaluation are calculated using the following formula based on the OI3 Value between 38 and 295.
$Punkte = 2*(0{,}0007*OI3_{TGH-BGF}^{2} - 0{,}623*OI3_{TGH-BGF} + 12)$

to OI3. ≤ 38 you assign 200 points;

to OI3 ≥ 295 you assign 0 points;</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
</table>

SCALE	
Application	This indicator can be used for buildings but it can be adapted for building clusters or wider areas
Details	
Multiscale	--
References	"CEC5 Tool – New Buildings" "CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

REFERENCES	
[1]	"CEC5 Tool – New Buildings"
[2]	"CEC5 Result Booklets - Key deliverables and benefits of the CEC5 Project"

A.4 – CLUE / ITACA

This Project is funded by the European Regional Development Fund through the INTERREG IVC programme

CLUE

Climate Neutral Urban Districts in Europe

http://www.clue-project.eu/

The project Climate Neutral Urban Districts in Europe, CLUE, tackles the challenges modern sustainable cities are facing. A climate neutral urban district uses innovative new technology and building techniques to reduce its carbon footprint.
A consortium of local and regional authorities as well as universities from 9 European countries aims to increase the local and regional capacity in policy development, to facilitate the implementation and assessment of new solutions and technologies for a low carbon economy in urban areas.
Working with climate neutral urban districts requires experimental attitudes, new business models, cooperation beyond administrative borders and the involvement of many stakeholders and sectors.

A.4 – CLUE / ITACA

Protocollo ITACA Scala Urbana

ISTITUTO PER L'INNOVAZIONE E TRASPARENZA DEGLI APPALTI E LA COMPATIBILITA' AMBIENTALE

http://www.itaca.org/valutazione_sostenibilita.asp

This protocol was approved by the Executive Council of ITACA (Institute for Innovation and transparency of procurement and environmental compatibility) and also technical body of the Conference of Regions and Autonomous Provinces, during the meeting of 21 December 2016.
The document was developed within the interregional working group "urban scale Protocol". It is a protocol dedicated to the transformation of urban areas, the concept of sustainability is increasingly considered as a complex set of "quality" able to respond to citizens' needs. It represent a new challenge for the development of an assessment system for urban areas. It's a multi scale tool applicable to the cluster, neighborhood, district and city. The protocol is targeted at whole life stages (design, construction and operation) and to new and existing urban areas. It's also a tool useful to support cities in their planning activities and target definition (performance based). Results achieving verification.
District retrofitting approach is frequently the most sustainable one: synergies among buildings, wasted energy exploitation, efficient use of renewable energy sources, cogeneration systems, economy scale factor.

Following the path marked by "Protocollo ITACA building scale", the urban scale ratings system followed a set of principles that have formed the basis for the identification of the most appropriate evaluation criteria to fully express the sustainability of urban interventions, in order that the protocol could represent a system:

- Complete, including all sustainability issues;
- Open, the use of open data from databases;
- Accessible, using clear and understandable metrics;
- Rigorous, use of scientific assessment methodologies;
- Performance based, the assessment of the performance not of the solutions;
- Flexible, the assessment at different urban scales;
- Contextualized, the use of local benchmarks and local priorities reflected.

SOC.Ac.22	Development and integration of land parcels (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Accessibility	A	N
GENERAL				
Description	The criterion calculates the amount of cadastral lots in the analyzed area and relates it to the value of the surrounding areas. The goal is to promote the homogeneous development of the existing blocks, and also the variety and inclusion of new areas in the context. The subdivision is the fragmentation of land which is carried out in order to obtain individual portions separated from each other: lots become separate units, in legal terms and therefore with regard to the properties, and also in administrative one. Historically, the division into lots, defining the properties, has influenced to a considerable extent on the morphology and on the size of the buildings; it is for this reason that the indicator has a fundamental importance for the morphological structure. In fact, a lot of small lots will constitute an obstacle to the realization of large isolated buildings and often surrounded by an empty space, forming on the contrary a continuous and dense urban fabric. This latter morphological typology it is typical of our city, and more generally of the Italian cities, especially with regard to the historic town. But we must not forget that the size of the buildings, and therefore the lots, goes together with the function of these buildings, and so it is necessary also some variety: thinking about, for example, a landmark building in a city, usually it is oversized and breaking with the environment, such as a museum, a university, a hospital, etc. The indicator that is calculated is an intensity indicator, which measures the concentration of the lots present in a certain area. Lots quantified are then compared with the average value of the city.			
Background	CLUE, Protocollo ITACA.			
References	[1], [2], [3], [4], [5]			
LEVEL				
Derived from	Software tool [ ] Operational data [ ] In situ measurements [ ] Simple Calculations [X] Empirical/Literature [ ]			
Details	For the calculation of the performance indicator proceeds as follows: 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). 4. Calculate the percentage deviation between the value of the area (A) and the average of the city or surrounding areas (B): (A / B) -1 * 100.			
Areas covered	Main focus on neighbourhood scale.			
Barriers	-			
Rating	The criterion evaluates the percentage deviation of the value for the number of cadastral lots in the analyzed than the city average. The value obtained from the area considered is then compared with the average value of reference of the city or of the adjacent areas, because the urban area in which it is inserted is the reference to be taken into consideration. This allows to have a benchmark calibrated to the specific situation in the evaluation phase: in fact it would be inappropriate to establish a reference value in absolute terms, untied from the context and undifferentiated.			
References	[1], [2], [3], [4], [5]			
SCALE				
Application	Applicable to the neighbourhood scale.			
Details	The “Scale” characterization is that of the neighbourhood.			
Multiscale	-			
References	[1], [2], [3], [4], [5]			

REFERENCES

[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA'S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

SOC.Ac.23	Homogeneity of the urban fabric (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Accessibility	A	N

GENERAL	
Description	The criterion evaluates the length of the perimeter of the area which is directly adjacent to urbanized areas. This value is divided by the total length of the perimeter of the area considered. The aim is to fill the voids of the urban fabric and at the same time to contain the peripheral expansion. The constitutive components of the urban form can be volumes and also open spaces, which are juxtaposed in the urban landscape, giving rise to forms of settlement that may present characters of unity or formal homogeneity, on the basis of their morphological characters. Urban sprawl, better known as diffuse city, it indicates a rapid and disorderly growth of a city. This phenomenon is often manifested in the recent expansion of peripheral areas and subjected to constant changes, having as a characteristic sign low population density and adverse effects such as the reduction of green spaces and soil consumption. Another consequence of urban sprawl is the dependence on cars because of the greater distance from services, from the workplace, the local public transport. In general, we note the lack of infrastructure for alternative mobility as cycle tracks, pavements or pedestrian crossings properly connected. The indicator, on the basis of the foregoing, has a fundamental importance to provide an understanding of the type of urban fabric with respect to which is conducted the analysis. An urban intervention in adjacency to already urbanized areas is considered more sustainable, as it avoids that we are going to affect free soil. At the same time it is essential to avoid the uncontrolled expansion peripheral and stimulate, on the contrary, the recovery of lots or large urban areas abandoned and discontinued. The policy can be applied to evaluate an existing area and a project one. In a similar way and in either case the length of the perimeter of the area covered by urban evaluation is quantified adjacent to urbanized areas, compared to total perimeter of the area in such a way as to obtain a percentage value.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to fill the gaps in the urban fabric and contain the peripheral expansion. For the calculation of the performance indicator proceeds as follows: 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.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion evaluates the length of the perimeter of the area analyzed which is directly adjacent to urbanized areas. The higher the percentage is, the better the performance of the area will be.
References	[1], [2], [3], [4], [5]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online].

	Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA'S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

ENV.LU.02	Preservation of land (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Environmental	Land Use	A	N
GENERAL				
Description	The criterion evaluates the reuse of soil previously occupied and / or contaminated for the construction of new buildings and infrastructure, for this reason it is only calculable for new construction areas. The aim here is to contain and stop the consumption of soil. The ground is in fact a non-renewable resource, characterized by a very rapid potentially degradation and at the same time by the processes of formation and regeneration extremely slow. The importance of this indicator is therefore clear: the free soil and agricultural land, becoming more and more scarcer, due to urban sprawl and fragmentation events, are the key elements for safeguarding the ecological and environmental balance, and therefore they must be protected. The elements that are considered here are essentially two: the consumption of soil from infrastructured surface and the consumption of soil by urbanized surface. These lead to the loss of the natural character of the soil and, between the devastating environmental consequences, we can mention the progressive increase of impervious surface, with the consequent impediment to water absorption. This is why the currency policy positively preserved the soil surface. The theme is very timely: in this regard the Council of Ministers recently approved a draft law on "Containment of the loss of land and soil reuse built", whose goal is to enhance the soil as a resource to protect and promote reuse and regeneration of already urbanized areas.			
Background	CLUE, Protocollo ITACA.			
References	[1], [2], [3], [4], [5]			
LEVEL				

Derived from						
	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to reduce soil consumption. To assess this criterion, assign to each homogeneous part of the cluster a weight as follows: - undisturbed land weight = -1 - agricultural land weight = 0 - occupied land weight = 3 - contaminated land weight = 5 Multiply each surface area by its weight and sum the weighted values. Divide the weighted by the total area.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion evaluates the percentage of reused land out of the total. The benchmark here is represented by agricultural land, to which it is assigned a weight equal to 0. It is therefore necessary for the purposes of a sustainable design achieve superior performance to this.
References	[1], [2], [3], [4], [5]
SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].

[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA'S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

ENV.LU.01	Conservation of built environment (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Environmental	Land Use	A	N

GENERAL	
Description	The criterion evaluates the existing built surface area (SLP, road surface, etc.) preserved compared to the total surface area, and therefore it is only calculable for new construction areas. The aim on one hand is to preserve, where possible, the existing urban morphology, on the other hand to reduce the consumption of soil and building materials. This allows a reduction of costs, especially as regards the construction materials, and a continuity of the existing urban forms, often crucial for the overall morphology of an area, that a limitation of consumption of soil, exhaustible resource to be protected. Must be excluded from the total surfaces that for different reasons are not preservable. It is important to emphasize how this indicator is applicable not only to the conserved and renovated buildings, but also to the road surface preserved: this aspect results to be critical to counteract the progressive increase waterproofing of soils.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	For the calculation of the performance indicator proceeds as follows: 1. Identify the surfaces preserved in the analyzed area (SLP buildings, road surface, etc.). 2. Calculate the total area preserved (A), as the sum of all preserved surfaces. 3. Calculate the total area (B), excluding from this the surfaces do not preservable. 4. Divide the total area preserved compared to the total surface area and calculate the percentage: (A / B) * 100.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion evaluates the percentage of existing surface preserved compared to the total. The higher this value is, the better the performance of the area will be.
References	[1], [2], [3], [4], [5]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
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[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	PROTOCOLLO ITACA SCALA URBANA http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

SOC.Tr.01	**Availability of safe bicycle routes (m)**					
	ISSUE	**CATEGORY**		**LEVEL**	**SCALE**	
	Social	Transport		A	N	
GENERAL						
Description	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 is distinguished from the sidewalk and motorized traffic, to ensure road safety, in compliance with the different speeds that characterize them. 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.					
Background	CLUE, Protocollo ITACA.					
References	[1], [2], [3], [4], [5]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			
Details	The intent is to ensure safe and continuous routes for cyclists. Calculate the length of safe cycle routes. For the calculation of the performance indicator proceeds 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.					
Areas covered	Main focus on neighbourhood scale.					
Barriers	-					
Rating	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.					
References	[1], [2], [3], [4], [5]					
SCALE						
Application	Applicable to the neighbourhood scale.					
Details	The “Scale” characterization is that of the neighbourhood.					
Multiscale	-					
References	[1], [2], [3], [4], [5]					

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
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SOC.Tr.05	Contiguity of bicycle and car routes (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Transport	A	N

GENERAL	
Description	The criterion calculates the percentage of vehicular traffic with adjacent cycle paths present in the area compared with to the total. The purpose in this case is to encourage the use of bicycles and it can be considered for all purposes as an alternative means of transport. The criterion above it considers the linear meters of cycle path per head without making distinctions, including then in the evaluation also cycling paths, for example, in public parks, etc. This criterion on the contrary wants to emphasize the importance of having bike paths associated with a vehicular route and contiguous to it, in order to actually use the bicycle for all the necessary movements, like the other means of transport. The requirement is to discourage the use of private cars: this would result in a decrease in traffic levels, as well as a decrease in the emission of polluting factors, with a significant improvement in air quality. The cycle paths in the green still remains significant.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	Allow the use of bicycles as an alternative option for transportation. Consider all car routes which have adjacent and safe bicycle routes which connect to the urban cycling network. To evaluate this criterion, are taken into account all the car routes to whom are adjacent safe bike paths connected to the urban cycle network. For the calculation of the performance indicator proceeds as follows: 1. Identify the safe cycle tracks adjacent to vehicular routes in the area. 2. Calculate the linear meters of vehicular traffic in adjacent to safe cycle tracks (A). 3. Calculate the total linear meters of vehicular traffic in the area analyzed (B). 4. Calculate the percentage of vehicular traffic relationship with adjacent to bike paths compared with to the total of vehicular paths A / B * 100.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion evaluates the percentage of road routes with cycle path adjacent compared to the total of the vehicular pathways. The value obtained must therefore be put in comparison with the average value of the city or of the surrounding urban areas, in order to evaluate if the performance are higher or lower than the average of the urban territory in which it is inserted.
References	[1], [2], [3], [4], [5]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
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<table>
<tr><td rowspan="3">SOC.Tr.20</td><td colspan="4">Connectivity of the street network (number /m^2)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Transport</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The criterion takes into account the number of intersections present in the analyzed area comparing them to the overall surface area itself.
The purpose is to quantify the number of interconnections present in the area with the intent to intensify them in order to have a very urban connective tissue. This condition ensures a large number of possible paths in the city, it allows to reduce the distances and the traffic slowdowns, and promotes the pedestrian accessibility. The issue of network connectivity can be considered one of the key elements of urban sustainability, as the road syntax (defined as mobility) is an integral part of the urban syntax. The degree of network connectivity and transport services measures the territorial accessibility, an area will be much more accessible to people and things as far as dense will be the interconnection grid in the area itself.
Streets are therefore among the basic components of the urban morphology and play a fundamental role in the definition of the same. The traditional city are very connective, having a large number of reduced amplitude paths, an average number of roadway of average size and a small number of wide streets with high sliding. In recent expansions, however, the grid is designed primarily for cars, and instead of the avenues we preferred to achieve higher-level roads which created a break with the historical city. The reduced average distance between the intersections and the high density of the same, are important elements for a sustainable mobility, as they reflect the concept of the city on a human scale, livable and also easily accessible on foot.
Based on the above, the importance of considering the connectivity of the road network is relevant for an urban assessment. Within an urban fabric, connectivity ensures the vitality of the city itself, creates customizable alternative path, encourages walking and human interaction, and helps to make the city dynamic.
The criterion can be calculated to evaluate an existing area, or a project one. In a similar way in both cases is counted, the area subjected to analysis, the number of road intersections, relating it to the total surface area.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] | Empirical/Literature [ ]</td></tr>
<tr><td>Details</td><td colspan="4">Generate interconnections to multiply the paths, reduce distances increasing the accessibility.
Quantify the number of intersections in the area.
For the calculation of the performance indicator proceeds as follows:
1. Calculate the total surface of the area analyzed (A)
2. Find in the area road intersections, quantifying them (B)
3. Relate the number of intersections, previously quantified, to the total area: B / A
4. Got the value related to density of intersections in the area (1 / m2).</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion measure the connectivity of the road network by calculating the density of road interconnections. It is quantified by the number of intersections in the road by comparing this value to the mesh surface of the area considered in the analysis.
The value obtained in the area is compared with the average value of the city or to the adjacent areas, because the urban area in which it is embedded is the reference to be taken into account. This allows to have a benchmark calibrated to the specific situation in the evaluation phase: in fact it would be inappropriate to establish a reference value in absolute terms, disconnected from the context and undifferentiated.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
</table>

Multiscale	-
References	[1], [2], [3], [4], [5]

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<table>
<tr><td rowspan="3">SOC.Ac.21</td><td colspan="6">Cyclomatic complexity of the street network (-)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td colspan="2">Accessibility</td><td colspan="2">A</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">The criterion takes into account the number of road intersections, called nodes, which are present in the analyzed area and the number of road sides, or the segments between two consecutive interconnections.
The purpose of this indicator is to quantify the number of possible routes in the area. The more will be the cyclomatic number, the better will be the performance of the area from the point of view of road connectivity. The theme of the road network connectivity is considered one of the key elements of urban sustainability, as the road syntax intended as mobility is an integral part of the urban syntax: the degree of network connectivity and transport services measures the spatial accessibility.
In the calculation of the indicator, compared with the previous one, era also taken into account the sections: the nodes of the road graph represent interconnections of road arteries while segments, between successive nodes, are identified sides. The road graph is strongly connected when a high number of nodes is associated with a consequent large number of sides.
Consequently, it can reinforce the concept that a reduced average distance between the intersections and a high density of the same are important elements for a sustainable mobility, as they reflect the concept of the city on a human scale, livable and also easily accessible on foot.
The criterion can be calculated to evaluate an existing area and for a project one.</td></tr>
<tr><td>Background</td><td colspan="6">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="6">Create many possible paths, allowing a more fluid traffic.
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.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="6">-</td></tr>
<tr><td>Rating</td><td colspan="6">The criterion measure the cyclomatic complexity of the road network by calculating the amount of road interconnections (nodes) and the number of segments (sides) identified between two successive nodes. It subtracts the number of the sides of those nodes and adds an amount equal to 1. The value obtained in the area is compared with the reference value of the city or of the adjacent areas because the urban area in which it is embedded is the reference to be taken into account. This allows to have a benchmark calibrated to the specific situation in the evaluation phase: in fact it would be inappropriate to establish a reference value in absolute terms, disconnected from the context and undifferentiated.</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="6">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="6">-</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5]</td></tr>
</table>

REFERENCES	
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	[Accessed January 23 2014].
[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
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SOC.Tr.22	**Scale of the street network (m)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Social	Transport		A		N
GENERAL						
Description	The criterion takes into account the distance between successive intersections, then calculating an average value of reference. The objective of this indicator is to ensure the possibility of moving on foot or by bicycle for daily routes: if the distances between the major points of interest in the city are not high, people are encouraged to walk displacement. Reduced distances between successive intersections determine, as previously stated for the indicator on connectivity of the road network, an urban fabric very connective and consequently are guaranteed more alternative path. The importance of having small distances between successive intersections makes the cities more on a human scale, encouraging greater social interaction, more alternative route and even minor speed of traffic flow in transit. Studies conducted on the matter, found that, for distances up to 500 m, people are still encouraged to go walk in the places chosen placed at that distance: this discourages private car use for travel, resulting in a decrease in traffic and air pollution. In the calculation of the indicator are taken into consideration sides comprised between two successive nodes, previously identified for the calculation of cyclomatic complexity, and calculates the exact length of each of these traits. They add up the values thus obtained and quantifies the average value of reference for the area based on the number of existing sides. The criterion can be calculated to evaluate an existing area or a project one.					
Background	CLUE, Protocollo ITACA.					
References	[1], [2], [3], [4], [5]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			
Details	The intent is to ensure the possibility to move using bicycle or walking for every day movements. Calculate the average distance between roads intersections. 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.					
Areas covered	Main focus on neighbourhood scale.					
Barriers	-					
Rating	The criterion measure the scale of the road network quantifying the number of segments (sides) identified between two successive nodes and their relative lengths. The resulting sum of the lengths is divided by the total number of sides, in order to obtain the average value of the distance between the intersections of the area. The optimum value of the scale reference of the road network can be a value between 80 and 200 meters, distances that conform to the size of a block type and at a very urban connective tissue.					
References	[1], [2], [3], [4], [5]					
SCALE						
Application	Applicable to the neighbourhood scale.					
Details	The “Scale” characterization is that of the neighbourhood.					
Multiscale	-					
References	[1], [2], [3], [4], [5]					

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
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SOC.Tr.15	Access to public transport: bus, tram, metro (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Transport	A	N

GENERAL	
Description	The criterion calculates the percentage of the resident population located at less than 300 meters from a public transport stop like tram, bus and metro, and at less than 1,000 meters in the case of a train station. The aim is discourage and reduce the use of private vehicles for transportation, on the contrary encouraging the use of public transport, more sustainable mobility. This can facilitate a decrease in traffic levels and levels of pollution, with a consequent improvement of air quality. This metric allows to see how much the population is effectively covered and served by public transportation: in fact some studies show that if you exceed a distance of 300 meters, the population has not stimulated to the use of public transport, preferring on the contrary to use their own private vehicle for travel. The distance between the transport node and the access of the building is not calculated on a linear distance, but considering the way actually walkable. In assessing this indicator it's important to identify four types of public transport nodes: tram, bus, subway and train stations.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to reduce the use of private vehicles. The indicator has been calculated with the percentage of users located at less than 300 meters from a public transport node (tram, bus, rail). The distances have been measured as it would be walking (not in a straight line). For the calculation of the performance indicator proceeds as follows: 1. Identify the nodes of the network of public transport in the area, distinguishing between bus, tram, metro and railway. 2. Calculate the actual distance on foot between these nodes and access the buildings. 3. Calculate the percentage of the population that is located at less than 300 meters away from bus served nodes, tram and metro and less than 1 000 meters from those rail.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion evaluates the percentage of the population that is close to the public transport nodes. The higher this value is, the better the performance of the area will be.
References	[1], [2], [3], [4], [5]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The "Scale" characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
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SOC.Tr.07	Accessibility of pedestrian paths (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Transport	A	N

GENERAL	
Description	The criterion takes into consideration the area of pedestrian paths that respect the principles of the Design for All and divides it by the total area of pedestrian routes in the area. The aim is make available to everyone, able and disabled, the use of the walking routes in the city. The importance of removing architectural barriers is an important and essential aspect in a city, because these components prevent, limit or make difficult travel and the use of services (especially by people with limited mobility or sensory impairment). Traditional examples of architectural barriers are steps, narrow doorways, excessively steep, narrow space, but there are countless others, all united from being obstacles and impediments, temporary or permanent basis, that prevent you to enjoy safely throughout that set of functions, equipment and services that man-made space should be guaranteed to all categories of users. These theoretical lines have been articulated in the first Italian framework law regulating the problem of accessibility, Law n°3 of January 9, 1989, "Regulations to facilitate the overcoming and removal of architectural barriers", which pays particular attention to public space, penetrating the technical part to identify the three different levels of quality of the built environment: Accessibility, Visitability, Adaptability. The human being is not standard, and consequently planning Design for All means designing environments, systems, usable products and services independently from people with different needs and skills involving human diversity in the design process. Regarding the calculation of the indicator, are quantified in terms of linear meters the paths that respect the principles of Design for All and relates them to the total meters of existing pedestrian routes in the area. The criterion can be calculated to evaluate an existing area and a project one.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to provide universal access to the population. For the calculation of the performance indicator proceeds as follows: 1. Identify and quantify linear meters of walking trails that follow the principles of Design for All in the area (A). 2. Calculate the total length of the pedestrian of the area paths (B). 3. Calculate the percentage value by dividing the total length of the pedestrian estimated routes to the length of the pedestrian paths designed according to the principles of Design for All: B / A * 100.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion measures the percentage of pedestrian paths that are directly accessible to all, compared to the total in the area of the same The higher the percentage of accessible routes is, the better the performance of the area will be.
References	[1], [2], [3], [4], [5]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].

[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA'S PROTOCOL AT URBAN SCALEhttp://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

SOC.Tr.09	Sharing Mobility (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Transport	A	N

GENERAL	
Description	The criterion calculates the percentage of the resident population which is located less than 400 meters from a bike sharing station present in the area and in those immediately adjacent to it. The main objective is to discourage and reduce the use of private vehicles for transportation to encourage the use of sustainable shared displacement means. This metric allows you to see how much the population was effectively used and covered by the service: in fact, some studies show that for large distances, the population is not stimulated to walking and prefers to use his private vehicle. The distance is not calculated on a linear distance, but considering the way actually walkable.
Background	Protocollo ITACA.
References	[1]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	For the calculation of the performance indicator proceeds as follows: 1. Identify the bike sharing stations in the area and surrounding areas. 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 400 meters from at least one station. In the case where it was not possible to calculate the distances actually traveled on foot, proceed as follows: 1. Identify the bike sharing stations in the area being analyzed. 2. Overlap graphically at each of these collection points a circle of radius 300m. 3. Calculate the percentage of the population that is less than 300 meters from the stations, checking which buildings are included within the circle.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion evaluates the percentage of the population that is less than 400 meters from at least one station. The higher this value is, the better the performance of the area will be.
References	[1]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1]

REFERENCES	
[1]	ITACA’S PROTOCOL AT URBAN SCALEhttp://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

SOC.Ac.01	**Access to a broadband communication network (%)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Social	Accessibility		A		N
GENERAL						
Description	The criterion calculates the percentage of public spaces or for public use, from which you can access the network with Wi-Fi mode. An easy accessibility to the network is an instrument to promote greater inclusivity by large segments of the population and to increase the competitiveness and attractiveness of an urban context.					
Background	Protocollo ITACA.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			
Details	For the calculation of the performance indicator proceeds as follows: 1. Calculate the total area of the gross floor area of public spaces or public use in the area (A). 2. Calculate the useful surface gross of public spaces or public use covered by the network with access Wi-Fi (B). 3. Calculate the percentage of AT covered by Wi-Fi. Calculate the percentage value through the following formula: X = A / B where: A = gross surface of public spaces or public use in the area [m2]. B = gross surface of public spaces or public use covered by Wi-Fi network with access [m2].					
Areas covered	Main focus on neighbourhood scale.					
Barriers	-					
Rating	The criterion evaluates the percentage of public spaces or for public use, from which you can access the network with Wi-Fi mode. The higher this value is, the better the performance of the area will be.					
References	[1]					
SCALE						
Application	Applicable to the neighbourhood scale.					
Details	The “Scale” characterization is that of the neighbourhood.					
Multiscale	-					
References	[1]					

REFERENCES	
[1]	ITACA’S PROTOCOL AT URBAN SCALEhttp://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

<table>
<tr><td rowspan="3">ENV.LU.04</td><td colspan="4">Permeability of land (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Land Use</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The criterion calculates the percentage of permeable surfaces compared to the total. The permeability is the ability of a soil to be traversed by fluids; allowing the percolation of rainwater into the ground, this capacity contributes to the feeding of aquifers. The need for this metric is to minimize the interruption and contamination of natural water flows.
The permeability is measured by the permeability index, it is expressed as a percentage, which defines the relationship between the permeable soil surface and the entire surface of the area object of study. The importance of this metric is evident if we consider the continuous and increasing waterproofing phenomenon of soil erosion, caused by a progressive decrease of agricultural areas, in favor of artificial areas, urbanized and intended to infrastructure.
All this has generated destructive environmental impacts, such as the progressive loss of fertile land and strong natural value, increasingly higher values of pollution, the interruption of natural communication corridors, the impairment of the original habitats and natural biotopes. The inability of the sealed areas to absorb a part of water by filtration increases significantly the superficial flow, also favoring the contamination by chemicals.
This sliding can cause obvious problems on the control of surface waters, in particular on the occasion of intense rain events, going to affect the charge capacity of the aquifers.
Soil is a finite resource and therefore be protected.
For the calculation of the indicator are taken into account all types of soil present in the area and to each of these is associated a permeability factor.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] | Empirical/Literature [ ]</td></tr>
<tr><td>Details</td><td colspan="4">The intent is to minimize the interruption and pollution of natural water flows.
Calculate the area of all the permeable surfaces in the neighbourhood. Identify all of the surfaces that are permeable and divide their overall area by the total surface of the area. For semi-permeable surfaces, apply a permeability factor to account for the reduction in performance.

For the calculation of the performance indicator proceeds as follows:
1. Divide the total area for homogeneous areas, according to the characteristics of the soil.
2. Calculate the total area of each homogeneous area (m2) and calculate the total surface area (A).
3. Add all areas each multiplied by its permeability coefficient (α), obtaining the overall extension of the permeable surface (B).
4. For the purposes of the calculation coefficients α refer to the following:
- lawn in the ground (high level) α = 1
- gravel, sand or other loose material (medium / high level) α = 0.9
- gratings elements the plastic material with filling of topsoil (medium level) α = 0.8
- gratings / alveolar concrete elements laid dry with vegetable soil or gravel filling (medium / low level) α = 0.6
- self-locking elements laid dry on the bottom in sand and gravel in the background (low level) α = 0.3
- paving continuous, discontinuous in sealed joints, laid on the slab or wrought cls (zero level) α = 0
5. Calculate the percentage of permeable surface on total B / A * 100.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion evaluates the percentage of the total permeable surface, in order to minimize disruption of the natural water streams. The higher this value is, the better the performance of the area will be.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
</table>

Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA’S PROTOCOL AT URBAN SCALEhttp://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

<table>
<tr><td rowspan="3">ENV.Wa.11</td><td colspan="4">Intensity of wasteater treatment (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Water</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The criterion calculates the percentage of sewage collected and treated to be reused in the area. For wastewater we consider the wastewater, then all those waters whose quality has been affected by human action after their use in different types of activities, including domestic ones.
This allows for a more sustainable management of water resources and a reduction of waste spilled into the sea.
The aim is reuse these wastewater into drinking water replacement, when possible, after an appropriate treatment, which essentially consists in the purification of these by organic and inorganic contaminants.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] | Empirical/Literature [ ]</td></tr>
<tr><td>Details</td><td colspan="4">The intent is to maximizing the potential of use of wastewater in place of drinking water whenever possible.
For the indicator of performance calculation proceeds as follows:
1. Calculate the volume of wastewater collected and treated to be reused in the area (A).
2. Divide the volume for the total water consumption in the area (B).
3. Calculate the percentage value of wastewater reused compared to the total A / B * 100</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion evaluates the percentage of sewage collected and treated compared to the total. The higher this value is, the better the performance of the area will be.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
</table>

REFERENCES	
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[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
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<table>
<tr><td rowspan="3">ENV.Bi.04</td><td colspan="4">Connectivity of green spaces (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environment</td><td>Biodiversity</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The criterion takes into account the related green areas, intended or actual, in the area relation to the total surface of green areas. The objective is to enhance and protect biodiversity. The urban green is a characterizing element of the environment built in fundamental relationship with the landscape, and a factor of great importance for improving the quality of life in cities. Today, however, many of these natural areas are subject to pressures and risk fragmentation. Habitat fragmentation is caused by a variety of factors related to growing urbanization and the intensification of transport infrastructure. This fragmentation undermines the functioning of ecosystems, which need space to prosper and continuity. For this purpose in the interventions of land management is increasingly highlighted the importance of issues such as "green corridors", or "green infrastructure", or "ecological network", which emphasized the importance of connectivity of these areas. Precisely for this reason, metric assesses only the interconnected green areas, which are also to be more accessible and usable by users of the area under analysis. This criterion is calculate for the existing connected green areas, and for those in project.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | | </td></tr>
<tr><td>Details</td><td colspan="4">The intent is to protect and increment biodiversity.
For the indicator of performance calculation proceeds as follows:
1. Identify the green spaces connected.
2. Calculate the total area of green spaces connected (A).
3. Calculate the percentage ratio between the green surfaces connected (A) and the total green surface (B): A / B * 100.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion evaluates the percentage of green areas interconnected present in the area compared to the total green areas. The higher this value is, the better the performance of the area will be.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
</table>

REFERENCES	
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[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
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[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
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ENV.Bi.07	**Use of local plants (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Biodiversity	A	N

GENERAL	
Description	The criterion takes into account the percentage of planted native plants in the area analyzed compared to the total. The purpose of this indicator is to protect and increase biodiversity, or the variety of life on Earth, through the use of local tree species. The importance of understanding the value of conservation in order to protect the environment's biodiversity is fundamental; highlight how each element is in connection with others and understand the importance of enhancing local environmental and cultural resources, is the basis of the decision to include this indicator for urban evaluation. These theoretical lines were materialized in different actions at the European level promoting conservation programs which result in a dense network of protected areas, preserving the local habitat. With regard to the calculation of the indicator, it is essential to be in possession of a catalog that identifies the planted tree species. These are then compared with the schedule of the local species and from this will be identified and quantified those present in the test sample urban area. It will then calculate the percentage ratio between the number of native species in the area and that of the total trees planted. The reference document for understanding the native species for urban green is processed by CREST "Center for Research in Ecology and Science of the Territory" of Turin. The criterion can be calculated to evaluate an existing area, and a project one.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to protect and increment biodiversity. For the indicator of performance calculation proceeds as follows: 1. Locate and quantify the tree species present in the area (A). 2. Find, among these, the number of native ones (B). 3. Expressing in percentage terms the relationship between the number of local tree species present in the area and the total number of species present: B / A * 100.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion measures the percentage of local plants planted in the area urban related to the total number of the same. The greater the number of native tree species planted is, the better the performance of the area will be, as they pursue the objective of preserving biodiversity.
References	[1], [2], [3], [4], [5]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The "Scale" characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
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[5]	ITACA'S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

ENV.Wa.14	Wastewater management (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Environmental	Water	A	N

GENERAL	
Description	The criterion calculates the percentage of wastewater for the treatment conferred outside the area compared to the total. For wastewater we consider the wastewater, then all those waters whose quality has been affected by human action after their use in different types of activities, including domestic ones. This allows for a more sustainable management of water resources and a reduction of waste spilled into the sea. The purpose is in fact minimize the interruption and contamination of natural water flows. The wastewater treatment allows to reuse these in place of drinking water, when possible, after an appropriate treatment, which essentially consists in the purification of these by organic and inorganic contaminants.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to minimize the interruption and contamination of natural water flows. For the indicator of performance calculation proceeds as follows: 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
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion evaluates the percentage of wastewater conferred outside the area for the treatment compared to the total. The higher this value is, the better the performance of the area will be.
References	[1], [2], [3], [4], [5]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
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[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
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<table>
<tr><td rowspan="3">ENV.Im.25</td><td colspan="4">Accessibility to differentiated waste collection (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The criterion takes into account the percentage of the population in the area that is located at a distance greater than 50 meters from the areas intended for waste collection.
The objective of this indicator is to identify the portion of the population not covered by the separate collection service with the intent of increasing the waste recycling rate, avoiding the landfilling. A proper waste management is crucial both to recover useful materials from waste, in order to reuse rather than dispose of them directly in landfills or incinerators, both for the reduction of the consumption of raw materials, use of energy and thus the emission of greenhouse gases associated.
Of significant importance is in any case encouraging the population to the use of the differentiated collection bins; the proximity the same to the housing is critical for the success of the refusal differentiation. Precisely for this reason have been taken as a reference value 50 meters away, the path over which the load is no incentive to use such service.
With regard to the calculation of the indicator, they are identified, by means of appropriate maps, the collection points (ecological areas) and any individual bins positioned on the road. Then it is calculated the amount of users who have access to collection points that do not attractive superior over 50 meters from the house. In this way it will be apparent to understand which part of the population is not covered by the differentiated waste collection system, obviously if present.
The distance between the collection point and the access of each building is not calculated as a linear distance, but we consider the route actually walkable. The criterion can be calculated to evaluate an existing area and a project one.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td>In situ measurements</td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td></tr>
<tr><td>Details</td><td colspan="4">The intent is to increase the rate of differentiated collection, reducing landfill.
For the indicator of 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.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion measures the percentage of the population that is more than 50 meters from the points collected separately, which therefore cannot easily take advantage of this service.
The higher the percentage is, the better the performance of the studied area will be, since a majority of the population will have access to waste collection service.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
</table>

REFERENCES

[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].

[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA'S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

<table>
<tr><td rowspan="3">ENV.Im.12</td><td colspan="6">Intensity of GHG EMISSIONS (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Impacts</td><td>A</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">This criterion calculates the percentage of greenhouse gases emitted compared to the limit. For evaluation we calculate the need for energy and the total area is associated with each of the component needs a CO2 emission factor, dependent on the energy carrier. In this case, not having a specific data, it is assumed as an energy vector methane and has been considered for the calculation only the primary energy for heating.
To obtain the performance limit, it calculates the comparative value (i.e. the greenhouse gas emissions limit) considering as a requirement the legal limit, defining a standard scenario for energy carriers. The limit value is the amount of CO2 that the area would produce if its requirements correspond to the legal limits.
The goal is to reduce CO2 emissions per capita, according to the targets set by the Kyoto Protocol, an international treaty of 1997 in which the signatory states commit themselves to a reduction of total emissions of at least 5% developed countries (8% if EU members) compared to 1990 levels, and the 20-20-20 climate and energy package, plan that provides, by the European Union member countries by 2020, a reduction of 20% of greenhouse gas emissions, increasing energy efficiency by 20% and meeting 20% of Europe's energy needs with renewable energies.</td></tr>
<tr><td>Background</td><td colspan="6">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="6">The intent is to reduce per capita CO2 emissions.
For the indicator of performance calculation proceeds as follows:
1. Calculate the total demand of the energy sector
2. Associate each time the component requirement a CO2 emission factor, corresponding to an energy carrier.
3. Multiply the requirements for each component for the relevant emission factor, obtaining the total emissions for each component.
4. Sum the values obtained for the total value of the area (A).
5. Calculate the legal limit requirement of the area total energy.
6. Multiply the limit requirements for each component for the emission factor of the energy carrier type, obtaining the total emissions for each component.
7. Sum the values obtained for the CO2 emissions limit (B).
8. Divide the real value (A) for limit setting (B).
9. Multiply by 100 to get the percentage value of the emissions compared to the limit.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="6">-</td></tr>
<tr><td>Rating</td><td colspan="6">The criterion compares the CO2 emissions of the area to the CO2 emissions that would have in the area considering as requirement the legal limit. The benchmark is therefore the standard case set by the limits established by Italian legislation.
The lower this value is, the best percentage of the area performance will be: the objective is indeed to have values below 100%, and therefore lower emissions at the statutory standard.</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="6">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="6">-</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5]</td></tr>
</table>

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
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	Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA'S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

ENV.Im.04	Intensity of acidifying emissions (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Environmental	Impacts	A	N

GENERAL	
Description	This criterion calculates the percentage of acidifying emissions compared to the limit. For evaluation we calculate the energy requirement of the total area associating with each component of this an SO2 and NOx emission factor, dependent on the energy carrier. In this case, will not have specific data, it is assumed as an energy vector methane and has been taken into account for the calculation only the primary energy for heating. To get the benefit limit, we calculate the comparative value (or limit emissions of acidifying) Whereas requirement as the legal limit, defining a standard scenario for energy carriers. The limit value is the proportion of acidifying emissions that the area would produce if its requirements correspond to the legal limits. The purpose is to reduce the emissions of SO2 (sulfur dioxide) and NOx (nitrogen oxides), polluting gases in large part derived from human actions. The effects of these acid deposits are harmful not only for freshwater systems and natural ecosystems, but also to the historical heritage of our city (monuments and architecture).
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to reduce per capitaSO2 and NOx emissions. For the indicator of performance calculation proceeds as follows: 1. Calculate the total needs of the energy sector. 2. Associate each time the component needs an SO2 and NOx emission factor, corresponding to an energy carrier. 3. Multiply the requirements for each component for the relevant emission factor, obtaining the total emissions for each component. 4. Normalize the emissions by multiplying each total by a factor of 0.5 to 1.2 for SO2 and NOx. 5. Sum the values obtained for the total value of the area (A). 6. Calculate the legal limit requirement of the total energy. 7. Multiply the limit requirements for each component for the emission factor of the energy carrier type, obtaining the total emissions for each component. 8. Normalize emissions by multiplying each total by a factor of 0.5 to 1.2 for SO2 and NOx. 9. Sum the values obtained for the emissions of SO2 and NOx limit (B). 10. Divide the real value (A) for limit setting (B). 11. Multiply by 100 to get the percentage value of the emissions compared to the limit.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion compares the SO2 and NOx emissions of the area to the SO2 and NOx emissions that would have in the area considering as requirement the legal limit. The benchmark is therefore the standard case set by the limits established by Italian legislation. The lower this value is, the best percentage of the area performance will be: the objective is indeed to have values below 100%, and therefore lower emissions at the statutory standard.
References	[1], [2], [3], [4], [5]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
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[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
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<table>
<tr><td rowspan="3">ENV.Im.15</td><td colspan="4">Intensity of photo-oxidants emissions (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">This criterion calculates the percentage of photo-oxidants emissions than the limit. For evaluation we calculate the need for energy and the total area is associated with each component of this a CO emission factor, NO2 and NMVOC, dependent on the energy carrier. In this case, will not have specific data, it is assumed as an energy vector methane and has been taken into account for the calculation only the primary energy for heating.
To get the benefit limit, we calculate the comparative value (i.e. the photo-oxidants limit emissions) Whereas requirement as the legal limit, defining a standard scenario for energy carriers. The limit value is the proportion of acidifying emissions that the area would produce if its requirements correspond to the limits of the law.
The purpose is to reduce CO (carbon monoxide), NO2 (nitrogen dioxide) and NMVOC (non-methane volatile organic compounds). These polluting gases, largely the product of human activities, have harmful effects on human health and contribute to air pollution and photochemical.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td></tr>
<tr><td></td><td colspan="4">In situ measurements: </td></tr>
<tr><td>Details</td><td colspan="4">The intent is to reduce per capita CO, NO2 e NMVOC emissions.
For the indicator of performance calculation proceeds as follows:
1. Calculate the total needs of the energy sector.
2. Associate each time the component needs an emission factor CO, NO2 and NMVOC, corresponding to an energy carrier.
3. Multiply the requirements for each component for the relevant emission factor, obtaining the total emissions for each component.
4. Normalize emissions by multiplying each total by a factor of 0.028 for CO, NO2 and of 0,027 to 0,416 for NMVOC.
5. Sum the values obtained for the total value of the area (A).
6. Calculate the total area requirement of energy considering the legal limit.
7. Multiply the limit requirements for each component for the emission factor of the energy carrier type, obtaining the total emissions for each component.
8. Normalize emissions by multiplying each total by a factor of 0.028 for CO, NO2 and of 0,027 to 0,416 for NMVOC.
9. Sum the values obtained for the limit emissions of CO, NO2 and NMVOC (B).
10. Divide the real value (A) for limit setting (B).
11. Multiply by 100 to get the percentage value of the emissions compared to the limit.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion compares the CO, NO2 e NMVOC emissions of the area to the CO, NO2 e NMVOC emissions that would have in the area considering as requirement the legal limit. The benchmark is therefore the standard case set by the limits established by Italian legislation.
The lower this value is, the best percentage of the area performance will be: the objective is indeed to have values below 100%, and therefore lower emissions at the statutory standard.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
</table>

REFERENCES	
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	reporting of indicators. Statistics New Zealand: Wellington.
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[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA'S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

ENV.En.15	**Primary energy for heating (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Energy	A	N

GENERAL

Description	The criterion quantifies primary energy demand for heating of each building in the analyzed area. The objective is to reduce the primary energy requirement for heating in order to reduce energy consumption, encouraging increasing energy efficiency in construction and the production of thermal energy from renewable sources. A crucial importance is consequently having an appropriate legal body that invokes the need to reduce the heat dispersions, to obtain improved efficiency of technological systems and to enhance the utilization of renewable energy sources. On a national level (Italian) the normative reference is the Legislative Decree 19 August 2005, n. 192 (and subsequent amendments). With the enactment of Legislative Decree no. 311/2006 and regional industry laws, a number of related objectives have been set: - the containment of energy consumption of buildings through the refinement of the wrap-thermal plant system, in order of relative reduction, in particular for that of fossil origin (oil and gas); - the development of renewable energy sources; - the improvement of the security situation, living comfort and environmental compatibility. The determination of the primary energy requirement for heating is quantified through the procedure described in the UNI TS 11300 part 2, on the basis of the technical specification on the energy performance of buildings. Based on the numerous laws enacted on the subject of consumption of primary energy for heating, the importance of monitoring over time the improvements related to energy performance of buildings is also of fundamental interest for the purposes of urban evaluation. For a deeper analysis indicator in question we were consulted national and international databases that provided data on energy consumption broken down on the basis of the period of historical reference.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL

Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to reduce energy consumption consumed for heating. For the indicator of performance calculation proceeds as follows: 1. Calculate the energy performance index for winter heating (EPI) for all buildings in accordance with the procedure described in the UNI TS 11300-2. 2. Calculate the mean value of the energy performance of the area for the winter heating weighed on the individual surfaces. 3. Calculate the index limit value of energy performance for winter heating (EPI, L) according to the Decree 192/2005 and subsequent amendments for each building. 4. Calculate the average value of the energy performance of the limit for winter heating weighed on the single surface. 5. Calculate the percentage ratio between the energy performance index for winter heating of the area to be evaluated (EPI) and the limit value (EPI, L).
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion evaluates the primary energy demand for heating (EPI). In order to calculate the index of performance value (EPI) is necessary to follow the calculation procedures described in the UNI TS 11300 part 2. With regard to the primary energy limit value (EPI, L) it is necessary to take into consideration the current legislation regulating the energy consumption for heating limit (Legislative Decree 192/2005, as amended).

S/V - GG	A	B		C		D		E		F
	<600	601	900	901	1400	1401	2100	2101	3000	≥3001
≤0,2	8,5	8,5	12,8	12,8	21,3	21,3	34	34	46,8	46,8
≥0,9	36	36	48	48	68	68	88	88	116	116

	As you can see from the table indicated by the standard for the purposes of calculation of the indicator, the necessary data is the volumetric compactness (S / V) of each building present in the area analyzed. The EPI calculated value is then compared with the average value of the law, which is consequently taken as a benchmark to assess whether the performance of the buildings included in the area are above or below the limit.
References	[1], [2], [3], [4], [5]
SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
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[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
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ENV.En.17	Primary energy for public lighting (kWh/a)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Environmental	Energy	A	N

GENERAL	
Description	The criterion quantifies the primary energy for public lighting in the analyzed area. In order to quantify the energy consumption is necessary to have a plan that identifies not only the points of light but also the installed power for each of these, in order to be able to sum the individual powers of the lighting bodies and to obtain the value of actual consumption. The goal is to reduce the energy consumption for public lighting. Fundamental importance is consequently having an appropriate legal body that invokes the need to reduce the energy consumption for public lighting, aiming at better efficiency of the plants and the types of installed light sources. On a national level there are different legal references. Of particular relevance is the UNI EN 13201-2 of 2004 relating to street lighting, which identifies the performance requirements and the uniformity of illumination to be respected. With regard to regional laws, in the Piedmont Region it enforces Regional Law of 24 March 2000 n. 31, "Provisions for the prevention and fight against light pollution and for the proper use of energy resources". The City of Turin has a Regulation of public lighting, decorative and private outdoor spaces: the Municipal Lighting Plan. In addition to providing explanatory reports, the Municipal Lighting Plan he categorizes punctually all light sources and attached equipment installed in the city. From these tabs contained in the Regulatory Plan Municipal Lighting, it is possible to obtain the specific data of the type of source installed and the relative potency, identified thanks to a municipal plan of support linked to the devices file. The determination of the energy consumption for public lighting of the area was assessed thanks to the Summary of the Municipal Lighting Plan identifying the type of apparatus and relative potencies, then adding them up to obtain an actual total value of energy consumption for public lighting in urban subjected to the analysis. The criterion can be calculated to evaluate an existing area or a project one.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			
Details	The intent is to reduce primary energy for public lighting. For the indicator of performance calculation proceeds as follows: 1. Identify on a reference mapping all the points of light present in the area and their installed power. 2. Add all the powers of the individual light fixtures present. 3. The value obtained is an expression of the actual consumption of all lighting devices present in the area and is reported to the hourly consumption (kWh). 4. The value refers to the hourly consumption is then multiplied by the number of hours of power a year of equipment (kWh / a) (Turin in 2012 was 4020 h).					
Areas covered	Main focus on neighbourhood scale.					
Barriers	-					
Rating	The Municipal Lighting Plan of the City of Turin.					
References	[1], [2], [3], [4], [5]					

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
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<table>
<tr><td rowspan="3">ENV.Im.23</td><td colspan="4">Thermal comfort of outdoor areas (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environment</td><td>Impacts</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The policy takes into account the albedo of the external areas, so, the fraction of incident radiation that is reflected in all directions, thus indicating the reflectivity of a surface.
The fundamental objective is to reduce the heat island effect, namely the hot microclimate that is generated in urban areas than the surrounding peripheral and rural areas, and thus minimize the impact on microclimate and human habitat. Among the main causes of the heat island we find the high incident radiation, the high absorption coefficient of the materials used outside, the heat accumulation result of widespread overbuilding and also the morphology itself which can prevent the wind to remove the excess heat by limiting the air is recirculated to the ground.
Thanks to the use of clear colors applied to urban and architectural surfaces of roofs and roads, changing the reflectance factors of the same surfaces and it is possible thus increase the albedo.
The criterion can be calculated to evaluate an existing area or a project one. In a similar way they are quantified and in either case the surface of each homogeneous zone in the area. At each surface is associated with a value of albedo, variable from 0 (fully absorbent) to 1 (green or shaded surfaces 12 to 21 June). then the surfaces are summed weighted by the relative albedo and are divided by the total area of the surfaces sum</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | | </td></tr>
<tr><td>Details</td><td colspan="4">The intent is to reduce the discomfort at ground level during summer. To assess this criterion, calculate the area of all the surfaces in the neighbourhood and assign to each surface an albedo value.
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 in percentage terms.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion evaluates the albedo of the outer surfaces related to the analyzed urban area. Higher are the values of albedo, better will be the temperature-humidity performance of the area.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
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[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization

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<table>
<tr><td rowspan="3">ENV.Im.22</td><td colspan="4">Monitoring of air quality (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The criterion takes into account the density of air quality monitoring stations in the area than the average of the whole city, derived from ISTAT.
The aim is to ensure regular monitoring of air quality, in order to provide complete and updated information to the population and to implement appropriate policies for local pollution control.
As pointed out by ARPA Piedmont, the chosen places for placement should be representative of the type of site identified.
A correct positioning of the measuring points allows to obtain extremely representative directions on air quality. However, it is essential to have a data acquisition center that transmits an hourly basis the results of the measurements carried out, allowing a constant control of the main factors that affect the air quality.
From a legal and legislative front, in Italy the first environmental law dates back to 1966 when the law was passed to combat air pollution and was called "law Antismog", increasing controls and bans against other major sources of pollution.
More recently, the issue of air quality is governed by several legislative decrees, in particular by Legislative Decree no. 152/06 (the so-called "unique environmental text") with regard to pollutant emissions and Legislative Decree no. 155/10 (transposition of Directive 2008/50 / EC) with regard to ambient air quality and then by Decree 24 December 2012, n. 250.
The criterion can be calculated to evaluate an existing area or a project one. In a similar way in both cases are quantified monitoring stations of air quality in the area analyzed and compared to the surface area. The value is then compared with the general trend of the city.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] | Empirical/Literature [ ]</td></tr>
<tr><td>Details</td><td colspan="4">The intent is to ensure the constant monitoring of air quality in the area.
For the indicator of performance calculation proceeds as follows:
1. Find the monitoring stations, if they are present, in the area.
2. Divide the number of stations for the total surface area analyzed.
3. Calculate the density of monitoring stations in the whole city (ISTAT), by dividing the total value for the urban area.
4. Calculate the percentage of deviation from the mean, dividing the density in the density in the whole city, subtracting 1 and multiplying by 100.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion evaluates the density of the air quality monitoring stations in the area compared to the average.
The benchmark for this indicator is consequently the mean value of the city, obtained by reading the ISTAT data. The value obtained in the area under consideration is compared with the average value of the reference of the city or of the adjacent areas, because the urban area in which it is inserted is the reference to be taken into consideration. This allows you to have a benchmark calibrated to the specific situation in the evaluation phase: in fact it would be inappropriate to establish a reference value in absolute terms, untied from the context and undifferentiated.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
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<table>
<tr><td rowspan="3">ENV.Im.17</td><td colspan="4">Light pollution (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The criterion takes into account the percentage of luminous flux emitted upwards from the illumination devices installed in the urban area. The fundamental objective is to reduce the illuminance of the celestial vault during the night hours, in order to avoid unnecessary losses outside the area that should illuminate, because of light pollution. It thus takes into consideration not only the type of installed light source, but also the type of appliance.
Light pollution is to all intents and purposes an alteration of the natural amount of light present in the environment caused by the introduction of night artificial light; the latter pollutes the moment should be to alter the amount of natural light in the environment.
The inconvenience caused by this type of phenomenon are many, from the disturbance to wildlife and the local flora, the impediment to the vision of the stars and other celestial bodies, major problem especially near astronomical observatories.
In all Italian regional laws have been enacted against the artificial light dispersion upwards, prepared starting from the provisions of Standard UNI 10819 on the requirements for the limitation of the upward dispersion of the luminous flux. In Piedmont Region refers to the Regional Law of 24 March 2000, n. 31 "Measures for the prevention and fight against light pollution and for the proper use of energy resources".
The City of Turin has an additional regulation of public lighting, decorative and exterior private spaces, the Municipal Lighting Plan. In addition to providing explanatory reports, the Municipal Lighting Plan. categorizes punctually all the lighting fixtures and attached sources installed in the city. From these tabs contained in the Regulatory Plan Municipal Lighting it is possible to obtain the data concerning the percentage of luminous flux upward dispersion of each unit present in the area under analysis, identified thanks to a municipal plan of support linked to the file the devices.
It is important to point out that often the devices installed in an area may be different for the typology between them and consequently have percentages of different luminous flux dispersion. For convenience of calculation are then considered as percentages of the reference range (0-1%, 1-3%, 3-6%, and so forth) in which to categorize the devices. In this way it is possible to easily identify the areas with greater or lesser light pollution upwards, comparing them to the neighboring areas or to the rest of the city.
The criterion can be calculated to evaluate an existing area or a project one. In a similar way in either case, they count the lighting fixtures installed in the area with attached sources; subsequently, tracking down the technical reference cards and identify those with luminous flux dispersed upwards null, then equal to 0%.
The devices thus quantified are compared to the total number of installed equipment in the area, multiplying the result obtained by 100 so as to obtain the percentage value.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="4">The intent is to reduce pollution of the celestial sphere at night.
For the indicator of performance calculation proceeds as follows:
1. Identify the lighting in the area using a specific technique card.
2. Obtain the technical data sheets of the devices installed in the area, taking care to locate the data concerning the percentage of luminous flux dispersed upwards of each present apparatus.
3. Count all the lighting in the area analyzed
4. Identify the luminaires that have a dispersion factor of the luminous flux upwards null, then equal to 0%.
5. Calculate the ratio between the number of apparatuses having bright dispersant upward flow zero and the total number of appliances installed in the area.
6. Multiply the value obtained by 100 to get the percentage value.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion evaluates the percentage of lighting devices that do not scatter light upward flow in</td></tr>
</table>

	the urban area. The higher this value is, the better the performance of the area will be.
References	[1], [2], [3], [4], [5]
SCALE	
Application	Applicable to the neighbourhood scale.
Details	The "Scale" characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

