

OPEN HOUSE

ASSESSMENT GUIDELINE



Version 1.2
New Office Buildings
July 2013

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Introduction

The Assessment Guideline is the main assessment document developed by all European partners of the project in a transparent and open process. It is the technical basis and includes the detailed description of each issue assessed.

Technical Information

Evaluation framework

The evaluation framework defines the hierarchical structure of the assessment methodology. It is composed of 6 main **categories**:



Figure 1: Overview of the 6 assessment categories of the OPEN HOUSE framework

Each **category** is composed of several **indicators** assessing different key issues for the sustainability performance of the project.

Each **indicator** consists in one or several **sub-indicators** that evaluate a precise issue covered by the indicator topic.

Indicator structure

Each indicator is described with the same sections:

Objective,
Assessment Methodology,
Calculation and Rating,
Documentation Guidelines,
Relation to other indicators,
Resources,
and Attachments.

Scoring process

The scoring process describes the way points are calculated, from the evaluation of each sub-indicator to the global performance of the building.

Fulfilling requirements set by sub-indicators awards a certain amount of points ranging from 0 to 100 depending on the performance met. Each sub-indicator is weighted from 0 to 4, with 0 meaning the sub-indicator is irrelevant, and 4 it is of high importance.

The score for each indicator is the weighted average of the points awarded for the sub-indicators.

Each indicator is weighted from 0 to 4, and the score achieved for each category is the weighted average of the points awarded for the indicators.

The final building performance is obtained by calculating the average of the environmental, social and economic category scores. (Environmental, social and economic categories are equally weighted)

The three other categories are evaluated separately.

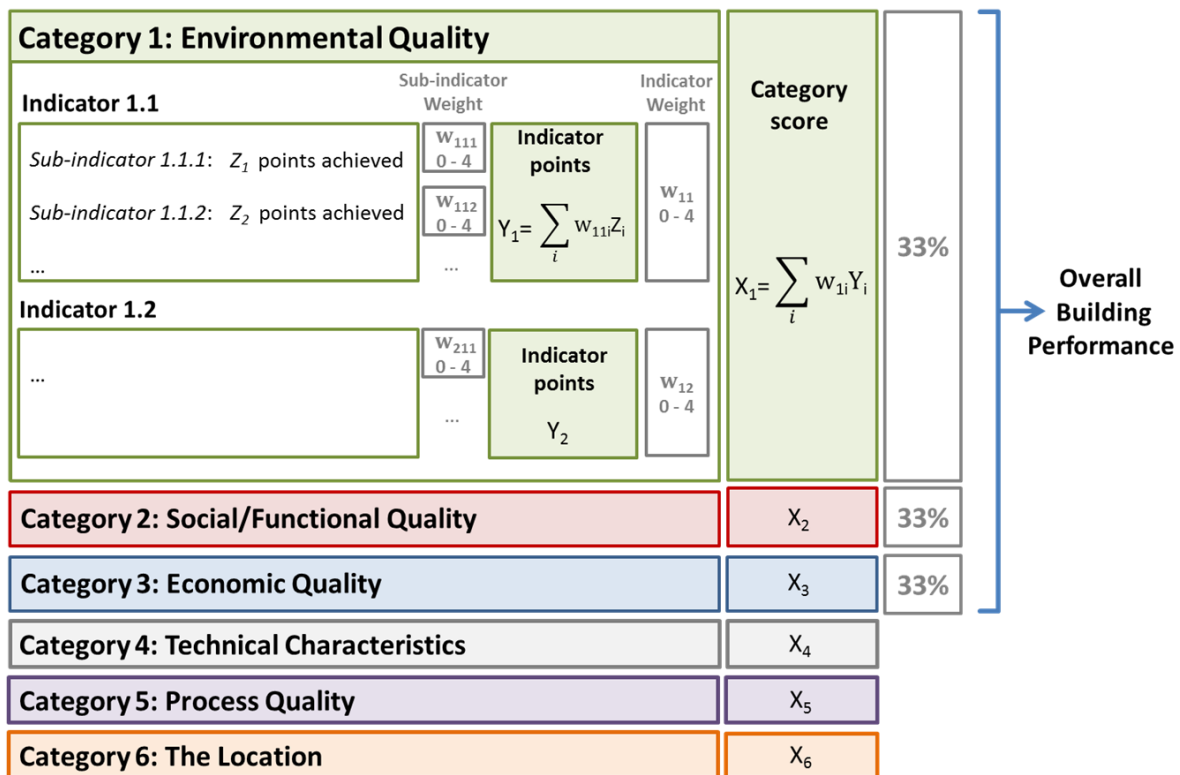


Figure 2: Overview of the scoring process

Scoring card

The scoring card is the table containing all information about the score achieved for each sub-indicator, indicator, category and overall building performance. It also displays the different weightings for each sub-indicator, indicator and category.

Scoring card:

	Sub-indicator Weight [EU]
Environmental Quality	
1.1 Global Warming Potential (GWP)	
1.1.1 Global Warming Potential (GWP)	4
1.2 Ozone Depletion Potential (ODP)	
1.2.1 Ozone Depletion Potential (ODP)	4
1.3 Acidification Potential (AP)	
1.3.1 Acidification Potential (AP)	4
1.4 Eutrophication Potential (EP)	
1.4.1 Eutrophication Potential (EP)	4
1.5 Photochemical Ozone Creation Potential (POCP)	
1.5.1 Photochemical Ozone Creation Potential (POCP)	4
1.7 Biodiversity and Depletion of Habitats	
1.7.1 Change in ecological value of the site	4
1.8 Light Pollution	
1.8.1 Light on properties	4
1.8.2 Luminaire intensity	4
1.8.3 Upward light	4
1.8.4 Luminance	4
1.9 Abiotic depletion of non renewable fossil fuels due to non renewable Primary Energy Demand (ADP_Enr)	
1.9.1 Abiotic Depletion Potential (ADP_Enr)	4
1.10 Total Primary Energy Demands and Share of Renewable Primary Energy	
1.10.1 Total Primary Energy Demand	4
1.10.2 Share of renewable Primary Energy in Total Primary Energy Demand	-
1.11 Water and Waste Water	
1.11.3 Operational Water Use and Waste Water	4
1.12 Land use	
1.12.1 Site location	4
1.12.2 Imperviousness change	2
1.13 Waste	
1.13.1 Recyclable Waste Storage	4
1.13.2 Composting	4
1.14 Energy efficiency of building equipment (lifts, escalators and moving walkways)	
1.14.1 Stairs and ramps planning	4
1.14.2 Lift design and efficiency	4
1.14.3 Escalator design and efficiency	4
1.14.4 Moving walkway design and efficiency	4
1.15 Contribution to the depletion of abiotic resources - non fossil fuels (ADPelement)	
1.15.1 Abiotic Depletion Potential (ADPelements)	4

Social / Functional Quality

2.1 Barrier-free Accessibility

2.1.1 Barrier-free Accessibility	1
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2.2 Personal Safety and Security of Users

2.2.1 The satisfaction of minimum health and safety requirements in the workplace	4
2.2.2 Reduction of the extent of damage if an accident should occur inside and outside the building	4
2.2.3 Measures preventing building users from crime	2

2.3 Thermal Comfort

2.3.1 Operative temperature	4
2.3.2 Radiant temperature asymmetry and floor temperature	1
2.3.3 Draught, air velocity	2
2.3.4 Humidity in indoor air	1

2.4 Indoor Air Quality

2.4.1 Occupancy-based ventilation rates	4
2.4.2 Indoor air contamination with the most relevant indoor air pollutants (formaldehyde, naphthalene, toluene, xylene, styrene) [Existing buildings]	4
2.4.3 CO ₂ concentration above outdoor level [Existing buildings]	4
2.4.4 Subjective reaction as classification of the indoor air quality [Existing buildings]	4
2.4.5 Occurrence of Radon	4

2.5 Water Quality

2.5.1 Constant Water Supply through the day	4
2.5.2 Use of alternative water supplies	4
2.5.3 Water Disinfection	4

2.6 Acoustic Comfort

2.6.1 Indoor ambient noise levels in unoccupied staff/office areas	4
2.6.2 Reverberation period	4

2.7 Visual Comfort

2.7.1 Availability of daylight throughout the building	4
2.7.2 Availability of daylight in regularly used work areas	4
2.7.3 View to the outside	3
2.7.4 Preventing glare in daylight	3
2.7.5 Preventing glare in artificial light	3
2.7.6 Light distribution in artificial lighting conditions	3
2.7.7 Color rendering	3
2.7.8 Blinking and flashing lights	2

2.8 Operation Comfort

2.8.1 Ventilation	3
2.8.2 Shading	3
2.8.3 Glare prevention	3
2.8.4 Temperatures during the heating period	3
2.8.5 Temperatures outside the heating period	3
2.8.6 Regulation of daylight and artificial light	3
2.8.7 Ease of operation	4

2.9	Service Quality	
2.9.1	Availability of services in the building	4
2.9.2	Service integration in building connected outdoor areas	4
2.11	Public Accessibility	
2.11.1	General public access to the building	4
2.11.2	External facilities open to the public	2
2.11.3	Interior facilities, such as libraries or cafeteria, open to the public	2
2.11.4	Possibility of third party to rent rooms in the building	2
2.11.5	Variety of uses for public areas	4
2.12	Noise from Building and Site	
2.12.1	Noise from Building and Site	4
2.16	Bicycle Amenities	
2.16.1	Number of bicycle parking spaces available for building users	4
2.16.2	Distance to bicycle parking system from a main building entrance	3
2.16.3	Existence of facilities for bicycle comfort and security	3
2.17	Material Sourcing	
2.17.1	Material Sourcing: Wood	4

Economic Quality		
3.1	Building-related Life Cycle Costs (LCC)	
3.1.1	Life cycle costs	4
3.1.3	Sensitivity analysis [design phase]	3
3.2	Value Stability	
3.2.1	Area Efficiency	2
3.2.2	Conversion feasibility	4
3.2.3	Energy and water dependency	1
3.2.4	Building performance management	1

Technical Characteristics

4.3	Cleaning and maintenance	
4.3.1	Load-bearing structure	4
4.3.2	Non-load-bearing external structures	4
4.3.3	Non-load-bearing interior structures	4
4.5	Noise Protection	
4.5.1	Airborne sound insulation with respect to exterior sound	4
4.5.2	Airborne sound insulation with respect to other working areas and to personal working areas	4
4.5.3	Insulation from impact sound with respect to other working areas and to personal working areas	4
4.5.4	Insulation from sound created by building services (water system and other services)	4
4.6	Quality of the building shell	
4.6.1	Median thermal transmittance coefficients of building components \bar{U}	3
4.6.2	Thermal Bridges	1
4.6.3	Air permeability class (window air-tightness)	3
4.6.4	Amount of condensation inside the structure	2
4.6.5	Air exchange n_{50} and if necessary q_{50}	1
4.6.6	Solar heat protection	1
4.7	Ease of Deconstruction, Recycling, and Dismantling	
4.7.1	Effort for dismantling /disassembly – divided into 5 steps	4
4.7.2	Effort for sorting/separation – divided into 3 steps	4
4.7.3	Verification of the inclusion of a recycling/disposal concept with information about construction components in the certification application	4

Process Quality

5.1 Project Brief Strategy		
5.1.1 Project Brief		3
5.1.2 Architectural competition		1
5.2 Integrated Planning		
5.2.1 Multidisciplinary formation of the planning team		4
5.2.2 Qualification of the Integrated Project Team		4
5.2.3 Design Charrette / Preparation of consultation		4
5.2.4 Integrated planning process		4
5.2.5 Participation of future building users and other relevant stakeholders / Community impact consultation		4
5.3 Building Performance Targets		
5.3.1 Energy target		4
5.3.2 Water target		4
5.3.3 Waste concept		4
5.3.4 Optimization of daylight and artificial lighting		4
5.3.5 Conversion, dismantling and recycling		4
5.3.6 Concept for ease of cleaning and maintenance		4
5.4 Evidence of Sustainability during Bid Invitation and Awarding		
5.4.1 Integration of Sustainability Aspects during Bid Invitation		4
5.4.2 Integration of Sustainability Aspects during Awarding		4
5.5 Construction Site impact/ Construction Process		
5.5.1 Low-waste and recycling on construction site		4
5.5.2 Low-noise construction site		4
5.5.3 Low-dust construction site		4
5.5.4 Environmental protection at the construction site		4
5.6 Quality of the Executing Contractors/Pre-Qualification		
5.6.1 Quality of Executing Contractors / Pre-Qualification		4
5.7 Quality Assurance of Construction Execution		
5.7.1 Documentation of the materials, auxiliary materials, and safety data sheets		4
5.7.2 Measurements for quality control		4
5.8 Commissioning		
5.8.1 Commissioning process management and documentation		4
5.9 Handover and Performance Evaluation		
5.9.1 Handover & Documentation		4
5.9.2 Building Performance Improvement		4

The Location

6.1 Risks at the Site

6.1.1	Earthquakes	2
6.1.2	Landslides	3
6.1.3	Volcanic eruptions	1
6.1.4	Tsunamis	1
6.1.5	Extreme temperatures	2
6.1.6	Forest fires	2
6.1.7	Drought	1
6.1.8	Floods	2
6.1.9	Storms	3
6.1.10	Avalanches	1
6.1.11	Technological hazard/Chemical plants accidents	2
6.1.12	Technological hazard/Contaminant release and explosions	2
6.1.13	Technological hazard/Radioactive contamination from nuclear power plants accidents	2

6.2 Circumstances at the Site

6.2.1	Outdoor Air Quality	4
6.2.2	Ambient Noise Level	4
6.2.3	Soil and building plot contamination	4
6.2.5	Urban Heat Island Effect	4
6.2.6	Electromagnetic pollution	4

6.3 Options for Transportation

6.3.1	Accessibility of the nearest railroad station	3
6.3.2	Accessibility of the nearest public local transportation stop	3
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	3
6.3.4	Availability of Walking and Bike Path	4

6.5 Access to amenities

6.5.1	Vicinity to Gastronomy facilities	4
6.5.2	Vicinity to Local Supply facilities	4
6.5.3	Vicinity to Parks and Open Spaces	4
6.5.4	Vicinity to Education facilities	4
6.5.5	Vicinity to Public Administration facilities	4
6.5.6	Vicinity to Medical Care facilities	4
6.5.7	Vicinity to Sport facilities	3
6.5.8	Vicinity to Leisure facilities	2
6.5.9	Vicinity to Services	4

OPEN HOUSE

ASSESSMENT GUIDELINE

Environmental Quality

- 1.1 **Global Warming Potential (GWP)**
- 1.2 **Ozone Depletion Potential (ODP)**
- 1.3 **Acidification Potential (AP)**
- 1.4 **Eutrophication Potential (EP)**
- 1.5 **Photochemical Ozone Creation Potential (POCP)**
- 1.7 Biodiversity and Depletion of Habitats
- 1.8 Light Pollution
- 1.9 **Abiotic depletion of non renewable fossil fuels due to non renewable Primary Energy Demand (ADP_Enr)**
- 1.10 **Total Primary Energy Demand and Percentage of Renewable Primary Energy**
- 1.11 **Water and Waste Water**
- 1.12 **Land use**
- 1.13 **Waste**
- 1.14 Energy efficiency of building equipment (lifts, escalators and moving walks)
- 1.15 **Contribution to the depletion of abiotic resources - non fossil fuels (ADPelement)**

Note: Core indicators are in bold

Indicator 1.1 Global Warming Potential (GWP)

(adapted from DGNB/BNB)

Core Indicator

1. Objective

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.

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 emissions¹. At the same time, the construction industry provides work for over 12.7 million people in the EU² and generates about one fifth (20.3 %) of the combined industrial and construction sectors' value added³. 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 2020⁴.

Therefore, this indicator, aiming at the reduction of buildings' global warming performance, highly contributes to the achievement of the EU targets mentioned above.

2. Assessment Methodology

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.

Goal and scope definition

The goal of all LCA studies is to analyse the environmental performance of the respective buildings' life cycles. The scope of the building assessment therefore includes the following life cycle stages:

- production: raw material supply, transport to manufacturing, manufacturing and transport to the construction site of products used in the building (Figure 1, modules A1-A4),
- use stage: a scenario is defined including use and replacement, including end-of-life of replaced products (Figure 1, modules B1 and B4); in addition the operational energy use is considered (Figure 1, module B6),
- end-of-life stage: waste processing and disposal of the building, (Figure 1, modules C3 and C4),
- a scenario for potential benefits and loads beyond the system boundaries, including loads for reuse and recycling as well as benefits from recycling potentials (Figure 1, module D).

¹ <http://www.e2b-ei.eu/default.php>

² <http://osha.europa.eu>

³ http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Industry_and_construction_statistics

⁴ Energy 2020 - A strategy for competitive, sustainable and secure energy

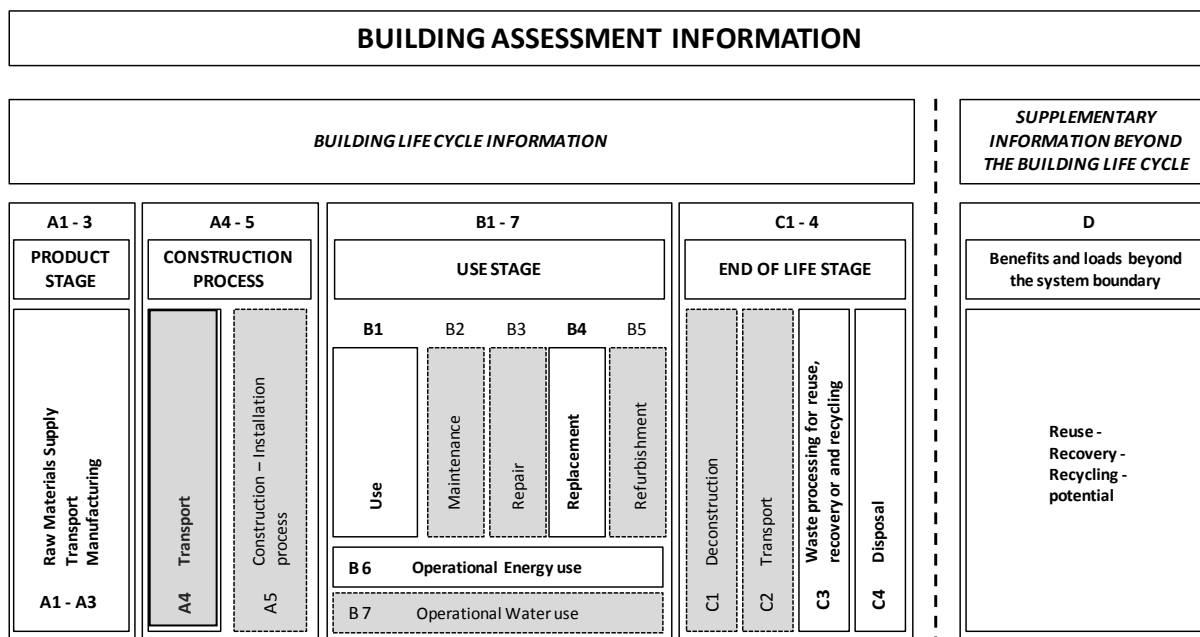


Figure 1: Building Life Cycle Phases according to FprEN 15978, adapted

The following processes are not included:

- Transport to construction side (Figure 1, module A4),
- Construction – Installation process (Figure 1, module A5),
- Energy use for user equipment during reference study period,
- Operational water use (Figure 1, module B7),
- Maintenance, repair and refurbishment during reference study period – (Figure 1, modules B2, B3 and B5),
- Deconstruction and transport to waste processing / disposal (Figure 1, modules C1 and C2),
- Transport to recycling (Figure 1, module C2).

The reference study period is defined with **50** years.

The functional equivalent (quantified functional requirements, intended use and/or technical requirements⁵), which is used as basis for comparison, is defined to be $m^2_{NFA} \cdot \text{year}$.

Inventory Analysis and Impact Assessment

During the inventory analysis of an LCA, emissions and resource consumption are identified, calculated and summed up over the life cycle of a product. Within building LCAs, separate calculations are carried out for the buildings` elements (product and end-of-life stage) and for the determination of emissions and resource uses during operation (see Equations 1, 2 and 3).

The inventory analysis of the buildings` elements mainly consists in providing quantitative information on the building elements used (see also Documentation Guidelines). Building compartments to be included are

1. Exterior walls and basement walls incl. windows and coatings,
2. Roof,
3. Ceilings incl. flooring and floor coverings / coatings,
4. Floor slab incl. flooring, floor coverings; floor slab above air,
5. Foundations,
6. Interior walls incl. coatings and supports,
7. Heat generation units.

⁵ prEN 15643-1:2010: Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework

For these, respective datasets are picked out from the ESUCO database, which include environmental profiles of the used component: for the respective component, a standardized LCA has been conducted earlier and the results are provided within this database format.

For the module A4, which contains transports from manufacturing to the construction site, information about transport distances and means of transportation have to be provided and connected to the respective ESUCO data sets⁶.

For the analysis of the use stage, a scenario has to be set up, including supply and disposal systems and repairs. For supply and disposal, values for end energy consumption for electricity and heat have to be derived from the respective national implementation of the EPBD directive⁷. Heating units as well as the electricity demand calculated have to be listed and linked to the respective ESUCO datasets.

For repair, calculations have to be made for all materials, building components and surfaces with service lives of less than 50 years. Sources for service lives are the “Guideline for Sustainable Building” for construction materials and the VDI 2067 for building services.

Also for the end-of-life stage, a scenario has to be defined for the recycling and disposal of the building materials that remain in the building after the end of the reference study period. So for each material, one end-of-life options has to be chosen and linked to the respective ESUCO dataset:

- Metals → recycling → ”metal recycling potential”,
- Mineral building materials → recycling → ”construction rubble processing”,
- Materials with a heating value → thermal recycling → respective material group in ESUCO database,
- Heat producers → Dataset corresponding to the manufacturing process,
- All other materials that can be deposited at construction or household waste sites → disposal at waste site → appropriate ESUCO dataset.

Within the impact assessment, the emissions determined in the inventory analysis are classified regarding their contributions to different environmental impacts and then characterized. Using characterization factors, they are converted into equivalents of lead emissions for the different impact categories (example: emissions contributing to Global Warming Potential are transformed to CO₂-equivalents, emissions contributing to Acidification Potential are transformed to SO₂-equivalents).

By using environmental profiles such as provided by ESUCO, the step of impact assessment has already been done by the data providers: Environmental profiles are given by providing the LCA results for the respective component in form of different environmental impact categories. These results are then used within the building LCA.

Interpretation

Resulting impacts are then evaluated against reference values to determine the respective indicator assessment (see overall Rating / Assessment Matrix).

⁶ It is suggested to use European average datasets. This means that the datasets represent technologies on average levels for Europe. These construction materials also contain European boundary conditions such as European datasets for electric or thermal energy or intermediate products and represent a common European market for construction materials. Using such European average datasets does not show the variability, for instance of the industry producing construction materials in Europe and thus has the advantage not to bias the analysis of the life cycle models by accounting for differences in different production techniques. This bias would reduce the significance of the results as the clear denotation of environmental hotspots in the structure and design of buildings would contain higher uncertainties on the origin of environmental impacts.

3. Calculation and Rating

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.

$$\mathbf{GWP_{LC} = GWP_C + GWP_O} \quad (1)$$

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:

$$\mathbf{GWP_C = (GWP_{MA} + GWP_{MC}) / t_d + GWP_{MB1,4}} \quad (2)$$

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:

$$\mathbf{GWP_O = GWP_{MB6,E} + GWP_{MB6,H}} \quad (3)$$

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)].

⁸ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

⁹ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

¹⁰ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

Rating Method

The “designed building” is rated against a case-specific reference building.

Global Warming Potential for Reference Building

$$R_{GWP} = GWP_{LCref} = GWP_{Cref} + GWP_{Oref} \quad (4)$$

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 $[\text{kg CO}_2 \text{ equiv.}/(\text{m}^2_{NFA} * \text{a})]$ 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 $[\text{kg CO}_2 \text{ equiv.}/(\text{m}^2_{NFA} * \text{a})]$.

The reference value for construction GWP_{Cref} is calculated as follows:

$$GWP_{Cref} = (GWP_{MAref} + GWP_{MCref}) / t_d + GWP_{MB1,4ref} \quad (5)$$

where

GWP_{MAref}	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 $[\text{kg CO}_2 \text{ equiv.}/(\text{m}^2_{NFA})]$,
GWP_{MCref}	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 $[\text{kg CO}_2 \text{ equiv.}/(\text{m}^2_{NFA})]$,
$GWP_{MB1,4ref}$	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 $[\text{kg CO}_2 \text{ equiv.}/(\text{m}^2_{NFA} * \text{a})]$
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

$$GWP_{Oref} = GWP_{MB6,Eref} + GWP_{MB6,Href} \quad (6)$$

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 $[\text{kg CO}_2 \text{ equiv.}/\text{m}^2_{NFA} * \text{a}]$,
$GWP_{MB6,Href}$	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 $[\text{kg CO}_2 \text{ equiv.}/\text{m}^2_{NFA} * \text{a}]$.

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 $[\text{kWh}/(\text{m}^2_{NFA} * \text{a})]$ should be used as basis when possible.

¹¹ GWP_{Cref} is derived from the case studies.

¹² Module A5 currently is not regarded due to a lack of data; compare chapter 2.

¹³ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

¹⁴ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

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.

Table 1: European average reference values for “Quick and Basic”

Quick and Basic									
Based on 18 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	6.5	3.1E-07	2.4E-02	2.7E-03	2.9E-03	24.2	4.8	29.0	1,9E-01
Oref	33.2	5.8E-06	1.8E-01	7.4E-03	1.1E-02	168.1	15.3	183.4	3,7E-02
Total	39.7	6.1E-06	2.0E-01	1.0E-02	1.3E-02	192.3	20.1	212.4	2,3E-01

Table 2: European average reference values for “Complete”

Complete									
Based on 6 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	10.6	3.8E-07	3.3E-02	3,3E-03	3.4E-03	33.1	4.9	38.0	4,2E-02
Oref	35.2	6.7E-06	2.1E-01	8.3E-03	1.2E-02	196.5	21.0	217.5	2,2E-01
Total	45.8	7.1E-06	2.4E-01	1.1E-02	1.5E-02	229.5	25.9	255.5	2.6 E-06

Table 1 and Table 2 also mention a reference value for the operational phase. These values can be used if nation benchmarks are not available. The procedure of choosing the benchmarks is described in Figure 2.

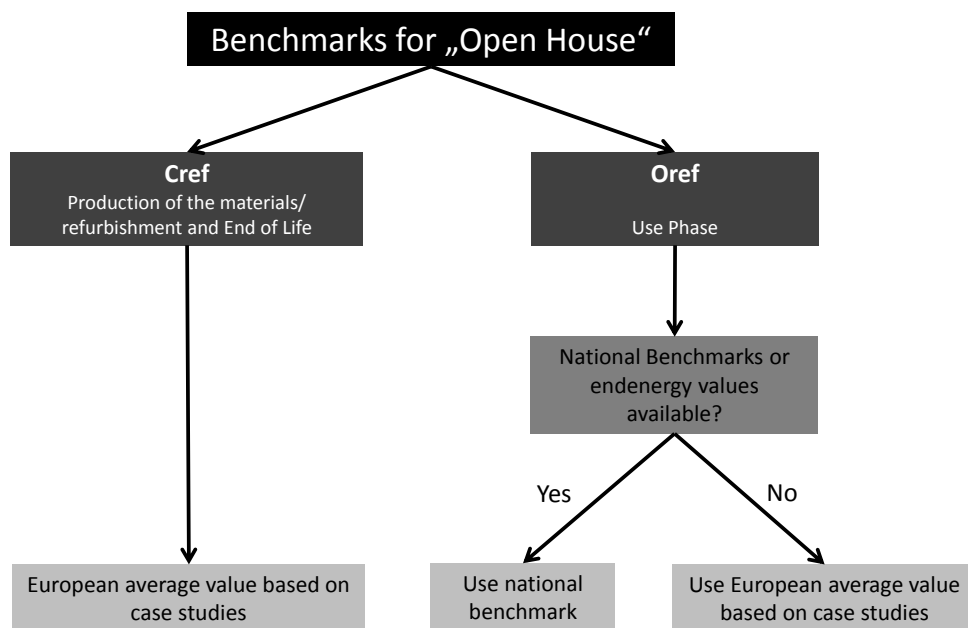


Figure 2: Setting of benchmarks in OPEN HOUSE

Limit value and target value calculation

Limit value L and target value T, needed to supplement the criterion’s evaluation, are determined as follows:

$$L = X * R \tag{7}$$

$$T = Y * R \tag{8}$$

The values X and Y are set as follows:

$$X = 1.4 \tag{9}$$

$$Y = 0.7 \tag{10}$$

Evaluation

The evaluation consists of a simultaneous optimization of carbon equivalent for design and operation over the entire lifecycle.

1.1 Global Warming Potential	Points
$GWP_{LC} = 0,7 * R$	100
$GWP_{LC} =$ according to local definition (default: $0,76 * R$)	90
$GWP_{LC} =$ according to local definition (default: $0,82 * R$)	80
$GWP_{LC} =$ according to local definition (default: $0,88 * R$)	70
$GWP_{LC} =$ according to local definition (default: $0,94 * R$)	60
$GWP_{LC} = R$ (GWP_{Gref} , reference value)	50
$GWP_{LC} =$ according to local definition $1,1 * R$)	40
$GWP_{LC} =$ according to local definition (default: $1,2 * R$)	30
$GWP_{LC} =$ according to local definition (default: $1,3 * R$)	20
$GWP_{LC} = 1,4 * R$ (limit value)	10
Minimum Energy Requirements not fulfilled	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

For Basic & Quick Assessment:

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

For Complete Assessment:

1. Building surface area and volume,
2. Building components or surfaces/materials with service lives of less than 50 years (amount and estimated service life),
3. Electricity and heat demand for the building to be certified and reference values according to the national implementation of the EPBD directive; the calculation and a reference to the national implementation must be included.
4. Quantity determination of the building envelope surfaces (external walls including windows/façade, foundation slab, roof) from the energy calculation in compliance with the national implementation of the EPBD directive and allocation to assessed building components,
5. Windows/French doors/post-and-beam façade with information on frame size, a depiction of a cross-section of the main profile system, the number of windows that can be opened, and the type of glazing,
6. Quantity determination of interior walls and supports; plausibility analysis for floor plans with information on types of interior walls/supports,
7. Inside doors: amount (number and area), list of most important types, and description of calculation,
8. Quantity determination for ceilings, divided into stories,
9. Representation of building components as a series of strata with layer thicknesses, estimated gross density, and allocation to a data set in the ESUCO database,
10. Representation of quantity determination for foundations,
11. For reinforced concrete, the share of reinforcement is to be given in kg/m^3 or kg/m^2 of the

- building component. Alternatively, the reinforcing steel can be verified in an overall summary of the project.
12. Documentation of heating unit,
 13. Documentation of transport distances and means of transport from manufacturing to construction site.

Most of these requirements can be met by providing a bill of materials (including masses, materials in a hierarchical structure, number of pieces, surface areas and volume of the building).

14. Documentation required for ecological footprint results:
Results are to be presented for the entire lifecycle per m^2_{NEA} and year, categorized by:
 - a. Manufacture
 - b. Use (electricity and heat)
 - c. Use (maintenance)
 - d. End of life (dismantling/recycling/disposal)

5. Relation to other Indicators

Data acquisition is the same for the indicators 1.1- 1.5, 1.9, 1.10, 1.15

6. Resources

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. prEN 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.

7. Attachments

None

Indicator 1.2 Ozone Depletion Potential (ODP)

(adapted from DGNB/BNB)

Core indicator

1. Objective

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-equivalents) 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.

2. Assessment Methodology

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.

Goal and scope definition

The goal of all LCA studies is to analyze and later benchmark the environmental performance of the respective buildings' life cycles. The scope of the building assessment therefore includes the following life cycle stages:

- production: raw material supply, transport to manufacturing, manufacturing and transport to the construction site of products used in the building (Figure 1, modules A1-A4),
- use stage: a scenario is defined including use and replacement, including end-of-life of replaced products (Figure 1, modules B1 and B4); in addition the operational energy use is considered (Figure 1, module B6),
- end-of-life stage: waste processing and disposal of the building, (Figure 1, modules C3 and C4),
- a scenario for potential benefits and loads beyond the system boundaries, including loads for reuse and recycling as well as benefits from recycling potentials (Figure 1, module D).

¹ REGULATION (EC) No 1005/2009 on substances that deplete the ozone layer

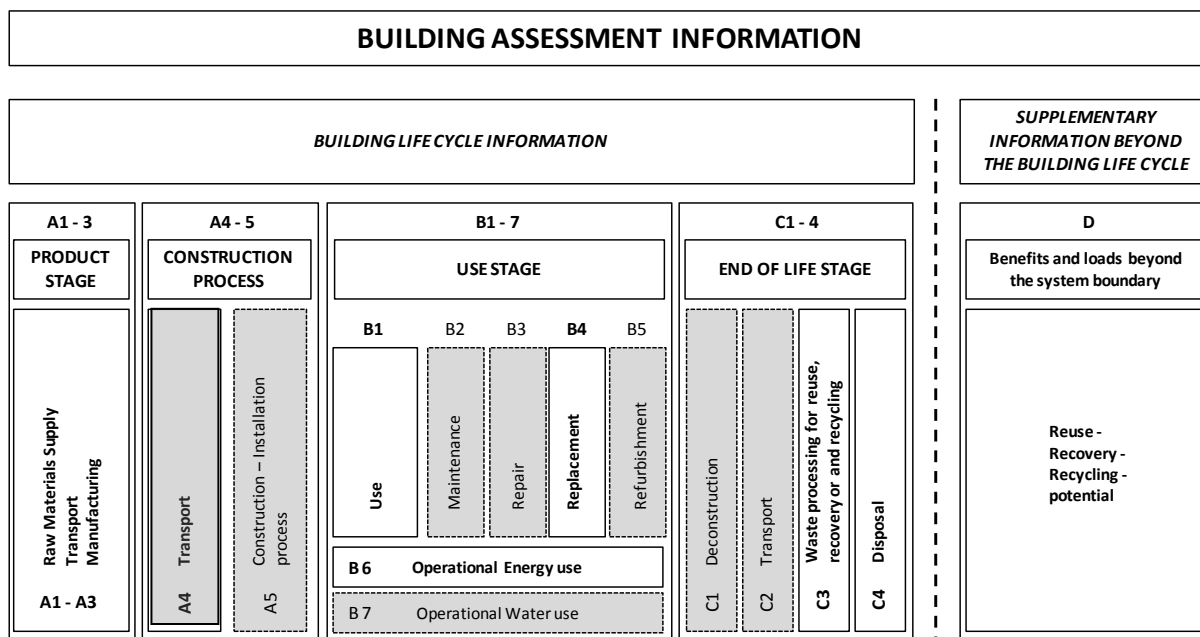


Figure 1 Building Life Cycle Phases according to FprEN 15978, adapted

The following processes are not included:

- Transport to construction side (Figure 1, module A4)
- Construction – Installation process (Figure 1, module A5),
- Energy use for user equipment during reference study period,
- Operational water use (Figure 1, module B7),
- Maintenance, repair and refurbishment during reference study period – (Figure 1, modules B2, B3 and B5),
- Deconstruction and transport to waste processing / disposal (Figure 1, modules C1 and C2),
- Transport to recycling (Figure 1, module C2).