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<table>
<tr><td rowspan="3">ECO.Eq.01</td><td colspan="4">Affordability of housing property (m^2)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Equity</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">This criterion calculates the economically accessible surface to the lowest quintile of income groups of the population present in the area.
The goal is to reduce obstacles to the residential property for the highest possible number of people. The metric then assesses how many square meters can be purchased in a year with the salary of the lowest quintile of the population. To do this divide the average wage in the bottom quintile of the population, based on ISTAT data, the average price per square meter of residential area.
Regarding the average sales prices can be referred to the Observatory Data Real Estate Town of Turin OICT (www.oict.polito.it).
For the residential sector, the city is divided into 40 census micro-zones; to each of these values is associated with a card that shows the unit prices offered, expressed in € / m2. The statistical indicators present in the tabs (average value, minimum value, maximum value, standard deviation, median) are differentiated by the flea market and that of the new construction. Finally, it is graphically presented the historical trend of the average value.
This metric is crucial for social sustainability: to provide a variety of housing choices for a number of inhabitants, owners, tenants, of a different composition and origin families, promotes so-called social mixité, develops cohesion and integration, reduction of inequalities and social exclusion.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td>Derived from</td><td colspan="4">Software tool [ ] · Operational data [ ] · In situ measurements [ ]
Simple Calculations [X] · Empirical/Literature [ ]</td></tr>
<tr><td>Details</td><td colspan="4">The intent is to reduce the barrier to home ownership.
To assess this criterion, divide the average yearly salary of the lowest quintile of the population in the region by the average price per square meter of housing in the area.
For the indicator of performance calculation proceeds as follows:
1. Identify the average property values of the reference micro-zone (€ / m2).
2. Identify the average annual wage of the lowest quintile of the population of the area under analysis (ISTAT).
3. Divide the average annual salary of the lowest quintile of the population (A) by the average price per square meter of residential area (B): A / B.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion evaluates the surface affordable to lower-income bracket of the population.
The higher this value is, the better the performance of area will be, for the benefit of the social mix and cohesion.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
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ECO.Eq.02	Affordability of housing rental (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Economic	Equity	A	N
GENERAL				
Description	This criterion calculates the percentage of the annual salary of the lowest quintile of the population that is destined to be rented. The goal is to reduce the economic burden of the rent housing for as many people as possible. To calculate this percentage divides the average annual rent for residences in the area by the average annual salary of the lowest quintile of the population. As for the rental average prices can be referred to the Revenue Agency data, cataloged under "house price" of the database. For the residential sector, the City of Turin is subdivided into 40 micro-zones census; to each of these values is associated with a card which lists the market values (minimum and maximum), expressed in € / m2, and the rental values (minimum and maximum), expressed in € / m2 x month. It is also indicated whether these values refer to the net surface (N) or gross (L). This metric is crucial for social sustainability: to provide a variety of housing choices for a number of inhabitants, owners, tenants, of a different composition and origin families, promotes so-called social mixité, develops cohesion and integration, ' reduction of inequalities and social exclusion.			
Background	CLUE, Protocollo ITACA.			
References	[1], [2], [3], [4], [5]			
LEVEL				
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			
Details	The intent is to reduce the financial load of housing. To assess this criterion, divide the average yearly rent for housing in the area by the average yearly salary of the lowest quintile of the population in the region. For the indicator of performance calculation proceeds as follows: 1. Identify the average rental values of the reference micro-zone (€ / m2). 2. Identify the average annual wage of the lowest quintile of the population of the area under analysis (ISTAT). 3. Divide the average annual rent in the area analyzed (A) by the average annual salary of the lowest quintile of the population (B): A / B.			
Areas covered	Main focus on neighbourhood scale.			
Barriers	-			
Rating	The criterion identifies the percentage of the annual salary value that is destined to be rented apartment. The smaller this value is, the better the performance of the area will be, for the benefit of the social mix and cohesion.			
References	[1], [2], [3], [4], [5]			
SCALE				
Application	Applicable to the neighbourhood scale.			
Details	The “Scale” characterization is that of the neighbourhood.			
Multiscale	-			
References	[1], [2], [3], [4], [5]			

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[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
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SOC.Ac.18	**Proximity to services (%)**					
	ISSUE	**CATEGORY**		**LEVEL**	**SCALE**	
	Social	Accessibility		A	N	
GENERAL						
Description	The criterion calculates the percentage of population that is less than 300 meters from the main facilities in the area and in those immediately adjacent to it. The main objective is to discourage and reduce the use of private vehicles for transportation to take advantage of these services, instead favoring walking and cycling. Additional positively evaluated areas with an appropriate mix of functions. This metric allows you to see how much people are actually served and covered the main services in the area: in fact, some studies show that if you exceed a distance of 300 meters, the population is not stimulated to walking and prefers instead to use their own private vehicle. The distance between the service and the access of the building is not calculated on a linear distance, but considering the way actually walkable. In assessing this indicator have identified two types of services: the trading facilities (home improvement stores, food products, newsagents, bars, restaurants, related) and service facilities (post offices, public or accredited health services, kindergartens d 'childhood, kindergartens, elementary schools, banks, pharmacies).					
Background	CLUE, Protocollo ITACA.					
References	[1], [2], [3], [4], [5]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			
Details	The intent is to reduce the need for vehicular transport outside the area. To assess this criterion, it is necessary to identify all the main services located in the neighbourhood. Graphically, overlay to each of these services a circle with a 300m radius. Calculate how many users are served by these services, by verifying which buildings are included in the radius of all the services. For the indicator of performance calculation proceeds as follows: 1. Identify the services in the area, distinguishing in service facilities and business facilities. 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 300 meters from at least one service for each of the two categories.					
Areas covered	Main focus on neighbourhood scale.					
Barriers	-					
Rating	The criterion evaluates the percentage of the population that is located close to major services. The higher this value is, the better the performance of the area will be.					
References	[1], [2], [3], [4], [5]					
SCALE						
Application	Applicable to the neighbourhood scale.					
Details	The "Scale" characterization is that of the neighbourhood.					
Multiscale	-					
References	[1], [2], [3], [4], [5]					

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<table>
<tr><td rowspan="3">SOC.Ac.04</td><td colspan="4">Flexibility use (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Accessibility</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The criterion takes into account the percentage of hours operating, within a day, of non-residential buildings and public facilities in the analyzed area.
The objective is to promote the prolonged and varied use of structures that can host different functions and activities, and then turning to a multiplicity of different users in relation to different opening hours. The flexibility use of these facilities has a dual objective: from one side, make the most vital area by encouraging integration and social cohesion on the other, maximizing the performance of the structures, reducing the cost of the life cycle. The criterion can only be calculated for new construction.
Identify all non-residential and public facilities present in the area, and quantifies the number of operating hours provided over a typical day. It then calculates the percentage of hours of daily use.</td></tr>
<tr><td>Background</td><td colspan="4">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | | </td></tr>
<tr><td>Details</td><td colspan="4">For the indicator of performance calculation proceeds as follows:
1. Identify in the area non-residential and public facilities.
2. Quantify the average number of hours provided for in the space of a typical day.
3. Expressing in terms of percentage the proportion of hours of use compared to 24h.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The criterion measures the percentage of hours during one day of the buildings non-residential and public facilities. The longer hours of use of the facilities are, the better the performance of the area will be.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
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[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA'S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

<table>
<tr><td rowspan="3">ECO.Eq.08</td><td colspan="4">Potential Employment (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Equity</td><td>A</td><td>N</td></tr>
</table>

GENERAL						
Description	The criterion evaluates the percentage of jobs in the area under consideration, in relation to the population in working age. A high number of jobs ensures to reduce the phenomenon of commuting, to ensure high mixité the area.					
Background	Protocollo ITACA.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			
Details	For the indicator of performance calculation proceeds as follows: 1. Calculate the number of jobs in the area (A). 2. Calculate the number of people in working age in the area (B). 3. Calculate the percentage of jobs than the population of working age in the area. Calculate the percentage value through the following formula: X = A / B where: A = the number of jobs in the area. B = number of people in working age in the area.					
Areas covered	Main focus on neighbourhood scale.					
Barriers	-					
Rating	-					
References	[1]					
SCALE						
Application	Applicable to the neighbourhood scale.					
Details	The “Scale” characterization is that of the neighbourhood.					
Multiscale	-					
References	[1]					

REFERENCES	
[1]	ITACA’S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

<table>
<tr><td rowspan="3">SOC.Ac.07</td><td colspan="6">Availability of green spaces (%)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td colspan="2">Accessibility</td><td colspan="2">A</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">The criterion takes into account the green areas in the area, comparing them to the number of occupants. The goal is to increase the availability of green space for users, evaluating the distribution of these within the area considered over the entire city. The urban green is a characterizing element of the environment built on fundamental relationship with the landscape, and a very important factor in improving the quality of life in cities (the disclosure of which is also sought by the Aalborg Charter and Agenda 21). For this reason many cities have a Green Urban Plan, a document you can refer to the assessment, when present. The importance of the presence of green spaces within the area is remarkable: both from a point of view microclimate, both for biodiversity conservation, and finally as a place of relaxation, recreation and socialization to the residents or users of 'area. The criterion under analysis focuses more on the latter, in fact, going to identify the square meters of greenery per capita.
In the definition of green spaces considered by the policy covered only public green areas, equipped and accessible, thus excluding the urban green furniture (eg. Medians) and private green (residential buildings, schools, etc.).
The green areas quantified, related to the number of occupants, are then compared with the average value of the city.</td></tr>
<tr><td>Background</td><td colspan="6">CLUE, Protocollo ITACA.</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="6">The intent is to increase the availability of green spaces for to the occupants.
To assess this criterion, calculate the surface of accessible green spaces per occupant (m^2/person) in the area and divide it by the per capita value of the city.
Subtract one, and multiply the result by 100 to obtain a percentage.
For the indicator of performance calculation proceeds as follows:
1. Identify the green spaces in the area, excluding the private green areas, street furniture, not accessible.
2. Calculate the total area of green spaces (m2).
3. Calculate the ratio between the green surface and the number of inhabitants (A).
4. Calculate the percentage deviation between the value of the area (A) and the average of the city (B): A / B -1 * 100.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="6">-</td></tr>
<tr><td>Rating</td><td colspan="6">The criterion evaluates the percentage deviation of the relative value to the green spaces of the area compared to the average of the city.
To make this comparison using the percentages identified by ISPRA (Institute for Environmental Protection and Research) on the basis of ISTAT (National Statistics Institute). The areas of urban furniture and private green should not be considered in total, and are deleted according to the percentages identified by ISPRA.
The databases to which it refers are public and easily accessible to all, administration and citizens.
The value obtained by the verification indicator is compared with the average value of reference of the city, in order to assess whether the performance of the area is higher or lower than the average of the urban territory in which it is inserted.
This allows you to have a benchmark calibrated to the specific situation being assessed.</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Applicable to the neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="6">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="6">-</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5]</td></tr>
</table>

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA'S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

SOC.Ac.17	**Proximity to leisure facilities (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Accessibility	A	N
GENERAL				
Description	The criterion calculates the percentage of the resident population which is located less than 300 meters from the structures for the free time in the area and in those immediately adjacent to it. The main objective is to discourage and reduce the use of private vehicles for transportation to take advantage of these services and facilities, instead favoring walking and cycling. Additional positively evaluated areas with an appropriate mix of functions. This metric allows you to see how much the population was effectively served and covered by these facilities in the area: in fact, some studies show that if it exceeds a distance of 300 meters, the population is not stimulated to walking and prefers to use his private vehicle. The distance between the service and the access of the building is not calculated on a linear distance, but considering the way actually walkable. In assessing this indicator we have identified two types of facilities for leisure: sports facilities and cultural facilities (museums, theaters, libraries, cinemas).			
Background	CLUE, Protocollo ITACA.			
References	[1], [2], [3], [4], [5]			

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to reduce the need for vehicular transport outside the area. To assess this criterion, it is necessary to identify all the main services located in the neighbourhood. Graphically, overlay to each of these services a circle with a 300m radius. Calculate how many users are served by these services, by verifying which buildings are included in the radius of all the services. 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 300 meters from at least one service for each of the two categories.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion evaluates the percentage of the population that is located close to major services. The higher this value is, the better the performance of the area will be.
References	[1], [2], [3], [4], [5]
SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA’S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

SOC.SS.03	**Pedestrian safety paths (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Safety & Security	A	N

GENERAL	
Description	The criterion takes into account the percentage of pedestrian street illuminated at night in the analyzed area The purpose is to ensure the safety of pedestrians who enjoy pedestrian areas. The issue of urban security is a very broad field, because there are many factors that contribute to its definition. One of the keys is the public lighting, crucial for city life service because it gives a greater sense of calm both physical and psychological. Good lighting of pedestrian paths is for all purposes a deterrent to aggression and is extremely assist the work of public security forces. From a regulatory point of view, the Technical Regulations for the Implementation of the P.R.I.C. of Turin, state that the minimum illuminance to ensure for pedestrian areas during the night hours is 7.5 lux. The criterion can be calculated to evaluate an existing area, or for a project one. In a similar way in either case, it calculates the pedestrian area of the surface illuminated during night hours and is divided by the total of pedestrian surfaces present in the test sample Urban.
Background	CLUE, Protocollo ITACA.
References	[1], [2], [3], [4], [5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature			

Details	The intent is to ensure pedestrian security. For the indicator of performance calculation proceeds as follows: 1. Calculate the surface intended to pedestrian areas in the area (A). 2. On the basis of the types of installed equipment, evaluate pedestrian paths illuminated during night hours (B). 3. Divide the surface of pedestrian areas illuminated during night hours for the overall pedestrian surface of the area analysis object. 4. Expressing in terms of percentage the amount of pedestrian surfaces are lit at night compared to the total: B / A * 100.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The criterion measures the percentage of the pedestrian area illuminated during night hours in the subject urban area analysis. The higher the percentage of illuminated walkways is, the better the performance of the area will be.
References	[1], [2], [3], [4], [5]

SCALE	
Application	Applicable to the neighbourhood scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	ADVISORY COMMITTEE ON OFFICIAL STATISTICS 2009. Good practice guidelines for the development and reporting of indicators. Statistics New Zealand: Wellington.
[2]	AGENCY FOR ENVIRONMENT AND ENERGY MANAGEMENT (ADEME). 2010. Bilan Carbone, Companies – Local Authorities - Regions, Methodology guide - version 6.1 - objectives and accounting principles [Online]. Available: http://www.associationbilancarbone.fr/sites/default/files/guide_methodolog ique_v6_euk-v.pdf [Accessed January 23 2014].
[3]	EUROPEAN COMISSION. not dated. The EU climate and energy package - European Commission. [Online]. Available: http://ec.europa.eu/clima/policies/package/ [Accessed November 30 2013].
[4]	ISO. 2006. ISO 14064-1:2006, Greenhouse gases -- Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals [Online]. Available: http://www.iso.org/iso/catalogue_detail?csnumber=38381
[5]	ITACA’S PROTOCOL AT URBAN SCALE http://www.itaca.org/documenti/news/Protocollo%20ITACA%20Scala%20urbana_211216.pdf

A.5 - ENERBUILD

ENERBUILD
Full project name

Project website : http://www.enerbuild.eu/

Period : 2009 - 2011
Source of funding: The initiative was co-financed by the EU Alpine Space Programme.

ENERBUILD focused on strengthening SMEs in the building sector and on developing tools relating to the energy production of buildings. The partners were cluster organizations from seven countries in the alps.
Craftsmen and architects received training on new techniques for ecological building. Developments have included the integration of photovoltaics in buildings, a participation model on green power plants for local supply and concepts for heat supply.
A transnational standardization initiative for the assessment of ecological construction started with the test of the Enerbuild Tool.

The ENERBUILD Tool is an „open-source-product". It is available for all European institutions as basis for appropriate adaptions and evaluations. The aim is not to implement the tool by 100% in all European countries. On the contrary, regional adaptions due to different climatic, legal and normative standards are required. But the classification scheme of the evaluation is supposed to be always the same.

The ENERBUILD tool has been tested and evaluated on 46 buildings in the Alpine Space. It is an interregional assessment tool to evaluate the environmental, social and economic performance of public buildings in the Alpine regions. The testing of the ENERBUILD Tool documents the operable structure of the tool. In particular the comprehension, usability, cost effectiveness, regional adaptability of the tool. This is supported by the positive feedback of the established advisory services and certification bodies. In addition the project partners made some suggestions for improvements on criteria level. The assessment criteria are listed below:

Issue/Category	**criterion name**	**Indicator**
ENV-Bi 2	Ecological quality of the building site	weighted score based on type of flora
ENV-En 2	Cooling Demand PHPP	energy performance cooling demand
ENV-En 8	Heating Demand PHPP	energy performance thermal heat PHPP
ENV-En 10	Operational Primary Energy Demand	operational primary energy demand
ENV-Im 12	Global Warming Potential	total carbon-equivalent emissions
ENV-Ma 1	Building materials and construction	OI3 index (GWP, AP, non-renewable energy demand)
ENV-Ma 2	Low-pollutant and low-emission materials	point based assessment of procurement

SOC-AC 3	Comfort ventilation - hygiene and soundproofing	A-weighted sound pressure from ventilation
SOC-LC 1	Availability of Daylight	daylight factor
SOC-TC 13	Thermal Comfort in Summer	cooling load or dynamic simulation of indoor temperature
SOC-Tr 1	Accessibility of public transport	amount of stops and frequency of public transport
ECO-LCC 1	Life Cycle Costs	life cycle costs
ECO-Ma 5	User information	provision of manuals for building use
ECO-Qu 3	Energy Optimization during Planning	point based assessment of energy design
ECO-Qu 5	Process and planning quality	points depending on planning activity report
ECO-Qu 7	Setting verifiable environmental targets	amount of details in setting target performance scores

INDICATORS

ENV.Bi.01	**Ecological quality of the building site (-)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Biodiversity	S	B

GENERAL	
Description	**Intent**: To encourage the selection of sites that have low ecological value or that are ecologically stable. **Indicator**: Ecological value of land used for construction. **Unit of measure**: -
Background	KGA Vorarlberg , Protocollo ITACA
References	This indicator was experimented in Enerbuild project [1], [2]

LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

Assessment method

1. Analysis of the pre-development range of flora existing on the site;
2. For each kind of flora identified, it has to be defined the area occupied and the relative extension (m2);
3. At each area it has to be assigned a code (from a1 to a6) on the base of the following table:

Code	Ecologic conditions	Typologies
a1 – area with zero ecological value	Autochthonous flora destroyed. Natural regenerative dynamics absent. No elements of the local potential flora.	Rubbles, buildings, infrastructure road borders.
a2 – area with very low ecological value	Autochthonous flora substituted. Natural regenerative dynamics absent.	Agricultural fields, orchards, wineries, grass lawns (extensive).
a3 – area with low ecological value	Autochthonous flora degraded. Natural regenerative dynamics present.	Artificial woods, abandoned agricultural fields and grass lawns pasture land (low extensive)
a4 – area with medium ecological value	Autochthonous flora - simple structure. Dominant presence of the local potential flora.	Pasture lands, natural grassland prairies, reforestation of autochthonous vegetation.
a5 – area with high ecological value	Autochthonous flora – secondary character.	Structured secondary woods and shrubs.
a6 – area with very high ecological value	Stable autochthonous flora, undisturbed.	Primary woods and shrubs, grass lawns (height).

4. The overall extension (m2) of the areas with the same code (from a1 to a6)

<table>
<tr><td></td><td>has to be calculated;
5. The Indicator’s value is calculated as a weighted sum:

$$\frac{s1\times 1+s2\times 2+s3\times 3+s4\times 5+s5\times 7+s6\times 10}{s1+s2+s3+s4+s5+s6}$$
Where:
s1 = total extension of the areas with code a1 - zero ecological value [m2]
a2 = total extension of the areas with code a2 - very low ecological value [m2]
a3 = total extension of the areas with code a3 - low ecological value [m2]
a4 = total extension of the areas with code a4 - medium ecological value [m2]
a5 = total extension of the areas with code a5 - high ecological value [m2]
a6 = total extension of the areas with code a6 - very high ecological value [m2]</td></tr>
<tr><td>Areas covered</td><td>All types of building.</td></tr>
<tr><td>Barriers</td><td>The biggest problem is to find the information about the state of the surfaces before the project.</td></tr>
<tr><td>Rating</td><td>Rating was not in the scope of the Enerbuild project.
A scoring has been used just based on partners agreement
Score:
On the base of the indicator’s value , the performance score ranging from -1 up to 5 (interpolation must be applied) is calculated on the base of the following linear scale:

<table>
<tr><td>Performance score</td><td>Calculated Ecological v</td></tr>
<tr><td>-1 – negative</td><td>>5</td></tr>
<tr><td>0 – standard</td><td>5</td></tr>
<tr><td>3 – good</td><td>2.6</td></tr>
<tr><td>5 – excellent</td><td>1</td></tr>
</table>
The “Land ecological value calculator” can be used to calculate the performance score.</td></tr>
<tr><td>References</td><td>This indicator was experimented in ENERBUILD project [1] and [2]</td></tr>
<tr><td colspan="2">SCALE</td></tr>
<tr><td>Application</td><td>This indicator is specific for building.</td></tr>
<tr><td>Details</td><td>The indicator is calculated for each of the building.</td></tr>
<tr><td>Multiscale</td><td>It’s not possible to make a simple sum of the building scores to evaluate the building cluster level but a global calculation concerning all the surfaces of the building cluster can be made at building cluster level.</td></tr>
<tr><td>References</td><td>This indicator was experimented in Enerbuild project [1], [2] and in Protocollo ITACA</td></tr>
</table>

<table>
<tr><td colspan="2">REFERENCES</td></tr>
<tr><td>[1]</td><td>http://wiki.cesba.eu/wiki/ENERBUILD_tool</td></tr>
<tr><td>[2]</td><td>http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf</td></tr>
<tr><td>[3]</td><td>Protocollo ITACA : http://www.proitaca.org/</td></tr>
</table>

ENV.En.06	Cooling Demand (kWh/m²)			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Energy	S	B

GENERAL						
Description	**Intent**: An active cooling system is more and more used for tertiary buildings but also for housing and public buildings. To limit the energy consumption, it is important to evaluate the cooling consumption. **Indicator**: Energy performance cooling demand **Unit of measure**: kWh/m² (PHPP calculation)					
Background	KGA Vorarlberg					
References	This indicator was experimented in Enerbuild project [1], [2]					
LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	
Details	The calculation of the building energy demand has to be made with PHPP software. The maximum temperature without cooling is 25°C in the file „Summer". Actions to increase summer comfort without cooling like reduction of internal heat production, windows shading… are also to be taken into account with the objectives of : - Max 10% of temperature over 25°C - Cooling demand < 5 W/m²					
Areas covered	All types of building.					
Barriers	The use of the PHPP calculation is a barrier (price, complexity…).					
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : Assign the minimum score of 10 points if the cooling needs are under 10 kWh/m² and the maximum of 100 points if the cooling consumption is 0 kWh/m². Determine the other scores proportionally.					
References	This indicator was experimented in ENERBUILD project [1] and [2]					
SCALE						
Application	This indicator is specific for building.					
Details						
Multiscale	No					
References	This indicator was experimented in Enerbuild project [1], [2]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf
[3]	PHPP calculation : http://passivehouse.com/04_phpp/04_phpp.htm

ENV.En.09	Heating Demand (kWh/m²)						
	ISSUE	CATEGORY		LEVEL		SCALE	
	Environmental	Energy		S		B	
GENERAL							
Description	**Intent**: Reduction of heating consumption is needed to reduce the GHG emissions. A good insulation of the building will also give more comfort. **Indicator**: Energy performance heating demand **Unit of measure**: kWh/m² (PHPP calculation)						
Background	KGA Vorarlberg						
References	This indicator was experimented in Enerbuild project [1], [2] and is used in KGA komunalgebäudeausweis [4]						
LEVEL							
Derived from	Software tool	X	Operational data		In situ measurements		
	Simple Calculations		Empirical/Literature		Other (specify)		
Details	The calculation of the building energy demand has to be made with PHPP software.						
Areas covered	All types of building .						
Barriers	The use of the PHPP calculation is a barrier (price, complexity…) [3].						
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners'agreement Score : Assign the minimum score of 10 points if the heating needs are under the thermal regulation limit and the maximum of 100 points if the heating consumption is under 15 kWh/m². Determine the other scores proportionally.						
References	This indicator was experimented in ENERBUILD project [1] and [2]						
SCALE							
Application	This indicator is specific for building.						
Details							
Multiscale	An average value at building cluster level can be compared to the sum of each building result but how to calculate this average value?						
References	This indicator was experimented in Enerbuild project [1], [2] and is used in KGA komunalgebäudeausweis [4]						

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf
[3]	http://www.passiv.de/de/04_phpp/04_phpp.htm
[4]	https://www.energieinstitut.at/unternehmen/bauen-und-sanieren-fuer-profis/gebaeudezertifizierung-und-evaluierung/der-kommunalgebaeudeausweis/

ENV.En.13	**Operational primary energy demand (kWh/m²)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Environmental	Energy		S		B
GENERAL						
Description	**Intent**: Reduction of total energy consumption of buildings including all types of energy use. This indicator is very important because for good insulated buildings, specific electricity consumption is the higher consumption. **Indicator**: Operational primary energy demand **Unit of measure**: kWh/m² (PHPP calculation), The primary energy consumption factors are those of the PHPP.					
Background	KGA Vorarlberg					
References	This indicator was experimented in Enerbuild project [1], [2] and is used in KGA in Vorarlberg [4]					
LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	
Details	The calculation of the building energy demand has to be made with PHPP software.					
Areas covered	All types of building					
Barriers	The use of the PHPP calculation is a barrier (price, complexity…) [3].					
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : Assign the minimum score of 10 points if the heating needs are under 160 kWh / m^2 and the maximum of 100 points if the heating consumption is under 120 kWh/m^2. Determine the other scores proportionally.					
References	This indicator was experimented in ENERBUILD project [1] and [2]					
SCALE						
Application	This indicator is specific for building.					
Details						
Multiscale						
References	This indicator was experimented in Enerbuild project [1], [2] , and is used in KGA in Vorarlberg [4]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf
[3]	http://www.passiv.de/de/04_phpp/04_phpp.htm
[4]	https://www.energieinstitut.at/unternehmen/bauen-und-sanieren-fuer-profis/gebaeudezertifizierung-und-evaluierung/der-kommunalgebaeudeausweis/

<table>
<tr><td rowspan="3">ENV.Im.11</td><td colspan="4">Global Warming Potential (kgCO2-eq/m^2 yr)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impact</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Intent:
Reduction of GHG emissions to limit the global warming.
Indicator: Global Warming Potential
Unit of measure: kgCO2-eq/m^2 yr (PHPP calculation), The primary energy consumption factors are those of the PHPP.</td></tr>
<tr><td>Background</td><td colspan="4">KGA Vorarlberg</td></tr>
<tr><td>References</td><td colspan="4">This indicator was experimented in Enerbuild project [1], [2], and is used in KGA in Vorarlberg [4]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | X | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | | Empirical/Literature | | Other (specify) | </td></tr>
<tr><td>Details</td><td colspan="4">The calculation of the global warming potential has to be made with PHPP software.</td></tr>
<tr><td>Areas covered</td><td colspan="4">All types of building</td></tr>
<tr><td>Barriers</td><td colspan="4">The use of the PHPP calculation is a barrier (price, complexity…) [3].</td></tr>
<tr><td>Rating</td><td colspan="4">Rating was not in the scope of the Enerbuild project.
A scoring has been used just based on partners agreement
Score :
Assign the minimum score of 10 points if the heating needs are under 60 kg/m^2 and the maximum of 100 points if the heating consumption is under 30 kg/m^2. Determine the other scores proportionally.
The emission factors of each energy are those of the PHPP calculation</td></tr>
<tr><td>References</td><td colspan="4">This indicator was experimented in ENERBUILD project [1] and [2] and is used in KGA in Vorarlberg [4]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">This indicator is specific for building.</td></tr>
<tr><td>Details</td><td colspan="4"></td></tr>
<tr><td>Multiscale</td><td colspan="4">No</td></tr>
<tr><td>References</td><td colspan="4">This indicator was experimented in Enerbuild project [1], [2]</td></tr>
</table>

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf
[3]	http://www.passiv.de/de/04_phpp/04_phpp.htm
[4]	https://www.energieinstitut.at/unternehmen/bauen-und-sanieren-fuer-profis/gebaeudezertifizierung-und-evaluierung/der-kommunalgebaeudeausweis/

ENV.Ma.02	**Building material and construction, OI3 Index (-)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Materials	A	B
GENERAL				
Description	**Intent**: The environmental impact of the building construction is quite equal to the energy consumption of this building for 100 years. Thus, optimization of the ecological impact of the building construction is important and has to be taken into account. The Ökoindex3, used in Austria is composed of 3 impacts : - Non renewable primary energy consumption - Global Warming (GWP) - Acidification (AP) **Indicator**: OI3 Index **Unit of measure**: Index			
Background	KGA Vorarlberg , OI3 guide line IBO [3]			
References	This indicator was experimented in Enerbuild project [1], [2] and is used in KGA in Vorarlberg [4]			
LEVEL *				
Derived from	Software tool X	Operational data	In situ measurements	
	Simple Calculations	Empirical/Literature	Other (specify)	
Details	The environmental impact of the construction has to be calculated with a specific software like: Ecotech, Archiphysik, GEQ; Ecosoft… These ‘Environmental impacts of the construction’ on climate change are immediate and for this reason worse than the ‘in-use’ consumption impacts.			
Areas covered	All types of building			
Barriers	The use of a specific software for calculation is a barrier (price, complexity…). Another barrier is that the results of the different tools used to calculate the global impact of materials comparable from one to the other. The IBO software is available in German but not in English.			
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : The lower the OI3 index is, the lower the impact on environment is, the better it is. Assign the minimum score of 10 points if the OI3 index is < 295 and the maximum of 100 points if the OI3 index is <38. Determine the other scores proportionally.			
References	This indicator was experimented in ENERBUILD project [1] and [2] and is used in KGA in Vorarlberg [4]			
SCALE				
Application	This indicator is specific for building.			
Details				
Multiscale	No			
References	This indicator was experimented in Enerbuild project [1], [2] and is used in KGA in Vorarlberg [4]			

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf

[3]	http://www.ibo.at/de/oekokennzahlen.htm
[4]	https://www.energieinstitut.at/unternehmen/bauen-und-sanieren-fuer-profis/gebaeudezertifizierung-und-evaluierung/der-kommunalgebaeudeausweis/

ENV.Ma.01	**Low-pollutant and low-emission materials (-)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Materials	S	B

GENERAL						
Description	**Intent**: We spend 90% of our lives in buildings. The internal air quality is then very important for health care reasons. Construction materials and products are important sources of pollutant in internal air (like COV, **formaldehydes**, heavy metals) for months and years. With the selection of material with low pollutants and low emissions, by 50 to 90%. Good results can be obtain by including low pollutants criteria in the public tenders (maximum values, avoided chemicals, labels, …), control of the used product during the construction phase (listing of the product before the work and 3 controls on site) and selection of cleaning products during the in use phase. These controls have to be made by experts and real measurement can also be done. **Indicator**: low-pollutant and low-emissions material. **Unit of measure**:					
Background	KGA Vorarlberg [4], Baubook [3]					
References	This indicator was experimented in Enerbuild project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	X
	Simple Calculations		Empirical/Literature	*X*	Other (specify)	
Details	The selection of low pollutant products needs expertise to define the selection criteria and control the results on site.					
Areas covered	All types of building					
Barriers	Expertise and measurement capacity in this field of internal air pollution is in most countries quite rare and the cost is for the moment very high.					
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score :					

Evaluation criteria	Points (max Total 60)
Did the project include a specific document concerning low pollution materials?	10
What is the final part of low pollutant materials : 100% of Eco-materials 90% of Eco-materials 70% of Eco-materials	 30 20 10
Products declaration: 100% of products have been declared? 90% of products have been declared? 70% of products have been declared?	 30 20 10
On site controls has been made?	20

References	This indicator was experimented in ENERBUILD project [1] and [2]
SCALE	
Application	This indicator is specific for building.
Details	
Multiscale	No

References	This indicator was experimented in Enerbuild project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf
[3]	https://www.baubook.info/?SW=6&lng=2
[4]	https://www.energieinstitut.at/unternehmen/bauen-und-sanieren-fuer-profis/gebaeudezertifizierung-und-evaluierung/der-kommunalgebaeudeausweis/

<table>
<tr><td rowspan="3">SOC.AC.02</td><td colspan="4">Weighted sound pressure from ventilation (dBA)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Acoustic Comfort</td><td>A</td><td>B</td></tr>
</table>

GENERAL	
Description	**Intent**: Ventilation increases the comfort and internal air quality in the buildings but must not create acoustic discomfort. **Indicator**: Weighted sound pressure from ventilation **Unit of measure**: dBA
Background	KGA Vorarlberg ,
References	This indicator was experimented in Enerbuild project [1], [2]

LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	X
	Simple Calculations		Empirical/Literature		Other (specify)	

Details	The noise of the ventilation system has to be very low (< 1db) to ensure an acoustic comfort.
Areas covered	Office buildings
Barriers	Acoustic measurement is quite complicated and needs specific expertise, software and equipment.
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : Scores are assigned with the following table :

	Points (maximum total 50)
Theoretical calculation of the acoustic level $L_{A, nT}$ <30 dB et $L_{C (50-4000), nT}$ <50 dB	25
Measurement at the exposed working places $L_{A,nT}$ < 30 dB und $L_{C(50-4000),nT}$ < 50 dB	50

References	This indicator was experimented in ENERBUILD project [1] and [2]

SCALE	
Application	This indicator is specific for office buildings.
Details	
Multiscale	No
References	This indicator was experimented in Enerbuild project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf

SOC.VC.02	**Daylight factor (%)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Social	Visual Comfort		A		B
GENERAL						
Description	**Intent**: To decrease energy consumption of artificial lighting, the natural sun lighting (daylight factor) has to be optimized. **Indicator**: Daylight factor **Unit of measure**: %					
Background	KGA Vorarlberg ,					
References	This indicator was experimented in Enerbuild project [1], [2]					
LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	X
	Simple Calculations		Empirical/Literature		Other (specify)	
Details	The daylight factor is the % of the sun light used for internal lighting. $D = E_p / E_{Hz}$ E_p ... light on the working surface/m² E_{Hz} ... sun light outside the building /m² A daylight factor of 5% is an objective and a daylight factor<2% is bad.					
Areas covered	Office buildings					
Barriers	Calculation of the daylight factor is quite complicated and needs specific expertise and software.					
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : Assign points with the following table : D — Points (max 50) < 2 % — 0 Pt 2-3 % — 10 Pt 3-4 % — 30 Pt 5 % — 50 Pt. Day light factor is an average value of 5 measurements in different places of the building.					
References	This indicator was experimented in ENERBUILD project [1] and [2]					
SCALE						
Application	This indicator is specific for office buildings.					
Details						
Multiscale	No					
References	This indicator was experimented in Enerbuild project [1], [2]					

Rating table:

D	Points (max 50)
< 2 %	0 Pt
2-3 %	10 Pt
3-4 %	30 Pt
5 %	50 Pt.

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf

<table>
<tr><td rowspan="3">SOC.TC.03</td><td colspan="4">Thermal Comfort in Summer (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Thermal Comfort</td><td>A</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Intent: Internal temperature is very important for the feeling of thermal comfort especially in offices. Optimization of the building in terms of material, daylight factor, ventilation and heating/cooling systems contributes to the thermal comfort all year round.
For summer comfort, night over ventilation, façade and windows shading can be used to avoid active systems of air conditioning and energy consumption.
Thermal dynamic simulation can demonstrate the effectiveness of the summer comfort.

Indicator: Static or dynamic simulation of indoor temperature

Unit of measure:</td></tr>
<tr><td>Background</td><td colspan="4">KGA Vorarlberg , Norm EN 15251</td></tr>
<tr><td>References</td><td colspan="4">This indicator was experimented in Enerbuild project [1], [2]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | X | Operational data | | In situ measurements | X</td></tr>
<tr><td colspan="4">Simple Calculations | | Empirical/Literature | | Other (specify) | </td></tr>
<tr><td>Details</td><td colspan="4"><u>For buildings with less than </u>35% of the facade surface in windows and a standard internal load (like offices, classrooms, gymnasium…), a static calculation like PHPP is sufficient.
<u>For buildings with more than </u>35% of the facade surface in windows and a high internal load (museums, computer rooms…), a dynamic calculation like PHPP is necessary to define if an active cooling is needed.
Scorching temperature data must be used to simulate the future climate and ensure the comfort in the worst situations.
Objective is less than 5% of the time with Temperatures over 26°C.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Office buildings</td></tr>
<tr><td>Barriers</td><td colspan="4">Thermal comfort simulations and especially dynamic ones need specific expertise and software.</td></tr>
<tr><td>Rating</td><td colspan="4">Rating was not in the scope of the Enerbuild project.
A scoring has been used just based on partners agreement
Score :Assign points with the following table :

<table><tr><td></td><td>Points (max 150)</td></tr><tr><td>Result of the calculation for critical parts of the building (last floor, west orientation …)

Temperature over 26°C<5%, without active cooling system
Temperature over 26°C<10%, without active cooling system
Temperature over 26°C<3% with active cooling system</td><td>

150
50
75</td></tr></table></td></tr>
<tr><td>References</td><td colspan="4">This indicator was experimented in ENERBUILD project [1] and [2]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">This indicator is specific for office buildings.</td></tr>
<tr><td>Details</td><td colspan="4"></td></tr>
<tr><td>Multiscale</td><td colspan="4">No</td></tr>
<tr><td>References</td><td colspan="4">This indicator was experimented in Enerbuild project [1], [2]</td></tr>
</table>

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf
[3]	EU Norm CEN EN 15251 : Indoor environmental Criteria

SOC.Tr.17	Accessibility of public transport, stops and frequency (-)			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Transport	S	B

GENERAL	
Description	**Intent**: Reduce the use of private vehicles. To reach such objective, public buildings must have a good public transport connection. **Indicator**: Amount of stops and frequency of public transport **Unit of measure**: -
Background	KGA Vorarlberg
References	This indicator was experimented in Enerbuild project [1], [2]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	X
	Simple Calculations	X	Empirical/Literature	*X*	Other (specify)	

Details	This indicator evaluates the accessibility of public transport taking into account the walk distance to nodes and the frequency of the buses/train/tram. Assessment method: Accessibility to public transport is calculated as follows. Step 1: Walking distance to public transport stops Determine the walking distance from the building's main entrance to each public transport stop served by rail, bus or tram. Use a notional walking speed of 80 meters per minute. Do not consider stops that are further than a 500 m radius of the building. Note: 1. For stops within the radius that are served by the same service/route consider only the closest stop, i.e. do not consider multiple stops which are on the same route. 2. The distance must be measured as it would be travelled on foot, i.e. do not measure in a straight line over inaccessible objects such as buildings or rivers. Step 2: Frequency of service at each stop For each stop that meets the requirements in step 1, determine the total number of services departing/arriving at each node in the following periods for a typical weekday: AM 08.00 – 10.00 PM 17.00 – 19.00 For domestic buildings, consider the number of services departing/arriving at each stop in the following periods for a typical weekday and on a Saturday: Weekday: AM 08.00 – 10.00 PM 17.00 – 19.00, Saturday: 08.00AM – 19.00PM Note: 1. For stops that have multiple routes, determine the frequency of service for each route and not a collective nodal frequency. 2. It is likely that each route at a stop will be bi-directional, consider only the route in the direction with the highest frequency of service. 3. For trains consider only those routes that have at least two stops within a 20 km radius of the development (Including the stop nearest to the building).
Areas covered	All types of buildings
Barriers	
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : Assign points with the following table :

		Points max. 50
	For stops closer than 300 m with a frequency of more than 1 bus per hour	6 pts per route and per stop
	For stops closer than 300 m with a frequency of more than 1 bus per ½ hour	10 pts per route and per stop
	For stops closer than 500 m with a frequency of more than 1 bus per hour	5 pts per route and per stop
	For stops closer than 500 m with a frequency of more than 1 bus per ½ hour	8 pts per route and per stop
References	This indicator was experimented in ENERBUILD project [1] and [2]	
SCALE		
Application	This indicator is specific for buildings.	
Details		
Multiscale	The same indicator can be calculated at building cluster scale but it is not just a sum of each building result because each node must be considered only once and not for each building.	
References	This indicator was experimented in Enerbuild project [1], [2]	

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf

ECO.LC.07	**Life Cycle Costs (-)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Economic	Life Cycle Costs	A	B
GENERAL				
Description	**Intent**: The objective of this indicator is to ensure an economic optimization of the project. By calculating the costs on all the life time of the building, over investments are compensated by lower using costs. Mostly, saving measures are not realized because they need over investments and the cost-effectiveness of these over investment is not easy to demonstrate. **Indicator**: Life Cycle Costs **Unit of measure**: -			
Background	KGA Vorarlberg , Norm ISO 15686-5			
References	This indicator was experimented in Enerbuild project [1], [2]			

LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	

Details	Assessment method : Points are given for Life Cycle Costs calculated following the official NORMS (ÖNORM M 7140 / VDI 2067 / ISO 15686-5). Two versions of the building have to be compared : one ‘standard version’ (minimum regulation level) and one ‘improved version’ and the following hypotheses : - Life duration for structural measures (windows, walls, insulation…) : 40 years - Life duration for technical measures (heating system, ventilation system …) 20 years - Duration of a bank credit 20 years - General inflation : 0% - Increase of energy prices per year : 3% - Interest rate : 3% Residual value of the systems at the end of the life time and all subsidies have to be taken into account.
Areas covered	All types of buildings
Barriers	
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : Assign 40 points when a LCC calculation has been made.
References	This indicator was experimented in ENERBUILD project [1] and [2]
SCALE	
Application	This indicator is specific for buildings.
Details	
Multiscale	LCC calculation can be made at building cluster level but the result is not the sum of the calculation for each building.
References	This indicator was experimented in Enerbuild project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf
[3}	https://www.iso.org/obp/ui/#iso:std:iso:15686:-5:ed-1:v1:en

ECO.Ma.04	**User Information (-)**						
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**	
	Economic	Management		S		B	
GENERAL							
Description	**Intent**: Users have a great impact of the efficiency of the building use and energy consumptions. Users have to be informed and trained to an efficient use of the building without reducing their comfort **Indicator**: Provision of manuals for building use **Unit of measure**: -						
Background	KGA Vorarlberg ,						
References	This indicator was experimented in Enerbuild project [1], [2]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements	X	
	Simple Calculations		Empirical/Literature	*X*	Other (specify)		
Details	Assessment method : A user manual has to be given to the users including information on : - How to manage temperature in each room (heating regulation…) - Ventilation and windows opening - Sun and shading - Lighting - Efficient use of electric devices and equipment						
Areas covered	All types of buildings						
Barriers							
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : Assign 25 points when a user manual has been given and explain in a meeting to the users.						
References	This indicator was experimented in ENERBUILD project [1] and [2]						
SCALE							
Application	This indicator is specific for buildings.						
Details							
Multiscale	The addition of each building cannot be added at building cluster level because the cluster level includes, in addition, common approach between buildings.						
References	This indicator was experimented in Enerbuild project [1], [2]						

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf

<table>
<tr><td rowspan="3">ECO.Qu.04</td><td colspan="4">Energy Optimization during Planning (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Quality</td><td>S</td><td>B</td></tr>
</table>

GENERAL	
Description	**Intent**: Objective of this indicator is the energy optimization of the project. The real consumption of the building should be as close as possible as the calculated one. Following tools will be used : • Energy optimization has to be taken into account at all steps of the project • Energy calculation will be controlled by an independent body • Calculation will be made on PHPP, software based on real consumptions of many buildings **Indicator**: Point based assessment of energy design **Unit of measure**: -
Background	KGA Vorarlberg,
References	This indicator was experimented in Enerbuild project [1], [2]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	*X*	Other (specify)	

Details	Assessment method : Points are given for each of the following documents produced : - Specific energy Management for each room and taking into account the real use - Air flows equal to PHPP requirements - Evaluation of internal thermal load - Detailed analysis of thermal bridges - Technical description and requirements of the energy systems in the tender (for example, U values for walls, windows… efficiency of heat recovering systems, air flow and energy consumption for ventilation systems…) - Control of energy part of the offers and conformity with the requirements - Conformity with local and/or national regulations - Air tightness test results - Verification of energy calculation after the construction by an independent expert
Areas covered	All types of buildings
Barriers	
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : Assign 45 points max. Give 5 point for each document of the previous list.
References	This indicator was experimented in ENERBUILD project [1] and [2]
SCALE	
Application	This indicator is specific for buildings.
Details	The list of document is specific for buildings.
Multiscale	No
References	This indicator was experimented in Enerbuild project [1], [2]

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf

<table>
<tr><td rowspan="3">ECO.Qu.12</td><td colspan="4">Process and planning quality (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Quality</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Intent: Building has to be useful and build to answer a specific need. This adaptation to the needs has to be evaluated through :
- Adaptation to the use and users
- sustainability
One efficient method is to launch competition to select the conception team.

Indicator: Points depending on planning activity report
Unit of measure: -</td></tr>
<tr><td>Background</td><td colspan="4">KGA Vorarlberg</td></tr>
<tr><td>References</td><td colspan="4">This indicator was experimented in Enerbuild project [1], [2]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | X
Simple Calculations | | Empirical/Literature | X | Other (specify) |</td></tr>
<tr></tr>
<tr><td>Details</td><td colspan="4">Assessment method :
The most ecological building is the one that is not build!
The comparison of different possibilities is important to select the one that fits better to the users' needs and to a sustainable global vision of the building use.
Social aspects have to be taken into account as well as soil waterproofing, accessibility to public transport, energy efficiency…</td></tr>
<tr><td>Areas covered</td><td colspan="4">All types of buildings</td></tr>
<tr><td>Barriers</td><td colspan="4"></td></tr>
<tr><td>Rating</td><td colspan="4">Rating was not in the scope of the Enerbuild project.
A scoring has been used just based on partners agreement
Score :
Assign 25 points max.</td></tr>
</table>

Criteria	Points (maximum total 25)
Has a good documentation be established to define the projects objectives?	10
Have different possibilities been proposed?	5
Has a base situation been established (without building project)? For example if the number of pupils decrease, will the building still be useful?	5
Has an evaluation system been established to compare the different possibilities?	4

	Are included in the evaluation • Urban planning • Accessibility with different transport modes • Soil quality and impact on landscape • Energy efficiency • Use of Eco materials	 2 2 2 2 2
References	This indicator was experimented in ENERBUILD project [1] and [2]	
SCALE		
Application	This indicator is specific for buildings.	
Details		
Multiscale		
References	This indicator was experimented in Enerbuild project [1], [2]	

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf

ECO.Qu.03	**Setting verifiable environmental targets (-)**					
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**		
	Economic	Quality	S	B		
GENERAL						
Description	**Intent**: Ecological and energy quality of a building depends on its scheduling with clear and measurable objectives. These objectives have to be described in the planning documents. **Indicator**: Amount of details in setting target performance scores **Unit of measure**: -					
Background	KGA Vorarlberg					
References	This indicator was experimented in Enerbuild project [1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	X
	Simple Calculations		Empirical/Literature	*X*	Other (specify)	
Details	Assessment method : 3 different methods can be used : 1 – Score = total of points for all criteria = this method gives the more possibilities for the conception team. 2 – Score = 1 specific score for each of the 5 evaluation categories 3 – Score = minimal requests for each of the 5 categories : this method gives less possibilities for the conception team as the technical solutions are given to have points Examples for method 3 : - For energy category : Minimum values for each criteria with PHPP calculation : heating demand, cooling demand, global primary energy consumption, air tightness measurement - For materials Avoid some products like PVC, ask for a proportion of local materials…					
Areas covered	All types of buildings					
Barriers						
Rating	Rating was not in the scope of the Enerbuild project. A scoring has been used just based on partners agreement Score : Assign 25 points max. The evaluation method (one of the three described previously) must be defined at the beginning with detailed criteria and points assignment. Example : 25 points for more than 500 points with the Enerbuild assessment tool					
References	This indicator was experimented in ENERBUILD project [1] and [2]					
SCALE						
Application	This indicator is specific for buildings.					
Details						
Multiscale						
References	This indicator was experimented in Enerbuild project [1], [2]					

REFERENCES	
[1]	http://wiki.cesba.eu/wiki/ENERBUILD_tool
[2]	http://www.enerbuild.eu/publications/2012-02_ENERBUILD-result_6_2-4.pdf

A.6 - EPISCOPE

Co-funded by the Intelligent Energy Europe Programme of the European Union

EPISCOPE

Energy Performance Indicator Tracking Schemes for the Continuous Optimisation of Refurbishment Processes in European Housing Stocks

www.episcope.eu

EPISCOPE (2013-16) was a multinational effort amongst 17 EU countries to develop a conceptual framework for assessing energy saving processes in the European housing sector in a transparent and effective way. The approach was applied through pilot studies in 16 European countries including large building portfolios, as well as building stocks on a regional and national level. Building stock models are developed based on the concept of national or regional building typologies developed in the framework of a predecessor IEE project TABULA [1]. The work facilitates realistic projections of heating energy use in dwellings and support national efforts for meeting energy savings or emissions targets. A concerted set of energy performance indicators was elaborated aiming to enable key experts and non-experts to ensure a high quality of energy refurbishment plans, check compliance with regulations, track and steer the refurbishment processes in a cost-effective way and compare the actual energy savings against targets.

INDICATORS

<table>
<tr><td rowspan="3">ENV.En.05</td><td colspan="4">Annual heat generation for space heating and DHW ($kWh/m^2_{ref\ area}$ a)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Energy</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The total annual heat demand (q_{total}) per m² floor area is equal to the total heat output of heat generators, solar systems and heat recovery divided by a “reference” area. It reflects the quality of the building envelope [2].
The EPISCOPE “reference” area (ref area) is the usable floor area inside the thermal envelope, determined on the basis of internal dimensions (measured from inside surface to inside surface of surrounding walls); considered are spaces with room height > 1.50 m; included are also footprints of stairwells and landings as well as storage and installation rooms, provided that they are located inside the thermal envelope. The reference floor area is equivalent to the conditioned gross floor area (measured at a room height of 1.50 m) minus the cross-section areas of all included constructions [3].</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[2], [3]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | X | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | | Empirical/Literature | | Other (specify) | </td></tr>
<tr><td>Details</td><td colspan="4">This indicator uses the total amount of heat generated by technical installations in the building (total heat demand for heating and DHW: sum of net heat need + storage losses + distribution and emission losses + heat recovered by ventilation systems). The total heat demand is a standard output of the tools that are used for the energy performance certification of buildings. Calculations can be based on existing National Standards or European Standards (EN13790) adapted to national technical guidelines. Higher complexity simulation models can also be used, but it would increase the computational effort and required level of expertise. For reasons of coherence, adaptation factors are used for deriving the EPISCOPE reference area from differently defined national reference areas.</td></tr>
<tr><td>Areas covered</td><td colspan="4">The main focus is on the residential sector. Only space heating and DHW are addressed. Cooling, cooking, lighting and operation of appliances are not considered.</td></tr>
<tr><td>Barriers</td><td colspan="4">Transnational applicability requires a common reporting scheme (i.e. EPISCOPE reference area)</td></tr>
<tr><td>Rating</td><td colspan="4">Rating was not in the scope of the EPISCOPE project. Benchmarks (EU-common and National) regarding the goals to be achieved in 2020, 2030 and beyond were used in order to assess the effectiveness of difference of retrofit scenarios applied in the residential buildings sector.</td></tr>
<tr><td>References</td><td colspan="4">[3]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application range</td><td colspan="4">In EPISCOPE the focus was on residential building stock scenario analysis (portfolios, regional/national scale); the indicator was calculated in pilot studies performed in 16 European countries</td></tr>
<tr><td>Details</td><td colspan="4">The indicator can be calculated for single buildings as well as building stocks (building portfolios, regional/national building stocks).
To derive it for a building stock: First, the total heat demand is calculated individually for a small number of typical buildings representing the studied building stock. Next, in combination with statistical data (number or total reference area of represented buildings) the indicator for building portfolios or groups of buildings at regional/national level is derived.</td></tr>
<tr><td>Multiscale</td><td colspan="4">Extrapolation of results from a single building to a group of buildings is only possible for buildings that belong to the same typology. Thus, a typology of the investigated building stock is necessary. The TABULA typology concept for residential buildings was used in EPISCOPE. In such a case, multiplication of the indicator derived for the single building with the total reference area of the studied stock subset provides the indicator value for a larger scale.</td></tr>
<tr><td>References</td><td colspan="4">[1], [4], [5]</td></tr>
</table>

ENV.Im.05	**Annual CO_2 emissions ($kg/m^2_{ref\ area}\ a$)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Impacts	S	B / N

GENERAL	
Description	This indicator refers to the contribution of the applied heat supply technologies (supply side) to the total annual carbon dioxide (CO_2) emissions, expressed in kilograms related to the EPISCOPE reference area. On-site CO_2 emissions of heating systems (for space heating and hot water, including auxiliary electric energy and ventilation) as well as the CO_2 emissions from district heating and electricity production (used for heat supply and auxiliary energy) are considered. CO_2 equivalent emissions of other greenhouse gases are not taken into account [2]. The EPISCOPE reference area (ref area) is the usable floor area inside the thermal envelope, determined on the basis of internal dimensions (measured from inside surface to inside surface of surrounding walls); considered are spaces with room height > 1.50 m; included are also footprints of stairwells and landings as well as storage and installation rooms, provided that they are located inside the thermal envelope. The reference floor area is equivalent to the conditioned gross floor area (measured at a room height of 1.50 m) minus the cross-section areas of all included constructions [3].
Background	--
References	[2], [3]
LEVEL	

Derived from						
	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	

Details	This indicator is derived by summing up the subtotals of energy demand covered by different energy carriers divided by the emission factors of the respective heat generators. The subtotals of energy demand (total heat demand for heating and DHW: sum of net heat need + storage losses + distribution and emission losses + heat recovered by ventilation systems) are calculated by tools that are used for the energy certification of buildings in order to derive the total energy demand. Calculations can be based on existing National Standards or European Standards (EN13790) adapted to national technical guidelines. For reasons of coherence, adaptation factors are used for deriving the EPISCOPE reference area from differently defined national reference areas.
Areas covered	Main focus on the residential sector. Only space heating and DHW are addressed. Cooling, cooking, lighting and operation of appliances are not considered.
Barriers	Transnational applicability requires a common reporting scheme (i.e. EPISCOPE reference area)
Rating	Rating was not in the scope of the EPISCOPE project. Benchmarks (EU-common and National) regarding the goals to be achieved in 2020, 2030 and beyond were used in order to assess the effectiveness of difference of retrofit scenarios applied in the residential buildings sector.
References	[3]
SCALE	
Application range	In EPISCOPE the focus was on residential building stock scenario analysis (portfolios, regional/national scale); the indicator was calculated in pilot studies performed in 16 European countries
Details	The indicator can be calculated for single buildings as well as building stocks (building portfolios, regional/national building stocks). To derive it for a building stock: First, the total CO_2 emissions are calculated individually for a small number of typical buildings representing the studied building stock. Next, in combination with statistical data (number or total reference area of represented buildings) the indicator for building portfolios or groups of buildings at regional/national level is derived.
Multiscale	Extrapolation of results from a single building to a group of buildings is only possible for buildings that belong to the same typology. Thus, a typology of the investigated building stock is necessary. The TABULA typology concept for residential buildings was used in EPISCOPE. In such a case, multiplication of the indicator derived for the single building with the total reference area of the studied stock subset provides the indicator value for a larger scale.
References	[1], [4], [5]

ENV.Im.06	**CO2 emission factor heat supply (kg/kWh)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Environment	Impacts		B		B / N
GENERAL						
Description	This indicator expresses the amount of CO_2 (kg) emitted per unit energy demand (kWh). It reflects the quality of the supply system including the processes for producing and transporting the energywares.					
Background	--					
References	[2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	This indicator is derived by dividing the total CO2 emissions (indicator ENV.Im.05) by the total energy demand for space heating and hot water, including auxiliary electric energy and ventilation (indicator ENV.En.18).					
Areas covered	Main focus on the residential sector. Only space heating and DHW are addressed. Cooling, cooking, lighting and operation of appliances are not considered.					
Barriers	--					
Rating	--					
References	[2]					
SCALE						
Application range	In EPISCOPE the focus was on residential building stock scenario analysis (portfolios, regional/national scale); the indicator was calculated in pilot studies performed in 16 European countries					
Details	The indicator can be calculated for single buildings as well as building stocks (building portfolios, regional/national building stocks). To derive it for a building stock: First, the total heating energy demand and CO_2 emissions are calculated individually for a small number of typical buildings representing the studied building stock. Next, in combination with statistical data (number of represented buildings) the calculated values are extrapolated for building portfolios or groups of buildings at regional/national level to derive the value of the indicator.					
Multiscale	To derive the value of the indicator at a large scale, the methodology described in section “Details” must be followed. Accordingly a typology of the investigated building stock is necessary. The TABULA typology concept for residential buildings was used in EPISCOPE.					
References	[1], [4], [5]					

REFERENCES	
[1]	Loga, T., Diefenbach, N. (ed.) (2010): Use of building typologies for energy performance assessment of national building stocks. Existent Experiences in European Countries and Common Approach. First TABULA Synthesis Report, Institut Wohnen und Umwelt, Darmstadt. Available at: http://episcope.eu/fileadmin/tabula/public/docs/report/TABULA_SR1.pdf
[2]	Diefenbach, N., Loga, T., Stein B. (ed.) (2016): Application of Energy Performance Indicators for Residential Building Stocks Experiences of the EPISCOPE project (Deliverable D4.1b). Available at: http://episcope.eu/fileadmin/episcope/public/docs/reports/EPISCOPE_Indicators_ConceptAndExperiences.pdf
[3]	Loga, T., Diefenbach, N. (ed.) (2013): TABULA Calculation Method – Energy Use for Heating and Domestic Hot Water – Reference Calculation and Adaptation to the Typical Level of Measured Consumption (ISBN 978-3-941140-31-8). Available at: http://www.episcope.eu/fileadmin/tabula/public/docs/report/TABULA_CommonCalculationMethod.pdf
[4]	Stein, B., Loga, T., Diefenbach, N. (ed.) (2016): Scenario Analyses Concerning Energy Efficiency and Climate Protection in Local Residential Building Stocks Examples from Eight European Countries - EPISCOPE Synthesis Report No. 2 - (Deliverable D3.4). Available at: http://episcope.eu/fileadmin/episcope/public/docs/reports/EPISCOPE_SR2_LocalScenarios.pdf

[5]	Stein, B., Loga, T., Diefenbach, N. (ed.) (2016): Scenario Analyses Concerning Energy Efficiency and Climate Protection in Regional and National Residential Building Stocks Examples from Eight European Countries - EPISCOPE Synthesis Report No. 3 - (Deliverable D3.5). Available at: http://episcope.eu/fileadmin/episcope/public/docs/reports/EPISCOPE_SR3_RegionalNationalScenarios.pdf

A.7 - FADUSIR

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 609222

FASUDIR

Friendly and Affordable Sustainable Urban Districts Retrofitting

http://fasudir.eu/

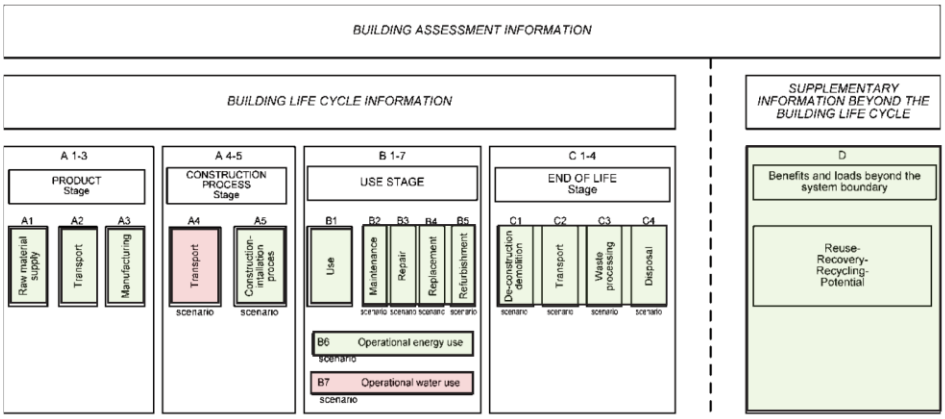
The FASUDIR project was born to develop new business models and financial supporting tools, to support the necessary building-retrofitting market mobilization in Europe to fulfill EU-targets in 2020 and 2050.
The key instrument will be the Integrated Decision Support Tool (IDST), developed to help decision makers to select the best energy retrofitting strategy to increase the sustainability of the whole district. With stakeholder feedback loops and validation in three diverse urban areas, the IDST will ensure robustness and applicability in the entire value chain.
The traditional approach to the building energy efficient retrofitting brings poor results in relation to the urban sustainability, resource efficiency and economic return. Although the district retrofitting approach is frequently the most sustainable and cost-effective, the complexity of decision making grows exponentially when the intervention targets larger scale, even more when considering the fragmentation of the construction sector.