The reference study period is defined with **50** years.

The functional equivalent (quantified functional requirements, intended use and/or technical requirements²), which is used as basis for comparison, is defined to be $m^2_{NFA} \cdot \text{year}$.

Inventory Analysis and Impact Assessment

During the inventory analysis of an LCA, emissions and resource consumption are identified, calculated and summed up over the life cycle of a product. Within building LCAs, separate calculations are carried out for the buildings` elements (product and end-of-life stage) and for the determination of emissions and resource uses during operation (see Equations 1, 2 and 3).

The inventory analysis of the buildings` elements mainly consists in providing quantitative information on the building elements used (see also Documentation Guidelines). Building compartments to be included are

1. Exterior walls and basement walls incl. windows and coatings,
2. Roof,
3. Ceilings incl. flooring and floor coverings / coatings,
4. Floor slab incl. flooring, floor coverings; floor slab above air,
5. Foundations,
6. Interior walls incl. coatings and supports,
7. Heat generation units.

² prEN 15643-1:2010: Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework

For these, respective datasets are picked out from the ESUCO database, which include environmental profiles of the used component: for the respective component, a standardized LCA has been conducted earlier and the results are provided within this database format.

For the module A4, which contains transports from manufacturing to the construction site, information about transport distances and means of transportation have to be provided and connected to the respective ESUCO data sets³.

For the analysis of the use stage, a scenario has to be set up, including supply and disposal systems and repairs. For supply and disposal, values for end energy consumption for electricity and heat have to be derived from the respective national implementation of the EPBD directive. Heating units as well as the electricity demand calculated have to be listed and linked to the respective ESUCO datasets.

For repair, calculations have to be made for all materials, building components and surfaces with service lives of less than 50 years. Sources for service lives are the “Guideline for Sustainable Building” for construction materials and the VDI 2067 for building services.

Also for the end-of-life stage, a scenario has to be defined for the recycling and disposal of the building materials that remain in the building after the end of the reference study period. So for each material, one end-of-life options has to be chosen and linked to the respective ESUCO dataset:

- Metals → recycling → ”metal recycling potential”,
- Mineral building materials → recycling → ”construction rubble processing”,
- Materials with a heating value → thermal recycling → respective material group in ESUCO database,
- Heat producers → Dataset corresponding to the manufacturing process,
- All other materials that can be deposited at construction or household waste sites → disposal at waste site → appropriate ESUCO dataset.

Within the impact assessment, the emissions determined in the inventory analysis are classified regarding their contributions to different environmental impacts and then characterized. Using characterization factors, they are converted into equivalents of lead emissions for the different impact categories (example: emissions contributing to ozone depletion potential are transformed to R₁₁-equivalents, emissions contributing to Acidification Potential are transformed to SO₂-equivalents).

By using environmental profiles such as provided by ESUCO, the step of impact assessment has already been done by the data providers: Environmental profiles are given by providing the LCA results for the respective component in form of different environmental impact categories. These results are then used within the building LCA.

Interpretation

Resulting impacts are then evaluated against reference values to determine the respective indicator assessment (see overall Rating / Assessment Matrix).

³ It is suggested to use European average datasets. This means that the datasets represent technologies on average levels for Europe. These construction materials also contain European boundary conditions such as European datasets for electric or thermal energy or intermediate products and represent a common European market for construction materials. Using such European average datasets does not show the variability, for instance of the industry producing construction materials in Europe and thus has the advantage not to bias the analysis of the life cycle models by accounting for differences in different production techniques. This bias would reduce the significance of the results as the clear denotation of environmental hotspots in the structure and design of buildings would contain higher uncertainties on the origin of environmental impacts.

3. Calculation and Rating

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.

$$\text{ODP}_{\text{LC}} = \text{ODP}_{\text{C}} + \text{ODP}_{\text{O}} \quad (1)$$

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 $[\text{kg R}_{11} \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$,
ODP_{O}	predicted annual ozone depletion potential for the operation of the building as constructed, derived from end energy demand according to national implementation of EPBD directive in $[\text{kg R}_{11} \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$,
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:

$$\text{ODP}_{\text{C}} = (\text{ODP}_{\text{MA}} + \text{ODP}_{\text{MC}}) / t_d + \text{ODP}_{\text{MB1,4}} \quad (2)$$

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 $[\text{kg R}_{11} \text{ equiv.}/(\text{m}^2_{\text{NFA}})]$,
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 $[\text{kg R}_{11} \text{ equiv.}/(\text{m}^2_{\text{NFA}})]$,
$\text{ODP}_{\text{MB1,4}}$	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 $[\text{kg R}_{11} \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$,
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:

$$\text{ODP}_{\text{O}} = \text{ODP}_{\text{MB6,E}} + \text{ODP}_{\text{MB6,H}} \quad (3)$$

where

$\text{ODP}_{\text{MB6,E}}$	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 $[\text{kg R}_{11} \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$,
$\text{ODP}_{\text{MB6,H}}$	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 $[\text{kg R}_{11} \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$.

⁴ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

⁵ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

⁶ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

Rating Method

The “designed building” is rated against a case-specific reference building.

Ozone Depletion Potential for Reference Building

$$R_{ODP} = ODP_{LCref} = ODP_{Cref} + ODP_{Oref} \quad (4)$$

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:

$$ODP_{Cref} = (ODP_{MAref} + ODP_{MCref}) / t_d + ODP_{MB1,4ref} \quad (5)$$

where

ODP_{MAref}	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_{MCref}	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)]
t_d	reference study period in [a]. This time period is set to 50 years.

The reference value for use ODP_{Oref} is calculated as follows

$$ODP_{Oref} = ODP_{MB6,Eref} + ODP_{MB6,Href} \quad (6)$$

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/ (m²_{NFA} *a)] should be used as basis when possible.

⁷ ODP_{Cref} is derived from case studies

⁸ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

⁹ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

¹⁰ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

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.

Table 1: European average reference values for “Quick and Basic”

Quick and Basic									
Based on 18 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	6.5	3.1E-07	2.4E-02	2.7E-03	2.9E-03	24.2	4.8	29.0	1,9E-01
Oref	33.2	5.8E-06	1.8E-01	7.4E-03	1.1E-02	168.1	15.3	183.4	3,7E-02
Total	39.7	6.1E-06	2.0E-01	1.0E-02	1.3E-02	192.3	20.1	212.4	2,3E-01

Table 2: European average reference values for “Complete”

Complete									
Based on 6 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	10.6	3.8E-07	3.3E-02	3,3E-03	3.4E-03	33.1	4.9	38.0	4,2E-02
Oref	35.2	6.7E-06	2.1E-01	8.3E-03	1.2E-02	196.5	21.0	217.5	2,2E-01
Total	45.8	7.1E-06	2.4E-01	1.1E-02	1.5E-02	229.5	25.9	255.5	2.6 E-06

Table 1 and Table 2 also mention a reference value for the operational phase. These values can be used if nation benchmarks are not available. The procedure of choosing the benchmarks is described in Figure 2.

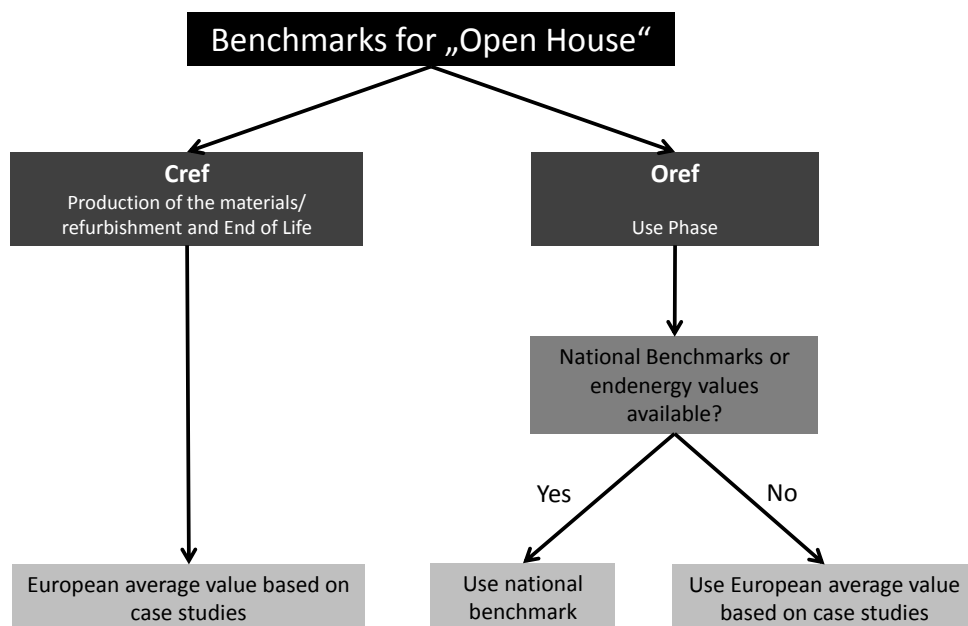


Figure 2: Setting of benchmarks in OPEN HOUSE

Limit value and target value calculation

Limit value L and target value T, needed to supplement the criterion’s evaluation, are determined as follows:

$$L = X * R \tag{7}$$

$$T = Y * R \tag{8}$$

The values X and Y are set as follows:

$$X = 10 \tag{9}$$

$$Y = 0.7 \tag{10}$$

Evaluation

The evaluation consists of a simultaneous reduction of buildings' Ozone Depletion Potential for design and operation over the entire lifecycle.

Overall Rating/ Assessment Matrix:

1.2 Ozone Depletion Potential	Points
$ODP_{LC} = 0,7 * R$	100
$ODP_{LC} =$ according to local definition (default: $0,76 * R$)	90
$ODP_{LC} =$ according to local definition (default: $0,82 * R$)	80
$ODP_{LC} =$ according to local definition (default: $0,85 * R$)	75
$ODP_{LC} =$ according to local definition (default: $0,88 * R$)	70
$ODP_{LC} =$ according to local definition (default: $0,94 * R$)	60
$ODP_{LC} = R$ ($ODP_{LC,ref}$, reference value)	50
$ODP_{LC} =$ according to local definition $3,25 * R$)	40
$ODP_{LC} =$ according to local definition (default: $5,5 * R$)	30
$ODP_{LC} =$ according to local definition (default: $7,75 * R$)	20
$ODP_{LC} = 10,0 * R$ (limit value)	10
Minimum Energy Requirements not fulfilled	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick and Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Building surface area and volume,
2. Building components or surfaces/materials with service lives of less than 50 years (amount and estimated service life),
3. Electricity and heat demand for the building to be certified and reference values according to the national implementation of the EPBD directive; the calculation and a reference to the national implementation of the EPBD directive must be included.
4. Quantity determination of the building envelope surfaces (external walls including windows/façade, foundation slab, roof) from the energy calculation in compliance with the national implementation of the EPBD directive and allocation to assessed building components,
5. Windows/French doors/post-and-beam façade with information on frame size, a depiction of a cross-section of the main profile system, the number of windows that can be opened, and the type of glazing,
6. Quantity determination of interior walls and supports; plausibility analysis for floor plans with information on types of interior walls/supports,
7. Inside doors: amount (number and area), list of most important types, and description of calculation,
8. Quantity determination for ceilings, divided into stories,

9. Representation of building components as a series of strata with layer thicknesses, estimated gross density, and allocation to a data set in the ESUCO database,
10. Representation of quantity determination for foundations,
11. For reinforced concrete, the share of reinforcement is to be given in kg/m³ or kg/m² of the building component. Alternatively, the reinforcing steel can be verified in an overall summary of the project.
12. Documentation of heating unit,
13. Documentation of transport distances and means of transport from manufacturing to construction site.

Most of these requirements can be met by providing a bill of materials (including masses, materials in a hierarchical structure, numbers of pieces, surface areas and volume of the building).

14. Documentation required for ecological footprint results:
Results are to be presented for the entire lifecycle per m² NFA and year, categorized by:
 - a. Manufacture
 - b. Use (electricity and heat)
 - c. Use (maintenance)
 - d. End of life (dismantling/recycling/disposal)

5. Relation to other Indicators

Data acquisition is the same for the indicators 1.1- 1.5, 1.9, 1.10, 1.15

6. Resources

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. prEN 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.

7. Attachments

None

Indicator 1.3 Acidification Potential (AP)

(adapted from DGNB/BNB)

Core Indicator

1. Objective

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 SO₂-equivalents. Acidification causing emissions are e.g. SO₂, NO_x or H₂S.

For the assessment of the Acidification Potential (AP) of a building life cycle (construction and operation), SO₂-equivalents 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 NO_x by 2020 compared to 1990s level¹. The objective is to reduce the threat to the natural environment from acidification by 55%².

2. Assessment Methodology

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.

Goal and scope definition

The goal of all LCA studies is to analyze and later benchmark the environmental performance of the respective buildings' life cycles. The scope of the building assessment therefore includes the following life cycle stages:

- production: raw material supply, transport to manufacturing, manufacturing and transport to the construction site of products used in the building (Figure 1, modules A1-A4),
- use stage: a scenario is defined including use and replacement, including end-of-life of replaced products (Figure 1, modules B1 and B4); in addition the operational energy use is considered (Figure 1, module B6),
- end-of-life stage: waste processing and disposal of the building, (Figure 1, modules C3 and C4),

¹ Impact Assessment SEC (2005) 1133

² Thematic Strategy on air pollution COM(2005) 446

- a scenario for potential benefits and loads beyond the system boundaries, including loads for reuse and recycling as well as benefits from recycling potentials (Figure 1, module D).

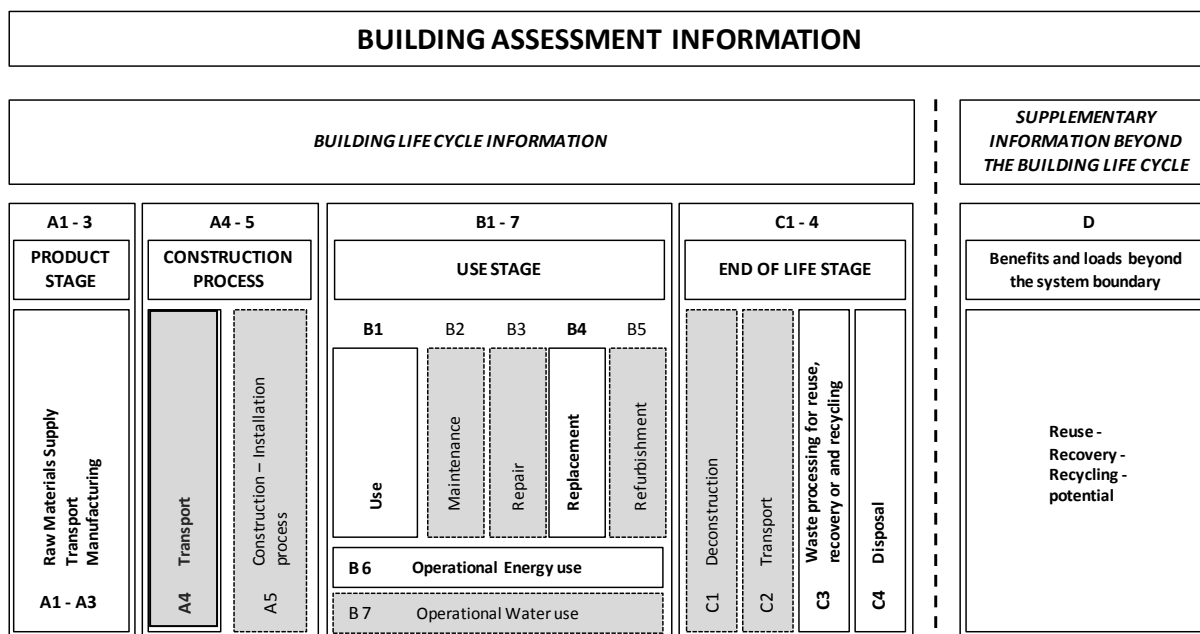


Figure 1: Building Life Cycle Phases according to FprEN 15978, adapted

The following processes are not included:

- Transport to construction side (Figure 1, module A4)
- Construction – Installation process (Figure 1, module A5),
- Energy use for user equipment during reference study period,
- Operational water use (Figure 1, module B7),
- Maintenance, repair and refurbishment during reference study period – (Figure 1, modules B2, B3 and B5),
- Deconstruction and transport to waste processing / disposal (Figure 1, modules C1 and C2).

The reference study period is defined with 50 years.

The functional equivalent (quantified functional requirements, intended use and/or technical requirements³), which is used as basis for comparison, is defined to be $m^2_{NFA} \cdot \text{year}$.

Inventory Analysis and Impact Assessment

During the inventory analysis of an LCA, emissions and resource consumption are identified, calculated and summed up over the life cycle of a product. Within building LCAs, separate calculations are carried out for the buildings` elements (product and end-of-life stage) and for the determination of emissions and resource uses during operation (see Equations 1, 2 and 3).

The inventory analysis of the buildings` elements mainly consists in providing quantitative information on the building elements used (see also Documentation Guidelines). Building compartments to be included are

1. Exterior walls and basement walls incl. windows and coatings,
2. Roof,
3. Ceilings incl. flooring and floor coverings / coatings,
4. Floor slab incl. flooring, floor coverings; floor slab above air,
5. Foundations,

³ prEN 15643-1:2010: Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework

6. Interior walls incl. coatings and supports,
7. Heat generation units.
8. Heat generation units.

For these, respective datasets are picked out from the ESUCO database, which include environmental profiles of the used component: for the respective component, a standardized LCA has been conducted earlier and the results are provided within this database format.

For the module A4, which contains transports from manufacturing to the construction site, information about transport distances and means of transportation have to be provided and connected to the respective ESUCO data sets⁴.

For the analysis of the use stage, a scenario has to be set up, including supply and disposal systems and repairs. For supply and disposal, values for end energy consumption for electricity and heat have to be derived from the respective national implementation of the EPBD directive. Heating units as well as the electricity demand calculated have to be listed and linked to the respective ESUCO datasets.

For repair, calculations have to be made for all materials, building components and surfaces with service lives of less than 50 years. Sources for service lives are the “Guideline for Sustainable Building” for construction materials and the VDI 2067 for building services.

Also for the end-of-life stage, a scenario has to be defined for the recycling and disposal of the building materials that remain in the building after the end of the reference study period. So for each material, one end-of-life options has to be chosen and linked to the respective ESUCO dataset:

- Metals → recycling → ”metal recycling potential”,
- Mineral building materials → recycling → ”construction rubble processing”,
- Materials with a heating value → thermal recycling → respective material group in ESUCO database,
- Heat producers → Dataset corresponding to the manufacturing process,
- All other materials that can be deposited at construction or household waste sites → disposal at waste site → appropriate ESUCO dataset.

Within the impact assessment, the emissions determined in the inventory analysis are classified regarding their contributions to different environmental impacts and then characterized. Using characterization factors, they are converted into equivalents of lead emissions for the different impact categories (example: emissions contributing to Global Warming Potential are transformed to CO₂ equivalents, emissions contributing to Acidification Potential are transformed to SO₂ equivalents).

By using environmental profiles such as provided by ESUCO, the step of impact assessment has already been done by the data providers: Environmental profiles are given by providing the LCA results for the respective component in form of different environmental impact categories. These results are then used within the building LCA.

Interpretation

Resulting impacts are then evaluated against reference values to determine the respective indicator assessment (see overall Rating / Assessment Matrix).

⁴ It is suggested to use European average datasets. This means that the datasets represent technologies on average levels for Europe. These construction materials also contain European boundary conditions such as European datasets for electric or thermal energy or intermediate products and represent a common European market for construction materials. Using such European average datasets does not show the variability, for instance of the industry producing construction materials in Europe and thus has the advantage not to bias the analysis of the life cycle models by accounting for differences in different production techniques. This bias would reduce the significance of the results as the clear denotation of environmental hotspots in the structure and design of buildings would contain higher uncertainties on the origin of environmental impacts.

3. Calculation and Rating

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.

$$AP_{LC} = AP_C + AP_O \quad (1)$$

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:

$$AP_C = (AP_{MA} + AP_{MC}) / t_d + AP_{MB1,4} \quad (2)$$

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:

$$AP_O = AP_{MB6,E} + AP_{MB6,H} \quad (3)$$

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)].

⁵ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

⁶ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

⁷ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

Rating Method

The “designed building” is rated against a case-specific reference building.

Acidification Potential for Reference Building

$$R_{AP} = AP_{LCref} = AP_{Cref} + AP_{Oref} \quad (4)$$

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:

$$AP_{Cref} = (AP_{MAref} + AP_{MCref}) / t_d + AP_{MB1,4ref} \quad (5)$$

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 $[kg\ SO_2\ equiv./m^2_{NFA} * a)]$
t_d	reference study period in [a]. This time period is set to 50 years.

The reference value for use AP_{Oref} is calculated as follows

$$AP_{Oref} = AP_{MB6,Eref} + AP_{MB6,Href} \quad (6)$$

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.

⁸ AP_{Cref} is derived from the case studies.

⁹ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

¹⁰ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

¹¹ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

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.

Table 1: European average reference values for “Quick and Basic”

Based on 18 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	6.5	3.1E-07	2.4E-02	2.7E-03	2.9E-03	24.2	4.8	29.0	1,9E-01
Oref	33.2	5.8E-06	1.8E-01	7.4E-03	1.1E-02	168.1	15.3	183.4	3,7E-02
Total	39.7	6.1E-06	2.0E-01	1.0E-02	1.3E-02	192.3	20.1	212.4	2,3E-01

Table 2: European average reference values for “Complete”

Based on 6 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	10.6	3.8E-07	3.3E-02	3,3E-03	3.4E-03	33.1	4.9	38.0	4,2E-02
Oref	35.2	6.7E-06	2.1E-01	8.3E-03	1.2E-02	196.5	21.0	217.5	2,2E-01
Total	45.8	7.1E-06	2.4E-01	1.1E-02	1.5E-02	229.5	25.9	255.5	2.6 E-06

Table1 and Table2 also mention a reference value for the operational phase. These values can be used if nation benchmarks are not available. The procedure of choosing the benchmarks is described in Figure 2.

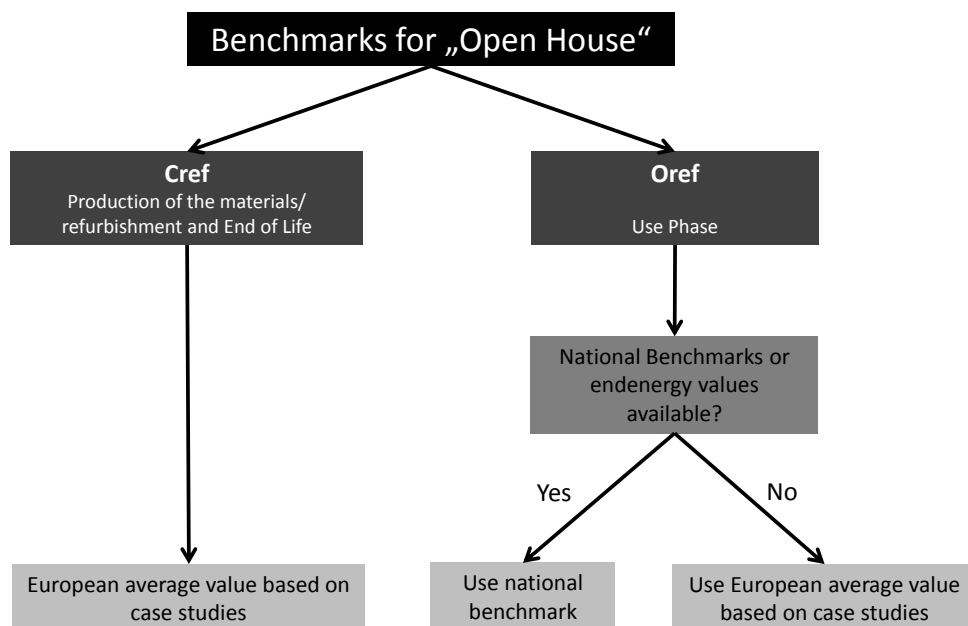


Figure 2: Setting of benchmarks in OPEN HOUSE

Limit value and target value calculation

Limit value L and target value T, needed to supplement the criterion’s evaluation, are determined as follows:

$$L = X * R \tag{7}$$

$$T = Y * R \tag{8}$$

The values X and Y are set as follows:

$$X = 1.7 \tag{9}$$

$$Y = 0.7 \tag{10}$$

Evaluation

The evaluation consists of a simultaneous reduction of buildings' Acidification Potential for design and operation over the entire lifecycle.

1.3 Acidification Potential	Points
$AP_{LC} = 0,7 * R$	100
$AP_{LC} =$ according to local definition (default: $0,76 * R$)	90
$AP_{LC} =$ according to local definition (default: $0,82 * R$)	80
$AP_{LC} =$ according to local definition (default: $0,85 * R$)	75
$AP_{LC} =$ according to local definition (default: $0,88 * R$)	70
$AP_{LC} =$ according to local definition (default: $0,94 * R$)	60
$AP_{LC} = R_{local}$ ($AP_{LC,ref}$, reference value)	50
$AP_{LC} =$ according to local definition $1,175 * R$)	40
$AP_{LC} =$ according to local definition (default: $1,35 * R$)	30
$AP_{LC} =$ according to local definition (default: $1,525 * R$)	20
$AP_{LC} = 1,7 * R$ (limit value)	10
Minimum Energy Requirements not fulfilled	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Basic & Quick Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Building surface area and volume,
2. Building components or surfaces/materials with service lives of less than 50 years (amount and estimated service life),
3. Electricity and heat demand for the building to be certified and reference values according to the national implementation of the EPBD directive; the calculation and a reference to the national implementation of the EPBD directive must be included.
4. Quantity determination of the building envelope surfaces (external walls including windows/façade, foundation slab, roof) from the energy calculation in compliance with the national implementation of the EPBD directive and allocation to assessed building components,
5. Windows/French doors/post-and-beam façade with information on frame size, a depiction of a cross-section of the main profile system, the number of windows that can be opened, and the type of glazing,
6. Quantity determination of interior walls and supports; plausibility analysis for floor plans with information on types of interior walls/supports,
7. Inside doors: amount (number and area), list of most important types, and description of calculation,
8. Quantity determination for ceilings, divided into stories,
9. Representation of building components as a series of strata with layer thicknesses, estimated gross

- density, and allocation to a data set in the ESUCO database,
10. Representation of quantity determination for foundations,
 11. For reinforced concrete, the share of reinforcement is to be given in kg/m³ or kg/m² of the building component. Alternatively, the reinforcing steel can be verified in an overall summary of the project.
 12. Documentation of heating unit,
 13. Documentation of transport distances and means of transport from manufacturing to construction site.

Most of these requirements can be met by providing a bill of materials (including masses, materials in a hierarchical structure, numbers of pieces, surface areas and volume of the building).

14. Documentation required for ecological footprint results:
Results are to be presented for the entire lifecycle per m² NFA and year, categorized by:
 - a. Manufacture
 - b. Use (electricity and heat)
 - c. Use (maintenance)
 - d. End of life (dismantling/recycling/disposal)

5. Relation to other Indicators

Data acquisition is the same for the indicators 1.1- 1.5, 1.9, 1.10, 1.15

6. Resources

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. prEN 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.

7. Attachments

None

Indicator 1.4 Eutrophication Potential (EP)

(adapted from DGNB/BNB)

Core Indicator

1. Objective

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), PO₄ equivalents per area and year are used. The lower the PO₄-equivalent 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 level¹. The objective is to reduce the threat to the natural environment from eutrophication by 55%².

2. Assessment Methodology

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.

Goal and scope definition

The goal of all LCA studies is to analyze and later benchmark the environmental performance of the respective buildings' life cycles. The scope of the building assessment therefore includes the following life cycle stages:

- production: raw material supply, transport to manufacturing, manufacturing and transport to the construction site of products used in the building (Figure 1, modules A1-A4),
- use stage: a scenario is defined including use and replacement, including end-of-life of replaced products (Figure 1, modules B1 and B4); in addition the operational energy use is considered (Figure 1, module B6),
- end-of-life stage: waste processing and disposal of the building, (Figure 1, modules C3 and C4),
- a scenario for potential benefits and loads beyond the system boundaries, including loads for reuse and recycling as well as benefits from recycling potentials (Figure 1, module D).

¹ Impact Assessment SEC (2005) 1133

² Thematic Strategy on air pollution COM(2005) 446

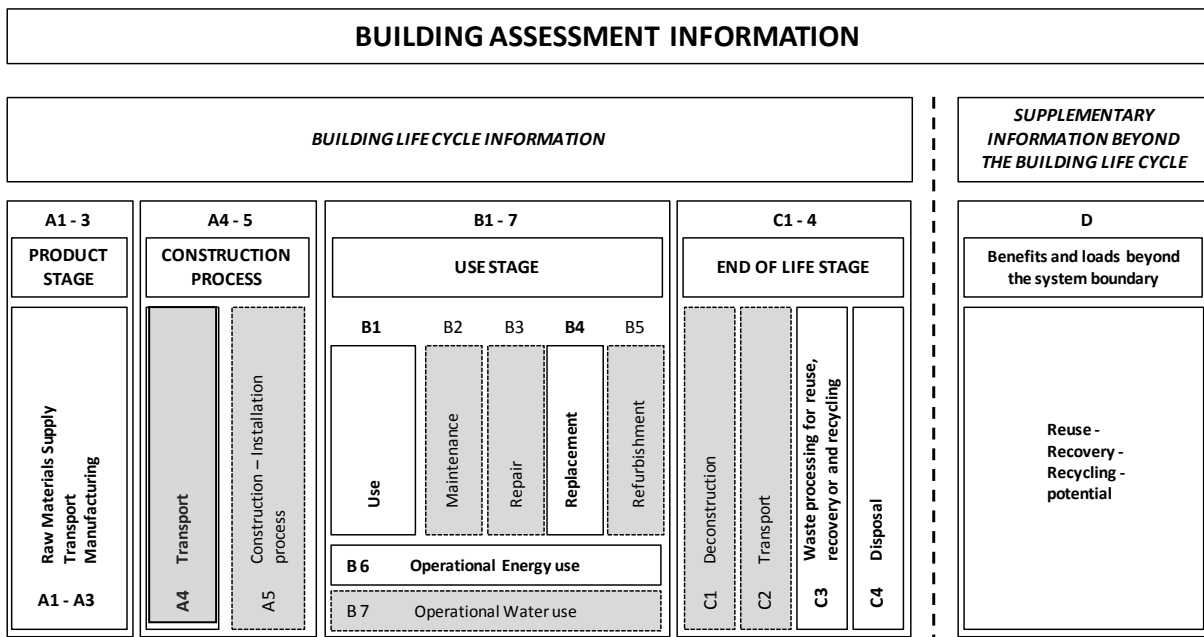


Figure 1 Building Life Cycle Phases according to FprEN 15978, adapted

The following processes are not included:

- Transport to construction side (Figure 1, module A4)
- Construction – Installation process (Figure 1, module A5),
- Energy use for user equipment during reference study period,
- Operational water use (Figure 1, module B7),
- Maintenance, repair and refurbishment during reference study period – (Figure 1, modules B2, B3 and B5),
- Deconstruction and transport to waste processing / disposal (Figure 1, modules C1 and C2),
- Transport to recycling (Figure 1, module C2).

The reference study period is defined with 50 years.

The functional equivalent (quantified functional requirements, intended use and/or technical requirements³), which is used as basis for comparison, is defined to be $m^2_{NFA} \cdot \text{year}$.

Inventory Analysis and Impact Assessment

During the inventory analysis of an LCA, emissions and resource consumption are identified, calculated and summed up over the life cycle of a product. Within building LCAs, separate calculations are carried out for the buildings` elements (product and end-of-life stage) and for the determination of emissions and resource uses during operation (see Equations 1, 2 and 3).

The inventory analysis of the buildings` elements mainly consists in providing quantitative information on the building elements used (see also Documentation Guidelines). Building compartments to be included are

1. Exterior walls and basement walls incl. windows and coatings,
2. Roof,
3. Ceilings incl. flooring and floor coverings / coatings,
4. Floor slab incl. flooring, floor coverings; floor slab above air,
5. Foundations,
6. Interior walls incl. coatings and supports,
7. Heat generation units.

³ prEN 15643-1:2010: Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework

For these, respective datasets are picked out from the ESUCO database, which include environmental profiles of the used component: for the respective component, a standardized LCA has been conducted earlier and the results are provided within this database format.

For the module A4, which contains transports from manufacturing to the construction site, information about transport distances and means of transportation have to be provided and connected to the respective ESUCO data sets⁴.

For the analysis of the use stage, a scenario has to be set up, including supply and disposal systems and repairs. For supply and disposal, values for end energy consumption for electricity and heat have to be derived from the respective national implementation of the EPBD directive. Heating units as well as the electricity demand calculated have to be listed and linked to the respective ESUCO datasets.

For repair, calculations have to be made for all materials, building components and surfaces with service lives of less than 50 years. Sources for service lives are the “Guideline for Sustainable Building” for construction materials and the VDI 2067 for building services.

Also for the end-of-life stage, a scenario has to be defined for the recycling and disposal of the building materials that remain in the building after the end of the reference study period. So for each material, one end-of-life options has to be chosen and linked to the respective ESUCO dataset:

- Metals → recycling → ”metal recycling potential”,
- Mineral building materials → recycling → ”construction rubble processing”,
- Materials with a heating value → thermal recycling → respective material group in ESUCO database,
- Heat producers → Dataset corresponding to the manufacturing process,
- All other materials that can be deposited at construction or household waste sites → disposal at waste site → appropriate ESUCO dataset.

Within the impact assessment, the emissions determined in the inventory analysis are classified regarding their contributions to different environmental impacts and then characterized. Using characterization factors, they are converted into equivalents of lead emissions for the different impact categories (example: emissions contributing to Eutrophication Potential are transformed to PO₄ equivalents, emissions contributing to Acidification Potential are transformed to SO₂ equivalents).

By using environmental profiles such as provided by ESUCO, the step of impact assessment has already been done by the data providers: Environmental profiles are given by providing the LCA results for the respective component in form of different environmental impact categories. These results are then used within the building LCA.

Interpretation

Resulting impacts are then evaluated against reference values to determine the respective indicator assessment (see overall Rating / Assessment Matrix).

⁴ It is suggested to use European average datasets. This means that the datasets represent technologies on average levels for Europe. These construction materials also contain European boundary conditions such as European datasets for electric or thermal energy or intermediate products and represent a common European market for construction materials. Using such European average datasets does not show the variability, for instance of the industry producing construction materials in Europe and thus has the advantage not to bias the analysis of the life cycle models by accounting for differences in different production techniques. This bias would reduce the significance of the results as the clear denotation of environmental hotspots in the structure and design of buildings would contain higher uncertainties on the origin of environmental impacts.

3. Calculation and Rating

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.

$$EP_{LC} = EP_C + EP_O \quad (1)$$

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:

$$EP_C = (EP_{MA} + EP_{MC}) / t_d + EP_{MB1,4} \quad (2)$$

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 PO ₄ 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:

$$EP_O = EP_{MB6,E} + EP_{MB6,H} \quad (3)$$

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)].

⁵ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

⁶ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

⁷ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

Rating Method

The “designed building” is rated against a case-specific reference building.

Eutrophication Potential for Reference Building

$$\mathbf{R_{EP} = EP_{LCref} = EP_{Cref} + EP_{Oref}} \quad (4)$$

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 $[\text{kg PO}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$ 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 $[\text{kg PO}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$.

The reference value for construction EP_{Cref} is calculated as follows:

$$\mathbf{EP_{Cref} = (EP_{MAref} + EP_{MCref}) / t_d + EP_{MB1,4ref}} \quad (5)$$

where

- EP_{MAref} reference value for eutrophication potential created during the modules A1-4⁹, including office building’s manufacture (construction and building systems technology) and transports to construction site in $[\text{kg PO}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}})]$,
- EP_{MCref} reference value for eutrophication potential created during module C3 and C4¹⁰, the office building’s end-of-life (design and building systems technology) in $[\text{kg PO}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}})]$,
- $EP_{MB1,4ref}$ reference value for annual eutrophication potential created during modules B1 and B4¹¹ on a yearly basis, the office building’s use and replacement (construction and building systems technology) in $[\text{kg PO}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$
- t_d reference study period in [a]. This time period is set to 50 years.

The reference value for use EP_{Oref} is calculated as follows

$$\mathbf{EP_{Oref} = EP_{MB6,Eref} + EP_{MB6,Href}} \quad (6)$$

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 $[\text{kg PO}_4 \text{ equiv.}/\text{m}^2_{\text{NFA}} * \text{a}]$,
- $EP_{MB6,Href}$ 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 $[\text{kg PO}_4 \text{ equiv.}/\text{m}^2_{\text{NFA}} * \text{a}]$.

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 $[\text{kWh}/(\text{m}^2_{\text{NFA}} * \text{a})]$ should be used as basis when possible.

⁸ EP_{Cref} will be derived from the case studies

⁹ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

¹⁰ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

¹¹ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

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.

Table 1: European average reference values for “Quick and Basic”

Based on 18 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	6.5	3.1E-07	2.4E-02	2.7E-03	2.9E-03	24.2	4.8	29.0	1,9E-01
Oref	33.2	5.8E-06	1.8E-01	7.4E-03	1.1E-02	168.1	15.3	183.4	3,7E-02
Total	39.7	6.1E-06	2.0E-01	1.0E-02	1.3E-02	192.3	20.1	212.4	2,3E-01

Table 2: European average reference values for “Complete”

Based on 6 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	10.6	3.8E-07	3.3E-02	3,3E-03	3.4E-03	33.1	4.9	38.0	4,2E-02
Oref	35.2	6.7E-06	2.1E-01	8.3E-03	1.2E-02	196.5	21.0	217.5	2,2E-01
Total	45.8	7.1E-06	2.4E-01	1.1E-02	1.5E-02	229.5	25.9	255.5	2.6 E-06

Table1 and Table2 also mention a reference value for the operational phase. These values can be used if nation benchmarks are not available. The procedure of choosing the benchmarks is described in Figure 2.

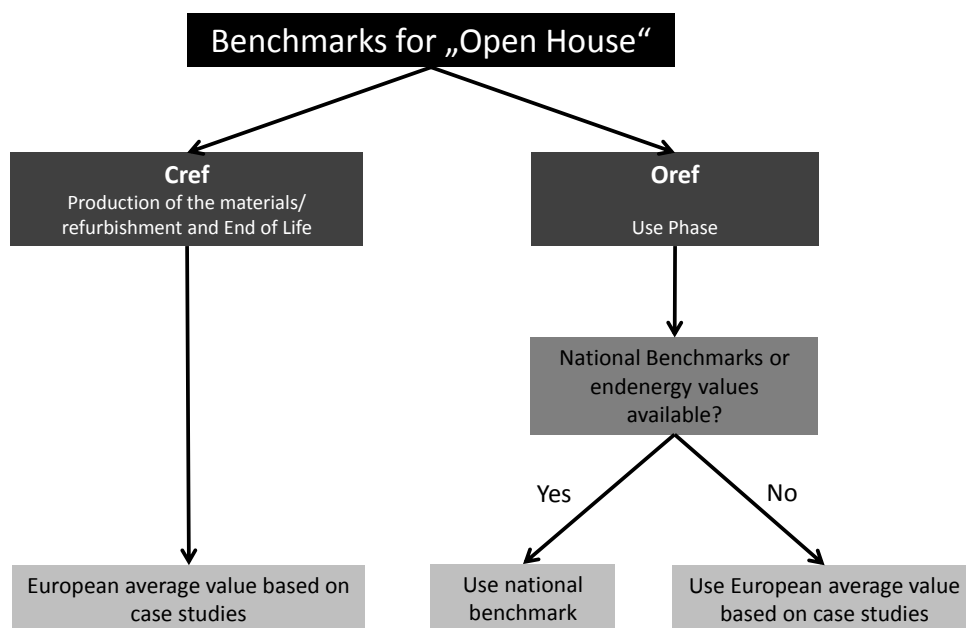


Figure 2: Setting of benchmarks in OPEN HOUSE

Limit value and target value calculation

Limit value L and target value T, needed to supplement the criterion’s evaluation, are determined as follows:

$$L = X * R \tag{7}$$

$$T = Y * R \tag{8}$$

The values X and Y are set as follows:

$$X = 1.7 \tag{9}$$

$$Y = 0.7 \tag{10}$$

Evaluation

The evaluation consists of a simultaneous reduction of buildings' Eutrophication Potential for design and operation over the entire lifecycle.

1.4 Eutrophication Potential	Points
$EP_{LC} = 0,7 * R$	100
$EP_{LC} =$ according to local definition (default: $0,76 * R$)	90
$EP_{LC} =$ according to local definition (default: $0,82 * R$)	80
$EP_{LC} =$ according to local definition (default: $0,85 * R$)	75
$EP_{LC} =$ according to local definition (default: $0,88 * R$)	70
$EP_{LC} =$ according to local definition (default: $0,94 * R$)	60
$EP_{LC} = R$ ($EP_{LC,ref}$, reference value)	50
$EP_{LC} =$ according to local definition $1,175 * R$)	40
$EP_{LC} =$ according to local definition (default: $1,35 * R$)	30
$EP_{LC} =$ according to local definition (default: $1,525 * R$)	20
$EP_{LC} = 1,7 * R$ (limit value)	10
Minimum Energy Requirements not fulfilled	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Basic & Quick Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Building surface area and volume,
2. Building components or surfaces/materials with service lives of less than 50 years (amount and estimated service life),
3. Electricity and heat demand for the building to be certified and reference values according to the national implementation of the EPBD directive; the calculation and a reference to the national implementation must be included.
4. Quantity determination of the building envelope surfaces (external walls including windows/façade, foundation slab, roof) from the energy calculation in compliance with the national implementation of the EPBD directive and allocation to assessed building components,
5. Windows/French doors/post-and-beam façade with information on frame size, a depiction of a cross-section of the main profile system, the number of windows that can be opened, and the type of glazing,
6. Quantity determination of interior walls and supports; plausibility analysis for floor plans with information on types of interior walls/supports,
7. Inside doors: amount (number and area), list of most important types, and description of calculation,
8. Quantity determination for ceilings, divided into stories,
9. Representation of building components as a series of strata with layer thicknesses, estimated gross density, and allocation to a data set in the ESUCO database,

10. Representation of quantity determination for foundations,
11. For reinforced concrete, the share of reinforcement is to be given in kg/m³ or kg/m² of the building component. Alternatively, the reinforcing steel can be verified in an overall summary of the project.
12. Documentation of heating unit,
13. Documentation of transport distances and means of transport from manufacturing to construction site.

Most of these requirements can be met by providing a bill of materials (including masses, materials in a hierarchical structure, numbers of pieces, surface areas and volume of the building).

14. Documentation required for ecological footprint results:
Results are to be presented for the entire lifecycle per m² NFA and year, categorized by:
 - a. Manufacture
 - b. Use (electricity and heat)
 - c. Use (maintenance)
 - d. End of life (dismantling/recycling/disposal)

5. Relation to other Indicators

Data acquisition is the same for the indicators 1.1- 1.5, 1.9, 1.10, 1.15

6. Resources

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. prEN 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.

7. Attachments

None

Indicator 1.5 Photochemical Ozone Creation Potential (POCP)

(adapted from DGNB/BNB)

Core Indicator

1. Objective

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 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 NO_x and 51% for VOCs (responsible for ozone creation) by 2020 compared to 1990s level².

2. Assessment Methodology

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.

Goal and scope definition

The goal of all LCA studies is to analyze and later benchmark the environmental performance of the respective buildings' life cycles. The scope of the building assessment therefore includes the following life cycle stages:

- production: raw material supply, transport to manufacturing, manufacturing and transport to the construction site of products used in the building (Figure 1, modules A1-A4),
- use stage: a scenario is defined including use and replacement, including end-of-life of replaced products (Figure 1, modules B1 and B4); in addition the operational energy use is considered (Figure 1, module B6),
- end-of-life stage: waste processing and disposal of the building, (Figure 1, modules C3 and C4),
- a scenario for potential benefits and loads beyond the system boundaries, including loads for reuse and recycling as well as benefits from recycling potentials (Figure 1, module D).

¹ <http://www.leonardo-energy.org>

² Impact Assessment SEC (2005) 1133

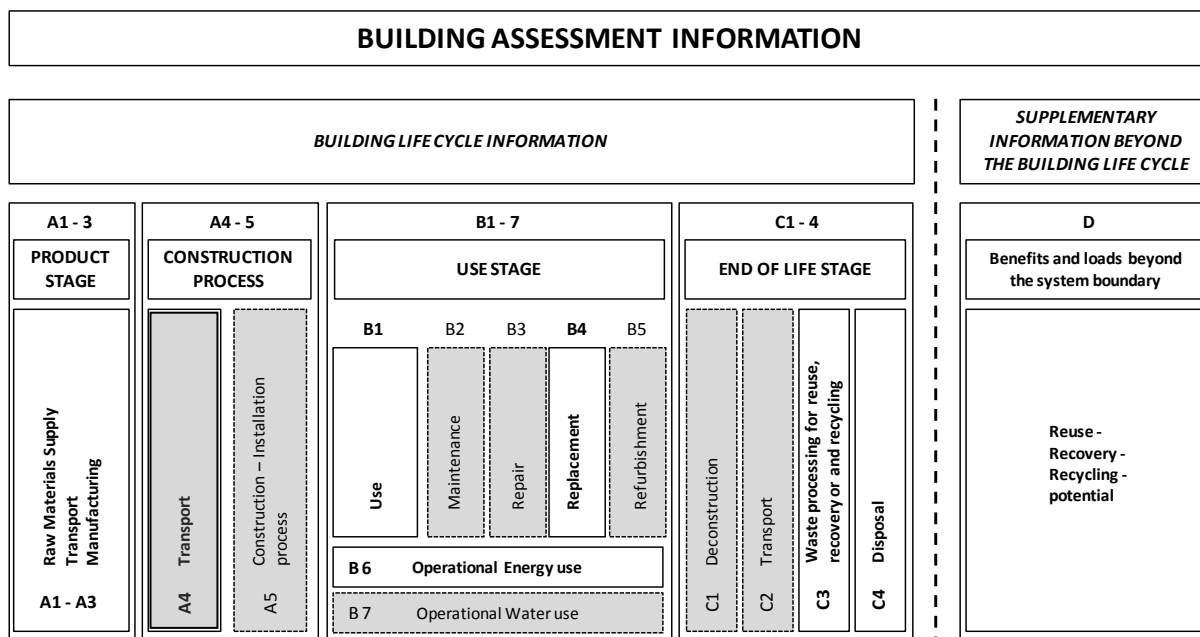


Figure 1 Building Life Cycle Phases according to FprEN 15978, adapted

The following processes are not included:

- Transport to construction side (Figure 1, module A4),
- Construction – Installation process (Figure 1, module A5),
- Energy use for user equipment during reference study period,
- Operational water use (Figure 1, module B7),
- Maintenance, repair and refurbishment during reference study period – (Figure 1, modules B2, B3 and B5),
- Deconstruction and transport to waste processing / disposal (Figure 1, modules C1 and C2),
- Transport to recycling (Figure 1, module C2).

The reference study period is defined with **50** years.

The functional equivalent (quantified functional requirements, intended use and/or technical requirements³), which is used as basis for comparison, is defined to be $m^2_{NFA} \cdot \text{year}$.

Inventory Analysis and Impact Assessment

During the inventory analysis of an LCA, emissions and resource consumption are identified, calculated and summed up over the life cycle of a product. Within building LCAs, separate calculations are carried out for the buildings` elements (product and end-of-life stage) and for the determination of emissions and resource uses during operation (see Equations 1, 2 and 3).

The inventory analysis of the buildings` elements mainly consists in providing quantitative information on the building elements used (see also Documentation Guidelines). Building compartments to be included are

1. Exterior walls and basement walls incl. windows and coatings,
2. Roof,
3. Ceilings incl. flooring and floor coverings / coatings,
4. Floor slab incl. flooring, floor coverings; floor slab above air,
5. Foundations,
6. Interior walls incl. coatings and supports,
7. Heat generation units.

³ prEN 15643-1:2010: Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework

For these, respective datasets are picked out from the ESUCO database, which include environmental profiles of the used component: for the respective component, a standardized LCA has been conducted earlier and the results are provided within this database format.

For the module A4, which contains transports from manufacturing to the construction site, information about transport distances and means of transportation have to be provided and connected to the respective ESUCO data sets⁴.

For the analysis of the use stage, a scenario has to be set up, including supply and disposal systems and repairs. For supply and disposal, values for end energy consumption for electricity and heat have to be derived from the respective national implementation of the EPBD directive. Heating units as well as the electricity demand calculated have to be listed and linked to the respective ESUCO datasets.

For repair, calculations have to be made for all materials, building components and surfaces with service lives of less than 50 years. Sources for service lives are the “Guideline for Sustainable Building” for construction materials and the VDI 2067 for building services.

Also for the end-of-life stage, a scenario has to be defined for the recycling and disposal of the building materials that remain in the building after the end of the reference study period. So for each material, one end-of-life options has to be chosen and linked to the respective ESUCO dataset:

- Metals → recycling → ”metal recycling potential”,
- Mineral building materials → recycling → ”construction rubble processing”,
- Materials with a heating value → thermal recycling → respective material group in ESUCO database,
- Heat producers → Dataset corresponding to the manufacturing process,
- All other materials that can be deposited at construction or household waste sites → disposal at waste site → appropriate ESUCO dataset.

Within the impact assessment, the emissions determined in the inventory analysis are classified regarding their contributions to different environmental impacts and then characterized. Using characterization factors, they are converted into equivalents of lead emissions for the different impact categories (example: emissions contributing to Photochemical Ozone Creation Potential are transformed to C₂H₄-equivalents, emissions contributing to Acidification Potential are transformed to SO₂-equivalents).

By using environmental profiles such as provided by ESUCO, the step of impact assessment has already been done by the data providers: Environmental profiles are given by providing the LCA results for the respective component in form of different environmental impact categories. These results are then used within the building LCA.

Interpretation

Resulting impacts are then evaluated against reference values to determine the respective indicator assessment (see overall Rating / Assessment Matrix).

⁴ It is suggested to use European average datasets. This means that the datasets represent technologies on average levels for Europe. These construction materials also contain European boundary conditions such as European datasets for electric or thermal energy or intermediate products and represent a common European market for construction materials. Using such European average datasets does not show the variability, for instance of the industry producing construction materials in Europe and thus has the advantage not to bias the analysis of the life cycle models by accounting for differences in different production techniques. This bias would reduce the significance of the results as the clear denotation of environmental hotspots in the structure and design of buildings would contain higher uncertainties on the origin of environmental impacts.

3. Calculation and Rating

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.

$$\text{POCP}_{\text{LC}} = \text{POCP}_{\text{C}} + \text{POCP}_{\text{O}} \quad (1)$$

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 ₂ H 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 ₂ H 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:

$$\text{POCP}_{\text{C}} = (\text{POCP}_{\text{MA}} + \text{POCP}_{\text{MC}}) / t_d + \text{POCP}_{\text{MB1,4}} \quad (2)$$

where

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 ₂ H 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 ₂ H 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 ₂ H 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:

$$\text{POCP}_{\text{O}} = \text{POCP}_{\text{MB6,E}} + \text{POCP}_{\text{MB6,H}} \quad (3)$$

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 ₂ H 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 ₂ H ₄ equiv./ (m ² _{NFA} *a)].

⁵ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

⁶ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

⁷ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

Rating Method

The “designed building” is rated against a case-specific reference building.

Photochemical Ozone Creation Potential for Reference Building

$$R_{POCP} = POCP_{LCref} = POCP_{Cref} + POCP_{Oref} \quad (4)$$

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 $[\text{kg C}_2\text{H}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$ 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 $[\text{kg C}_2\text{H}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$.

The reference value for construction $POCP_{Cref}$ is calculated as follows:

$$POCP_{Cref} = (POCP_{MAref} + POCP_{MCref}) / t_d + POCP_{MB1,4ref} \quad (5)$$

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 $[\text{kg C}_2\text{H}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}})]$,
$POCP_{MCref}$	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 $[\text{kg C}_2\text{H}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}})]$,
$POCP_{MB1,4ref}$	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 $[\text{kg C}_2\text{H}_4 \text{ equiv.}/(\text{m}^2_{\text{NFA}} * \text{a})]$
t_d	reference study period in [a]. This time period is set to 50 years.

The reference value for use $POCP_{Oref}$ is calculated as follows

$$POCP_{Oref} = POCP_{MB6,Eref} + POCP_{MB6,Href} \quad (6)$$

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 $[\text{kg C}_2\text{H}_4 \text{ equiv.}/\text{m}^2_{\text{NFA}} * \text{a}]$,
$POCP_{MB6,Href}$	photochemical ozone creation 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 $[\text{kg C}_2\text{H}_4 \text{ equiv.}/\text{m}^2_{\text{NFA}} * \text{a}]$.

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 $[\text{kWh}/(\text{m}^2_{\text{NFA}} * \text{a})]$ should be used as basis when possible.

⁸ $POCP_{Cref}$ will be derived from case studies

⁹ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

¹⁰ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

¹¹ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

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.

Table 1: European average reference values for “Quick and Basic”

Quick and Basic									
Based on 18 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	6.5	3.1E-07	2.4E-02	2.7E-03	2.9E-03	24.2	4.8	29.0	1,9E-01
Oref	33.2	5.8E-06	1.8E-01	7.4E-03	1.1E-02	168.1	15.3	183.4	3,7E-02
Total	39.7	6.1E-06	2.0E-01	1.0E-02	1.3E-02	192.3	20.1	212.4	2,3E-01

Table 2: European average reference values for “Complete”

Complete									
Based on 6 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	10.6	3.8E-07	3.3E-02	3,3E-03	3.4E-03	33.1	4.9	38.0	4,2E-02
Oref	35.2	6.7E-06	2.1E-01	8.3E-03	1.2E-02	196.5	21.0	217.5	2,2E-01
Total	45.8	7.1E-06	2.4E-01	1.1E-02	1.5E-02	229.5	25.9	255.5	2,6 E-06

Table1 and Table2 also mention a reference value for the operational phase. These values can be used if nation benchmarks are not available. The procedure of choosing the benchmarks is described in Figure 2.

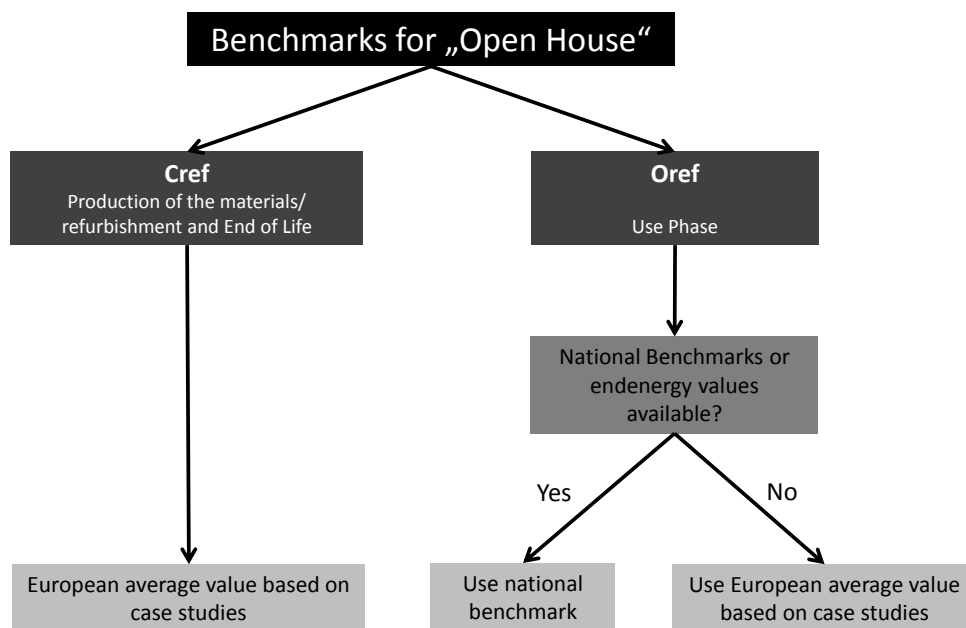


Figure 2: Setting of benchmarks in OPEN HOUSE

Limit value and target value calculation

Limit value L and target value T, needed to supplement the criterion’s evaluation, are determined as follows:

$$L = X * R \tag{7}$$

$$T = Y * R \tag{8}$$

The values X and Y are set as follows:

$$X = 2.0 \tag{9}$$

$$Y = 0.7 \tag{10}$$

Evaluation

The evaluation consists of a simultaneous reduction of buildings' Photochemical Ozone Creation Potential for design and operation over the entire lifecycle.

1.5 Photochemical Ozone Creation Potential	Points
$POCP_{LC} = 0,7 * R$	100
$POCP_{LC} =$ according to local definition (default: $0,76 * R$)	90
$POCP_{LC} =$ according to local definition (default: $0,82 * R$)	80
$POCP_{LC} =$ according to local definition (default: $0,85 * R$)	75
$POCP_{LC} =$ according to local definition (default: $0,88 * R$)	70
$POCP_{LC} =$ according to local definition (default: $0,94 * R$)	60
$POCP_{LC} = R$ ($POCP_{Gref}$, reference value)	50
$POCP_{LC} =$ according to local definition ($1,25 * R$)	40
$POCP_{LC} =$ according to local definition (default: $1,50 * R$)	30
$POCP_{LC} =$ according to local definition (default: $1,75 * R$)	20
$POCP_{LC} = 2,0 * R$ (limit value)	10
$POCP_{LC} > 2,0 * R$ (limit value)	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Basic & Quick Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Building surface area and volume,
2. Building components or surfaces/materials with service lives of less than 50 years (amount and estimated service life),
3. Electricity and heat demand for the building to be certified and reference values according to the national implementation of the EPBD directive; the calculation and a reference to the national implementation must be included.
4. Quantity determination of the building envelope surfaces (external walls including windows/façade, foundation slab, roof) from the energy calculation in compliance with the national implementation of the EPBD directive and allocation to assessed building components,
5. Windows/French doors/post-and-beam façade with information on frame size, a depiction of a cross-section of the main profile system, the number of windows that can be opened, and the type of glazing,
6. Quantity determination of interior walls and supports; plausibility analysis for floor plans with information on types of interior walls/supports,
7. Inside doors: amount (number and area), list of most important types, and description of calculation,
8. Quantity determination for ceilings, divided into stories,
9. Representation of building components as a series of strata with layer thicknesses, estimated gross

- density, and allocation to a data set in the ESUCO database,
10. Representation of quantity determination for foundations,
 11. For reinforced concrete, the share of reinforcement is to be given in kg/m³ or kg/m² of the building component. Alternatively, the reinforcing steel can be verified in an overall summary of the project.
 12. Documentation of heating unit,
 13. Documentation of transport distances and means of transport from manufacturing to construction site.

Most of these requirements can be met by providing a bill of materials (including masses, materials in a hierarchical structure, numbers of pieces, surface areas and volume of the building).

14. Documentation required for ecological footprint results:
Results are to be presented for the entire lifecycle per m² NFA and year, categorized by:
 - a. Manufacture
 - b. Use (electricity and heat)
 - c. Use (maintenance)
 - d. End of life (dismantling/recycling/disposal)

5. Relation to other Indicators

Data acquisition is the same for the indicators 1.1- 1.5, 1.9, 1.10, 1.15

6. Resources

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. prEN 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.

7. Attachments

None

Indicator 1.7

Biodiversity and depletion of habitats

(adapted from BREEAM)

1. Objective

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 loss¹.

2. Assessment Methodology

This indicator is evaluated by assessing the change in ecological value of the site.

The following sub-indicator will be assessed:

1.7.1. Change in ecological value of the site: enhancement of biodiversity

¹ Our life insurance, our natural capital: an EU biodiversity strategy to 2020

3. Calculation and Rating

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.

Requirements

Three options can satisfy the requirements of this indicator:

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

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.

1.7.3. Change in ecological value of the site: enhancement of biodiversity	Points
Change in ecological value ≥ 6	100
$5 \leq$ Change in ecological value < 6	90
$4 \leq$ Change in ecological value < 5	80
$3 \leq$ Change in ecological value < 4 OR Previously developed site with Biodiversity Management Plan	60
$2 \leq$ Change in ecological value < 3	50
$1 \leq$ Change in ecological value < 2 OR Biodiversity Management Plan is developed	20
$0 \leq$ Change in ecological value < 1	10
Change in ecological value < 0	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Basic & Quick Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1.7.1. Change in ecological value of the site: enhancement of biodiversity

1. Calculation of change in ecological value by suitably qualified ecologist

- A copy of the ecologist's report containing:

- Details and scope of the site survey.
- Calculations of the change in ecological value

- A copy of the relevant section of the specification requiring the main contractor to implement the suitably qualified ecologist's recommendations for protection and enhancement

- Assessor site inspection report and photographic evidence confirming that the ecologist's recommendations have been implemented.

For large mixed-use/multi-building developments, where the whole site has not been completed and ecological enhancements have not been added, or where features are being added at a later date in an appropriate planting season:

- A copy of the contract/specification or a letter from the main contractor confirming when the planting will be complete.

This must be within 18 months from completion of the development.

2. Previously developed sites

- Proof of the state of development of the site
- Biodiversity Management Plan Report

3. Biodiversity Management Plan

Biodiversity Management Plan Report with measures to preserve part of the existing ecosystems and to create habitats to maintain the biodiversity of the site

5. Relation to other Indicators

Indicator 1.12 Land Use

Indicator 5.5 Construction site impact/Construction process

6. Resources

BREEAM: LE 4 Mitigating Ecological Impact

7. Attachments

Annex 1: Calculating the change in ecological value

The change in ecological value is calculated by comparing the diversity (number and area) of plant species on the site pre and post construction. The ecological value of the site is expressed as an area-weighted average of plant species for the site's landscape type. This enables to use this as an indicator of the proposed development's impact on the site's existing ecological value.

A simple example of the calculation of the change in ecological value is provided below:

1. Calculate the ecological value of the existing site:

The 2065m² existing site consists of the following types of land:

- 1865 m² hard landscaping = 0 species
- 200 m² parkland - infertile grassland = 17.6 species (as defined by ecologist).

The ecological value of the existing site is calculated as follows. For each type of land the number of species on each plot type is multiplied by plot type area (as % of total area). Therefore, for our example site:

- Hard landscaping: $\{(0 \text{ species} \times (1865 \text{ m}^2/2065 \text{ m}^2))\} = 0 \text{ species}$
- Parkland-infertile grassland: $\{(17.6 \text{ species} \times (200 \text{ m}^2/2065 \text{ m}^2))\} = 1.70 \text{ species}$
- Ecological value of the existing site = $0 + 1.70 = 1.70 \text{ species}$

2. Calculate the ecological value of the proposed site:

The 2065 m² post-construction site consists of the following types of land:

- 1375 m² of building = 0 species.
- 5500 m² of hard landscaping = 0 species
- 140 m² has remained as parkland-infertile grassland = 17.6 species

The ecological value of the proposed site is as follows:

- Building: $\{(0 \text{ species} \times (1375 \text{ m}^2/2065 \text{ m}^2))\} = 0 \text{ species}$
- Hard landscaping: $\{(0 \text{ species} \times (550 \text{ m}^2/2065 \text{ m}^2))\} = 0 \text{ species}$
- Parkland-infertile grassland: $\{(17.6 \text{ species} \times (140 \text{ m}^2/2065 \text{ m}^2))\} = 1.19 \text{ species}$
- Ecological value of the proposed site = $0 + 0 + 1.19 = 1.19 \text{ species}$

The change in ecological value is calculated by subtracting the value of the existing site from the proposed site:

Change in ecological value: $1.19 - 1.70 = -0.51 \text{ species}$

The calculation can be illustrated and documented with the following table:

Ecological value of the existing site before construction		1,7	
Type of land		Area [m ²]	Species
1	Hard landscaping	1865	0
2	Parkland - infertile grassland	200	17,6

Ecological value of the proposed site after construction		1,2	
Type of land		Area [m ²]	Species
1	Hard landscaping	550	0
2	Parkland - infertile grassland	140	17,6
3	Building	1375	0

Change in ecological value

-0,5

The template for this table is provided within the package of assessment tools.

Relevant definitions

Suitably Qualified Ecologist (SQE): An individual achieving all the following items can be considered to be “suitably qualified” for the purposes of an OPEN HOUSE assessment:

1. Holds a degree or equivalent qualification in ecology or a related qualification. Other related qualifications will have a significant ecology component but may come from a wide range of areas including but not limited to:

- Biologists, botanists, entomologists etc
- Arboriculturalists
- Nature conservationists
- Landscape engineers/architects
- Environmental engineers/scientists

2. Is a practising ecologist, with a minimum of three years relevant experience (within the last five years). Such experience must clearly demonstrate a practical understanding of factors affecting ecology in relation to construction and the built environment; including, acting in an advisory capacity to provide recommendations for ecological protection, enhancement and mitigation measures. The relevant experience must relate to the country that the assessment is being carried out in.

Indicator 1.8 **Light Pollution**

(adapted from LEED, BREEAM, HQE, EN 12464-2)

1. Objective

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).

2. Assessment Methodology

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 luminaires 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 will be assessed:

1.8.1. Light on properties

1.8.2 Luminaire intensity

1.8.3 Upward light

1.8.4 Luminance

3. Calculation and Rating

The location has to be classified in one of the four environmental zones defined in EN 12464-2:

Zone	Lighting Environment	Characterization
E1	Intrinsically dark	Developed areas within national parks or protected sites
E2	Low district brightness	Primarily residential zones, neighbourhood business districts, light industrial with limited night-time use and residential mixed-use areas)
E3	Medium district brightness	All other areas not included in E1, E2 or E4, such as commercial/industrial, and high-density residential
E4	High district brightness	High activity commercial districts in major metropolitan areas and town centres

1.8.1. Light on properties

The maximum value of vertical illuminance on properties E_v given in EN 12464-2 should be respected:

Zone	Light on Properties E_v [lx]	
	Pre-curfew*	Post-curfew
E1	2	0
E2	5	1
E3	10	2
E4	25	5

* In case no curfew regulations are available, the higher values shall not be exceeded and the lower values should be taken as preferable limits

1.8.1. Light on properties	Points
The maximum value of vertical illuminance on properties is lower than the EN 12464-2 value for the classified zone	100
The maximum value of vertical illuminance on properties is higher than the EN 12464-2 value for the classified zone	0

1.8.2. Luminaire intensity

The light intensity of each source in the potentially obtrusive direction given in EN 12464-2 should be respected:

Zone	Luminaire intensity I [cd]	
	Pre-curfew*	Post-curfew
E1	2500	0
E2	7500	500
E3	10000	1000
E4	25000	2500

* In case no curfew regulations are available, the higher values shall not be exceeded and the lower values should be taken as preferable limits

1.8.2. Luminaire intensity	Points
The maximum value of the light intensity of each source in the potentially obtrusive direction is lower than the EN 12464-2 value for the classified zone	100
The maximum value of the light intensity of each source in the potentially obtrusive direction is higher than the EN 12464-2 value for the classified zone	0

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:

Zone	Upward light <i>ULR</i> [%]
E1	0
E2	5
E3	15
E4	25

1.8.3. Upward light	Points
The upward light values are lower than the requirements from EN 12464-2 for the classified zone	100
The upward light values are higher than the requirements from EN 12464-2 for the classified zone	0

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:

Zone	Luminance [cd/m ²]	
	Building facade	Signs
E1	0	50
E2	5	400
E3	10	800
E4	25	1000

1.8.3. Luminance	Points
The maximum average luminance of the signs and of the facade of a building is lower than the EN 12464-2 values for the classified zone	100
The maximum average luminance of the signs and of the facade of a building is higher than the EN 12464-2 values for the classified zone	0

Weights of Sub-indicators

Indicator 1.8	Weight
Sub-indicator 1.8.1. Light on properties	4
Sub-indicator 1.8.2 Luminaire intensity	4
Sub-indicator 1.8.3 Upward light	4
Sub-indicator 1.8.4 Luminance	4

4. Documentation Guidelines

The following documents are required to assess the building:

Basic & Quick Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

The classification for a project site is necessary for all sub-indicators.

1.8.1. Light on properties

- Description of the calculation of the vertical illuminance

1.8.2 Luminaire intensity

- Technical data sheet of lighting fixtures,
- Manufacturer's data for lamps used on a project site,

1.8.3 Upward light

- Description of installed fixtures
- Pictures of installed fixtures showing the angle of light emission

1.8.4 Luminance

- Technical data sheet of lighting fixtures

5. Relation to other Indicators

Indicator 2.7 Visual comfort

Indicator 1.9 Non-Renewable Primary Energy Demand (PE_{nr})

Indicator 1.10 Total Primary Energy demand and Share of renewable Primary Energy

Indicator 2.2 Personal safety of users

6. Resources

BREEAM 2009: Pol4 Reduction of night time light pollution

LEED 2009: Site 8 Light Pollution Reduction

HQE 2012: 1.3. Impacts of the building on the local residents

ANSI/ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Lighting, Section 9 (without amendments)

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)

International Dark-Sky Association (www.darksky.org)

EN 12464-2, Light and lighting — Lighting of work places — Part 2 : Outdoor work places.

7. Attachments

None

Indicator 1.9 Abiotic depletion of non renewable fossil fuels due to non renewable Primary Energy Demand (ADP_{Enr})

(adapted from EN 15978)

Core Indicator

1. Objective

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.

This supports the European Commission target to reach a 20% share of renewable energies in EU energy consumption by 2020¹.

2. Assessment Methodology

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.

Goal and scope definition

The goal of all LCA studies is to analyze and later benchmark the environmental performance of the respective buildings` life cycles. The scope of the building assessment therefore includes the following life cycle stages:

- production: raw material supply, transport to manufacturing, manufacturing and transport to the construction site of products used in the building (Figure 1, modules A1-A4),
- use stage: a scenario is defined including use and replacement, including end-of-life of replaced products (Figure 1, modules B1 and B4); in addition the operational energy use is considered (Figure 1, module B6),
- end-of-life stage: waste processing and disposal of the building, (Figure 1, modules C3 and C4),
- a scenario for potential benefits and loads beyond the system boundaries, including loads for reuse and recycling as well as benefits from recycling potentials (Figure 1, module D).