ANNEX 4: ASSESSMENT GUIDELINE FOR FASUDIR KPIS ON DISTRICT LEVEL

FASUDIR Key Performance Indicators
District Level

Category	Indicator	Nr.	Sub-Indicator
1. Environmental Category	**D.1.1 Energy Demand**		
		D.1.1.1	Total Primary Energy Demand
		D.1.1.2	Operational Energy Use
		D.1.1.3	Energy Demand Embodied
		D.1.1.4	Share of Renewable Energy on site
	D.1.2 Impacts on the Environment		
		D.1.2.1	Global Warming Potential (GWP)
		D.1.2.2	Acidification Potential (AC)
		D.1.2.3	Ozone Depletion Potential (OCP)
		D.1.2.4	Eutrophication Potential (EP)
		D.1.2.5	Photochemical Ozone Creation Potential (POCP)
		D.1.2.6	Abiotic Depletion Potential Elements (ADPe)
	D.1.3 Water Use		
		D.1.3.1	Intensity of Water Treatment
	D.1.5 Land Use		
		D.1.5.1	Soil Sealing
2. Social Category	D.2.1 Motor Transport Infrastructure		
		D.2.1.1	Parking facilities
		D.2.1.2	Infrastructure for innovative concepts: car sharing, charging infrastructure for electric/hybrid vehicles
	D.2.2 Public Transport Infrastructure		
		D.2.2.1	Internal Accessibility: Bus, Tram, Subway stops, Railway station
	D.2.3 Bicycle and Pedestrian Infrastructure		
		D.2.3.1	Bicycle facilities
		D.2.3.2	Bicycle and Pedestrian network quality
	D.2.4 Accessibility		
		D.2.4.1	Barrier-free Accessibility of the District
		D.2.4.2	Access to Services and Facilities
		D.2.4.2	Access to Parks and Open Spaces
	D.2.5 Noise Level		
		D.2.5.1	Percentage of building area over noise limit
	D.2.6 Thermal Comfort		
		D.2.6.1	Outdoor temperature / Heat island effect
	D.2.7 Gentrification		
		D.2.7.1	Gentrification Index
3. Economic Category	D.3.1 Life Cycle Costs Building & Energy Infrastructure		
		D.3.1.1	Life Cycle Costs (LCC)
		D.3.1.2	Investment costs
		D.3.1.3	Running costs energy
		D.3.1.4	Running costs non-energy
	D.3.2 Return on Investment Building & Energy Infrastructure		
		D.3.2.1	Return on Investment

INDICATORS

ENV.En.18	**Total Primary Energy Demand (kWh/m²)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Environmental	Energy		A		N
GENERAL						
Description	Total Primary Energy Demand considering the whole building life cycle.					
Background	OPEN HOUSE, FASUDIR					
References	ISO 14040:2006, 10044:2006, EN 15978					
LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	
Details	The indicator is calculated according to the ISO 14040:2006 and 14044:2006 as well as the EN 15978.					
Areas covered	The indicator considers the whole building life cycle with all life cycle stages from A1 to D. In green the stages included in the calculation. 					
Barriers	Availability of a LCA Data Bank					
Rating	FASUDIR IDST Methodology					
References	[1],[2],[3],[4]					
SCALE						
Application	Neighbourhood scale.					
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.					
Multiscale	Possible aggregated values at neighbourhood scale.					
References	[1],[2],[3],[4]					
REFERENCES						
[1]	FASUDIR D2.4 IDST Key Performance Indicators					
[2]	EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.					
[3]	Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD). Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011- 2015					
[4]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013					

ENV.En.13	Operational Energy Use (kWh/m²)			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Energy	A	N

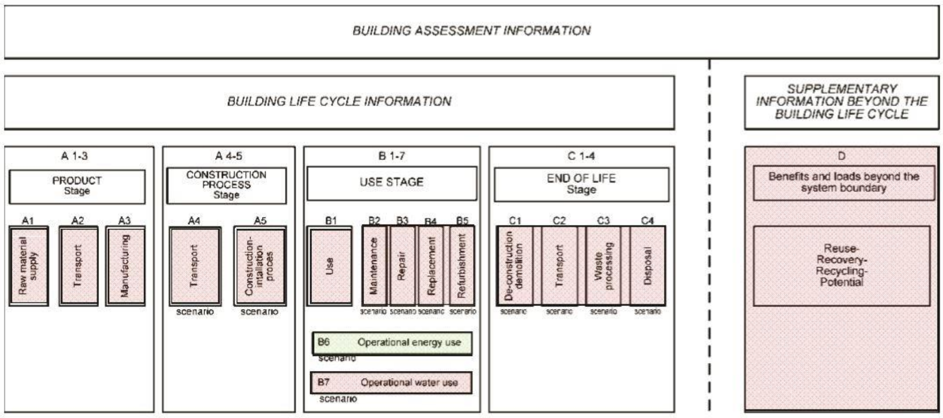
GENERAL

Description	The indicator is a partial result of the Total Primary Energy Demand to display only the energy used for operating the whole district. It is based on the same principals as at the building scale but includes the operation energy used by the energy infrastructure.
Background	OPEN HOUSE, FASUDIR
References	ISO 14040:2006, 10044:2006, EN 15978

LEVEL

Derived from						
	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	

Details	The Operational Energy Use (PE,op) is calculated by considering only the operational energy use stage component of the calculation of the overall PE (Phase B6), according to the EN 15978 standard.
Areas covered	The indicator considers the use stage phase. In green the stages included in the calculation.



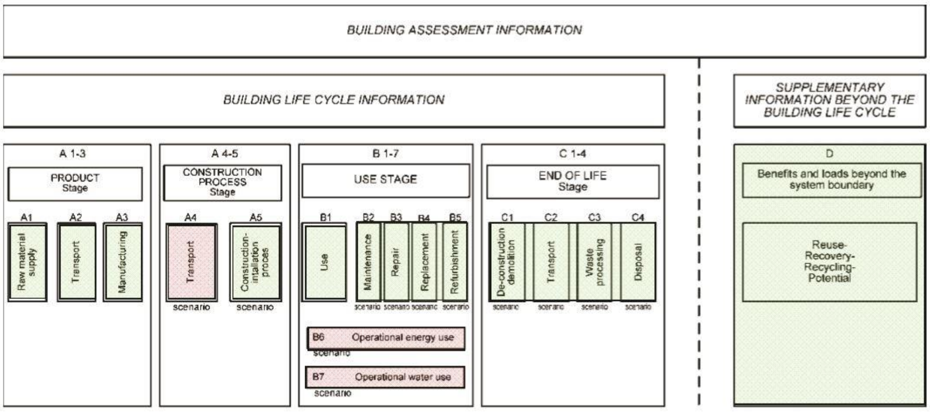
Barriers	Availability of a LCA Data Bank
Rating	FASUDIR IDST Methodology
References	[1],[2],[3],[4]

SCALE

Application	Neighbourhood scale.
Details	Provide details to justify the "Scale" characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	Possible aggregated values at neighbourhood scale.
References	[1],[2],[3],[4]

REFERENCES

[1]	FASUDIR D2.4 IDST Key Performance Indicators
[2]	EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.
[3]	Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD). Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011- 2015
[4]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013

<table>
<tr><td rowspan="3">ENV.En.04</td><td colspan="6">Embodied energy demand (kWh/m²)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Energy</td><td>A</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">The indicator is based on the same principals as the indicator at building scale. In order to assess the caused embodied energy demand for the energy infrastructure in the district (e.g. construction of heat networks, heat storages) the relevant values will be added to the aggregated embodied energy demand sum from building level.</td></tr>
<tr><td>Background</td><td colspan="6">OPEN HOUSE, FASUDIR</td></tr>
<tr><td>References</td><td colspan="6">ISO 14040:2006, 10044:2006, EN 15978</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">The indicator is calculated according to the ISO 14040:2006 and 14044:2006 as well as the EN 15978.</td></tr>
<tr><td>Areas covered</td><td colspan="6">The indicator considers the whole life cycle with all life cycle stages. In green the stages included in the calculation.

</td></tr>
<tr><td>Barriers</td><td colspan="6">Availability of a LCA Data Bank</td></tr>
<tr><td>Rating</td><td colspan="6">FASUDIR IDST Methodology</td></tr>
<tr><td>References</td><td colspan="6">[1],[2],[3],[4]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="6">Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.</td></tr>
<tr><td>Multiscale</td><td colspan="6">Possible aggregated values at neighbourhood scale.</td></tr>
<tr><td>References</td><td colspan="6">[1],[2],[3],[4]</td></tr>
<tr><td colspan="7">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="6">FASUDIR D2.4 IDST Key Performance Indicators</td></tr>
<tr><td>[2]</td><td colspan="6">EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.</td></tr>
<tr><td>[3]</td><td colspan="6">Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD). Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011- 2015</td></tr>
<tr><td>[4]</td><td colspan="6">OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.En.20</td><td colspan="6">Share of Renewable Energy on Site (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Energy</td><td>A</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">The value of the indicator is the ratio of the on-site yearly production of renewable primary energy and the yearly average of the total primary energy demand.</td></tr>
<tr><td>Background</td><td colspan="6">OPEN HOUSE, FASUDIR</td></tr>
<tr><td>References</td><td colspan="6">ISO 14040:2006, 10044:2006, EN 15978</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Energy Simulation</td><td>X</td></tr>
<tr><td>Details</td><td colspan="6">The indicator is calculated by the IDST according to the EN 15978 standard and from the energy simulation for the on-site production of renewable energy</td></tr>
<tr><td>Areas covered</td><td colspan="6">Focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="6">Availability of a LCA Data Bank</td></tr>
<tr><td>Rating</td><td colspan="6">FASUDIR IDST Methodology
In order to calculate the performance of the indicator, a linear interpolation method is recommended.

D.1.1.4 Share of Renewable Energy on Site — Points
Share of renewable energy in the district = 20% — 100
(intermediate values are calculated through linear interpolation)
Share of renewable energy in the district= 0% — 0</td></tr>
<tr><td>References</td><td colspan="6">[1],[2],[3],[4]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="6">Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.</td></tr>
<tr><td>Multiscale</td><td colspan="6">Possible aggregated values at neighbourhood scale.</td></tr>
<tr><td>References</td><td colspan="6">[1],[2],[3],[4]</td></tr>
<tr><td colspan="7">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="6">FASUDIR D2.4 IDST Key Performance Indicators</td></tr>
<tr><td>[2]</td><td colspan="6">EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.</td></tr>
<tr><td>[3]</td><td colspan="6">Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD). Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011- 2015</td></tr>
<tr><td>[4]</td><td colspan="6">OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.Im.10</td><td colspan="7">Global Warming Potential (GWP) (-)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td colspan="2">SCALE</td></tr>
<tr><td>Environmental</td><td colspan="2">Impacts</td><td colspan="2">A</td><td colspan="2">N</td></tr>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td>Description</td><td colspan="7">The Global Warming Potential is a substances potential contribution to the global warming of near-ground air layers, also named greenhouse effect. It is specified as the GWP value in relation to the global warming potential of carbon dioxide (CO2). For evaluation, GWP100 is used, meaning the averaged contribution of a material to the greenhouse effect over one hundred years. For the building assessment, CO2equivalents per area and year are calculated for the life cycle of the building. The lower the CO2-equivalent result is, the lower is the potential influence on global warming and the related impacts on the environment. The construction industry is a large contributor to CO2 emissions, with buildings responsible for 40% of the total European energy consumption and a third of CO2 emissions. At the same time, the construction industry provides work for over 12.7 million people in the EU and generates about one fifth (20.3 %) of the combined industrial and construction sectors value added. These circumstances form the basis for different targets and objectives formulated by the European Commission: For example, the 20/20 targets are to reduce energy consumption by 20%, reduce CO2 emissions by 20% compared to 1990s level and provide 20% of the total energy share with renewable energy by the year 2020. Therefore, this indicator, aiming at the reduction of buildings global warming performance, highly contributes to the achievement of the EU targets mentioned above.</td></tr>
<tr><td>Background</td><td colspan="7">OPEN HOUSE, FASUDIR</td></tr>
<tr><td>References</td><td colspan="7">EN 15978</td></tr>
<tr><td colspan="8">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td></td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="7">The indicator is calculated according to the EN 15978.</td></tr>
<tr><td>Areas covered</td><td colspan="7">The Calculation of this indicator is similar to the method used for the building scale. The indicator is based on the method of Life Cycle Assessment (LCA), in order to assess also the caused impacts on the environment for the energy infrastructure in the neighbourhood (e.g. construction of heat networks, heat storages, lighting of streets) the relevant values will be added to the aggregated environmental impact sum from building level.
Environmental impacts caused by retrofitting measures that are not related to energy on neighbourhood level (e.g. adding green spaces, improving the barrier-free accessibility) are currently not considered in the district LCA due to poor data availability.</td></tr>
<tr><td>Barriers</td><td colspan="7">Availability of a LCA Data Bank</td></tr>
<tr><td>Rating</td><td colspan="7">FASUDIR IDST Methodology</td></tr>
<tr><td>References</td><td colspan="7">[1],[2],[3],[4]</td></tr>
<tr><td colspan="8">SCALE</td></tr>
<tr><td>Application</td><td colspan="7">Neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="7">Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.</td></tr>
<tr><td>Multiscale</td><td colspan="7">The values of the sub-indicators, calculated at the building level, are aggregated at district level with the sub-indicator values calculated for all other buildings in the area, and with the value for infrastructure. Through this calculation it is possible to obtain an overall value of the indicator for the neighbourhood.</td></tr>
<tr><td>References</td><td colspan="7">[1],[2],[3],[4]</td></tr>
<tr><td colspan="8">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="7">FASUDIR D2.4 IDST Key Performance Indicators</td></tr>
<tr><td>[2]</td><td colspan="7">EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.</td></tr>
<tr><td>[3]</td><td colspan="7">Energy Country Factsheet, EU DG ENER:
http://ec.europa.eu/energy/observatory/countries/countries_en.htm</td></tr>
<tr><td>[4]</td><td colspan="7">OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013</td></tr>
</table>

ENV.Im.03	**Acidification Potential, AP (kgSO2-eq/m²yr)**							
	ISSUE		**CATEGORY**		**LEVEL**		**SCALE**	
	Environmental		Impacts		A		N	
GENERAL								
Description	Acidification is the increase of the hydrogen ion concentration in air, water and soil. Sulfur and nitrogen compounds from anthropogenic emissions react to sulfuric acid or nitric acid in the air, fall down as acid rain and cause damage to soil, water, organisms and buildings. In acidic soils nutrients decompose quickly and can easily be washed out. Furthermore, toxications may be released, which affect root systems and cause damage to the nutrient supply of organisms. Another possible effect is the disturbance of the water balance. All in all, the combination of acidification aspects contributes to forest decline. In addition, in surface water bodies with low chemical buffer capacity, fish decline occurs. Acid rain also affects historic buildings (e.g. sandstone). The environmental impacts described above are measured using the acidification potential, which is stated in SO2-equivalents. Acidification causing emissions are e.g. SO2, NOx or H2S. **For the assessment of the Acidification Potential (AP) of a building life cycle, SO2-eqivalents per area and year are used.** The lower the AP value, the lower is the risk of acid rain and the related environmental damage. The indicator aims at the reduction of buildings Acidification Potential, thus preventing the environmental impacts described above. This supports the European Commission target of emission reductions in the EU-25 of 82% for SO2, and 60% for NOx by 2020 compared to 1990s level. The objective is to reduce the threat to the natural environment from acidification by 55%.							
Background	OPEN HOUSE, FASUDIR							
References	EN 15978							
LEVEL								
Derived from	Software tool	X	Operational data		In situ measurements			
	Simple Calculations		Empirical/Literature		Other (specify)			
Details	The indicator is calculated according to the EN 15978.							
Areas covered	The Calculation of this indicator is similar to the method used for the building scale. The indicator is based on the method of Life Cycle Assessment (LCA), in order to assess also the caused impacts on the environment for the energy infrastructure in the neighbourhood (e.g. construction of heat networks, heat storages, lighting of streets) the relevant values will be added to the aggregated environmental impact sum from building level. Environmental impacts caused by retrofitting measures that are not related to energy on neighbourhood level (e.g. adding green spaces, improving the barrier-free accessibility) are currently not considered in the district LCA due to poor data availability.							
Barriers	Availability of a LCA Data Bank							
Rating	FASUDIR IDST Methodology							
References	[1],[2],[3],[4]							
SCALE								
Application	Neighbourhood scale.							
Details	Provide details to justify the "Scale" characterization (building / neighbourhood) of the indicator given in the appointed space above.							
Multiscale	The values of the sub-indicators, calculated at the building level, are aggregated at district level with the sub-indicator values calculated for all other buildings in the area, and with the value for infrastructure. Through this calculation it is possible to obtain an overall value of the indicator for the neighbourhood.							
References	[1],[2],[3],[4]							
REFERENCES								
[1]	FASUDIR D2.4 IDST Key Performance Indicators							
[2]	EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.							
[3]	Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD). Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011- 2015							
[4]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013							

ENV.Im.13	**Ozone Depletion Potential, ODP (kgR11-eq/m²yr)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Environmental	Impacts		A		N
GENERAL						
Description	Ozone, which is only existent in low concentration in the atmosphere, has a significant impact on life on earth. It is able to absorb short-wave UV-radiation and to release it, irrespective of direction, with longer wave length. In addition, the ozone layer protects the earth from a large proportion of UV-radiation and therefore prevents the earth surface of an excessive temperature rise and contributes to the protection of man and flora against UV-A and UV-B radiation. The accumulation of R11-equivalents in the atmosphere contributes to the destruction of the ozone layer. As a consequence, amongst others, men and animals can develop tumors as well as the photosynthesis may be disturbed. For the assessment of the ozone depletion potential of a building life cycle, **Trichlorofluoromethane-equivalents (R11-eqivalents) per area and year are used.** The indicator aims at the reduction of buildings Ozone Depletion Potential, thus preventing the environmental impacts described above. It supports the European Commission target of phasing out of Ozone Depletion Substances.					
Background	OPEN HOUSE, FASUDIR					
References	EN 15978					
LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	
Details	The indicator is calculated according to the EN 15978.					
Areas covered	The Calculation of this indicator is similar to the method used for the building scale. The indicator is based on the method of Life Cycle Assessment (LCA), in order to assess also the caused impacts on the environment for the energy infrastructure in the neighbourhood (e.g. construction of heat networks, heat storages, lighting of streets) the relevant values will be added to the aggregated environmental impact sum from building level. Environmental impacts caused by retrofitting measures that are not related to energy on neighbourhood level (e.g. adding green spaces, improving the barrier-free accessibility) are currently not considered in the district LCA due to poor data availability.					
Barriers	Availability of a LCA Data Bank					
Rating	FASUDIR IDST Methodology					
References	[1],[2],[3],[4]					
SCALE						
Application	Neighbourhood scale.					
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.					
Multiscale	The values of the sub-indicators, calculated at the building level, are aggregated at district level with the sub-indicator values calculated for all other buildings in the area, and with the value for infrastructure. Through this calculation it is possible to obtain an overall value of the indicator for the neighbourhood.					
References	[1],[2],[3],[4]					
REFERENCES						
[1]	FASUDIR D2.4 IDST Key Performance Indicators					
[2]	EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.					
[3]	Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD). Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011- 2015					
[4]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013					

<table>
<tr><td rowspan="3">ENV.Im.08</td><td colspan="4">Eutrophication Potential, EP (kgPO4-eq/m²yr)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Over-fertilization (eutrophication) is the transition of water or soils from a nutrient-poor to a nutrient-rich state. This is caused by supply of nutrients, especially phosphor and nitrogen compounds. The nutrients can emerge from the manufacturing of building products, but mainly from the wash-out of emissions into the environment. The resulting changes in the nutrient supply manifests e.g. in water in the form of an increased algae appearance, which again may cause fish decline. For the assessment of the Eutrophication Potential (EP) of a building life cycle, PO4 equivalents per area and year are used. The lower the PO4-eqivalent value, the lower is the potential of negative side effects on men and the environment. The indicator aims at the reduction of buildings Eutrophication Potential, thus preventing the environmental impacts described above. This supports the European Commission target of emission reductions in the EU-25 of 27% for Ammonia NH3 (responsible for eutrophication) by 2020 compared to 1990s level. The objective is to reduce the threat to the natural environment from eutrophication by 55%.</td></tr>
<tr><td>Background</td><td colspan="4">OPEN HOUSE, FASUDIR</td></tr>
<tr><td>References</td><td colspan="4">EN 15978</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [X] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [ ] | Empirical/Literature [ ] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">The indicator is calculated according to the EN 15978.</td></tr>
<tr><td>Areas covered</td><td colspan="4">The Calculation of this indicator is similar to the method used for the building scale. The indicator is based on the method of Life Cycle Assessment (LCA), in order to assess also the caused impacts on the environment for the energy infrastructure in the neighbourhood (e.g. construction of heat networks, heat storages, lighting of streets) the relevant values will be added to the aggregated environmental impact sum from building level.
Environmental impacts caused by retrofitting measures that are not related to energy on neighbourhood level (e.g. adding green spaces, improving the barrier-free accessibility) are currently not considered in the district LCA due to poor data availability.</td></tr>
<tr><td>Barriers</td><td colspan="4">Availability of a LCA Data Bank</td></tr>
<tr><td>Rating</td><td colspan="4">FASUDIR IDST Methodology</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.</td></tr>
<tr><td>Multiscale</td><td colspan="4">The values of the sub-indicators, calculated at the building level are aggregated at district level with the sub-indicator values calculated for all other buildings in the area, and with the value for infrastructure. Through this calculation it is possible to obtain an overall value of the indicator for the neighbourhood.</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4]</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">FASUDIR D2.4 IDST Key Performance Indicators</td></tr>
<tr><td>[2]</td><td colspan="4">EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.</td></tr>
<tr><td>[3]</td><td colspan="4">Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD). Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011- 2015</td></tr>
<tr><td>[4]</td><td colspan="4">OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.Im.14</td><td colspan="4">Photochemical Ozone Creation Potential, POCP (kgC2H4-eq/m²yr)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Radiation from the sun and the presence of nitrogen oxides and hydrocarbons incur different chemical reactions, producing aggressive reaction products, one of which is ozone. Such near-ground ozone also known as summer smog is suspected to damage vegetation and material. High concentrations of ozone are toxic to humans. A substance‘s contribution is indicated relatively to the Photochemical Ozone Creation Potential of C2H4. The indicator aims at the reduction of buildings Photochemical Ozone Creation Potential, thus preventing the environmental impacts described above. This supports the European Commission target of emission reductions in the EU-25 of 60% for NOx and 51% for VOCs (responsible for ozone creation) by 2020 compared to 1990s level.</td></tr>
<tr><td>Background</td><td colspan="4">OPEN HOUSE, FASUDIR</td></tr>
<tr><td>References</td><td colspan="4">EN 15978</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | X | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | | Empirical/Literature | | Other (specify) | </td></tr>
<tr><td>Details</td><td colspan="4">The indicator is calculated according to the EN 15978.</td></tr>
<tr><td>Areas covered</td><td colspan="4">The Calculation of this indicator is similar to the method used for the building scale. The indicator is based on the method of Life Cycle Assessment (LCA), in order to assess also the caused impacts on the environment for the energy infrastructure in the neighbourhood (e.g. construction of heat networks, heat storages, lighting of streets) the relevant values will be added to the aggregated environmental impact sum from building level.
Environmental impacts caused by retrofitting measures that are not related to energy on neighbourhood level (e.g. adding green spaces, improving the barrier-free accessibility) are currently not considered in the district LCA due to poor data availability.</td></tr>
<tr><td>Barriers</td><td colspan="4">Availability of a LCA Data Bank</td></tr>
<tr><td>Rating</td><td colspan="4">FASUDIR IDST Methodology</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.</td></tr>
<tr><td>Multiscale</td><td colspan="4">The values of the sub-indicators, calculated at the building level, are aggregated at district level with the sub-indicator values calculated for all other buildings in the area, and with the value for infrastructure. Through this calculation it is possible to obtain an overall value of the indicator for the neighbourhood.</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4]</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">FASUDIR D2.4 IDST Key Performance Indicators</td></tr>
<tr><td>[2]</td><td colspan="4">EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.</td></tr>
<tr><td>[3]</td><td colspan="4">Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD). Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011- 2015</td></tr>
<tr><td>[4]</td><td colspan="4">OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.Im.24</td><td colspan="4">Abiotic Depletion Potential Elements, ADPe (kgSB-eq/m²yr)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>A</td><td>N</td></tr>
</table>

GENERAL	
Description	To address the scarcity of materials caused by the building the Abiotic Depletion Potential Elements is used. For calculation of the ADPe the extraction rate of the resource is associated with its ultimate reserves and specified in kg of antimony equivalent. Ultimate reserves are defined as the amount of resources that are totally available in the earth's crust. For estimating ultimate reserves, the average natural concentration of the resource in the earth's crust is multiplied with the assumed volume of the earth's crust. Hence, the indicator allows comparing the geological scarcity of different resources. **The higher the value of antimony equivalent, the higher the geological scarcity of the resource will** be. Specifically, the indicator does not take into account fossil fuels. For expressing the aspect of raw material scarcity, the indicator ADPe is the best choice at this time according to the ILCD framework and CEN/TC 350 Standards.
Background	OPEN HOUSE, FASUDIR
References	EN 15978

LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	
Details	The indicator is calculated according to the EN 15978.					
Areas covered	The Calculation of this indicator is similar to the method used for the building scale. The indicator is based on the method of Life Cycle Assessment (LCA), in order to assess also the caused impacts on the environment for the energy infrastructure in the neighbourhood (e.g. construction of heat networks, heat storages, lighting of streets) the relevant values will be added to the aggregated environmental impact sum from building level. Environmental impacts caused by retrofitting measures that are not related to energy on neighbourhood level (e.g. adding green spaces, improving the barrier-free accessibility) are currently not considered in the district LCA due to poor data availability.					
Barriers	Availability of a LCA Data Bank					
Rating	FASUDIR IDST Methodology					
References	[1],[2],[3],[4]					

SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the "Scale" characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	The values of the sub-indicators, calculated at the building level, are aggregated at district level with the sub-indicator values calculated for all other buildings in the area, and with the value for infrastructure. Through this calculation it is possible to obtain an overall value of the indicator for the neighbourhood.
References	[1],[2],[3],[4]

REFERENCES	
[1]	FASUDIR D2.4 IDST Key Performance Indicators
[2]	EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. European Committee for Standardization CEN.
[3]	Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD). Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011- 2015
[4]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013

ENV.Wa.02	**Intensity of water treatment (%)**					
	ISSUE		**CATEGORY**		**LEVEL**	**SCALE**
	Environmental		Water		A	N
GENERAL						
Description	Water use is widely considered as an issue of concern of sustainable development. One of the themes addressed by UN's Commission on Sustainable Development CSD is Freshwater. The EEA indicators, which can be considered to reflect areas of environmental concerns, cover the following themes: agriculture, air pollution, biodiversity, climate change, energy, fisheries, land management, transport, waste and water. Based on best available estimates, buildings are responsible for about 20% of global fresh water consumption. The domestic sector is responsible for about 60% of national drinking water consumption in Europe. **The indicator is calculated by the IDST as the percentage ratio between the amount of water that is collected and treated in the district and the amount of water that is consumed in the district**.					
Background	Urban Morphology Lab, SuPerBuildings, FASUDIR					
References	[1],[2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	The indicator is calculated through the quantification of the water that is collected and treated in the district, and the consumption for non-potable uses (for users and irrigation). The amount of collected and treated water (W,t) is the total volume of rainwater and grey water that is collected in the area in an average year. This includes rainwater collected from roofs, pavings, and all other surfaces in the area, and grey water that is recovered after potable use (from sinks, kitchens, etc), and is stocked and treated inside the district through one or more tanks with appropriate filtering systems. The overall non-potable water consumption (WC) is an average yearly volume calculated by the aggregation of two values: 1. the non-potable needs of buildings (which can be calculated parametrically, e.g. from data on the average liters of water used for toilet flushing per building occupant, or through specific district data); 2. the irrigation requirements of green areas (which can be calculated parametrically by green surface, as 0,4 m3/m2 for the April-September months, or through specific district data depending on the type of plants and local irrigation period)					
Areas covered	The indicator considers the whole building life cycle with all life cycle stages.					
Barriers	Availability of Data					
Rating	FASUDIR IDST Methodology					
References	[1],[2]					
SCALE						
Application	Only at neighbourhood scale.					
Details	Provide details to justify the "Scale" characterization (building / neighbourhood) of the indicator given in the appointed space above.					
Multiscale	While this indicator is only present at district scale, its value depends on the water use of the buildings and can vary significantly as water saving measures are introduced at building level, together with rainwater harvesting systems. Therefore, it will be possible to assess scenarios that include interventions at building retrofitting together with district water treatment, linking together the building and the district scale.					
References	[1],[2]					
REFERENCES						
[1]	Tarja Hkkinen (Ed.), Sustainability and performance assessment and benchmarking of building Final report, Espoo 2012, VTT Technology					
[2]	Serge Salat, Cities and Forms: On Sustainable Urbanism, Paris 2011, Editions Hermann					

<table>
<tr><td rowspan="3">ENV.LU.04</td><td colspan="4">Soil sealing - Permeability of site/land (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Land Use</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The ability of a soil to store water depends on a range of factors including its texture, structure, depth and organic matter content. The objective of this indicator is to give information about the permeability of surface in the district area.</td></tr>
<tr><td>Background</td><td colspan="4">FASUDIR</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool: X | Operational data: | In situ measurements:</td></tr>
<tr><td colspan="4">Simple Calculations: | Empirical/Literature: | Other (specify):</td></tr>
<tr><td>Details</td><td colspan="4">This indicator measures the ability of a district to store water.
Soils compacted by urban development are highly impervious. Impervious surfaces are mainly artificial structures such as pavements (roads, sidewalks, driveways and parking lots) that are covered by impenetrable materials such as asphalt, concrete, brick, and stone-and rooftops.
For the evaluation of the impervious surface, there is possibility to use software tools.
For example interface surface can be determined using color infrared aerial photos. Image processing and subsequent data refinement within a GIS can be used to classify ground features. The analysis covers measurement of the impervious surface area [m2] and overall studied district area [m2] using software tool.
The impervious surface range can be calculated from the formula below:
Impervious Surface [%]= Impervious Surface area [m2] / Overall District area [m2].</td></tr>
<tr><td>Areas covered</td><td colspan="4">The indicator considers the whole building life cycle stages. In order to calculate the performance of the indicator, a linear interpolation method is recommended.
<table><tr><th>D.1.4.1 Soil Sealing</th><th>Points</th></tr><tr><td>Impervious surface 0-20 %</td><td>100</td></tr><tr><td>Impervious surface 20-40%</td><td>75</td></tr><tr><td>Impervious surface 40-60%</td><td>50</td></tr><tr><td>Impervious surface 60-80%</td><td>25</td></tr><tr><td>Impervious surface 80-100%</td><td>1</td></tr></table></td></tr>
<tr><td>Barriers</td><td colspan="4">Availability of data</td></tr>
<tr><td>Rating</td><td colspan="4">FASUDIR IDST Methodology</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Only at neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.</td></tr>
<tr><td>Multiscale</td><td colspan="4">The indicator is only used on district level and has no related KPI on building level. The soil sealing on building level is not assessed in FASUDIR because the retrofitting measures on building level are only related to energy and no changes in the soil sealing of the properties of the single buildings (adding new parking space) will arise. If new buildings are built in the course of the retrofitting, the change in soil sealing in the district will be evaluated by the district KPI.</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4]</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">EC COMMISSION STAFF WORKING DOCUMENT: Guidelines on best practice to limit, mitigate or compensate soil sealing, Brussels, 12.4.2012 SWD(2012) 101 final</td></tr>
<tr><td>[2]</td><td colspan="4">Ewan M. Last; CITY WATER BALANCE: A New Scoping Tool For Integrated Urban Water Management Options; A thesis submitted to the University of Birmingham for the degree of PhD; September 2010</td></tr>
<tr><td>[3]</td><td colspan="4">Mark Dougherty et al; Evaluation of Impervious Surface Estimates in a Rapidly Urbanizing Watershed; Photogrammetric Engineering & Remote Sensing Vol. 70, No. 11, November 2004, pp. 1275128</td></tr>
<tr><td>[4]</td><td colspan="4">D. Lu, Q. Weng; Use of impervious surface in urban land-use classification; Remote Sensing of Environment 102 (2006) 146 160</td></tr>
</table>

SOC.Tr.11	Parking facilities, off-street parking spaces (%)			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Transport	A	N
GENERAL				
Description	The occupation of the street by the private vehicle is a problem in the most of the cities. It reduces the availability to public spaces for citizens. The objective of this indicator is to achieve better planning and control of parking in the public space to release and recover this space for pedestrians. Maximum amount off-street parking and infrastructure for innovative concepts is required.			
Background	OPEN HOUSE, FASUDIR and also adapted from LEED.			
References	[1],[2],[3]			
LEVEL				

Derived from						
	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

The aim of this indicator is to identify if parking facilities are appropriate for the expected users and give information about their accessibilities in the district.
The distribution of parking in the street and off the street shows the relationship between the number of parking spaces which are in the street and the number of parking spaces which are located outside (public parking, public-private parking)

Parking facilities (%) = (off-street parking spaces / total parking spaces)

D.2.1.1 Parking facilities	Points
More than 90% of the parking spaces are allocated to off-street parking facilities	100
More than 80% of the parking spaces are allocated to off-street parking facilities	50
More than 20% of the parking spaces are allocated to off-street parking facilities	1

Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1],[2],[3]
SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	This indicator is only used on neighbourhood level.
References	[1],[2],[3]
REFERENCES	
[1]	Ministerio de Medio Ambiente, y Medio Rural y Marino; Sistema de indicadores y condiciones para ciudades grandes y medianas
[2]	LEED Criterion Credit 4.3: Alternative Transportation: Low Emitting & Fuel Efficient Vehicles
[3]	OPEN HOUSE Sub-Indicator 6.3.3: Availability of modern low emission transport options: city bike scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines

SOC.Tr.12	**Parking places with innovative features (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Transport	A	N

GENERAL	
Description	The evaluation of this indicator depends on the existence of infrastructure for innovative concepts: car sharing, charging infrastructure for electric / hybrid vehicles and car sharing.
Background	OPEN HOUSE, FASUDIR and also adapted from LEED.
References	[1],[2],[3]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	This indicator can be calculated using formula below: **Infrastructure for innovative concepts = Parking places to be dedicated to fuel efficiency electric and/or hybrid vehicles + car sharing / Total parking places**

D.2.1.2 Infrastructure for innovative concepts: car sharing, charging infrastructure for electric / hybrid vehicles	Points
5% of the site parking places to be dedicated to fuel efficiency electric / hybrid vehicles & car sharing	100
3% of the site parking places to be dedicated to fuel efficiency electric / hybrid vehicles & car sharing	50
< 3% of the site parking places to be dedicated to fuel efficiency electric / hybrid vehicles & car sharing	1

Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1],[2],[3]

SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	This indicator is only used on neighbourhood level.
References	[1],[2],[3]

REFERENCES	
[1]	Ministerio de Medio Ambiente, y Medio Rural y Marino; Sistema de indicadores y condiciones para ciudades grandes y medianas
[2]	LEED Criterion Credit 4.3: Alternative Transportation: Low Emitting & Fuel Efficient Vehicles
[3]	OPEN HOUSE Sub-Indicator 6.3.3: Availability of modern low emission transport options: city bike scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines

SOC.Tr.14	Access to public transport nodes (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Transport	A	N

GENERAL	
Description	Public Transport Infrastructure indicator gives information about public transport systems and their accessibility in districts of the city. This indicator identifies how a variety of transportation and mobility options (railway, bus, tram or subway) can be available for citizens. This indicator measures the accessibility of citizens to the public transport network, taking into account distance to the transport node. This method is a way of measuring the density of the public transport network.
Background	FASUDIR and adapted from BREEAM Communities
References	[1],[2]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	To evaluate the availability to public transport nodes (bus, tram, subway stops, railway station) it is necessary to have an access to the public transport network for example via GIS map. The calculation method is presented below: Access to public transport nodes (%) = Living area / Area that is within a specific distance to a transport node.

D.2.2.1 Sub-indicator: Internal Accessibility: Bus, Tram, Subway stops, Railway station	Points
Share of living area within an aerial distance of 300m to a transport node is: ≤ 100%	100
Share of living area within an aerial distance of 300m to a transport node is: ≤ 90%	60
Share of living area within an aerial distance of 300m to a transport node is: ≤ 80%	40
Share of living area within an aerial distance of 300m to a transport node is: ≤ 70%	20
Share of living area within an aerial distance of 300m to a transport node is: 50-60%	1

Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1],[2]

SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	This indicator is only used on neighbourhood level.
References	[1],[2]

REFERENCES	
[1]	BREEAM Communities, Technical Manual SD202 0.0:2012
[2]	LEED for Neighbourhood Development

SOC.Tr.03	Bicycle facilities (-)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Transport	A	N

GENERAL	
Description	The objective of this indicator is to promote cycling and walking as an alternative to vehicle use by providing a safe and efficient mobility networks. The bicycle and pedestrian infrastructure are evaluated by considering availability of bicycle and walking spaces for citizens, and facilities for bicyclist comfort.
Background	FASUDIR, adapted from BREEAM, DGNB, OPEN HOUSE
References	[1],[2]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

Facilities for bicycles:
1) Bicycle parking places
2) Bike paths
3) Protection against theft
4) Protection against weather

D.2.3.1 Bicycle facilities	Points
4 kinds of facilities	100
3 kinds of facilities	75
2 kinds of facilities	50
1 kinds of facilities	25
0 kinds of facilities	1

Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1],[2]

SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	This indicator is only used on neighbourhood level.
References	[1],[2]

REFERENCES	
[1]	DGNB International Criterion 30: Bicycle comfort
[2]	BREEAM Criterion 3: Alternative modes of transport

SOC.Tr.02	Bicycle and Pedestrian network quality (-)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Transport	A	N
GENERAL				
Description	The objective of this indicator is to promote cycling and walking as an alternative to vehicle use by providing a safe and efficient mobility networks. The bicycle and pedestrian infrastructure are evaluated by considering availability of bicycle and walking spaces for citizens, and facilities for bicyclist comfort.			
Background	FASUDIR, adapted from BREEAM, DGNB, OPEN HOUSE			
References	[1],[2]			
LEVEL				

Derived from						
	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

This indicator is calculated according to the following formula:
Bicycle and pedestrian networks = Number of inhabitants / Signal lights in the district.

D.2.3.2 Bicycle and Pedestrian network quality	Points
Number of inhabitants per signal light in the district: ≤ 800	100
Number of inhabitants per signal light in the district: ≤ 1200	60
Number of inhabitants per signal light in the district: ≤ 1400	40
Number of inhabitants per signal light in the district: ≤ 1600	20
Number of inhabitants per signal light in the district: ≤ 1800	1

Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1],[2]
SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the "Scale" characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	Possible aggregated values at neighbourhood scale.
References	[1],[2]
REFERENCES	
[1]	DGNB International Criterion 30: Bicycle comfort
[2]	BREEAM Criterion 3: Alternative modes of transport

SOC.Ac.09	Barrier-Free Accessibility of the District (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Accessibility	A	N

GENERAL

Description	The public accessibility of a building promotes the communal life. Various usage offerings stimulate the district and increase the communication. Also the acceptance of the building and the feel of safety will be enhanced. Especially the barrier-free accessibility of the buildings and open spaces in the district is a main sustainability issue. Accessibility thus varies greatly from one building to the next. The aims of this indicator are to evaluate the accessibility of various urban resources using spatial data analysis in geographical information systems. This indicator is evaluating, how buildings and open spaces are integrated in the community. To determine the degree of barrier-free accessibility of the district BFA the ratio between the public open spaces (green spaces, circulation areas, pavements and bicycle lanes, playgrounds for children, public squares) and the barrier-free accessible areas is calculated.
Background	FASUDIR, Adapted from DGNB Neighbourhood
References	[1],[2],[3],[4]

LEVEL

Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Detail

Public green spaces are barrier-free accessible if the design of footpaths enables person with disability to use them with wheelchairs. Person with disabilities are defined as follows:

- Users of wheelchairs
- Blind persons
- Deaf persons
- Mobility impaired persons
- Old persons
- Children, small and tall statured persons

Calculation formula:

BFA = Sum of barrier-free accessible public district area [m2] / Sum of entire public district area [m2]

D.2.4.1 Barrier-Free Accessibility of the District	Points
Ratio ≥ 0,90	100
Ratio < 0,90	75
Ratio < 0,60	50
Ratio < 0,30	25
Ratio < 0,1	0

Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1],[2],[3],[4]

SCALE

Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	The indicator is only used on neighbourhood level to assess the overall accessibility of the area.
References	[1],[2],[3],[4]

REFERENCES

[1]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013
[2]	Measuring the accessibility of services and facilities for residents of public housing in Montreal; Philippe Apparicio and Anne-Marie Sèguin; Institut national de la recherche scientifique, INRS Urbanisation Culture et Sociètè, Canada
[3]	European Environmental Agency Impact and Indicators; www.eea.europa.eu
[4]	DGNB Rating Scheme for newly-built districts Version 2012

SOC.Ac.14	Access to Services and Facilities (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Accessibility	A	N
GENERAL				
Description	The indicator considers the **percentage of building area in the district that is able to reach the service or facility in a specific distance**.			
Background	FASUDIR, Adapted from DGNB Neighbourhood			
References	[1],[2],[3],[4]			
LEVEL				

Derived from						
	Software tool		Operational data		In situ measurements	X
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

Services & Facilities are defined as:

- Health (public health facilities, such as doctors, hospital, clinic, first aid)
- Schools
- Kindergarten
- Supermarket
- Banks
- Restaurants
- Bars
- Sport facilities

For the assessment the following tables have to be used:

Percentage of building area within the specific distance radius around the service or facility	*Reduction Factor (Interpolation possible)*
≤ 100 %	1
≤ 75 %	0,75
≤ 50 %	0,50
≤ 25 %	0,25
0 %	0

Facility or service category	*Distance radius for specific facility or service*	*Assessment Points if any building in the district is within the radius around the service or facility*
School	1300 m	10
Playground	500 m	6
Kindergarten	1000 m	6
Supermarket	1300 m	10
Health	700 m	18
Bank	700 m	14
Restaurant	700 m	12
Bar	700 m	12
Indoor Sport facility (Sports Hall, Swimming bathes, etc.)	1400 m	12

Calculation of overall points:

- Overall points = sum of specific points of each facility or service
- **Percentage value of coverage x Assessment Points of facility = Specific Points of facility or service**

The calculation has to be repeated for all categories in order to calculate **the overall points of the district.**

D.2.4.2 Access to Services & Facilities	Points
Overall Points ≥ 80	100
Overall Points ≥ 60	75
Overall Points ≥ 40	50
Overall Points ≥ 20	25
Overall Points > 20	0

Areas covered: The indicator can be calculated at whole life cycle stages.

Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1],[2],[3],[4]
SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	The indicator is only used on neighbourhood level to assess the overall accessibility of the area.
References	[1],[2],[3],[4]
REFERENCES	
[1]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013
[2]	Measuring the accessibility of services and facilities for residents of public housing in Montreal; Philippe Apparicio and Anne-Marie Sèguin; Institut national de la recherche scientifique, INRS Urbanisation Culture et Socièté, Canada
[3]	European Environmental Agency Impact and Indicators; www.eea.europa.eu
[4]	DGNB Rating Scheme for newly-built districts Version 2012

SOC.Ac.05	**Access to Parks and Open Spaces (-)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Accessibility	A	N

GENERAL

Description	Urban green spaces are quite significant in reducing negative effects of urbanization. They are viewed as the green lung of the city, and typically performing important functions, including absorbing rainwater and pollutants, and mitigating urban heat. Urban green spaces can also provide considerable socioeconomic benefits, such reducing work-related stress, and increasing property values.
Background	FASUDIR, Adapted from DGNB Neighbourhood
References	[1],[2],[3],[4]

LEVEL

Derived from						
	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

The calculation of the indicator is similar to the method used in “Access to Services and Facilities”.
Parks & Open Spaced are defined as:

- Public garden, green spaces, parks and other facilities for pedestrians and cyclists
- Outdoor sport facilities with freedom of access

For the assessment the following tables have to be used:

Percentage of building area within the specific distance radius	*Reduction Factor (Interpolation possible)*
≤ 100 %	1
≤ 75 %	0,75
≤ 50 %	0,50
≤ 25 %	0,25
0 %	0

Facility or service	*Distance radius for specific facility or service*	*Assessment Points if facility or service is available within the radius*
Public garden	1000 m	40
Open spaces where citizens can meet (e.g. Central Squares, etc.)	500 m	40
Outdoor sport facilities (Soccer fields, basketball court, etc.)	1300 m	20

D.2.4.3 Access to Parks and Open Spaces	Points
Overall Points ≥ 80	100
Overall Points ≥ 60	75
Overall Points ≥ 40	50
Overall Points ≥ 20	25
Overall Points > 20	0

Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1],[2],[3],[4]

SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the "Scale" characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	The indicator is only used on neighbourhood level to assess the overall accessibility of the area.
References	[1],[2],[3],[4]
REFERENCES	
[1]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings July 2013
[2]	Measuring the accessibility of services and facilities for residents of public housing in Montreal; Philippe Apparicio and Anne-Marie Sèguin; Institut national de la recherche scientifique, INRS Urbanisation Culture et Socièté, Canada
[3]	European Environmental Agency Impact and Indicators; www.eea.europa.eu
[4]	DGNB Rating Scheme for newly-built districts Version 2012

SOC.AC.03	Building area over noise limit (%)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Acoustic Comfort	A	N

GENERAL

Description	The acoustic comfort is one of the most important factors for a healthy and safe environment. The aim is to achieve a percentage of buildings with low level interference and background noise to avoid affecting use, health and capability of the users. The lower the level of interference and background noises is, the less detraction and detriment to health and capability. About 8% of the urban population are exposed to outdoor noise at a level greater than 70 dB(A), while 11% are exposed at levels greater than 65 dB(A). The specific noise level of the district is created by various sources of noise. The main source is road traffic followed by neighbourhood and aircraft noise. Sources of ambient noise are emissions from road, rail and traffic, construction sites, industrial sites and recreational areas. Excessive noise seriously harms human health and interferes with people daily activities at school, at work, at home and during leisure time. It can disturb sleep, cause cardiovascular and psycho-physiological effects, reduce performance and provoke annoyance responses and changes in social behaviour. Traffic noise alone is harming the health of almost every third person in the WHO European Region. One in five Europeans is regularly exposed to sound levels at night that could significantly damage health. (World Health Organization- Regional office for Europe). Quality of living is affected by noise levels which can vary at different times of the day. Residential areas have a greater density of people living in proximity to each other than other areas. More people often means more noise. Some pockets of residential areas have local shops such as dairies, takeaways and hairdressers which create people and traffic noise. Likewise some residential areas are adjacent to recreational or industrial areas. Social events such as concerts, parties and associated music and people noise play a big part in noise complaints. Monitoring noise levels and noise complaints in the urban area highlights trends and issues that may need addressing.
Background	FASUDIR, Adapted from DGNB Neighbourhood
References	[1],[2]

LEVEL

Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

The Decibel (dB) is a unit of measurement used to quantify the intensity or magnitude of sound. A 10 dB change is generally perceived by the human ear as a doubling of noise. The LDN (Level Day/Night) noise level averages the daytime and night-time noise levels (logarithmically) over a 24-hour period and includes a 10 dB (penalty) added to the night-time noise level (10 pm to 7 am). This indicator measures the percent of the population living in an area with a LDN of greater than a certain value of dB, which can vary according the national or regional regulation for each country.
Sources of noise close to the site to be identified and their distance from the site to be measured.
Noise maps where available- must to be used.
The evaluation is based on the classification of the site location based on ambient noise levels according to the following table (BNB 2011).

Level	*Site characterization*	*Noise level*
1.1	rural	≤55dB
1.2	rural	56-60 dB
2.1	provincial	61-65 dB
2.2	provincial	66-70 dB
3.1	metropolitan	71-75 dB
3.2	metropolitan	76-80 dB

It is important to consider that multiple other factors influence the levels of noise in a neighbourhood including topography, wind patterns, the density and type of traffic at different hours throughout the day and night, the presence or lack of trees, sound barrier walls and other noise obstructions, stationary sources of noise, the height and density of housing, etc.

D.2.5.1 Percentage of building area over noise limit (over level 1.2, 2.2 or 3.2 depending on location)	Points
Percentage of building area over noise limit ≤ 10 %	100
Percentage of building area over noise limit ≤ 20 %	75
Percentage of building area over noise limit ≤ 40 %	50
Percentage of building area over noise limit ≤ 50 %	25
Percentage of building area over noise limit > 60 %	0

Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of noise maps
Rating	FASUDIR IDST Methodology
References	[1],[2]
SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	The indicator is only used on neighbourhood level in order to assess the noise level of the whole district. On building level an application of the indicator is not useful because the individual noise protection of each building has to be considered.
References	[1],[2]
REFERENCES	
[1]	European Environmental Agency Impact and Indicators; www.eea.europa.eu
[2]	WHO Night Noise guidelines for Europe;2009

SOC.TC.07	Microclimate Index I (-)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Thermal Comfort	A	N

GENERAL

Description

The main goal is to evaluate the thermal comfort within the district, in order to assess the urban heat island effect within a certain area.
The FASUDIR tool will take into account the distribution of areas and types of surface materials in the district (Buildings, Streets, green spaces).
In the calculation method different surfaces coefficients for streets, green spaces, buildings etc. are defined and weighted with their relevant district area. The higher the coefficient is the higher is the likeliness of contributing to produce heat islands. Within FASUDIR IDST tool, we will take into account these values according a specific index, called Microclimate Index I. It can be calculated through GIS database computation. As result a Microclimate Index I is calculated that represents the aggregated likeliness of heat islands in the district.
The term "heat island" describes built up areas that are hotter than nearby rural areas. The annual mean air temperature of a city with 1 million people or more can be 13C warmer than its surroundings. In the evening, the difference can be as high as 12C. Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality.

Background: FASUDIR, Adapted from DGNB Neighbourhood

References: [1],[2],[3]

LEVEL

Derived from						
	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

To calculate the Microclimate Index I for the neighbourhood using the following formula:
Microclimate Index I = (AreaA1 x F1 + AreaA2 x F2 … + AreaA11 x F11) / Area neighbourhood

Example for calculation.
Overall District Area: 90000 m2
Area 1: Green Spaces with dense tree population 25000 m2 - Surface Coefficient F 1,7.
Area 2: Roads, Streets and squares completely soiled 40000 m2- Surface Coefficient F 0.
Area 3: Water Area 25000 m2- Surface Coefficient F 1,5.

Microclimate Index I = (25000 m2* 1,7 + 0*40000 m2+ 25000 m2*1,5) / 90000 m2 = 0,89
→50 Points

Area surface types	Surface coefficient F
Building areas	
1. Small single buildings (detached houses, semi-detached houses)	1,7
2. Apartment blocks and large buildings	1,4
3. Large multi-storey houses	1,0
4. Industrial and commercial areas	0,8
Circulation areas and squares	
5. Railway system	0,5
6. Roads, Streets and squares completely soiled	0
7. Squares and parking spaces with green elements	0,5
Green Spaces	
8. Green Spaces with dense tree population	1,7
9. Green Spaces with light tree population	2,0
10. Small gardens and green backyards	1,5
11. Grass field	1,0
12. Forest area	2,0
Water areas	
13. Permanent lakes and ponds or rivers	1,5
Other areas	
14. Green roofs	0,7

D.2.6.1 Outdoor temperature / Heat island effect	Points
Microclimate Index I >1,2	100
Microclimate Index I between 0,8 to 0,99	50
Microclimate Index I between 0,6 to 0,79 (Compliant with minimum standards)	1

Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1],[2],[3]
SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	It is a specific neighbourhood-related indicator. The indicator cannot be used on building level.
References	[1],[2],[3]
REFERENCES	
[1]	Microclimatic variation of thermal comfort in a district of Lisbon (Telheiras) at night; H. Andrade and M.-J. Alcoforado, Centro de Estudos GeogrÆficos, Universidade de Lisboa, Alameda da Universidade, 1600-214 Lisboa, Portugal.
[2]	DGNB.
[3]	EPA United States Environmental Protection Agency.