¹ Energy 2020 - A strategy for competitive, sustainable and secure energy

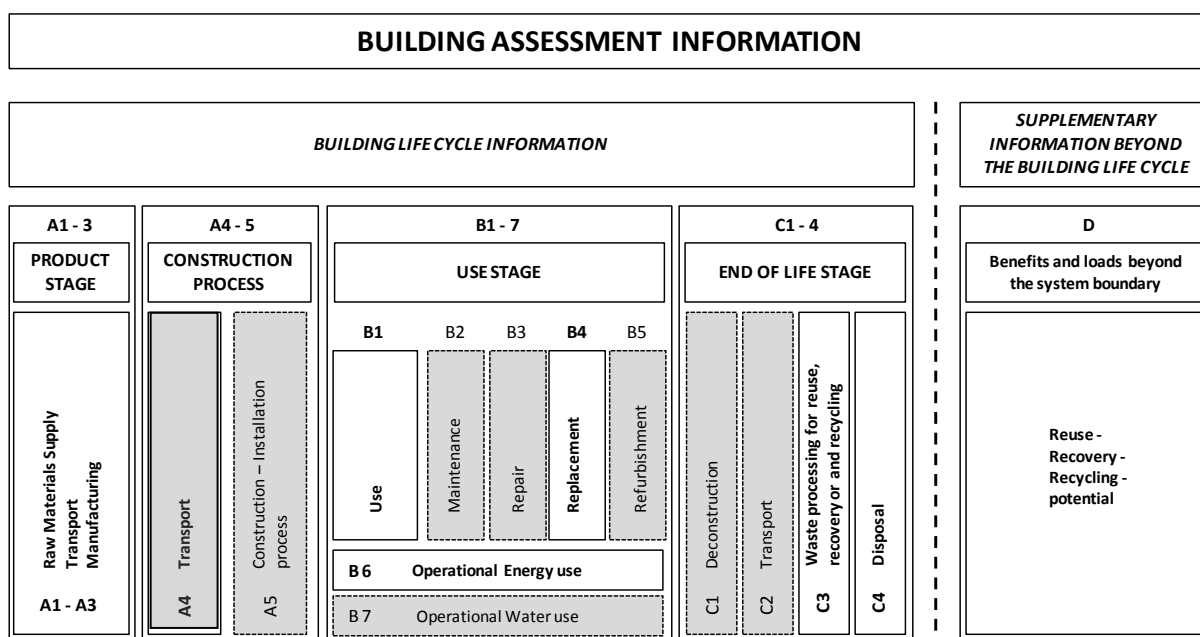


Figure 1 Building Life Cycle Phases according to EN 15978, adapted

The following processes are not included:

- Transport to construction side (Figure 1, module A4),
- Construction – Installation process (Figure 1, module A5),
- Energy use for user equipment during reference study period,
- Operational water use (Figure 1, module B7),
- Maintenance, repair and refurbishment during reference study period – (Figure 1, modules B2, B3 and B5),
- Deconstruction and transport to waste processing / disposal (Figure 1, modules C1 and C2),
- Transport to recycling (Figure 1, module C2).

The reference study period is defined with **50** years.

The functional equivalent (quantified functional requirements, intended use and/or technical requirements²), which is used as basis for comparison, is defined to be $m^2_{NFA} \cdot \text{year}$.

Inventory Analysis and Impact Assessment

During the inventory analysis of an LCA, emissions and resource consumption are identified, calculated and summed up over the life cycle of a product. Within building LCAs, separate calculations are carried out for the buildings` elements (product and end-of-life stage) and for the determination of emissions and resource uses during operation (see Equations 1, 2 and 3).

The inventory analysis of the buildings` elements mainly consists in providing quantitative information on the building elements used (see also Documentation Guidelines). Building compartments to be included are

1. Exterior walls and basement walls incl. windows and coatings,
2. Roof,
3. Ceilings incl. flooring and floor coverings / coatings,
4. Floor slab incl. flooring, floor coverings; floor slab above air,
5. Foundations,
6. Interior walls incl. coatings and supports,
7. Heat generation units.

² prEN 15643-1:2010: Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework

For these, respective datasets are picked out from the ESUCO database, which include environmental profiles of the used component: for the respective component, a standardized LCA has been conducted earlier and the results are provided within this database format.

For the module A4, which contains transports from manufacturing to the construction site, information about transport distances and means of transportation have to be provided and connected to the respective ESUCO data sets³.

For the analysis of the use stage, a scenario has to be set up, including supply and disposal systems and repairs. For supply and disposal, values for end energy consumption for electricity and heat have to be derived from the respective national implementation of the EPBD directive. Heating units as well as the electricity demand calculated have to be listed and linked to the respective ESUCO datasets.

For repair, calculations have to be made for all materials, building components and surfaces with service lives of less than 50 years. Sources for service lives are the “Guideline for Sustainable Building” for construction materials and the VDI 2067 for building services.

Also for the end-of-life stage, a scenario has to be defined for the recycling and disposal of the building materials that remain in the building after the end of the reference study period. So for each material, one end-of-life options has to be chosen and linked to the respective ESUCO dataset:

- Metals → recycling → ”metal recycling potential”,
- Mineral building materials → recycling → ”construction rubble processing”,
- Materials with a heating value → thermal recycling → respective material group in ESUCO database,
- Heat producers → Dataset corresponding to the manufacturing process,
- All other materials that can be deposited at construction or household waste sites → disposal at waste site → appropriate ESUCO dataset.

By using environmental profiles such as provided by ESUCO, the step of impact assessment has already been done by the data providers: Environmental profiles are given by providing the LCA results for the respective component in form of different environmental impact categories. These results are then used within the building LCA.

Interpretation

Resulting impacts are then evaluated against reference values to determine the respective indicator assessment (see overall Rating / Assessment Matrix).

³ It is suggested to use European average datasets. This means that the datasets represent technologies on average levels for Europe. These construction materials also contain European boundary conditions such as European datasets for electric or thermal energy or intermediate products and represent a common European market for construction materials. Using such European average datasets does not show the variability, for instance of the industry producing construction materials in Europe and thus has the advantage not to bias the analysis of the life cycle models by accounting for differences in different production techniques. This bias would reduce the significance of the results as the clear denotation of environmental hotspots in the structure and design of buildings would contain higher uncertainties on the origin of environmental impacts.

3. Calculation and Rating

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 E_i .

$$ADP_{E_{nr,LC}} = \sum_i ADP_{E_i} \times (E_{nr,LC,E_i} + E_{nr,O,E_i}) \quad (1)$$

where

ADP_{E_i}	Abiotic Depletion Potential for reference energy carrier E_i ,
E_{nr,LC,E_i}	non-renewable energy demand for energy carrier E_i of the life cycle of the entire building, E_{nr,C,E_i} 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/(m ² _{NFA} *a)],
E_{nr,O,E_i}	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 / (m ² _{NFA} *a)] for any energy carrier E_i ,
NFA	Net Floor Area of the building.

Based on the modules as defined in Figure 1, the value for construction $ADP_{E_{nr,C,E_i}}$ is calculated as follows:

$$ADP_{E_{nr,C,E_i}} = \sum_i ADP_{E_i} ((E_{nr,MA,E_i} + E_{nr,MC,E_i}) / t_d + E_{nr,MB1,4,E_i}) \quad (2)$$

where

ADP_{E_i}	Abiotic Depletion Potential for reference energy carrier E_i
E_{nr,MA,E_i}	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 E_i ,
E_{nr,MC,E_i}	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 E_i ,
$E_{nr,MB1,4,E_i}$	predicted value of non-renewable energy demand for any energy carrier E_i 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.

⁴ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

⁵ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

⁶ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

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 :

$$E_{nr,O,Ei} = E_{nr,MB6,Ei} + \sum_i ADP_Ei \times E_{nr,MB6,H,Ei} \quad (3)$$

where

ADP_Ei Abiotic Depletion Potential for reference energy carrier Ei

$E_{nr,MB6,Ei}$ 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

$$R_{ADP_Enr} = ADP_Eref \times E_{nr,L,Cref} = ADP_Eref (E_{nr,Cref} + E_{nr,Oref}) \quad (4)$$

where

ADP Eref Abiotic Depletion Potential for reference energy carrier E_{ref}

$E_{nr,L,Cref}$ 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 $[kWh/(m^2_{NFA} * a)]^7$,

$E_{nr,Oref}$ 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 $[kWh/(m^2_{NFA} * a)]$.

The reference value for construction $ADP_E_{nr,Cref}$ is calculated as follows:

$$ADP_E_{nr,Cref} = (ADP_Eref \times E_{nr,MAref} + ADP_Eref \times PE_{nr,MCref}) / t_d + ADP_Eref * E_{nr,MB1,4ref} \quad (5)$$

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 A1-4⁸, including office building's manufacture (construction and building systems technology) and transports to construction site in $[kWh/(m^2_{NFA})]$,

$E_{nr,MCref}$ reference value for non-renewable energy demand created during module C3 and C4⁹, the office building's end-of-life (design and building systems technology) in $[kWh/(m^2_{NFA})]$,

$E_{nr,MB1,4ref}$ reference value for annual non-renewable energy demand created during modules B1 and B4¹⁰ 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.

⁷ $E_{nr,Cref}$ will be derived from case studies

⁸ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

⁹ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

¹⁰ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

The reference value for use $E_{nr,Oref}$ is calculated as follows

$$ADP_{E_{nr,Oref}} = ADP_{E_{l}} \times E_{nr,MB6,Eref,E_{l}} + \sum_i ADP_{E_{i}} \times E_{nr,MB6,Href,E_{i}} \quad (6)$$

Where

ADP_{E_l} **Abiotic Depletion Potential for electrical energy**

ADP_{E_i} **Abiotic Depletion Potential for energy carrier E_i**

E_{nr,MB6,Eref,E_l} non-renewable energy demand for the national reference value for building's annual electricity demand (end energy) according to the national implementation of the EPBD in [kWh/m²_{NFA} *a],

E_{nr,MB6,Href,E_i} 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 EPBD in [kWh/m²_{NFA} *a] for fossil fuel E_i.

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.

Note: table to be amended with European reference values for ADP_{fossil fuels}

Table 1: European average reference values for “Quick and Basic”

Quick and Basic									
Based on 18 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	6.5	3.1E-07	2.4E-02	2.7E-03	2.9E-03	24.2	4.8	29.0	1,9E-01
Oref	33.2	5.8E-06	1.8E-01	7.4E-03	1.1E-02	168.1	15.3	183.4	3,7E-02
Total	39.7	6.1E-06	2.0E-01	1.0E-02	1.3E-02	192.3	20.1	212.4	2,3E-01

Table 2: European average reference values for “Complete”

Complete									
Based on 6 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	10.6	3.8E-07	3.3E-02	3,3E-03	3.4E-03	33.1	4.9	38.0	4,2E-02
Oref	35.2	6.7E-06	2.1E-01	8.3E-03	1.2E-02	196.5	21.0	217.5	2,2E-01
Total	45.8	7.1E-06	2.4E-01	1.1E-02	1.5E-02	229.5	25.9	255.5	2.6 E-06

Table 1 and Table 2 also mention a reference value for the operational phase. These values can be used if nation benchmarks are not available. The procedure of choosing the benchmarks is described in Figure 2.

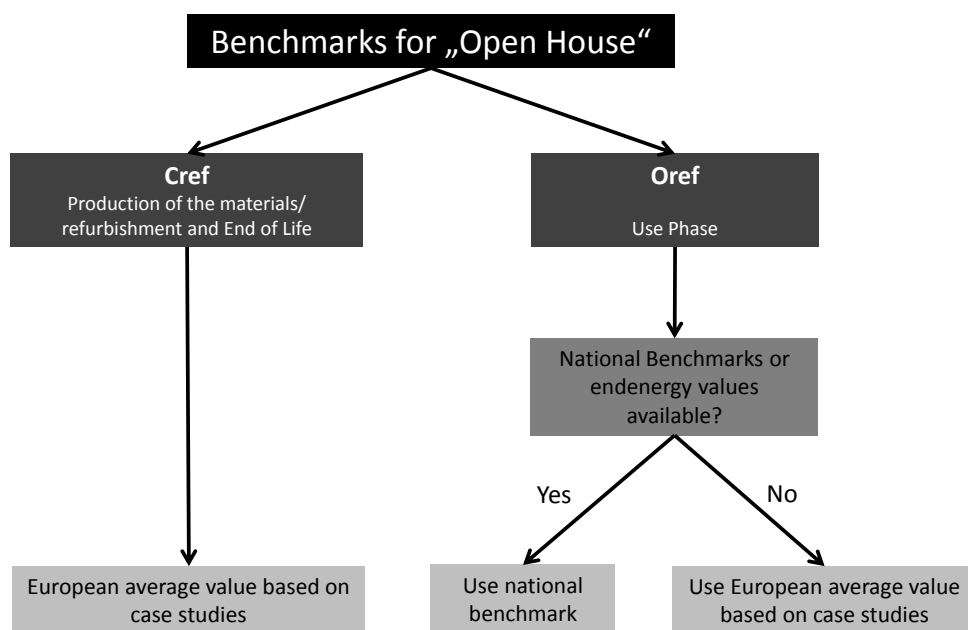


Figure 2: Setting of benchmarks in OPEN HOUSE

Limit value and target value calculation

Limit value L and target value T, needed to supplement the criterion's evaluation, are determined as follows:

$$L = X * R \tag{7}$$

$$T = Y * R \tag{8}$$

The values X and Y are set as follows:

$$X = 1.4 \tag{9}$$

$$Y = 0.7 \tag{10}$$

1.9 Non-Renewable Primary Energy Demand	Points
$ADP_{Enr,LC} = 0,7 * R$	100
$ADP_{Enr,LC} =$ according to local definition (default: $0,76 * R$)	90
$ADP_{Enr,LC} =$ according to local definition (default: $0,82 * R$)	80
$ADP_{Enr,LC} =$ according to local definition (default: $0,85 * R$)	75
$ADP_{Enr,LC} =$ according to local definition (default: $0,88 * R$)	70
$ADP_{Enr,LC} =$ according to local definition (default: $0,94 * R$)	60
$ADP_{Enr,LC} = R$ ($PE_{nr,LCref}$, reference value)	50
$ADP_{Enr,LC} =$ according to local definition $1,1 * R$)	40
$ADP_{Enr,LC} =$ according to local definition (default: $1,2 * R$)	30
$ADP_{Enr,LC} =$ according to local definition (default: $1,3 * R$)	20
$ADP_{Enr,LC} = 1,4 * R$ (limit value)	10
$ADP_{Enr,LC} > 1,4 * R$ (limit value)	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Basic & Quick Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Building surface area and volume,
2. Building components or surfaces/materials with service lives of less than 50 years (amount and estimated service life),
3. Electricity and heat demand for the building to be certified and reference values according to the national implementation of the EPBD directive; the calculation and a reference to the national implementation must be included.
4. Quantity determination of the building envelope surfaces (external walls including windows/façade, foundation slab, roof) from the energy calculation in compliance with the national implementation of the EPBD directive and allocation to assessed building components,
5. Windows/French doors/post-and-beam façade with information on frame size, a depiction of a cross-section of the main profile system, the number of windows that can be opened, and the type of glazing,
6. Quantity determination of interior walls and supports; plausibility analysis for floor plans with information on types of interior walls/supports,
7. Inside doors: amount (number and area), list of most important types, and description of calculation,
8. Quantity determination for ceilings, divided into stories,
9. Representation of building components as a series of strata with layer thicknesses, estimated gross density, and allocation to a data set in the ESUCO database,
10. Representation of quantity determination for foundations,
11. For reinforced concrete, the share of reinforcement is to be given in kg/m³ or kg/m² of the building component. Alternatively, the reinforcing steel can be verified in an overall summary of the project.
12. Documentation of heating unit,
13. Documentation of transport distances and means of transport from manufacturing to construction site.

Most of these requirements can be met by providing a bill of materials (including masses, materials in a hierarchical structure, numbers of pieces, surface areas and volume of the building).

14. Documentation required for ecological footprint results:

Results are to be presented for the entire lifecycle per m² NFA and year, categorized by:

- a. Manufacture
- b. Use (electricity and heat)
- c. Use (maintenance)
- d. End of life (dismantling/recycling/disposal)

5. Relation to other Indicators

Data acquisition is the same for the indicators of

- 1.1 Global Warming Potential
- 1.2 Ozone Depletion Potential
- 1.3 Acidification Potential
- 1.4 Eutrophication Potential
- 1.5 Photochemical Ozone Creation Potential
- 1.9 Abiotic depletion of non renewable fossil fuels due to non renewable Primary Energy Demand (ADP_Enr)
- 1.10 Total Primary Energy Demands and Percentage of Renewable Primary Energy
- 1.15 Abiotic Depletion Potential for non fossil fuels (ADP_element)

6. Resources

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. EN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
4. EN 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.

7. Attachments

None

Indicator 1.10 **Total Primary Energy demand and Share of renewable Primary Energy**

(adapted from DGNB/BNB)

Core Indicator

1. Objective

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.

This supports the European Commission target to reach a 20% improvement in energy efficiency as well as a 20% share of renewable energies in EU energy consumption by 2020¹.

2. Assessment Methodology

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.

Goal and scope definition

The goal of all LCA studies is to analyze and later benchmark the environmental performance of the respective buildings' life cycles. The scope of the building assessment therefore includes the following life cycle stages:

- production: raw material supply, transport to manufacturing, manufacturing and transport to the construction site of products used in the building (Figure 1, modules A1-A4),
- use stage: a scenario is defined including use and replacement, including end-of-life of replaced products (Figure 1, modules B1 and B4); in addition the operational energy use is considered (Figure 1, module B6),
- end-of-life stage: waste processing and disposal of the building, (Figure 1, modules C3 and C4),
- a scenario for potential benefits and loads beyond the system boundaries, including loads for reuse and recycling as well as benefits from recycling potentials (Figure 1, module D).

¹ Energy 2020 - A strategy for competitive, sustainable and secure energy

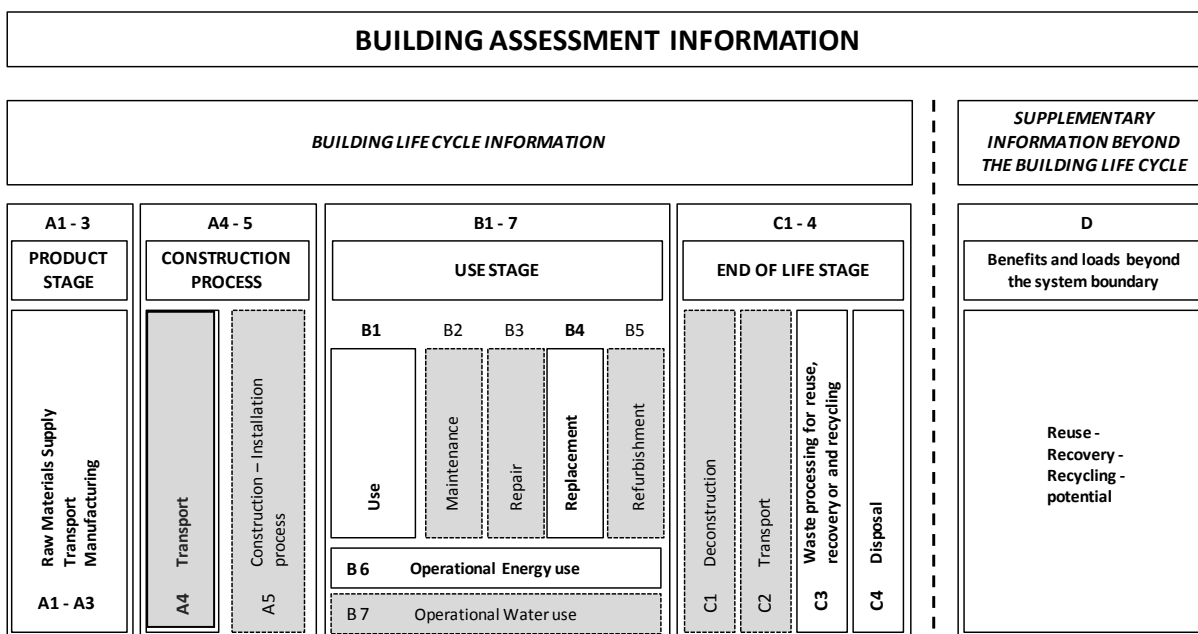


Figure 1 Building Life Cycle Phases according to FprEN 15978, adapted

The following processes are not included:

- Transport to construction side (Figure 1, module A4),
- Construction – Installation process (Figure 1, module A5),
- Energy use for user equipment during reference study period,
- Operational water use (Figure 1, module B7),
- Maintenance, repair and refurbishment during reference study period – (Figure 1, modules B2, B3 and B5),
- Deconstruction and transport to waste processing / disposal (Figure 1, modules C1 and C2),
- Transport to recycling (Figure 1, module C2).

The reference study period is defined with **50** years.

The functional equivalent (quantified functional requirements, intended use and/or technical requirements²), which is used as basis for comparison, is defined to be $m^2_{NFA} \cdot \text{year}$.

Inventory Analysis and Impact Assessment

During the inventory analysis of an LCA, emissions and resource consumption are identified, calculated and summed up over the life cycle of a product. Within building LCAs, separate calculations are carried out for the buildings` elements (product and end-of-life stage) and for the determination of emissions and resource uses during operation (see Equations 1, 2 and 3).

The inventory analysis of the buildings` elements mainly consists in providing quantitative information on the building elements used (see also Documentation Guidelines). Building compartments to be included are

1. Exterior walls and basement walls incl. windows and coatings,
2. Roof,
3. Ceilings incl. flooring and floor coverings / coatings,
4. Floor slab incl. flooring, floor coverings; floor slab above air,
5. Foundations,
6. Interior walls incl. coatings and supports,

² prEN 15643-1:2010: Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework

7. Heat generation units.

For these, respective datasets are picked out from the ESUCO database, which include environmental profiles of the used component: for the respective component, a standardized LCA has been conducted earlier and the results are provided within this database format.

For the module A4, which contains transports from manufacturing to the construction site, information about transport distances and means of transportation have to be provided and connected to the respective ESUCO data sets³.

For the analysis of the use stage, a scenario has to be set up, including supply and disposal systems and repairs. For supply and disposal, values for end energy consumption for electricity and heat have to be derived from the respective national implementation of the EPBD directive. Heating units as well as the electricity demand calculated have to be listed and linked to the respective ESUCO datasets.

For repair, calculations have to be made for all materials, building components and surfaces with service lives of less than 50 years. Sources for service lives are the “Guideline for Sustainable Building” for construction materials and the VDI 2067 for building services.

Also for the end-of-life stage, a scenario has to be defined for the recycling and disposal of the building materials that remain in the building after the end of the reference study period. So for each material, one end-of-life options has to be chosen and linked to the respective ESUCO dataset:

- Metals → recycling → ”metal recycling potential”,
- Mineral building materials → recycling → ”construction rubble processing”,
- Materials with a heating value → thermal recycling → respective material group in ESUCO database,
- Heat producers → Dataset corresponding to the manufacturing process,
- All other materials that can be deposited at construction or household waste sites → disposal at waste site → appropriate ESUCO dataset.

By using environmental profiles such as provided by ESUCO, the step of impact assessment has already been done by the data providers: Environmental profiles are given by providing the LCA results for the respective component in form of different environmental impact categories. These results are then used within the building LCA.

Interpretation

Resulting impacts are then evaluated against reference values to determine the respective indicator assessment (see overall Rating / Assessment Matrix).

The following sub-indicators will be assessed:

1.10.1 Total Primary Energy Demand

1.10.2 Share of renewable Primary Energy in Total Primary Energy Demand

³ It is suggested to use European average datasets. This means that the datasets represent technologies on average levels for Europe. These construction materials also contain European boundary conditions such as European datasets for electric or thermal energy or intermediate products and represent a common European market for construction materials. Using such European average datasets does not show the variability, for instance of the industry producing construction materials in Europe and thus has the advantage not to bias the analysis of the life cycle models by accounting for differences in different production techniques. This bias would reduce the significance of the results as the clear denotation of environmental hotspots in the structure and design of buildings would contain higher uncertainties on the origin of environmental impacts.

3. Calculation and Rating

Calculation

The total primary energy demand over the building life cycle, $PE_{tot,LC}$, is calculated as follows:

$$PE_{tot,LC} = PE_{nr,LC} + PE_{ren,LC}$$

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 $[kWh/(m^2_{NFA} * a)]$,

$PE_{ren,LC}$ 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 $[kWh/(m^2_{NFA} * a)]$; 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.

1.10.1 Total Primary Energy Demand

Rating Method

The “designed building” is rated against a case-specific reference building.

Total Primary Energy Demand for Reference Building

$$PE_{tot,LC,ref} = PE_{tot,Cref} + PE_{tot,Oref} \quad (4)$$

where

$PE_{tot,LC,ref}$ 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:

$$PE_{tot,Cref} = (PE_{tot,MAref} + PE_{tot,MCref}) / t_d + PE_{tot,MB1,4ref} \quad (5)$$

where

$PE_{tot,MAref}$ reference value for total primary energy demand created during the modules A1-4⁵, including office building’s manufacture (construction and building systems technology) and transports to construction site in $[kWh/(m^2_{NFA} * a)]$,

$PE_{tot,MCref}$ reference value for total primary energy demand created during module C3 and C4⁶, 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 B4⁷ 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.

⁴ $PE_{tot,Cref}$ is derived from the case studies.

⁵ Module A5 currently is not regarded due to a lack of data; compare chapter 2.

⁶ Modules C1 and C2 currently are not regarded due to a lack of data; compare chapter 2.

⁷ Modules B2, B3 and B5 currently are not regarded due to a lack of data; compare chapter 2.

The reference value for use $PE_{tot,Oref}$ is calculated as follows

$$PE_{tot,Oref} = PE_{tot,MB6,Eref} + PE_{tot,MB6,Href} \quad (6)$$

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.

Table 1: European average reference values for “Quick and Basic”

Quick and Basic									
Based on 18 case studies	GWP [kg CO ₂ E /(m ² *y)]	ODP [kg R11E /(m ² *a)]	AP [kg SO ₂ E /(m ² *a)]	EP [kg PO ₄ ³⁻ E /(m ² *a)]	POCP [kg C ₂ H ₄ E /(m ² *a)]	Penr [kWh /(m ² *a)]	PEre [kWh /(m ² *a)]	PEtot [kWh /(m ² *a)]	ADP _{elements} [kg SB-E /(m ² *a)]
Cref	6.5	3.1E-07	2.4E-02	2.7E-03	2.9E-03	24.2	4.8	29.0	1,9E-01
Oref	33.2	5.8E-06	1.8E-01	7.4E-03	1.1E-02	168.1	15.3	183.4	3,7E-02
Total	39.7	6.1E-06	2.0E-01	1.0E-02	1.3E-02	192.3	20.1	212.4	2,3E-01

Table 2: European average reference values for “Complete”

Complete									
Based on 6 case studies	GWP [kg CO ₂ E /(m ² *y)]	ODP [kg R11E /(m ² *a)]	AP [kg SO ₂ E /(m ² *a)]	EP [kg PO ₄ ³⁻ E /(m ² *a)]	POCP [kg C ₂ H ₄ E /(m ² *a)]	Penr [kWh /(m ² *a)]	PEre [kWh /(m ² *a)]	PEtot [kWh /(m ² *a)]	ADP _{elements} [kg SB-E /(m ² *a)]
Cref	10.6	3.8E-07	3.3E-02	3.3E-03	3.4E-03	33.1	4.9	38.0	4,2E-02
Oref	35.2	6.7E-06	2.1E-01	8.3E-03	1.2E-02	196.5	21.0	217.5	2,2E-01
Total	45.8	7.1E-06	2.4E-01	1.1E-02	1.5E-02	229.5	25.9	255.5	2,6 E-06

Table1 and Table2 also mention a reference value for the operational phase. These values can be used if nation benchmarks are not available. The procedure of choosing the benchmarks is described in Figure 2.

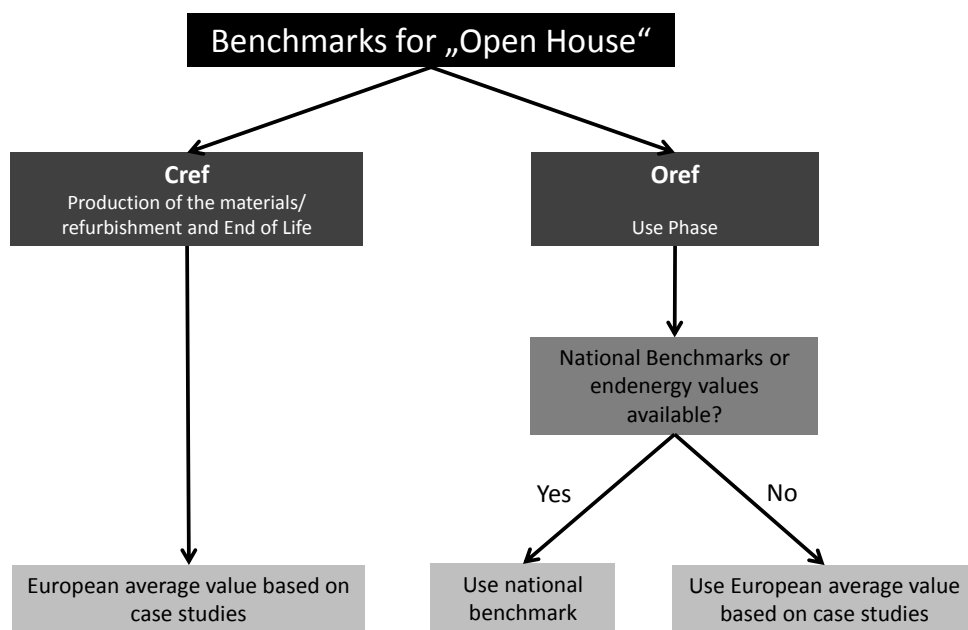


Figure 2: Setting of benchmarks in OPEN HOUSE

Limit value and target value calculation

Limit value L and target value T, needed to supplement the criterion’s evaluation, are determined as follows:

$$L = X * R \tag{7}$$

$$T = Y * R \tag{8}$$

The values X and Y are set as follows:

$$X = 1.4 \tag{9}$$

$$Y = 0.4 \tag{10}$$

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 following table.

1.10.1 Total Primary Energy Demand	Points
$PE_{tot,LC} = 0.4 * PE_{tot,LCref}$ (target value)	100
$PE_{tot,LC} = 0.43 * PE_{tot,LCref}$	95
$PE_{tot,LC} = 0.46 * PE_{tot,LCref}$	90
$PE_{tot,LC} = 0.49 * PE_{tot,LCref}$	85
$PE_{tot,LC} = 0.52 * PE_{tot,LCref}$	80
$PE_{tot,LC} = 0.55 * PE_{tot,LCref}$	75
$PE_{tot,LC} = 0.58 * PE_{tot,LCref}$	70
$PE_{tot,LC} = 0.61 * PE_{tot,LCref}$	65
$PE_{tot,LC} = 0.64 * PE_{tot,LCref}$	60
$PE_{tot,LC} = 0.67 * PE_{tot,LCref}$	55
$PE_{tot,LC} = 0.7 * PE_{tot,LCref}$	50
$PE_{tot,LC} = 0.78 * PE_{tot,LCref}$	45
$PE_{tot,LC} = 0.82 * PE_{tot,LCref}$	40
$PE_{tot,LC} = 0.88 * PE_{tot,LCref}$	35
$PE_{tot,LC} = 0.94 * PE_{tot,LCref}$	30
$PE_{tot,LC} = PE_{tot,LCref}$ (reference value)	25
$PE_{tot,LC} = 1.1 * PE_{tot,LCref}$	20
$PE_{tot,LC} = 1.2 * PE_{tot,LCref}$	15
$PE_{tot,LC} = 1.3 * PE_{tot,LCref}$	10
$PE_{tot,LC} = 1.4 * PE_{tot,LCref}$ (limit value)	5
$PE_{tot,LC} > 1.4 * PE_{tot,LCref}$ (limit value)	0

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 the following table.

1.10.2 Share of renewable Primary Energy in Total Primary Energy Demand	Points
$PE_{ren,LC} / PE_{tot,LC} \geq 20\%$ (target value)	50
$PE_{ren,LC} / PE_{tot,LC} \geq 18\%$	45
$PE_{ren,LC} / PE_{tot,LC} \geq 16\%$	40
$PE_{ren,LC} / PE_{tot,LC} \geq 14\%$	35
$PE_{ren,LC} / PE_{tot,LC} \geq 12\%$	30
$PE_{ren,LC} / PE_{tot,LC} \geq 10\%$	25
$PE_{ren,LC} / PE_{tot,LC} \geq 8\%$	20
$PE_{ren,LC} / PE_{tot,LC} \geq 6\%$	15
$PE_{ren,LC} / PE_{tot,LC} \geq 4\%$	10
$PE_{ren,LC} / PE_{tot,LC} \geq 2\%$	5
$PE_{ren,LC} / PE_{tot,LC} \geq 0\%$ (limit value)	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Building surface area and volume,
2. Building components or surfaces/materials with service lives of less than 50 years (amount and estimated service life),
3. Electricity and heat demand for the building to be certified and reference values according to the national implementation of the EPBD directive; the calculation and a reference to the national implementation must be included.
4. Quantity determination of the building envelope surfaces (external walls including windows/façade, foundation slab, roof) from the energy calculation in compliance with the national implementation of the EPBD directive and allocation to assessed building components,
5. Windows/French doors/post-and-beam façade with information on frame size, a depiction of a cross-section of the main profile system, the number of windows that can be opened, and the type of glazing,
6. Quantity determination of interior walls and supports; plausibility analysis for floor plans with information on types of interior walls/supports,
7. Inside doors: amount (number and area), list of most important types, and description of calculation,
8. Quantity determination for ceilings, divided into stories,
9. Representation of building components as a series of strata with layer thicknesses, estimated gross

- density, and allocation to a data set in the ESUCO database,
10. Representation of quantity determination for foundations,
 11. For reinforced concrete, the share of reinforcement is to be given in kg/m³ or kg/m² of the building component. Alternatively, the reinforcing steel can be verified in an overall summary of the project.
 12. Documentation of heating unit,
 13. Documentation of transport distances and means of transport from manufacturing to construction site.

Most of these requirements can be met by providing a bill of materials (including masses, materials in a hierarchical structure, numbers of pieces, surface areas and volume of the building).

14. Documentation required for ecological footprint results:
Results are to be presented for the entire lifecycle per m² NFA and year, categorized by:
 - a. Manufacture
 - b. Use (electricity and heat)
 - c. Use (maintenance)
 - d. End of life (dismantling/recycling/disposal)

5. Relation to other Indicators

Data acquisition is the same for the indicators 1.1- 1.5, 1.9, 1.10, 1.15

6. Resources

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. prEN 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.

7. Attachments

None

Indicator 1.11 Water and Waste Water

(adapted from DGNB/BNB)

Core Indicator

1. Objective

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 stormwater 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 priority¹, in order to ensure that water is available in sufficient quantities in European countries.

2. Assessment Methodology

The following subindicators 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.