ECO.Eq.06	Gentrification Index (-)			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Economic	Equity	A	N

GENERAL

Description

Gentrification is the process by which the socioeconomic status of a neighbourhood populated mostly by lower-income households is substantially elevated by renewed interests and investments by higher-income households. Gentrification has emerged as a major issue in district retrofitting projects. Increased rental fees caused by the retrofitting measures often create or accelerate gentrification processes. Especially older neighbourhoods, once occupied exclusively by very-low income and low-income residents, are being re-inhabited by more affluent residents after an urban renewal. The objective of this indicator is to identify the likelihood of gentrification in districts, which would allow urban planners, policy-makers to be proactive in their approach to preventing many of the negative effects of gentrification. Therefore municipalities have instruments like social housing promotion or grants for retrofitting measures in district with high likelihood for gentrification.
To estimate the likelihood of gentrification in the district in the assessment method the Gentrification Index is calculated considering the following criteria:

- Percentage of Housing Built Pre-1960
- Average change in purchase prices of residential buildings
- Change in district population (average of last 3 years)
- Change in rental fees of residential buildings (average of last 3 years)
- Change in area median income (average of last 3 years)
- Unemployment rate (average of last 3 years)
- Share of inhabitants older than 60 years in the district

Background: FASUDIR, adapted from NESBITT 2005

References: [1]

LEVEL

Derived from						
	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

Gentrification Index G = Points A + Points B + Points C + Points D + Points E + Points F
A: Percentage of Housing Built Pre-1960.
The percentages of houses with construction date before 1960 in the district is calculated according to the following formula:
Number of residential buildings built before 1960 / Number of all residential buildings in the district = A [%]

Percentage of Housing Built Pre-1960	Points
A < 20 %	1
A > 20 %	0

B: Average change in purchase prices of residential buildings.
The average of the yearly changes in purchase prices of residential buildings in the district B is calculated according to the following formula:
Change of purchase prices of residential buildings year 1 [%] + Change purchase prices of residential buildings year 2 [%] + Change of purchase prices of residential buildings year 3 [%] / 3 = C [%]

Average change in purchase prices of residential buildings	Points
B < 126 %	1
B ≥ 126 %	0

C: Yearly change in rental fees of residential buildings (average of last 3 years in percent).
The average of the yearly changes in rental fees in the district C is calculated according to the following formula:
Change of rental fees year 1 [%] + Change of rental fees year 2 [%] + Change of rental fees year 3 [%] / 3 = C [%]

Yearly change in rental fees of residential buildings	Points
C < 5 %	1
C ≥ 5%	0

	D: Change in area median income (average of last 3 years in percent). The average of the yearly changes in area median income in the district D is calculated according to the following formula: Change in area median income year 1 [%] + Change in area median income yea 2 [%] + Change in area median income year 3 [%] / 3 = D [%] **Change in area median income** — **Points** D < 10 % — 1 D ≥ 10 % — 0 E: Unemployment rate in district (average of last 3 years in percent). The average unemployment rate in the district is calculated according to the following formula: Unemployment rate year 1 [%] + Unemployment rate year 2 [%] + Unemployment rate year 3 [%] / 3 = E [%] **Unemployment rate** — **Points** E < 10 % — 1 E ≥ 10 % — 0 F: Yearly change in district population (average of last 3 years in percent). The average yearly change in district population in the district is calculated according to the following formula: Change in district population year 1 [%] + Change in district population year 2 [%] + Change in district population year 3 [%] / 3 = F [%] **Yearly change in district population** — **Points** F < 4 % — 1 F ≥ 4 % — 0 G: Share of inhabitants older than 60 years in the district. The share of inhabitants that is older than 60 years is calculated according to the following formula: Number of inhabitants older than 60 years / Number of all inhabitants in the district = G [%] **Share of inhabitants older than 60 years** — **Points** G ≥ 30,0 % — 1 G < 30,0 % — 0 **D.2.7.1 Gentrification Index** — **Points** Gentrification Index = 6 — 100 Gentrification Index =3 — 50 Gentrification Index = 1 — 1
Areas covered	The indicator can be calculated at whole life cycle stages.
Barriers	Availability of data
Rating	FASUDIR IDST Methodology
References	[1]
SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	It is a specific neighbourhood-related indicator. The indicator cannot be used on building level.
References	[1]
REFERENCES	
[1]	Nesbitt, A: A Model of Gentrification Monitoring Community Change in selected Neighbourhoods of St. Petersburg, Florida using the Analytical Hierarchy Process

<table>
<tr><td rowspan="3">ECO.LC.09</td><td colspan="8">Life cycle costs aggregated (€)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td colspan="2">SCALE</td></tr>
<tr><td colspan="2">Economic</td><td colspan="2">Life Cycle costs</td><td colspan="2">A</td><td colspan="2">N</td></tr>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td>Description</td><td colspan="8">Life Cycle costing on district level will help decision makers to select the best solutions for the whole district. Therefore all life cycle costs from building level will be aggregated and life cycle costs for energy infrastructure will be added.
The Life cycle costs calculation on district level includes the sum of all building life cycle costs in the district as well as all life cycle costs concerning the energy infrastructure in the district over a period of 50 years.
The Life cycle costs calculation for districts is based on the same calculation method used for single building Life cycle cost calculations. In order to assess all buildings in the whole district the Life Cycle costs of each building will be summed up to an aggregated Building Life cycle costs value. Furthermore the Life cycle costs arising from the energy infrastructure in the whole district are summed up to an aggregated Energy Infrastructure Life cycle cost value.
The whole district Life cycle costs then are aggregated from the building and energy infrastructure Life cycle cost values to an overall Life cycle cost value for the whole district.</td></tr>
<tr><td>Background</td><td colspan="8">FASUDIR</td></tr>
<tr><td>References</td><td colspan="8">[1],[2],[3],[4],[5]</td></tr>
<tr><td colspan="9">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td colspan="2">Operational data</td><td></td><td colspan="2">In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td colspan="2">Empirical/Literature</td><td></td><td colspan="2">Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="8">1. Building Life cycle costs value.
The Building Life cycle costs value is calculated by summing up all Life cycle cost values from the Life cycle cost calculations conducted in Building.
2. Energy Infrastructure Life cycle cost value.
The Energy Infrastructure Life cycle cost value includes the investment costs and non-energy running costs of all energy infrastructure facilities in the district. Running costs energy for the energy infrastructure (auxiliary energy etc.) are not considered in FASUDIR due to poor data availability.
For the determination of construction costs and non-energy operational costs arising from repair, maintenance and replacement of energy infrastructure it is necessary to differentiate between two main cases:
Existing energy infrastructure with retrofitting measures
Existing energy infrastructure without retrofitting measures
The costs arising from retrofitting measures shall include:
Costs for deconstruction and disposal of eliminated energy infrastructure
Repair, maintenance and replacement costs for energy infrastructure
Construction costs for all new energy infrastructure brought to the district in the course of the energy retrofitting measures (investment costs for construction and installation process).
In the case that no retrofitting measures are executed the costs shall include:
Costs for deconstruction and disposal of remaining energy infrastructure
Repair, maintenance and replacement costs for remaining energy infrastructure
The investment costs for the construction and installation process shall be set to zero if no retrofitting measures on the energy infrastructure are executed.
Energy infrastructure is defined in FASUDIR as:
All central operating facilities providing energy to more than one building in the district (e.g. thermal power stations, combined heat and power units, solar powered plants, wind turbines, etc.)
All energy distribution facilities (e.g. heat and electricity grids) used in the district
Energy transmission stations in buildings (e.g. district heating transmission station) are not included in the energy infrastructure costs, but are considered in the building Life cycle costs.</td></tr>
<tr><td>Areas covered</td><td colspan="8">-</td></tr>
<tr><td>Barriers</td><td colspan="8">Availability of data</td></tr>
<tr><td>Rating</td><td colspan="8">Benchmark for the Life cycle cost indicator on neighbourhood level is not defined.</td></tr>
<tr><td>References</td><td colspan="8">[1],[2],[3],[4],[5]</td></tr>
</table>

SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the "Scale" characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	The indicator will be used concurrently on building and district level and can be defined as multiscale KPI.
References	[1],[2],[3],[4],[5]
REFERENCES	
[1]	VDI 2067 : Economic efficiency of building installations Fundamentals for economic calculation
[2]	EN 15459 : Energy performance of buildings Economic evaluation procedure for energy systems in buildings
[3]	EN ISO 15686-5 : Buildings and constructed assets Service life planning - Part 5: Life cycle costing
[4]	EN ISO 15686-9 Buildings and constructed assets Part 8 Reference service life and service life information
[5]	Bayerisches Staatsministerium fr Umwelt und Gesundheit (StMUG): Leitfaden Energienutzungsplan, 2011

ECO.IC.03	Investment costs aggregated (€)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Economic	Investment Costs	A	N

GENERAL	
Description	Life Cycle costing on neighbourhood level will help decision makers to select the best solutions for the whole area. Therefore all life cycle costs from building level will be aggregated and life cycle costs for energy infrastructure will be added. The Life cycle costs calculation on neighbourhood level includes the sum of all building life cycle costs in the neighbourhood as well as all life cycle costs concerning the energy infrastructure in the district over a period of 50 years. The Life cycle costs calculation for neighbourhoods is based on the same calculation method used for single building Life cycle cost calculations. In order to assess all buildings in the whole area the Life Cycle costs of each building will be summed up to an aggregated Building Life cycle costs value. Furthermore the Life cycle costs arising from the energy infrastructure in the whole neighbourhood are summed up to an aggregated Energy Infrastructure Life cycle cost value. The whole neighbourhood Life cycle costs then are aggregated from the building and energy infrastructure to an overall Life cycle cost value for the whole neighbourhood.
Background	FASUDIR
References	[1],[2],[3],[4],[5]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	The calculation of the aggregated investment costs of all energy infrastructure facilities in the district follows the same principles used for the D.3.1.1 “Life cycle cost aggregation”					
Areas covered	-					
Barriers	Availability of data					
Rating	Benchmark is not available, due to poor data availability.					
References	[1],[2],[3],[4],[5]					

SCALE	
Application	Neighbourhood scale.
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.
Multiscale	The indicator will be used concurrently on building and district level and can be defined as multiscale KPI.
References	[1],[2],[3],[4],[5]

REFERENCES	
[1]	FASUDIR D2.4 IDST Key Performance Indicators
[2]	EN 15459 : Energy performance of buildings Economic evaluation procedure for energy systems in buildings
[3]	EN ISO 15686-5 : Buildings and constructed assets Service life planning - Part 5: Life cycle costing
[4]	EN ISO 15686-9 Buildings and constructed assets Part 8 Reference service life and service life information
[5]	Bayerisches Staatsministerium fr Umwelt und Gesundheit (StMUG): Leitfaden Energienutzungsplan, 2011

<table>
<tr><td rowspan="3">ECO.LC.04</td><td colspan="4">Operational Energy Costs aggregated (€)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Life Cycle costs</td><td>A</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Life Cycle costing on district level will help decision makers to select the best solutions for the whole district. Therefore all life cycle costs from building level will be aggregated and life cycle costs for energy infrastructure will be added.
The Life cycle costs calculation on district level includes the sum of all building life cycle costs in the district as well as all life cycle costs concerning the energy infrastructure in the district over a period of 50 years.
The Life cycle costs calculation for districts is based on the same calculation method used for single building Life cycle cost calculations. In order to assess all buildings in the whole district the Life Cycle costs of each building will be summed up to an aggregated Building Life cycle costs value. Furthermore the Life cycle costs arising from the energy infrastructure in the whole district are summed up to an aggregated Energy Infrastructure Life cycle cost value.
The whole district Life cycle costs then are aggregated from the building and energy infrastructure Life cycle cost values to an overall Life cycle cost value for the whole district.</td></tr>
<tr><td>Background</td><td colspan="4">FASUDIR</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4],[5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] | Empirical/Literature [ ] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">The calculation of the aggregated running costs energy in the district follows the same principles used for the Life cycle cost aggregation in D.3.1.1.
Therefore the running costs energy for all buildings (results from Building KPI) are summed up. Running costs energy for the energy infrastructure (auxiliary energy etc.) are not considered in the aggregation due to poor data availability.</td></tr>
<tr><td>Areas covered</td><td colspan="4">-</td></tr>
<tr><td>Barriers</td><td colspan="4">Availability of data</td></tr>
<tr><td>Rating</td><td colspan="4">Benchmark is not available, due to poor data availability.</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4],[5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Neighbourhood scale.</td></tr>
<tr><td>Details</td><td colspan="4">Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.</td></tr>
<tr><td>Multiscale</td><td colspan="4">The indicator will be used concurrently on building and district level and can be defined as multiscale KPI.</td></tr>
<tr><td>References</td><td colspan="4">[1],[2],[3],[4],[5]</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">FASUDIR D2.4 IDST Key Performance Indicators</td></tr>
<tr><td>[2]</td><td colspan="4">EN 15459 : Energy performance of buildings Economic evaluation procedure for energy systems in buildings</td></tr>
<tr><td>[3]</td><td colspan="4">EN ISO 15686-5 : Buildings and constructed assets Service life planning - Part 5: Life cycle costing</td></tr>
<tr><td>[4]</td><td colspan="4">EN ISO 15686-9 Buildings and constructed assets Part 8 Reference service life and service life information</td></tr>
<tr><td>[5]</td><td colspan="4">Bayerisches Staatsministerium fr Umwelt und Gesundheit (StMUG): Leitfaden Energienutzungsplan, 2011</td></tr>
</table>

ECO.LC.05	Operational non-energy costs aggregated (€)					
	ISSUE	CATEGORY		LEVEL		SCALE
	Economic	Life Cycle costs		A		N
GENERAL						
Description	Life Cycle costing on district level will help decision makers to select the best solutions for the whole district. Therefore all life cycle costs from building level will be aggregated and life cycle costs for energy infrastructure will be added. The Life cycle costs calculation on district level includes the sum of all building life cycle costs in the district as well as all life cycle costs concerning the energy infrastructure in the district over a period of 50 years. The Life cycle costs calculation for districts is based on the same calculation method used for single building Life cycle cost calculations. In order to assess all buildings in the whole district the Life Cycle costs of each building will be summed up to an aggregated Building Life cycle costs value. Furthermore the Life cycle costs arising from the energy infrastructure in the whole district are summed up to an aggregated Energy Infrastructure Life cycle cost value. The whole district Life cycle costs then are aggregated from the building and energy infrastructure Life cycle cost values to an overall Life cycle cost value for the whole district.					
Background	FASUDIR					
References	[1],[2],[3],[4],[5]					
LEVEL						
Derived from *(Check – X - as appropriate)*	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	The calculation of the aggregated running costs non-energy in the district follows the same principles used for the Life cycle cost aggregation in D.3.1.1. Therefore the running costs non-energy for all buildings (results from Building KPI) and the energy infrastructure facilities are summed up to an aggregated value. If no data is available for calculation of the running costs non-energy for the energy infrastructure they can be neglected or estimated by using default values.					
Areas covered	-					
Barriers	Availability of data					
Rating	Benchmark is not available, due to poor data availability.					
References	[1],[2],[3],[4],[5]					
SCALE						
Application	Neighbourhood scale.					
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.					
Multiscale	The indicator will be used concurrently on building and district level and can be defined as multiscale KPI.					
References	[1],[2],[3],[4],[5]					
REFERENCES						
[1]	FASUDIR D2.4 IDST Key Performance Indicators					
[2]	EN 15459 : Energy performance of buildings Economic evaluation procedure for energy systems in buildings					
[3]	EN ISO 15686-5 : Buildings and constructed assets Service life planning - Part 5: Life cycle costing					
[4]	EN ISO 15686-9 Buildings and constructed assets Part 8 Reference service life and service life information					
[5]	Bayerisches Staatsministerium fr Umwelt und Gesundheit (StMUG): Leitfaden Energienutzungsplan, 2011					

ECO.IC.05	**Return on Investment (%)**						
	ISSUE		**CATEGORY**		**LEVEL**	**SCALE**	
	Economic		Investment Costs		A	N	
GENERAL							
Description	Energy retrofitting measures for districts are economic efficient if the energy savings caused by the retrofitting measures over the whole life cycle exceed the total investment costs for the measures. The Return on Investment is a very important issue for decision-makers in retrofitting projects to evaluate the economic efficiency of retrofitting measures on district level. The indicator assesses the Return on Investment of energy retrofitting measures for the whole district by using the overall investment costs and the savings in running costs energy. The indicator only relies on the costs and savings from measures that are directly affecting the energy demand of the district						
Background	FASUDIR						
References	[1]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements		
	Simple Calculations	X	Empirical/Literature		Other (specify)		
Details	For the calculation of Return on Investment the following steps have to be executed: 1: The yearly savings in running costs energy (S) have to be calculated by subtracting the running costs energy of all buildings (aggregation) in the retrofitted district from the aggregated running costs energy of the original district (Building KPI). S: Yearly savings in running costs energy [€] = District running costs energy $_{original}$ - District running costs energy $_{retrofitted}$ 2: INVEST: The total investment costs for the energy retrofitting measures have to be calculated (take over from District KPI) [€] 3: Determination of discount rate i 4: Determination of energy price changing rate z 5: Determination of period of consideration t 6: Calculation of ROI $ROI = [\, S^{*}\sum_{j=0}^{t} (1+z)^{t}] \,/\, [INVEST \, ^{*}(1+i)^{t}] \;\; ^{*}\, 100\%$						
Areas covered	-						
Barriers	Availability of data						
Rating	Benchmark is not available, due to poor data availability.						
References	[1]						
SCALE							
Application	Neighbourhood scale.						
Details	Provide details to justify the “Scale” characterization (building / neighbourhood) of the indicator given in the appointed space above.						
Multiscale	The indicator will be used concurrently on building and neighbourhood level and can be defined as multiscale KPI.						
References	[1]						
REFERENCES							
[1]	FASUDIR D2.4 IDST Key Performance Indicators						

A.8 – IRH MED

IRH - MED

Guidelines for Innovative Responsible Housing

http://www.irh-med.eu/

IRH-Med stands for Innovative Residential Housing for the Mediterranean. Within the IRH-Med project, 10 partners from South European countries jointly work on the topic of innovative housing. The partners from Spain, Italy, France, Greece and Hungary are willing to jointly advance paths and solutions for innovative housing. By focusing on a comprehensive and sustainable RH concept, which optimally fits into the socio-economic & cultural surroundings & actively preserves environment, the partnership intends to bolster the market and increase the competitiveness for innovative models of RH in the Med Space.

INDICATORS

ENV.LU.03	Site quality					
	ISSUE	CATEGORY		LEVEL		SCALE
	Environmental	Land Use		B		N
GENERAL						
Description	The site of the housing building brings assets related to the user' health and comfort. The air quality, the ambient noise level, the existence of sources of pollution on the land (due for instance to past industrial uses), the electromagnetic fields (due to the presence of high-tension cables, buried cables, transformers) and the presence of radon (depending on the geologic nature of the land) are important parameters ot assess the sustainability of the site.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	*X*		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

ENV.LU.14	Urban context					
	ISSUE	CATEGORY		LEVEL		SCALE
	Environmental	Land Use		B		N
GENERAL						
Description	The urban characteristics of the site (density of inhabitants, proximity to the urban centre, level of equipment, infrastructures proximity and quality…) will model the behaviour of its inhabitants. Isolated situation, far from the equipment and services, are not sustainable for housing.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

ENV.LU.10	**Outdoor space (-)**					
	ISSUE		**CATEGORY**		**LEVEL**	**SCALE**
	Environmental		Land Use		B	N
GENERAL						
Description	It outdoor spaces are available, their treatment should be sustainable either keeping their existing treatment should be sustainable, either keeping their existing conditions or anticipation their improvement. This includes the treatment of soil and topography, the management of runoff and the maintenance or introduction of native plants adapted to the local climate.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

<table>
<tr><td rowspan="3">ENV.Im.18</td><td colspan="6">Light pollution</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environment</td><td colspan="2">Impacts</td><td>B</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Darkness is being increasingly replaced by artificial light. Though this brings safety improvements in many places, it also makes clear observation of the right sky impossible and the habitants of nocturnal animals are adversely affected. Furthermore, negative effects on the circadian and endocrine systems of man and animals alike has been reported, the human senses to the visual qualities of the naturally intact nocturnal landscape are dulled and energy is wasted due to light spill.</td></tr>
<tr><td>Background</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td>X</td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="6"></td></tr>
<tr><td>Areas covered</td><td colspan="6"></td></tr>
<tr><td>Barriers</td><td colspan="6"></td></tr>
<tr><td>Rating</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6"></td></tr>
<tr><td>Details</td><td colspan="6"></td></tr>
<tr><td>Multiscale</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
</table>

REFERENCES	
[1]	
[2]	

SOC.TC.05	Heat Island effect					
	ISSUE		CATEGORY	LEVEL	SCALE	
	Social		Thermal Comfort	B	N	
GENERAL						
Description	Urban areas cause overheating around themselves due to the dissipation of internal loads, transportation and less presence of vegetation. Part of this “heat island” can be limited by increasing the reflectivity of the surfaces exposed to the ground, vertical and horizontal – especially roofs and paved public spaces – by shading and using vegetation.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

ENV.En.10	**Peak Energy demand**					
	ISSUE		CATEGORY	LEVEL		SCALE
	Environment		Energy	B		B / N
GENERAL						
Description	The reduction of the electrical peak demand for building operations contributes to a more efficient electricity network management.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	x
	Simple Calculations		Empirical/Literature			
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

ECO.Eq.05	**Future evolution and modularity**					
	ISSUE		CATEGORY		LEVEL	SCALE
	Economic		Equity		B	N
GENERAL						
Description	Dwellings and facilities should be adaptable to other future needs, either because individual needs evolve (size of family, age and ability, etc.) or because part or all of the building can be devoted to other functions. By anticipating the future needs, the necessary evolutions can be made with minimal extra works (and extra environmental and economic costs).					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

ECO.Eq.04	**Prevention of prejudice**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Economic	Equity		B		N
GENERAL						
Description	All potential prejudices along the building life must be identified and corrected through a preliminary audit, an appropriate follow-up and careful dialogue with stakeholders 'neighbourhood, design team and building crew, owner and users.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	*X*		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

ECO.Va.04	Competent professional team					
	ISSUE	CATEGORY		LEVEL		SCALE
	Economic	Value		B		N
GENERAL						
Description	All the participants in the different stages of the project (including monitoring and maintenance) must have assessed know-how in sustainable building. This can be replaced or corrected by proper training through the project process. At this stage of the development of the sustainable building market, training the designing, building and maintenance teams during the whole building process seems quite crucial to help develop and raise the awareness and know-how of the sustainable building industry.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	*X*		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

FIN.Eq.10	Social mixing and solidarity based economy					
	ISSUE	CATEGORY		LEVEL		SCALE
	Economic	Equity		B		N
GENERAL						
Description	Claiming sustainability further means that, at all stages, the project must contribute to promoting social mixing and equal opportunities for all (unemployed, genders, disabled…),.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

<table>
<tr><td rowspan="3">ECO.Va.06</td><td colspan="6">Equipment and services pooling</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td colspan="2">Value</td><td colspan="2">B</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Natural resources conservation additionally implies promoting an economy based on a functionality and services approach, rather than on individual ownership of goods. Thus housing projects should include collective equipment, rooms or services (laundry, sports, restaurant, composting, hospitality rooms, etc.). Moreover, these shared equipment help promote better citizenship and friendlier communities.</td></tr>
<tr><td>Background</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td>X</td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="6"></td></tr>
<tr><td>Areas covered</td><td colspan="6"></td></tr>
<tr><td>Barriers</td><td colspan="6"></td></tr>
<tr><td>Rating</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6"></td></tr>
<tr><td>Details</td><td colspan="6"></td></tr>
<tr><td>Multiscale</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
</table>

REFERENCES	
[1]	
[2]	

ECO.LC.02	Cost benefit analysis focused on sustainability					
	ISSUE	CATEGORY	LEVEL	SCALE		
	Economic	Life Cycle costs	B	B / N		
GENERAL						
Description	Economic sustainability of the measures implemented is essential in order to ensure the feasibility of housing sustainability concept. The project must be designated so as to minimize the costs due to the implementation of the sustainable measures. A cost/benefit analysis tool, including in-use and externalities costs, may help put into perspective and mitigate the allegedly “extra “costs that are often emphasized.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

Project co-financed by the European Regional Development Fund

<table>
<tr><td rowspan="2">ECO.LC.01</td><td colspan="6">Verifiable sustainable targets</td></tr>
<tr><td colspan="6">ISSUE | CATEGORY | LEVEL | SCALE</td></tr>
<tr><td></td><td colspan="6">Economic | Life Cycle costs | B | B/N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">From the start, the project design formulates and determines sustainable targets for each criterion. This includes using advanced calculation/optimization tools for those subject to actual measurements (energy, water…). It further implies that the monitoring tools and equipment necessary for measuring and controlling the main sustainability criteria are installed.</td></tr>
<tr><td>Background</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td>X</td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="6"></td></tr>
<tr><td>Areas covered</td><td colspan="6"></td></tr>
<tr><td>Barriers</td><td colspan="6"></td></tr>
<tr><td>Rating</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6"></td></tr>
<tr><td>Details</td><td colspan="6"></td></tr>
<tr><td>Multiscale</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
</table>

REFERENCES	
[1]	
[2]	

ECO.Qu.06	**Building works quality control**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Economic	Quality		B		B
GENERAL						
Description	In order to ensure the actual and correct implementation of sustainable measures and criteria, the constructor must adopt measurement and documentation systems for quality control. It includes good monitoring of the construction stage itself (minimizing water and energy consumption, optimizing material use, reducing and recycling waste). In addition, it includes fair wages and safe working conditions for construction crews.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

ECO.Ma.02	Information and participation of users					
	ISSUE	CATEGORY		LEVEL		SCALE
	Economic	Management		B		B/N
GENERAL						
Description	Sustainability further depends on the final users' behaviour, so they should be involved as early as the initial design stage (as was shown above). The monitoring system must provide useful data for managing sustainability through the operative life of the building. Therefore, it is further used to inform building users and help them adjust their behaviour and control the operating costs.					
Background						
References						
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	X		
Details						
Areas covered						
Barriers						
Rating						
References						
SCALE						
Application						
Details						
Multiscale						
References						

REFERENCES	
[1]	
[2]	

A.9 - NewTREND

NewTREND

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 680474.

New integrated methodology and Tools for Retrofit design towards a next generation of ENergy efficient and sustainable buildings and Districts

http://newtrend-project.eu/

NewTREND seeks to improve the energy efficiency of the existing European building stock and to improve the current renovation rate by developing a new participatory integrated design methodology targeted to the energy retrofit of buildings and neighbourhoods, establishing energy performance as a key component of refurbishments. The methodology will foster collaboration among stakeholders in the value chain, engaging occupants and building users and supporting all the refurbishment phases through the whole life cycle of the renovation. The methodology will be supported by an online platform to ease collaborative design, which will play the role of exchanging information and facilitating dialogue between the different stakeholders involved in the retrofit process. It will store all the information useful to the design of the retrofit intervention in a cloud based interoperable data exchange server, i.e. the District Information Model server, which has the ability to and export multiple file formats thanks to semantic web technologies.
A Data Manager tool will be developed to guide the designers in the data collection phase, which might be a complex task for retrofit projects where information and drawings are scattered or even not available.
The NewTREND platform will be a tool for collaborative design allowing evaluation of different design options at both building and district level through dynamic simulations via a Simulation & Design Hub. Design options, including district schemes and shared renewables will be presented to the design team, together with available financing schemes and applicable business models, in a library which will build on lessons from past and ongoing R&D projects. The NewTREND methodology and tools will be validated in three real refurbishment projects in Hungary, Finland and Spain where the involvement of all the stakeholders in the design .process, will be evaluated and specific activities will be dedicated to inhabitants and users.

INDICATORS

<table>
<tr><td rowspan="3">ENV.En.13</td><td colspan="6">Operational Primary Energy Demand (kWh/m² yr)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Energy</td><td>A</td><td>B / N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Primary energy is energy found in nature that has not been subjected to any conversion or transformation process. It is energy contained in raw fuels as well as other forms of energy received as input to a system. The indicator Energy Demand aims at the reduction of the Total Primary Energy Demand. The indicator is in line with the EU’s 40-27-27 targets for 2030 compared to 1990 which aim to reduce the greenhouse gas emissions compared to 1990 levels up to 40%, to increase the share of renewable energy consumption by at least 27% and to save at least 27% of energy compared with the business-as-usual scenario.
Considering the quantitative improvement of the Operational Primary energy demand of buildings before and after retrofitting took place it is possible to use the results for the selection of the most primary energy efficient retrofitting measures in building retrofitting projects.
The indicator is based on the method of TPEF (EN 15603). The indicator uses primary energy factors defined for different fuels in order to calculate the primary energy demand based on the delivered energy demand, which is obtained either through a simulation in basic and advanced mode, or from metered data in premium mode. As the indicator is focussed on the operational primary energy demand only the life cycle stage is considered in the calculations according to the EN 15978 standard, which means that no Life Cycle Assessment calculation needs to be performed.</td></tr>
<tr><td>Background</td><td colspan="6">NewTREND, OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings – July 2013</td></tr>
<tr><td>References</td><td colspan="6">[1], [2] ,[3], [4], [5], [6], [7]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from)</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Simulation and Design Hub</td><td>X</td></tr>
<tr><td>Details</td><td colspan="6">The indicator shall be calculated by the Simulation and Design Hub according to the TPEF (EN 15603 Standard). As the indicator is based only on the building operational energy demand it considers only the life cycle stage according to the EN 15978 standard. Therefore a Life Cycle Assessment is not performed.
The indicator is calculated by using defined primary energy factors (total primary energy factors TPEF (EN 15603)) for different fuel types in the different countries which are multiplied with the simulated total delivered energy demand of the building. If data for primary energy factors of the fuel types are not available a default set will form the core of the Simulation and Design Hub engine will be used for performing the calculations. The simulated total delivered thermal and electrical energy demand of the building, which is the input for the operational primary energy demand calculation, will consider all sources and uses, such as:
• Heating
• Cooling
• Hot water
• Cooking
• Lighting
• Power
• Solar thermal contribution to DHW, space heating or processes
• Auxiliary energy</td></tr>
<tr><td>Areas covered</td><td colspan="6">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="6">-</td></tr>
<tr><td>Rating</td><td colspan="6">In order to calculate the performance of the indicator, a linear interpolation method is recommended, with the following thresholds as defined by the OPEN HOUSE EU FP7 project:
• Best performance: 60 kWh/m2 yr
• Minimum performance: 450 kWh/m2 yr</td></tr>
<tr><td>References</td><td colspan="6">[1], [2] ,[3], [4], [5], [6], [7]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
</table>

Application	Applicable to the small (building) or large (neighbourhood) scale.
Details	The “Scale” characterization is that of the building and of the neighbourhood.
Multiscale	The indicator is used by an aggregation of each building on district mode and therefore can be described as a multiscale KPI.
References	[1], [2] ,[3], [4], [5], [6], [7]

REFERENCES	
[1]	European Commission- EU 2030 targets: http://ec.europa.eu/energy/en/topics/energy-strategy/2030-energy-strategy (29.03.2016)
[2]	BS EN 15603:2008: Energy performance of buildings. Overall energy use and definition of energy ratings
[3]	EN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
[4]	FprCEN/TR 15615:2014: Energy Performance of buildings — Module M1-x — Accompanying Technical Report on draft Overarching standard EPBD (prEN 15603)
[5]	prEN ISO/DIS 52000-1:2015, draft prEN 15603:2015: Energy performance of buildings — Overarching EPB assessment – Part 1: General framework and procedures
[6]	Draft ISO-TR 52000-2 - Overarching EPB assessment - Part 2: Explanation and justification of ISO 52000-1
[7]	Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011-2015
[8]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings – July 2013

<table>
<tr><td rowspan="3">ENV.En.07</td><td colspan="4">Delivered Energy Demand (kWh/m² yr)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Energy</td><td>A</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The delivered energy demand on district level shows the aggregated total performance of all buildings within the district. Delivered energy demand is defined as the part of the primary energy demand in a building after subtracting the different conversion and transport losses (e.g. conversion of oil into electricity in a power plant) for providing the energy. This means the part of the primary energy which passes finally the system boundary of the building. Delivered energy demand shows the building operators the demand of energy which needs to be paid on the energy bill. Therefore the figure is useful to demonstrate measurable energy saving in the district and to calculate energy cost savings. Hence, the KPI results are used as basis for further KPIs calculations like Total Carbon Emissions, Return of Investment which are important in decision-making and design in retrofitting projects on district scale.
For all modes, the values of the indicator on building level B1.2 are aggregated at district level with the indicator results calculated for all other buildings in the area. Through this calculation it is possible to obtain an overall value of the indicator for the district.</td></tr>
<tr><td>Background</td><td colspan="4">NewTREND, the results of EPBD-CA.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">
<table>
<tr><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Simulation and Design Hub</td><td>X</td></tr>
</table>
</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Details</td><td colspan="4">In order to get a result for the whole district in the unit KWh/m2.yr the results of the total delivered energy demand (kWh) for each single building within the district, calculated for the building, will be aggregated to a total figure for the neighbourhood and after this aggregation it will be divided by the sum of the reference floor areas of each building in the neighbourhood.

The delivered energy is obtained either through a simulation in basic and advanced mode, or from metered data in premium mode.
The indicator shall be calculated by using the simulated total delivered energy demand of the building in the Simulation and Design Hub. The energy demand of the buildings, which is the input for the operational primary energy demand calculation, will consider all sources, such as:
• Heating
• Cooling
• Hot water
• Cooking
• Lighting
• Power
• Solar thermal contribution to DHW, space heating or processes
• Auxiliary energy

The KPI will be presented in the project in the Collaborative Design Platform to the users in the way of a relative value of kWh/m2.yr (m² total floor area of all buildings in the neighbourhood as sum utilizing the data entered for the building).</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">In order to calculate the performance of the indicator a linear interpolation method is recommended, with the following thresholds as defined by the results of EPBD-CA:
• Best performance: 40 kWh/m2 yr
• Minimum performance: 300 kWh/m2 yr</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the small (building) or large (neighbourhood) scale.</td></tr>
<tr><td>Details</td><td colspan="4">-</td></tr>
</table>

Multiscale	The indicator is calculated based on an aggregation of each building delivered energy demand to a total neighbourhood figure and therefore can be described as a multiscale indicator.
References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	FprCEN/TR 15615:2014: Energy Performance of buildings — Module M1-x — Accompanying Technical Report on draft Overarching standard EPBD (prEN 15603)
[2]	prEN ISO/DIS 52000-1:2015, draft prEN 15603:2015: Energy performance of buildings — Overarching EPB assessment – Part 1: General framework and procedures
[3]	Draft ISO-TR 52000-2 - Overarching EPB assessment - Part 2: Explanation and justification of ISO 52000-1
[4]	European Commission- EU 2030 targets: http://ec.europa.eu/energy/en/topics/energy-strategy/2030-energy-strategy (29.03.2016)
[5]	Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011-2015

<table>
<tr><td rowspan="3">ENV.En.20</td><td colspan="4">Renewable Energy on Site (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Energy</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">One main sustainability target within the European Union is to increase the share of renewable energy consumption on the total energy consumption in order to lower the dependency of the EU from fossil energy sources and to reduce the greenhouse gas emissions caused by fossil energy sources. This KPI therefore aims to measure the share of renewable energy consumption in a building on the total final energy consumption. The KPI is in line with the EU's 40-27-27 targets for 2030 compared to 1990 which aim to reduce the greenhouse gas emissions compared to 1990 levels up to 40%, to increase the share of renewable energy consumption by at least 27% and to save at least 27% of energy compared with the business-as-usual scenario. The KPI is important as additional information for decision-making processes in retrofitting projects as the share of renewable energy produced on-site shows in detail how a building performs in terms of active energy production. Hence, by using this KPI it is not only possible to assess the primary energy consumed in the building as well as the carbon emission during building operation, but also to assess the active contribution of the building to a decentralized energy production.
The values of the indicator on building level are aggregated at neighbourhood level encompassing the entirety of all buildings in the neighbourhood, and urban production sources are added.
The indicator assesses the share of renewable produced energy in a neighbourhood compared to the total final energy demand of all buildings in the area.</td></tr>
<tr><td>Background</td><td colspan="4">NewTREND</td></tr>
<tr><td>References</td><td colspan="4">[4], [5]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">
<table>
<tr><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Simulation and Design Hub</td><td>x</td></tr>
</table>
</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Details</td><td colspan="4">The indicator is calculated according to the methodology defined in EN 15603, by dividing the renewable primary energy on site by the total primary energy demand of the buildings. Both renewable and non-renewable primary energies are obtained either through a simulation in basic and advanced mode, or from metered data in premium mode.
The indicator is calculated by using the total renewable produced energy on site (defined as sum of PV, wind & solar thermal) and dividing it by the simulated total primary energy demand of the building as calculated for indicator in basic mode.

The calculation formula is as follows:

$RER\ [\%] = (E_{(Pren;RER)\ [kWh]})/(E_{\_Ptot\ [kWh]})*100$

Where:
EP_{tot} is the total primary energy calculated according to EN 15603;
$EP_{ren;RER}$ is the renewable primary energy, calculated according to EN 15603 within the on-site perimeter</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">In order to calculate the performance of the indicator, a linear interpolation method is recommended, with the following thresholds as defined by the EU 2030 targets:
• Best performance: 20%
• Minimum performance: 0%</td></tr>
<tr><td>References</td><td colspan="4">[1], [2] ,[3], [4], [5]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the small (building) or large (neighbourhood) scale.</td></tr>
<tr><td>Details</td><td colspan="4">The indicator is calculated for each building in the district and can be aggregated to a total district figure which represents the total share of renewable energy production in a district.</td></tr>
<tr><td>Multiscale</td><td colspan="4">The indicator is based on an aggregation for each building in the neighbourhood which</td></tr>
</table>

	represents the total share of renewable energy production in a neighbourhood. Therefore the KPI can be described as multiscale KPI.
References	[1], [2] ,[3], [4], [5]

REFERENCES	
[1]	FprCEN/TR 15615:2014: Energy Performance of buildings — Module M1-x — Accompanying Technical Report on draft Overarching standard EPBD (prEN 15603)
[2]	prEN ISO/DIS 52000-1:2015, draft prEN 15603:2015: Energy performance of buildings — Overarching EPB assessment – Part 1: General framework and procedures
[3]	Draft ISO-TR 52000-2 - Overarching EPB assessment - Part 2: Explanation and justification of ISO 52000-1
[4]	European Commission- EU 2030 targets: http://ec.europa.eu/energy/en/topics/energy-strategy/2030-energy-strategy (29.03.2016)
[5]	Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011-2015

<table>
<tr><td rowspan="3">ENV.Im.09</td><td colspan="4">Global Warming Potential (kgCO2-eq/m2 yr)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>S/A</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The indicator assesses the impacts on the environment caused by the Total carbon emissions caused by used fuels of all the buildings in a district during their operation stage. The KPI is in line with the EU's 40-27-27 targets for 2030 compared to 1990 which aim to reduce the greenhouse gas emissions compared to 1990 levels up to 40%, to increase the share of renewable energy consumption by at least 27% and to save at least 27% of energy compared with the business-as-usual scenario. The KPI supports planners in the selection of retrofitting measures in the district in decision-making and design as it quantifies the operational energy consumption of the district not only in terms of energy but shows the impact of the consumed energy also in terms of a contribution to the Green House Gas Effect. This opens new views on the suitability of retrofitting measures on district level which cannot be provided by the sole use of the KPIs Operational Primary Energy Demand and Delivered Operational Energy Demand in the district.

For all modes, the values of the indicator on building level are aggregated at neighbourhood level with the indicator results calculated for all other buildings in the area. Through this calculation it is possible to obtain an overall value of the indicator for the neighbourhood.
In order to get a result for the whole district in the unit kgCO2/m2.yr the results of the total carbon emissions (kgCO2) for each single building within the neighbourhood will be aggregated to a total figure for the neighbourhood and after this aggregation it will be divided by the sum of the reference floor areas of each building in the area.</td></tr>
<tr><td>Background</td><td colspan="4">NewTREND, OPEN HOUSE EU FP7 project</td></tr>
<tr><td>References</td><td colspan="4">[1], [2] ,[3], [4], [5] ,[6], [7], [8]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
</table>

Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Simulation and Design Hub	X

Details

The KPI will be presented in the Collaborative Design Platform to the users in the way of a relative value of kgCO2/m2.yr (m² total reference floor area of all buildings in the neighbourhood as sum). The user will be able to enter reference floor areas of the buildings as attributes which can be summed up to a total neighbourhood reference floor area for the Indicator calculation.
In order to get a result for the whole district in the unit kgCO2/m2.yr, the emissions calculated from metered annual data of the total delivered energy demand (kWh) for each single building within the neighbourhood will be aggregated to a total figure for the neighbourhood and after this aggregation it will be divided by the sum of the reference floor areas of each building in the district.
The indicator will be presented in the Collaborative Design Platform to the users in the way of a relative value of kgCO2/m2.yr (m² total floor area of all buildings in the district as sum utilizing the data entered for the indicator at building level).

At the building level, the indicator shall be calculated by the Simulation and Design Hub according to the EN 15603 Standard. As the indicator is based only on the carbon emissions for building operation caused by fuels it considers only the life cycle stage according to the EN 15978 standard: hence, a Life Cycle Assessment is not performed.

The indicator is calculated by using defined carbon emission factors (EN 15603)) for different fuel types in the different countries which are multiplied with the simulated delivered energy demand per fuel per year of the building. The definition of those factors will be done within the development of the Simulation and Design Hub. If data for carbon emission factors of the fuel types are not available, a default set will be used for performing the calculations.
The simulated delivered energy demand per fuel per year of the building, which is the input for the total carbon emissions calculation, shall be acquired by the results of the indicator.
In order to get a result in the unit kWh/m2.yr the result of the above described simulation shall be divided by the Reference Floor Area of the building.
Instead of using the simulated Total final energy demand of the building the calculations will use a user entered value (attribute in the front-end) for which the user specifies for each used fuel

	type in the building the total annual consumption value (values from the energy bill or meters) • Oil (excluding fuel used for CHP electricity generation) • LPG • Natural Gas • Electricity • Biofuel • Biogas • Coal • Peat • Waste Heat The KPI will be presented in the Collaborative Design Platform to the users in the way of a relative value of kgCO2/m².yr by dividing the result of the total annual value by the Reference Floor Area of the building.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	In order to calculate the performance of the indicator, a linear interpolation method is recommended, with the following thresholds as defined by the OPEN HOUSE EU FP7 project: • Best performance: 10 kgCO2/m2 yr • Minimum performance: 100 kgCO2/m2 yr
References	[1], [2] ,[3], [4], [5] ,[6], [7], [8]
SCALE	
Application	Applicable to the small (building) or large (neighbourhood) scale.
Details	-
Multiscale	The indicator is used by an aggregation of each building on neighbourhood mode and therefore can be described as a multiscale indicator.
References	[1], [2] ,[3], [4], [5] ,[6], [7], [8]

REFERENCES	
[1]	European Commission- EU 2030 targets: http://ec.europa.eu/energy/en/topics/energy-strategy/2030-energy-strategy (29.03.2016)
[2]	BS EN 15603:2008: Energy performance of buildings. Overall energy use and definition of energy ratings
[3]	EN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN
[4]	FprCEN/TR 15615:2014: Energy Performance of buildings — Module M1-x — Accompanying Technical Report on draft Overarching standard EPBD (prEN 15603)
[5]	prEN ISO/DIS 52000-1:2015, draft prEN 15603:2015: Energy performance of buildings — Overarching EPB assessment – Part 1: General framework and procedures
[6]	Draft ISO-TR 52000-2 - Overarching EPB assessment - Part 2: Explanation and justification of ISO 52000-1
[7]	Concerted Action EPBD, Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports 2012, http://www.epbd-ca.eu/ca-outcomes/2011-2015
[8]	OPEN HOUSE Assessment Guideline, Version 1.2 New Office Buildings – July 2013

<table>
<tr><td rowspan="3">ENV.LU.04</td><td colspan="4">Soil Sealing, Permeability of site/land (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Land Use</td><td>S</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Urban spaces are increasingly less permeable, with roofing and concrete paving that interrupt the natural flow of storm water and the replenishment of ground reservoirs. The increase of soil sealing leads to collection and funnelling of storm water in sewers, reducing the onsite usage of the water and increasing the pressure on wastewater systems. Counteracting the soil sealing tendency can lead to a reduction in the use of potable water for irrigation and improve water management in the district.
Soil sealing is assessed in the same way in all three modes, by assigning a surface permeability coefficient to each homogeneous area in the district and aggregating the coefficient values through a weighted average on the area surfaces.</td></tr>
<tr><td>Background</td><td colspan="4">NewTREND</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] | Empirical/Literature [ ] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">For every homogenous surface in the neighbourhood Si [m2], assign a permeability coefficient αi [%] according to the product data sheet if available or according to the following reference values:
- Natural / uninterrupted ground, or water collection for in situ subirrigation: αi = 100%
- Gravel, sand, or other loose aggregate: αi = 90%
- Plastic grid elements filled with grass soil: αi = 80%
- Concrete grid elements filled with grass soil: αi = 60%
- Interlocking pavement on a sand or gravel base: αi = 30%
- Continuous / sealed paving, concrete slabs: αi = 0%
- Calculate the overall permeability coefficient α [%] as follows:
$$\frac{\sum_{i=1}^{n} \alpha_i * S_i}{\sum_{i=1}^{n} S_i} \ [\%]$$</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">As there are no reference values in standards and laws for permeability, the minimum value 0% can be considered the minimum performance, and the maximum value 100% can be considered the best performance.</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable only to the large (neighbourhood) scale.</td></tr>
<tr><td>Details</td><td colspan="4">This indicator is assessed only at neighbourhood scale.</td></tr>
<tr><td>Multiscale</td><td colspan="4">-</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
</table>

REFERENCES	
[1]	Protocollo ITACA: UNI/PdR 13:2015 "Sostenibilità ambientale nelle costruzioni - Strumenti operativi per la valutazione della sostenibilità"

SOC.Tr.15	**Access to public transport nodes (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Transport	S	N

GENERAL	
Description	Public transportation plays an important role in sustainability as public transportation can improve air quality, reduce greenhouse gas emissions, save energy and resources and support higher density land development. The internal accessibility indicator gives a good indication on the public transport amenities in the neighbourhood. The stakeholders in the retrofitting project from the municipality side can decide to upgrade the public transport access of the area based on the results. Stakeholder should also consider the city scale energy saving and reduction of CO2 emissions potential when deciding upon developing the public transport infrastructure. The assessment methodology is simple for the basic mode, and a complex indicator with more variables is available for the Advanced and premium modes. The accessibility of the neighbourhood depends on the presence of public transport in the neighbourhood. Its efficiency is high when users can reach the line connection points in a short time and have to wait only a short time for the arrival of the vehicle. Therefore, for the basic mode the indicator measures the accessibility of citizens to the public transport network, taking into account distance to the transport node. For advanced and premium mode, the indicator also takes into account the running frequency and the reliability of different transport options.
Background	NewTREND
References	[1], [2] ,[3]

LEVEL

Derived from						
	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

A public transport network plan is needed to evaluate the accessibility of public transport nodes in the neighbourhood.

1. Identify the number of all users (O) in the district by adding up all residents and non-residential users
2. Calculate the number of users that are within 400 m walking distance from public transport nodes (Ot,400). Walking distance is measured between the building entrance and the public transport stop.
3. Calculate the share of users who are within walking distance from public transport nodes with the following formula:

$$IA_b = \frac{O_{t,400}}{O}$$

Areas covered	Main focus on neighbourhood scale.
Barriers	-

Rating

Minimum, good and best practice performance levels are differentiated by the share of users that have access to public transport. The benchmarks for the measurement are:

Performance level	Measure
Minimum performance	50 % of users are within 400m walking distance from a public transport node Transport diversity is at least 1.
Good practice	75% of users are within 400m walking distance from a public transport node
Best practice	100% of users are within 400m walking distance from a public transport node

References [1], [2] ,[3]

SCALE	
Application	Applicable only to the large (neighbourhood) scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	This indicator is only used on neighbourhood level.
References	[1], [2] ,[3]

REFERENCES

[1]	BREEAM Communities, 2012. Technical Manual, BRE Global.
[2]	LEED v4 Neighborhood Development, LEED Reference Guide for Neighborhood Development, USGBC, U.S.A., 2014.
[3]	UNI/PdR 13.1:2015 Sostenibilità ambientale nelle costruzioni - Strumenti operativi per la valutazione della sostenibilità Edifici residenziali

<table>
<tr><td rowspan="3">SOC.Tr.16</td><td colspan="6">Access to public transport, District Accessibility Index (-)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td colspan="2">Transport</td><td colspan="2">S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Public transportation plays an important role in sustainability as public transportation can improve air quality, reduce greenhouse gas emissions, save energy and resources and support higher density land development.
The internal accessibility indicator gives a good indication on the public transport amenities in the district. The stakeholders in the retrofitting project from the municipality side can decide to upgrade the public transport access of the area based on the results. Stakeholder should also consider the city scale energy saving and reduction of CO2 emissions potential when deciding upon developing the public transport infrastructure.
The assessment methodology is simple for the basic mode, and a complex indicator with more variables is available for the Advanced and premium modes.
The accessibility of the district depends on the presence of public transport in the neighbourhood. Its efficiency is high when users can reach the line connection points in a short time and have to wait only a short time for the arrival of the vehicle. Therefore, for the basic mode the indicator measures the accessibility of citizens to the public transport network, taking into account distance to the transport node. For advanced and premium mode, the indicator also takes into account the running frequency and the reliability of different transport options.</td></tr>
<tr><td>Background</td><td colspan="6">NewTREND</td></tr>
<tr><td>References</td><td colspan="6">[1], [2] ,[3]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">A public transport network plan is needed to evaluate the accessibility of public transport nodes in the neighbourhood.

1. Determine the distance of the public transport network nodes (d) served by trains, buses and trams from the building entrances. Only consider the bus, tram stops and metro station that are within a radial distance of 500 meters from the main entrance and the railway services that are within 1000 meters.
2. For each node that meets the requirements in step 1, determine the total number of services (n) departing/arriving at each node in the following periods for a typical weekday:
AM 08.00 – 10.00 PM 17.00 – 19.00
Consider only the nearest node for each line, only one direction for a line and that have at least one stops within 20 km-s of the district.
3. Calculate the walk time for each transport line and its selected node according to the following formula:
$$\mathrm{Wt} = \frac{\mathrm{dn}}{\mathrm{v}}$$
dn = the distance of the public transport network nodes served by trains, buses and trams from the building entrances (m);
v = notional walk speed (80 m/min)
4. Determine the service waiting time (Swt):
$$\mathrm{S_{wt}} = 0{,}5 * \left(\frac{60 * 4}{\mathrm{n}}\right) + \mathrm{R_f}$$
Rf= reliability factor to the service waiting time: Bus/trams=2,Train = 0.75
n= No. of services during peak time

5. Determine total access time (At):
$$\mathrm{At} = \mathrm{Wt} + \mathrm{Swt}$$
6. Calculate the Equivalent Building Entrance (EBE) frequency:
$$\mathrm{FI} = \frac{30}{\mathrm{At}}$$
7. Calculate the public transport Accessibility index:</td></tr>
</table>

$$IA_i = FI_{i,max} + 0{,}5(\Sigma FI_i - FI_{i,max})$$

8. Summarize the accessibility index of all public transport types (IA) for each building.
9. Calculate the District Accessibility Index (DAI) that is the average of the accessibility indexes of all buildings in the district weighted by the number of users in each building

$$DAI = \frac{IA_1 * O_1 + IA_2 * O_1 + \cdots + IA_n * O_n}{O}$$

Oi = number of occupants in a building
O = number of all users in the district

Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The benchmarks for the measurement are differentiated by the location type of the neighbourhood:

Performance level	Requirements by district location			
	Capital / regional center or inner city	**Capital / regional city district center of district town / city**	**Small / medium town or city suburb**	**Rural**
Minimum performance	**2,5**	**1,5**	**1**	**0,5**
Good practice	**13**	**7,8**	**5,2**	**2,6**
Best practice	**20**	**12**	**8**	**4**

References	[1], [2] ,[3]
SCALE	
Application	Applicable only to the large (neighbourhood) scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	-
References	[1], [2] ,[3]

REFERENCES	
[1]	BREEAM Communities, 2012. Technical Manual, BRE Global.
[2]	LEED v4 Neighborhood Development, LEED Reference Guide for Neighborhood Development, USGBC, U.S.A., 2014.
[3]	UNI/PdR 13.1:2015 Sostenibilità ambientale nelle costruzioni - Strumenti operativi per la valutazione della sostenibilità Edifici residenziali

SOC.TC.07	Microclimate Index I (-)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Thermal Comfort	S	N

GENERAL

Description	In urban communities, heat island effect adds another layer to the temperature increases caused by climate change and associated drought. Heat island effect causes increased summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and deteriorated water quality. The microclimate index influences the outdoor comfort of the neighbourhood users. Heat island effect can also contribute to the external heating and cooling loads of the buildings in the neighbourhood. Therefore, the indicator can be used to optimize the outdoor surface area retrofitting for the benefit of outdoor comfort and energy use reduction. The indicator shows the contribution of surface to the Heat Island Effect. The different type of surfaces are grouped then the related surface coefficient is determined. The microclimatic Index is calculated as the average surface coefficient weighted by the surface areas.
Background	NewTREND, FASUDIR.
References	[1]

LEVEL

Derived from					
Software tool		Operational data		In situ measurements	
Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

To calculate the Microclimate Index for the neighbourhood the following formula has to be used:

- Microclimate Index = (Area 1 x F1 + Area 2 x F2 + … Area 11 x F11) / neighbourhood area

The Surface Coefficient 'F' is to be selected from the following table based on the type of the area:

Area surface types	Surface coefficient F
Building areas	
1. Small single buildings (detached houses, semi-detached houses)	1,7
2. Apartment blocks and large buildings	1,4
3. Large multi-storey houses	1,0
4. Industrial and commercial areas	0,8
Circulation areas and squares	
5. Railway system	0,5
6. Roads, Streets and squares completely soiled	0
7. Squares and parking spaces with green elements	0,5
Green Spaces	
8. Green Spaces with dense tree population	1,7
9. Green Spaces with light tree population	2,0
10. Small gardens and green backyards	1,5
11. Grass field	1,0
12. Forest area	2,0
Water areas	
13. Permanent lakes and ponds or rivers	1,5
Other areas	
14. Green roofs	0,7

Areas covered	Main focus on neighbourhood scale.
Barriers	-

Rating

The benchmarks for the measurement are as follows:

Performance level	Measure
Minimum performance	Microclimate Index is between 0,6 to 0,79
Good practice	Microclimate Index is between 0,8 to 0,99
Best practice	Microclimate Index > 1,2

References [1]

SCALE	
Application	Applicable to the large (neighbourhood) scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	This indicator is only used on neighbourhood level.
References	[1]

REFERENCES	
[1]	Zukowska et al. (2014) FASUDIR Friendly and Affordable Sustainable Urban Districts Retrofitting Deliverable D2.4 IDST Key Performance Indicators. Available at: http://fasudir.eu/documents/

<table>
<tr><td rowspan="3">SOC.AC.01</td><td colspan="4">Indoor A-weighted sound pressure level (dBA)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Acoustic Comfort</td><td>S</td><td>B/ N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">High levels of noise inside buildings have a direct effect on the comfort of inhabitants and users, with possible impacts on their well-being, productivity and health. Acoustic comfort can be assessed through the indoor A-weighted sound pressure level [dB(A)]. The value of indoor A-weighted sound pressure level can be evaluated either from computation or from measurement (at the assessment position) of the outdoor sound pressure level, by using the sound level difference of the façade.
The aim of the indicator is to guide the designer throughout the selection of the renovation work of the façades in the neighbourhood and increase the overall comfort and well-being of its inhabitants.
Acoustic comfort is assessed only in Advanced and Premium modes, as it requires room scale evaluations. In both modes, the indoor sound pressure levels are assessed against a set limit in order to identify how far they are from the acceptable comfort value; then the room values are aggregated through a floor-area weighted average.
In Advanced mode, the indoor noise values are obtained from simulations, while in Premium mode, the indoor noise values are acquired from on-site measurements.</td></tr>
<tr><td>Background</td><td colspan="4">NewTREND</td></tr>
<tr><td>References</td><td colspan="4">[1],</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [X]</td></tr>
<tr><td colspan="4">Simple Calculations [ ] | Empirical/Literature [ ] | Simulation [X]</td></tr>
<tr><td>Details</td><td colspan="4">Calculation method:
1. For each room in each building in the neighbourhood, calculate the indoor A-weighted sound pressure level $L_{2,nT,w}$ by using simulated outdoor noise levels (as in B.8.1 advanced mode);
2. Calculate the final value of the whole building, making use of the acoustic classification of each room, as shown in building scale calculation method;
3. Determine the final value for each building of the neighbourhood;
4. Determine the final value representative for the neighbourhood calculating the weighted average of the score of each building on the totality of building in the neighbourhood:

$$DS = \left(\frac{\sum_{i=1}^{n} BS_i * S_i}{S_{tot}}\right)$$
Where:

BS_i = score assigned to each building i [-]
S_i = reference floor area of each building i [m²]
S_{tot} = total reference floor area of all the buildings in the neighbourhood [m²]

Note: only consider main rooms that are occupied for several hours (e.g. bedrooms, offices, classrooms). Do not consider short-term occupancy and transit areas (e.g. bathrooms, corridors, small storage areas).</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">Neighbourhood scale benchmarks are the same as building scale benchmarks.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5], [6]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the small (building) or large (neighbourhood) scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">At neighbourhood level, the room values for all buildings are aggregated to provide an average level of indoor noise for the entire district.</td></tr>
</table>

References	[1], [2], [3], [4], [5]

REFERENCES	
[1]	EN ISO Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 3: Airborne sound insulation against outdoor sound.
[2]	EN ISO 16283-3 Acoustics - Field measurement of sound insulation in buildings and of building elements - Part 3: Façade sound insulation.
[3]	EN 15251- Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.
[4]	EN 717-1 - Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation.
[5]	Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise.
[6]	World Health Organization (WHO).

<table>
<tr><td rowspan="3">ECO.LC.03</td><td colspan="4">Operational Energy Costs (€/m2)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Life Cycle costs</td><td>S</td><td>B/ N</td></tr>
</table>

GENERAL	
Description	After a building is constructed or deep retrofitted, it enters the operational phase. The energy used during building operation is a multiple of the energy used during construction. A similar issue motivates the *operational* certification administered by BRE (Building Research Establishment). The BRE briefing refers to research findings that 80 – 90% of a building's emissions occur during its operational phase. The performance of new buildings after this transition from construction to full operation is prone to **performance degradation**. The objective of this indicator is identification of performance degradation and buildings or neighbourhood suffering from performance gaps. A building/energy manager can subsequently prioritise and implement remedial action. The indicator is beneficial to the developers, the operator and the users of the building as well. It can influence the decision making by allowing comparison between the current state and the retrofitting variants. It can show the financial benefits of the energy use reduction measures in the refurbishment. The operational energy cost of the neighbourhood is the sum of the individual costs of its buildings. Energy accounts for the largest cost during a commercial building operation, excluding the salaries of the building occupants. An average financial ratio of initial costs, operational costs and salary costs of 1:10:200, is applicable to commercial buildings. Since this is an economic indicator, energy costs refers to final energy consumed by the building. The aspects of primary energy conversion to final energy are excluded. This indicator result is improved by use of locally generated renewable energy, which is not billed by usage, for example per kWh or per KJ. Thus renewable energy and storage that reduces demand at higher cost times, are both encouraged indirectly by this indicator.
Background	NewTREND
References	[1], [2], [3]
LEVEL	

Derived from						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	Calculation method: 1- Determine the delivered energy demand as described in the related mode of the indicator "Delivered energy demand [kWh/m² yr]". The simulated total final energy demand of the building will include the Energy end use breakdown by fuel type. 2- Calculate the yearly operational energy costs by multiplying the energy demands and the energy price by fuel types. 3- Calculate the operational energy costs (normalised) for the neighbourhood based on the reference floor area as follows: $Operational\ energy\ cost\ (annual, normalised) = \frac{\sum_1^{nb} Annual\ operational\ energy\ costs}{\sum_1^{nb} Refernce\ floor\ area}$
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The reference values for the NewTREND KPI will be determined taking into account the results of WP5 - Innovative financial instruments and business models of the project (http://newtrend-project.eu/).
References	[1], [2], [3]
SCALE	
Application	Applicable to the small (building) or large (neighbourhood) scale.
Details	The "Scale" characterization is that of the neighbourhood.
Multiscale	The investment costs (normalised) indicator is applicable across all or part of the proposed retrofit. For example: single or multiple buildings or a block of multiple units. All inputs must

	match the specified scale.
References	[1], [2], [3]

REFERENCES	
[1]	BRE. (2009). BREEAM In-Use: Driving sustainability through existing buildings. Available: http://www.breeam.org/filelibrary/BREEAM In Use/KN5686---BREEAM-In-Use-White-Paper_dft2.pdf
[2]	M. Deru, K. Field, and S. Punjabi. (2014). ISO 50001 for Commercial Buildings: Lessons Learned From U.S. DOE Pilot Project: Preprint - 61496.pdf. Available: http://www.nrel.gov/docs/fy14osti/61496.pdf
[3]	D. Clements-Croome, Intelligent buildings : design, management and operation. London: Thomas Telford, 2004.

<table>
<tr><td rowspan="3">ECO.IC.02</td><td colspan="4">Investment Costs (€/m2)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Investment Costs</td><td>S</td><td>B/ N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The NewTREND tools analyse building retrofits. This is consistent with research findings that the retrofit of equivalent buildings almost always offers environmental savings over demolition and new constructions. A similar conclusion is reached at a campus/neighbourhood level. In order to compare the cost effectiveness of different retrofit options a normalised investment cost is computed.
This indicator is an analysis metric that enables a landlord or municipality to compare and prioritise retrofits at multiple locations, or different retrofit options at the same location based on the cost of development.
The total retrofit costs incurred in the financial year 0 are initially summed. Costs include all material and disposal of discarded elements. Subsequently the building(s) area, in terms of internal floor space, is summed in m^2.
The retrofit cost of the neighbourhood is the sum of the individual costs of its building.</td></tr>
<tr><td>Background</td><td colspan="4">NewTREND</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5], [6], [7]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td>Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements |
Simple Calculations | X | Empirical/Literature | | Other (specify) |</td></tr>
<tr><td>Details</td><td colspan="4">Calculate the investment costs (normalised) for the buildings of the neighbourhood based on gross floor area as follows:
$$Investment\ costs\ (normalised) = \frac{Investment\ costs}{Reference\ floor\ area}$$</td></tr>
<tr><td>Areas covered</td><td colspan="4">Main focus on neighbourhood scale.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">The reference values for the NewTREND indicator will be determined taking into account the results of WP5 - Innovative financial instruments and business models of the project (http://newtrend-project.eu/).

A collection of current benchmarks in different projects and countries can be found in the following.
Five cases of thermal retrofits to German dwellings are analysed by Galvin and Sunikka-Blank. The median retrofit case costs 122 €/m². The five retrofit cases range in cost from 36 - 314 €/m².
Curtin surveys building retrofits, referring to an Irish deep retrofit project of “average” cost €8,000 approx. per dwelling in 2012.
The project called SERVE (Sustainable Energy for the Rural Village Environment), carried out between 2007 – 2011 was co-funded by the EU CONCERTO Programme. Further figures on the SERVE project indicate a normalised investment cost of 50.3 €/m².
The experimental Retrofit for the Future (RfF) programme in Britain has a high maximum cost per deep retrofit of 150,000 GBP, that includes design and monitoring. Details of the average “supplied and fitted” cost of individual RfF measures, normalised by area, are available online. Examples are insulation, window replacement, mechanical ventilation and heat recovery (MVHR) and photovoltaics (PV). This retrofit cost analysis includes a cost planning tool and recommendations to reduce costs for a scaled retrofit.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5], [6], [7]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Applicable to the small (building) or large (neighbourhood) scale.</td></tr>
<tr><td>Details</td><td colspan="4">The “Scale” characterization is that of the neighbourhood.</td></tr>
<tr><td>Multiscale</td><td colspan="4">The investment costs (normalised) is applicable across all or part of the proposed retrofit. For example: single or multiple buildings or a block of multiple units. All inputs must match the specified scale.</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5], [6], [7]</td></tr>
</table>

REFERENCES	
[1]	Preservation Green Lab. (2011). The Greenest Building: Quantifying the Environmental Value of Building Reuse. Available: http://www.preservationnation.org/information-center/sustainable-communities/green-lab/lca/The_Greenest_Building_lowres.pdf
[2]	C. Reinhart. (2014). Managing Building Energy Efficiency at the Neighborhood/Campus Level. Available: http://mitei.mit.edu/system/files/2014-MITEI-Reinhart-Managing-Building-Energy-Efficiency-at-the-Neighborhood-Campus.pdf
[3]	R. Galvin and M. Sunikka-Blank, "Including fuel price elasticity of demand in net present value and payback time calculations of thermal retrofits: Case study of German dwellings," Energy and Buildings, vol. 50, pp. 219--228, 2012.
[4]	J. Curtin. (2013). From Grants to Finance: How to Unlock Home Retrofit Investment. Available: http://www.publicpolicy.ie/wp-content/uploads/From-Grants-to-Finance1.pdf
[5]	S. Hoyne and P. Kenny, "SERVING the nation – applying lessons from the SERVE CONCERTO project to Ireland," in European Council for Energy Efficient Council, Belambra Les Criques, Toulon/Hyères, France, 2013.
[6]	R. Gupta, M. Gregg, S. Passmore, and G. Stevens, "Intent and outcomes from the Retrofit for the Future programme: key lessons," Building Research and Information, vol. 43, pp. 435-451, Jul 2015.
[7]	I. Meikle. (2014). Retrofit for the Future: analysis of cost data. Available: http://retrofit.innovateuk.org/documents/1524978/1866952/Retrofit for the Future - analysis of cost data report 2014

<table>
<tr><td rowspan="3">ECO.IC.05</td><td colspan="4">Return on Investment (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Investment Costs</td><td>S</td><td>B/ N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The audience for risk return ratios are investors, fund managers and their agents. Return on investment (ROI) is the most important of the return ratios. The objective is to compute a meaningful indicator for this financial audience, and make the case for investment in building retrofits.
A desirable ROI depends on the investor attitude towards risk, their investment strategy (growth or value oriented) and the time horizon (short, medium, long-term). Time horizon is the period of study (n) in years.
The indicator is the most beneficial for the developer and the financial partners of the refurbishment as it shows the return of investment from an energy use point of view. When the owner and the user of the building and neighbourhood is not the same the investment costs and the energy use costs are usually not financed by the same person, yet the indicator can represent the marketing value and environmental benefits of the refurbishment.
Generally there is no universal standard for ROI.
The NewTREND calculations use the annual energy savings, UPV factor and the investment costs for the calculation.
The value of future income or savings is affected by time. Thus the present value (PV) of future savings is needed for the RoI calculations. A publication by the Society of Chartered Surveyors Ireland (SCSI) describes different present value calculations.
One calculation is the modified uniform present value (UPV*). UPV* converts to present value recurring costs, that annually increase at a constant escalation rate (e).
In NewTREND the study period is post retrofit and associated energy savings are converted to present value. With the UPV* factor the present value of energy savings over time is comparable to the retrofit costs and a ROI is computable.
The equations discussed for this ROI do not measure financial depreciation or residual value.</td></tr>
<tr><td>Background</td><td colspan="4">NewTREND</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5], [6]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] | Empirical/Literature [ ] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">Calculation method:
1. Calculate the modified uniform present value (UPV*) with the following equation.
$$UPV^{*}\ factor = \frac{1 - \left[\frac{1+e}{1+d}\right]^{n}}{\left[\frac{1+d}{1+e}\right] - 1}$$
The UPV* equation depends on inputs: discount rate (d), escalation (e) and study period (n) in years. Any degradation in energy efficiency or improvements health and comfort are not accounted for.

The retrofits discussed by Coyle, Audenaert and Reinhart assume a future building lifespan of at least 50 years. Galvin & Sunikka-Blank do not specify a building lifespan, but calculate a minority of payback periods of over 100 years.
The ROI period of study must naturally be shorter than the building lifespan.

Information/Attribute — Coyle — Audenaert et al
Discount rate (d) — 4% (10% max.) — Not Applied
Escalation rate of energy costs (e) — 4% (15% max) — 0 – 25%
Number of years for study (n) — 30 (100 max) — 20

2. Determine the total investment cost (not normalized) form the indicator “Investment costs”.
3. Determine the Delivered energy$_{original}$ and the Delivered energy$_{retrofitted}$ in accordance with the calculation of the investment costs.</td></tr>
</table>

	4. Determine the annual energy savings in financial terms: $$\text{Yearly savings in delivered energy } [€] = \text{ Delivered energy}_{original} - \text{ Delivered energy}_{retrofitted}$$ 5. Calculate the Return of Investment with the following formula: $$investment\ Term\ \ ROI\ (\%) = \left[\frac{annual\ energy\ saving\ \ \times\ UPV^{*}\ factor}{investment\ cost} - 1\right] \times\ 100$$ An ROI of a negative percentage is caused by the PV of annual energy savings over the period of study, not exceeding the initial retrofit costs.
Areas covered	Main focus on neighbourhood scale.
Barriers	-
Rating	The reference values for the NewTREND KPI will be determined taking into account the results of WP5 - Innovative financial instruments and business models of the project (http://newtrend-project.eu/). The indicator in Premium mode is based on the same principles like the basic mode. However, the data source for the operational energy demand is not the simulated data but a user entered value. Based on this data the same calculation as in basic mode will be performed in order to calculate the indicator in premium mode.
References	[1], [2], [3], [4], [5], [6]
SCALE	
Application	Applicable to the small (building) or large (neighbourhood) scale.
Details	The “Scale” characterization is that of the neighbourhood.
Multiscale	The return in investment indicator is applicable across all or part of the proposed retrofit. For example: single or multiple buildings or a block of multiple units. All inputs must match the specified scale.
References	[1], [2], [3], [4], [5], [6]

REFERENCES	
[1]	C. Lowe and A. Ponce. (2009). UNEP - FI / SBCI's Financial & Sustainability Metrics Report. Available: http://www.unepfi.org/fileadmin/documents/metrics_report_01.pdf
[2]	D. Kehily. (2011). Life Cycle Cost Guidance Notes. Available: http://arrow.dit.ie/cgi/viewcontent.cgi?article=1002&context=beschrecrep
[3]	D. Coyle. (2015). A Life Cycle Cost Analysis of an Irish Dwelling Retrofitted to Passive House Standard: Can Passive House Become a Cost-Optimal Low-Energy Retrofit Standard? Available: http://www.dit.ie/media/built/documents/architecture/springboard2015/nZEB15 Session 2 05 Daniel Coyle.pdf
[4]	A. Audenaert, S. H. De Cleyn, and B. Vankerckhove, "Economic analysis of passive houses and low-energy houses compared with standard houses," Energy Policy, vol. 36, pp. 47-55, 1// 2008.
[5]	C. Reinhart, "Managing Building Energy Efficiency at the Neighborhood/Campus Level," ed, 2014.
[6]	R. Galvin and M. Sunikka-Blank, "Including fuel price elasticity of demand in net present value and payback time calculations of thermal retrofits: Case study of German dwellings," Energy and Buildings, vol. 50, pp. 219--228, 2012.

A.10 – Open House Assessment Guidelines (AG)

Open House

Open House Assessment Guidelines (AG)
Version 1.2 New office Buildings – July 2013
http://www.openhouse-fp7.eu/

The overall objective of OPEN HOUSE was to develop and to implement a common European transparent building assessment methodology, complementing the existing ones, for planning and constructing sustainable buildings by means of an open approach and technical platform. The method is based on existing standards (CEN/TC 350 and ISO TC59/SC17), the EPBD Directive and its national transpositions and methodologies for assessing building sustainability at international, European and national level. The core assumption of the approach is that for any assessment methodology to become the mainstream and to reach the "label" level, it needs to be developed in a transparent, collective way. Therefore EU wide discussion towards a common approach produced an EU wide assessment methodology for sustainable buildings contributing to current activities on standardisation of assessment methodologies at European level and also to a potential European standard. The OPEN HOUSE European Project was established under the framework of a FP7 R&D programme by a European consortium of 19 partners from research institutions, the building industry and the political sector. The project was active from February 2010 to July 2013, with the overall objective of merging existing methodologies for sustainability assessment of buildings towards a common methodology.

INDICATORS

<table>
<tr><td rowspan="3">ENV.Im.09
(1.1)</td><td colspan="6">Global Warming Potential, GWP (kg CO2 equiv./m²)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td colspan="2">Impacts</td><td colspan="2">S</td><td>B</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">The Global Warming Potential is a substance`s potential contribution to the global warming of near-ground air layers, also named greenhouse effect. It is specified as the GWP value in relation to the global warming potential of carbon dioxide (CO2). For evaluation, GWP100 is used, meaning the averaged contribution of a material to the greenhouse effect over one hundred years. For the building assessment, CO2-equivalents per area and year are calculated for the life cycle of the building (construction and operation). The lower the CO2-equivalent result is, the lower is the potential influence on global warming and the related impacts on the environment. This indicator, aiming at the reduction of buildings' global warming performance, highly contributes to the achievement of the EU targets.</td></tr>
<tr><td>Background</td><td colspan="6">Core Indicator adapted from: DGNB/BNB</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5], [6], [7], [8], [9], [10]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">The indicator is mainly based on the method of Life Cycle Assessment (LCA): LCA results of the building to be assessed will be calculated in a standardized way and evaluated against benchmarks. Thus Global Warming Potential is a quantitative indicator.

According to the standards EN ISO 14040 and 14044, the method of Life-Cycle Assessment generally consists of four steps: Definition of goal and scope of the study, inventory analysis, impact assessment and interpretation. The indicators 1.1-1.5, 1.9 and 1.10 are based on LCAs and for all these indicators the same definitions for goal and scope and for the inventory analysis do apply.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Calculation
When calculating the global warming potential for the building, the following calculation rules must be followed:
Global Warming Potential for "Designed Building"
Generally, the GWP for the building life cycle is composed of the GWP caused by the building construction and of the GWP caused during operation.
$\mathbf{GWP_{LC} = GWP_C + GWP_O}$ (1)
where
GWP_{LC} global warming potential of the life cycle of the entire building,
GWP_C building's construction, maintenance, dismantling, and disposal including building systems technology as an average annual value of global warming potential over the time reference study period t_d in [kg CO_2 equiv./(m^2_{NFA} *a)],
GWP_O predicted annual global warming potential for the operation of the building as constructed, derived from end energy demand according to national implementation of EPBD directive in [kg CO_2 equiv./(m^2_{NFA} *a)],
NFA Net Floor Area of the building.
Based on the modules as defined in Figure 1, the value for construction GWP_C is calculated as follows:</td></tr>
</table>

$GWP_C = (GWP_{MA} + GWP_{MC}) / t_d + GWP_{MB1,4}$ (2)

where

GWP_{MA} predicted value of global warming potential created during the modules A1-4[8], including office building's manufacture (construction and building systems technology) and transports to construction site in[kg CO_2 equiv./(m^2_{NFA})],

GWP_{MC} predicted value of global warming potential created during module C3 and C4[9], the office building's end-of-life (design and building systems technology) in [kg CO_2 equiv./(m^2_{NFA})],

$GWP_{MB1,4}$ predicted value of global warming potential created during modules B1 and B4[10] on a yearly basis, the office building's use and replacement (construction and building systems technology) in[kg CO_2 equiv./(m^2_{NFA} *a)],

t_d time period for the reference study period for certification in [a]. This time period is set at 50 years.

The average annual value for use GWP_O generally consists of the GWP caused by the building`s electricity and heating demand during operation:

$GWP_O = GWP_{MB6,E} + GWP_{MB6,H}$ (3)

where

$GWP_{MB6,E}$ global warming potential for module B6, electricity demand during use, calculated with the national implementation of the EPBD directive, multiplied by the GWP factor for electricity of the ESUCO database in [kg CO_2 equiv./(m^2_{NFA} *a)],

$GWP_{MB6,H}$ global warming potential for module B7, heating demand during use, calculated with the national implementation of the EPBD directive, multiplied by the GWP factor of the specific energy sources in the ESUCO database in [kg CO_2 equiv./(m^2_{NFA} *a)].

Rating Method

The "designed building" is rated against a case-specific reference building.

Global Warming Potential for Reference Building

$R_{GWP} = GWP_{LCref} = GWP_{Cref} + GWP_{Oref}$ (4)

where

GWP_{LCref} reference value for the global warming potential of the life cycle of the reference building,

GWP_{Cref} reference value for the average annual value of global warming potential for the building's construction, maintenance, dismantling, and disposal including building systems technology over the reference study period t_d, calculated from an average office building in [kg CO_2 equiv./(m^2_{NFA} *a)][11]

GWP_{Oref} reference value for the annual global warming potential created by building operations, derived from the reference value according to the national implementation of the EPBD directive in [kg CO_2 equiv./(m^2_{NFA} *a)].

The reference value for construction GWP_{Cref} is calculated as follows:

$GWP_{Cref} = (GWP_{MAref} + GWP_{MCref}) / t_d + GWP_{MB1,4ref}$ (5)

where

$GWP_{MA\ ref}$ reference value for global warming potential created during the modules A1-4[12], including office building's manufacture (construction and building systems technology) and transports to construction site in[kg CO_2 equiv./(m^2_{NFA})],

$GWP_{MC\ ref}$ reference value for global warming potential created during module C3 and C4[13], the office building's end-of-life (design and building systems

	technology) in [kg CO_2 equiv./(m^2_{NFA})], $GWP_{MB1,4ref}$ reference value for annual global warming potential created during modules B1 and B4[14] on a yearly basis, the office building's use and replacement (construction and building systems technology) in [kg CO_2 equiv./(m^2_{NFA} *a)] t_d reference study period in [a]. This time period is set to 50 years. The reference value for use GWP_{Oref} is calculated as follows **$GWP_{Oref} = GWP_{MB6,Eref} + GWP_{MB6,Href}$ (6)** where $GWP_{MB6,Eref}$ global warming potential for the national reference value for building`s annual electricity demand (end energy) according to the national implementation of the EPBD directive in [kg $CO_2$ equiv./$m^2_{NFA}$ *a], $GWP_{MB6,Href}$ global warming potential for the national reference value for the building`s annual heating demand (end energy) according to the national implementation of the EPBD directive in [kg CO_2 equiv./m^2_{NFA} *a]. For the GWP_{Oref} reference values for the building's heating and electricity demand (end energy) according to the national implementation of the EPBD directive in [kWh/(m^2_{NFA} *a)] should be used as basis when possible. The reference values for GWP_{Gref} can be extracted from Table1 and Table2. These tables show reference values for both assessment types – "Quick and Basic" assessment and "Complete" assessment. **Evaluation** The evaluation consists of a simultaneous optimization of carbon equivalent for design and operation over the entire lifecycle.
Barriers	-
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
[2]	ISO 14044: 2006-10: Environmental management – Life cycle assessment – Requirements and guidelines. International Organization for Standardization.
[3]	FprEN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
[4]	prEN 15804: 2010: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction

	products. European Committee for Standardization CEN.
[5]	Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[6]	Kreißig, J., Binder, M. (2007): Methodische Grundlagen- Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktualisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen“ (AZ 10.06.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp.
[7]	United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf.
[8]	Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building. Eigenverlag, 2001.
[9]	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
[10]	VDI 2067: Economic efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

<table>
<tr><td rowspan="3">ENV.Im.13
(1.2.)</td><td colspan="4">Ozone Depletion Potential, ODP (kg R11 equiv./(m²)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Ozone, which is only existent in low concentration in the atmosphere, has a significant impact on life on earth. It is able to absorb short-wave UV-radiation and to release it, irrespective of direction, with longer wave length. In addition, the ozone layer protects the earth from a large proportion of UV-radiation and therefore prevents the earth surface of an excessive temperature rise and contributes to the protection of man and flora against UV-A and UV-B radiation.
The accumulation of R11-equivalents in the atmosphere contributes to the destruction of the ozone layer. As a consequence, amongst others, men and animals can develop tumors as well as the photosynthesis may be disturbed.
For the assessment of the ozone depletion potential of a building life cycle (construction and operation), Trichlorofluoromethane-equivalents (R11-eqivalents) per area and year are used.
The indicator aims at the reduction of buildings' Ozone Depletion Potential, thus preventing the environmental impacts described above.
It supports the European Commission target of phasing out of Ozone Depletion Substances1.</td></tr>
<tr><td>Background</td><td colspan="4">Core Indicator adapted from DGNB/BNB</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5], [6], [7], [8], [9], [10].</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | Other (specify) | </td></tr>
<tr><td>Details</td><td colspan="4">The indicator is mainly based on the method of Life Cycle Assessment (LCA): LCA results of the building to be assessed will be calculated in a standardized way and evaluated against benchmarks. Thus Ozone Depletion Potential is a quantitative indicator

According to the standards EN ISO 14040 and 14044, the method of Life-Cycle Assessment generally consists of four steps: Definition of goal and scope of the study, inventory analysis, impact assessment and interpretation. The indicators 1.1-1.5, 1.9, 1.10 and 1.15 are based on LCAs and for all these indicators the same definitions for goal and scope and for the inventory analysis do apply.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Calculation
When calculating the ozone depletion potential for the building, the following calculation rules must be followed:
Ozone Depletion Potential for "Designed Building"
Generally, the ODP for the building life cycle is composed of the ODP caused by the building construction and of the ODP caused during operation.
$\mathbf{ODP_{LC} = ODP_C + ODP_O}$ (1)
where
ODP_{LC} ozone depletion potential of the life cycle of the entire building,
ODP_C building's construction, maintenance, dismantling, and disposal including building systems technology as an average annual value of ozone depletion potential over the time reference study period t_d in [kg R_{11} equiv./(m^2_{NFA} *a)],
ODP_O predicted annual ozone depletion potential for the operation of the</td></tr>
</table>

building as constructed, derived from end energy demand according to national implementation of EPBD directive in [kg R_{11} equiv./(m^2_{NFA} *a)],
NFA Net Floor Area of the building.
Based on the modules as defined in Figure 1, the value for construction ODP_C is calculated as follows:

$$\mathbf{ODP_C = (ODP_{MA} + ODP_{MC}) / t_d + ODP_{MB1,4}\ (2)}$$

where
ODP_{MA} predicted value of ozone depletion potential created during the modules A1-4[4], including office building's manufacture (construction and building systems technology) and transports to construction site in[kg R_{11} equiv./(m^2_{NFA})],
ODP_{MC} predicted value of ozone depletion potential created during module C3 and C4[5], the office building's end-of-life (design and building systems technology) in [kg R_{11} equiv./(m^2_{NFA})],
$ODP_{MB1,4}$ predicted value of ozone depletion potential created during modules B1 and B4[6] on a yearly basis, the office building's use and replacement (construction and building systems technology) in [kg R_{11} equiv./(m^2_{NFA} *a)],
t_d time period for the reference study period for certification in [a]. This time period is set at 50 years.
The average annual value for use ODP_O generally consists of the ODP caused by the building`s electricity and heating demand during operation:

$$\mathbf{ODP_O = ODP_{MB6,E} + ODP_{MB6,H}\ (3)}$$

where
$ODP_{MB6,E}$ ozone depletion potential for module B6, electricity demand during use, calculated with the national implementation of the EPBD directive, multiplied by the ODP factor for electricity of the ESUCO database in [kg R_{11} equiv./(m^2_{NFA} *a)],
$ODP_{MB6,H}$ ozone depletion potential for module B7, heating demand during use, calculated with the national implementation of the EPBD directive, multiplied by the ODP factor of the specific energy sources in the ESUCO database in [kg R_{11} equiv./(m^2_{NFA} *a)].

Rating Method
The "designed building" is rated against a case-specific reference building.
Ozone Depletion Potential for Reference Building

$$\mathbf{R_{ODP} = ODP_{LCref} = ODP_{Cref} + ODP_{Oref}\ (4)}$$

where
ODP_{LCref} reference value for the ozone depletion potential of the life cycle of the reference building,
ODP_{Cref} reference value for the average annual value of ozone depletion potential for the building's construction, maintenance, dismantling, and disposal including building systems technology over the reference study period t_d, calculated from an average office building in [kg R_{11} equiv./(m^2_{NFa} *a)][7],
ODP_{Oref} reference value for the annual ozone depletion potential created by building operations, derived from the reference value according to the national implementation of the EPBD directive in [kg R_{11} equiv./(m^2_{NFA} *a)].
The reference value for construction ODP_{Cref} is calculated as follows:

$$\mathbf{ODP_{Cref} = (ODP_{MAref} + ODP_{MCref}) / t_d + ODP_{MB1,4ref}\ (5)}$$

where
$ODP_{MA\ ref}$ reference value for ozone depletion potential created during the modules A1-4[8], including office building's manufacture (construction and

	building systems technology) and transports to construction site in [kg R_{11} equiv./(m^2_{NFA})], $ODP_{MC\ ref}$ reference value for ozone depletion potential created during module C3 and C4[9], the office building's end-of-life (design and building systems technology) in [kg R_{11} equiv./(m^2_{NFA})], $ODP_{MB1,4ref}$ reference value for annual ozone depletion potential created during modules B1 and B4[10] on a yearly basis, the office building's use and replacement (construction and building systems technology) in [kg R_{11} equiv./(m^2_{NFA}*a)] td reference study period in [a]. This time period is set to 50 years. The reference value for use ODP_{Oref} is calculated as follows **$ODP_{Oref} = ODP_{MB6,Eref} + ODP_{MB6,Href}$ (6)** where $ODP_{MB6,Eref}$ ozone depletion potential for the national reference value for building`s annual electricity demand (end energy) according to the national implementation of the EPBD directive in [kg $R_{11}$ equiv./$m^2_{NFA}$*a], $ODP_{MB6,Href}$ ozone depletion potential for the national reference value for the building`s annual heating demand (end energy) according to the national implementation of the EPBD directive in [kg R_{11} equiv./m^2_{NFA}*a]. For the ODP_{Oref} reference values for the building's heating and electricity demand (end energy) according to the national implementation of the EPBD directive in [kWh/(m^2_{NFA}*a)] should be used as basis when possible. The reference values for ODP_{Cref} can be extracted from Table1 and Table2. These tables show reference values for both assessment types – "Quick and Basic" assessment and "Complete" assessment. **Evaluation** The evaluation consists of a simultaneous reduction of buildings' Ozone Depletion Potential for design and operation over the entire lifecycle.
Barriers	-
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below.
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
[2]	ISO 14044: 2006-10: Environmental management – Life cycle assessment – Requirements and guidelines. International Organization for Standardization.
[3]	FprEN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.

[4]	prEN 15804: 2010: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. European Committee for Standardization CEN.
[5]	Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[6]	Kreißig, J., Binder, M. (2007): Methodische Grundlagen- Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktualisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen“ (AZ 10.06.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp.
[7]	United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf.
[8]	Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building. Eigenverlag, 2001.
[9]	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
[10]	VDI 2067: Economic efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

ENV.Im.03 (1.3)	**Acidification Potential, AP (kg SO2 equiv./(m²)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Impacts	S	B

GENERAL	
Description	Acidification is the increase of the hydrogen ion concentration in air, water and soil. Sulfur and nitrogen compounds from anthropogenic emissions react to sulfuric acid or nitric acid in the air, fall down as "acid rain" and cause damage to soil, water, organisms and buildings. In acidic soils nutrients decompose quickly and can easily be washed out. Furthermore, toxic cations may be released, which affect root systems and cause damage to the nutrient supply of organisms. Another possible effect is the disturbance of the water balance. All in all, the combination of acidification aspects contributes to forest decline. In addition, in surface water bodies with low chemical buffer capacity, fish decline occurs. Acid rain also affects historic buildings (e.g. sandstone). The environmental impacts described above are measured using the acidification potential, which is stated in SO_2-equivalents. Acidification causing emissions are e.g. SO_2, NO_x or H_2S. For the assessment of the Acidification Potential (AP) of a building life cycle (construction and operation), SO_2-eqivalents per area and year are used. The lower the AP value, the lower is the risk of acid rain and the related environmental damage. The indicator aims at the reduction of buildings' Acidification Potential, thus preventing the environmental impacts described above. This supports the European Commission target of emission reductions in the EU-25 of 82% for SO_2, and 60% for NO_x by 2020 compared to 1990s level[1]. The objective is to reduce the threat to the natural environment from acidification by 55%[2].
Background	Core indicator adapted from DGNB/BNB)
References	[1], [2], [3], [4], [5], [6], [7], [8], [9], [10].

LEVEL						
Derived from *(Check – X - as appropriate)*	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	The indicator is mainly based on the method of Life Cycle Assessment (LCA): LCA results of the building to be assessed will be calculated in a standardized way and evaluated against benchmarks. Thus Acidification Potential is a quantitative indicator. According to the standards EN ISO 14040 and 14044, the method of Life-Cycle Assessment generally consists of four steps: Definition of goal and scope of the study, inventory analysis, impact assessment and interpretation. The indicators 1.1-1.5, 1.9, 1.10 and 1.15 are based on LCAs and for all these indicators the same definitions for goal and scope and for the inventory analysis do apply.
Areas covered	**Calculation** When calculating the acidification potential for the building, the following calculation rules must be followed: **Acidification Potential for "Designed Building"** Generally, the AP for the building life cycle is composed of the AP caused by the building construction and of the AP caused during operation. **APLC = APC + APO (1)**

	where AP_{LC} acidification potential of the life cycle of the entire building, AP_C building's construction, maintenance, dismantling, and disposal including building systems technology as an average annual value of acidification potential over the time reference study period t_d in [kg SO_2 equiv./(m^2_{NFA} *a)], AP_O predicted annual acidification potential for the operation of the building as constructed, derived from end energy demand according to national implementation of EPBD directive in [kg SO_2 equiv./(m^2_{NFA} *a)], NFA Net Floor Area of the building. Based on the modules as defined in Figure 1, the value for construction AP_C is calculated as follows: **$AP_C = (AP_{MA} + AP_{MC}) / t_d + AP_{MB1,4}$ (2)** where AP_{MA} predicted value of acidification potential created during the modules A1-4[5], including office building's manufacture (construction and building systems technology) and transports to construction site in[kg SO_2 equiv./(m^2_{NFA})], AP_{MC} predicted value of acidification potential created during module C3 and C4[6], the office building's end-of-life (design and building systems technology) in [kg SO_2 equiv./(m^2_{NFA})], $AP_{MB1,4}$ predicted value of acidification potential created during modules B1 and B4[7] on a yearly basis, the office building's use and replacement (construction and building systems technology) in[kg SO_2 equiv./(m^2_{NFA} *a)], t_d time period for the reference study period for certification in [a]. This time period is set at 50 years. The average annual value for use AP_O generally consists of the AP caused by the building`s electricity and heating demand during operation: **APO = APMB6,E + APMB6,H (3)** where $AP_{MB6,E}$ acidification potential for module B6, electricity demand during use, calculated with the national implementation of the EPBD directive, multiplied by the AP factor for electricity of the ESUCO database in [kg SO_2 equiv./(m^2_{NFA} *a)], $AP_{MB6,H}$ acidification potential for module B7, heating demand during use, calculated with the national implementation of the EPBD directive, multiplied by the AP factor of the specific energy sources in the ESUCO database in [kg SO_2 equiv./(m^2_{NFA} *a)] **Rating Method** The "designed building" is rated against a case-specific reference building. **Acidification Potential for Reference Building** **$R_{AP} = AP_{LCref} = AP_{Cref} + AP_{Oref}$ (4)** where AP_{LCref} reference value for the acidification potential of the life cycle of the reference building, AP_{Cref} reference value for the average annual value of acidification potential for the building's construction, maintenance, dismantling, and disposal including building systems technology over the reference study period t_d, calculated from an average office building in [kg SO_2 equiv./(m^2_{NFa} *a)][8] AP_{Oref} reference value for the annual acidification potential created by building operations, derived from the reference value according to the national

	implementation of the EPBD directive in [kg SO_2 equiv./(m^2_{NFA} *a)]. The reference value for construction AP_{Cref} is calculated as follows: **$AP_{Cref} = (AP_{MAref} + AP_{MCref}) / t_d + AP_{MB1,4ref}$ (5)** where $AP_{MA,ref}$ reference value for acidification potential created during the modules A1-4[9], including office building's manufacture (construction and building systems technology) and transports to construction site in[kg SO_2 equiv./(m^2_{NFA})], $AP_{MC,ref}$ reference value for acidification potential created during module C3 and C4[10], the office building's end-of-life (design and building systems technology) in [kg SO_2 equiv./(m^2_{NFA})], $AP_{MB1,4ref}$ reference value for annual acidification potential created during modules B1 and B4[11] on a yearly basis, the office building's use and replacement (construction and building systems technology) in [kg SO_2 equiv./(m^2_{NFA} *a)] td reference study period in [a]. This time period is set to 50 years. The reference value for use AP_{Oref} is calculated as follows **$AP_{Oref} = AP_{MB6,Eref} + AP_{MB6,Href}$ (6)** where $AP_{MB6,Eref}$ acidification potential for the national reference value for building`s annual electricity demand (end energy) according to the national implementation of the EPBD directive in [kg $SO_2$ equiv./$m^2_{NFA}$ *a], $AP_{MB6,Href}$ acidification potential for the national reference value for the building`s annual heating demand (end energy) according to the national implementation of the EPBD directive in [kg SO_2 equiv./m^2_{NFA} *a]. For the AP_{Oref} reference values for the building's heating and electricity demand (end energy) according to the national implementation of the EPBD directive in [kWh/(m^2_{NFA} *a)] should be used as basis when possible. The reference values for AP_{Cref} can be extracted from Table1 and Table2. These tables show reference values for both assessment types – "Quick and Basic" assessment and "Complete" assessment. **Evaluation** The evaluation consists of a simultaneous reduction of buildings' Acidification Potential for design and operation over the entire lifecycle.
Barriers	-
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below.
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below
REFERENCES	

[1]	ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
[2]	ISO 14044: 2006-10: Environmental management – Life cycle assessment – Requirements and guidelines. International Organization for Standardization.
[3]	FprEN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
[4]	prEN 15804: 2010: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. European Committee for Standardization CEN.
[5]	Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[6]	Kreißig, J., Binder, M. (2007): Methodische Grundlagen- Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktualisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen“ (AZ 10.06.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp.
[7]	United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf.
[8]	Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building. Eigenverlag, 2001.
[9]	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
[10]	VDI 2067: Economic efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

ENV.Im.08 (1.4)	**Eutrophication Potential, EP (kg PO4 equiv./(m²)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Impacts	S	B

GENERAL	
Description	Over-fertilization (eutrophication) is the transition of water or soils from a nutrient-poor to a nutrient-rich state. This is caused by supply of nutrients, especially phosphor and nitrogen compounds. The nutrients can emerge from the manufacturing of building products, but mainly from the wash-out of emissions into the environment. The resulting changes in the nutrient supply manifests e.g. in water in the form of an increased algae appearance, which again may cause fish decline. For the assessment of the Eutrophication Potential (EP) of a building life cycle (construction and operation), PO_4 equivalents per area and year are used. The lower the PO_4-eqivalent value, the lower is the potential of negative side effects on men and the environment. The indicator aims at the reduction of buildings` Eutrophication Potential, thus preventing the environmental impacts described above. This supports the European Commission target of emission reductions in the EU-25 of 27% for Ammonia NH_3 (responsible for eutrophication) by 2020 compared to 1990s level[1]. The objective is to reduce the threat to the natural environment from eutrophication by 55%[2]
Background	Core Indicator adapted from DGNB/BNB.
References	[1], [2], [3], [4], [5], [6], [7], [8], [9], [10].

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	The indicator is mainly based on the method of Life Cycle Assessment (LCA): LCA results of the building to be assessed will be calculated in a standardized way and evaluated against benchmarks. Thus Eutrophication Potential is a quantitative indicator. According to the standards EN ISO 14040 and 14044, the method of Life-Cycle Assessment generally consists of four steps: Definition of goal and scope of the study, inventory analysis, impact assessment and interpretation. The indicators 1.1-1.5, 1.9 and 1.10 are based on LCAs and for all these indicators the same definitions for goal and scope and for the inventory analysis do apply.
Areas covered	**Calculation** the following calculation rules must be followed: **Eutrophication Potential for "Designed Building"** Generally, the EP for the building life cycle is composed of the EP caused by the building construction and of the EP caused during operation. **EPLC = EPC + EPO (1)** where EP_{LC} eutrophication potential of the life cycle of the entire building, EP_C building's construction, maintenance, dismantling, and disposal including building systems technology as an average annual value of eutrophication potential over the time reference study period t_d in [kg PO_4 equiv./(m^2_{NFA} *a)], EP_O predicted annual eutrophication potential for the operation of the building as constructed, derived from end energy demand according to national

implementation of EPBD directive in [kg PO_4 equiv./(m^2_{NFA} *a)],
NFA Net Floor Area of the building.
Based on the modules as defined in Figure 1, the value for construction EP_C is calculated as follows:
$EP_C = (EP_{MA} + EP_{MC}) / t_d + EP_{MB1,4}$ (2)
where
EP_{MA} predicted value of eutrophication potential created during the modules A1-4[5], including office building's manufacture (construction and building systems technology) and transports to construction site in [kg PO_4 equiv./(m^2_{NFA})],
EP_{MC} predicted value of eutrophication potential created during module C3 and C4[6], the office building's end-of-life (design and building systems technology) in [kg PO4 equiv./(m^2_{NFA})],
$EP_{MB1,4}$ predicted value of eutrophication potential created during modules B1 and B4[7] on a yearly basis, the office building's use and replacement (construction and building systems technology) in [kg PO_4 equiv./(m^2_{NFA} *a)],
t_d time period for the reference study period for certification in [a]. This time period is set at 50 years.
The average annual value for use EP_O generally consists of the EP caused by the building`s electricity and heating demand during operation:
EPO = EPMB6,E + EPMB6,H (3)
where
$EP_{MB6,E}$ eutrophication potential for module B6, electricity demand during use, calculated with the national implementation of the EPBD directive, multiplied by the EP factor for electricity of the ESUCO database in [kg PO_4 equiv./(m^2_{NFA} *a)],
$EP_{MB6,H}$ eutrophication potential for module B7, heating demand during use, calculated with the national implementation of the EPBD directive, multiplied by the EP factor of the specific energy sources in the ESUCO database in [kg PO_4 equiv./(m^2_{NFA} *a)].

Rating Method
The "designed building" is rated against a case-specific reference building.
Eutrophication Potential for Reference Building
$R_{EP} = EP_{LCref} = EP_{Cref} + EP_{Oref}$ (4)
where
EP_{LCref} reference value for the eutrophication potential of the life cycle of the reference building,
EP_{Cref} reference value for the average annual value of eutrophication potential for the building's construction, maintenance, dismantling, and disposal including building systems technology over the reference study period t_d, calculated from an average office building in [kg PO_4 equiv./(m^2_{NFA} *a)][8],
EP_{Oref} reference value for the annual eutrophication potential created by building operations, derived from the reference value according to the national implementation of the EPBD directive in [kg PO_4 equiv./(m^2_{NFA} *a)].
The reference value for construction EP_{Cref} is calculated as follows:
$EP_{Cref} = (EP_{MAref} + EP_{MCref}) / t_d + EP_{MB1,4ref}$ (5)
where
$EP_{MA\ ref}$ reference value for eutrophication potential created during the modules A1-4[9], including office building's manufacture (construction and

	building systems technology) and transports to construction site in[kg PO_4 equiv./(m^2_{NFA})], $EP_{MC\ ref}$ reference value for eutrophication potential created during module C3 and C4[10], the office building's end-of-life (design and building systems technology) in [kg PO_4 equiv./(m^2_{NFA})], $EP_{MB1,4ref}$ reference value for annual eutrophication potential created during modules B1 and B4[11] on a yearly basis, the office building's use and replacement (construction and building systems technology) in [kg PO_4 equiv./(m^2_{NFA} *a)] td reference study period in [a]. This time period is set to 50 years. The reference value for use EP_{Oref} is calculated as follows **$EP_{Oref} = EP_{MB6,Eref} + EP_{MB6,Href}$ (6)** where $EP_{MB6,Eref}$ eutrophication potential for the national reference value for building`s annual electricity demand (end energy) according to the national implementation of the EPBD directive in [kg $PO_4$ equiv./$m^2_{NFA}$ *a], $EP_{MB6,Href}$ eutrophication potential for the national reference value for the building`s annual heating demand (end energy) according to the national implementation of the EPBD directive in [kg PO_4 equiv./m^2_{NFA} *a]. For the EP_{Oref} reference values for the building's heating and electricity demand (end energy) according to the national implementation of the EPBD directive in [kWh/(m^2_{NFA} *a)] should be used as basis when possible. The reference values for EP_{Cref} can be extracted from Table1 and Table2. These tables show reference values for both assessment types – "Quick and Basic" assessment and "Complete" assessment. **Evaluation** The evaluation consists of a simultaneous reduction of buildings' Eutrophication Potential for design and operation over the entire lifecycle.
Barriers	-
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below.
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
[2]	ISO 14044: 2006-10: Environmental management – Life cycle assessment – Requirements and guidelines. International Organization for Standardization.
[3]	FprEN 15978: 2011: Sustainability of construction works — Assessment of

	environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
[4]	prEN 15804: 2010: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. European Committee for Standardization CEN.
[5]	Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[6]	Kreißig, J., Binder, M. (2007): Methodische Grundlagen- Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktualisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen“ (AZ 10.06.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp.
[7]	United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf.
[8]	Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building. Eigenverlag, 2001.
[9]	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
[10]	VDI 2067: Economic efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

<table>
<tr><td rowspan="3">ENV.Im.14
(1.4)</td><td colspan="4">Photochemical Ozone Creation Potential, POCP (kg C2H4 equiv./(m²)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Radiation from the sun and the presence of nitrogen oxides and hydrocarbons incur different chemical reactions, producing aggressive reaction products, one of which is ozone.
Such near-ground ozone also known as summer smog is suspected to damage vegetation and material. High concentrations of ozone are toxic to humans.[1]
A substance`s contribution is indicated relatively to the Photochemical Ozone Creation Potential of C_2H_4.</td></tr>
<tr><td>Background</td><td colspan="4">Core Indicator adapted from DGNB/BNB</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5], [6], [7], [8], [9], [10].</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | |</td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | Other (specify) | |</td></tr>
<tr><td>Details</td><td colspan="4">The indicator is mainly based on the method of Life Cycle Assessment (LCA): LCA results of the building to be assessed will be calculated in a standardized way and evaluated against benchmarks. Thus Photochemical Ozone Creation Potential is a quantitative indicator.
According to the standards EN ISO 14040 and 14044, the method of Life-Cycle Assessment generally consists of four steps: Definition of goal and scope of the study, inventory analysis, impact assessment and interpretation. The indicators 1.1-1.5, 1.9 and 1.10 are based on LCAs and for all these indicators the same definitions for goal and scope and for the inventory analysis do apply.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Calculation
The following calculation rules must be followed:
Photochemical Ozone Creation Potential for “Designed Building”
Generally, the POCP for the building life cycle is composed of the POCP caused by the building construction and of the POCP caused during operation.
$POCP_{LC} = POCP_C + POCP_O$ (1)
where
$POCP_{LC}$ photochemical ozone creation potential of the life cycle of the entire building,
$POCP_C$ building’s construction, maintenance, dismantling, and disposal including building systems technology as an average annual value of photochemical ozone creation potential over the time reference study period t_d in [kg C_2H_4 equiv./(m^2_{NFA} *a)],
$POCP_O$ predicted annual photochemical ozone creation potential for the operation of the building as constructed, derived from end energy demand according to national implementation of EPBD directive in [kg C_2H_4 equiv./(m^2_{NFA} *a)],
NFA Net Floor Area of the building.
Based on the modules as defined in Figure 1, the value for construction $POCP_C$ is calculated as follows:
$POCP_C = (POCP_{MA} + POCP_{MC}) / t_d + POCP_{MB1,4}$ (2)
where</td></tr>
</table>

	$POCP_{MA}$ predicted value of photochemical ozone creation potential created during the modules A1-4[5], including office building's manufacture (construction and building systems technology) and transports to construction site in[kg C_2H_4 equiv./(m^2_{NFA})], $POCP_{MC}$ predicted value of photochemical ozone creation potential created during module C3 and C4[6], the office building's end-of-life (design and building systems technology) in [kg C_2H_4 equiv./(m^2_{NFA})], $POCP_{MB1,4}$ predicted value of photochemical ozone creation potential created during modules B1 and B4[7] on a yearly basis, the office building's use and replacement (construction and building systems technology) in[kg C_2H_4 equiv./(m^2_{NFA} *a)], t_d time period for the reference study period for certification in [a]. This time period is set at 50 years. The average annual value for use $POCP_O$ generally consists of the POCP caused by the building`s electricity and heating demand during operation: **$POCP_O = POCP_{MB6,E} + POCP_{MB6,H}$ (3)** where $POCP_{MB6,E}$ photochemical ozone creation potential for module B6, electricity demand during use, calculated with the national implementation of the EPBD directive, multiplied by the POCP factor for electricity of the ESUCO database in [kg C_2H_4 equiv./(m^2_{NFA} *a)], $POCP_{MB6,H}$ photochemical ozone creation potential for module B7, heating demand during use, calculated with the national implementation of the EPBD directive, multiplied by the POCP factor of the specific energy sources in the ESUCO database in [kg C_2H_4 equiv./(m^2_{NFA} *a)]. **Rating Method** The "designed building" is rated against a case-specific reference building. **Photochemical Ozone Creation Potential for Reference Building** **$R_{POCP} = POCP_{LCref} = POCP_{Cref} + POCP_{Oref}$ (4)** where $POCP_{LCref}$ reference value for the photochemical ozone creation potential of the life cycle of the reference building, $POCP_{Cref}$ reference value for the average annual value of photochemical ozone creation potential for the building's construction, maintenance, dismantling, and disposal including building systems technology over the reference study period t_d, calculated from an average office building in [kg C_2H_4 equiv./(m^2_{NFA} *a)][8], $POCP_{Oref}$ reference value for the annual photochemical ozone creation potential created by building operations, derived from the reference value according to the national implementation of the EPBD directive in [kg C_2H_4 equiv./(m^2_{NFA} *a)]. The reference value for construction $POCP_{Cref}$ is calculated as follows: **$POCP_{Cref} = (POCP_{MAref} + POCP_{MCref}) / t_d + POCP_{MB1,4ref}$ (5)** where $POCP_{MAref}$ reference value for photochemical ozone creation potential created during the modules A1-4[9], including office building's manufacture (construction and building systems technology) and transports to construction site in [kg C_2H_4 equiv./(m^2_{NFA})], $POCP_{MCref}$ reference value for photochemical ozone creation potential created

	during module C3 and C4[10], the office building's end-of-life (design and building systems technology) in [kg C_2H_4 equiv./(m^2_{NFA})], $POCP_{MB1,4ref}$ reference value for annual photochemical ozone creation potential created during modules B1 and B4[11] on a yearly basis, the office building's use and replacement (construction and building systems technology) in [kg C_2H_4 equiv./(m^2_{NFA} *a)] td reference study period in [a]. This time period is set to 50 years. The reference value for use $POCP_{Oref}$ is calculated as follows **$POCP_{Oref} = POCP_{MB6,Eref} + POCP_{MB6,Href}$ (6)** where $POCP_{MB6,Eref}$ photochemical ozone creation potential for the national reference value for building`s annual electricity demand (end energy) according to the national implementation of the EPBD directive in [kg $C_2H_4$ equiv./$m^2_{NFA}$ *a], $POCP_{MB6,Href}$ photochemical ozone creation potential vfor the national reference value for the building`s annual heating demand (end energy) according to the national implementation of the EPBD directive in [kg C_2H_4 equiv./m^2_{NFA} *a]. For the $POCP_{Oref}$ reference values for the building's heating and electricity demand (end energy) according to the national implementation of the EPBD directive in [kWh/(m^2_{NFA} *a)] should be used as basis when possible. The reference values for $POCP_{Gref}$ can be extracted from Table1 and Table2. These tables show reference values for both assessment types – "Quick and Basic" assessment and "Complete" assessment. **Evaluation** The evaluation consists of a simultaneous reduction of buildings' Photochemical Ozone Creation Potential for design and operation over the entire lifecycle.
Barriers	-
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below.
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
[2]	ISO 14044: 2006-10: Environmental management – Life cycle assessment – Requirements and guidelines. International Organization for Standardization.
[3]	FprEN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.

[4]	prEN 15804: 2010: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. European Committee for Standardization CEN.
[5]	Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[6]	Kreißig, J., Binder, M. (2007): Methodische Grundlagen- Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktualisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen“ (AZ 10.06.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp.
[7]	United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf.
[8]	Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building. Eigenverlag, 2001.
[9]	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
[10]	VDI 2067: Economic efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

<table>
<tr><td rowspan="3">ENV.Bi.03
(1.7)</td><td colspan="6">Change in Ecological Value of the Site, Species (-)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td colspan="2">Biodiversity</td><td colspan="2">S</td><td>B / N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">The goal is to assess the ecological value of the site prior to and after the development of the case-study building in order to minimize the impact of the building development on existing site ecology enhancing the ecological value of the site and increasing biodiversity.
This indicator supports the European Commission headline target of halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss[1].</td></tr>
<tr><td>Background</td><td colspan="6">Indicator Adapted from BREEAM</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td>X</td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">1.7.1. Change in ecological value of the site: enhancement of biodiversity

This sub-indicator assesses the ecological characteristics of the site immediately prior to and after the development of the case-study building. The amount and type of vegetation retained or introduced into the development is a critical part of the preservation, restoration and maintenance of site ecology.</td></tr>
<tr><td>Areas covered</td><td colspan="6">1. Calculation of change in ecological value by suitably qualified ecologist

A suitably qualified ecologist (SQE) has to be appointed to report on the enhancement and protection of the biodiversity of the site.
a. The SQE provides an Ecology Report with appropriate recommendations for protection and enhancement of the site’s ecology.
b. The report is based on a site visit/survey by the SQE prior to the commencement of initial site preparation works.
c. The general recommendations of the Ecology Report for enhancement and protection of site ecology have been, or will be, implemented.
The suitably qualified ecologist (SQE) confirms that this will result in a change in ecological value of the site. An example of the calculation of the change in ecological value can be found in Annex 1.

2. Previously developed sites

If the site is previously developed (buildings or landscapes such as parking on more than 75% of the site area), the design team can choose not to use a qualified ecologist as long as a biodiversity management plan has been developed.

3. Biodiversity Management Plan</td></tr>
</table>

	A biodiversity plan has been developed by the design team without the help of a Suitably Qualified Ecologist in order to minimize the impact of the construction on the existing ecosystems. In particular, measures should be taken to preserve part of the existing ecosystems and to create habitats to maintain the biodiversity of the site.
Barriers	-
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below.
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator to the site - for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	BREEAM: LE 4 Mitigating Ecological Impact

<table>
<tr><td rowspan="3">ENV.Im.16</td><td colspan="6">Light on properties, Ev (lx)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td colspan="2">Impacts</td><td colspan="2">S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Although outdoor lighting is imperative to illuminate sidewalks, parking lots and driveways for safety and convenience reasons, it can alter a site’s nocturnal ecosystem and limit sky observations.
The objectives of this indicator are listed below:
▪ To design only the strict necessary external lighting and to ensure that external lighting is concentrated in the appropriate areas,
▪ To avoid disturbance on animal and human health and psychology,
▪ To avoid disruption of ecosystems,
▪ To reduce sky glow and glare,
▪ To improve nocturnal sky observations (effects on astronomy).</td></tr>
<tr><td>Background</td><td colspan="6">Indicator adapted from LEED, BREEAM, HQE, EN 12464-2)</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5], [6], [7]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td>X</td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Light Pollution.