¹ European Commission: A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy

3. 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 subindicators 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 can not be determined at this stage.

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:

$$W_{UV} = (WD_E + WW_E) + (WD_C + WW_C) + (WW_{RW} * f_r) \quad (1)$$

where

W_{UV}	water use value in [m ³ /a]
WD_E	employee potable water demand in [m ³ /a]
WW_E	employee waste water volume in [m ³ /a]
WD_C	potable water needed for cleaning in [m ³ /a]
WW_C	volume of waste water from cleaning in [m ³ /a]
WW_{RW}	share of rainwater diverted to the drain system in [m ³ /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
h_{CR}	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
h_{CS}	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

The following is assumed:

Installation	Installation-specific factor f_I for water use (seconds or flushes per person and day)
Bathroom sink	45
Toilet short/light flush	1
Toilet	1
Urinal	1
Shower	30
Kitchen sink	20

Table 1: installation-specific factor for water use

* The installation factors are based on the assumptions that:

- All employees wash their hands for 15 seconds three times a day
- the ratio of »short flush« and/or urinal use the regular toilet use is 2:1; this assumes 50 % men and 50 % women
- 10 % of employees shower for 5 minutes a day (if showers are available)
- per employee, one cup (for example) is washed in the kitchen sink

Water consumption for cleaning	l/(m ² *a)
Washable floors, once a month	1.50
Washable floors, once a week	6.25
Washable floors, three times a week	18.75
Glass surfaces, twice a year	0.60
Glass surfaces, four times a year	1.20
Glass surfaces, six times a year	1.80

Table 2: Water consumption for cleaning

* Results of the study « Ökologische Referenzwerte der Gebäudereinigung (Ecological reference values for building cleaning) » on-site building cleaning was studied in twelve buildings.

1. Employee potable water demand and waste water volume

Employee potable water demand WD_E is calculated from the sum of the potable water demand of installations in the building under specified assumptions for user behavior. Rain or gray water used to replace potable water is subtracted from the water demand:

$$WD_E = \sum_{i=1}^n wd_I - U_{RW} - U_{GW} \quad (2)$$

where

WD_E employee water demand
in [m³/a]

wd_I specific potable water demand of installations in building
in [m³/a]

U_{RW} amount of rainwater used, for example to flush toilets
in [m³/a]

U_{GW} amount of gray water used, for example to flush toilets
in [m³/a]

The amount of rain and/or gray water used can be seen in the economic efficiency calculation for rain and/or gray water.

The specific water demand for installations in the building wd_I is calculated based on daily water demand under the assumption of 210 work days:

$$wd_I = (n_E * f_I * cv_I * 210 \text{ d/a}) / 1000 \quad (3)$$

where

wd_I specific potable water demand of installations in building
in [m³/a]

n_E number of employees

f_I installation-specific factor for water use
as in Table 1 in [seconds/day] or [flushes/day]

cv_I installation-specific consumption value
in [liters/second] or [liters/flush]

The volume of waste water produced by employees WW_E is the sum of the specific water demand for installations in the building less reused gray water and/or waste water purified on-site:

$$WW_E = \sum_{i=1}^n wd_i - U_{GW} - P_{WW} \quad (4)$$

where

- WW_E employee waste water volume
in $[m^3/a]$
- U_{GW} amount of gray water reused, for example to flush toilets
in $[m^3/a]$
- P_{WW} amount of waste water purified on-site
in $[m^3/a]$

The amount of gray water used can be seen in the economy efficiency calculation for gray water use; the amount of purified waste water, in the design of the on-site (small-scale) purification system.

2. Potable water demand and waste water volume from cleaning

The potable water demand for cleaning WD_C and the volume of waste water WW_C is based on the sum of the potable water demand for cleaning washable floors and window surfaces.

$$WD_C = \sum_{i=1}^n wdc \quad (5)$$

$$WW_C = WD_C \quad (6)$$

where

- WD_C potable water needed for cleaning
in $[m^3/a]$
- WW_C volume of waste water from cleaning
in $[m^3/a]$
- wdc potable water demand for a specific surface to be cleaned
in $[m^3/a]$

The potable water demand wdc for cleaning washable floors and window surfaces is calculated according to the surface, the interval of cleaning, and the specific potable water demand. Surfaces with significantly different requirements must be considered differently:

$$wdc = (A_c * wdc_{c/A}) / 1000 \quad (7)$$

where

- wdc potable water demand for a specific surface to be cleaned
in $[m^3/a]$
- A_c specific surface to be cleaned (washable flooring and window surfaces, each differenced according to cleaning interval)
in $[m^2]$
- $wdc_{c/A}$ water demand for cleaning based on surface area (for the specific surface to be cleaned, depending on cleaning interval)
as in Table 2 in $[l/(m^2*a)]$

3. Potable water demand for irrigation

The potable water demand for irrigation WD_I is not yet calculated in this version.

4. Volume of surface water from diverted rainwater

The share of rainwater diverted via the drain system WW_{RW} is calculated as follows:

$$WW_{RW} = P_V - D_{RW} - U_{RW} \quad (8)$$

where

- P_V amount of precipitation
in $[m^3/a]$
- D_{RW} amount of rainwater drained away for infiltration
in $[m^3/a]$
- U_{RW} amount of rainwater used, for example to flush toilets
in $[m^3/a]$

The amount of rainwater being drained into the soil must be verified.

The considered amount of precipitation P_V is calculated as follows:

$$P_V = (A_R * hc_R + A_S * hc_S) * S_{RW} \quad (9)$$

where

- A_R roof surface area
- A_S sealed surface area
- hc_R harvest coefficient of roof surface²
- hc_S harvest coefficient of sealed ground surface
- S_{RW} site-specific annual precipitation

Condition	Harvest coefficient
Sloped roof (hard)	0,8
Flate roof (without gravel)	0,8
Flate roof (with gravel)	0,6
Green roof (intensively planted)	0,3
Green roof (extensively planted)	0,5
Paved surface	0,5
Asphalt pavement	0,8

Table 3: harvest coefficients ini regards to DIN 1989

² Harvest coefficients according to DIN 1989

Evaluation

Depending on the number of employees, the surface area of the roof and planted areas, a building's annual need for potable water and the amount of waste water can be very different. Therefore, dynamic limit values are calculated as shown below.

Limit values (L)

Limit values are calculated with the following assumptions. This does not include waste water use, rainwater use, or on-site waste water purification. With a simplified method, the relevant assumptions from Table 14-1 and the relevant statements in Table 2, Table 5, Table 6 and Table 6 result in:

for office buildings without showers

$$L \text{ (m}^3\text{/a)} = (n_E * 11.9 \text{ m}^3\text{/a}) + (A_{NFAa} * 0.008 \text{ m}^3\text{/(m}^2\text{*a)}) + P_V$$

for office buildings with showers

$$L \text{ (m}^3\text{/a)} = (n_E * 15.0 \text{ m}^3\text{/a}) + (A_{NFAa} * 0.008 \text{ m}^3\text{/(m}^2\text{*a)}) + P_V$$

where

- n_E** number of employees
- A_{NFAa}** net floor area
- P_V** amount of precipitation

Reference (R) and target values (TV) are calculated with the following reduction factors:

$$R = X * L$$

$$TV = Y * L$$

The reduction factors X and Y³ are set as follows: **X = 0.66 ; Y = 0.33**

The calculations for the dynamic limit, reference, and target values are based on the following:

Installation	Bathroom sink (l/sec)	Toilet (l/flush)	Toilet Short/Light flush (l/flush)	Urinal (l/flush)	Shower (l/sec)	Kitchen sink (l/sec)
Consumption value (in l/sec or l/flush)	0.15 (Flow class Z)	9	4.5	3	0.25 (Flow class A)	0.25 (Flow class A)

Table 4: consumption value of installations

Surface to be cleaned	M ³ /m ² _{NFA}	Average cleaning interval
Washable flooring	0.3	Twice a week
Glass surfaces	0.3	Four times a year

Table 5: average cleaning interval

Precipitation coefficient Roof surface area	0.5
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Table 6: precipitation coefficient roof surface area

³ Numbers may be revised after case studies

The target value can be reached with savings from innovative water-saving installations (for example, waterless urinals), intelligent irrigation strategies, use of gray water, and complete seepage and/or use of rainwater.

Evaluation

1.11.3 Operational Water Use and Waste Water	Points
Calculation result for the calculation is available and the calculation result is lower than the dynamic target value: $W_{UV} \leq TV$	100
Calculation result for the calculation is available and the calculation result is lower than the dynamic limit value: $W_{UV} \leq R$	50
Calculation result for the calculation is available and the calculation result is lower than the dynamic limit value: $W_{UV} \leq L$	10
Calculation result for the calculation is available and the calculation result is greater than the dynamic limit value: $W_{UV} > L$	1
Calculation result for the calculation is not available	0

4. Documentation Guidelines

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

Water use value W_{UV}

Comprehensible calculation of the water use value W_{UV} (m^3/a) for the constructed building and of the limit (L (m^3/a)), reference (R (m^3/a)), and target values (TV (m^3/a)) in compliance with the indicator's calculation method. It must be shown that the initial values for reference and actual calculations are the same. All results and intermediate results of the calculation must be clearly presented.

Documentation on the initial values used to calculate W_{UV}

Clear presentation of the initial values used to calculate the water use value. This includes the information required for the criterion, such as:

- net floor area
- harvest coefficient of roof surfaces and of sealed soil areas; annual precipitation
- a list of space types with information on number of employees
- a list of armatures with the information on the number installed and the flow rates (flow classes / flush volume)
- a list of washable floorings with the information on surface area

5. Relation to other Indicators

This indicator has the potential to become a life cycle assessment based indicator when an appropriate method for assessing the water embodied in construction materials is developed.

6. Resources

DGNB 14 – Freshwater Demand

7. Attachments

None

Indicator 1.12 Land use

(adapted from LEED, BREEAM, DGNB/BNB)

Core Indicator

1. Objective

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.¹

2. Assessment Methodology

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 will be assessed:

1.12.1: Site location

1.12.2: Imperviousness changes

¹ European Commission: Thematic Strategy for Soil Protection COM(2006)231

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.

1.12.1 Site location	Points
Brownfield redevelopment of contaminated industry and military Locations	100
Brownfield redevelopment of other types of sites	70
Previously developed area or undisturbed greenfields with compensatory measures (green roofs or vegetated areas with native and adapted species) covering 50% of the site area	50
Undisturbed greenfields with compensatory measures (green roofs or vegetated areas with native and adapted species) covering 30% of the site area	30
Undisturbed greenfields without compensatory measures or prime farmland, protected ecosystems, parks, wetlands	0

1.12.2: Permeability changes

1.12.2 Imperviousness change	Points
Improve Imperviousness Surface Coefficient by 0.6	100
Improve Imperviousness Surface Coefficient by 0.5	80
Improve Imperviousness Surface Coefficient by 0.4	70
Improve Imperviousness Surface Coefficient by 0.3	60
Improve Imperviousness Surface Coefficient by 0.2	50
Improve Imperviousness Surface Coefficient by 0.1	40
Preserve existing imperviousness coefficient	30
Degrade Imperviousness Surface Coefficient by 0.1	20
Degrade Imperviousness Surface Coefficient by 0.2	10
Degrade Imperviousness Surface Coefficient by 0.3 or more	0

Weights of sub-indicators

Indicator 1.12	Weights
Sub-indicator 1.12.1 Site location	4
Sub-indicator 1.12.2 Imperviousness change	2

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or easily and quickly accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1.12.1: Site location

- Verification of the previous type of use of the area to be used for construction by excerpts from the land register and/or land survey register.
- Verification of the initial level of pollution of the area to be used for construction through a pollution study and/or pollution register with information on the degree of contamination, waste categorization, and location of pollution, and a criteria-based evaluation of whether the area is highly contaminated, low contaminated, or without noteworthy contamination.
- Verification of compensatory measures that must be submitted in the form of recognition of the implemented measures as compensatory measures by the appropriate authorities.
- Verification of the recognition of a green roof as a compensatory measure.

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

5. Relation to other Indicators

Indicator 6.1 Risks at the Site

Indicator 6.2 Circumstances at the Site

6. Resources

LEED 2009: Site 1 Site Selection and Site 3 Brownfield Redevelopment

BREEAM 2011: LE6 Reuse of land and LE7 Contaminated land

DGNB 2009: 15 Space Demand

BNB 2011: 1.2.4 Demand of Space

http://www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_124.pdf

7. Attachments

None

Indicator 1.13 **Operational Waste Management** (adapted from BREEAM, LEED, HQE)

Core Indicator

1. Objective

To recognise 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 impact¹. The targets for the recycling of waste are: 50% of household waste and 70% for construction and demolition waste recycled by 2020².

2. Assessment Methodology

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 will be assessed:

1.13.1 Recyclable Waste Storage

1.13.2 Composting

¹ Taking sustainable use of resources forward: A Thematic Strategy on the prevention and recycling of waste COM(2005)666

² Directive 2008/98/EC on Waste

3. 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 m² per 1000 m² of net floor area for buildings <5000 m²
 - b. A minimum of 10 m² for buildings ≥5000 m²
 - c. An additional 2 m² per 1000 m² of net floor area where catering is provided (with an additional minimum of 10 m² for buildings ≥5000 m²).

1.13.1 Recyclable Waste Storage	Points
Compliance with both requirements	100
Compliance with one requirement	50
Not compliant	0

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.

1.13.2 Composting	Points
Compliant with one of the options	100
Not compliant with any option	0

Weights of sub-indicators

Indicator 1.13	Weights
Sub-indicator 1.13.1 Recyclable Waste Storage	4
Sub-indicator 1.13.2 Composting	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1.13.1 Recyclable Waste Storage

Marked-up building/site plan and/or copy of the specification confirming:

- The location of the dedicated recyclable storage area
- Storage area for general waste
- The area (m²) of the storage space(s)
- Description of the labelling.

Where applicable, information from the local waste collection scheme confirming the types of recyclable materials to be separated and stored.

After construction, building/site inspection and photographic evidence confirming:

- The location, size and capacity of the storage provision
- Labelling of the dedicated facilities

1.13.2 Composting

In case no compostable waste is produced, a letter from the occupier or a study confirming the absence of production of compostable waste is required.

Option 1: onsite composting

Marked-up design plan and/or a copy of the specification confirming (as appropriate):

- Specification of composting vessel
- Location and size of space for vessel and storage of waste/compost
- Water outlet.

After construction, building/site inspection and photographic evidence confirming:

- The installation of the vessel
- The provision of adequate storage space/facilities
- Installation of a water outlet

Option 2: offsite composting

If appropriate, a letter from the occupier or service provider confirming:

- Location of the off-site facility where compostable material will be delivered.
- The procedure and frequency for collecting the compostable material.

Marked-up design plan and/or a copy of the specification confirming (as appropriate):

- Location and size of space for storing compostable waste
- Water outlet.

After construction, building/site inspection and photographic evidence confirming:

- The provision of adequate storage space/facilities
- Installation of a water outlet

5. Relation to other Indicators

None.

6. Resources

BREEAM 2011: Wst 3 - Recyclable Waste Storage and Wst 5 – Composting

LEED 2009: Materials Pre 1 Storage and Collection of Recyclables

HQE 2012: 6.1. Optimising the recycling of operational waste and 6.2. Quality of the operational waste management system

7. Attachments

Relevant Definitions

Typically ‘accessible reach’ is defined as within 20m of a building entrance. In some circumstances, depending on the size of the building, site restrictions or tenancy arrangements, it may not be possible to meet a 20m requirement. If it is the opinion of the assessor that it is not feasible to meet this 20m requirement then they can use their judgement to determine if the facility is in an easily accessible location for building occupants and vehicle collection and to state their reasons in the assessment report.

The following footprint dimensions can act as a guide when determining size and accessibility criteria for the recyclable storage space:

- **Compactor dimensions:** about the size of one car parking bay; 4.8 x 2.4 m
- **Skip:** The footprint of an 8 and 12 cubic yard skip measures 3.4 m x 1.8 m, therefore allow a minimum of 2.0 m width and 4.0 m length or 8 m² area for the storage and access of such containers
- **Wheeled bins:** 360 litre = 0.86 m x 0.62 / 660 L = 1.2 m x 0.7 m / 1100 L = 1.28 m x 0.98 m
- **Roll-on-roll-off containers:** allow a minimum of 6.1 m x 2.4 m.
- **Vehicle access:** The following are dimensions for lorry types that are typically used to collect waste. Therefore gate height/widths should not be smaller than these measurements:
 - o Dustcart: medium capacity; length = 7.4 m Height = 4 m width 3.1 m
 - o Skip lorry: length = 7 m Height = 3.35 m width 3.1 m

Consideration must also be given to any other types of vehicle requiring access to this area, e.g. lorries for roll on/off containers.

Indicator 1.14 **Energy efficiency of building equipment (lifts, escalators and moving walks)**

(adapted from BREEAM, EN ISO 25745)

1. Objective

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

This indicator supports the objective of the European Commission to improve the energy efficiency by 20% by 2020¹.

2. Assessment Methodology

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-indicators will be assessed:

1.14.1 Stairs and ramps planning

1.14.2 Lifts design and efficiency

1.14.3 Escalators and moving walks design and efficiency

¹ Energy 2020 - A strategy for competitive, sustainable and secure energy

3. 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.

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.

1.14.1 Stairs and ramps planning	Points
Both requirements are fulfilled, and there is clear signage indicating the location of the stairs/ramps	100
One of the two requirements if fulfilled, and there is clear signage indicating the location of the stairs/ramps	55
There is clear signage indicating the location of the stairs/ramps	10
There is no measure facilitating the use of stair/ramps	0

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 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.

1.14.2 Lift design and efficiency	Points
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio.</p> <p>The energy consumption of the lifts in real time is metered and the information can be easily accessed by the building occupants (e.g. it is available through the network, the internet, or displayed in a visible location like the lift lobby or inside the lifts).</p> <p>The average energy efficiency class for all the lifts in the building as defined by EN ISO 25745-2 is A OR All requirements are achieved.</p>	100
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio.</p> <p>The average energy efficiency class for all the lifts in the building as defined by EN ISO 25745-2 is A OR All requirements are achieved.</p>	90
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio.</p> <p>The average energy efficiency class for all the lifts in the building as defined by EN ISO 25745-2 is B OR Five of the six requirements are achieved.</p>	80

<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio.</p> <p>The average energy efficiency class for all the lifts in the building as defined by EN ISO 25745-2 is C</p> <p>OR</p> <p>Four of the six requirements are achieved.</p>	70
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio.</p> <p>The average energy efficiency class for all the lifts in the building as defined by EN ISO 25745-2 is D</p> <p>OR</p> <p>Three of the six requirements are achieved.</p>	60
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio.</p> <p>The average energy efficiency class for all the lifts in the building as defined by EN ISO 25745-2 is E</p> <p>OR</p> <p>Two of the six requirements are achieved.</p>	50
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio.</p> <p>The average energy efficiency class for all the lifts in the building as defined by EN ISO 25745-2 is F</p> <p>OR</p> <p>One of the six requirements is achieved.</p>	40
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio.</p>	10
<p>No analysis was carried out.</p>	0

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 following requirements:

- i. The escalators and moving walks are fitted with a load sensing device that synchronises 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.

1.14.3 Escalators and moving walks design and efficiency	Points
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of escalators and moving walks.</p> <p>The average energy efficiency class for all the escalators and moving walks in the building as defined by EN ISO 25745-3 is A+++.</p> <p>OR</p> <p>All requirements are fulfilled</p>	100
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of escalators and moving walks.</p> <p>The average energy efficiency class for all the escalators and moving walks in the building as defined by EN ISO 25745-3 is A++.</p>	90
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of escalators and moving walks.</p> <p>The average energy efficiency class for all the escalators and moving walks in the building as defined by EN ISO 25745-3 is A+.</p>	80
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of escalators and moving walks.</p> <p>The average energy efficiency class for all the escalators and moving walks in the building as defined by EN ISO 25745-3 is A.</p>	70

<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of escalators and moving walks.</p> <p>The average energy efficiency class for all the escalators and moving walks in the building as defined by EN ISO 25745-3 is B.</p> <p>OR</p> <p>Two of the three requirements are fulfilled</p>	60
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of escalators and moving walks.</p> <p>The average energy efficiency class for all the escalators and moving walks in the building as defined by EN ISO 25745-3 is C.</p>	50
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of escalators and moving walks.</p> <p>The average energy efficiency class for all the escalators and moving walks in the building as defined by EN ISO 25745-3 is D.</p> <p>OR</p> <p>One of the three requirements is fulfilled</p>	40
<p>An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of escalators and moving walks</p>	10
<p>No analysis was carried out</p>	0

Weights of sub-indicators

Indicator 1.14	Weights
Sub-indicator 1.14.1 Stairs and ramps planning	3
Sub-indicator 1.14.2 Lifts design and efficiency	4
Sub-indicator 1.14.3 Escalators and moving walks design and efficiency	3

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1.14.1 Stairs and Ramps planning

Architectural drawings showing location and design of stairs, lifts, escalators and moving walks
The drawings should contain enough information to judge the compliance with the criteria required in this indicator. Elevations, sections and architectural renderings might be also required.

1.14.2-3 Lifts - Escalators - Moving Walks design and efficiency

Professional report / study of transportation analysis

Information related to the design and efficiency of lifts, escalators and moving walks

A copy of the specification and manufacturer's technical literature confirming:

- Number and type of lifts, escalators and moving walks specified
- Lifts, escalators and moving walks efficiency strategy.

After construction:

Selection of lift and energy rating according to EN ISO 25745-2

Selection of escalators and moving walks and energy rating according to EN ISO 25745-3

Lift-Escalator-Moving Walks manufacturer's/supplier's technical literature.

Assessor's building/site inspection and photographic evidence confirming installation of compliant Lift-Escalator-Moving Walks.

5. Relation to other Indicators

1.9 Non-Renewable Primary Energy Demands (PE_{nr})/Abiotic Depletion Potential for Fossil Fuels (ADP Fossil)

1.10 Total Primary Energy Demands and Percentage of Renewable Primary Energy

6. Resources

1. EN ISO 25745: Energy performance of lifts, escalators and moving walks (joint standardisation 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

7. Attachments

Counterbalancing ratio: Traction lifts may use a counterweight to balance the weight of the car plus a proportion of the rated load; this reduces the size of the drive motor required for the lift. Lowering the counterbalancing ratio means a smaller motor and controlling drive unit are required, thus saving energy. Counterbalancing ratios are normally provided in the range of 40-50% for safety reasons. Any other values should be carefully considered. Hydraulic lifts may use a balance weight to balance out a proportion of the weight of the car; this reduces the size of the drive motor required for the lift.

Indicator 1.15 Contribution to the depletion of abiotic resources - non fossil fuels (ADP_{element})

(adapted from EN 15978)

Core Indicator

1. Objective

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.

This supports the European Commission strategy for resource efficiency¹.

2. Assessment Methodology

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.

Goal and scope definition

The goal of all LCA studies is to analyze and later benchmark the environmental performance of the respective buildings` life cycles. The scope of the building assessment therefore includes the following life cycle stages:

- production: raw material supply, transport to manufacturing, manufacturing and transport to the construction site of products used in the building (Figure 1, modules A1-A4),
- use stage: a scenario is defined including use and replacement, including end-of-life of replaced products (Figure 1, modules B1 and B4); in addition the operational energy use is considered (Figure 1, module B6),
- end-of-life stage: waste processing and disposal of the building, (Figure 1, modules C3 and C4),
- a scenario for potential benefits and loads beyond the system boundaries, including loads for reuse and recycling as well as benefits from recycling potentials (Figure 1, module D).

¹ A resource-efficient Europe – flagship initiative under the Europe 2020 strategy

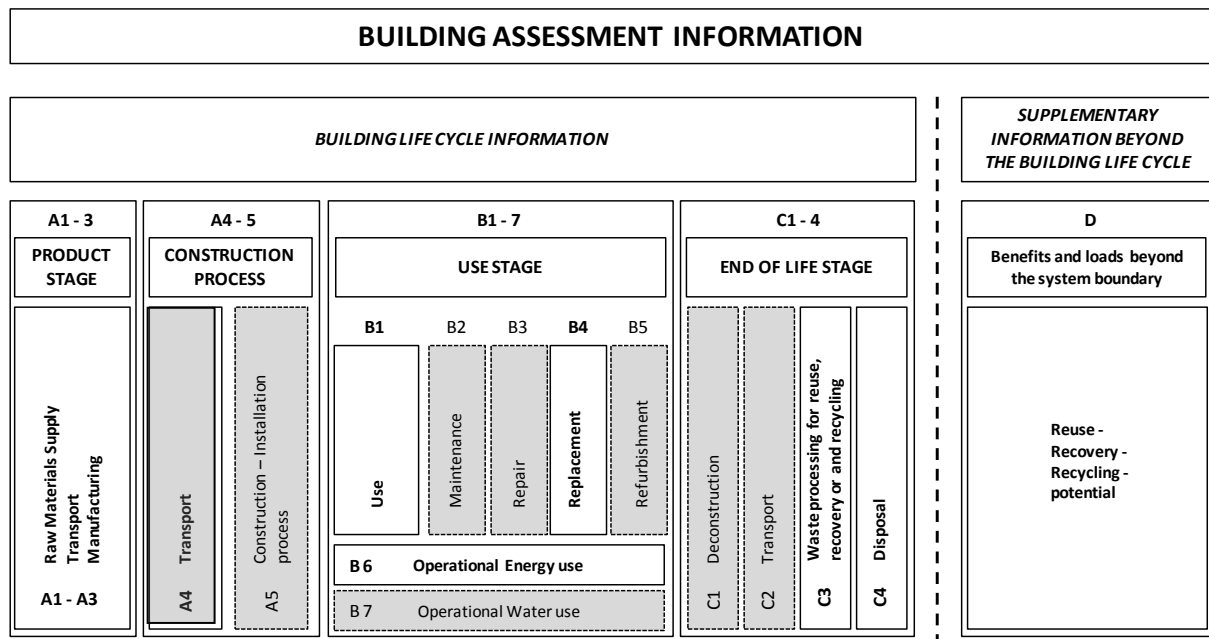


Figure 1 Building Life Cycle Phases according to EN 15978, adapted

The following processes are not included:

- Transport to construction side (Figure 1, module A4),
- Construction – Installation process (Figure 1, module A5),
- Energy use for user equipment during reference study period,
- Operational water use (Figure 1, module B7),
- Maintenance, repair and refurbishment during reference study period – (Figure 1, modules B2, B3 and B5),
- Deconstruction and transport to waste processing / disposal (Figure 1, modules C1 and C2),
- Transport to recycling (Figure 1, module C2).

The reference study period is defined with **50** years.

The functional equivalent (quantified functional requirements, intended use and/or technical requirements²), which is used as basis for comparison, is defined to be $m^2_{NFA} \cdot \text{year}$.

Inventory Analysis and Impact Assessment

During the inventory analysis of an LCA, emissions and resource consumption are identified, calculated and summed up over the life cycle of a product. Within building LCAs, separate calculations are carried out for the buildings` elements (product and end-of-life stage) and for the determination of emissions and resource uses during operation (see Equations 1, 2 and 3).

The inventory analysis of the buildings` elements mainly consists in providing quantitative information on the building elements used (see also Documentation Guidelines). Building compartments to be included are

1. Exterior walls and basement walls incl. windows and coatings,
2. Roof,
3. Ceilings incl. flooring and floor coverings / coatings,
4. Floor slab incl. flooring, floor coverings; floor slab above air,
5. Foundations,
6. Interior walls incl. coatings and supports,
7. Heat generation units.

² prEN 15643-1:2010: Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework

For these, respective datasets are picked out from the ESUCO database, which include environmental profiles of the used component: for the respective component, a standardized LCA has been conducted earlier and the results are provided within this database format.

For the module A4, which contains transports from manufacturing to the construction site, information about transport distances and means of transportation have to be provided and connected to the respective ESUCO data sets³.

For the analysis of the use stage, a scenario has to be set up, including supply and disposal systems and repairs. For supply and disposal, values for end energy consumption for electricity and heat have to be derived from the respective national implementation of the EPBD directive. Heating units as well as the electricity demand calculated have to be listed and linked to the respective ESUCO datasets.

For repair, calculations have to be made for all materials, building components and surfaces with service lives of less than 50 years. Sources for service lives are the “Guideline for Sustainable Building” for construction materials and the VDI 2067 for building services.

Also for the end-of-life stage, a scenario has to be defined for the recycling and disposal of the building materials that remain in the building after the end of the reference study period. So for each material, one end-of-life options has to be chosen and linked to the respective ESUCO dataset:

- Metals → recycling → ”metal recycling potential”,
- Mineral building materials → recycling → ”construction rubble processing”,
- Materials with a heating value → thermal recycling → respective material group in ESUCO database,
- Heat producers → Dataset corresponding to the manufacturing process,
- All other materials that can be deposited at construction or household waste sites → disposal at waste site → appropriate ESUCO dataset.

By using environmental profiles such as provided by ESUCO, the step of impact assessment has already been done by the data providers: Environmental profiles are given by providing the LCA results for the respective component in form of different environmental impact categories. These results are then used within the building LCA.

Interpretation

Resulting impacts are then evaluated against reference values to determine the respective indicator assessment (see overall Rating / Assessment Matrix).

³ It is suggested to use European average datasets. This means that the datasets represent technologies on average levels for Europe. These construction materials also contain European boundary conditions such as European datasets for electric or thermal energy or intermediate products and represent a common European market for construction materials. Using such European average datasets does not show the variability, for instance of the industry producing construction materials in Europe and thus has the advantage not to bias the analysis of the life cycle models by accounting for differences in different production techniques. This bias would reduce the significance of the results as the clear denotation of environmental hotspots in the structure and design of buildings would contain higher uncertainties on the origin of environmental impacts.

3. Calculation and Rating

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.

$$ADP_{element,LC} = (ADP_{element,pr} + ADP_{element,C} + ADP_{element,0} + ADP_{element,eol})/NFA \quad (1)$$

where

$ADP_{element,LC}$	Abiotic depletion potential of the building during the life cycle of the entire building,
$ADP_{element,pr}$	Contribution of the building construction products for the product stage (from cradle to gate),
$ADP_{element,C}$	Contribution of the building construction products and temporary construction works during the construction stage of the building,
$ADP_{element,0}$	Contribution of the building construction product for maintenance, repair and change of products during the operational stage,
$ADP_{element,eol}$	Contribution of the building construction products during the end of life stage (deconstruction, material segregation and transportation to final destination),
$ADP_{element,LC}$	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.

$$ADP_{element,Ref,LC} = (ADP_{element,Ref,pr} + ADP_{element,Ref,C} + ADP_{element,Ref,0} + ADP_{element,Ref,eol})/NFA \quad (2)$$

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.

Table 1: European average reference values for “Quick and Basic”

Quick and Basic									
Based on 18 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	6.5	3.1E-07	2.4E-02	2.7E-03	2.9E-03	24.2	4.8	29.0	1,9E-01
Oref	33.2	5.8E-06	1.8E-01	7.4E-03	1.1E-02	168.1	15.3	183.4	3,7E-02
Total	39.7	6.1E-06	2.0E-01	1.0E-02	1.3E-02	192.3	20.1	212.4	2,3E-01

Table 2: European average reference values for “Complete”

Complete									
Based on 6 case studies	GWP [kg CO ₂ E / (m ² *y)]	ODP [kg R11E / (m ² *a)]	AP [kg SO ₂ E / (m ² *a)]	EP [kg PO ₄ ³⁻ E / (m ² *a)]	POCP [kg C ₂ H ₄ E / (m ² *a)]	Penr [kWh / (m ² *a)]	PEre [kWh / (m ² *a)]	PEtot [kWh / (m ² *a)]	ADP _{elements} [kg SB-E / (m ² *a)]
Cref	10.6	3.8E-07	3.3E-02	3,3E-03	3.4E-03	33.1	4.9	38.0	4,2E-02
Oref	35.2	6.7E-06	2.1E-01	8.3E-03	1.2E-02	196.5	21.0	217.5	2,2E-01
Total	45.8	7.1E-06	2.4E-01	1.1E-02	1.5E-02	229.5	25.9	255.5	2.6 E-06

Table1 and Table2 also mention a reference value for the operational phase. These values can be used if nation benchmarks are not available. The procedure of choosing the benchmarks is described in Figure 2.

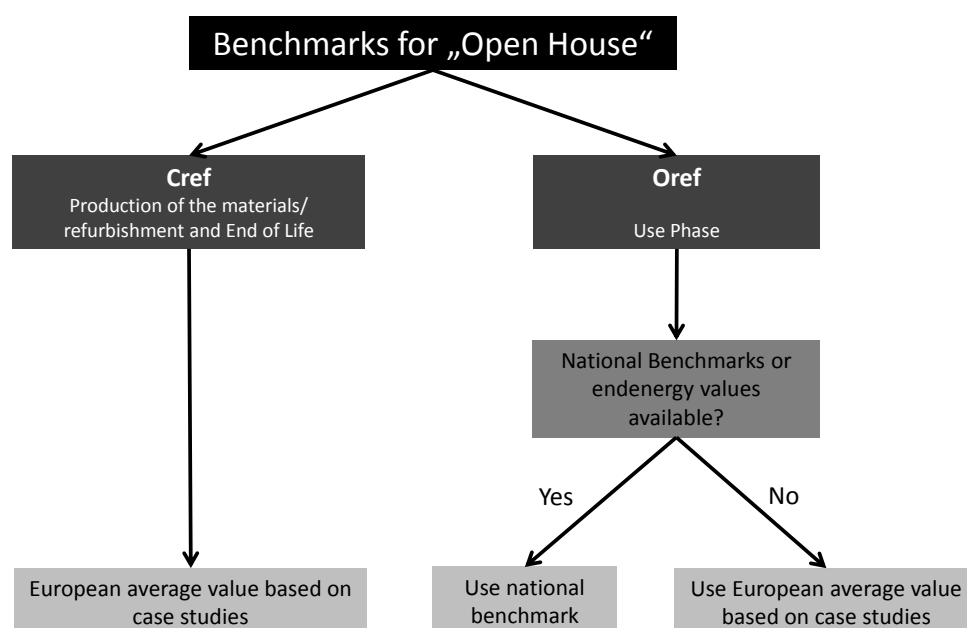


Figure 2: Setting of benchmarks in OPEN HOUSE

Limit value and target value calculation

Limit value L and target value T, needed to supplement the criterion's evaluation, are determined as follows:

$$L = X * R \quad (7)$$

$$T = Y * R \quad (8)$$

The values X and Y are set as follows:

$$X = 1.4 \quad (9)$$

$$Y = 0.7 \quad (10)$$

1.9 ADP _{element}	Points
ADP _{element,LC} = 0,7 * R	100
ADP _{element,LC} = according to local definition (default: 0,76 * R)	90
ADP _{element,LC} = according to local definition (default: 0,82 * R)	80
ADP _{element,LC} = according to local definition (default: 0,85 * R)	75
ADP _{element,LC} = according to local definition (default: 0,88 * R)	70
ADP _{element,LC} = according to local definition (default: 0,94 * R)	60
ADP _{element,LC} = R (ADP _{element,Ref,LC} reference value)	50
ADP _{element,LC} = according to local definition 1,1 * R)	40
ADP _{element,LC} = according to local definition (default: 1,2 * R)	30
ADP _{element,LC} = according to local definition (default: 1,3 * R)	20
ADP _{element,LC} = 1,4 * R (limit value)	10
ADP _{element,LC} > 1,4 * R (limit value)	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Basic & Quick Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Building surface area and volume,
2. Building components or surfaces/materials with service lives of less than 50 years (amount and estimated service life),
3. Electricity and heat demand for the building to be certified and reference values according to the national implementation of the EPBD directive; the calculation and a reference to the national implementation must be included.
4. Quantity determination of the building envelope surfaces (external walls including windows/façade, foundation slab, roof) from the energy calculation in compliance with the national implementation of the EPBD directive and allocation to assessed building components,
5. Windows/French doors/post-and-beam façade with information on frame size, a depiction of a cross-section of the main profile system, the number of windows that can be opened, and the type of glazing,
6. Quantity determination of interior walls and supports; plausibility analysis for floor plans with information on types of interior walls/supports,
7. Inside doors: amount (number and area), list of most important types, and description of calculation,
8. Quantity determination for ceilings, divided into stories,
9. Representation of building components as a series of strata with layer thicknesses, estimated gross density, and allocation to a data set in the ESUCO database,
10. Representation of quantity determination for foundations,
11. For reinforced concrete, the share of reinforcement is to be given in kg/m³ or kg/m² of the building component. Alternatively, the reinforcing steel can be verified in an overall summary of the project.
12. Documentation of heating unit,
13. Documentation of transport distances and means of transport from manufacturing to construction site.