Projects should illuminate areas only as required for safety and comfort, provide only the light levels necessary to meet the design intent, and select efficient fixtures using efficient sources to meet the lighting requirements of the site while minimizing light pollution (LEED, SSc8). Therefore, the installed lighting power densities including emergency lighting is compared to maximal acceptable values.
High illuminance at a site boundary can affect neighbouring areas and buildings and impact surrounding ecosystems or neighbourhoods. The goal is to retain the emitted light within the site boundaries and the horizontal and vertical illuminance values at the site boundary are thus assessed.
Light sources pointing directly towards the sky cover have a critical impact in terms of night-time sky glow and glare, thus limiting the potential for night sky observations. The goal is to limit the amount of light pointing directly towards the sky cover and this is assessed with the percentage of luminaries with lumens emitted at 90° or higher from nadir (nadir is the direction pointing directly below a particular point).
The assessment is based on the guidance provided in the European standard EN 12464-2.
The following sub-indicators are assessed:
1.8.1. Light on properties
1.8.2 Luminaire intensity
1.8.3 Upward light
1.8.4 Luminance

Indicator 1.8.1 refers to Light on properties</td></tr>
<tr><td>Areas covered</td><td colspan="6">The location has to be classified in one of the four environmental zones defined</td></tr>
</table>

	in EN 12464-2: **1.8.1. Light on properties** The maximum value of vertical illuminance on properties Ev given in EN 12464-2 should be respected:
Barriers	-
Rating	-
References	Refer to the References Section
SCALE	
Application	Large neighbourhood scale - High illuminance at a site boundary can affect neighbouring areas and buildings and impact surrounding ecosystems or neighbourhoods. The goal is to retain the emitted light within the site boundaries and the horizontal and vertical illuminance values at the site boundary are thus assessed.
Details	Lighting on properties – spaces surrounding buildings.
Multiscale	Neighbourhood scale – spaces surrounding buildings.
References	Refer to the References Section

REFERENCES	
[1]	BREEAM 2009: Pol4 Reduction of night time light pollution
[2]	LEED 2009: Site 8 Light Pollution Reduction
[3]	HQE 2012: 1.3. Impacts of the building on the local residents
[4]	ANSI/ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Lighting, Section 9 (without amendments)
[5]	*Lighting for Exterior Environments RP-33-99,* by the Outdoor Environment Lighting Committee of Illuminating Engineering Society of North America (www.iesna.org) (IESNA, 1999)
[6]	International Dark-Sky Association (www.darksky.org)
[7]	EN 12464-2, Light and lighting — Lighting of work places — Part 2 : Outdoor work places.

<table>
<tr><td rowspan="3">ENV.Im.19</td><td colspan="4">Luminaire Intensity (cd)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>S</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Although outdoor lighting is imperative to illuminate sidewalks, parking lots and driveways for safety and convenience reasons, it can alter a site's nocturnal ecosystem and limit sky observations.
The objectives of this indicator are listed below:
▪ To design only the strict necessary external lighting and to ensure that external lighting is concentrated in the appropriate areas,
▪ To avoid disturbance on animal and human health and psychology,
▪ To avoid disruption of ecosystems,
▪ To reduce sky glow and glare,
▪ To improve nocturnal sky observations (effects on astronomy).</td></tr>
<tr><td>Background</td><td colspan="4">Indicator adapted from LEED, BREEAM, HQE, EN 12464-2)</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5], [6], [7]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [X] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [ ] | Empirical/Literature [ ] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">Light Pollution.

Projects should illuminate areas only as required for safety and comfort, provide only the light levels necessary to meet the design intent, and select efficient fixtures using efficient sources to meet the lighting requirements of the site while minimizing light pollution (LEED, SSc8). Therefore, the installed lighting power densities including emergency lighting is compared to maximal acceptable values.
High illuminance at a site boundary can affect neighbouring areas and buildings and impact surrounding ecosystems or neighbourhoods. The goal is to retain the emitted light within the site boundaries and the horizontal and vertical illuminance values at the site boundary are thus assessed.
Light sources pointing directly towards the sky cover have a critical impact in terms of night-time sky glow and glare, thus limiting the potential for night sky observations. The goal is to limit the amount of light pointing directly towards the sky cover and this is assessed with the percentage of luminaries with lumens emitted at 90° or higher from nadir (nadir is the direction pointing directly below a particular point).
The assessment is based on the guidance provided in the European standard EN 12464-2.
The following sub-indicators are assessed:
1.8.1. Light on properties
1.8.2 Luminaire intensity
1.8.3 Upward light
1.8.4 Luminance

Indicator 1.8.2 Luminaire intensity</td></tr>
<tr><td>Areas covered</td><td colspan="4">The location has to be classified in one of the four environmental zones defined in EN 12464-2:</td></tr>
</table>

	1.8.2. Luminaire intensity The light intensity of each source in the potentially obtrusive direction given in EN 12464-2 should be respected:
Barriers	-
Rating	Sub Indicator Weighting 4
References	Refer to the References Section
SCALE	
Application	Large neighbourhood scale - High illuminance at a site boundary can affect neighbouring areas and buildings and impact surrounding ecosystems or neighbourhoods. The goal is to retain the emitted light within the site boundaries and the horizontal and vertical illuminance values at the site boundary are thus assessed.
Details	Luminaire intensity – spaces surrounding buildings.
Multiscale	Neighbourhood scale – spaces surrounding buildings.
References	Refer to the References Section

REFERENCES	
[1]	BREEAM 2009: Pol4 Reduction of night time light pollution
[2]	LEED 2009: Site 8 Light Pollution Reduction
[3]	HQE 2012: 1.3. Impacts of the building on the local residents
[4]	ANSI/ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Lighting, Section 9 (without amendments)
[5]	*Lighting for Exterior Environments RP-33-99,* by the Outdoor Environment Lighting Committee of Illuminating Engineering Society of North America (www.iesna.org) (IESNA, 1999)
[6]	International Dark-Sky Association (www.darksky.org)
[7]	EN 12464-2, Light and lighting — Lighting of work places — Part 2 : Outdoor work places.

<table>
<tr><td rowspan="3">ENV.Im.21</td><td colspan="6">Upward Light</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td colspan="2">LEVEL</td><td colspan="2">SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td colspan="2">S</td><td colspan="2">N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Although outdoor lighting is imperative to illuminate sidewalks, parking lots and driveways for safety and convenience reasons, it can alter a site's nocturnal ecosystem and limit sky observations.
The objectives of this indicator are listed below:
▪ To design only the strict necessary external lighting and to ensure that external lighting is concentrated in the appropriate areas,
▪ To avoid disturbance on animal and human health and psychology,
▪ To avoid disruption of ecosystems,
▪ To reduce sky glow and glare,
▪ To improve nocturnal sky observations (effects on astronomy).</td></tr>
<tr><td>Background</td><td colspan="6">Indicator adapted from LEED, BREEAM, HQE, EN 12464-2)</td></tr>
<tr><td>References</td><td colspan="6">[1], [2], [3], [4], [5], [6], [7]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Light Pollution.
Projects should illuminate areas only as required for safety and comfort, provide only the light levels necessary to meet the design intent, and select efficient fixtures using efficient sources to meet the lighting requirements of the site while minimizing light pollution (LEED, SSc8). Therefore, the installed lighting power densities including emergency lighting is compared to maximal acceptable values.
High illuminance at a site boundary can affect neighbouring areas and buildings and impact surrounding ecosystems or neighbourhoods. The goal is to retain the emitted light within the site boundaries and the horizontal and vertical illuminance values at the site boundary are thus assessed.
Light sources pointing directly towards the sky cover have a critical impact in terms of night-time sky glow and glare, thus limiting the potential for night sky observations. The goal is to limit the amount of light pointing directly towards the sky cover and this is assessed with the percentage of luminaries with lumens emitted at 90° or higher from nadir (nadir is the direction pointing directly below a particular point).
The assessment is based on the guidance provided in the European standard EN 12464-2.
The following sub-indicators are assessed:
1.8.1. Light on properties
1.8.2 Luminaire intensity
1.8.3 Upward light
1.8.4 Luminance

Indicator 1.8.3 Upward Light</td></tr>
<tr><td>Areas covered</td><td colspan="6">The location has to be classified in one of the four environmental zones defined in EN 12464-2:</td></tr>
</table>

	1.8.3. Upward light The requirements for the angle of light emission depend of the classification of the building location. The upward light should be limited.
Barriers	-
Rating	Sub Indicator Weighting 4
References	Refer to the References Section
SCALE	
Application	Large neighbourhood scale - High illuminance at a site boundary can affect neighbouring areas and buildings and impact surrounding ecosystems or neighbourhoods. The goal is to retain the emitted light within the site boundaries and the horizontal and vertical illuminance values at the site boundary are thus assessed.
Details	Upward Lighting – spaces surrounding buildings.
Multiscale	Neighbourhood scale – spaces surrounding buildings.
References	Refer to the References Section

REFERENCES	
[1]	BREEAM 2009: Pol4 Reduction of night time light pollution
[2]	LEED 2009: Site 8 Light Pollution Reduction
[3]	HQE 2012: 1.3. Impacts of the building on the local residents
[4]	ANSI/ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Lighting, Section 9 (without amendments)
[5]	*Lighting for Exterior Environments RP-33-99,* by the Outdoor Environment Lighting Committee of Illuminating Engineering Society of North America (www.iesna.org) (IESNA, 1999)
[6]	International Dark-Sky Association (www.darksky.org)
[7]	EN 12464-2, Light and lighting — Lighting of work places — Part 2: Outdoor work places.

<table>
<tr><td rowspan="3">ENV.Im.20</td><td colspan="8">Luminance (cd/m²)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td colspan="2">SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Impacts</td><td colspan="2">S</td><td colspan="2">N</td></tr>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td>Description</td><td colspan="8">Although outdoor lighting is imperative to illuminate sidewalks, parking lots and driveways for safety and convenience reasons, it can alter a site’s nocturnal ecosystem and limit sky observations.
The objectives of this indicator are listed below:
▪ To design only the strict necessary external lighting and to ensure that external lighting is concentrated in the appropriate areas,
▪ To avoid disturbance on animal and human health and psychology,
▪ To avoid disruption of ecosystems,
▪ To reduce sky glow and glare,
▪ To improve nocturnal sky observations (effects on astronomy).</td></tr>
<tr><td>Background</td><td colspan="8">Indicator adapted from LEED, BREEAM, HQE, EN 12464-2)</td></tr>
<tr><td>References</td><td colspan="8">[1], [2], [3], [4], [5], [6], [7]</td></tr>
<tr><td colspan="9">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="2">Software tool</td><td></td><td>Operational data</td><td>X</td><td>In situ measurements</td><td colspan="2"></td></tr>
<tr><td colspan="2">Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td colspan="2"></td></tr>
<tr><td>Details</td><td colspan="8">Light Pollution.

Projects should illuminate areas only as required for safety and comfort, provide only the light levels necessary to meet the design intent, and select efficient fixtures using efficient sources to meet the lighting requirements of the site while minimizing light pollution (LEED, SSc8). Therefore, the installed lighting power densities including emergency lighting is compared to maximal acceptable values.
High illuminance at a site boundary can affect neighbouring areas and buildings and impact surrounding ecosystems or neighbourhoods. The goal is to retain the emitted light within the site boundaries and the horizontal and vertical illuminance values at the site boundary are thus assessed.
Light sources pointing directly towards the sky cover have a critical impact in terms of night-time sky glow and glare, thus limiting the potential for night sky observations. The goal is to limit the amount of light pointing directly towards the sky cover and this is assessed with the percentage of luminaries with lumens emitted at 90° or higher from nadir (nadir is the direction pointing directly below a particular point).
The assessment is based on the guidance provided in the European standard EN 12464-2.
The following sub-indicators are assessed:
1.8.1. Light on properties
1.8.2 Luminaire intensity
1.8.3 Upward light
1.8.4 Luminance

Indicator 1.8.4 Luminance</td></tr>
<tr><td>Areas covered</td><td colspan="8">The location has to be classified in one of the four environmental zones defined in EN 12464-2:</td></tr>
</table>

	1.8.4 Luminance The maximum average luminance of the signs and of the facade of a building given in EN 12464-2 should be respected.
Barriers	-
Rating	Sub Indicator Weighting 4
References	Refer to the References Section
SCALE	
Application	Large neighbourhood scale - High illuminance at a site boundary can affect neighbouring areas and buildings and impact surrounding ecosystems or neighbourhoods. The goal is to retain the emitted light within the site boundaries and the horizontal and vertical illuminance values at the site boundary are thus assessed.
Details	Luminance – spaces surrounding buildings.
Multiscale	Neighbourhood scale – spaces surrounding buildings.
References	Refer to the References Section

REFERENCES	
[1]	BREEAM 2009: Pol4 Reduction of night time light pollution
[2]	LEED 2009: Site 8 Light Pollution Reduction
[3]	HQE 2012: 1.3. Impacts of the building on the local residents
[4]	ANSI/ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Lighting, Section 9 (without amendments)
[5]	*Lighting for Exterior Environments RP-33-99,* by the Outdoor Environment Lighting Committee of Illuminating Engineering Society of North America (www.iesna.org) (IESNA, 1999)
[6]	International Dark-Sky Association (www.darksky.org)
[7]	EN 12464-2, Light and lighting — Lighting of work places — Part 2: Outdoor work places.

ENV.Im.11 (1.9)	**Abiotic Depletion Potential, ADP_Enr (kWh/(m²)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Environmental	Energy		S		B
GENERAL						
Description	Primary energy is energy found in nature that has not been subjected to any conversion or transformation process. It is energy contained in raw fuels as well as other forms of energy received as input to a system. The indicator Non-Renewable Primary Energy Demand aims at the reduction of the share of primary energy demand provided by fossil and therefore limited fuels.					
Background	Core Indicator adapted from EN 15978.					
References	[1], [2], [3], [4], [5], [6], [7], [8], [9], [10]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	The indicator is mainly based on the method of Life Cycle Assessment (LCA): LCA results of the building to be assessed will be calculated in a standardized way and evaluated against benchmarks. Thus Non-Renewable Primary Energy Demand is a quantitative indicator. According to the standards EN ISO 14040 and 14044, the method of Life-Cycle Assessment generally consists of four steps: Definition of goal and scope of the study, inventory analysis, impact assessment and interpretation. The indicators 1.1-1.5, 1.9 and 1.10 are based on LCAs and for all these indicators the same definitions for goal and scope and for the inventory analysis do apply.					
Areas covered	**Calculation** When calculating the Abiotic Resource Depletion for fossil fuels related to non-renewable energy demand for the building, the following calculation rules must be followed and based on the value for any energy carrier: **Non-Renewable Energy Demand for “Designed Building”** Generally, the E_{nr} for the building life cycle is composed of the E_{nr} caused by the building construction and of the E_{nr} caused during operation for any energy carrier Ei. **ADP_$E_{nr,LC}$ = $\sum_i$** **ADP_Ei x ($E_{nr,LC,Ei}$ + $E_{nr,O,Ei}$) (1)** where ADP_Ei Abiotic Depletion Potential for reference energy carrier $E_{i,}$, $E_{nr,LC,Ei}$ non-renewable energy demand for energy carrier Ei of the life cycle of the entire building, $E_{nr,C,Ei}$ building’s construction, maintenance, dismantling, and disposal including building systems technology as an average annual non-renewable primary energy demand over the time reference study period t_d in [kWh/(m²$_{NFA}$ *a)], $E_{nr,O,Ei}$ predicted annual non-renewable energy demand for the operation of the building as constructed, derived from end energy demand according to national implementation of EPBD in [kWh /(m²$_{NFA}$ *a)] for any energy carrier Ei,					

NFA Net Floor Area of the building.
Based on the modules as defined in Figure 1, the value for construction $ADP\_E_{nr,C,Ei}$ is calculated as follows:

$ADP\_E_{nr,C,Ei} = \boxed{?}_i$
$ADP\_Ei\ ((E_{nr,MA,Ei} + E_{nr,MC,Ei})\ /\ t_d + E_{nr,MB1,4,Ei})$ (2)
where
ADP_Ei Abiotic Depletion Potential for reference energy carrier E_i
$E_{nr,MA,Ei}$ predicted value of non-renewable energy demand created during the modules A1-4[4], including office building's manufacture (construction and building systems technology) and transports to construction site in [kWh/(m^2_{NFA})] for energy carrier Ei,
$E_{nr,MC,Ei}$ predicted value of non-renewable energy demand created during module C3 and C4[5], the office building's end-of-life (design and building systems technology) in [kWh /(m^2_{NFA})] for energy carrier Ei,
$E_{nr,MB1,4,Ei}$ predicted value of non-renewable energy demand for any energy carrier Ei created during modules B1 and B4[6] on a yearly basis, the office building's use and replacement (construction and building systems technology) in[kWh/(m^2_{NFA} *a)], t_d time period for the reference study period for certification in [a]. This time period is set at 50 years.

The average annual value for use $E_{nr,O,Ei}$ generally consists of the $E_{nr,Ei}$ caused by the building`s electricity and heating demand during operation for any energy carrier Ei:

$E_{nr,O,Ei} = E_{nr,MB6,EI} + \boxed{?}_i$
$ADP\_Ei \times E_{nr,MB6,H,Ei}$ (3)
where
ADP_Ei Abiotic Depletion Potential for reference energy carrier E_i
$E_{nr,MB6,EI}$ non-renewable energy demand for module B6, electricity demand during use, calculated with the national implementation of the EPBD directive, multiplied by the PE_{nr} factor for energy carrier electricity of the ESUCO database in [kWh/(m^2_{NFA} *a)],
$E_{nr,MB6,H}$ non-renewable energy demand for module B6, heating demand during use, calculated with the national implementation of the EPBD, [kWh/(m^2_{NFA} *a)] for energy carrier Ei.

Rating Method
The "designed building" is rated against a case-specific reference building.

Contribution to depletion of non-renewable energy resources Reference Building
$R_{ADP\_Enr} = ADP\_Eref \times E_{nr,LCref} = ADP\_Eref\ (E_{nr,Cref} + E_{nr,Oref})$ (4)
where
ADP Eref Abiotic Depletion Potential for reference energy carrier E_{ref}
$E_{nr,LCref}$ reference value for the non-renewable energy demand of the life cycle of the reference building,
$E_{nr,Cref}$ reference value for the average annual value of non-renewable energy demand for the
building's construction, maintenance, dismantling, and disposal including building

	systems technology over the reference study period t_d, calculated from an average office building in [kWh/(m²$_{NFA}$ *a)][7], $E_{nr,Oref}$ reference value for the annual non-renewable energy demand created by building operations, derived from the reference value according to the national implementation of the EPBD directive in [kWh/(m²$_{NFA}$ *a)]. The reference value for construction ADP_$E_{nr,Cref}$ is calculated as follows: **$ADP\_E_{nr,Cref} = (ADP\_Eref \times E_{nr,MAref} + ADP\ Eref \times PE_{nr,MCref}) / t_d + ADP\ Eref * E_{nr,MB1,4ref}$ (5)** where ADP Eref Abiotic Depletion Potential for reference energy carrier E_{ref} $E_{nr,MAref}$ reference value for non-renewable energy demand using reference energy carrier created during the modules A1-4[8], including office building's manufacture (construction and building systems technology) and transports to construction site in[kWh/(m²$_{NFA}$)] , $E_{nr,MCref}$ reference value for non-renewable energy demand created during module C3 and C4[9], the office building's end-of-life (design and building systems technology) in [kWh/(m²$_{NFA}$)], $E_{nr,MB1,4ref}$ reference value for annual non-renewable energy demand created during modules B1 and B4[10] on a yearly basis, the office building's use and replacement (construction and building systems technology) in [kWh/(m²$_{NFA}$ *a)] t_d reference study period in [a]. This time period is set to 50 years. The reference value for use $E_{nr,Oref}$ is calculated as follows **$ADP\_E_{nr,Oref} = ADP\_El \times E_{nr,MB6,Eref,El} + \boxed{?}_i$** **$ADP\_Ei \times E_{nr,MB6,Href,Ei}$ (6)** Where **ADP_El Abiotic Depletion Potential for electrical energy** **ADP_Ei Abiotic Depletion Potential for energy carrier Ei** $E_{nr,MB6,Eref,El}$ non-renewable energy demand for the national reference value for building`s annual electricity demand (end energy) according to the national implementation of the EPBDin [kWh/m²$_{NFA}$ *a], $E_{nr,MB6,Href,Ei}$ non-renewable energy demand for the national reference value for the building`s annual heating demand (end energy) according to the national implementation of the EPBDin [kWh/m²$_{NFA}$ *a] for fossil fuel Ei. The reference values for ADP_$E_{ne,Href}$ be extracted from Table1 and Table2 using the respective ADP factor for the reference fuels. These tables show reference values for both assessment types – "Quick and Basic" assessment and "Complete" assessment.
Barriers	-
Rating	-
References	Refer to the References Section
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
[2]	ISO 14044: 2006-10: Environmental management – Life cycle assessment – Requirements and guidelines. International Organization for Standardization.
[3]	FprEN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
[4]	prEN 15804: 2010: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. European Committee for Standardization CEN.
[5]	Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[6]	Kreißig, J., Binder, M. (2007): Methodische Grundlagen- Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktualisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen“ (AZ 10.06.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp.
[7]	United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf.
[8]	Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building. Eigenverlag, 2001.
[9]	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
[10]	VDI 2067: Economic efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

<table>
<tr><td rowspan="3">ENV.En.18
(1.10)</td><td colspan="4">Total primary Energy Demand (kWh/m²)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Energy</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Primary energy is energy found in nature that has not been subjected to any conversion or transformation process. It is energy contained in raw fuels as well as other forms of energy received as input to a system.
The indicator Total Primary Energy Demand and Share of renewable Primary Energy aims at the reduction of the Total Primary Energy Demand and at the increase of the share of renewable Primary Energy Demand.

The following sub-indicator is assessed:
1.10.1 Total Primary Energy Demand</td></tr>
<tr><td>Background</td><td colspan="4">Core Indicator adapted from DGNB/BNB)</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3], [4], [5], [6], [7], [8], [9], [10]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | Other (specify) | </td></tr>
<tr><td>Details</td><td colspan="4">The indicator is mainly based on the method of Life Cycle Assessment (LCA): LCA results of the building to be assessed will be calculated in a standardized way and evaluated against benchmarks. Thus Total Primary Energy demand and Share of renewable Primary Energy is a quantitative indicator.
According to the standards EN ISO 14040 and 14044, the method of Life-Cycle Assessment generally consists of four steps: Definition of goal and scope of the study, inventory analysis, impact assessment and interpretation. The indicators 1.1-1.5, 1.9-1.10 and 1.15 are based on LCAs and for all these indicators the same definitions for goal and scope and for the inventory analysis do apply.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Calculation
The total primary energy demand over the building life cycle, $PE_{tot, LC}$, is calculated as follows:
$\mathbf{PE_{tot, LC} = PE_{nr, LC} + PE_{ren, LC}}$
where
$PE_{nr, LC}$ result from indicator Non-renewable Primary Energy Demand: Non-Renewable Primary Energy Demand of the entire life cycle of the entire building as an average annual value over the time reference study period t_d in [kWh/(m²$_{NFA}$*a)],
$PE_{ren, LC}$ renewable primary energy demand of the entire life cycle of the entire building as an average annual value over the time reference study period t_d in [kWh/(m²$_{NFA}$*a)]; also calculated according to the equations given for Non-renewable Primary Energy Demand but using the ESUCO dataset for renewable primary energy demand.
To assess the sub-indicator “Share of renewable Primary Energy Demand $PE_{ren,LC}$“, the ratio of renewable primary energy to total primary energy use $PE_{ren, LC}$ / $PE_{nr, LC}$ must be presented as a percent.
<h3>1.10.1 Total Primary Energy Demand</h3>Rating Method
The “designed building” is rated against a case-specific reference building.
Total Primary Energy Demand for Reference Building
$\mathbf{PE_{tot,LC,ref} = PE_{tot,Cref} + PE_{tot,Oref}}$ (4)</td></tr>
</table>

	where $PE_{tot,LCref}$ Reference value for the for the total primary energy demand of the life cycle of the reference building in [kWh/(m^2_{NFA}*a)], $PE_{tot,Cref}$ reference value for the average annual value of total primary energy demand for the building's construction, maintenance, dismantling, and disposal including building systems technology over the reference study period t_d, calculated from an average office building in [kWh/(m^2_{NFA}*a)][4], $PE_{tot,Oref}$ reference value for the annual total primary energy demand created by building operations, derived from the reference value according to the national implementation of the EPBD directive in [kWh/(m^2_{NFA}*a)]. The reference value for construction $PE_{tot,Cref}$ is calculated as follows: **$PE_{tot,Cref} = (PE_{tot,MAref} + PE_{tot,MCref}) / t_d + PE_{tot,MB1,4ref}$ (5)** where $PE_{tot,MA\ ref}$ reference value for total primary energy demand created during the modules A1-4[5], including office building's manufacture (construction and building systems technology) and transports to construction site in [kWh/(m^2_{NFA}*a)], $PE_{tot,MC\ ref}$ reference value for total primary energy demand created during module C3 and C4[6], the office building's end-of-life (design and building systems technology) in [kWh/(m^2_{NFA}*a)], $PE_{tot,MB1,4ref}$ reference value for total primary energy demand created during modules B1 and B4[7] on a yearly basis, the office building's use and replacement (construction and building systems technology) in [kWh/(m^2_{NFA}*a)]. t_d reference study period in [a]. This time period is set to 50 years. The reference value for use $PE_{tot,Oref}$ is calculated as follows **$PE_{tot,Oref} = PE_{tot,MB6,Eref} + PE_{tot,MB6,Href}$ (6)** where $PE_{tot,MB6,Eref}$ total primary energy demand for the national reference value for building`s annual electricity demand (end energy) according to the national implementation of the EPBD directive in [kWh/($m^2_{NFA}$*a)], $PE_{tot,MB6,Href}$ total primary energy demand for the national reference value for the building`s annual heating demand (end energy) according to the national implementation of the EPBD directive in [kWh/(m^2_{NFA}*a)]. For the $PE_{tot,Oref}$ reference values for the building's heating and electricity demand (end energy) according to the national implementation of the EPBD directive in [kWh/(m^2_{NFA} *a)] should be used as basis when possible. The reference values for $PE_{tot,Cref}$ can be extracted from Table1 and Table2. These tables show reference values for both assessment types – "Quick and Basic" assessment and "Complete" assessment. **Evaluation** For the final evaluation of the sub-indicator "Total Primary Energy", the values L, R_{local}, R_{global} and T are depicted in a diagram. The allocation of points for limit, reference and target values can be found in the table 1.10.1.
Barriers	-
Rating	Sub Indicator Weighting 4
References	Refer to the References Section
SCALE	

Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
[2]	ISO 14044: 2006-10: Environmental management – Life cycle assessment – Requirements and guidelines. International Organization for Standardization.
[3]	FprEN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
[4]	prEN 15804: 2010: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. European Committee for Standardization CEN.
[5]	Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[6]	Kreißig, J., Binder, M. (2007): Methodische Grundlagen- Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktualisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen“ (AZ 10.06.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp.
[7]	United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf.
[8]	Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building. Eigenverlag, 2001.
[9]	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
[10]	VDI 2067: Economic efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

ENV.En.21 (1.10)	**Share of Renewable Primary Energy in Total Primary Energy Demand (kWh/m²)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Energy	S	B

GENERAL

Description	Primary energy is energy found in nature that has not been subjected to any conversion or transformation process. It is energy contained in raw fuels as well as other forms of energy received as input to a system. The indicator Total Primary Energy Demand and Share of renewable Primary Energy aims at the reduction of the Total Primary Energy Demand and at the increase of the share of renewable Primary Energy Demand. The following sub-indicator is assessed: **1.10.2 Share of renewable Primary Energy in Total Primary Energy Demand**
Background	Core Indicator adapted from DGNB/BNB)
References	[1], [2], [3], [4], [5], [6], [7], [8], [9], [10]

LEVEL

Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	The indicator is mainly based on the method of Life Cycle Assessment (LCA): LCA results of the building to be assessed will be calculated in a standardized way and evaluated against benchmarks. Thus Total Primary Energy demand and Share of renewable Primary Energy is a quantitative indicator. According to the standards EN ISO 14040 and 14044, the method of Life-Cycle Assessment generally consists of four steps: Definition of goal and scope of the study, inventory analysis, impact assessment and interpretation. The indicators 1.1-1.5, 1.9-1.10 and 1.15 are based on LCAs and for all these indicators the same definitions for goal and scope and for the inventory analysis do apply.
Areas covered	**Calculation** The total primary energy demand over the building life cycle, $PE_{tot, LC}$, is calculated as follows: $\mathbf{PE_{tot, LC} = PE_{nr, LC} + PE_{ren, LC}}$ where $PE_{nr, LC}$ result from indicator Non-renewable Primary Energy Demand: Non-Renewable Primary Energy Demand of the entire life cycle of the entire building as an average annual value over the time reference study period t_d in [kWh/(m²$_{NFA}$*a)], $PE_{ren, LC}$ renewable primary energy demand of the entire life cycle of the entire building as an average annual value over the time reference study period t_d in [kWh/(m²$_{NFA}$*a)]; also calculated according to the equations given for Non-renewable Primary Energy Demand but using the ESUCO dataset for renewable primary energy demand. To assess the sub-indicator "Share of renewable Primary Energy Demand $PE_{ren,LC}$", the ratio of renewable primary energy to total primary energy use $PE_{ren, LC}$ / $PE_{nr, LC}$ must be presented as a percent.

	1.10.2 Share of renewable Primary Energy in Total Primary Energy Demand For the final evaluation of the sub-indicator "Share of renewable Primary Energy in Total Primary Energy demand", the achieved percent must be compared to the values in table 1.10.2.
Barriers	-
Rating	Sub Indicator Weighting -
References	Refer to the References Section
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
[2]	ISO 14044: 2006-10: Environmental management – Life cycle assessment – Requirements and guidelines. International Organization for Standardization.
[3]	FprEN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
[4]	prEN 15804: 2010: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. European Committee for Standardization CEN.
[5]	Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[6]	Kreißig, J., Binder, M. (2007): Methodische Grundlagen- Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktualisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen" (AZ 10.06.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp.
[7]	United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf.
[8]	Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building. Eigenverlag, 2001.
[9]	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
[10]	VDI 2067: Economic efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

ENV.Wa.10 (1.11)	**Operation Water use and Waste Water (m³)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Water	S	B / N

GENERAL	
Description	Potable water consumption and sewage generation shall be reduced within the Life Cycle of a building. Aspects to be regarded are water embodied in building materials in the Product stage, water used in the Construction and Deconstruction Processes and operational water use during the Use stage. A further objective is to limit disruption and pollution of natural water flows by managing storm-water runoff. This indicator aims at the reduction of consumption of freshwater and supports the European Commission objective to make water saving measures and increasing water efficiency a priority[1], in order to ensure that water is available in sufficient quantities in European countries.
Background	Core Indicator adapted from DGNB/BNB
References	[1]

Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	[1] The following sub indicators should be assessed in order to take in account the freshwater demand over the whole life cycle of the building: **1.11.1 Embodied water in building materials** **1.11.2 Embodied water in construction and deconstruction processes** **1.11.3 Operational Water Use and Waste Water** However, due to data issues in materials production as well as building construction and deconstruction processes, only the operational water use will be assessed in this version of the OPEN HOUSE methodology.
Areas covered	**1.11.3 Operational Water Use and Waste Water** Operational Water Use is assessed using the »water use value« W_{uv}, which takes into consideration the potable water demand and the volume of waste water. For the calculation, the following items are taken into consideration: ▪ Potable water consumed by staff for bathrooms, sinks, toilets, urinals, showers and kitchen sinks and respective waste water. Dish washers and washing machines are not included. ▪ Potable water consumed for cleaning, based on the surfaces of washable floors and glass, and respective waste water. ▪ Potable water consumed for watering plants. This can be reduced by using rainwater, plants that are well adapted to the location, or intelligent watering systems. In the current state of the assessment system, watering plants is not calculated, since outdoor facilities are not included, but this may be changed in future versions. ▪ Rainwater that is not drained into the soil but is diverted to the technical drain system is considered as waste water. Due to rainwater`s low degree of pollution compared to other waste water from the building, a corrective reduction factor is used. If rainwater diverted to the drain system is used to replace potable water (e.g. for

	flushing toilets), this amount is subtracted from the total potable water demand, but not from the volume of waste water. If gray water from the building is not led directly to the drain system but is reused, it both replaces potable water and is no longer considered waste water. Waste water purified on site is subtracted from the volume of waste water. **Method description** **Water use value** The water use value W_{UV} is calculated as follows: $\mathbf{W_{UV} = (WD_E + WW_E) + (WD_C + WW_C) + (WW_{RW} * f_r) \ (1)}$ **where** W_{UV} water use value in [m³/a] WD_E employee potable water demand in [m³/a] WW_E employee waste water volume in [m³/a] WD_C potable water needed for cleaning in [m³/a] WW_C volume of waste water from cleaning in [m³/a] WW_{RW} share of rainwater diverted to the drain system in [m³/a] f_r corrective reduction factor of 0,5* * Factor based on costs of a split sewage fee The following information is needed to calculate the water use value: n_E number of employees cv_I consumption value of installations (flow classes / flushing volume) NFA net floor area A_{WF} area of washable floor A_R roof surface area hc_R harvest coefficient for roof surface S_{RW} site-specific annual precipitation In some case, the following values may also needed to be considered: A_S sealed surface area hc_S harvest coefficient for sealed surfaces S_{RW} planned rainwater seepage U_{RW} planned rainwater use U_{GW} planned gray water use P_{WW} planned on-site purification of waste water
Barriers	Due to data issues in materials production as well as building construction and deconstruction processes, only the operational water use will be assessed in the 2013 version of the OPEN HOUSE methodology. Therefore the following where not considered: **1.11.1 Embodied water in building materials** **1.11.2 Embodied water in construction and deconstruction processes** **Calculation and Rating**

	Regarding a complete water use of a building`s Life Cycle, embodied water from building materials and construction / deconstruction processes should be considered. The sub indicators 1.11.1 and 1.11.2 should be included into calculations as soon as respective data is available. **1.11.1 Embodied water in building materials (NOT ASSESSED)** To calculate the embodied water in building materials, the same system boundaries as in the LCA-based indicators do apply. As far as possible, respective data provided by LCA databases is used. The indicator should be expressed in [$m^3/(m^2_{NFA}*a)$]. Due to these data issues, assessment and rating can not be determined at this stage. **1.11.2 Embodied water in construction and deconstruction processes (NOT ASSESSED)** As far as possible, embodied water in construction and deconstruction processes should be collected and summed up. The indicator should be expressed in [$m^3/(m^2_{NFA}*a)$]. Due to data issues, assessment and rating cannot be determined at this stage.
Rating	Sub Indicator Weighting 4
References	Refer to the References Section
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	DGNB 14 – Freshwater Demand

ENV.LU.05 (1.12)	**Site Location - Change of land use (n/a)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Environmental	Land Use		S		N
GENERAL						
Description	The constant increase in traffic and settlement areas shall be reduced. Preferably, areas shall be used that are already assigned as traffic or settlement areas or that are allocated for the recovery of contaminated locations. This indicator supports the European Commission target to achieve a more rational use of soil, requiring Member States to take appropriate measures to limit sealing by rehabilitating brownfield sites and to mitigate its effects by using construction techniques that allow maintaining as many soil functions as possible.					
Background	Core Indicator adapted from LEED, BREEAM, DGNB/BNB					
References	[1], [2], [3], [4], [5]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify) Site Verification	x
Details	Based on the existing situation of the site prior to construction, the impact that the project has on the environment can vary from a positive change (remediation of brownfield) to a negative change (depletion of prime farmland or greenfield) Increasing the imperviousness of the site can have major repercussions on the site and its surroundings through the increase of water run-off. Strategies such as green roofs, pervious surfaces and reduction of hardscapes can be used to minimize the volume and rates of storm water run-off from the site. The overall permeability of the site can be determined by weighting the permeability of each area on the site. The following sub-indicator is assessed: **1.12.1: Site location**					
Areas covered	**1.12.1: Site location** This sub-indicator evaluates in which degree and in which sense the type of land use is changed by the construction project. Area is not “consumed”, but a usage-change of the area takes place. 1. The previous use of the area can be determined from the certificates of title or extracts from the land survey register. 2. The previous contamination (i.e. the initial level of pollution) of the property by contaminated sites, munitions, etc. can be determined based on available survey reports. 3. The implementation of compensatory measures can be identified based on available documents. 4. Based on the planning documents, it is checked if a green roof is planned, and can be approved as a compensation measure. 5. The type, extent, and direction of change of the actual use of the area are recorded and evaluated according to measuring specifications (change from					

	near-natural toward built-up = negative, respectively change from contaminated area toward built-up = positive). The actual type of use according to the land survey register is decisive for the evaluation.
Barriers	-
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below
SCALE	
Application	The Indicator can be applied at the neighbourhood scale.
Details	-
Multiscale	The Indicator can be applied at the neighbourhood scale.
References	References provided in the References Section Below

REFERENCES	
[1]	LEED 2009: Site 1 Site Selection and Site 3 Brownfield Redevelopment
[2]	BREEAM 2011: LE6 Reuse of land and LE7 Contaminated land
[3]	DGNB 2009: 15 Space Demand
[4]	BNB 2011: 1.2.4 Demand of Space
[5]	http://www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_124.pdf

<table>
<tr><td rowspan="2">ENV.LU.06
(1.12)</td><td colspan="4">Imperviousness Change, Imperviousness coefficient (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td></td><td>Environmental</td><td>Land Use</td><td>S</td><td>N</td></tr>
</table>

GENERAL	
Description	The constant increase in traffic and settlement areas shall be reduced. Preferably, areas shall be used that are already assigned as traffic or settlement areas or that are allocated for the recovery of contaminated locations. This indicator supports the European Commission target to achieve a more rational use of soil, requiring Member States to take appropriate measures to limit sealing by rehabilitating brownfield sites and to mitigate its effects by using construction techniques that allow maintaining as many soil functions as possible.
Background	Core Indicator adapted from LEED, BREEAM, DGNB/BNB
References	[1], [2], [3], [4], [5]
LEVEL	

Derived from						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details	Based on the existing situation of the site prior to construction, the impact that the project has on the environment can vary from a positive change (remediation of brownfield) to a negative change (depletion of prime farmland or greenfield) Increasing the imperviousness of the site can have major repercussions on the site and its surroundings through the increase of water run-off. Strategies such as green roofs, pervious surfaces and reduction of hardscapes can be used to minimize the volume and rates of storm water run-off from the site. The overall permeability of the site can be determined by weighting the permeability of each area on the site. The following sub-indicator is assessed: **1.12.2: Imperviousness changes**
Areas covered	**1.12.2: Permeability changes** **Note** 1.12.2: Imperviousness changes - Calculation of existing site and developed site imperviousness coefficient - Site plan indicating each type of surface's area and imperviousness coefficient
Barriers	-
Rating	Sub Indicator Weighting 2
References	References provided in the References Section Below
SCALE	
Application	The Indicator can be applied at the neighbourhood scale.
Details	-
Multiscale	The Indicator can be applied at the neighbourhood scale.
References	References provided in the References Section Below

REFERENCES	
[1]	LEED 2009: Site 1 Site Selection and Site 3 Brownfield Redevelopment
[2]	BREEAM 2011: LE6 Reuse of land and LE7 Contaminated land
[3]	DGNB 2009: 15 Space Demand
[4]	BNB 2011: 1.2.4 Demand of Space
[5]	http://www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_124.pdf

<table>
<tr><td rowspan="3">ENV.Im.29
(1.13)</td><td colspan="7">Recyclable Waste Storage (m^2)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td colspan="2">SCALE</td></tr>
<tr><td>Environmental</td><td colspan="2">Impacts</td><td colspan="2">S</td><td colspan="2">B</td></tr>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td>Description</td><td colspan="7">To recognize the provision of dedicated storage facilities for a building’s operational-related recyclable waste streams, so that such waste is diverted from landfill or incineration.
To encourage the provision of facilities that help facilitate the reduction in volume of compostable organic waste going directly to landfill during the building’s operation.
This supports the objectives of current EU waste policy: to prevent waste and promote re-use, recycling and recovery so as to reduce the negative environmental impact[1]. The targets for the recycling of waste are: 50% of household waste and 70% for construction and demolition waste recycled by 2020.</td></tr>
<tr><td>Background</td><td colspan="7">Core Indicator adapted from BREEAM, LEED, HQE</td></tr>
<tr><td>References</td><td colspan="7">[1], [2], [3]</td></tr>
<tr><td colspan="8">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify) Site Verification</td><td>x</td><td></td></tr>
<tr><td>Details</td><td colspan="7">This indicator assesses the provision of space for sorting and storage of solid wastes within the case-study building, which will likely affect the success of waste-minimization programs during operation.

The following sub-indicators is assessed:
1.13.1 Recyclable Waste Storage.</td></tr>
<tr><td>Areas covered</td><td colspan="7">Calculation and Rating

1.13.1 Recyclable Waste Storage

Requirements
The compliance with the following two requirements is evaluated:
1. A dedicated storage space to cater for recyclable materials generated by the building during occupation, compliant with the following:
a. Clearly labelled for recycling
b. Placed within accessible reach of the building
c. In a location with good vehicular access to facilitate collections.
2. The size of the space allocated must be adequate to store the likely volume of recyclable materials generated by the building’s occupants/operation. The following must be complied with as a minimum:
a. At least 2 m_2 per 1000 m_2 of net floor area for buildings <5000 m_2
b. A minimum of 10 m_2 for buildings ≥5000 m_2
c. An additional 2 m_2 per 1000 m_2 of net floor area where catering is provided (with an additional minimum of 10 m_2 for buildings ≥5000 m_2).</td></tr>
<tr><td>Barriers</td><td colspan="7">-</td></tr>
<tr><td>Rating</td><td colspan="7">Sub Indicator Weighting 4</td></tr>
<tr><td>References</td><td colspan="7">References provided in the References Section Below</td></tr>
</table>

SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	BREEAM 2011: Wst 3 - Recyclable Waste Storage and Wst 5 – Composting
[2]	LEED 2009: Materials Pre 1 Storage and Collection of Recyclables
[3]	HQE 2012: 6.1. Optimising the recycling of operational waste and 6.2. Quality of the operational waste management system

<table>
<tr><td rowspan="3">ENV.Im.27
(1.13)</td><td colspan="4">Composting (n/a)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Impacts</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">To recognize the provision of dedicated storage facilities for a building’s operational-related recyclable waste streams, so that such waste is diverted from landfill or incineration.
To encourage the provision of facilities that help facilitate the reduction in volume of compostable organic waste going directly to landfill during the building’s operation.
This supports the objectives of current EU waste policy: to prevent waste and promote re-use, recycling and recovery so as to reduce the negative environmental impact[1]. The targets for the recycling of waste are: 50% of household waste and 70% for construction and demolition waste recycled by 2020.</td></tr>
<tr><td>Background</td><td colspan="4">Core Indicator adapted from BREEAM, LEED, HQE</td></tr>
<tr><td>References</td><td colspan="4">[1], [2], [3]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | | Empirical/Literature | | Other (specify) Site Verification | x</td></tr>
<tr><td>Details</td><td colspan="4">This indicator assesses the provision of space for sorting and storage of solid wastes within the case-study building, which will likely affect the success of waste-minimization programs during operation.

The following sub-indicators is assessed:
1.13.2 Composting
.</td></tr>
<tr><td>Areas covered</td><td colspan="4">1.13.2 Composting
When no compostable waste is produced within the building, this sub-indicator is not evaluated. In that case, the score achieved for this indicator is the score achieved for the sub-indicator 1.13.1
The compliance with one of the two following options is evaluated:
Option 1: onsite composting
1. A vessel is installed on site for composting suitable food waste resulting from the building’s daily operation and use.
2. There is adequate space for storing segregated food waste and composted organic material.
3. At least one water outlet is provided for cleaning in and around the facility.
OR
Option 2: offsite composting
1. There is a dedicated segregated space for storing compostable food waste prior to collection and delivery to an alternative composting facility.
2. At least one water outlet is provided for cleaning in and around the facility.</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Rating</td><td colspan="4">Sub Indicator Weighting 4</td></tr>
<tr><td>References</td><td colspan="4">References provided in the References Section Below</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.</td></tr>
</table>

Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below

REFERENCES	
[1]	BREEAM 2011: Wst 3 - Recyclable Waste Storage and Wst 5 – Composting
[2]	LEED 2009: Materials Pre 1 Storage and Collection of Recyclables
[3]	HQE 2012: 6.1. Optimising the recycling of operational waste and 6.2. Quality of the operational waste management system

<table>
<tr><td rowspan="3">ENV.En.03
(1.14)</td><td colspan="8">Stairs and Ramps Planning (n/a)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td colspan="2">SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Energy</td><td colspan="2">S</td><td colspan="2">B</td></tr>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td>Description</td><td colspan="8">There is already about 4,8 million lifts, as well as about 75 thousand escalators and moving walks installed in the EU-27. Their energy consumption adds up to 3 to 5 % of the overall consumption of a building.
The objective is to reduce the energy consumption of the vertical transportation systems through:
- encouraging the use of stairs and ramps in preference to lifts, escalators and moving walks
- encouraging the specification of energy efficient lifts, escalators and moving walks</td></tr>
<tr><td>Background</td><td colspan="8">Indicator adapted from BREEAM, EN ISO 25745</td></tr>
<tr><td>References</td><td colspan="8">[1], [2]</td></tr>
<tr><td colspan="9">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td><td colspan="2"></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify) Site Verification</td><td>x</td><td colspan="2"></td></tr>
<tr><td>Details</td><td colspan="8">The planning of the building to encourage the use of stairs and ramps will be assessed, as well as the design and efficiency of the lifts, escalators and moving walks. Buildings where none of these systems are present meet the requirements of this indicator by default as there is no energy consumption associated with them.
If no lifts or escalators are present then this indicator is not assessed and full points are given.
The following sub-indicator is assessed:
1.14.1 Stairs and ramps planning</td></tr>
<tr><td>Areas covered</td><td colspan="8">Calculation and Rating
The points achieved in 1.14.2 and 1.14.3 are calculated only for those systems present in the building. Systems not present in the building are excluded from the calculation. For example, if the building has only one of these systems (e.g. lifts are present but no escalators nor moving walks), then only the points achieved for the lifts are taken into account. If more than one of these is present, then the number of points for these systems which are present is awarded.
If none of these systems are present, there will be no energy consumption associated with them. Therefore full points for the indicator 1.14 will be achieved.

1.14.1 Stairs and ramps planning
This sub-indicator assesses the easiness of using stairs and ramps to access different levels of the building. It focuses on the visibility and attractiveness of the stairs and ramps in comparison to the lifts. The energy use of lifts, escalators and moving walks can be reduced considerably if ‘energy-free’ alternative means of travelling to different levels within the building can be used. Making stairs and ramps more visible and appealing than lifts will encourage its use, reducing the energy consumption of lifts.</td></tr>
</table>

	The benefit of visible and easily accessible stairs and ramps is particularly relevant to the first few floors and to inter-floor traffic in any building, regardless of it being high rise or lower rise. However, the impact will be greater in lower rise buildings as there will be proportionally more floors where traffic can be diverted from the lifts to the stairs. The following requirements are used to assess this indicator: 1. Stairs/ramps are visible from building entrance or they can be seen before the lift AND Stairs/ramps are see-through or open throughout the occupied floors of the building. Alternatively, if this is not possible (e.g. due to fire separation requirements), they are expressed in a way that they are easily identified and architecturally appealing to building users 2. Travel distance from entrance to the stairs or ramps is less than to the lifts.
Barriers	**The points achieved in 1.14.2 and 1.14.3 are calculated only for those systems present in the building.** Systems not present in the building are excluded from the calculation. For example, if the building has only one of these systems (e.g. lifts are present but no escalators nor moving walks), then only the points achieved for the lifts are taken into account. If more than one of these is present, then the number of points for these systems which are present is awarded. **If none of these systems are present, there will be no energy consumption associated with them. Therefore full points for the indicator 1.14 will be achieved.**
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below
SCALE	
Application	The Indicator can be applied at the building scale.
Details	-
Multiscale	The Indicator can be applied at the building scale.
References	References provided in the References Section Below

REFERENCES	
[1]	EN ISO 25745: Energy performance of lifts, escalators and moving walks (joint standardization work between ISO and CEN). Part 1 defines the measurement and verification method and related tools for energy consumption. Part 2 covers the energy efficiency for lifts, including energy classification for lifts. Part 2 covers the energy efficiency for escalators and moving walks, including energy classification for escalators and moving walks.
[2]	BREEAM Europe Commercial 2009: Ene 8 - Lifts and Ene 9 - Escalators and travelling walks

<table>
<tr><td rowspan="3">ENV.En.02
(1.14)</td><td colspan="4">Lift Design and Efficiency (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Energy</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">There is already about 4,8 million lifts, as well as about 75 thousand escalators and moving walks installed in the EU-27. Their energy consumption adds up to 3 to 5 % of the overall consumption of a building.
The objective is to reduce the energy consumption of the vertical transportation systems through:
- encouraging the use of stairs and ramps in preference to lifts, escalators and moving walks
- encouraging the specification of energy efficient lifts, escalators and moving walks</td></tr>
<tr><td>Background</td><td colspan="4">Indicator adapted from BREEAM, EN ISO 25745</td></tr>
<tr><td>References</td><td colspan="4">[1], [2]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | | Empirical/Literature | | Other (specify) Site Verification | x</td></tr>
<tr><td>Details</td><td colspan="4">The planning of the building to encourage the use of stairs and ramps will be assessed, as well as the design and efficiency of the lifts, escalators and moving walks. Buildings where none of these systems are present meet the requirements of this indicator by default as there is no energy consumption associated with them.
If no lifts or escalators are present then this indicator is not assessed and full points are given.
The following sub-indicator is assessed:
1.14.2 Lifts design and efficiency</td></tr>
<tr><td>Areas covered</td><td colspan="4">Calculation and Rating
The points achieved in 1.14.2 and 1.14.3 are calculated only for those systems present in the building. Systems not present in the building are excluded from the calculation. For example, if the building has only one of these systems (e.g. lifts are present but no escalators nor moving walks), then only the points achieved for the lifts are taken into account. If more than one of these is present, then the number of points for these systems which are present is awarded.
If none of these systems are present, there will be no energy consumption associated with them. Therefore full points for the indicator 1.14 will be achieved.

1.14.2 Lifts design and efficiency
This sub-indicator assesses the design and efficiency of the lifts with a focus on energy efficiency.
If EN ISO 25745-2 available
If the average energy efficiency class for all the lifts in the building is available as defined by EN ISO 25745-2, the points will be given according to the class achieved: A, B, C, D, E, F, G
If EN ISO 25745-2 not available
If the energy efficiency class as defined by EN ISO 25745-2 is not available for</td></tr>
</table>

	all the lifts, the points will be given according to the achievement of the following requirements: i. The total weight of the car (including frame, finishes and associated equipment) doesn't exceed 60% of the rating of the lift (i.e. nominal load). ii. The lifts operate in a standby mode during off-peak and idle periods. For example, the power side of the lift controller and other auxiliary equipment such as lift car lighting and ventilation fan switch off when the lift is not in motion. iii. Lift motors use a drive controller capable of variable-speed, variable-voltage, variable-frequency control of the drive motor. iv. The lift car uses energy-efficient lighting and display lighting (>60 lumens/watt or fittings that consume less than 5W e.g. LEDs). v. Where it is proved to be beneficial from the energy saving point of view, the lift has a regenerative unit so that energy generated by the lift (due to running up empty and down full) is returned back to the grid or used elsewhere on site. vi. The lift cars (or lift shafts) do not require air conditioning or heating
Barriers	**The points achieved in 1.14.2 and 1.14.3 are calculated only for those systems present in the building.** Systems not present in the building are excluded from the calculation. For example, if the building has only one of these systems (e.g. lifts are present but no escalators nor moving walks), then only the points achieved for the lifts are taken into account. If more than one of these is present, then the number of points for these systems which are present is awarded. **If none of these systems are present, there will be no energy consumption associated with them. Therefore full points for the indicator 1.14 will be achieved.**
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below
SCALE	
Application	The Indicator can be applied at the building scale.
Details	-
Multiscale	The Indicator can be applied at the building scale.
References	References provided in the References Section Below

REFERENCES	
[1]	EN ISO 25745: Energy performance of lifts, escalators and moving walks (joint standardization work between ISO and CEN). Part 1 defines the measurement and verification method and related tools for energy consumption. Part 2 covers the energy efficiency for lifts, including energy classification for lifts. Part 2 covers the energy efficiency for escalators and moving walks, including energy classification for escalators and moving walks.
[2]	BREEAM Europe Commercial 2009: Ene 8 - Lifts and Ene 9 - Escalators and travelling walks

<table>
<tr><td rowspan="2">ENV.En.01
(1.14)</td><td colspan="4">Escalators and moving walks design and efficiency (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td></td><td>Environmental</td><td>Energy</td><td>S</td><td>B</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">There is already about 4,8 million lifts, as well as about 75 thousand escalators and moving walks installed in the EU-27. Their energy consumption adds up to 3 to 5 % of the overall consumption of a building.
The objective is to reduce the energy consumption of the vertical transportation systems through:
- encouraging the use of stairs and ramps in preference to lifts, escalators and moving walks
- encouraging the specification of energy efficient lifts, escalators and moving walks</td></tr>
<tr><td>Background</td><td colspan="4">Indicator adapted from BREEAM, EN ISO 25745</td></tr>
<tr><td>References</td><td colspan="4">[1], [2]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from
(Check – X - as appropriate)</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [ ] | Empirical/Literature [ ] | Other (specify) Site Verification [x]</td></tr>
<tr><td>Details</td><td colspan="4">The planning of the building to encourage the use of stairs and ramps will be assessed, as well as the design and efficiency of the lifts, escalators and moving walks. Buildings where none of these systems are present meet the requirements of this indicator by default as there is no energy consumption associated with them.
If no lifts or escalators are present then this indicator is not assessed and full points are given.
The following sub-indicator is assessed:
1.14.3 Escalators and moving walks design and efficiency</td></tr>
<tr><td>Areas covered</td><td colspan="4">Calculation and Rating
The points achieved in 1.14.2 and 1.14.3 are calculated only for those systems present in the building. Systems not present in the building are excluded from the calculation. For example, if the building has only one of these systems (e.g. lifts are present but no escalators nor moving walks), then only the points achieved for the lifts are taken into account. If more than one of these is present, then the number of points for these systems which are present is awarded.
If none of these systems are present, there will be no energy consumption associated with them. Therefore full points for the indicator 1.14 will be achieved.

1.14.3 Escalators and moving walks design and efficiency
This sub-indicator assesses the efficiency of escalators and moving walks.
If EN ISO 25745-3 available
If the average energy efficiency class for all the escalators and moving walks in the building is available as defined by EN ISO 25745-3, the points will be given according to the class achieved: A+++, A++, A+, A, B, C, D, E.
If EN ISO 25745-3 not available
If the energy efficiency class as defined by EN ISO 25745-3 is not available for all the lifts, the points will be given according to the achievement of the</td></tr>
</table>

	following requirements: i. The escalators and moving walks are fitted with a load sensing device that synchronizes motor output to passenger demand through a variable speed drive ii. The escalators and moving walks are fitted with a passenger sensing device for automated operation, so they operate in standby mode when there is no passenger demand. iii. The escalators and moving walks do not have handrail lighting.
Barriers	**The points achieved in 1.14.2 and 1.14.3 are calculated only for those systems present in the building.** Systems not present in the building are excluded from the calculation. For example, if the building has only one of these systems (e.g. lifts are present but no escalators nor moving walks), then only the points achieved for the lifts are taken into account. If more than one of these is present, then the number of points for these systems which are present is awarded. **If none of these systems are present, there will be no energy consumption associated with them. Therefore full points for the indicator 1.14 will be achieved.**
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below
SCALE	
Application	The Indicator can be applied at the building scale.
Details	-
Multiscale	The Indicator can be applied at the building scale.
References	References provided in the References Section Below

REFERENCES	
[1]	EN ISO 25745: Energy performance of lifts, escalators and moving walks (joint standardization work between ISO and CEN). Part 1 defines the measurement and verification method and related tools for energy consumption. Part 2 covers the energy efficiency for lifts, including energy classification for lifts. Part 2 covers the energy efficiency for escalators and moving walks, including energy classification for escalators and moving walks.
[2]	BREEAM Europe Commercial 2009: Ene 8 - Lifts and Ene 9 - Escalators and travelling walks

ENV.Im.24 (1.15)	**Abiotic Depletion Potential, ADP elements (kg SB-E /m²)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Impacts	S	B

GENERAL	
Description	Abiotic resources are found in nature that has not been subjected to any mining or transformation process into final products. The indicator Contribution to the depletion of abiotic resources - non fossil fuels, figures the contribution of the building to reducing the quantity of mineral resources available.
Background	Core Indicator adapted from EN 15978
References	Give valid references for English speaking readers to get further insight on the indicator. Supply references as numbers in brackets. The corresponding full reference will be supplied in the section “REFERENCES”.

LEVEL						
Derived from	Software tool	X	Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	

Details	The indicator is mainly based on the method of Life Cycle Assessment (LCA): LCA results of the building to be assessed will be calculated in a standardized way and evaluated against benchmarks. Thus Abiotic Depletion Potential for non-renewable resources is a quantitative indicator. According to the standards EN 15804 and EN 15978, the method of Life-Cycle Assessment generally consists of four steps: Definition of goal and scope of the study, inventory analysis, impact assessment and interpretation. The indicators 1.1-1.5, 1.9-1.10 and 1.15 are based on LCAs and for all these indicators the same definitions for goal and scope and for the inventory analysis do apply.
Areas covered	**Calculation** When calculating the non-renewable primary energy demand for the building, the following calculation rules must be followed: **Abiotic Depletion Potential for “Designed Building”** According to figure the $ADP_{element}$ for the building life cycle is composed of the contribution to the abiotic resource depletion caused during the different life cycle stages of the building. $\mathbf{ADP_{element,LC} = (ADP_{element,pr} + ADP_{element,C} + ADP_{element,0} + ADP_{element,eol})/NFA}$ **(1)** where $\mathbf{ADP_{element,LC}}$ Abiotic depletion potential of the building during the life cycle of the entire building, $\mathbf{ADP_{element,pr}}$ Contribution of the building construction products for the product stage (from cradle to gate), $\mathbf{ADP_{element,C}}$ Contribution of the building construction products and temporary construction works during the construction stage of the building, $\mathbf{ADP_{element,0}}$ Contribution of the building construction product for maintenance, repair and change of products during the operational stage, $\mathbf{ADP_{element,eol}}$ Contribution of the building construction products during the end of life stage (deconstruction, material segregation and transportation to final destination), $\mathbf{ADP_{element,LC}}$ Contribution of the building construction products for the product stage (from cradle to gate), NFA Net Floor Area of the building. **Rating Method** The “designed building” is rated against a case-specific reference building.

	Abiotic Depletion Potential for "Reference Building" Calculation for the $ADP_{Element, Ref}$ for the building life cycle is composed of the contribution to the abiotic resource depletion caused during the different life cycle stages of the building. $ADP_{element,Ref,LC} = (ADP_{element,Ref,pr} + ADP_{element,Ref,C} + ADP_{element,Ref,0} + ADP_{element,Ref,eol})/NFA$ **(2)** where **$ADP_{element\ Ref,LC}$** Abiotic depletion potential of the building during the life cycle of the entire building, **$ADP_{element\ Ref,pr}$** Contribution of the building construction products for the product stage (from cradle to gate), **$ADP_{element\ Ref,c}$** Contribution of the building construction products and temporary construction works during the construction stage of the building, **$ADP_{element,Ref,0}$** Contribution of the building construction product for maintenance, repair and change of products during the operational stage, **$ADP_{element,Ref,eol}$** Contribution of the building construction products during the end of life stage (deconstruction, material segregation and transportation to final destination), NFA Net Floor Area of the building. The reference values for $ADP_{element,Ref,LC}$ can be extracted from Table1 and Table2. These tables show reference values for both assessment types – "Quick and Basic" assessment and "Complete" assessment.
Barriers	-
Rating	Sub Indicator Weighting 4
References	References provided in the References Section Below
SCALE	
Application	The Indicator can be applied at the building scale but can also be applied at the neighbourhood scale for more buildings.
Details	-
Multiscale	It is possible to apply the indicator for the single building scale and also to a group of buildings of similar function.
References	References provided in the References Section Below
REFERENCES	
[1]	ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
[2]	ISO 14044: 2006-10: Environmental management – Life cycle assessment – Requirements and guidelines. International Organization for Standardization.
[3]	FprEN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
[4]	prEN 15804: 2010: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. European Committee for Standardization CEN.
[5]	Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and

	amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[6]	Kreißig, J., Binder, M. (2007): Methodische Grundlagen- Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktualisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen“ (AZ 10.06.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp.
[7]	United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf.
[8]	Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building. Eigenverlag, 2001.
[9]	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
[10]	VDI 2067: Economic efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

A.11 – SuPerBuildings

Project cofinanced by the European Regional Development Fund (ERDF)

SuPerBuildings

Sustainability and Performance assessment and benchmarking of Buildings

http://cic.vtt.fi/superbuildings/

Sustainability and Performance assessment of Buildings – SuPerBuildings

SuPerBuildings (2010-2012) was project developed and selected sustainability indicators for buildings; improved the understanding about performance levels considering new and existing buildings, different building types and different national and local requirements; developed methods for the assessment and benchmarking of sustainable buildings; and made recommendations for the effective use of benchmarking systems as instruments of steering and in different stages of building projects.

The framework for the assessment of environmental, social and economic performance is being developed within CEN and ISO. SuPerBuildings considered the output of the standardization processes and focused on the development of the validity of sustainable building indicators, comparability of assessment results, benchmarking criteria and the usability of indicators in building processes. The project also provided recommendations for the improvement of standards.

INDICATORS

<table>
<tr><td rowspan="2">ENV.En.12</td><td colspan="4">Consumption of non-renewable primary energy (kWh/m² yr)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td></td><td>Environmental</td><td>Energy</td><td>S</td><td>B/ N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Sum of amounts of non-renewable energies used all along the life cycle of the building, expressed in primary energy. This is a quantitative indicator. Fossil and nuclear fuels are mainly concerned, including electricity based on these fuels.
Primary energy means energy which has not undergone any conversion or transformation process.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
</table>

Derived from						
	Software tool		Operational data		In situ measurements	X
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

Definition:
For transparency and decision-aid purposes, it is useful to be able to distinguish the calculation/ measure of:

- Embodied energy in the life cycle of construction products (production, construction, use, end of- life), considering the replacement of certain products during the service life of the building
- Energy consumed during the operation phase due to the building itself (building-related energy uses, with separation of EPBD uses and others (e.g. energy use of lifts, water pump for rain water use, ...), see EN 15978)
- Energy consumed during the operation phase due to activity-related equipment (non-building related, optional in design phase, e.g. washing machines, cooking, ...)
- Energy linked to transportation of persons due to the location / urban context of the building (optional)
- Energy embodied in water-related services during the operation phase (provision of drinkable water, treatment of waste water), distinguishing building-related and non-building related water uses (optional)

All these amounts of energy should be converted into primary energy, whatever the source of energy may be, and expressed for one year (for embodied energy it is necessary to divide the total embodied energy by the service life of the building).
Considering the efforts made and to be made on the reduction of energy consumed during the operation phase, embodied energy in construction products is not negligible, as well as energy due to activity-related equipment.

Measurement unit
kWh_{pe} / m^2 year or MJ_{pe} / m^2 year
pe stands for primary energy
m^2 net floor area (but this definition varies according to the countries)
Energy is based on the net calorific value

Classification
Classes may be defined, linked to the national context (climate, policy objectives) and type of building. Confusion must be avoided with energy labels existing for operational energy.

Areas covered: Building/site/location area

Barriers

- Need database with embodied energy of construction products, based on LCA, and related tool in order to facilitate calculation. Limits come from the lack of available EPDs of construction products and related databases. EPDs on technical equipment (heating, etc.) are often lacking.
- The quantities of materials included in a building are not always available and complete, or are expressed in units not directly compatible with those used in EPDs.
- If dynamic simulation is chosen, adequate software is needed, knowing that it is relatively time-consuming.
- It is difficult to separate energy consumed for the building itself (heating, lighting, etc.) and the one for activities (computers, cooking, etc.) when energy metering is not specific per use.

Weighting	As this indicator is a quantitative sum of kWh, no weighting or aggregation is necessary. If the intention is to go further and express an indicator in terms of depletion of non-renewable resources, some conversion or weighting factors should be used in order to be able to sum results from different energy sources.
References	
SCALE	
Application	Building/site/location
Details	--
Multiscale	--
References	--
REFERENCES	
[1]	Sustainability and performance assessment and benchmarking of buildings http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf

<table>
<tr><td rowspan="3">ENV.Wa.01</td><td colspan="6">Embodied water use (m^3/m^2 yr)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Water</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">On-site water management that aims at limiting the depletion of fresh water resources.</td></tr>
<tr><td>Background</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Definition:
Water necessary to produce, build, use, maintain and dispose of the building materials/equipment and the outdoor constructions on the building site.
Contribution of building materials and equipment to the total water consumption.

Measurement unit

m^3/functional unit (e.g. m^2 net floor area) calculated either per year or total amount for the whole life cycle of the building

Classification:
The values of the indicators are compared to the typical values obtained for the building type in question and a score is given based on the water saving levels obtained.

Calculation method:
Lifecycle inventory of water use (EN 15978: m^3 of fresh water)</td></tr>
<tr><td>Areas covered</td><td colspan="6">Building/site areas</td></tr>
<tr><td>Barriers</td><td colspan="6">A database on embodied water use is needed for all building materials and equipment's and a tool to analyse the data on the building level. Due to a lack of data, this indicator may be difficult to evaluate at the moment. However, some databases exist with embodied water data, as INIES in France, or Ecoinvent for generic data.</td></tr>
<tr><td>Weighting</td><td colspan="6">For the embodied water use, aggregation can be carried out by water type (e.g. drinking water, rain water,). Or, if a total sum of all water consumed is required, different types of water can eventually be aggregated using weighting factors based on the quality of the water. In any case, it is recommended to provide operational drinking water use separately from other water consumption as this number is needed to evaluate operational costs of the building.</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Building/site scale</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
<tr><td colspan="7">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="6">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.Wa.03</td><td colspan="4">Operational water use (m^3/yr)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Water</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">On-site water management that aims at limiting the depletion of fresh water resources.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] Operational data [ ] In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] Empirical/Literature [ ] Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">Definition:
Water use of the building-integrated technical systems and of the user, as needed for the technically and functionally defined operation of the building.
Measurement unit
m^3/time unit (e.g. year or day)/person (e.g. per full time equivalent or per inhabitant) or m^3/time unit (e.g. year or day)/functional unit (e.g. m2 net floor area)
Classification:
The values of the indicators are compared to the typical values obtained for the building type in question and a score is given based on the water saving levels obtained.
Calculation method:
Calculation of total (drinking) water consumption based on the characteristics of the chosen water consuming building related appliances (and eventually also non-building related appliances like washing machines) and scenarios for water use (e.g. number of flushes per day, amount of water for irrigation).</td></tr>
<tr><td>Areas covered</td><td colspan="4">Building/site areas</td></tr>
<tr><td>Barriers</td><td colspan="4">Water consumption (technical information) of appliances is needed, as well as estimations of typical patterns of use (scenarios) for different building types/users and eventually a tool to easily calculate the amount of water used based on the chosen appliances and patterns of use. Taking into account the amount of rainwater that can be used within the building requires a tool to dimension and evaluate the efficiency of the rainwater collection system based on average rainfalls within the considered region, technical characteristics of the rainwater collection system (volume of the water tank, efficiency of filters, ...) and estimated operational water needs of the building.</td></tr>
<tr><td>Weighting</td><td colspan="4">For the operational water use, aggregation can be carried out by water type (e.g. drinking water, rain water,). Or, if a total sum of all water consumed is required, different types of water can eventually be aggregated using weighting factors based on the quality of the water. In any case, it is recommended to provide operational drinking water use separately from other water consumption as this number is needed to evaluate operational costs of the building.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Building/site scale</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.Wa.15</td><td colspan="8">Waste water management (m^3/m^2 yr)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td colspan="2">SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Water</td><td colspan="2">S</td><td colspan="2">B / N</td></tr>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td>Description</td><td colspan="8">On-site water management that aims at limiting the depletion of fresh water resources.</td></tr>
<tr><td>Background</td><td colspan="8">--</td></tr>
<tr><td>References</td><td colspan="8">[1]</td></tr>
<tr><td colspan="9">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td>X</td><td colspan="2"></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td><td colspan="2"></td></tr>
<tr><td>Details</td><td colspan="8">Definition
Evacuation of wastewater and excess rainwater from the building site to the public sewage system.

Measurement unit
m^3/functional unit (e.g. m2 net floor area) /year or m^3/person (e.g. per full time equivalent or per inhabitant)/year

Classification:
The values of the indicators are compared to the typical values obtained for the building type in question and a score is given based on the water saving levels obtained.

Calculation method:
Assessment of the amount of water evacuated to the sewage system based on estimated operational water use (minus water “consumed” onsite for example for irrigation), excess rainwater and onsite water recycling.</td></tr>
<tr><td>Areas covered</td><td colspan="8">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="8">In addition to data and tools needed for the calculation of the operational water use, additional tools are needed to dimension and evaluate the efficiency of possible infiltration systems so that amounts of excess rainwater that need to be evacuated through the sewage system can also be evaluated, and tools to evaluate the amount of water that will be evacuated by onsite waste water treatment equipment’s.</td></tr>
<tr><td>Weighting</td><td colspan="8">The total amount of water evacuated through the sewage system is the sum of the excess rainwater and waste water that is evacuated to the sewage. A lower weighting factor can eventually be used for rainwater as it has lower levels of pollution compared to wastewater and a lower factor can certainly be used in case that rainwater is evacuated through a separate system (not mixed with the wastewater).</td></tr>
<tr><td>References</td><td colspan="8"></td></tr>
<tr><td colspan="9">SCALE</td></tr>
<tr><td>Application</td><td colspan="8">Building / site</td></tr>
<tr><td>Details</td><td colspan="8">--</td></tr>
<tr><td>Multiscale</td><td colspan="8">--</td></tr>
<tr><td>References</td><td colspan="8">--</td></tr>
<tr><td colspan="9">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="8">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.LU.04</td><td colspan="4">Permeability of site / land (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Land Use</td><td>A</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The indicator refers to the land that is used for buildings.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [X] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [ ] | Empirical/Literature [ ] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">Definition

Soil sealing occurs because of covering earth with non-permeable or low-permeable layers as a result of construction works (roads, buildings, parking etc.). The indicator measures the degree of soil sealing on a building plot. Normally the figure does not refer to the whole area of the building plot, but only to the area which is not built-on or which is not permitted to build on. The reason for that is that during the planning and building process especially the design of those areas can be influenced.

Measurement unit
The level of soil sealing is normally given as a ratio of areas (percentage or m^2 / m^2). Examples:
In Austria, the figure indicating the level of soil sealing is the “area free of soil sealing [m^2]” divided by the “area not built-on [m^2]” and is given as a percentage. It must be calculated for each plot; the higher the percentage is the better.
In Germany, the level of soil sealing is calculated by dividing the “sealed area [m^2]” by the “area not permitted to build on [m^2]”.
Classification:
The assessment result of a building is the better the less of a building plot is sealed.
Calculation method:
Quantitative assessment of area ratios</td></tr>
<tr><td>Areas covered</td><td colspan="4">Building / site</td></tr>
<tr><td>Barriers</td><td colspan="4">Land use is dealt with on local or community level and there is a lack of superior planning institutions. Each municipality has their own requirements for the level of soil sealing and is responsible for the designation of areas. In order to enable sustainable development in the field of land use, spatial planning should be dealt with on superior level.</td></tr>
<tr><td>Weighting</td><td colspan="4">There is no common way of weighting and aggregating the land use sub-indicators.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Building / site</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

<table>
<tr><td rowspan="2">ENV.LU.05</td><td colspan="4">Change of land use (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td></td><td>Environmental</td><td>Land Use</td><td>S</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">The indicator refers to the land that is used for buildings.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | </td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | Other (specify) | </td></tr>
<tr><td>Details</td><td colspan="4">Definition

As stated in ISO 21929-1:2011, “This indicator measures the avoidance of consuming of greenfield lands through the reuse of brownfield and derelict areas, refurbishment, using infill sites and redevelopment of existing built environment.”
Measurement unit

The type of land used is given as a qualitative description (e.g. use of an existing building, recycling of a previous building plot, development of new building areas, etc.).
Examples (from best to worst case):
- Use of contaminated land (after decontamination)
- Use of an existing building or recycling of a building plot / brownfield site
- Building on already developed sites inside of an existing housing settlement
- Building on plots defined as building areas in addition to an existing housing settlement
- Development of new building areas (provision of services necessary)
- Building on re-designated, ecologically valuable areas

Classification:
The assessment result is the better, the lower the ecological value of a building plot is.
Calculation method:
Qualitative assessment of the type of land used</td></tr>
<tr><td>Areas covered</td><td colspan="4">Site areas</td></tr>
<tr><td>Barriers</td><td colspan="4">Land use is dealt with on local or community level and there is a lack of superior planning institutions. Each municipality has their own requirements for the level of soil sealing and is responsible for the designation of areas. In order to enable sustainable development in the field of land use, spatial planning should be dealt with on superior level.</td></tr>
<tr><td>Weighting</td><td colspan="4">There is no common way of weighting and aggregating the land use sub-indicators.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Site</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

<table>
<tr><td rowspan="2" colspan="2">ENV.Im.09</td><td colspan="6">Global warming potential (kg CO_2 / (m^2 yr)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2"></td><td colspan="2">Environmental</td><td colspan="2">Impacts</td><td>S / A</td><td>B / N</td></tr>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td colspan="2">Description</td><td colspan="6">Weighted sum of greenhouse gases because of the building including its operation</td></tr>
<tr><td colspan="2">Background</td><td colspan="6">--</td></tr>
<tr><td colspan="2">References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="8">LEVEL</td></tr>
<tr><td rowspan="2" colspan="2">Derived from</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td>X</td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td colspan="2">Details</td><td colspan="6">Definition

Greenhouse gases including at least CO_2, CH_4 and N_2O

Measurement unit
kg (or tones) per m^2 (net floor area) calculated either per year or total amount during the chosen period (the chosen period may be the service life of the building).

Classification:
When benchmarking, the value of the indicator is compared to the average (or typical) value of the building type in question considering the purpose of use and the age group of the building.</td></tr>
<tr><td colspan="2">Areas covered</td><td colspan="6">Building/site/location</td></tr>
<tr><td colspan="2">Barriers</td><td colspan="6">Applicable and relevant data base of carbon footprint of energy, water and materials and a calculation tool are needed.</td></tr>
<tr><td colspan="2">Weighting</td><td colspan="6">Weighting in terms of global warming potential (GWP).</td></tr>
<tr><td colspan="2">References</td><td colspan="6"></td></tr>
<tr><td colspan="8">SCALE</td></tr>
<tr><td colspan="2">Application</td><td colspan="6">Building/site/location</td></tr>
<tr><td colspan="2">Details</td><td colspan="6">--</td></tr>
<tr><td colspan="2">Multiscale</td><td colspan="6">--</td></tr>
<tr><td colspan="2">References</td><td colspan="6">--</td></tr>
<tr><td colspan="8">REFERENCES</td></tr>
<tr><td colspan="2">[1]</td><td colspan="6">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.Im.28</td><td colspan="6">Construction and demolition waste generation (kg/m^2)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Impacts</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Summary of construction and demolition waste generated through construction, refurbishment and end-of-life phases of the building life cycle</td></tr>
<tr><td>Background</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td>X</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Definition
Calculation of construction waste generated at the construction phase, construction and demolition waste generated by refurbishment/replacements, and demolition waste generated at the end of the life cycle when removing the building.
Sub-indicators:
- Non-hazardous waste to disposal
- Hazardous waste to disposal
- Nuclear waste to disposal
Measurement unit
kg/m^2 – amount of (each type of) waste per square meter of gross building area
Other possible units:
kg/m^2/year – amount of (each type of) waste per square meter of gross building area annualized for planned lifespan of building
% – percentage of construction and demolition waste for recycling or energy recovery (may be used as a way to evaluate waste management on site)
Classification:
The value of the indicator is compared to the average (or typical) value of the building type considering the purpose of use, new construction and reconstruction</td></tr>
<tr><td>Areas covered</td><td colspan="6">Building/site areas</td></tr>
<tr><td>Barriers</td><td colspan="6">- It depends on the availability of EPDs. When EPDs don’t cover all phases of life cycle (in EN 15804 only cradle to gate is mandatory, other phases are optional), it is necessary to define scenarios for the phases not covered, especially construction and end of-life.
- Time consuming
- Tracking amounts of waste leaving site and/or being produced on site and reused (landscaping). Hard to measure into detail.</td></tr>
<tr><td>Weighting</td><td colspan="6">The waste components can be combined, if one figure is needed. In this case, the amounts of different categories of waste can’t be simply summed up. Weighting factors are needed, for instance based on the cost of treatment / storage / management of each waste category. This cost evolves over time, and it may vary from one country to another, or from one region to another. The cost reflects more or less the efforts that it is necessary to make in order to limit the environmental impacts of the different categories of waste.
Another possibility: we may keep the result split into the 3 sub-indicators (corresponding to the 3 categories of waste), and let the experts who set the system for local conditions to set the weights within the whole system. The weighting system must reflect the potential environmental damage or risks (also on health) of each waste category.</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Building/site</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
<tr><td colspan="7">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="6">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.Im.30</td><td colspan="6">Water pollution due to material leaching (mg/m² yr)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Impacts</td><td>A</td><td>B / N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">On-site water pollution induced by the leaching phenomena (water contact with the built environment) during operation phase.</td></tr>
<tr><td>Background</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td>X</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Definition
A list of Regulated Dangerous Substances possibly associated with construction products under the CPD – Construction Product Directive / Regulation was established at European level [1]. The list is based on the database on legislation on dangerous substances relevant for construction products developed by the Commission in cooperation with Member States. This list indicates on which substances and parameters the evaluation should focus. The substances are listed in Annex A, List A “Soil and water” and structured as follows:
• A-1. Regulated dangerous substances in main pollutant categories of Directive 2000/60/EC (Water Framework Directive)
• A-2. Further regulated substances and parameters
• A-3. Other substances deemed relevant
Measurement unit
mg /m² exposed surface /time unit (e.g. year)
and/or mg /m² exposed surface /service life
Classification:
The specific requirements regarding the environmental compatibility of construction products will be defined nationally by the Member States. At present only few Member States have quantitative requirements on the release of regulated dangerous substances from construction products / construction works: The Netherlands and Germany.
Classification is not possible yet, as further work is necessary in order to establish the harmonized or specific limit values for each pollutant.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Building/site areas</td></tr>
<tr><td>Barriers</td><td colspan="6">Commercial and free models, databases and tools are available. Nevertheless, specialists are needed for data exploitation and interpretation and the process could be considered as time consuming. Moreover, no consensus exists presently on different scenarios or hypothesis to be defined.</td></tr>
<tr><td>Weighting</td><td colspan="6">The emissions of pollutants (cf. list of Dangerous Substances in [2]) into water should be evaluated via the CEN/TC 351 protocols. No aggregation is foreseen. For each pollutant, limit values are/will be defined at national level.</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Building / Site</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
<tr><td colspan="7">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="6">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
<tr><td>[2]</td><td colspan="6">European Commission. Enterprise and Industry Directorate-General. Chemicals and Construction. Construction. DS 041/051 rev.12. Indicative list of regulated dangerous substances possibly associated with construction products under the CPD, March 2012, 31p.</td></tr>
</table>

<table>
<tr><td rowspan="3">ENV.Im.01</td><td colspan="6">Eco-mobility potential of building in its context (km/ unit)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td colspan="2">Impacts</td><td colspan="2">S</td><td>B / N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">It refers to environmental impacts due to commuting transport, or daily journeys, of persons using the building, attributable to the building and its characteristics, including its location features.
From the location data of the building (urban context, distance from the building to key points), dana on the occupants and from statistical data (national or regional transport surveys), the number of journeys, mode of transport and environmental impacts are identified or calculated.
Eco-mobility potential of a building in its context could be an indicator on its own, but it is also considered as a contributor for other indicators. Transport is one contributor to the building environmental performances calculation. In LCA terms, transport of users during operation phase is one of the processes included within the system boundaries.</td></tr>
<tr><td>Background</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Definition
The transversal issue of the mobility is expressed through various indicators:
- It could be expressed as kilometres travelled by transportation mode as a mid-point indicator.
- Because occupants' mobility is considered as a contributor to the environmental performance of the building (as energy services, construction products, etc.), environmental profiles of each transport mode are associated to kilometres travelled. According to adopted standard and environmental data, the environmental indicators are the usual LCA ones: primary energy, greenhouse gas emissions, air pollution, waste, water consumption, etc.
- It would be possible to translate mobility in terms of time spent into transport as a social indicator. (not developed here)
Measurement unit
Mobility as an indicator:
- kilometres by transportation mode, by square meter or occupant, or by dwelling;
Mobility as a contributor:
- usual units for LCA indicators
Classification:
Currently, there is no method of classification for this contributor and no one at the building scale (sum of various contributors).</td></tr>
<tr><td>Areas covered</td><td colspan="6">Building/location areas</td></tr>
<tr><td>Barriers</td><td colspan="6">The challenge is in the availability of:
- Statistical data specific for the location of the building (in France there is 80 regional surveys dataset...but 36000 municipalities);
- Statistical data illustrating the influence of design elements on occupant's behaviour (bicycle park spaces, restricted number of car park spaces, etc.) or the close proximity of the building to a public transport stop (currently, there is no difference in the assessment results if the building is located 500 m or 5 m from a tram stop);
- Environmental data/profile for the different modes of transport for one person kilometre.</td></tr>
<tr><td>Weighting</td><td colspan="6">There is no need of aggregation of the different environmental impacts at the contributor scale. When a building is assessed from an LCA point of view, including construction products life cycle, energy and water operational services, if users' transport is also considered as a contributor, it is necessary to adopt coherent assumptions and the same units in order to have consistent, comparable and "aggregable" figures. However, it is recommended to keep results separated, so as to be able to clearly distinguish between impacts due to the building itself and those due to users' transport.</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
</table>

Application	Building / Location
Details	--
Multiscale	--
References	--
REFERENCES	
[1]	Sustainability and performance assessment and benchmarking of buildings http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf

<table>
<tr><td rowspan="3">SOC.AQ.01</td><td colspan="4">Concentrations of pollutants (µg/m³)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Air Quality</td><td>S</td><td>B / N</td></tr>
</table>

GENERAL	
Description	Indoor air quality is assessed in terms of concentration levels of pollutants.
Background	--
References	[1]

LEVEL

Derived from						
	Software tool	X	Operational data	X	In situ measurements	
	Simple Calculations		Empirical/Literature		Other (specify)	

Details

Definition

Several pollutants are considered. The different pollutants are considered and assessed independently from each other.

WHO gives guideline values for the following parameters of indoor air quality:

- Benzene: unit risk 1 µg/m³ $6x10^{-6}$
- carbon monoxide: 7mg/m³ (24 h)
- formaldehyde: 0.1 mg/m³ (30 min average)
- nitrogen dioxide: 200µg/m³ (1-hour average) and 40µg/m³ (annual average)
- PAH B[a]P (benzo-a-pyrene): unit risk for lung cancer 1 ng/m³ 8.7×10^{-5}
- Trichloroethylene: unit risk estimate µg/m³ 4.3×10^{-7}
- Tetrachloroethylene: 0.25 mg/m³ (annual average)
- radon excess: life time risk for non-smokers 0.6×10^{-5} Bq/m³ (and 15×10^{-5} for smokers)
- naphtalene: 0.01 mg/m³ (annual average)

WHO also gives guideline values for biological indoor air pollutants:

- dampness
- mould

In addition, CO_2 should be included.

Measurement unit

ppm or µg/m³ or RH (%) or cfu (colony forming unit)

Classification:

When benchmarking, the value of the indicator is compared to the average (or typical) value of the building type in question considering the purpose of use, corresponding ventilation requirement and occupant density.

Areas covered	Building / location areas
Barriers	- Commercial and free models and software are available. But in certain countries, such simulation tools are not broadly known and spread. - CO_2 and RH can be easily anticipated by calculation models (static or dynamic) but for chemical substances (formaldehyde, VOCs…), it is much more complex. - Equipments and standards are available. But in certain countries or regions, there is a lack of well-equipped laboratories.
Weighting	In each class, limit values are always defined for all parameters considered.
References	

SCALE	
Application	Building / location
Details	--
Multiscale	--
References	--

REFERENCES

[1] Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf

<table>
<tr><td rowspan="3">SOC.TC.01
SOC.TC.02</td><td colspan="4">Predicted Mean Vote, PMV (-)
Predicted Percentage Dissatisfied, PPD (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Thermal Comfort</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Indicators to describe hygro-thermal comfort in indoor environments.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
</table>

Derived from						
	Software tool	X	Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	

Details

Definition

PMV (Predicted Mean Vote):

It is an index defined in ISO 730:2005 that predicts the mean value of the votes of a large group of persons on the 7-point scale (+3 hot +2 warm +1 slightly warm 0 neutral -1 slightly cool -2 cool -3 cold), based on the heat balance of the human body. Thermal balance is obtained when the internal heat production in the body is equal to the loss of heat to the environment.

$$PMV = [\ 0.303\ .\ \exp(-0.036.M) + 0.028\ ]\ .\ L$$

where M = metabolic rate, L = thermal load

PPD (Predicted Percentage Dissatisfied):

Quantitative measure of the thermal comfort of a group of people under a particular thermal environment, also defined in ISO 730:2005.

$$PPD = 100 - 95\ .\ \exp(-0{,}03353.PMV^4 - 0{,}2179.\ PMV^2)$$

Operative temperature:

Uniform temperature of an imaginary black enclosure in which an occupant would exchange the same amount of heat by radiation and convection as in the actual nonuniform environment.

Percentage of hours outside a temperature range.

Air temperature

Percentage of hours outside a temperature range.

Relative Humidity (RH)

Air velocity

Measurement unit:

PMV (-3, +3)
PPD (%)
Operative temperature (degree Celsius)
Percentage of hours outside a temperature range
(% winter, % summer)
Air temperature (degree Celsius)
Percentage of hours outside a temperature range
(% winter, % summer)
RH (%)
Air velocity (m/s)

Classification:

Human's thermal sensation is mainly related to the thermal balance of the body as a whole. This balance is influenced by physical activity and clothing, as well as the environmental parameters. Numerous indices for the assessment and design of thermal comfort conditions have been developed during the past 50 to 60 years. One of the most widely used indices in moderate thermal environments, the PMV index (predicted mean vote), predicts the mean value of the overall thermal sensation of a large group of persons as a function of activity (metabolic rate), clothing insulation, and the four environmental parameters: air temperature, mean radiant

	temperature, air velocity, and air humidity. The principles are described in detail in the standard ISO 7730:2005. Indoor comfort is frequently classified just by setting indoor air temperatures ranges.
Areas covered	Urban areas
Barriers	-
Weighting	Three different "Comfort categories" are proposed in ISO 7730:2005 which suggest the possibility of using some values for the different sub-indicators depending on the comfort requirements for a particular building. The higher comfort requirements of a building, the narrower comfort bands will be accepted. This issue of classifying comfort is also considered in the standard EN 15251:2007 which suggests up to four categories, and tries to distance itself from the implication of closer control being superior, and to avoid the penalization of buildings with less control. However, it is suspected that categories are still used as quality indicators (Santamouris & Sfakianaki 2009). Recent research in this area even suggests that strictly controlled comfort bands offer no relative satisfaction benefits to occupants, compared to larger bands of comfort (Arens et al. 2010).
References	
SCALE	
Application	Building, site, location
Details	--
Multiscale	--
References	--
REFERENCES	
[1]	Sustainability and performance assessment and benchmarking of buildings http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf

<table>
<tr><td rowspan="3">SOC.VC.01
SOC.VC.02</td><td colspan="6">Illuminance (lx)
Daylight factor (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Social</td><td colspan="2">Visual Comfort</td><td>S / A</td><td>B / N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Requirements for visual performance and daylight</td></tr>
<tr><td>Background</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td>X</td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Definition
Illuminance
The Illuminance of a surface is defined as the luminous flux per unit area at any point on a surface exposed to incident (artificial) light. [2]

Daylight factor
The daylight factor is the ratio of the illuminance from the skylight measured on a horizontal surface within the room to the illuminance from a CIE (Commission Internationale de l’Eclairage) overcast sky measured on a horizontal plane which has an unobstructed access to the hemisphere of the sky.

Measurement unit

Illuminance [lux]
Daylight factor [%]

Classification:
Classes may be defined for each sub-indicator. Attention has to be paid to high classes. Indeed, comfort is a matter of balance and adequacy to user’s needs, so very high values of daylight factor and illuminance are not desirable, because they may be disturbing.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="6">-</td></tr>
<tr><td>Weighting</td><td colspan="6">From a general point of view, for comfort or IAQ indicators, two levels of assessment exist: at the premise/room scale and at the building scale. The indicators proposed above are appropriate for a single space/room, or space by space. An average value for the entire building is not appropriate because it leads to a "compensation" between good and bad performance. A better aggregation principle may be based on a combination of classes covering all the spaces of the building (e.g. see EN 15251:2007 – Annex I). [3]</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Building, site, location</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
<tr><td colspan="7">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="6">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
<tr><td>[2]</td><td colspan="6">Huovila A., Prokka J., Huovila P., Steskens P., Loomans M., Botsi S., Sakkas N.: D1.5 A Generic Framework for Key Indoor Performance Indicators. Public report of the project PERFECTION – Performance Indicators for Health, Comfort and Safety of the Indoor Environment</td></tr>
<tr><td>[3]</td><td colspan="6">EN 15251:2007. Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.</td></tr>
</table>

<table>
<tr><td rowspan="3">ECO.Qu.01</td><td colspan="4">Aesthetic quality (-)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Quality</td><td>S</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">This indicator considers architectural quality in terms of aesthetic quality (functional quality is covered elsewhere, as many guides exist).
Nevertheless, the aesthetic quality of a building can be decisive for its long-term success (making the resources invested in it worthwhile). It is also important for the buildings contribution to urban design and “place making” and contributes to the cultural value of the built environment.
What makes “good” architecture, in particular good architectural aesthetics is notoriously difficult to define and most architects will shy away from any attempt at categorising or defining what such qualities are. One fear is that the skills of architects are compromised by reducing architectural aesthetics to “pattern books”.
What makes good architectural quality is:
– dependent on the context (site, socio-cultural, environmental...)
– often subjective
– near-impossible to define objectively
– changes over time with fashion etc.
Where attempts at including architectural aesthetics into sustainability indicator systems are being made, these therefore concentrate on processes of arriving at good aesthetics. e.g.:
– asking for several design options to choose from
– undertaking a formal design competition
– including arts and crafts e.g. by local artists or craftsmen
However, such processes do not per se guarantee good quality, therefore an attempt is being made further a more rational process of decision making within such processes.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">
<table>
<tr><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td>X</td></tr>
</table>
</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Details</td><td colspan="4">Definition
– Architectural Quality in the design stage (design competition, considering alternative design options)
– Architectural Quality in the tender stage (as obligation on contractor)
– “Educated” decision making (as part of a design competition, considering alternative design options)
– Public art in/ on/ around buildings (mandatory inclusion of art work)
N.B. This form concentrates on “educated” decision making (as part of a design competition, considering alternative design options)

Measurement unit
Qualitative</td></tr>
<tr><td>Areas covered</td><td colspan="4">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Weighting</td><td colspan="4">There is no inherent reason for weighting the indicators.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Building, site, location</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

<table>
<tr><td rowspan="3">ECO.Qu.05</td><td colspan="6">Monument or monumental value / Historical value (-)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Economic</td><td colspan="2">Quality</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">The characterisation of the historic, historical, aesthetical significance of a building or site.</td></tr>
<tr><td>Background</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td>X</td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Definition
The heritage value of a building or site is a result of a complex (quite often very subjective) decision process. Since part of this decision process is subjective, pragmatic (depending on a situation not directly connected to a building, such as the economic situation of a country) or emotional, a clear indication of a definition cannot be given. Giving a definition for ‘cultural heritage’ would imply that ‘heritage value’ is an intrinsic property of a building or site, and this is not the case. Examples will be given below. The decision process, to decide “which building is heritage, and which building is not” is more enlightening when it comes to ‘cultural heritage value’.

Measurement unit:

Non-quantitative or, very rarely, semi-quantitative

Classification:

Usually at least a vague classification exists: a hierarchy between different levels of heritage value (e.g. full protection, or only parts of the building), even though this may differ from country to country, and even region to region. This hierarchy is, as earlier stated, quite often subjective.
Hierarchy in classification systems
Usually we find different ways of ‘listing’ heritage buildings. What is quite general is the upper level, where the entire building or site is protected, and where for every single intervention the approval of the monument administration is necessary. This does not mean that nothing can be changed. ‘Lower’ levels are less general, and the systems differ from country to country and from region to region.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="6">All works or interventions have to be approved by a commission, which is supposed to work completely independent from any government, to ensure an objective evaluation of every work or intervention done on these buildings.</td></tr>
<tr><td>Weighting</td><td colspan="6">-</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Building, site, location</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
<tr><td colspan="7">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="6">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

ECO.LC.08	**Life cycle costs (€)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Economic	Life Cycle costs		S		B
GENERAL						
Description	The LCC approach is that of total cost of ownership. Only costs/ expenses, not incomes that occur in the course of the life cycle are being captured. These have to be defined in accordance with ISO15686-5. Furthermore, assumptions and parameters related to life cycle costs need to be defined. As a special case the income from electricity generated with PV or similar could be included as negative costs. This approach can also be applied to incomes from recycling. LCC generally fits the point of view of owner occupiers. If used during the design stage it can be used as a tool for design optimization. Here the trade-off between one-off (capital) cost and ongoing (in-use) costs is being weighed up.					
Background	--					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	**Definition** In accordance with ISO 15686-5:2008: - Construction costs - Operational costs - Maintenance costs - End of life costs **Measurement unit:** Currency unit e.g. EUR as absolute value or discounted to present day value (net present value/ NPV). **Classification:** A typical NPV value over a given reference study period needs to be established with which the building to be assessed can be compared An assessment scale can be set in terms of performance of XXX% above or below the typical value. Generally, the net present value of incomes should exceed the net present value of outgoings. In the operational phase the assessment will be qualitative and process related.					
Areas covered	Building area					
Barriers	Calculation is straight forward in principle, but maintenance costs and end-of-life costs can be difficult to obtain.					
Weighting	N/A – while Present Value is a way of aggregating sub-indicators (i.e. different types of cost) and while these sub-indicators should be declared separately, they are not separately assessed and weighted.					
References						
SCALE						
Application	Building / site					
Details	--					
Multiscale	--					
References	--					
REFERENCES						
[1]	Sustainability and performance assessment and benchmarking of buildings http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf					

ECO.IC.01	**Additional costs for energy efficiency and sustainability (€)**					
	ISSUE	**CATEGORY**		**LEVEL**	**SCALE**	
	Economic	Investment Costs		S	B / N	
GENERAL						
Description	The indicator aims to identify the additional capital costs for energy efficiency and sustainability in comparison to average buildings of same type and use. Capital cost is the actual initial outlay required to pay for the construction project. It includes construction and non-construction costs. Capital costs are costs incurred on the purchase of land, buildings, construction and equipment to be used in the production of goods or the rendering of services, in other words, the total cost needed of bringing a project to a commercially operable status. Often when planning and designing a sustainable building it is feared that there will be considerable extra capital costs/ construction costs. Sustainable buildings however should not be a luxury solution. Additional capital costs should be limited. Capital costs can be assessed in their own right or be considered as part-indicator of LCC, WLC or “cost/ value ratio at point of hand-over”.					
Background	--					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature	X	Other (specify)	
Details	**Definition** Additional costs for energy efficiency and sustainability can be seen as a sub-indicator of the absolute capital costs. **Measurement unit:** currency unit e.g. EUR **Classification:** Additional costs in comparison to average buildings of same type and use acceptable maximum additional capital costs need to be established, as basis for a comparison. An assessment scale can be set in terms of performance of XXX% above or below the maximum acceptable value. Switzerland restricts extra cost to a maximum of 10% extra for highly energy efficient buildings as part of the MINERGIE standard.					
Areas covered	Building / site areas					
Barriers	Fear of increased capital costs is one of the main reasons for not building sustainably, making this an important and necessary indicator.					
Weighting	N/A.					
References						
SCALE						
Application	Building / site					
Details	--					
Multiscale	--					
References	--					
REFERENCES						
[1]	Sustainability and performance assessment and benchmarking of buildings http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf					

<table>
<tr><td rowspan="2">ECO.LC.06</td><td colspan="4">Cost in operational phase (€)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td></td><td>Economic</td><td>Life Cycle costs</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">It covers the building related costs that arise after the hand-over for the on-going running / operating of the building.
It comprises maintenance, servicing, repair and replacement, as well as utility costs to ensure the building operates as intended.
Costs of the use stage are influenced by decisions made at design stage. However, as sometimes the implications of decisions are not understood or discarded because they do not affect the investor (except for in an owner-occupier scenario) these costs are often not sufficiently considered. Aiming for low replacement costs and low utility costs will also mean aiming for low environmental impacts resulting from utility use or manufacture of spare parts.
Operational phase costs in use can be assessed in their own right or be considered as part indicator of LCC or WLC.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [X] | Empirical/Literature [ ] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">Definition
Sub-indicators are:
- operational costs
- maintenance costs
Indicators can also be subdivided in
- costs that affect the tenant
- costs that affect the management/ the landlord
(both as defined by ISO 15686-5:2008)
Measurement unit:
currency unit e.g. EUR
as absolute value or discounted to present day value (Net present Value).
Classification:
Typical costs in use need to be established with which the building to be assessed can be compared. Often only a limited time period is considered as reference study period (e.g. 50 years).
An assessment scale can be set in terms of performance of XXX% above or below the typical value.
The sub-indicators may or may not be assessed separately in this way, but the relevant figures should be shown separately.
In the operational phase the assessment may include qualitative and process related elements relating to data capture.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Building / site areas</td></tr>
<tr><td>Barriers</td><td colspan="4">There is generally a lack of reliable data on in-use costs (e.g. maintenance costs), though this varies from country to country (e.g. relatively good data availability in the UK).</td></tr>
<tr><td>Weighting</td><td colspan="4">N/A – the sub-indicators are only declared separately, but not separately assessed and weighted.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Building / site</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

<table>
<tr><td rowspan="3">ECO.Qu.15</td><td colspan="4">Long term stability of value (€)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Quality</td><td>S</td><td>B / N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Long-term stability of value / positive development of value or conversely, long-term financial risk.
This indicator assesses certain building characteristics that can be expected to help safeguard the value of a building in the long term and that mean the building is less affected by market related fluctuation in value.</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool | | Operational data | | In situ measurements | |</td></tr>
<tr><td colspan="4">Simple Calculations | X | Empirical/Literature | | Other (specify) | |</td></tr>
<tr><td>Details</td><td colspan="4">Definition
Depending on approach used – can be assessed using consequential sub- indicators such as:
– options for easy adaptation to change of use
– ability to meet future legislative requirements (e.g. Energy legislation)
– ability to adapt to climate change (e.g. to greater over-heating risks)
– certain physical characteristics that have been proven to remain in demand over decades (e.g.” neutrality “of spaces)
– financial risk indicators: (e.g. according to TEGOVA- PaM):
o (Market)
o (Location (suitability/ standing/ transport infrastructure/ facilities/ environment))
o Property (Construction/ layout/sustainability/energy performance)
o Cash flow
N.B. Only building/ site related indicators should be considered in this context

Measurement unit:
(depending on indicators chosen may or may not be quantitative units)

Classification:
So far, no mature assessment method is available. Examples for the assessment of potential subindicators are:
change of use adaptation:
– qualitative assessment levels need to be defined, capturing building characteristics that allow for easy adaptation
Financial risk indicators:
– – (proprietary risk assessment tool to be used such as TEGOVA PaM)</td></tr>
<tr><td>Areas covered</td><td colspan="4">Building / site area</td></tr>
<tr><td>Barriers</td><td colspan="4">-</td></tr>
<tr><td>Weighting</td><td colspan="4">Depending on the choice of indicator(s), weighting factors may have to be introduced.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Building</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">Sustainability and performance assessment and benchmarking of buildings
http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf</td></tr>
</table>

ECO.Qu.10	**Integrated design in the planning process (-)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Economic	Quality	S	N
GENERAL				
Description	Project management before, during and after design, involving a multi-disciplinary team, a collaborative and iterative work, aiming at optimising the sustainable performances of the building.			
Background	--			
References	[1]			
LEVEL				
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	**Definition** This indicator is made of a list of qualitative sub-criteria covering several phases of the planning process of a building, from concept design to operation. Additional requirements related to the optimisation of the planning process could be integrated in the single description of the criteria of the certification schemes (environmental, social and economic). **Measurement unit:** The evaluation of the integrated design can be only qualitative. The sub-criteria are organised as a structured checklist. A list of credits / points may be associated to that checklist. **Classification:** According to the number of credits obtained, a level of performance may be defined (e.g. fair, good, very good, or excellent). Some credits as well as their documentation materials may be mandatory			
Areas covered	-			
Barriers	This approach requires some investment in time and money, especially during the upstream stages, but it can lead to significant savings and advantages during the next phases. This approach requires some investment in time and money, in staff and measurement instruments (meters, probes, BEMS, etc.) but it can lead to significant savings during operation, high environmental performance and satisfaction of users. Applicability is easier if the integrated design was correctly implemented in the previous phases (concept, design, construction, hand-over).			
Weighting	This is not clearly defined yet. There exist several possibilities for a process-related indicator. The simplest one consists in affecting a given number of credits to each question / item of the checklist, according to its expected influence on the building performances and project coherence. Another solution may be based on mandatory sub-criteria plus optional ones. It is also possible to implement the quality management principle "plan-do-check-act" and allow credits according to the completeness of this principle, for each sub-criterion.			
References				
SCALE				
Application	Processes			
Details	--			
Multiscale	--			
References	--			
REFERENCES				
[1]	Sustainability and performance assessment and benchmarking of buildings http://www.vtt.fi/inf/pdf/technology/2012/T72.pdf			

A.12 – French Label Eco Quartier (eco-district)

FRENCH LABEL ECO-QUARTIER

http://www.ecoquartiers.logement.gouv.fr

www.eco-quartiers.fr/dl//img/dossier-de-labelisation-ecoquartier-986.pdf

The label formalizes the ambition of the French ministry to distinguish examples of sustainable development of districts and to clarify the conditions of success of Eco-districts. This approach is compatible with The Reference Framework for Sustainable Cities (http://rfsc.eu/). The certified projects meet 20 commitments of a common charter, distributed in 4 issues: governance and process; life quality and users practices; territorial development; environment and climate. Through their application file, communities have to measure several performance indicators. The Label is not a standard but a progressive approach, which recognizes the quality of a finished operation.

3 stages are included:

- Signature of the Charter by the community (stage 1);
- Commitment in the approach of labelling (stage 2) when the works begin,
- The label Eco-district (stage 3) when the operation is delivered and when objectives can be verified. After three campaigns of labelling until 2015:

39 operations "Eco-district" are certified which illustrates the concept of sustainable city everywhere in France;
98 projects are committed and carried the values of the Eco-districts of tomorrow.
The ministry has launched a 4th campaign of labelling in 2016.

This Tool was not in the initial project list we had to analyse for CESBA Med project but we add it because we think some indicators can be interesting for the Cesba-med project. As most of the indicators are also described in other tools, we just give details here on 9 indicators that are not in other projects/tools.

ISSUE/Category	criterion name	Indicator
ENV-En 20	Renewable Energy production on Site	renewable electricity production over annual consumption
ENV-LU 9	Urban compactness gross	ratio of housings over urban area (district area)
ENV-LU 10	Urban conversion	ratio of surface of buildings converted over total area
ENV-Bi 4	Vegetal areas (roof included)	ratio of vegetal areas (roof included) over total area
SOC-Tr 14	Access to Public transport	ratio of housing under 500 m from a stop over total housings
SOC-Tr 15	Parking Facilities	ratio of parking places pro housing
SOC-Ac 14	Availability of green spaces	ratio of green space pro inhabitant
ECO-IC4	Participation of local authority in the total investment cost	investment cost of authority

INDICATORS

ENV.En.19	**Renewable electricity production (%)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Environmental	Energy	S	N

GENERAL						
Description	This indicator is a ratio of the electricity produced in the district compared to the electricity consumption. It gives an idea of the autonomy of the district regarding electricity. Unit : %					
Background	French State Eco-district labelling					
References	[1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	X
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	Evaluation method : Divide the renewable electricity production inside the district boundaries (kWh/year) by the total electricity consumption (kWh/year) in the district					
Areas covered	All types of building clusters					
Barriers						
Rating						
References	[1], [2]					
SCALE						
Application range	This indicator is dedicated to building cluster level even if it can be used at building level					
Details						
Multiscale	The indicator can be calculated at building level but the interest here is to assess the impact of the building cluster.					
References	[1], [2]					
REFERENCES						
[1]	http://www.ecoquartiers.logement.gouv.fr					
[2]	www.eco-quartiers.fr/dl//img/dossier-de-labelisation-ecoquartier-986.pdf					

ENV.LU.12	Urban compactness (dwelling/m²)						
	ISSUE		CATEGORY		LEVEL		SCALE
	Environmental		Land Use		S		N
GENERAL							
Description	This indicator is a ratio of the number of dwellings over the total district surface. Unit : dwelling/m²						
Background	French State Eco-district labelling						
References	[1], [2]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements	X	
	Simple Calculations	X	Empirical/Literature		Other (specify)		
Details	Evaluation method : Divide the total number of dwellings by the total surface of the district.						
Areas covered	This indicator is dedicated to housing districts						
Barriers							
Rating							
References	[1], [2]						
SCALE							
Application range	This indicator is dedicated to building cluster level.						
Details							
Multiscale							
References	[1], [2]						
REFERENCES							
[1]	http://www.ecoquartiers.logement.gouv.fr						
[2]	www.eco-quartiers.fr/dl//img/dossier-de-labelisation-ecoquartier-986.pdf						

<table>
<tr><td rowspan="3">ENV.LU.15</td><td colspan="6">Urban conversion (% ref area)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Land use</td><td>S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">This indicator is a ratio of surface of buildings converted over total area
It gives an idea of the attention given to the rehabilitation or reconvertion of land with regard to the existing surfaces which are already built.
Unit : %</td></tr>
<tr><td>Background</td><td colspan="6">French State Eco-district labelling</td></tr>
<tr><td>References</td><td colspan="6">[1], [2]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td>X</td></tr>
<tr><td>Simple Calculations</td><td>X</td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Evaluation method :
Divide the <u>m² of rehabilitated or reconverted existing surface</u> *100 by total m² of surface of floor of the Eco-district</td></tr>
<tr><td>Areas covered</td><td colspan="6">All the districts</td></tr>
<tr><td>Barriers</td><td colspan="6">For this indicator it is necessary to collect information very early in the project.</td></tr>
<tr><td>Rating</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6">[1], [2]</td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application range</td><td colspan="6">This indicator is dedicated to building cluster level even if can be used at building level</td></tr>
<tr><td>Details</td><td colspan="6"></td></tr>
<tr><td>Multiscale</td><td colspan="6">The indicator can be calculated at building level but the interest here is to assess the impact of the building cluster.</td></tr>
<tr><td>References</td><td colspan="6">[1], [2]</td></tr>
<tr><td colspan="7">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="6">http://www.ecoquartiers.logement.gouv.fr</td></tr>
<tr><td>[2]</td><td colspan="6">www.eco-quartiers.fr/dl//img/dossier-de-labelisation-ecoquartier-986.pdf</td></tr>
</table>

ENV.Bi.08	Vegetal areas (roof included) (% ref area)					
	ISSUE	CATEGORY		LEVEL		SCALE
	Environmental	Biodiversity		S		N
GENERAL						
Description	This indicator is the ratio of vegetal areas (roof included) over total area % It gives information on vegetated surfaces where biodiversity can be developed. It gives also an idea of the capacity to absorb rain water and to stock green effect gazes. It contributes to the freshness and to life quality of the district. It is a direct link between building and district quality.					
Background	--					
References	Label Eco-quartier – France					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	X
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	Assessment Method Divide the m^2 of the vegetated surfaces (spaces and roof) * 100 by total m^2 of surface of floor of the Eco-district All the districts. Public spaces, private gardens, building roofs, roadsides, sport fields, woods…are considered.					
Areas covered	All types of building clusters.					
Barriers	The indicator can be calculated programming phase to assign objectives to the project and at the end to evaluate if the objective has been reached.					
Rating						
References	[1], [2]					
SCALE						
Application range	This indicator is dedicated to building cluster level.					
Details						
Multiscale						
References	[1], [2]					
REFERENCES						
[1]	http://www.ecoquartiers.logement.gouv.fr					
[2]	www.eco-quartiers.fr/dl//img/dossier-de-labelisation-ecoquartier-986.pdf					

<table>
<tr><td rowspan="3">ECO.IC.04</td><td colspan="4">Participation of local authority in the total investment cost (% ref euros)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Investment Costs</td><td>S</td><td>N</td></tr>
</table>

GENERAL	
Description	This indicator is a ratio of investment cost of the authority in the total balance of the project. It gives information on investment. The lower the participation is, the better the balance of the project is.
Background	--
References	[1], [2]

LEVEL

<table>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td>X</td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td></td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">Assessment Method
Divide the <u>Investment expenditure of the local authority in the project by the total investment cost of the project in euros Excl Taxes</u></td></tr>
<tr><td>Areas covered</td><td colspan="6">All types of districts</td></tr>
<tr><td>Barriers</td><td colspan="6">Defining the total investment of the project is not always simple to establish because of some privacy issues in the data and also because the project duration is very long, almost 10 years or more.</td></tr>
<tr><td>Rating</td><td colspan="6"></td></tr>
<tr><td>References</td><td colspan="6">[1], [2]</td></tr>
</table>

SCALE	
Application range	This indicator is dedicated to building cluster level.
Details	The investment of local authorities in the project is not dedicated to one building but to the building cluster.
Multiscale	
References	[1], [2]

REFERENCES

[1]	http://www.ecoquartiers.logement.gouv.fr
[2]	www.eco-quartiers.fr/dl//img/dossier-de-labelisation-ecoquartier-986.pdf

SOC.Tr.10	**Parking facilities (number/dwelling)**						
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**	
	Social	Transport		S		N	
GENERAL							
Description	This indicator is to evaluate the level of priority given to single cars at building cluster level. Ratio of the parking places per dwelling Unit : number /dwelling						
Background	--						
References	[1], [2]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements	X	
	Simple Calculations		Empirical/Literature		Other (specify)		
Details	Assessment Method Divide the number of parking places dedicated to the dwellings by the number of dwellings.						
Areas covered	All types of districts but mostly for housing districts.						
Barriers	When the building cluster is composed of housing buildings and tertiary buildings, the places ‘dedicated to dwellings’ is complicated to define.						
Rating							
References	[1], [2]						
SCALE							
Application range	This indicator is dedicated to building cluster level.						
Details	The objective of the indicator is to define the share of parking places at building cluster level.						
Multiscale							
References	[1], [2]						
REFERENCES							
[1]	http://www.ecoquartiers.logement.gouv.fr						
[2]	www.eco-quartiers.fr/dl//img/dossier-de-labelisation-ecoquartier-986.pdf						

<table>
<tr><td rowspan="3">SOC.Tr.19</td><td colspan="4">Dwellings with access to public transport (%)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Transport</td><td>S</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">This indicator is to evaluate the proximity of public transports for the district inhabitants.
Ration of dwellings with a short access to public transport.
Unit : %</td></tr>
<tr><td>Background</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">[1], [2]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] · Operational data [ ] · In situ measurements [X]</td></tr>
<tr><td colspan="4">Simple Calculations [ ] · Empirical/Literature [ ] · Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">Assessment Method
Divide the number of parking places dedicated to the dwellings by the number of dwellings
Assessment method: For each building in the cluster, calculate if the walking distance to public transport nodes (train, tram, bus…) is under or higher than 500 m.
Then calculate the accessibility ratio by dividing the number of dwellings with an access < 500m by the total of the dwellings.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Specific for housing districts</td></tr>
<tr><td>Barriers</td><td colspan="4"></td></tr>
<tr><td>Rating</td><td colspan="4"></td></tr>
<tr><td>References</td><td colspan="4">[1], [2]</td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application range</td><td colspan="4">This indicator is dedicated to building cluster level.</td></tr>
<tr><td>Details</td><td colspan="4"></td></tr>
<tr><td>Multiscale</td><td colspan="4">The calculation is based on the sum of the calculation for each building but the interest of the indicator is only at building cluster level. All dwellings of one building have the same distance to public transport nodes!</td></tr>
<tr><td>References</td><td colspan="4">[1], [2]</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td>[1]</td><td colspan="4">http://www.ecoquartiers.logement.gouv.fr</td></tr>
<tr><td>[2]</td><td colspan="4">www.eco-quartiers.fr/dl//img/dossier-de-labelisation-ecoquartier-986.pdf</td></tr>
</table>

SOC.Ac.08	**Availability of public green spaces (m² /inhabitant)**					
	ISSUE		**CATEGORY**		**LEVEL**	**SCALE**
	Social		Accessibility		S	N
GENERAL						
Description	This indicator is to evaluate the quality of life through the quantity of green spaces. Ratio of green spaces (m²) per inhabitant. Unit : m²/inhabitant					
Background	--					
References	[1], [2]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	Assessment Method Divide the surface of public green spaces by the number of inhabitants.					
Areas covered	Specific for housing districts					
Barriers						
Rating						
References	[1], [2]					
SCALE						
Application range	This indicator is dedicated to building cluster level.					
Details						
Multiscale						
References	[1], [2]					
REFERENCES						
[1]	http://www.ecoquartiers.logement.gouv.fr					
[2]	www.eco-quartiers.fr/dl//img/dossier-de-labelisation-ecoquartier-986.pdf					

A.13 – QDM

QDM

Quartiers Durables Méditerranéens
Sustainable Mediterranean Neighbourhoods

http://www.envirobatbdm.eu/baroque

Quartiers Durables Méditerranéens – QDM – is a local and contextualised approach to sustainability in neighbourhood planning developed by EnvirobatBDM in Provence. Based on its successful experience on sustainable Mediterranean buildings approach, EnvirobatBDM broaden the scope of reflexion by addressing neighbourhood issues. The bottom up and participative approach is the core of the methodology used by EnvirobatBDM. It aims at putting back sustainability and Mediterranean issues at the top of the agenda. Through 8 themes, 31 criteria and 240 indicators; the QDM frame aims at supporting Provence local authorities, their contractors and partners in decision making. It was launched in 2017 in Avignon.