Most of these requirements can be met by providing a bill of materials (including masses, materials in a hierarchical structure, numbers of pieces, surface areas and volume of the building).

14. Documentation required for ecological footprint results:

Results are to be presented for the entire lifecycle per m²_{NFA} and year, categorized by:

- a. Manufacture
- b. Use (electricity and heat)
- c. Use (maintenance)
- d. End of life (dismantling/recycling/disposal)

5. Relation to other Indicators

Data acquisition is the same for the indicators of

- 1.1 Global Warming Potential
- 1.2 Ozone Depletion Potential
- 1.3 Acidification Potential
- 1.4 Eutrophication Potential
- 1.5 Photochemical Ozone Creation Potential
- 1.9 Non-Renewable Primary Energy Demands (PE_{nr})
- 1.10 Total Primary Energy Demands and Percentage of Renewable Primary Energy

6. Resources

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. EN 15978: 2011: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method. European Committee for Standardization CEN.
4. EN 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.

7. Attachments

None

OPEN HOUSE

ASSESSMENT GUIDELINE

Social / Functional Quality

- 2.1 **Barrier-free Accessibility**
- 2.2 Personal Safety and Security of Users
- 2.3 **Thermal Comfort**
- 2.4 **Indoor Air Quality**
- 2.5 Water Quality
- 2.6 **Acoustic Comfort**
- 2.7 **Visual Comfort**
- 2.8 **Operation Comfort**
- 2.9 Service Quality
- 2.11 **Public Accessibility**
- 2.12 Noise from Building and Site
- 2.16 **Bicycle Amenities**
- 2.17 **Material Sourcing**

Note: Core indicators are in bold

Indicator 2.1 **Barrier-free Accessibility**

(adapted from DGNB/BNB)

Core indicator

1. Objective

Around 80 million Europeans have a disability, representing one out of six people in the EU. They have the right to participate fully and equally in all aspects of life, both in the economy and society as a whole, but in practice continue to face barriers in everyday life, both physical and in terms of attitudes. People with disabilities are on average poorer than other Europeans, are less likely to have a job, and face more limited access to goods and services such as education, healthcare, transport, housing and technology.

There are three major types of barriers to access: social barriers, psychological barriers and structural barriers. These barriers are found in buildings, the space between and around buildings, and in the ‘virtual environment’. Also older people have similar problems. In regard to the demographic change (people in Europe getting older: 1990 - 18 % of the Europeans have been older than 60 years, and until 2030 more than 30 % will be older than 60 years). In the context of buildings, freedom from barriers means: eliminating obstacles in the built environment and making information and communication services suitable for use by all.

Accessibility to the built infrastructure is essential for people with disabilities to be able to exercise their rights and participate fully in society. The right to education, to engage in work can only be exercised if people with disabilities are able to enter, leave and use the place where those activities take place (schools, work environment). Furthermore, accessibility to the built environment is essential to ensure access to transport (stations, airports, harbours) and to leisure and cultural facilities (libraries, museums, theatres, cultural centres, concert halls, hotels, restaurants etc).

The main goal is to plan and construct buildings which have the best accessibility for people with physical, sensorial and cognitive disabilities (“Design for all”).

This indicator supports the objective of the European Commission, which aims at eliminating barriers to access that people with disabilities are facing. Key areas for action include the built environment, transport, information and communication, and services.¹

Moreover, workplaces must be organized to take account of workers with disabilities, if necessary. This provision applies in particular to the doors, passageways, staircases, showers, washbasins, lavatories and workstations used or occupied directly by people with disability².

¹ European Disability Strategy 2010-2020: A Renewed Commitment to a Barrier-Free Europe COM(2010) 636

² DIRECTIVE 89/654/EC

2. Assessment Methodology

The criteria address the needs of people with disabilities, as well as the needs of older persons. People with walking disabilities, palsies or missing extremities need special additives, like wheel chairs, walking frames or handles. Therefore the building must provide enough free places, areaways with special width and length, planar movement areas and ramps(entrance etc.). People with sensoric limitations need tactile elements or inductive audio systems.

Barrier-free accessibility of an office building should be possible in:

- all publically accessible areas (local public infrastructure) and
- the areas required for work (offices, toilets, kitchen etc.)

The evaluation is qualitative.

Points will be given to which extent the use of the building is possible for all people.

An important aspect is the basic access and the compliance with the national building standard. If these standards are not observed, no points can be achieved.

The larger areas of the building are accessible for all people, the better the building will be evaluated.

The following indicator will be assessed:

2.1.1 Barrier-free Accessibility

3. Calculation and Rating

The assessment of the barrier free accessibility of a building is measured in the way how much percent of the net floor area of the public spaces and working areas could be used by all people (“Design for all”).

The assessment is based on existing international and European building standards for barrier free accessibility of buildings.

At the moment no European Building Standard has been developed to address the accessibility of buildings. The EU directive 2000/78/EC “General framework for equal treatment in employment and occupation” establishes conditions for a reasonable accomodation of employees with disabilities, which means that people with disability have a right to get adaptations to the workplace in order to be able to fulfil their job. The EU directive 89/654/EC mentions that workplaces must be organized to take account of workers with disabilities

These directives have to be adapted in the national disability policy of each Member State.

Therefore the assessment is based on the national standards for accessibility.

If there is no national building standard for barrier free accessibility, requirements from the ISO 21542:2011 should be respected.

Public places of office buildings are:

- Entrance
- Lobby (desk officer etc.)
- Cafeteria
- Public sanitary rooms

Working areas of office buildings are:

- Working rooms (offices, conference rooms etc.)
- Infrastructure (doors, stairways, lifts, emergency exit etc.)
- Secondary rooms (rooms for printing etc.)
- Sanitary rooms (toilets, changing rooms etc.)
- Kitchen and break rooms

For a quick and basic assessment, the following definition may be used:.

A building is **basically barrier-free accessible**:

- One entrance does not have a threshold and has a clearance width of at least 90cm
- Operating information (entrance, elevators...) is offered in more than one sensory format (visible, audible, tactile)
- Free space in front of the entrance (and all elevators) measures at least 150x150 cm
- At least one bathroom is designed for use by persons with physical limitations

2.1 Barrier-free Accessibility	Points
<p>The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility (ISO 21542:2011).</p> <p>In addition at least 95% of the work areas (net floor area³) and the accessible parts of the outdoor facilities -if existing- are accessible in compliance with the building standard of the country or other applicable standards for barrier free accessibility.</p>	100
<p>The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility (ISO 21542:2011).</p> <p>In addition at least 75% of the work areas (net floor area) and at least 50% of the accessible parts of the outdoor facilities -if existing- are accessible in compliance with the building standard of the country or other applicable standards for barrier free accessibility.</p>	75
<p>The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility (ISO 21542:2011).</p> <p>In addition at least 50% of the work areas (net floor area) are accessible in compliance with the building standard of the country or other applicable standards for barrier free accessibility..</p>	50
<p>The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility (ISO 21542:2011).</p> <p>In addition some work areas are accessible compliance with the building standard of the country or other applicable standards for barrier free accessibility.</p>	25
<p>The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility (ISO 21542:2011).</p>	10
<p>The building is not barrier free accessible</p>	0

³ Calculation of Net Floor Area must be done according to national regulations, ISO 9836:1992 or European Commission Measuring Code: http://ec.europa.eu/oib/pdf/mesuring-code_en.pdf

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

Before Construction:

- Floor plan of the entrance level with outdoor facilities and illustration of connection to public spaces
- Floor plans
- Plans of the parking lots
- Relevant sections that demonstrates the stories heights
- Declaration of intent or specifications for measures for barrier free accessibility

After Construction

- Relevant details and photos (front door, room entrances, lifts, stairways, handrail, parking lots etc.)

5. Relation to other Indicators

Indicator 2.8: Operation Comfort

6. Resources

1. DGNB International
Criterion 26: Barrier-free accessibility
2. BNB: Bewertungssystem Nachhaltiges Bauen (Germany)
Criterion 3.2.1: Barrierefreiheit
http://www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_321.pdf
3. European Commission: European Disability Strategy 2010-2010
<http://www.internationaldisabilityalliance.org/.../European-Disability-Strategy-2010-2020>; 2011-04-04
4. International Convention on the rights of persons with disabilities
<http://www.un.org/disabilities/convention/conventionfull.shtml>; 2011-04-04
5. European Commission, M/420, Public procurement in the built environment – Mandate 420
<http://www.cen.eu/cen/Sectors/Sectors/Accessibility/Guidance/Pages/default.aspx>
6. Council Directive 2000/78/EC of 27 November 2000 establishing a general framework for equal treatment in employment and occupation
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:303:0016:0022:EN:PDF>
7. ISO/FDIS 21542:2011 Building construction — Accessibility and usability of the built environment

Example of national standards related to accessibility:**Germany:**

- DIN 18024-1: 1998-01: Barrierefreies Bauen - Teil 1: Straßen, Plätze, Wege, öffentliche Verkehrs- und Grünanlagen sowie Spielplätze; Planungsgrundlagen (zukünftig DIN 18070)
- DIN 18040-1: 2010-10: Barrierefreies Bauen - Teil 1: Öffentlich zugängliche Gebäude (Erstz für DIN 18024-2: 1996-11: Öffentlich zugängliche Gebäude und Arbeitsstätten)
- DIN 18041: 2004-05: Hörsamkeit in kleinen bis mittelgroßen Räumen

Austria

- ÖNORM B 1600:1994 Barrierefreies Bauen: Planungsgrundsätze.
- ÖNORM B 1601:1994 Spezielle Baulichkeiten für behinderte und alte Menschen: Planungsgrundsätze.

7. Attachments

None

Indicator 2.2 Personal Safety and Security of Users

(adapted from DGNB/BNB, Directive 89/654/EEC)

1. Objective

Personal Safety and Security of Users aims at assessing the prevention strategies and the preparedness of a building against accidents, disasters, users' health issues, damages and losses of building items.

Danger, accidents and catastrophes shall be avoided; safety shall be assured as far as possible if accidents or catastrophes happen. Insecurity and anxiety can constrain the movement of humans. The subjective sensation of safety contributes basically to the comfort of humans. Objective safety is present if actual dangers are avoided or for example with accidents if the extent of damage can be reduced as far as possible.

This supports the objectives of the European Directive 89/654/EEC on minimum safety and health requirements for the workplace.

2. Assessment Methodology

This criterion is assessed qualitatively by taking into account three aspects:

1. Satisfaction of minimum health and safety requirements at the workplace

Appropriate measures have to be taken in order to avoid physical injuries, electricity risks, dangers from building components or traffic routes (vehicles, pedestrians, escalators, ramps etc) integrated in the building and to ensure a safe design of first aid rooms, rest, personnel changing and sanitary areas.

All these issues are covered by the Council Directive 89/654/EEC of 30 November 1989 concerning the minimum safety and health requirements for the workplace.

Other issues addressed in the same Directive, such as fire prevention, protection of workers with special needs, health issues due to bad indoor air quality and lighting, are reflected by other OPEN HOUSE indicators.

2. Reduction of damage if an accident should occur inside and outside the building:

Appropriate measures have to be taken to reduce the extent of damage as much as possible in case an accident should occur. Issues affecting emergency routes and emergency exits are addressed in Directive 89/654/EEC.

3. Measures preventing building users from crime

The existence and performance of a monitoring or alarm system should be checked.

Note: For the purposes of Directive 89/654/EEC, 'workplace' means the place intended to house workstations on the premises of the undertaking and/or establishment and any other place within the area of the undertaking and/or establishment to which the employee has access in the course of his employment. In the current context of OPEN HOUSE, 'workplace' is focused on office buildings intended to house "office" type workstations, storage rooms, meeting areas, printing rooms, etc. and therefore no manufacturing areas. According to the Directive 89/654/EEC, workplaces used for the first time after 31 December 1992 must satisfy the minimum safety and health requirements laid down in Annex I of the Directive. The ones affecting office spaces are included in the next paragraphs.

The three sub-indicators presented below will be assessed:

2.2.1 Satisfaction of minimum health and safety requirements at the workplace

2.2.2 Reduction of damage if an accident should occur

2.2.3 Measures preventing building users from crime

3. Calculation and Rating

2.2.1. Satisfaction of minimum health and safety requirements at the workplace

Evaluation points are awarded to the building according to the level of compliance with Directive 89/654/EEC with regard to different issues:

2.2.1 Satisfaction of minimum health and safety requirements at the workplace	Points
<p>All paths are clearly marked, visible, and well lit. Technical safety equipment (emergency telephones, video surveillance, etc.) is present. Emergency telephones are easily recognizable and accessible. Family parking lots*, close to the building, and well lit are available or reserved in case of a building in the design phase. Employees and/or their representatives are informed of all measures to be taken concerning safety and health at the workplace. Electrical installations is designed and constructed so as not to present danger in case of accidents. The workplace and the equipment and devices are regularly cleaned to an adequate level of hygiene.</p>	100
<p>All paths are clearly marked, visible, and well lit. Technical safety equipment (emergency telephones, video surveillance, etc.) is present. Employees and/or their representatives are informed of all measures to be taken concerning safety and health at the workplace. Electrical installations is designed and constructed so as not to present danger in case of accidents. The workplace and the equipment and devices are regularly cleaned to an adequate level of hygiene.</p>	75
<p>Main paths are clearly marked, visible, and well lit. Technical safety equipment (emergency telephones, video surveillance, etc.) is present. Electrical installations is designed and constructed so as not to present danger in case of accidents. The workplace and the equipment and devices are regularly cleaned to an adequate level of hygiene.</p>	50
<p>Main paths are clearly marked, visible, and well lit.</p>	10
<p>Minimum health and safety requirements at the workplace are not satisfied</p>	0

* Family parking lots: parking lots reserved for families with young children and pregnant ladies.

2.2.2. Reduction of damage if an accident should occur

A project that implements all necessary precautions avoiding any damage to users' health and to the building in the case of an accident will receive the maximum number of points. Projects that do not fulfil the legal requirements will receive no points.

2.2.2 Reduction of damage if an accident should occur	Points
Evacuation plans for contaminated air inside the building are present. People with physical limitations (impaired mobility, visually impaired, or hard of hearing) can use the escape routes and/or alternative escape routes are available for these groups.	100
Evacuation plans for contaminated air inside the building are present.	75
Operating instructions are available for ventilation systems in the case of contaminated air inside the building	50
All legal requirements for fire protection and disaster control are fully met.	10
Legal requirements are not met	0

2.2.3. Measures preventing building users from crime

Points are awarded to a building if the followings measures are taken or planned:

2.2.3 Measures preventing building users from crime	Points
Outdoor facilities are under video surveillance even during non-working hours by a person who is available at any time (doorman, security). An alarm system is in place with central monitoring.	100
Contact people (doorman, security) are available even during non-working hours. An alarm system is in place.	75
Contact people (doorman, security) are available during working hours. An alarm system is in place.	50
An alarm system is in place	10
No measure is taken.	0

Weights of Sub-indicators

Indicator 2.2	Weight
Sub-indicator 2.2.1 Satisfaction of minimum health and safety requirements at the workplace	4
Sub-indicator 2.2.2 Reduction of damage if an accident should occur	4
Sub-indicator 2.2.3 Measures preventing building users from crime	2

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

2.2.1 Satisfaction of minimum health and safety requirements at the workplace

Demonstration of visible paths on the grounds and in the building via relevant planning documents (plan of the ground floor with outdoor facilities and a typical floor plan).

Excerpts from plans and texts from the implementation planning stage, which include the following information:

- location of family's parking lots relative to the main entrance;
- illumination concept for the parking lots and the paths between the lots and the main entrance.

Information on the predicted technical safety equipment, such as emergency telephones, video surveillance, etc., with site maps to assess their accessibility.

Specification for the safety of electrical installations.

Specification for the regular cleaning of the workplaces.

After Construction:

Report based on building's audit in order to ensure that the basic safety rules are considered (e.g. no emergency exits locked, no obstacles in emergency routes, emergency lights in function, street lighting around the building in function, etc.).

Feedback from questionnaire answered by employees, evaluating at what level they are informed on safety and escape measures implemented in the building.

2.2.2 Reduction of damage if an accident should occur

Documentation of the building materials, which will be used, must include adequate information about their contents (such as halogen content) to enable an evaluation of the potential fume risk.

Relevant excerpts from building plans for escape routes, which include the following information:

- the minimum legal requirement for escape route planning;
- the measures that go beyond the minimum legal requirement;
- confirmation that the escape routes are also suitable for people with physical limitations.

Evacuation plans in the case of contaminated air inside the building.

Operating instructions for predicted ventilation systems in the case of contaminated air inside and outside the building.

2.2.3 Measures preventing building users from crime

Demonstration of provisions for security during non-working hours with information on contact people (doorman, security) and their accessibility, video surveillance, and/or other measures.

5. Relation to other Indicators

Indicator 2.1 “Barrier-free Accessibility”

Indicator 2.4 “Indoor Air Quality”

Indicator 2.17 “Responsible Material Sourcing”

Indicator 4.1 “Fire protection”

Indicator 6.1 “Risks at the Site”

Indicator 6.2 “Circumstances at the Site”

6. Resources

Council Directive 89/654/EEC concerning the minimum safety and health requirements for the workplace <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1989:393:0001:0012:EN:PDF>

DGNB 2009 - 25 Safety and Risk of Hazardous Incidents

BNB 2011 - 3.1.8 Safety and Incident risks

www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_318.pdf

7. Attachments:

Extracts from the Council Directive 89/654/EEC concerning the minimum safety and health requirements for the workplace

Extracts from the Council Directive 89/654/EEC

General requirements

1. Traffic routes to emergency exits and the exits themselves are kept clear at all times (more detailed requirements for emergency routes and exits are included in the next sub-indicator 2.2.2).
2. Technical maintenance of the workplace and of the equipment and devices is carried out and any faults found which affect the safety and health of workers are rectified as quickly as possible.
3. The workplace and the equipment and devices are regularly cleaned to an adequate level of hygiene.
4. Safety equipment and devices intended to prevent or eliminate hazards are regularly maintained and checked.

Information to workers

1. Employees and/or their representatives shall be informed of all measures to be taken concerning safety and health at the workplace.

Electrical installations

1. Electrical installations must be designed and constructed so as not to present a fire or explosion hazard; persons must be adequately protected against the risk of accidents caused by direct or indirect contact.
2. The design, construction and choice of material and protection devices must be appropriate to the voltage, external conditions and the competence of persons with access to parts of the installation.

Floors, walls, ceilings and roofs of rooms

1. The floors of workplaces must have no dangerous bumps, holes or slopes and must be fixed, stable and not slippery.
2. The surfaces of floors, walls and ceilings in rooms must be such that they can be cleaned or refurbished to an appropriate standard of hygiene.
3. Transparent or translucent walls, in particular all-glass partitions, in rooms or in the vicinity of workplaces and traffic routes must be clearly indicated and made of safety material or be shielded from such places or traffic routes to prevent workers from coming into contact with walls or being injured should the walls shatter.
4. Access to roofs made of materials of **insufficient strength** must not be permitted unless equipment is provided to ensure that the work can be carried out in a safe manner.

Windows and skylights

1. It must be possible for workers to open, close, adjust or secure windows, skylights and ventilators in a safe manner. When open, they must not be positioned so as to constitute a hazard to workers.
2. Windows and skylights must be designed in conjunction with equipment or otherwise fitted with devices allowing them to be cleaned without risk to the workers carrying out this work or to workers present in and around the building.

Doors and gates

1. Transparent doors must be appropriately marked at a conspicuous level.
2. Swing doors and gates must be transparent or have see-through panels.
3. If transparent or translucent surfaces in doors and gates are not made of safety material and if there is a danger that workers may be injured if a door or gate should shatter, the surfaces must be protected against breakage.
4. Sliding doors must be fitted with a safety device to prevent them from being derailed and falling over.
5. Doors and gates opening upwards must be fitted with a mechanism to secure them against falling back.
6. Doors along escape routes must be appropriately marked.
7. It must be possible to open them from the inside at any time without special assistance.
8. It must be possible to open the doors when the workplaces are occupied.
9. Doors for pedestrians must be provided in the immediate vicinity of any gates intended essentially for vehicle traffic, unless it is safe for pedestrians to pass through; such doors must be clearly marked and left permanently unobstructed. Transparent doors must be appropriately marked at a conspicuous level.

Traffic routes, escalators, danger areas

1. Traffic routes, including stairs, fixed ladders and loading bays and ramps, must be located and dimensioned to ensure easy, safe and appropriate access for pedestrians or vehicles in such a way as not to endanger employees in the vicinity of these routes.
2. Routes used for pedestrian traffic and/or goods traffic must be dimensioned in accordance with the number of potential users and the type of undertaking.
3. If means of transport are used on traffic routes, a sufficient safety clearance must be provided for pedestrians.
4. Sufficient clearance must be allowed between vehicle traffic routes and doors, gates, passages for pedestrians, corridors and staircases.
5. If the workplaces contain danger areas in which, owing to the nature of the work, there is a risk of the employee or objects falling, the places must be equipped, as far as possible, with devices preventing unauthorized employees from entering those areas.
6. Appropriate measures must be taken to protect employees authorized to enter danger areas.
7. Danger areas must be clearly indicated.
8. Escalators and travelators must work safely.
9. They must be equipped with any necessary safety devices.
10. They must be fitted with easily identifiable and accessible emergency shutdown devices.

First aid rooms

1. One or more first aid rooms must be provided where the size of the premises, type of activity being carried out and frequency of accidents so dictate.
2. First aid rooms must be fitted with essential first aid installations and equipment and be easily accessible to stretchers.
3. They must be signposted in accordance with the national regulations.
4. In addition, first aid equipment must be available in all places where working conditions require it. This equipment must be suitably marked and easily accessible.

Rest rooms

1. Rest rooms must be large enough and equipped with an adequate number of tables and seats with backs for the number of workers.
2. In rest rooms appropriate measures must be introduced for the protection of non-smokers against discomfort caused by tobacco smoke.
3. If working hours are regularly and frequently interrupted and there is no rest room, other rooms must be provided in which employers can stay during such interruptions, wherever this is required for the

safety or health of workers.

4. Pregnant women and nursing mothers must be able to lie down to rest in appropriate conditions.

Emergency routes and exits

1. Emergency routes and exits must remain clear and lead as directly as possible to the open air or to a safe area.
2. In the event of danger, it must be possible for employees to evacuate all workstations quickly and as safely as possible.
3. The number, distribution and dimensions of the emergency routes and exits depend on the use, equipment and dimensions of the workplaces and the maximum number of persons that may be present.
4. Emergency doors must open outwards.
5. Sliding or revolving doors are not permitted if they are specifically intended as emergency exits.
6. Emergency doors should not be so locked or fastened that they cannot be easily and immediately opened by any person who may require to use them in an emergency.
7. Specific emergency routes and exits must be indicated by signs in accordance with the national regulations.
8. Such signs must be placed at appropriate points and be made to last.
9. Emergency doors must not be locked.
10. The emergency routes and exits, and the traffic routes and doors giving access to them, must be free from obstruction so that they can be used at any time without hindrance.
11. Emergency routes and exits requiring illumination must be provided with emergency lighting of adequate intensity in case the lighting fails.

Indicator 2.3 Thermal Comfort

(adapted from DGNB/BNB, EN 15251, EN ISO 7730)

Core Indicator

1. Objective

The objective of Thermal Comfort Indicator is to provide a comfortable thermal environment supporting productivity and well-being of building occupants, both during summer and winter. On one hand it is defined by an overall comfort; on the other hand local uncomfortable phenomenon can impact the thermal comfort. As an example, a person can feel thermal comfort but can be adversely affected by local draught on a body part. The perception of thermal comfort is subjective; therefore it is impossible to provide optimum comfort levels for everyone at the same time. It is an essential objective for building occupants to enjoy their environment, although it is a subjective concept. Designers must provide neutral conditions for comfort within which occupants will adapt.

Especially in buildings without mechanical cooling, the expectations of occupants and their adaptation to heat stress are strongly dependent on external climatic conditions during the warm season compared to the expectation of people in buildings with mechanical cooling. Therefore, criteria for the thermal environment in buildings without mechanical cooling may be specified differently from those with mechanical cooling.

This supports the objective of the European Commission to ensure that temperatures in rooms containing workplaces are adequate for human beings¹.

2. Assessment Methodology

The different sub-indicators for Thermal Comfort can be measured by calculation or measurements. If concept values will be used for classification in design phase, control measurements must be performed within the first year in use.

As the criteria are based on instantaneous values, variations outside the recommended range may be acceptable for short periods during any given day. It is recommended that for up to 5% of working hours the calculated or measured values can be permitted to be outside the range. The figure of 3 to 5% may be applied to daily (15-25 minutes during a working day), weekly (24-120 working minutes) and yearly (50-100 working hours) periods.

Three categories of expectation level can be used regarding to EN 15251:

Category	Explanation
I	High level of expectation and is recommended for spaces occupied by very sensitive and fragile persons with special requirements like handicapped, sick, very young children and elderly persons
II	Normal level of expectation and should be used for new buildings and renovations
III	An acceptable, moderate level of expectation and may be used for existing buildings
IV	Values outside the criteria for the above categories. This category should only be accepted for a limited part of the year

Note: in other standards eg. EN ISO 7730 these categories are also used, but may be named different (A,B,C or 1, 2, 3)

Category I ~ 90 % Category II ~ 80 % Category III ~ 65 % satisfaction (EN 15251)

¹ DIRECTIVE 89/654/EC

The following sub-indicators will be assessed:

2.3.1 Operative temperature

2.3.2 Radiant temperature asymmetry and floor temperature

2.3.3 Draught, air velocity

2.3.4 Humidity in indoor air

Standards used as reference:

Indicator 2.3.1 is based on EN 15251 and EN ISO 7730.

Indicator 2.3.2 and 2.3.3 are based on EN ISO7730.

Operative temperature has been estimated as the most important factor for Thermal Comfort followed by draught/air velocity, temperature asymmetry/surface temperature, and humidity in indoor air (see table with weightings).

3. Calculation and Rating

Design/construction phase: Calculations

Existing buildings: Calculations and/or measurements

2.3.1 Operative Temperature

Operative temperature is the average of the air dry-bulb temperature and of the mean radiant temperature at a given place in a room for air velocities that do not exceed the 0.2m/sec. It is defined as the 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 non-uniform environment.

Evaluation of Operative Temperature is based on EN 15251 and EN 7730. The recommended criteria in EN 15251 for the thermal environment are separate for buildings with and buildings without mechanical ventilation-cooling. Studies have shown that in buildings without mechanical cooling, occupants are predicted to be less critical to higher temperatures than in buildings with mechanical cooling.

Buildings without mechanical cooling (ISO EN 15251)

Design values for the indoor operative temperature for buildings without mechanical cooling systems, as a function of the exponentially-weighted running mean of the outdoor temperature.

Example: Recommended design values of indoor temperature (EN 15251)

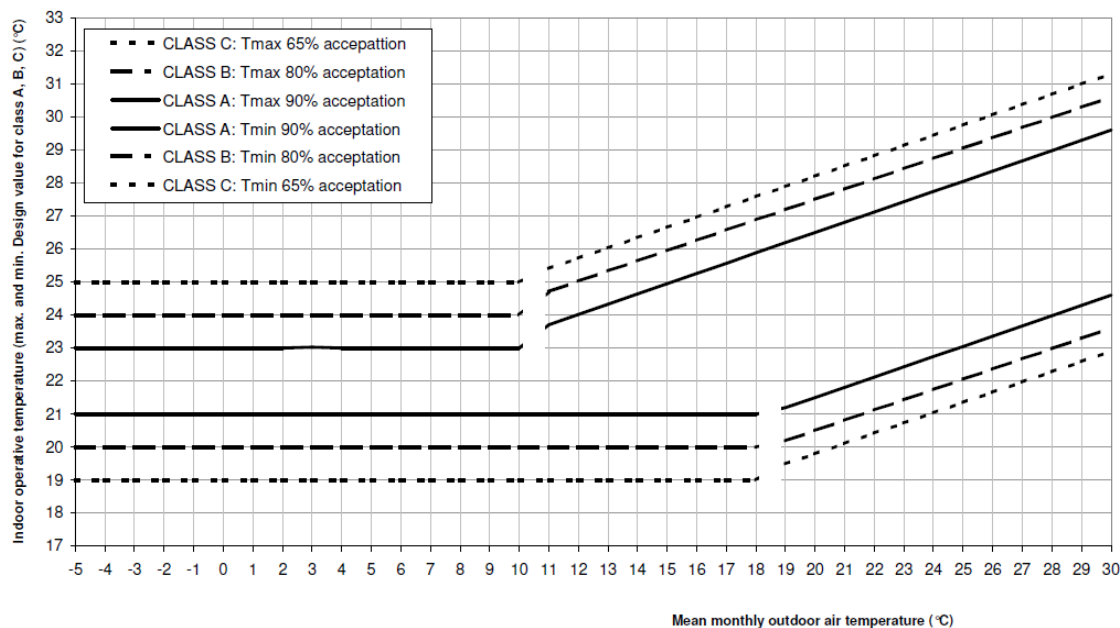
Type of building/space	Category	Operative temperature °C Cooling (summer season)	Operative temperature °C Heating (winter season)
Offices (single, landscape, conference rooms, auditoriums)	I	25,5	21,0
	II	26,0	20,0
	III	27,0	19,0

By calculation:

Type of building/space	Category	Upper limit °C	Lower limit °C
Offices (single, landscape, conference rooms, auditoriums)	I	$0,33 * Z + 18,8 + 2$	$0,33 * Z + 18,8 - 2$
	II	$0,33 * Z + 18,8 + 3$	$0,33 * Z + 18,8 - 3$
	III	$0,33 * Z + 18,8 + 4$	$0,33 * Z + 18,8 - 4$

Z=Exponentially weighted running mean of the daily outdoor temperature (EN 15251)

Or: Outdoor air temperature can be taken into account using figure or calculation (EN 15251):



Buildings with mechanical cooling (Table A.5 EN ISO 7730)

Type of building/space	Category	Operative temperature °C	
		Summer (cooling season)	Winter (heating season)
Offices (single, landscape, conference rooms, auditoriums)	I	24,5 ± 1,0	22,0 ± 1,0
	II	24,5 ± 1,5	22,0 ± 2,0
	III	24,5 ± 2,5	22,0 ± 3,0

Evaluation methods

1. Thermal building simulations that show compliance with the categories of EN 15251/EN ISO 7730
2. Measurements according to EN ISO 7726 that show compliance with the categories of EN 15251
3. Heating load calculations according to EN 12831 (Only for buildings with a window area of less than 40 %)

2.3.1.a Operative Temperature (Winter)	Points
Compliance with Category I of EN 15251/ EN ISO 7730 OR compliance with EN 12831 (minimum room temperature 21°C)	50
Compliance with Category II of EN 15251/ EN ISO 7730 OR compliance with EN 12831 (minimum room temperature 20°C)	25
Compliance with Category III of EN 15251/ EN ISO 7730 OR compliance with minimum national criteria, whatever is more restrictive	5
No compliance with minimum national criteria	0

2.3.1.b Operative Temperature (Summer)	Points
Compliance with Category I of EN 15251/ EN ISO 7730 AND Compliance with national standards to avoid summerly overheating	50
Compliance with Category III of EN 15251/ EN ISO 7730 AND compliance with national standards to avoid summerly overheating	25
Compliance with Category III of EN 15251/ EN ISO 7730 AND compliance with national standards to avoid summerly overheating	15
Compliance with national standards to avoid summerly overheating	10
No compliance with minimum national criteria	0

2.3.2a Radiant temperature asymmetry

Radiant asymmetry can cause thermal discomfort and people are most sensitive to asymmetry caused by warm ceiling or cool walls (windows).

ISO EN 7730:2005 paragraph A3, Table A4: Radiant temperature asymmetry

Category	Radiant temperature asymmetry °C			
	Warm ceiling	Cool wall	Cool ceiling	Warm wall
A	< 5	< 10	< 14	< 23
B	< 5	< 10	< 14	< 23
C	< 7	< 13	< 18	< 35

2.3.2.b Floor temperature

ISO EN 7730:2005 paragraph A3, Table A3: Range of floor surface temperature

Category	Range of floor surface temperature °C
A	19 to 29
B	19 to 29
C	17 to 31

2.3.2 Radiant temperature asymmetry and floor temperature	Points
Values are compliant (EN 7730) Category A,B	100
Values are compliant (EN 7730) Category C	50
Values are not compliant (EN 7730)	0

2.3.3 Draught, air velocity

Air drafts on part of the body affect the thermal comfort of the occupant.

The air velocity has thus to be limited.

The method of EN ISO 7730 paragraph A.4 Table A5 can be used to determine the maximum mean air velocity.

It is valid within temperature range of 20 to 26°C and a turbulence intensity of approximately 40%.

If turbulence intensity is not known, these values can still be used in first approximation.

ISO EN 7730:2005 paragraph A4, Table A5: maximum mean air velocity

Category	Maximum mean air velocity m/s	
	Summer (cooling season)	Winter (heating season)
I	0,12	0,10
II	0,19	0,16
III	0,24	0,21

All buildings without HVAC (Heating, Ventilating and Air Conditioning) systems are considered compliant.

2.3.3 Draught, air velocity	Points
Compliant with Category I, II EN ISO 7730, paragraph A4, Table A5	100
Compliant with Category III EN ISO 7730, paragraph A4, Table A5	50
Non-compliant with Category I, II, III EN ISO 7730, paragraph A4, Table A5	0

2.3.4 Humidity in indoor air

The upper limit for absolute humidity (perceived humidity) of 12 g of water per kg of dry air should not be exceeded (based on EN 15251, appendix B3).