INDICATORS

ENV.Bi.02	**During programming, design and before the beginning of the works; the land is maintained through mowings, prunings, maintenance of canals and hedges (yes / no)**					
	ISSUE		CATEGORY		LEVEL	SCALE
	Environmental		Biodiversity		B	N
GENERAL						
Description	Development sites before building works begin include a range of ecological systems and infrastructures. If taken care of, they can be preserved and remain in the project. The assessment indicator therefore aims at promoting that during programming, design and before the beginning of the works, the land is maintained through mowing, pruning, and a maintenance of canals and hedges implemented.					
Background	It is included as part of the Strategic Environmental Assessment (SEA) as per Directive 2011/42/EC that encourages a 3 step approach: avoid, reduce and compensate damages to the environment. This indicator is linked to the “avoid damages to the environment” criterion. It can be linked to “commitment n°20” of the French Ecoquartier label “Preserve and enhance biodiversity, soils and natural ecosystems”.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is more a qualitative indicator that focuses on the approach : The site is taken care of instead of being abandoned. The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers	The content of the specifications is not detailed					
Rating	Binary (yes or no) The assessment team will check the effectiveness of land maintenance contracts. Pictures can help proving the maintenance process.					
References	[1]					
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

<table>
<tr><td rowspan="3">ENV.Bi.06</td><td colspan="4">Ecological corridors and continuity (yes / no)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Environmental</td><td>Biodiversity</td><td>B</td><td>N</td></tr>
</table>

GENERAL	
Description	The continuity of natural spaces is a core issue for maintaining biodiversity. The development of a project can disturb the local balance. Some ecological corridors are now identified in different planning documents set up by different scales of local authorities from the regional council to the city. On a smaller scale, some continuity or corridors exist and should be maintained or recreated on the same basis. The emphasis is therefore put on the idea of continuity between existing non built areas and the project under development. The project should be thought in its interaction with the rest of the city and not as an isolated enclave. The indicators aims at assessing if ecological corridors are maintained or recreated with non-built surrounding spaces.
Background	It is included as part of the Strategic Environmental Assessment (SEA) as per Directive 2011/42/EC that encourages a 3 step approach: avoid, reduce and compensate damages to the environment. This indicator is linked to the “avoid damages to the environment” criterion. It can be linked to “commitment n°20” of the French Ecoquartier label “Preserve and enhance biodiversity, soils and natural ecosystems”.
References	[1]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that focuses on the approach: the ecological corridors are preserved or destroyed. The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers	Need for a prior analysis on the existence of surrounding natural areas					
Rating	Binary (yes or no) The assessment team will check the effectiveness of existence of the continuity with non-built areas on plans, sketches and eventually works.					
References						

SCALE	
Application	Urban scale
Details	--
Multiscale	--
References	--

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ENV.Bi.05	Diversity (yes/no)					
	ISSUE		CATEGORY		LEVEL	SCALE
	Environmental		Biodiversity		B	N
GENERAL						
Description	The indicator aims at promoting the diversity of plants and in public spaces. The assessment is made through a simple approach assuming that public spaces should get 3 different types of plant structures					
Background	It is included as part of the Strategic Environmental Assessment (SEA) as per Directive 2011/42/EC that encourages a 3 step approach: avoid, reduce and compensate damages to the environment. This indicator is linked to the “compensate damages to the environment” criterion. It can be linked to “commitment n°20” of the French Ecoquartier label “Preserve and enhance biodiversity, soils and natural ecosystems”.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	It is a qualitative approach with a yes or no answer to the following statement : public spaces should get 3 of the 5 following plant structures : -tall standard trees, -bushes, -herbaceous plants, -ground covering plants, -flower beds					
Areas covered	Urban areas					
Barriers	-					
Rating	Binary (yes or no) The assessment team will check the effectiveness of existence of the corridors on plans, sketches and eventually works. Contracts to buy plants will also be proof.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ECO.Qu.02	Enhance architectural, cultural and landscape patrimony (yes/no)					
	ISSUE	CATEGORY		LEVEL		SCALE
	Economic	Quality		B		N
GENERAL						
Description	The indicator aims at promoting a local and contextualized approach to architecture and life-style. It assumes that vernacular or typical architectural features are adapted to local use and practices. Housings are therefore supposed to include typical Mediterranean spaces such as terraces, loggias, balconies.					
Background	It can be linked to the “commitment n°10” of the French Ecoquartier label “Enhance patrimony (natural and built), history and identity.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative approach with a yes or no answer to the following statement : Housings include typical Mediterranean spaces : terraces, loggias, balconies, of at least 8 m² (except for 1 bedroom flat)					
Areas covered	Urban areas					
Barriers	-					
Rating	Binary (yes or no) The assessment team will check the effectiveness of existence of the Mediterranean architecture described features in specifications, sketches and eventually works					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

SOC.Tr.21	Cul-de-sac roads and path ratio (%)					
	ISSUE	CATEGORY		LEVEL		SCALE
	Social	Transport		S		N
GENERAL						
Description	This indicator measures the actual connection and accessibility of the neighbourhood to the rest of the city. A greater proportion of cul-de-sac or dead end streets reveals a low level of connection and accessibility of the neighbourhood. Being isolated, it is less likely the neighbourhood will be accessible, especially with public transport.					
Background	It can be linked to “commitment n°9” of the Ecoquartier French label “Implement architectural and planning quality that reconciles intensity and life quality”					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations	X	Empirical/Literature		Other (specify)	
Details	The proportion of cul-de-sac is measured by a percentage. It the ratio between cul-de-sac streets and the total number of streets. The calculation is quite simple as the detailed data is available in specifications, plans and sketch.					
Areas covered	Urban areas					
Barriers	–					
Rating	Cul-de-sac roads and path should represent less than 20% of all roads and paths					
References	[1]					
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					
REFERENCES						
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque					

SOC.Tr.04	Car sharing pool/station (yes/no)					
	ISSUE		CATEGORY		LEVEL	SCALE
	Social		Transport		S	N
GENERAL						
Description	Car sharing is a way of reducing the predominance of car on public space as well being the main mean for mobility. Car clubs offer, through subscription, the possibility to share the use of a car on a flexible way. Still the implementation of such a service requires the implementation of a dedicated infrastructure. The indicator aims at promoting car sharing to reduce problems and pollution due to car. A car sharing pool/station is expected to be implemented as part of the development project.					
Background	It can be linked to “commitment n°14” of the French Ecoquartier label: “promote soft mobility and public transport to lower dependency to cars”.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative approach with a yes or no answer to the following statement : A car sharing pool/station is implemented as part of the project					
Areas covered	Urban areas					
Barriers	–					
Rating	Binary (yes or no) The assessment team will check the specifications or discuss with the team regarding their will regarding that issue.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ENV.Wa.09	Respecting streaming continuity (yes/no)						
	ISSUE		CATEGORY		LEVEL		SCALE
	Environmental		Water		B		N
GENERAL							
Description	Rainwater streaming create natural water corridor or supply ponds with water. Preserving natural streaming is important to preserve the continuity and ecosystems downstream. In the Mediterranean area, rains can be particularly intensive and heavy causing fast floodings. Preserving the permeability of soils, easing draining and streaming are therefore major issues of flooding prevention. For a neighbourhood development project, the indicator focuses on buildings implementation and whether it respects the site topography and do not modify streaming continuities.						
Background	It can be linked to "commitment n°19" of the French Ecoquartier label "Preserve water resource and ensure a qualitative and economical management" of the resource						
References	[1]						
LEVEL							
Derived from	Software tool		Operational data		In situ measurements		
	Simple Calculations		Empirical/Literature	x	Other (specify)		
Details	It is a qualitative indicator that aims at checking the following statement: buildings implementation respect the site topography and do not modify streaming continuities The answer will therefore be a yes or no.						
Areas covered	Urban areas						
Barriers	Need for a prior analysis on the existing streaming. Particular attention will be given to the topography						
Rating	Binary (yes or no) The assessment team will check plans and sketches to see if they respect the continuities identified in prior studies.						
References							
SCALE							
Application	Urban scale						
Details	--						
Multiscale	--						
References	--						

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ENV.Wa.07	Landscaped and accessible retention ponds and ditches (yes/no)					
	ISSUE	CATEGORY		LEVEL		SCALE
	Environmental	Water		B		N
GENERAL						
Description	Retention ponds and ditches are part of rainwater management systems. Being part of people's environment, it is assumed that they should be therefore landscaped and accessible to the public so they become enjoyable. The indicators assesses if retention ponds and ditches are landscaped and accessible to users					
Background	It can be linked to "commitment n°19" of the French Ecoquartier label "Preserve water resource and ensure a qualitative and economical management" of the resource					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that focuses on the approach checking the statement: retention ponds and ditches are landscaped and accessible to users. The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers	-					
Rating	Binary (yes or no) The assessment team will check the specifications, sketches and eventually works.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

Interreg Mediterranean
CESBA MED
Project co-financed by the European Regional Development Fund

<table>
<tr><td rowspan="3">ENV.Wa.08</td><td colspan="6">Rainwater collection from roofs (%)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Environmental</td><td colspan="2">Water</td><td>S</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Rainwater can be a resource to different kind of uses and practices. Prior to the implementation of rainwater using devices; collection must be designed and implemented. Roofs are a key tool to collect rainwater because of the area they cover.
The indicators aims at assessing if roofs collect rainwater to dedicated cisterns or barrels in a large scale</td></tr>
<tr><td>Background</td><td colspan="6">It can be linked to “commitment n°19” of the French Ecoquartier label “Preserve water resource and ensure a qualitative and economical management” of the resource</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td>x</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">It is a qualitative indicator that focuses on the approach: the ecological corridors are preserved or destroyed.
The answer will therefore be a yes or no.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="6"></td></tr>
<tr><td>Rating</td><td colspan="6">Threshold is 50% : at least 50% of roofs should collect rainwater
The assessment team will check the effectiveness through specifications, sketches and eventually works.</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Urban scale</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
</table>

<table>
<tr><td colspan="2">REFERENCES</td></tr>
<tr><td>[1]</td><td>Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque</td></tr>
</table>

ENV.Wa.05	Dedicated network (yes/no)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Environmental	Water	B	N
GENERAL				
Description	The separation of domestic wastewater and rainwater networks helps preventing pollution to the environment and/or designing a more cost effective networks as well as water treatment plant. Separated networks help coping with brutal changes in flows due to heavy rains, like in the Mediterranean area. It prevents wastewater overflow to the environment. Network separation also means a downsizing of water treatment plants as rainwater flows are managed. The indicators aims at assessing if wastewater network and rainwater networks are two separated networks			
Background	It can be linked to "commitment n°19" of the French Ecoquartier label "Preserve water resource and ensure a qualitative and economical management" of the resource			
References	[1]			
LEVEL				
Derived from	Software tool	Operational data	In situ measurements	
	Simple Calculations	Empirical/Literature	x	Other (specify)
Details	It is a qualitative indicator that check the statement: wastewater network and rainwater networks are two separated networks. The answer will therefore be a yes or no.			
Areas covered	Urban areas			
Barriers				
Rating	Binary (yes or no) The assessment team will check the effectiveness of existence of the 2 networks on sketches and eventually works.			
References				
SCALE				
Application	Urban scale			
Details	--			
Multiscale	--			
References	--			

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

SOC.TC.06	**Urban heat island (yes/no)**					
	ISSUE	CATEGORY		LEVEL	SCALE	
	Social	Thermal Comfort		B	N	
GENERAL						
Description	Urban heat island phenomenon is a major issue for urban areas. Heat increase and storage as well as incapacity to cool down impact life quality. With global warming and the increase of the number and duration of heatwaves, that phenomenon could take greater proportion. Linked to the design or urban areas, urban heat island effect needs to be tackled well in advance in the design of the project. The indicators aims at assessing if consideration is given upstream to urban heat island, especially regarding material albedo, positioning to winds, Venturi effect, interest of plants…					
Background	It can be linked to “commitment n°16” of the French Ecoquartier label : “produce a planning that anticipate and adapt to climate change”					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that focuses on the approach to check the statement: is consideration given upstream to urban heat island, especially regarding material albedo, positioning to winds, Venturi effect, interest of plants… A preliminary note on heat island effect made as part of the project should be provided					
Areas covered	Urban areas					
Barriers						
Rating	The assessment team will check the existing note on heat island effect and the references made to it in the project development scheme					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

SOC.Ac.06	**Adaptation to users practices (yes/no)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Social	Accessibility	B	N

GENERAL	
Description	The practice of public space by users does not always match anticipated uses made by planers through a top-down approach. There are many examples of empty public spaces because of their unsuitability to users' needs. In existing sites, a prior analysis of users' practices provides a great basis to public spaces design. In particular, regarding pedestrian paths, using previous practices can provide the best basis to a walking path scheme that can connect public spaces. The indicator actually assesses if public spaces network lean on marks let by users passing or existing tracks
Background	It can be linked to the "commitment n°10" of the French Ecoquartier label "Enhance patrimony (natural and built), history and identity.
References	[1]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	

Details	It is a qualitative indicator that focuses on the approach: do public spaces network lean on marks let by users passing or existing tracks. The answer will therefore be a yes or no.
Areas covered	Urban areas
Barriers	
Rating	Binary (yes or no) The justification has to be provided by the local authority and/or contractor
References	

SCALE	
Application	Urban scale
Details	--
Multiscale	--
References	--

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

<table>
<tr><td rowspan="3">SOC.Ac.12</td><td colspan="4">Public space quality (yes/no)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Accessibility</td><td>B</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Public spaces are a major component of life quality and community living. Diversity and complementary spaces offer a wide range of practices and therefore help including all users. An emphasis on their design should therefore prevail to neighbourhood programming. Indeed as Oriol Bohigas taught us; public spaces are not the remainder of buildings; they actually are the contrary.
The indicator aims at assessing if various public spaces are offered in sufficient number.</td></tr>
<tr><td>Background</td><td colspan="4">This can be linked to “commitment n°9” of French Ecoquartier label : “Implement architectural and urban quality that reconciles intensity and life quality’</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [x] | Empirical/Literature [ ] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">The project offers at least 4 out of the 5 following public spaces :
1.squares
2.walks and parks
3.Primary highways (boulevards, avenues, roads)
4. Secondary ways (streets, dead ends)
5.Transitional spaces for traffic (pathways, lanes, alleys)</td></tr>
<tr><td>Areas covered</td><td colspan="4">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="4"></td></tr>
<tr><td>Rating</td><td colspan="4">Binary (yes or no)
The assessment team will check the specifications, sketches and eventually works.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Urban scale</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
</table>

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

<table>
<tr><td rowspan="3">SOC.Ac.11</td><td colspan="4">Parks and vegetated spaces network (yes/no)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td>Accessibility</td><td>B</td><td>N</td></tr>
</table>

GENERAL	
Description	Parks and green spaces have a central place in life quality. Their too often small size and/or isolation even if numerous does not really meet people's expectations. Creating connection and continuity between green open spaces can provide a better user experience. It also meets the need for continuity of natural spaces to maintain biodiversity. The project should therefore think global and integrate the need for interaction between green spaces as a network. The indicators aims at assessing if parks and vegetated spaces are organised in networks
Background	This can be linked to "commitment n°9" of French Ecoquartier label : "Implement architectural and urban quality that reconciles intensity and life quality'
References	[1]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	

Details	It is a qualitative indicator that focuses on checking the statement: are parks and vegetated spaces are organized in networks. The answer will therefore be a yes or no.
Areas covered	Urban areas
Barriers	
Rating	Binary (yes or no) The assessment team will check the effectiveness on specifications, sketches and eventually works
References	

SCALE	
Application	Urban scale
Details	--
Multiscale	--
References	--

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

SOC.AC.06	**Accoustics studies (yes/no)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Social	Acoustic Comfort		B		N
GENERAL						
Description	Noise pollution cannot always be avoided. Nevertheless, potential exposure to noise can be limited if taken into consideration upstream. An acoustics study is necessary to provide objective measures on noise, identifying sources, analyzing aggravating factors. The data will provide useful information to design a neighbourhood that lower exposure to noise.					
Background	It can be linked to “commitment n°1” of the French Ecoquartier label “Design project answering everybody’s requirement and based on resources and pressure”.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that aims at ensuring an acoustics study is made before the design phase (measurements, sources identification, analysis of aggravating factors and frequency). The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers						
Rating	Binary (yes or no) The assessment team will check the study and the developing team will explain how it has taken the results into consideration					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

SOC.Ac.13	Shared community spaces (yes/no)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Social	Accessibility	B	N
GENERAL				
Description	Public spaces are a major component of life quality and community living. Diversity and complementary spaces offer a wide range of practice and therefore help including all users. An emphasis on their design should therefore prevail to neighbourhood programming. Community and shared spaces also help people inclusive practice of living together. The indicators aims at assessing if shared spaces are designed on public spaces (squares, community gardens, playgrounds, picnic areas…)			
Background	It can be linked to “commitment n°7” of the French Ecoquartier label “Implement conditions for social and intergenerational mixity, living together and solidarity”.			
References	[1]			

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that focuses on the approach if shared spaces are designed on public spaces (squares, community gardens, playgrounds, picnic areas…). The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers	Need for a prior analysis on the existence of surrounding natural areas					
Rating	Binary (yes or no) The assessment team will check the effectiveness the development scheme, plans, sketches and eventually works.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

<table>
<tr><td rowspan="3">SOC.Ac.16</td><td colspan="6">Community support (yes/no)</td></tr>
<tr><td colspan="2">ISSUE</td><td colspan="2">CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td colspan="2">Social</td><td colspan="2">Accessibility</td><td>B</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Community associations provide a base to community living. They initiate and support local initiatives. Local authority can support community association by providing facilities to host them.
The indicators aims at assessing if community association facilities are hosted in the neighbourhood</td></tr>
<tr><td>Background</td><td colspan="6">It can be linked to “commitment n°7” of the French Ecoquartier label “Implement conditions for social and intergenerational mixity, living together and solidarity”.</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td>x</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">It is a qualitative indicator that focuses on checking the statement: community association facilities are hosted in the neighbourhood.
The answer will therefore be a yes or no.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="6"></td></tr>
<tr><td>Rating</td><td colspan="6">Binary (yes or no)
The assessment team will check the effectiveness with planners</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Urban scale</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
</table>

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

SOC.Ac.10	**Community gardens (yes/no)**					
	ISSUE	**CATEGORY**		**LEVEL**		**SCALE**
	Social	Accessibility		B		N
GENERAL						
Description	Community garden have ecological and social benefits. They support people connecting to the land through gardening. They become a place where the community can meet and get on together. Not to threaten the environment, they should be run on organic principles. The indicators aims at assessing if open ground agricultural project (community gardens...) are implemented and that they are organic based.					
Background	It can be linked to "commitment n°11" of the French Ecoquartier label "Contribute to a local and fair economic development".					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	*x*	Other (specify)	
Details	It is a qualitative indicator that check the following statement: open ground agricultural project (community gardens...) are implemented and if they are organic based. The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers						
Rating	Binary (yes or no) The assessment team will check the effectiveness with local authorities and planners.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ECO.Eq.03	**Support to local economy (%)**					
	ISSUE	CATEGORY		LEVEL		SCALE
	Economic	Equity		S		N
GENERAL						
Description	Project development through the studies and works they require supports economic development. Ideally the expenses made for the project should benefit to local companies and therefore local employment. The indicators aims at assessing if the companies involved in the project are based locally.					
Background	It can be linked to “commitment n°11” of the French Ecoquartier label “Contribute to a local and fair economic development”.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	80% of the companies involved in the project are based locally					
Areas covered	Urban areas					
Barriers						
Rating	The threshold is 80% i.e. 80% of the companies involved in the project are based locally The assessment team will check the contracts.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ECO.Va.02	**Flexibility and adaptability, programming (yes/no)**					
	ISSUE	CATEGORY		LEVEL	SCALE	
	Economic	Value		B	N	
GENERAL						
Description	Neighbourhood developments are long and complex projects. The initial project can change and evolve to answer new needs or requirements. The capacity of the project to adapt to a changing environment is an important advantage to keep the relevancy and avoid failures. The indicator aims at assessing adaptability and flexibility. The indicator assesses if some plots / parcel lands are not assigned to a specific development in order to adapt to the possible evolution of the project.					
Background	It can be linked to “commitment n°4” of the French Ecoquartier label “Take into account use and practices of developers and buildings managers in choice of conception”.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that focuses on checking the statement: are some plots / parcel lands are not assigned to a specific development in order to adapt to the possible evolution of the project. The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers						
Rating	Binary (yes or no) The assessment team will check the effectiveness of available plots in plans and schemes					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					
REFERENCES						
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque					

ECO.Va.01	**Flexibility and adaptability, during the life of the project (yes/no)**										
	ISSUE		CATEGORY			LEVEL			SCALE		
	Economic		Value			B			N		
GENERAL											
Description	Neighbourhood developments are long and complex projects. It is difficult to anticipate the future needs in an evolving environment on the long run. The capacity of the project to adapt to such a changing environment is an important advantage to keep the relevancy and avoid failures. The indicator aims at assessing adaptability and flexibility of the project though its lifetime. The indicator assess if some land is preserved for the possible evolution of the neighbourhood.										
Background	It can be linked to “commitment n°4” of the French Ecoquartier label “Take into account use and practices of developers and buildings managers in choice of conception”.										
References	[1]										
LEVEL											
Derived from	Software tool			Operational data				In situ measurements			
	Simple Calculations			Empirical/Literature			x	Other (specify)			
REFERENCES											
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque										
Details	It is a qualitative indicator that focuses on checking the statement: Some land is preserved for the possible evolution of the neighbourhood. The answer will therefore be a yes or no.										
Areas covered	Urban areas										
Barriers	Need for a prior analysis on the existence of surrounding natural areas										
Rating	Binary (yes or no) The assessment team will check the development scheme and plans, sketches and eventually works.										
References											
SCALE											
Application	Urban scale										
Details	--										
Multiscale	--										
References	--										

<table>
<tr><td rowspan="3">ECO.Qu.14</td><td colspan="4">Working with skilled professionals (yes/no)</td></tr>
<tr><td>ISSUE</td><td>CATEGORY</td><td>LEVEL</td><td>SCALE</td></tr>
<tr><td>Economic</td><td>Quality</td><td>B</td><td>N</td></tr>
<tr><td colspan="5">GENERAL</td></tr>
<tr><td>Description</td><td colspan="4">Neighbourhood developments are long and complex projects. To ensure the quality of the process along the project from design to works, local authorities can make a specific call for tender to get an external support from a consultant to develop the project. Through its expertise, it will provide a complementary view on the project issues, supporting the decision making process.
The indicator assess if an assistant to the contracting authority on environmental quality is assigned to follow the totality of the project (design, works, environmental quality of buildings).</td></tr>
<tr><td>Background</td><td colspan="4">It can be linked to “commitment n°2” of the French Ecoquartier label “Formalising and implementing a management process and an enlarged governance”.</td></tr>
<tr><td>References</td><td colspan="4">[1]</td></tr>
<tr><td colspan="5">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td colspan="4">Software tool [ ] | Operational data [ ] | In situ measurements [ ]</td></tr>
<tr><td colspan="4">Simple Calculations [ ] | Empirical/Literature [x] | Other (specify) [ ]</td></tr>
<tr><td>Details</td><td colspan="4">It is a qualitative indicator that focuses on checking the statement: is an assistant to the contracting authority on environmental quality is assigned to follow the totality of the project (design, works, environmental quality of buildings).
The answer will therefore be a yes or no.</td></tr>
<tr><td>Areas covered</td><td colspan="4">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="4"></td></tr>
<tr><td>Rating</td><td colspan="4">Binary (yes or no)
The assessment team will check the existing contracts between local authorities and the consultancy assistant.</td></tr>
<tr><td>References</td><td colspan="4"></td></tr>
<tr><td colspan="5">SCALE</td></tr>
<tr><td>Application</td><td colspan="4">Urban scale</td></tr>
<tr><td>Details</td><td colspan="4">--</td></tr>
<tr><td>Multiscale</td><td colspan="4">--</td></tr>
<tr><td>References</td><td colspan="4">--</td></tr>
</table>

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ECO.Qu.13	Project management (yes/no)			
	ISSUE	CATEGORY	LEVEL	SCALE
	Economic	Quality	B	N
GENERAL				
Description	Neighbourhood developments are long and complex projects. It is important that the local authority develops internally skills and expertise. Someone should be designated as being in charge of “sustainable planning” and follow the project. That person must be identified by partners and contractors to follow the whole process. The indicator assesses if a member of the local authority is identified and dedicated to "sustainable planning" and if that person follows the project.			
Background	It can be linked to “commitment n°2” of the French Ecoquartier label “Formalising and implementing a management process and an enlarged governance”.			
References	[1]			
LEVEL				
Derived from	Software tool	Operational data	In situ measurements	
	Simple Calculations	Empirical/Literature	x	Other (specify)
Details	It is a qualitative indicator that focuses on checking the statement: is a member of the local authority is identified and dedicated to "sustainable planning" and is that person follows the project. The answer will therefore be a yes or no.			
Areas covered	Urban areas			
Barriers				
Rating	Binary (yes or no) The assessment team will that person in charge of “sustainable planning”. Signed presence sheets will prove its participation to the project process.			
References				
SCALE				
Application	Urban scale			
Details	--			
Multiscale	--			
References	--			

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ECO.Va.03	Assessing the current situation (yes/no)					
	ISSUE	CATEGORY		LEVEL		SCALE
	Economic	Value		B		N
GENERAL						
Description	Neighbourhood developments are made in existing urban environments. Each city and site has its own history, community, geography that built its identity. A project can only be successful if it takes into consideration all these matters and respects them. It is a condition for a successful insertion in the existing urban environment. The indicator assesses if on a broader scale, a study is made including an analysis on history, geography, sociology, urbanism and environment, and if cross analysis helped define the project directions					
Background	It can be linked to "commitment n°1" of the French Ecoquartier label "Making projects suitable to all users' needs based on local resources and pressures".					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that focuses on checking the statement: is on a broader scale, a study made including an analysis on history, geography, sociology, urbanism and environment, and does cross analysis help define the project directions. The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers						
Rating	Binary (yes or no) The assessment team will consult the study and check if references to that study is made in the project development scheme					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ECO.Qu.11	Plus6 (+6) project management (yes/no)					
	ISSUE		CATEGORY		LEVEL	SCALE
	Economic		Quality		B	N
GENERAL						
Description	Neighbourhood developments are long and complex projects. It is important someone in the contracting authority is identified as being in charge of the project. This person is the representative to contractors and the assessment team. The indicator assesses if a coordinator or a project manager is identified for the contracting authority.					
Background	It can be linked to "commitment n°2" of the French Ecoquartier label "Formalising and implementing a management process and an enlarged governance".					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that focuses on checking the statement: is a coordinator or a project manager identified for the contracting authority. The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers						
Rating	Binary (yes or no) The assessment team will meet that person and check its position in the contracting authority.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ECO.Qu.09	**Finalising the design phase (yes/no)**					
	ISSUE		CATEGORY		LEVEL	SCALE
	Economic		Quality		B	N
GENERAL						
Description	The tendering package is provided by the public authority (or its delegate) to the potential contractors who want to answer the call for tender for neighbourhood development. The tendering package is therefore a core set of documents that conveys the public authority intents for the project. It should therefore include all the means chosen in the sustainable neighbourhood (QDM) approach as it guides potential contractors answer to the bid. It enforces the integration of the approach. The indicator assesses if the tendering package was written including means chosen in the sustainable neighbourhood (QDM) approach.					
Background	It can be linked to “commitment n°3” of the French Ecoquartier label “Integrating global cost approach when investing”.					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that focuses on checking the statement: is the tendering package written including means chosen in the sustainable neighbourhood (QDM) approach. The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers						
Rating	Binary (yes or no) The assessment team will check the tendering package.					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ECO.Qu.08	**Community planning (yes/no)**			
	ISSUE	**CATEGORY**	**LEVEL**	**SCALE**
	Economic	Quality	B	N

GENERAL	
Description	Neighbourhood developments are made in existing urban environments. Each city and site has its own history and community with its specific identity. A project can only be successful if it takes into consideration all this matters and respects them. Communities more and more legitimately claims to be real part of the project designing. Including communities is a condition for a successful insertion in the existing urban environment of a project that will actually match the users' desires. The indicator assesses if above mandatory consultation, a participatory approach is implemented during the design step (design choice, materials, furniture….) and if users ideas are taken into consideration
Background	It can be linked to "commitment n°2" of the French Ecoquartier label "Formalising and implementing a management process and an enlarged governance".
References	[1]

LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	

Details	It is a qualitative indicator that focuses on checking the statement: is above mandatory consultation, a participatory approach implemented during the design step (design choice, materials, furniture….) and if users ideas are taken into consideration. The answer will therefore be a yes or no.
Areas covered	Urban areas
Barriers	
Rating	Binary (yes or no) The assessment team will check the number of community planning meetings, the possible contract signed with a consultant dedicated to community planning. Eventually the developers will have to present which part of the project comes from the results of the participatory approach.
References	
SCALE	
Application	Urban scale
Details	--
Multiscale	--
References	--

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

ECO.Qu.07	**Community management (yes/no)**					
	ISSUE	**CATEGORY**		**LEVEL**	**SCALE**	
	Economic	Quality		B	N	
GENERAL						
Description	Communities now reclaim their right to public spaces use and management. Including communities to urban spaces management is a condition to build a relevant project that will actually match the users' desires. Community project and initiatives can be of a community garden for instance. The indicator assesses if community planning is implemented for the management of urban spaces (management of community gardens…).					
Background	It can be linked to "commitment n°2" of the French Ecoquartier label "Formalising and implementing a management process and an enlarged governance".					
References	[1]					
LEVEL						
Derived from	Software tool		Operational data		In situ measurements	
	Simple Calculations		Empirical/Literature	x	Other (specify)	
Details	It is a qualitative indicator that focuses on checking the statement: is community planning implemented for the management of urban spaces (management of community gardens…). The answer will therefore be a yes or no.					
Areas covered	Urban areas					
Barriers						
Rating	Binary (yes or no) The assessment team will check the documents proving the development of such schemes (e.g agreements signed between the local authority or contracting authority with the community representative)					
References						
SCALE						
Application	Urban scale					
Details	--					
Multiscale	--					
References	--					

REFERENCES	
[1]	Quartiers Durables Méditerranéens : http://www.envirobatbdm.eu/baroque

<table>
<tr><td rowspan="3">SOC.Ac.24</td><td colspan="6">Mixing functions (yes/no)</td></tr>
<tr><td>ISSUE</td><td colspan="2">CATEGORY</td><td colspan="2">LEVEL</td><td>SCALE</td></tr>
<tr><td>Social</td><td colspan="2">Accessibility</td><td colspan="2">B</td><td>N</td></tr>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td>Description</td><td colspan="6">Mixing functions in neighbourhood i.e planning a mix of different buildings from residential to shops or offices is important for the life quality of residents and users.

The indicator assesses if mixing functions is planned.</td></tr>
<tr><td>Background</td><td colspan="6">It can be linked to “commitment n°12” of the French Ecoquartier label “Promoting diversity of functions for a short distance territory”</td></tr>
<tr><td>References</td><td colspan="6">[1]</td></tr>
<tr><td colspan="7">LEVEL</td></tr>
<tr><td rowspan="2">Derived from</td><td>Software tool</td><td></td><td>Operational data</td><td></td><td>In situ measurements</td><td></td></tr>
<tr><td>Simple Calculations</td><td></td><td>Empirical/Literature</td><td>x</td><td>Other (specify)</td><td></td></tr>
<tr><td>Details</td><td colspan="6">It is a qualitative indicator that focuses on checking the statement: is mixing functions planned for the neighbourhood.
The answer will therefore be a yes or no.</td></tr>
<tr><td>Areas covered</td><td colspan="6">Urban areas</td></tr>
<tr><td>Barriers</td><td colspan="6"></td></tr>
<tr><td>Rating</td><td colspan="6">Binary (yes or no)
The assessment team will check the planning documents provided by the contracting authority</td></tr>
<tr><td>References</td><td colspan="6"></td></tr>
<tr><td colspan="7">SCALE</td></tr>
<tr><td>Application</td><td colspan="6">Urban scale</td></tr>
<tr><td>Details</td><td colspan="6">--</td></tr>
<tr><td>Multiscale</td><td colspan="6">--</td></tr>
<tr><td>References</td><td colspan="6">--</td></tr>
</table>

Appendix B

Overview of available indicators and frequencies in transnational projects and PAS

						level			scale		projects											public a.s.			
No	ISSUE	CATEGORY	CRITERION	INDICATOR	UNITS	basic	standard	advanced	building	neighbourhood	CLUE	FASUDIR	CABEE	CAT-MED	EPISCOPE	ENERBUILD	CECS	OPEN HOUSE	IRH-MED	SuPerBuildings	NewTREND	Protocollo ITACA	QDM	Eco-Quartier BDM	count
1	ECO	equity	Housing value	Affordability of housing property	m2			X		X	A											A			2
2	ECO	equity	Housing value	Affordability of housing rental	%			X		X	A											A			2
3	ECO	equity	Local economy	Support to local economy	%		X			X													S		1
4	ECO	equity	Prevention of prejudice	Prevention of prejudice		X				X									B						1
5	ECO	equity	Social & Economic cohesion	Future evolution and modularity		X				X									B						1
6	ECO	equity	Social & Economic cohesion	Gentrification index	-			X		X		A													1
7	ECO	equity	Social & Economic cohesion	Labor force participation	%		X			X				S											1
8	ECO	equity	Social & Economic cohesion	Potential Employment	%			X		X	A											A			2
9	ECO	equity	Social & Economic cohesion	Social housing ratio	%		X			X				S											1
10	ECO	equity	Social & Economic cohesion	Social mixing and solidarity based economy		X				X									B						1
11	ECO	equity	Social & Economic cohesion	Unemployment rate	%		X			X				S											1
1	ECO	investment costs	Capital cost	Additional costs for energy efficiency and sustainability	€		X		X	X										S					1
2	ECO	investment costs	Capital cost	Investment costs	€/m2		X		X	X											S				1
3	ECO	investment costs	Capital cost	Investment costs aggregated	€			X		X		A													1
4	ECO	investment costs	Capital cost	Participation of local authority in the total investment cost	%		X			X														S	1
5	ECO	investment costs	Performance	Return on investment	%		X	X	X	X		A									S				2
1	ECO	life cycle costs	Benchmarking & Targeting	Verifiable sustainable targets		X			X	X									B						1
2	ECO	life cycle costs	Cost benefit	Cost benefit analysis focused on sustainability		X			X	X									B						1
3	ECO	life cycle costs	Energy cost	Operational energy costs	€/m2		X		X	X											S				1
4	ECO	life cycle costs	Energy cost	Operational energy costs aggregated	€		X	X	X	X		A								S					2
5	ECO	life cycle costs	Non- Energy cost	Operational non-energy costs aggregated	€			X		X		A													1
6	ECO	life cycle costs	Total cost	Cost in operational phase	€		X		X	X										S					1
7	ECO	life cycle costs	Total cost	Life cycle costs	-			X	X							A	A								2
8	ECO	life cycle costs	Total cost	Life cycle costs	€		X		X											S					1
9	ECO	life cycle costs	Total cost	Life cycle costs aggregated	€			X		X		A													1
1	ECO	management	Building operation	Communication and information management	%		X		X	X			S												1
2	ECO	management	Building operation	Information and participation of users		X			X	X									B						1
3	ECO	management	Building operation	Synergy management	-		X			X			S												1
4	ECO	management	Building operation	User information	-	X	X		X							S	B								2
5	ECO	management	Social & Economic cohesion	Environmental activities in primary school	%		X			X				S											1
1	ECO	quality	Architectural	Aesthetic quality	-		X			X										S					1
2	ECO	quality	Architectural	Enhance architectural, cultural and landscape patrimony	yes / no	X				X													B		1
3	ECO	quality	Benchmarking & Targeting	Setting verifiable environmental targets	-		X		X							S	S								2
4	ECO	quality	Building energy performance	Energy optimization during planning	-		X		X							S	S								2
5	ECO	quality	Cultural heritage	Monument or monumental value / Historical value	-		X		X	X										S					1
6	ECO	quality	Process & Planning	Building works quality control		X			X										B						1
7	ECO	quality	Process & Planning	Community management	yes / no	X				X													B		1
8	ECO	quality	Process & Planning	Community planning	yes / no	X				X													B		1
9	ECO	quality	Process & Planning	Finalising the design phase	yes / no	X				X													B		1
10	ECO	quality	Process & Planning	Integrated design in the planning process	-		X			X										S					1
11	ECO	quality	Process & Planning	Internal project management	yes / no	X				X													B		1
12	ECO	quality	Process & Planning	Process and planning quality	-		X		X	X			S			S	S								3
13	ECO	quality	Process & Planning	Project management	yes / no	X				X													B		1
14	ECO	quality	Process & Planning	Working with skilled professionals	yes / no	X				X													B		1
15	ECO	quality	Risk management	Long term stability of value	€		X		X	X										S					1
16	ECO	quality	Risk management	Risk management	-		X			X			S												1
17	ECO	quality	Territorial management & Urban design	Urban complexity, Shannon-Wiener index	-		X			X				S											1
1	ECO	value	Flexibility & Adaptability	Flexibility and adaptability, during the life of the project	yes / no	X				X													B		1
2	ECO	value	Flexibility & Adaptability	Flexibility and adaptability, programming	yes / no	X				X													B		1
3	ECO	value	Process & Planning	Assessing the current situation	yes / no	X				X													B		1
4	ECO	value	Process & Planning	Competent professional team		X				X									B						1
5	ECO	value	Process & Planning	Economic advantage of cluster in comparison to single buildings	-	X	X	X		X			B /S /A												1
6	ECO	value	Process & Planning	Equipment and services pooling		X				X									B						1
7	ECO	value	Social & Economic cohesion	Tourist frequency trends, seasonality overnight stays	%		X			X				S											1
8	ECO	value	Social & Economic cohesion	Tourist frequency trends, seasonality tourists	%		X			X				S											1
1	ENV	biodiversity	Building site	Ecological quality of the building site	-		X		X							S	S								2
2	ENV	biodiversity	Land preservation	During programming, design and before the beginning of the works; the	yes / no	X				X													B		1
3	ENV	biodiversity	Public spaces	Change in ecological value of the site, species	-		X		X	X								S							1
4	ENV	biodiversity	Public spaces	Connectivity of green spaces	%			X		X	A											A			2

5	ENV	biodiversity	Public spaces	Diversity	yes / no	X				X													B		1
6	ENV	biodiversity	Public spaces	Ecological corridors and continuity	yes / no	X				X													B		1
7	ENV	biodiversity	Public spaces	Use of local plants	%			X		X	A											A			2
8	ENV	biodiversity	Public spaces	Vegetal areas	%		X			X														S	1
1	ENV	energy	Building vertical transportation	Escalators and moving walks design and efficiency	-		X		X									S							1
2	ENV	energy	Building vertical transportation	Lift design and efficiency	-		X		X									S							1
3	ENV	energy	Building vertical transportation	Stairs and ramps planning	-		X		X									S							1
4	ENV	energy	Embodied energy	Embodied energy demand	kWh/m2			X	X			A													1
5	ENV	energy	Final energy	Annual heat generation for space heating and DHW	kWh/m2 yr		X		X	X					S										1
6	ENV	energy	Final energy	Cooling demand	kWh/m2 yr		X	X	X							S	A								2
7	ENV	energy	Final energy	Delivered energy demand	kWh/m2 yr			X	X	X											A				1
8	ENV	energy	Final energy	Energy consumption	Toe/inhabitant yr		X			X				S											1
9	ENV	energy	Final energy	Heating demand	kWh/m2 yr		X	X	X							S	A								2
10	ENV	energy	Final energy	Peak Energy demand		X			X	X									B						1
11	ENV	energy	Primary energy	Abiotic Depletion Potential, ADP_Enr	kWh/m2		X		X									S							1
12	ENV	energy	Primary energy	Consumption of non-renewable primary energy	kWh/m2 yr		X		X	X										S					1
13	ENV	energy	Primary energy	Operational primary energy	kWh/m2 yr		X	X	X	X		A				S	A				A				4
14	ENV	energy	Primary energy	Primary energy for cooling	%		X			X			S												1
15	ENV	energy	Primary energy	Primary energy for heating	%		X	X		X	A		S									A			3
16	ENV	energy	Primary energy	Primary energy for public lighting	%		X			X			S												1
17	ENV	energy	Primary energy	Primary energy for public lighting	kWh/yr			X		X	A											A			2
18	ENV	energy	Primary energy	Total primary energy demand	kWh/m2		X	X	X	X		A						S							2
19	ENV	energy	Renewables	Renewable electricity production	%		X			X														S	1
20	ENV	energy	Renewables	Renewable energy on site	%		X	X	X	X		A									S				2
21	ENV	energy	Renewables	Share of renewable primary energy in total primary energy demand	kWh/m2		X		X									S							1
22	ENV	energy	Renewables	PV-power plant	kWh/a		X		X								S								1
23	ENV	energy	Virtual power systems	Electric energy and Virtual power systems	%		X			X			S												1
1	ENV	impacts	Eco-mobility	Eco-mobility potential of a building in its context	km/unit		X		X	X										S					1
2	ENV	impacts	Effects on surrounding buildings	Impacts on surrounding buildings	%		X	X		X			S /A												1
3	ENV	impacts	Emissions	Acidification potential	kgSO2-eq/m2yr		X	X	X	X		A						S							2
4	ENV	impacts	Emissions	Acidifying emissions, Intensity	%			X		X	A											A			2
5	ENV	impacts	Emissions	Annual CO2 emissions	kgCO2/m2 yr		X		X	X					S										1
6	ENV	impacts	Emissions	CO2 emission factor heat supply	kg/kWh	X			X	X					B										1
7	ENV	impacts	Emissions	CO2 emissions	tonnes CO2-eq/yr		X			X				S											1
8	ENV	impacts	Emissions	Eutrophication potential	kgPO4-eq/m2yr		X	X	X	X		A						S							2
9	ENV	impacts	Emissions	Global Warming Potential	kgCO2-eq/m2 yr		X	X	X	X								S		S/A	S/A				3
10	ENV	impacts	Emissions	Global Warming Potential	-			X		X		A													1
11	ENV	impacts	Emissions	Global Warming Potential	kgCO2-eq/m2 yr		X	X	X	X						S	S/A								2
12	ENV	impacts	Emissions	Intensity of GHG emissions	%		X	X		X	A		S									A			3
13	ENV	impacts	Emissions	Ozone depletion potential	kgR11-eq/m2yr		X	X	X	X		A						S							2
14	ENV	impacts	Emissions	Photochemical Ozone creation potential	kgC2H4-eq/m2yr		X	X	X	X		A						S							2
15	ENV	impacts	Emissions	Photo-oxidants emissions,intensity	%			X		X	A											A			2
16	ENV	impacts	Light pollution	Light on properties	lx		X			X								S							1
17	ENV	impacts	Light pollution	Light pollution	%			X		X	A											A			2
18	ENV	impacts	Light pollution	Light pollution		X				X									B						1
19	ENV	impacts	Light pollution	Luminaire Intensity	cd		X			X								S							1
20	ENV	impacts	Light pollution	Luminance	cd/m2		X			X								S							1
21	ENV	impacts	Light pollution	Upward Light			X			X								S							1
22	ENV	impacts	Outdoor conditions	Monitoring of air quality	%			X		X	A											A			2
23	ENV	impacts	Outdoor conditions	Thermal comfort of outdoor areas	%			X		X	A											A			2
24	ENV	impacts	Raw materials	Abiotic Depletion Potential elements	kgSB-eq/m2yr		X	X	X	X		A						S							2
25	ENV	impacts	Solid waste management	Accessibility to differentiated waste collection	%			X		X	A											A			2
26	ENV	impacts	Solid waste management	Accessibility to waste sorting facilities	%		X		X	X			S												1
27	ENV	impacts	Solid waste management	Composting	-		X		X									S							1
28	ENV	impacts	Solid waste management	Construction and demolition waste generation	kg/m2		X		X	X										S					1
29	ENV	impacts	Solid waste management	Recyclable waste storage	m2		X		X									S							1
30	ENV	impacts	Water pollution	Water pollution due to material leaching	mg/m2 yr			X	X	X										A					1
1	ENV	land use	Preservation	Conservation of built environment	%			X		X	**A**											A			2
2	ENV	land use	Preservation	Preservation of land	%	X		X	X	X	A		B									A			3
3	ENV	land use	Quality	Site quality	-	X				X									B						1
4	ENV	land use	Soil sealing	Permeability of site / land	%		X	X	X	X	A	A								A	S	A			5
5	ENV	land use	Spatial planning	Change of land use	-		X			X								S		S					2
6	ENV	land use	Spatial planning	Imperviousness change, Imperviousness coefficient	-		X			X								S							1
7	ENV	land use	Urban design	Green zones & recreation areas	m2 /inhabitant		X			X				S											1
8	ENV	land use	Urban design	Green zones & recreation areas density	%		X			X				S											1
9	ENV	land use	Urban design	Green zones & recreation areas proximity	%		X			X				S											1

10	ENV	land use	Urban design	Outdoor space	-	X				X									B						1
11	ENV	land use	Urban design	Population density	inhabitants/ha		X			X				S											1
12	ENV	land use	Urban design	Urban compactness	dwelling/m²		X			X														S	1
13	ENV	land use	Urban design	Urban compactness	m3/m2		X			X				S											1
14	ENV	land use	Urban design	Urban context	-	X				X									B						1
15	ENV	land use	Urban design	Urban conversion	%		X			X														S	1
1	ENV	materials	ECO materials	Low-pollutant and low-emission materials	-		X		X							S	S								2
2	ENV	materials	Emmissions	Building materials and construction, OI3 index	-			X	X	X						A	A								2
1	ENV	water	Embodied water	Embodied water use	m3/m2 yr		X		X	X										S					1
2	ENV	water	Freshwater	Intensity of water treatment	%			X		X		A													1
3	ENV	water	Freshwater	Operational water use	m3/yr		X		X	X										S					1
4	ENV	water	Freshwater	Water consumption	l/inhabitant day		X			X				S											1
5	ENV	water	Rainwater	Dedicated network	yes / no	X				X													B		1
6	ENV	water	Rainwater	Intensity of rainwater usage	%		X			X			S												1
7	ENV	water	Rainwater	Landscaped and accessible retention ponds and ditches	yes / no	X				X													B		1
8	ENV	water	Rainwater	Rainwater collection from roofs	%		X			X													S		1
9	ENV	water	Rainwater	Respecting streaming continuity	yes / no	X				X													B		1
10	ENV	water	Total water use	Operational water use and waste water	m3		X		X	X								S							1
11	ENV	water	Wastewater	Intensity of wastewater treatment	%			X		X	A											A			2
12	ENV	water	Wastewater	Waste management & removal	l/inhabitant day		X			X				S											1
13	ENV	water	Wastewater	Waste management & removal	%		X			X				S											1
14	ENV	water	Wastewater	Wastewater management	%			X		X	A											A			2
15	ENV	water	Wastewater	Wastewater management	m3/m2 yr		X		X	X										S					1
16	ENV	water	Water use	Water consumption & use of rainwater	-		X		X								S								
1	SOC	accessibility	Broadband communication network	Access to a broadband communication network, areas	%			X		X	A											A			2
2	SOC	accessibility	Broadband communication network	Access to a broadband communication network, population	%		X			X			S												1
3	SOC	accessibility	Flexibility	Flexibility of residential buildings	%		X		X	X			S												1
4	SOC	accessibility	Flexibility	Flexibility use	%			X		X	A											A			2
5	SOC	accessibility	Public space planning	Access to parks and open spaces	-			X		X		A													1
6	SOC	accessibility	Public space planning	Adaptation to users practices	yes/no	X				X													B		1
7	SOC	accessibility	Public space planning	Availability of green spaces	%			X		X	A											A			2
8	SOC	accessibility	Public space planning	Availability of public green spaces	m² /inhabitant		X			X														S	1
9	SOC	accessibility	Public space planning	Barrier-Free accessibility of the district	%			X		X		A													1
10	SOC	accessibility	Public space planning	Community gardens	yes / no	X				X													B		1
11	SOC	accessibility	Public space planning	Parks and vegetated spaces network	yes/no	X				X													B		1
12	SOC	accessibility	Public space planning	Public space quality	yes/no	X				X													B		1
13	SOC	accessibility	Public space planning	Shared community spaces	yes / no	X				X													B		1
14	SOC	accessibility	Services & Leisure facilities	Access to services and facilities	%			X		X		A													1
15	SOC	accessibility	Services & Leisure facilities	Collective facilities and outsourcing of services	%		X			X			S												1
16	SOC	accessibility	Services & Leisure facilities	Community support	yes / no	X				X													B		1
17	SOC	accessibility	Services & Leisure facilities	Proximity to leisure facilities	%			X		X	A											A			2
18	SOC	accessibility	Services & Leisure facilities	Proximity to services	%		X	X		X	A			S								A			3
19	SOC	accessibility	Services & Leisure facilities	Proximity to services and leisure facilities	%		X			X			S												1
20	SOC	accessibility	Services & Leisure facilities	Social gatherings and common cluster activities	-		X			X			S												1
21	SOC	accessibility	Street network	Cyclomatic complexity of the street network	-			X		X	A											A			2
22	SOC	accessibility	Urban planning	Development and integration of land parcels	%			X		X	A											A			2
23	SOC	accessibility	Urban planning	Homogeneity of the urban fabric	%			X		X	A											A			2
24	SOC	accessibility	Urban planning	Mixing functions	yes /no		X			X													B		1
1	SOC	acoustic comfort	Noise - Indoor	Indoor A-weighted sound pressure level	dBA		X		X	X											S				1
2	SOC	acoustic comfort	Noise - Indoor	Weighted sound pressure from ventilation	dBA			X	X							A	S								2
3	SOC	acoustic comfort	Noise - Outdoor	Building area over noise limit	%			X		X		A													1
4	SOC	acoustic comfort	Noise - Outdoor	Noise Pollution, silence quality - day	%		X			X				S											1
5	SOC	acoustic comfort	Noise - Outdoor	Noise Pollution, silence quality - night	%		X			X				S											1
6	SOC	acoustic comfort	Noise pollution management	Accoustics studies	yes / no	X				X													B		1
1	SOC	air quality	Indoor air quality	Concentration of pollutants	µg/m3		X		X	X										S					1
2	SOC	air quality	Outdoor air quality	Number of days with bad air quality	days/y		X			X				S											1
1	SOC	safety&security	Energy & Management systems	Objective/subjective safety measures	-		X			X			S												1
2	SOC	safety&security	Green production	Local production of food	m²/inhabitant		X			X			S												1
3	SOC	safety&security	Mobility	Pedestrian safety paths	%			X		X	A											A			2
1	SOC	thermal comfort	Indoor conditions	Predicted Mean Vote, PMV	-		X		X	X										S					1
2	SOC	thermal comfort	Indoor conditions	Predicted Percentage Dissatisfied, PPD	%		X		X	X										S					1
3	SOC	thermal comfort	Indoor conditions	Thermal comfort in summer	-			X	X							A	A								2
4	SOC	thermal comfort	Outdoor conditions	Exploitation of local resources: sun, daylight, wind	-			X		X			A												1
5	SOC	thermal comfort	Outdoor conditions	Heat island effect	-	X				X									B						1
6	SOC	thermal comfort	Outdoor conditions	Heat island effect, urban	yes / no	X				X													B		1
7	SOC	thermal comfort	Outdoor conditions	Microclimate Index I	-		X	X		X		A									S				2

1	SOC	transport	Mobility & Alternative transportation	Availability of safe bicycle routes	m			X		X	A											A			2
2	SOC	transport	Mobility & Alternative transportation	Bicycle and pedestrian network quality	-			X		X		A													1
3	SOC	transport	Mobility & Alternative transportation	Bicycle facilities	-			X		X		A													1
4	SOC	transport	Mobility & Alternative transportation	Car sharing pool/station	yes/no		X			X													S		1
5	SOC	transport	Mobility & Alternative transportation	Contiguity of bicycle and car routes	%			X		X	A											A			2
6	SOC	transport	Mobility & Alternative transportation	Pedestrian streets and walkways, area	%		X			X				S											1
7	SOC	transport	Mobility & Alternative transportation	Pedestrian streets and walkways, length	%		X	X		X	A			S								A			3
8	SOC	transport	Mobility & Alternative transportation	Proximity to bicycle lanes and paths	%		X			X				S											1
9	SOC	transport	Mobility & Alternative transportation	Shared mobility	%		X	X	X	X	A		S									A			3
10	SOC	transport	Parking facilities	Parking facilities	number/dwelling		X			X														S	1
11	SOC	transport	Parking facilities	Parking facilities, Off-street parking spaces	%			X		X		A													1
12	SOC	transport	Parking facilities	Parking places with innovative features	%			X		X		A													1
13	SOC	transport	Parking facilities	Bicycle Parking	%		X		X								S								1
14	SOC	transport	Public transportation	Access to public transport nodes, areas	%			X		X		A													1
15	SOC	transport	Public transportation	Access to public transport nodes, population	%		X	X		X	A			S							S	A			4
16	SOC	transport	Public transportation	Access to public transport, District Accessibility Index	-		X			X											S				1
17	SOC	transport	Public transportation	Accessibility of public transport, stops and frequency	-		X		X							S	S								2
18	SOC	transport	Public transportation	Accessibility to public transport, Lense index	-		X		X	X			S												1
19	SOC	transport	Public transportation	Dwellings with access to public transport	%		X			X														S	1
20	SOC	transport	Street network	Connectivity of the street network	number/m2			X		X	A											A			2
21	SOC	transport	Street network	Cul-de-sac roads and path ratio	%		X			X													S		1
22	SOC	transport	Street network	Scale of the street network	m			X		X	A											A			2
23	SOC	transport	Street network	Traffic modal split	%		X			X				S											1
1	SOC	Visual comfort	Artificial lighting	Illuminance	lx		X	X	X	X										S/A					1
2	SOC	Visual comfort	Dayligthing	Daylight factor	%		X	X	X	X						A	S/A			S/A					3
						43	**125**	**77**	**74**	**192**	**35**	**28**	**24**	**26**	**3**	**16**	**19**	**22**	**15**	**23**	**12**	**35**	**29**	**8**	