2.3.4 Humidity in indoor air	Points
Absolute humidity of 12 g of water per kg of dry air compliant	100
Absolute humidity of 12 g of water per kg of dry air non-compliant	0

Weights of sub-indicators

Indicator 2.3	Weights
Sub-indicator 2.3.1 Operative temperature	4
Sub-indicator 2.3.2 Radiant temperature asymmetry and floor temperature	1
Sub-indicator 2.3.3 Draught, air velocity	2
Sub-indicator 2.3.4 Humidity in indoor air	1

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

Before Construction Stage:

2.3.1 Operative temperature

Depending on the method chosen:

1. Thermal building simulations that show compliance with the categories of EN 15251/EN ISO 7730
3. Heating load calculations according to EN 12831 (for buildings with a window area of less than 40 %)

2.3.2 Radiant temperature asymmetry and floor temperature

Winter and Summer design temperatures of building components

2.3.3 Draught, air velocity

Technical specifications of the air-outlets

Evidence of the compliance with EN ISO 7730

2.3.4 Humidity in indoor air

Description of HVAC system

For Post Construction Stage (Measuring, Assessment):

2.3.1 Operative temperature

Depending on the method chosen:

1. Thermal building simulations that show compliance with the categories of EN 15251/EN ISO 7730
2. Measurements according to EN ISO 7726 that show compliance with the categories of EN 15251
3. Heating load calculations according to EN 12831 (for buildings with a window area of less than 40 %)

2.3.2 Radiant temperature asymmetry and floor temperature

Winter and Summer design temperatures of building components

Assessment of the maximum and minimum surface temperatures of building components with a large surface area:

- Ceiling
- Glazed facade/wall surfaces, if glazed surfaces comprise more than 40 % of the interior façade or wall surface area,
- Floor

2.3.3 Draught, air velocity

Technical specifications of the air-outlets

Evidence of the compliance with EN ISO 7730

2.3.4 Humidity in indoor air

Description of HVAC system

5. Relation to other Indicators

Indicator 2.4: Indoor Air Quality

Indicator 2.8: Operation Comfort

Indicator 5.3: Optimization and Complexity of the Approach to Planning

6. Resources

1. Germany
 - DIN EN 15251 – 2007: Eingangsparemeter für das Raumklima zur Auslegung und Bewertung der Energieeffizienz von Gebäuden - Raumluftqualität, Temperatur, Licht und Akustik
 - VDI 3804 Air-conditioning - Office buildings (VDI ventilation code of practice), 2009-03
 - Arbeitsstätten-Richtlinie ASR 6 Raumtemperatur, Mai 2001
2. Europe
 - EN 15251 - Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics
 - EN 12831:2003 - Heating systems in buildings – Method for calculation of the design heat load
 - ISO 7726 / 1998: Ergonomics of the thermal environment -- Instruments for measuring physical quantities
 - ISO 7730 /2005 Ergonomics of the thermal environment -- Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria
 - ISO 15099:2003 Thermal performance of windows, doors and shading devices -- Detailed calculations
3. USA
 - ASHRAE Standard 62.1-2007: Ventilation for Acceptable Indoor Air Quality
 - ASHRAE Standard 55-2004: Thermal Environmental Conditions for Human Occupancy
 - Chartered Institute of Building Services Engineers (CIBSE) Applications Manual 10-2005
 - Center for the Built Environment (www.cbe.berkeley.edu)
 - Article: “Do Green Buildings Enhance the Well Being of Workers? Yes.” July/August 2000 issue of EBN Magazine. The author, Judith Heerwagen, is an Environmental Psychologist whose research and writing have focused on workplace ecology.

Other relevant literature regarding Thermal Comfort

4. Fergus Nicol, Michael Humphreys, Oliver Sykes, Susan Roaf (1995): “Standards for Thermal Comfort: Indoor Air Temperature Standards for the 21st Century.”
5. Fanger, P. O. (1970). Thermal Comfort. Copenhagen: Danish Technical Press.
6. Nancy B. Solomon: “The Comfort Zone.” Article published in the March/April 2011 issue of GreenSource.
7. Laurent Grignon-Massé, Jérôme Adnot, and Philippe Rivière (2008): Towards Adaptive PMV/PPD Indices for European Climates... Ecole des Mines de Paris, 2008 ACEEE Summer Study on Energy Efficiency in Buildings (http://eec.ucdavis.edu/ACEEE/2008/data/papers/7_693.pdf)
8. Giving Occupants What They Want: Guidelines for Implementing Personal Environmental Control in Your Building Paper by Fred S. Bauman, P.E.; Center for the Built Environment; University of California, Berkeley, CA 94720-1839; Presented at World Workplace 99, October 3-5, 1999, Los Angeles, CA
9. Olesen Bjarne. The philosophy behind EN15251: Indoor environmental criteria for design and calculation of energy performance of buildings. Energy and Buildings Volume 39, Issue 7, July 2007, Pages 740-749
10. Dear de R., Schiller Brager, G. The adaptive model of thermal comfort and energy conservation in the built environment. Int J Biometeorol (2001) 45:100-108

7. Attachments

None

Indicator 2.4 Indoor Air Quality

(adapted from EN 15251)

Core Indicator

1. Objective

Indoor air quality (IAQ) is one of the factors that determine building functionality and economics. IAQ affects building occupants and their ability to conduct their activities, creates positive or negative impressions on citizens, customers, clients and other visitors to the building. When IAQ is good, buildings are more desirable places to live, work, to learn, to conduct business and to rent. IAQ directly affects occupant health, comfort and productivity.

The goal is to assure the indoor air quality and to avoid negative impacts on the user's state of health.

The building is low polluting if the majority of the materials are low polluting. Low polluting materials are known to be safe with respect to emissions which fulfill the following requirements:

- Emission of TVOC (Total Volatile Organic Compound) is below 0,2 mg/m²h
- Emission of formaldehyde is below 0,05 mg/m²h
- Emission of VOC (Volatile Organic Compound) is below national standard
- Emission of carcinogenic compounds IARC (International Agency for Research on Cancer) is below 0,002 mg/m²h
- Material is not odorous (dissatisfaction with the odor is below 15%)

This indicator supports the objective of the European Commission to ensure that enclosed workplaces are provided with sufficient clean and fresh air¹.

2. Assessment Methodology

The quality of indoor air climate is affected equally by heating, ventilation and air conditioning equipment, construction engineering, quality of construction work, building materials as well as the operation and maintenance of the building. Good indoor climate requires taking these aspects into consideration during all stages of building life; design, construction and use. Some of the problems may originate from building themselves, some caused by actions of the occupants or operation, some by maintenance. Because of these multiple origins of the air quality impacts it is important to specify the performance of the building and construction process so that the building industry can prove through accepted procedures that the building meets the agreed performance criteria for health and unnecessary claims are avoided.

The following sub-indicators will be assessed:

2.4.1 Occupancy-based ventilation rates

2.4.2 Indoor air contamination with the most relevant indoor air pollutants [existing buildings]

2.4.3 CO₂ concentration above outdoor level [existing buildings]

2.4.4 Subjective reaction as classification of the indoor air quality [existing buildings]

2.4.5 Occurrence of Radon [existing buildings]

¹ DIRECTIVE 89/654/EC

3. Calculation and Rating

2.4.1 Occupancy-based ventilation rates

According to the standards EN 15251 the indoor air quality can be expressed as the required level of ventilation. Ventilation in the building should be designed considering all sources of pollution present including material emissions and adequate air for every person. Basis for the criteria for indoor air quality and ventilation rates are in the Annex B of mentioned standard. 4 classes/categories of the recommended IAQ are given (table 1) and for each category different values are established. The evaluation of the indoor environment of a building is made by evaluating the indoor environment of typical rooms representing different zones in the building. Evaluation can be based on design, measurements or calculations.

Table 1. Description of the applicability of the categories used.

Category	Explanation
I	High level of expectation and is recommended for spaces occupied by very sensitive and fragile persons with special requirements like handicapped, sick, very young children and elderly persons
II	Normal level of expectation and should be used for new buildings and renovations
III	An acceptable, moderate level of expectation and may be used for existing buildings
IV	Values outside the criteria for the above categories. This category should only be accepted for a limited part of the year

For non-residential buildings with mechanical ventilation, recommended ventilation rates are presented in table 2a and 2b. The ventilation rate for non-residential buildings should be designed based on building and occupancy components. The occupancy components take into account natural emissions of users as well as CO₂ pollution caused by breathing.

Table 2a Recommended ventilation rate for adequate air for each person : q_p

Category	Recommended Ventilation Rate for one person q_p [l/s.pers]
I	10
II	7
III	4

Table 2b Recommended ventilation rate related to building emissions : q_B

Category	Recommended Building emission related Ventilation rate q_B [l/s.m ²]		
	Very low polluted building	Low polluted building	Non-low polluted building
I	0,5	1,0	2,0
II	0,3	0,7	1,4
III	0,2	0,4	0,8

The q_B varies with the level of pollution of the building. The different levels: very low, low and non-low polluting buildings are defined in the Annex C of the EN 15251 and can be found in attachment “Appendix 1: Definition of polluting buildings”.

Calculation

q_{tot} : total ventilation rate [l/s]

q_B : recommended ventilation rate for building emissions [l/s.m²]

1. The building level of pollution has to be determined: very low, low or non-low
2. For each room of area A [m²] and each category (I,II or III), calculate:
 - $q_{catI} = q_{tot} - A \cdot q_{BI}$,
 - $q_{catII} = q_{tot} - A \cdot q_{BII}$
 - $q_{catIII} = q_{tot} - A \cdot q_{BIII}$
3. Compare with the recommended ventilation rate for adequate air for each person q_p for the corresponding category:
 - If $q_{catI,pers} > q_{PI}$: Category I is achieved
 - If $q_{catII,pers} > q_{PII}$: Category II is achieved
 - If $q_{catIII,pers} > q_{PIII}$: Category III is achieved

2.4.1 Occupancy-based ventilation rates	Points
Category I	100
Category II	75
Category III or national regulations	10
Category IV	0

2.4.2 Indoor air contamination with indoor air pollutants [existing buildings]

The substances considered: formaldehyde, naphthalene, toluene, xylenes, styrene were selected from the other indoor air pollutions because of the existence of indoor sources, the availability of toxicological and epidemiological data and exposure levels causing health concerns (WHO 2006, 2010, INDEX, EnVIE, national rules). Problems of indoor air quality are recognized as important risk factors for human health in both low- and middle- and high-income countries. Indoor air is also important because people spend a substantial proportion of their time in buildings.

Formaldehyde is classified by IARC as carcinogenic to humans (Group 1). The major exposure route of formaldehyde is inhalation from indoor sources and indoor exposures are the dominant contributor to personal exposures through inhalation and indoor concentrations may be high enough to cause adverse health effects.

The principal health concerns of exposure to naphthalene are respiratory tract lesions, including tumours in the upper respiratory tract demonstrated in animal studies and hemolytic anemia in humans.

Toluene has been used as a solvent in a variety of household products and is almost always present in indoor air in detectable concentrations. Toluene should not be inhaled due to its health effects. Low to moderate levels can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite, and hearing and color vision loss.

Xylenes exhibit neurological effects. High levels from exposure for acute or chronic periods can cause headaches, and other illness. Exposure of people to high levels of xylenes for short periods can also cause irritation of the skin, eyes, nose, and throat, difficulty in breathing and other problems with the lungs, delayed reaction time, memory difficulties and stomach discomfort.

The International Agency for Research on Cancer considers styrene to be "possibly carcinogenic to humans. Chronic exposure to styrene leads to tiredness/ lethargy memory deficits, headaches. Nowadays, building material including xylene, naphthalene, styrene and toluene are rare. However, even a very limited amount of building material with such contents can affect the indoor air quality.

Note: this sub-indicator is only relevant for existing buildings (measurements required).

2.4.2.a Indoor air contamination with the most relevant indoor air pollutants: Formaldehyde	Points
<10 µg/m ³	60
<10-60 µg/m ³	40
<60-100 µg/m ³	5
>100 µg/m ³	0

2.4.2.b Indoor air contamination with the most relevant indoor air pollutants: Naphthalene	Points
<2 µg/m ³	10
<2-5 µg/m ³	7
<5-10 µg/m ³	3
>10 µg/m ³	0

2.4.1.c Indoor air contamination with the most relevant indoor air pollutants: Toluene	Points
<5 µg/m ³	10
<5-80 µg/m ³	7
80-100 µg/m ³	5
<180-250 µg/m ³	3
>250 µg/m ³	0

2.4.1.d Indoor air contamination with the most relevant indoor air pollutants: Styrene	Points
<2 µg/m ³	10
<2-20 µg/m ³	7
<20-30 µg/m ³	3
>30 µg/m ³	0

2.4.1.e Indoor air contamination with the most relevant indoor air pollutants: Xylenes	Points
<5 µg/m ³	10
<5-30 µg/m ³	7
<30-80 µg/m ³	5
<80-150 µg/m ³	3
>150 µg/m ³	0

2.4.3 CO₂ concentration above outdoor level [existing buildings]

The levels are based on the recommended measured indoor CO₂ concentrations above outdoor concentration. (EN 15251)

2.4.3 CO ₂ concentration above outdoor level	Points
< 300 PPM above outdoor level	100
<400 PPM	80
<500 PPM	50
<600 PPM	30
<700 PPM	20
<800 PPM	10
More than 800 PPM above outdoor level	0

2.4.4 Subjective reaction as classification of the indoor air quality [existing buildings]

The use of subjective evaluations has been introduced in the standard EN 15251. By using all or some of the scales recommended in Annex H of this standard the occupants are asked to fill in the questionnaires at representative times during the year. The percentage of people voting acceptable, good or very good (air quality) is calculated for each of the representative spaces in the buildings. > 80% positive votes define high air quality level. A response rate of at least 70% is to be reached; lower must be commented and analyzed. (A questionnaire can be used also for questions about thermal comfort, acoustic comfort and other types of questions, however not yet included in OPEN HOUSE). Low satisfaction of perceived indoor air quality can be a sign of insufficient ventilation or other defects.

- What is your general opinion about the indoor air quality in your work area?
 - Very good
 - Good
 - Acceptable
 - Bad
 - Very bad

Complementary suggested question

- During the last 3 months, have you noticed any of the following odors in your work area?

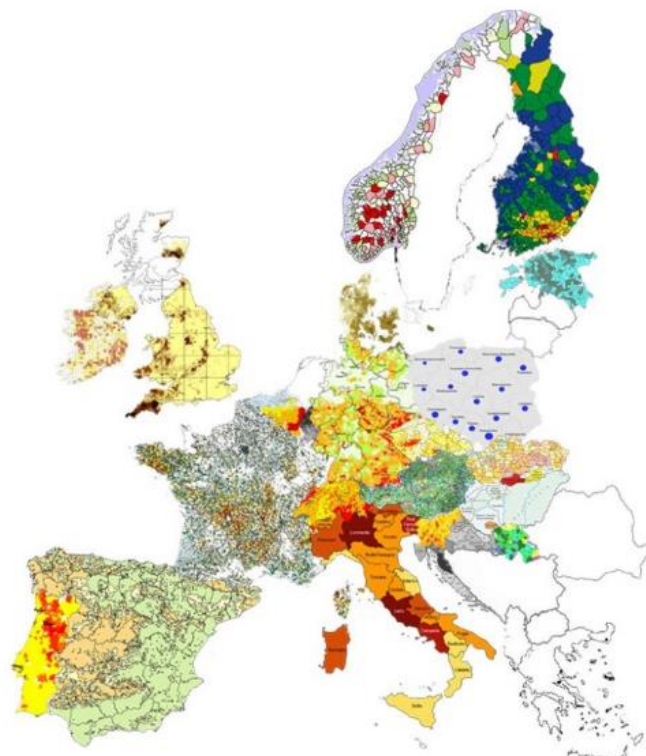
	Never	Yes, often	Yes, sometimes
Tobacco smoke	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Food smells	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Musty, moldy smell	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chemical odors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stuffy odor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diesel or other exhaust odors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.4.4 Subjective reaction as classification of the indoor air quality	Points
> 80-100% good or very good	100
>70%	80
>75%	60
>70%	40
>60%	20
Below 50 % satisfied	0

2.4.5 Occurrence of Radon [existing buildings]

Indoor radon concentration levels of 200 and 400 Becquerel per cubic meter (Bq/m³) are the reference concentrations in buildings above which mitigation measures should be taken in order to reduce exposure to radon.

However, the variety of means and methods to measure and report radon levels is very large across EU countries, whereas there are not detailed radon maps for all countries.



An overview of radon surveys in Europe – G. Dubois

The assessment can take into account published radon maps, where available, or be done on site by a qualified tester.

Attenuation measures:

When radon exposure exceeds 400 Bq/m³, possible attenuation measures are (BRE):

1. Installing a radon sump system
2. Sealing floors and walls
3. Increasing under floor ventilation
4. Installing a whole building positive pressurisation or positive supply ventilation system
5. Improving the ventilation of the building

2.4.5 Occurrence of Radon	Points
Indoor radon concentration < 400 Bq/m ³	100
Indoor radon concentration > 400 Bq/m ³ AND 4 out of 5 attenuation measures taken	75
Indoor radon concentration > 400 Bq/m ³ AND 2 out of 5 attenuation measures taken	50
Indoor radon concentration > 400 Bq/m ³ and no attenuation measures taken	0

Weights of Sub-indicators

Indicator 2.4	Weight
Sub-indicator 2.4.1 Occupancy based ventilation rates	4
Sub-indicator 2.4.2 Indoor air contamination with the most relevant indoor air pollutants	4
Sub-indicator 2.4.3 CO ₂ concentration above outdoor level	4
Sub-indicator 2.4.4 Subjective reaction as classification of the indoor air quality	4
Sub-indicator 2.4.5 Occurrence of radon	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment:

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment:

2.4.1 Occupancy based ventilation rates

Determination of the occupancy based ventilation rate for building for categories I to III in accordance with standard EN 15251. Documented report must be signed by building physics expert.

2.4.2 Indoor air contamination with the most relevant indoor air pollutants [existing buildings]

1. Laboratory report: indoor air contamination with the most relevant indoor air pollutants.
2. Determining the presence of indoor air pollutants in accordance with:
 - ISO 16000-3 Indoor air - Part 3. Determination of formaldehyde and other carbonyl compounds. Active or passive sampling method.
 - ISO 16017-1 Indoor, ambient and workplace air. Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography. Part 1. Pumped sampling
3. Check the test results with the levels from the tables in guidelines and present them in the appropriate tabular form.
4. Accreditation of the measurement facility. Name, business address, legal form and accreditation certificate (copy).

2.4.3 CO₂ concentration above outdoor level [existing buildings]

Measured or calculated CO₂ concentration. Documented report must be signed by building physics expert.

2.4.4 Subjective reaction as classification of the indoor air quality [existing buildings]

Information on questionnaire distribution, number of participants and response rates, and questions used.

2.4.5 Occurrence of radon

Documentation of current information on the possible radon levels in the soil at the building site with reference to the source:

5. Relation to other Indicators

1.6 Risks from Materials

6. Resources

Development of WHO Guidelines for Indoor Air Quality, WHO 2006

<http://www.who.int/rpc/guidelines/year/en/index.html>

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”.

EnVIE Co-ordination Action on Indoor Air Quality and Health Effects. www.envie-iaq.eu
(Critical Appraisal of the Setting and Implementation of Indoor Exposure Limits in the EU) Summary on recommendations and management options, EC JRC, 2004,
http://ec.europa.eu/health/ph_projects/2002/pollution/fp_pollution_2002_exs_02.pdf

INDEX (2004) INDEX project (Critical Appraisal of the Setting and Implementation of Indoor Exposure Limits in the EU) Scope of INDEX was to identify priorities and to assess the needs for a Community strategy and action plan in the area of indoor air pollution.
http://ec.europa.eu/health/ph_projects/2002/pollution/fp_pollution_2002_exs_02.pdf

ISO 16000: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=29049

WHO guidelines for indoor air quality: selected pollutants, WHO 2010,
<http://www.who.int/rpc/guidelines/year/en/index.html>

An overview of radon surveys in Europe – G. Dubois. European Commission – DG Joint Research Centre, Institute for Environment and Sustainability.
http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=5450&dt_code=NWS&lang=en

7. Attachments

Appendix 1: Definition of polluting buildings

These definitions are given in Annex C of EN 15251:2007.

Very Low polluting building

The building is very low polluting if all of the materials are very low polluting and smoking has never occurred and is not allowed. Very low polluting materials are natural traditional materials, such as stone, glass and metals, which are known to be safe with respect to emissions, and materials which fulfill the following requirements:

- The emission of total volatile organic compounds (TVOC) is below 0.1 mg/m²h.
- The emission of formaldehyde is below 0.02 mg/m²h.
- The emission of ammonia is below 0.01 mg/m²h.
- The emission of carcinogenic compounds (IARC) is below 0.002 mg/m²h.
- The material is not odorous (dissatisfaction with the odour is below 10 %).

Low polluting building

The building is low polluting if the majority of the materials are low polluting. Low polluting materials are natural traditional materials, such as stone and glass, which are known to be safe with respect to emissions, and materials which fulfill the following requirements:

- The emission of total volatile organic compounds (TVOC) is below 0.2 mg/m²h.
- The emission of formaldehyde is below 0.05 mg/m²h.
- The emission of ammonia is below 0.03 mg/m²h.
- The emission of carcinogenic compounds (IARC) is below 0.005 mg/m²h.
- The material is not odorous (dissatisfaction with the odour is below 15 %).

Non-low polluting building

The building is non-low polluting if he exceeds the requirements for a low polluting building.

Appendix 2: More information about radon

Radon is considered a significant contaminant that affects indoor air quality worldwide posing a serious health threat that can lead to lung cancer. Radon exposure in buildings may arise from certain subsurface rock formations and also from certain building materials (e.g. some granites); greatest risk of radon exposure arises from buildings that are extremely well insulated and hence offer least air exchange with the atmosphere. Relatively heavier than air, radon shows low concentrations outdoor (the mean annual concentration outdoor is on the order of 10Bq/m³), but tends to be trapped in the basements and the lower floors of buildings. Increased concentration in outdoor air therefore leads to higher concentration indoor, and measurements have to be carried out in order to prevent negative impacts on human health

Indicator 2.5 Water Quality

(adapted from Directive 98/83/EC)

1. Objective

The objective of the evaluation of water quality in a building is:

1. to protect building users' health from the adverse effects of any contamination of water intended for human consumption and produced by water systems installed in the building, by ensuring that it is wholesome and clean.
2. to ensure a reliable water supply system

Water intended for building users' consumption shall mean:

- (a) all water either in its original state or after treatment, intended for drinking, cooking, food preparation or other domestic purposes, regardless of its origin and whether it is supplied from a distribution network, from a tanker, or in bottles or containers;
- (b) all water used in any food-production undertaking for the manufacture, processing, preservation or marketing of products or substances intended for human consumption unless the competent national authorities are satisfied that the quality of the water cannot affect the wholesomeness of the foodstuff in its finished form.

Water systems installed in a building include domestic hot and cold water systems, evaporative condensers, cooling towers, other systems containing water which are likely to exceed 20°C and which may release a spray or aerosol during operation or when being maintained, for example: humidifiers and air washers, spa baths and pods, car/bus washes, wet scrubbers, indoor fountains.

Member states' national laws are required to comply with DIRECTIVE 98/83/EC. Below are requirements for Member states.

Water intended for human consumption, according to the COUNCIL DIRECTIVE 98/83/EC, should be wholesome and clean. The water is wholesome and clean if:

- (a) it is free from any micro-organisms and parasites and from any substances which, in numbers or concentrations, constitute a potential danger to human health, and
- (b) it meets the minimum requirements set out in Annex I, Parts A and B of DIRECTIVE 98/83/EC, as regards to microbiological parameters, chemical parameters, indicator parameters and radioactivity.

Municipal water supply is a water supply serving a community. Water quality must meet CD 98/83/EC.

Private water supply is not part of the municipal supply. Water quality must meet CD 98/83/EC.

Where alternative water supplies (eg borehole, rainwater use, grey re-use) are used a Water Safety Plan must be established and operated.

This indicator supports the European Commission objective to ensure that water is available in sufficient quantities, is of appropriate quality, is used sustainably and with minimum resource input, and is ultimately returned to the environment with acceptable quality.¹

¹ European Commission: A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy

2. Assessment Methodology

To meet ensure a reliable water supply and safe alternative water supplies the following should be evaluated:

2.5.1 Constant Water Supply through the day/ year (Reliable water supply)

2.5.2 Use of alternative water supplies

2.5.3 Water Disinfection

3. Calculation and Rating

2.5.1. Constant water supply through the day/year

The lack of constant water supply through the year or the day is a usual problem in many European locations, where local distribution networks do not function properly. This kind of problems can be addressed in a building if it is equipped with special technologies that can stabilize up to a certain level or improve water flow in the supply system installed in the building.

2.5.1 Constant water supply through the day/year	Points
Constant water supply through the day/year	100
No constant water supply	0

This indicator can be excluded where this is supplied through the national network.

2.5.2 Use of alternative water supplies

2.5.2 Use of Alternative water supplies	Points
Water supplied from municipal / private water supply only OR use of alternative water supply with a Water Safety Plan	100
Use of alternative water supplies with no Water Safety Plan	0

2.5.3. Water disinfection

A disadvantage of chlorine is its ability to react with natural organic matter to produce THMs (TriHaloMethanes) and other halogenated DBPs (Disinfection By-Products), which in high concentrations in drinking water may pose risk in the development of cancer.

Ozone reacts with natural organics to increase their biodegradability, measured as assimilable organic carbon. Ozone is effective for the degradation of a wide range of pesticides and other organic chemicals. The ozonation process utilizes a short contact time to “kill” viruses and bacteria and there are no harmful residuals that need to be removed after ozonation because ozone decomposes rapidly. However, Ozonation is a more complex technology than is chlorination, requiring complicated equipment and efficient contacting systems.

2.5.3 Ozonation instead of chlorination for water disinfection	Points
Ozonation instead of chlorination for water disinfection	100
Not compliant	0

Note: This indicator can be excluded if no on-site disinfection is provided.

Weights of sub-indicators

Indicator 2.5	Weights
Sub-indicator 2.5.1 Constant Water Supply through the day/ year (Reliable water supply)	4
Sub-indicator 2.5.2 Use of alternative water supplies	4
Sub-indicator 2.5.3 Water Disinfection	3

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

Sub-indicator 2.5.1 Constant Water Supply through the day/ year (Reliable water supply)

- The study report and drawings detailing the water supply system that will be implemented in the building.
- Invoices proving the purchase of materials and technical equipment selected in the water system study report.

Sub-indicator 2.5.2 Use of alternative water supplies

- Description of alternative water supply with a Water Safety Plan

Sub-indicator 2.5.3 Water Disinfection

- Documentation proofing the use of ozonation for water disinfection.

5. Relation to other Indicators

Indicator 1.11 “Water and Waste Water”

Indicator 1.12 “Contamination of undisturbed areas”

6. Resources

DIRECTIVE 98/83/EC:

http://europa.eu/legislation_summaries/environment/water_protection_management/l28079_en.htm

GUIDELINES FOR DRINKING-WATER QUALITY, World Health Organization, Geneva 2008

World Health Organisation: Water Safety Plan

http://www.who.int/water_sanitation_health/dwq/wsp0506/en/

7. Attachments

None

Indicator 2.6 Acoustic Comfort

(adapted from DGNB/BNB, BREEAM)

Core Indicator

1. Objective

The aim is to achieve a low level interference and background noise with speech intelligibility in all rooms to avoid affecting use, health and capability of the users. The lower the level of interference and background noises is, the less distraction and detriment to health and capability. High speech intelligibility in communication rooms and high absorbability of sound propagation to restrict the mutual interfering potential is of advantage.

This supports the European Commission objective to protect workers from risks to their health and safety arising or likely to arise from exposure to noise and in particular the risk to hearing¹.

2. Assessment Methodology

For the evaluation of offices different acoustic input parameters are necessary:

- 2.6.1. **Indoor ambient noise levels in unoccupied staff/office areas**
- 2.6.2. **Reverberation period**

Sound level and acoustics for the following rooms' typologies should be evaluated:

- **Individual offices and multi-person offices with areas up to 40 m²**
- **Multi-person offices with areas greater than 40 m²**
- **Conference rooms**
- **Cafeterias with areas greater than 50 m²**

¹ DIRECTIVE 2003/10/EC

3. Calculation and Rating

2.6.1 Indoor ambient noise levels in *unoccupied* staff/office areas

Indoor ambient noise levels in unoccupied staff/office areas comply with the following:

- a. $< 40\text{dB } LA_{eq,T}$ in Individual offices and multi-person offices with areas up to 40 m^2
- b. $40\text{-}50\text{dB } LA_{eq,T}$ in Multi-person offices with areas greater than 40 m^2
- c. $< 40\text{ dB } LA_{eq,T}$ general spaces (staffrooms, restrooms)
- d. $< 35\text{ dB } LA_{eq,T}$ in spaces designed for speech e.g. seminar/lecture/conference rooms
- e. $< 50\text{ dB } LA_{eq,T}$ in informal café/canteen areas with areas greater than 50 m^2

Table 1: 2.6.1 Indoor ambient noise levels in unoccupied staff / office areas

2.6.1 Indoor ambient noise levels in unoccupied staff/office areas	Points
Compliance with all the requirements	100
Compliance with four of the requirements	80
Compliance with three of the requirements	60
Compliance with two of the requirements	40
Compliance with one of the requirements	20
Not compliance with any of the requirements	0

2.6.2 Reverberation period in s, oriented on the values according to ISO 3382-2

a). Individual offices and multi-person offices with areas up to 40 m^2

Sound damping in individual furnished offices in use can be judged by reverberation time. A reverberation time of $T \leq 0.8\text{ s}$ ensures good acoustic conditions in a room. Comfortable conditions are present at a reverberation time of $T \leq 0.5\text{ s}$. Reverberation time in furnished, occupied offices is highly dependent on furnishings, as well as on the quantity and type of users' occupancy-associated equipment. Therefore, this evaluation focuses on assurance of basic sound damping in rooms via sound absorption on the interior of the enclosing surfaces of rooms. Sound absorption by furnishings is thus not taken into account. Floor coverings may be taken into account.

The assessment is performed by calculating reverberation time in empty individual offices in accordance with the calculation guidelines in DIN 18041.

Alternatively, measurements in accordance with the standard procedure in ISO 3382-2 for empty, unfurnished rooms can be used; however for empty, it is important to ensure adequate sound-field diffusion (sound damping) when using this method.

The calculation or measurement should be performed in the octave bands from 125 to 4,000 Hz.

The arithmetical mean of the six octave bands should be evaluated. The evaluation is based on the arithmetic mean reverberation time T in s in an empty, unfurnished state (mean of reverberation times in octave bands 125 to 4,000 Hz) :

Table 2 : 2.6.2.a Individual offices and multi-person offices with areas up to 40 m^2

2.6.2.a Individual offices and multi-person offices with areas up to 40 m^2	Points
$T \leq 0,8\text{ s}$	25
$T \leq 1,0\text{ s}$	15
$T \leq 1,5\text{ s}$	10
$T > 1,5\text{ s}$	0

b). Multi-person offices with areas greater than 40 m²

This evaluation focuses on assurance of basic sound damping in rooms via sound absorption on the interior of the enclosing surfaces of rooms. Sound absorption by furnishings is thus not taken into account. Floor coverings may be taken into account.

Very comfortable indoor acoustic conditions in large multi-person offices with an open office structure can be achieved by using:

- sound-absorbing surfaces on the ceiling, which are significantly more effective at damping the spread of sound than sound-absorbing surfaces on floors;
- dual-sided floor-to-ceiling sound absorbing partitions.

In both cases, additional checklist points can be awarded for sound-absorbing surfaces on the ceilings and partitions.

The assessment is performed by measuring the reverberation time, if the ratio between maximum room width/length and height is no greater than 5, in accordance with the standard procedure in ISO 3382-2 for empty, unfurnished rooms. It is important to ensure adequate sound-field diffusion when using this method. The measurement should be performed in the octave bands from 125 to 4,000 Hz. The evaluation is based on the arithmetic mean reverberation time T in s in an empty, unfurnished state (mean value of reverberation times in octave bands 125 to 4,000 Hz) :

Table 3 : 2.6.2.b Multi-person offices with areas greater than 40 m²

2.6.2.b Multi-person offices with areas greater than 40 m ²	Points
$T \leq 0,8$ s	25
$T \leq 1,0$ s	10
$T > 1,0$ s	0

c). Conference rooms

Sound damping in furnished occupied conference rooms can be judged by reverberation time.

The assessment is performed by calculating reverberation time in a furnished conference room filled to 80% capacity in accordance with the calculation guidelines in DIN 18041. The sound absorption of furnishings and occupants should be accounted for in accordance with the specifications of DIN 18041 or test results from test-stand measurements in accordance with EN ISO 354.

Alternatively, the assessment can be completed by performing measurements in the furnished room in accordance with the standard procedure in ISO 3382-2. Occupancy of 80 % can be taken into account with a mathematical model.

The calculation or measurement should be performed in the octave bands from 125 to 4,000 Hz.

The evaluation is based on the arithmetic mean reverberation time T in s in a furnished state with 80 % occupancy (octave bands 125 to 4,000 Hz) :

Table 4 : 2.6.2.c Conference rooms

2.6.2.c Conference rooms	Points
$0,7 \leq T \leq 1,5$ s	25
$T < 0,7$ s	10
$T > 1,5$ s	0

d). Cafeterias with areas greater than 50 m²

Sound damping in furnished occupied cafeterias can be judged by reverberation time. A reverberation time of $T \leq 1.0$ s is necessary to ensure good acoustic conditions in a room. Comfortable conditions are present at a reverberation time of $T \leq 0.5$ s.

The assessment is performed by calculating reverberation time in the cafeteria filled to 50 % capacity in accordance with the calculation guidelines in DIN 18041. The sound absorption of furnishings and occupants should be accounted for in accordance with the specifications of DIN 18041 or test results from test-stand measurements in accordance with EN ISO 354.

Alternatively, the assessment can be completed by performing measurements in the furnished room in accordance with the standard procedure in ISO 3382-2. The occupancy of 50 % can be accounted for with a mathematical model. The six octave bands should be evaluated.

The evaluation is based on the arithmetic mean reverberation time T in s in a furnished state with 50 % occupancy (octave bands 125 to 4,000 Hz)

Table 5 : 2.6.2.d Cafeterias with areas greater than 50 m²

2.6.2.d Cafeterias with areas greater than 50 m ²	Points
$T \leq 0,5$ s	25
$T \leq 0,8$ s	10
$T > 0,8$ s	0

Weights of Sub-indicators

Indicator 2.6	Weight
Sub-indicator 2.6.1 Indoor ambient noise levels in unoccupied staff/office areas	4
Sub-indicator 2.6.2 Reverberation period	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

2.6.1 Indoor ambient noise levels in unoccupied staff/office areas

A copy of the design plan for each level of the building with each room/area clearly labelled.

A copy of the specification clause or acousticians calculations confirming:

- Indoor ambient noise levels in each relevant room/area.
- The standards to which calculations/measurements have complied, or are required to comply with.

2.6.2 Reverberation period

a. For individual offices:

Depending on the method chosen:

Submission of calculated reverberation time in empty individual offices in accordance with the calculation guidelines in DIN 18041

OR

Submission of calculated reverberation time in accordance with the standard procedure in ISO 3382-2 for empty, unfurnished rooms.

b. For multi-persons offices:

Submission of calculated reverberation time in accordance with the standard procedure in ISO 3382-2 for empty, unfurnished rooms.

c. For conference rooms:

Depending on the method chosen:

Submission of the calculations for reverberation time in furnished conference rooms filled to 80 % capacity in accordance with the calculation guidelines in DIN 18041.

OR

Submission of measured reverberation time in the furnished room in accordance with the standard procedure in ISO 3382-2.

d. For cafeterias:

Depending on the method chosen:

Submission of the calculations for reverberation time in furnished cafeterias filled to 50 % capacity in accordance with the calculation guidelines in DIN 18041

OR

Submission of the calculated reverberation time in furnished cafeterias in accordance with the standard procedure in ISO 3382-2.

5. Relation to other Indicators

Indicator 2.12: Noise from building and site

Indicator 4.5: Noise protection

6. Resources

DGNB - 21 Acoustic comfort

BNB 2011 - 3.1.4 Acoustic comfort

BREEAM Europe Commercial 2009 - Hea 13 - Acoustic Performance

EU standards ISO 3382-2:2008 specifies methods for the measurement of reverberation time in ordinary rooms. It describes the measurement procedure, the apparatus needed, the required number of measurement positions, and the method for evaluating the data and presenting the test report. The measurement results can be used for correction of other acoustic measurements, e.g. sound pressure level from sound sources or measurements of sound insulation, and for comparison with requirements for reverberation time in rooms.

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=36201

7. Attachments

None

Indicator 2.7 **Visual Comfort**

(adapted from DGNB/BNB, prEN 16309)

Core Indicator

1. Objective

By an early and integral daylight and artificial light planning, a high quality of illumination can be created with low energy demands for illumination and cooling. Furthermore, a high degree of daylight use can enhance workplace capability and health and reduce the operational costs. Lighting control integrated with daylighting is recognised as an important and useful strategy in energy-efficient building designs and operations. It is believed that proper daylighting schemes can help reduce the electrical demand and contribute to achieving environmentally sustainable building development.

This supports the European Commission objective to protect workers' safety and health in workplaces, which must as far as possible receive sufficient natural light and be equipped with adequate artificial lighting¹.

2. Assessment Methodology

Visual comfort shall be achieved by balanced illumination without appreciable interferences such as direct and reflected glare, a sufficient illumination level and the possibility to adjust illumination individually to the particular needs. Vitally important for the workplace contentment is the view that informs about time of day, location, weather conditions etc. Further criteria are non glaring, light distribution and spectral colour in the room. The requirements are valid both for illumination by daylight and artificial light.

Also, presence of blinking, flashing, coloured lighting can cause irritation, loss of concentration. The goal is to limit the amount of blinking and flashing lights.

In particular for the evaluation of visual comfort within offices different parameters should be considered:

- 2.7.1 Availability of daylight throughout the building**
- 2.7.2 Availability of daylight in regularly used work areas**
- 2.7.3 View to the outside**
- 2.7.4 Preventing glare in daylight**
- 2.7.5 Preventing glare in artificial light**
- 2.7.6 Light distribution in artificial lighting conditions**
- 2.7.7 Colour rendering**
- 2.7.8 Blinking and flashing lights**

¹ Directive 89/654/EEC

3. Calculation and Rating

2.7.1 Availability of daylight throughout the building

Availability of daylight throughout the building's entire usable area (Usable Area = UA according to ISO9836, EC Measuring Code or other method to be specified) is determined via the **daylight factor (see definition attached)**.

A good supply of daylight generally exists at low room depths, adequately sized openings, well positioned openings, division of openings into a viewing and daylighting zones adjustable sun shades for shielding direct light and, if necessary, individually adjustable blinds. The lighter in colour the surfaces of a room are, the better light is distributed and the better daylighting is.

The goal is to supply the entire usable area with daylight.

2.7.1 Availability of daylight throughout the building	Points
50% of UA has a daylight factor >2%	100
50% of UA has a daylight factor >1,5%	75
50% of UA has a daylight factor >1%	50
50% of UA has a daylight factor <1%	0

2.7.2 Availability of daylight in regularly used work areas

All regularly used office workspaces and occupied areas must be provided with adequate daylight, the mean daylight factor in work areas must not drop below minimum requirements; furthermore, every workspace and occupied area must have a view to the outside. The evaluation, based on simulation procedures, starts with calculation of the daylight factor for openings in the shell construction. Based on this initial value, façade characteristics are defined. The sun shades/blinds are activated as soon as the façade gets direct sunlight. Finally, annual relative lighting percentage during standard office hours should be determined in accordance with the specific national/local life cycle energy modelling method.

2.7.2 Availability of daylight in regularly used work	Points
Annual relative lighting percentage > 80%	100
Annual relative lighting percentage between 60 and 80%	75
Annual relative lighting percentage between 45 and 60%	50
Annual relative lighting percentage < 45%	0

2.7.3 View to the outside

Providing personnel with a view to the outside is an important requirement because it is in the spirit of sustainable and user-oriented planning and is necessary for user satisfaction in constantly occupied areas. An unimpeded view to the outside is often limited or even obstructed by the use of blinds or shading. Therefore, an evaluation based on the view with closed blinds or sun shades has to be executed. The evaluation involves a simple assessment and documentation with photographs, manufacturers' specifications, or a sampling. The contours, colours, and brightness gradients of surrounding outside areas should be clearly recognizable by looking through.

2.7.3 View to the outside	Points
A view to the outside is still possible when sun shades are closed.	100
A view to the outside is still possible when sun shades are activated, by adjusting them (Cut-Off-position, sun tracking control)	75
A view to the outside is not possible anymore when sun shades are activated.	0

2.7.4 Preventing glare in daylight

The assessment of glare prevention in daylight includes the planned antiglare system, which may be the same as the sun-shade system. The antiglare system generally serves the purpose of reducing excessive contrast in luminance between the workplace and the window. Ideally, it consists of a system independent of the sun shade, which can be regulated individually and which can be adjusted such that daylighting conditions in the room can only be slightly reduced. Workstations with displays must be arranged such that the illuminating or illuminated surfaces do not cause glare and that reflections on the screen are prevented to the greatest extent possible. Windows must be equipped with a sufficiently adjustable shading mechanism which allows the intensity of the daylight reaching the workstation with display to be reduced.

2.7.4 Preventing glare in daylight	Points
Light-guiding system in combination with a glare protection system forcing direct light to fade	100
Presence of a glare protection system	75
No glare protection system	0

2.7.5 Preventing glare in artificial light

Preventing glare in artificial light should be achieved through compliance with EN 12464-1.

2.7.5 Preventing glare in artificial light	Points
Compliant	100
Not compliant	0

2.7.6 Light distribution in artificial lighting conditions

Illuminance and uniformity of artificial lighting should comply with the specifications according to EN 12464-1. Additionally, qualitative evaluations will be performed to enable increased acceptance in the workplace. Combined direct and indirect lighting should be preferred over purely direct lighting; higher acceptance can also be achieved by providing individual desk lighting. A combination of general and individual lighting has the further advantage of flexibility when workstations are rearranged.

2.7.6 Light distribution in artificial lighting conditions	Points
Combination of direct and indirect lighting with individual desk control.	100
Combination of direct and indirect lighting	75
Compliance with standards	50
No individual lighting	0

2.7.7 Colour rendering

Colour rendering and light colour in daylight and artificial light conditions influences user perception and acceptance. Generally, a light colour resembling daylight is seen as positive and increases acceptance. The evaluation is based on the colour rendering index for artificial light and daylight. For artificial light, it includes all artificial lighting systems in all permanently occupied areas. For daylight, it concerns all glazing, shading and glare protections in all permanently occupied areas.

Applicable rules dictate a colour rendering index of Ra 80 (limit value) for artificial lighting in regularly used areas. Improvements, such as considering a colour rendering index greater than Ra 90 (target value) should receive a better rating.

2.7.7 Colour rendering	Points
Colour rendering index for artificial light and day light > 90	100
Colour rendering index for artificial light and day light between 80 and 90	50
Colour rendering index for artificial light and day light < 80	0

2.7.8 Blinking and flashing lights

The presence of blinking, flashing and coloured lighting that may cause irritation, loss of concentration, should be assessed. For this indicator the selected basis of design chosen shall be briefly stated together with reference to supporting documents.

2.7.8. Blinking and flashing lights	Points
No blinking and flashing lights on the buildings	100
Existence of blinking and flashing lights on the building	0

Weights of Sub-indicators

Indicator 2.7	Weight
Sub-indicator 2.7.1 Availability of daylight throughout the building	4
Sub-indicator 2.7.2 Availability of daylight in regularly used work areas	4
Sub-indicator 2.7.3 View to the outside	3
Sub-indicator 2.7.4 Preventing glare in daylight	3
Sub-indicator 2.7.5 Preventing glare in artificial light	3
Sub-indicator 2.7.6 Light distribution in artificial lighting conditions	3
Sub-indicator 2.7.7 Colour rendering	3
Sub-indicator 2.7.8 Blinking and flashing lights	2

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

Sub-indicator 2.7.1 Availability of daylight throughout the building

Results of a daylight simulation provided by a qualified planner for the essential areas of the building, taking into account room geometry, shading, window placement, light transmission, and reflection characteristics of internal surfaces.

Sub-indicator 2.7.2 Availability of daylight in regularly used work areas

Calculations performed by a qualified planner should be based on simulation processes for standard office hours taking into account the building shell opening and façade characteristics.

Sub-indicator 2.7.3 View to the outside

Evidence of line of sight for permanently used office workspaces and occupied areas and evidence of view to the outside with closed blinds or sun shades, the latter in form of demonstrative photographs or manufacturer specifications.

Sub-indicator 2.7.4 Preventing glare in daylight

Information on the type, quantity, and installed location on the building for light reflection, sun shade and/or anti-glare systems, including the names of the manufacturers and products.

Sub-indicator 2.7.5 Preventing glare in artificial light

Evidence of glare limitation in accordance with EN 12464-1.

Sub-indicator 2.7.6 Light distribution in artificial lighting conditions

Information pertaining to direct and indirect lighting and individual desk lighting. Information on manufacturers and products for the office workstation lighting.

Sub-indicator 2.7.7 Colour rendering

List of the products used with manufacturers' colour rendering specifications for artificial light, glazing, and sun shades/antiglare systems.

Sub-indicator 2.7.8 Blinking and flashing lights

List of the lighting fixtures installed with manufacturers' specification
After construction, pictures of installed fixtures

5. Relation to other Indicators

None

6. Resources

DGNB 22 Visual Comfort

BNB 3.1.5 Visual Comfort

prEN 16309 Sustainability of construction works — Assessment of social performance of buildings — Methods

7. Attachments

Daylight Factor:

The daylight factor is the ratio of internal light level to external light level and is defined as follows:

$$DF = (E_i / E_o) \times 100\%$$

where, E_i = illuminance due to daylight at a point on the indoors working plane, E_o = simultaneous outdoor illuminance on a horizontal plane from an unobstructed hemisphere of overcast sky.
(http://en.wikipedia.org/wiki/Daylight_factor)

Indicator 2.8 **Operation Comfort**

(adapted from DGNB/BNB)

Core Indicator

1. Objective

Operation comfort is an indicator describing the possibilities of the user to control or have an impact on the parameters of the indoor environment. It includes the following factors that affect and determine the living environment:

- ventilation,
- shading and glare,
- temperatures during the heating season,
- temperatures outside the heating season,
- control of daylight and artificial light,
- ease of operation

The goal is to assure the indoor environment quality at the workplace by allowing individual/zonal control (in the sectors mentioned above), and to avoid negative impacts on the user's comfort.

However, the individual control aims at meeting individual comfort needs of the users with consideration of the general building performance characteristics targeted by zonal control with automatic steering.

2. Assessment Methodology

This indicator is qualitative. Scores for each listed sub-indicator are aggregated; maximum number of points (highest rating) is 100. The maximum points can be reached when all criteria have established the highest level possible, meaning that the operation comfort was taken into account comprehensively.

The following sub-indicators will be assessed:

2.8.1 Ventilation

2.8.2 Shading

2.8.3 Glare prevention

2.8.4 Temperatures during the heating period

2.8.5 Temperatures outside the heating period

2.8.6 Regulation of daylight and artificial light

2.8.7 Ease of operation

3. Calculation and Rating

The important point to consider is that here we are not dealing with indoor comfort features expressed numerically (e.g. number of air changes per hour, and similar), but with the provision of control over them. Operation comfort as comprised in this indicator thus describes more “functional” aspects of control over indoor environment: is such a control enabled and how detailed it is.

2.8.1 Ventilation

Table 1: 2.8.1 Ventilation

2.8.1 Ventilation	Points
Room air exchange controllable (max. 3 persons)	100
Zone air exchange controllable (more than 3 persons)	50
No air exchange control	0

Note: A “**room**” here means an enclosed space which may or may not be physically completely divided from other spaces. In practice this can for example represent an individual work area (desk) or an area where max 3 people work considerably close to each other. A “**zone**” is again an enclosed space which may or may not be physically completely divided from other spaces. It can be a larger room (for > 3 people), a part of an open plan office, an open plan office as a whole, and similar.

2.8.2 Shading

Table 2: 2.8.2 Shading

2.8.2 Shading	Points
Shading control for a room (max. 3 persons)	100
Shading control for a zone (more than 3 persons)	50
No shading control	0

2.8.3 Glare prevention

Table 3: 2.8.3 Glare prevention

2.8.3 Glare prevention	Points
Glare prevention control for a room (max. 3 persons)	100
Glare prevention control for a zone (more than 3 persons)	50
No glare prevention control	0

2.8.4 Temperatures during the heating period

Table 4: 2.8.4 Temperatures during the heating period

2.8.4 Temperatures during the heating period	Points
Room temperature control (max. 3 persons)	100
Zone temperature control (more than 3 persons)	50
No temperature control	0

2.8.5 Temperatures outside the heating period

Table 5: 2.8.5 Temperatures outside the heating period

2.8.5 Temperatures outside the heating period	Points
Room temperature control (max. 3 persons)	100
Zone temperature control (more than 3 persons)	50
No temperature control	0

2.8.6 Regulation of daylight and artificial light

Table 6: 2.8.6 Regulation of daylight and artificial light

2.8.6 Regulation of daylight and artificial light	Points
Light level control for a room (max. 3 persons)	100
Light level control for a zone (more than 3 persons)	50
No control on daylight nor artificial light	0

2.8.7 Ease of operation

Table 7: 2.8.7 Ease of operation

2.8.7 Ease of operation	Points
Central display and management of operation comfort indicators/functions: ventilation, shading, glare, temperatures, lighting, as an overall solution; for example use of web browser to operate with indicators	100
Central display and management of operation comfort indicators/functions: ventilation, temperatures, lighting, as an overall solution; for example use of web browser to operate with indicators	75
Separate/local management (i.e. switch) and display of operation comfort indicators/functions: ventilation, temperatures	50
Separate/local management (i.e. switch) without display of operation comfort indicators/functions: ventilation, shading, glare, temperatures, lighting	0

Weight of sub-indicators

Indicator 2.8	Weight
Sub-indicator 2.8.1 Ventilation	3
Sub-indicator 2.8.2 Shading	3
Sub-indicator 2.8.3 Glare prevention	3
Sub-indicator 2.8.4 Temperatures during the heating period	3
Sub-indicator 2.8.5 Temperatures outside the heating period	3
Sub-indicator 2.8.6 Regulation of daylight and artificial light	3
Sub-indicator 2.8.7 Ease of operation	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

2.8.1 Ventilation

Excerpt from the building's ventilation concept

2.8.2 Shading

Description of shading system including products and manufacturers, with information on type and extent of control possibilities

2.8.3 Glare prevention

Description of glare protection system including products and manufacturers, with information on type and extent of control possibilities

2.8.4 Temperatures during the heating period

Information on control over indoor temperatures during the heating period in each room or zone

2.8.5 Temperatures outside the heating period

Demonstration of possibility of control over ventilation and/or cooling via windows or technical systems in each room or zone

2.8.6 Regulation of daylight and artificial light

Information on control over daylight and/or artificial light in each room or zone; product data with functional descriptions

2.8.7 User friendliness

Information on the operating and display functions in each room or zone for the available systems for ventilation, shading, glare protection, temperature, and lighting

5. Relation to other Indicators

2.3 Thermal Comfort

2.4 Indoor Air Quality

2.7 Visual Comfort

6. Resources

DGNB - 23 User Control Possibilities

BNB 2011 - 316 Influence of the user

7. Attachments

None

Indicator 2.9 Service Quality

(adapted from DGNB)

1. Objective

Service quality is a measure of how well the service level delivered in a building matches user expectations and provides functional quality in everyday processes of an office building.

2. Assessment Methodology

A number of issues affecting the service quality of the building will be evaluated in order to examine the availability and quantity of services in it as well as the connected outdoor areas. Services addressed by this indicator are related to recreational facilities, restaurant/cafeteria facilities, sport facilities and other amenities potentially present in office buildings. Services with regard to technology equipment (HVAC, lighting etc) are reflected by other OH indicators.

Another issue which is important as regards the building services is the utilization of building parts and components, often designed and constructed for other reasons, in order to integrate a number of services. This mainly refers to the exploitation of outdoor areas connected to the building (roof areas, balconies, terraces, atria, outdoor seating areas, etc.) for the implementation of services promoting social activities and enhancing users welfare.

The following sub-indicators will be assessed:

2.9.1 Availability of services in the building or in direct proximity to the building

2.9.2 Service integration in building connected outdoor areas

3. Calculation and Rating

2.9.1 Availability of services in the building, or in direct proximity to the building

The evaluation is based on the existence of the following services inside the building:

- **Recreation or relaxation areas:** including sofa, bed, games, dining table, etc.
- **Restaurant or cafeteria, kitchenette** with basic amenities for storing & warming food, beverages
- **Sport centre:** including fitness, wellness, sauna, shower rooms, massage
- **Elderly care / Child care**
- **Medical facilities and personnel:** sick room with a bed and first aid facilities is also accepted.
- **Concierge service:** building-integrated Flower delivery, Drying place, Pet care
- **Post / Courier services**

Restaurant and sport centre within **100 m** from the building's entrance can also be taken into account provided that they offer special advantages for the building's users.

2.9.1 Availability of services in the building	Points
At least 4 of the 7 services are present	100
3 of the 7 services are present	75
2 of the 7 services are present	30
1 of the 7 services is present	10
None of the services is present	0

2.9.2 Service integration in building connected outdoor areas

The outdoor areas design is proved with reference to planning documents and in case of an existing building it can be controlled during a site audit.

Outdoor areas connected to the building include areas around the ground floor, roof gardens, outdoor seating areas and terraces.

They are evaluated based on the existence of the following requirements:

- **areas for sitting and/or lying down**
- **flexible sheltering roofs**
- **rain/snow protection**
- **shading**
- **protection against wind from the prevailing wind direction**

2.9.2 Service integration in building connected outdoor areas	Points
At least 4 of the 5 requirements are fulfilled in the outdoor area	100
3 of the 5 requirements are fulfilled in the outdoor area	75
2 of the 5 requirements are fulfilled in the outdoor area	50
1 of the 5 requirements is fulfilled in the outdoor area	25
None of the requirements is fulfilled in the outdoor area	0

Weights of Sub-indicators

Indicator 2.9	Weight
Sub-indicator 2.9.1 Availability of services in the building, or in direct proximity to the building	4
Sub-indicator 2.9.2 Service integration in building connected outdoor areas	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Signed statement verifying the existing services, or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

2.9.1 Availability of services in the building

Drawings with details on the location, space and furniture arrangement of the existing services.

Narratives with details on the services included

2.9.2 Service integration in building connected outdoor areas

Plan of the building connected outdoor areas

Information on the type and number of outdoor features, including, but not limited to, the following:

- areas for sitting and/or lying down,
- water features,
- flexible sheltering roofs,
- rain/snow protection,
- shading,
- protection against wind from the prevailing wind direction.

5. Relation to other Indicators

Indicator 6.5 Vicinity to amenities

6. Resources

Architect's Data, 3rd edition, Ernst and Peter Neufert
DGNB - 24 Exterior quality as affected by the building

7. Attachment

None

Indicator 2.11 Public Accessibility

(adapted from DGNB/BNB)

1. Objective

The public accessibility of a building promotes the communal life. Various usage offerings stimulate the quarter and increase the communication. Also the acceptance of the building and the feel of safety will be enhanced.

Not all office buildings can be publicly accessible. It depends on the occupiers and the location of a building if public accessibility is necessary or relevant.

This indicator is applicable only to the buildings that are required by a function to provide public access.

2. Assessment Methodology

This indicator is evaluating, how the building and the open space is integrated in the community.

The following sub-indicators will be assessed:

- 2.11.1. General public access to the building
- 2.11.2. External facilities open to the public
- 2.11.3. Interior facilities, such as libraries or cafeteria, open to the public
- 2.11.4. Possibility of third party to rent rooms in the building
- 2.11.5. Variety of uses for public areas

3. Calculation and Rating

2.11.1. General public access to the building

2.11.1. General public access to the building	Points
There is an intention to provide an access to the building for public	100
There is no plan for public access to the building	0

2.11.2. Outdoor facilities open to the public

2.11.2. External facilities open to the public	Points
The outdoor facilities surrounding the building are accessible to the public	100
The outdoor facilities surrounding the building are not accessible to the public	0

2.11.3. Interior facilities, such as libraries or cafeteria, open to the public

2.11.3. Interior facilities, such as libraries or cafeteria, open to the public	Points
The building offers facilities open to the public	100
The building does not offer facilities open to the public	0

2.11.4. Possibility of third party to rent rooms in the building

2.11.4. Possibility of third party to rent rooms in the building	Points
Third party can rent rooms in the building	100
Third party cannot rent rooms in the building	0

2.11.5. Variety of uses for public areas

2.11.5. Variety of uses for public areas	Points
The rentable areas are available for a variety of uses that make them attractive for as many interested parties as possible (e.g: conferences, services, retail, etc.)	100
The rentable areas are not available for a variety of uses	0

Weights of Sub-indicators

Indicator 2.11	Weight
Sub-indicator 2.11.1. General public access to the building	2
Sub-indicator 2.11.2. External facilities open to the public	2
Sub-indicator 2.11.3. Interior facilities, such as libraries or cafeteria, open to the public	2
Sub-indicator 2.11.4. Possibility of third party to rent rooms in the building	2
Sub-indicator 2.11.5. Variety of uses for public areas	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

2.11.1. General public access to the building

Demonstration of free entrance to the building and its reception area

2.11.2. External facilities open to the public

Information on accessibility of outdoor facilities

Excerpts from illustrated and written specifications for the outdoor facilities that include the type and extent of public use. Plans must also be included for resolving possible conflicts between internal and public use (boundaries, signage, and security in the building and its facilities).

2.11.3. Interior facilities, such as libraries or cafeteria, open to the public

Design information on publicly accessible facilities

Excerpts from illustrated and written specifications for publically accessible facilities in the building that clearly include the following information:

- Type and location of facility/facilities

- Type of access

- Boundaries, signage, and security in the building and facilities

- How are conflicts between internal and public use resolved?

Information on the facilities that can be used by the public:

- Accessibility from outside

- Signs in the building

- Time period in which the building is accessible to the public

- Facilities' opening hours

2.11.4. Possibility of third party to rent rooms in the building

Demonstration of rooms that can be rented to third parties

2.11.5. Variety of uses for public areas

Demonstration of variety of uses

Description of various units of use and their attractiveness for multiple interested parties

5. Relation to other Indicators

None

6. Resources

1. DGNB International

Criterion 29: Public Access

2. BNB: Bewertungssystem Nachhaltiges Bauen (Germany)

Criterion 3.2.4: Zugänglichkeit

www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_324.pdf

7. Attachments

None

Indicator 2.12 Noise from Building and Site

(adapted from BREEAM)

1. Objective

This indicator aims at calculating the likelihood of noise from the building and site affecting nearby noise-sensitive buildings.

This supports the European Commission objective to adopt action plans, based upon noise-mapping results, with a view to preventing and reducing environmental noise where necessary and particularly where exposure levels can induce harmful effects on human health and to preserving environmental noise quality where it is good¹.

2. Assessment Methodology

A noise impact assessment in compliance with ISO 1996 should be carried out and the following noise levels measured/determined:

- Existing background noise levels at the nearest or most exposed noise-sensitive development to the proposed development; or at a location where background conditions can be argued to be similar.
- The rating noise level resulting from the proposed noise-source. This can be based upon reference to similar installations or sites, or determined by calculation.

The noise impact assessment must be carried out by a *suitably qualified acoustic consultant* holding a recognised acoustic qualification and membership of an appropriate professional body (see relevant definitions in the attachments section).

The following sub-indicator will be assessed:

2.12.1 Noise from Building and Site

¹ DIRECTIVE 2002/49/EC

3. Calculation and Rating

2.12 Noise from building and site	Points
The specific noise level of the noise sources from the site/building is less than +5dB during the day (0700hrs to 2200hrs) and less than +3dB at night (2200hrs to 0700hrs) compared to the background noise level OR There are or will be no <i>noise-sensitive areas or buildings</i> in the locality of the assessed building	100
A noise impact assessment in compliance with ISO 1996 was carried and the specific noise level is lower than the maximum noise level accepted by national regulations.	10
A noise impact assessment in compliance with ISO 1996 was carried and the rating level of the noise sources from the site/building is greater than the background noise level	5
There was no noise impact assessment carried.	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Site plan highlighting or Assessor's building/site inspection report and photographic evidence confirming:
 - All existing and proposed noise-sensitive buildings local to, and within, the site boundary
 - Proposed sources of noise from the new development
 - Distance (m) from these buildings to the assessed development.
2. A copy of the acoustician's report.
A copy of the specification clause requiring:
 - A noise assessment in compliance with ISO 1996 by a suitably qualified acoustician or a formal letter from the client or design team confirming that they will appoint an acoustician to carry out a noise assessment in compliance with ISO 1996.

5. Relation to other Indicators

- 2.6 Acoustic comfort
- 4.5 Noise protection

6. Resources

ISO1996: Acoustics -- Description, measurement and assessment of environmental noise
BREEAM Europe Commercial 2009: Pol 8 Noise Attenuation

7. Attachments

Relevant definitions

Ambient noise: totally encompassing sound in a given situation and given time usually composed of sounds from sources near and far.

Background noise level: the A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval.

Noise sensitive area: landscapes or buildings where the occupiers are likely to be sensitive to noise created by the new plant installed in the assessed building, including:

- Residential areas
- Hospitals, health centres, care homes, doctor's surgeries etc.
- Schools, colleges and other teaching establishments.
- Libraries
- Places of worship
- Wildlife areas, historic landscapes, parks and gardens.
- Located in an area of Outstanding natural beauty or near a Site of Special Scientific Interest (SSSI).
- Any other development that can be considered noise sensitive.

Rating noise level: the specific noise level plus any adjustments for characteristics features of the noise (typically 5dB).

Residual noise: the ambient noise remaining at a given position in a given situation when the specific noise source is suppressed to a degree such that it does not contribute to the ambient noise.

Specific noise level: the equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval.

Specific noise source: the noise source under investigation for assessing the likelihood of complaints.

Suitably qualified acoustician: an individual achieving all the following items can be considered to be "suitably qualified" for the purposes of an OPEN HOUSE assessment:

- Holds a degree, PhD or equivalent qualification in acoustics/sound testing.
- Has a minimum of three years relevant experience (within the last five years). Such experience must clearly demonstrate a practical understanding of factors affecting acoustics in relation to construction and the built environment; including, acting in an advisory capacity to provide recommendations for suitable acoustic performance levels and mitigation measures.

Indicator 2.16 **Bicycle Amenities**

(adapted from BREEAM, DGNB/BNB)

Core Indicator

1. Objective

In order to contribute to the development of an environmentally sound and energy-efficient mobility, people should be motivated and encouraged to modify their transportation habits by constructing new or improving existing infrastructure for bicycles, such as bike parking in the public space inside or outside of a building. Cycling is the most low-carbon and the least occupying space mode of transportation other than walking, thus it should be particularly encouraged.

This supports the European Commission objective to reduce both the CO₂ emissions, the noise levels and to maintain good ambient air quality level. Indeed, the EC sees as a priority the adoption of measures which would promote a return to the bicycle as a mode of urban transport¹.

2. Assessment Methodology

The bicycle comfort is evaluated by considering availability of bicycle parking spaces for building users, its distance in respect to the main entrance of a building, the existence of facilities for employees such as changing rooms and showers.

The following sub-indicators will be assessed:

2.16.1 Number of bicycle parking spaces available for building users

2.16.2 Distance to bicycle parking system from a main building entrance

2.16.3 Existence of facilities for cyclists comfort and security

¹ EUROPEAN COMMISSION DG XI — Environment, Nuclear Safety and Civil Protection- Cycling: the way ahead for towns and cities

3. Calculation and Rating

2.16.1 Number of bicycle parking spaces available for building users

Use the actual number of building users in case of existing buildings in use or estimated planned number of building users in case of buildings in phase of design or construction or not yet in use for other reasons.

2.16.1 Number of bicycle parking spaces available for building users	Points
> 10% of the number of building users	100
> 7% of the number of building users	75
> 5% of the number of building users	50
> 3% of the number of building users	10
< 3% of the number of building users	0

2.16.2 Distance to bicycle parking system from a main building entrance

2.16.2 Distance to bicycle parking system from a main building entrance	Points
< 15 m	100
< 30 m	75
< 50 m	50
< 70 m	25
< 100 m	10
> 100 m	0

2.16.3 Existence of facilities for bicycle comfort and security

Facilities or building-specific infrastructure for bicycles and cyclists:

- 1) showers
 - 2) changing rooms
 - 3) protection against theft (locked storage possibility, bicycle rack, etc.)
 - 4) protection against weather
- should be available and appropriate for the building's employees.

2.16.3 Existence of facilities for bicycle comfort and security	Points
4 kinds of facility	100
3 kinds of facility	75
2 kinds of facility	50
1 kind of facility	25
0 kind of facility	0

Weights of Sub-indicators

Indicator 2.16	Weight
Sub-indicator 2.16.1 Number of bicycle parking spaces available for building users	4
Sub-indicator 2.16.2 Distance to bicycle parking system from a main building entrance	3
Sub-indicator 2.16.3 Existence of facilities for bicycle comfort and security	3

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

2.16.1 Number of bicycle parking spaces available for building users

Number of building users

Number of bicycle parking spaces

2.16.2 Distance to bicycle parking system from a main building entrance

Floor plan of entrance level that indicates the bicycle parking spaces' location and distance from the main entrance with measurements.

2.16.3 Existence of facilities for bicycle comfort and security

Information on the facilities for bicycles: protection against theft and weather

Information on the service facilities for cyclists: number of showers and changing rooms.

After Construction, Assessor's building/site inspection and photographic evidence confirming the installation of the compliant facilities.

5. Relation to other Indicators

Indicator 6.3: Options for Transportation

6. Resources

1. DGNB International Criterion 30: Bicycle Comfort
2. LENSE Criterion Bicycle Parking System
3. BREEAM Criterion Tra 3 - Alternative modes of transport
4. LEED Criterion Credit 4.2: Alternative Transportation – Bicycle Storage and Changing Rooms
5. San Francisco Department of Public Health Bicycle Environmental Quality Index (BEQI)

7. Attachments

Relevant definition:

Building users: in an office building, building users include:

- Full-time staff
- Part-time staff
- Peak Transients (visitors, customers, etc.)

Indicator 2.17 **Material Sourcing** (adapted from DGNB/BNB)

Core Indicator

1. Objective

The objective is to recognize and encourage the sourcing of environmentally and socially responsible products. At present the only internationally recognized schemes are for wood products and therefore this indicator is limited to the sourcing of timber for wooden building products and components. It is the expectation that the scope of this indicator will expand to include other material classes beyond timber.

The indicator aims at encouraging the specification of timber from sustainably managed sources. It supports the European Commission goal to halt the trade in illegally harvested timber and products made from such timber in the EU and to contribute to stopping deforestation and forest degradation and related carbon emissions and biodiversity loss globally while promoting sustainable economic growth, sustainable human development and respect for indigenous and local people¹. It also supports the Roadmap to a Resource Efficient Europe that encourages developing incentives to reward resource efficient buildings, and to promote the sustainable use of wood in construction.²

2. Assessment Methodology

For all timber products used, the supplier must be able to certify the “controlled, sustainable cultivation of the forest of origin”.

Only certificates that are issued by the Forest Stewardship Council (FSC) or certification authorities that are accredited by the Program for Endorsement of Forest Certification Schemes (PEFC) are accepted. The certification criteria of sustainable forestry established by the FSC have international consensus. For the verifiability, the supplier has to declare both the country of origin and the wood species. An FSC/PEFC certificate is only valid in combination with the appropriate “chain-of-custody” certificate.

A minimum of 50% (based on cost) of wooden materials and products certified in accordance with FSC/PEFC principles and criteria should be used for wood building components. These components include, at a minimum, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes. Only materials permanently installed in the project should be included. Wood products purchased for temporary use on the project (e.g., formwork, bracing, scaffolding, sidewalk protection, and guard rails) may be included in the calculation at the project team’s discretion. If any such materials are included, all such materials must be included in the calculation.

If such materials are purchased for use on multiple projects, the applicant may include these materials for each project, at its discretion.

A project goal for certified wood products has to be established and suppliers that can achieve this goal have to be identified. During construction, it should be ensured that the certified wood products are installed and the total percentage of certified wood products installed has to be quantified.

¹ European Parliament legislative resolution of 22 April 2009 on the proposal for a regulation of the European Parliament and of the Council laying down the obligations of operators who place timber and timber products on the market (COM(2008)0644 – C6-0373/2008 – 2008/0198(COD))

² European Commission Roadmap to a Resource Efficient Europe

The following sub-indicator will be assessed:

2.17.1 Material Sourcing: wood

2.17.2 Material Sourcing: other materials [NOT ASSESSED]

2.17.3 Social aspects of Material Sourcing [NOT ASSESSED]

3. Calculation and Rating

2.17.1 Material Sourcing: wood

If no wood products are used in the building then this sub-indicator shall not be assessed.

The assessment is conducted quantitatively using three different quality levels.

Quality level 1: It can be verified that documents from the planning stage and the call for tenders underlines the importance of ensuring that all wood products procured emanate from sustainably managed forests. FSC/PEFC certificates and corresponding CoC (Chain of Custody) certificates are at this level only required for wood products from tropical and subtropical timbers.

Quality level 2: At least 50% of all timber and wood products are produced by sustainable forestry. This is verified by an FSC/PEFC certificate and a corresponding CoC certificate. Quantification can be determined by a quantity estimate based on the component catalogue for the life cycle assessment (see indicator 3.1) or for each trade based on the calls for tenders.

Quality level 3: At least 80% of all timber and wood products are produced by sustainable forestry. This is verified by an FSC/PEFC certificate and a corresponding CoC certificate. Quantification can be determined by a quantity estimate based on the component catalogue for the life cycle assessment (see indicator 3.1) or for each trade based on the calls for tenders.

2.17.1 Material Sourcing: wood	Points
Quality level 3 is achieved	100
Quality level 2 is achieved	50
Quality level 1 is achieved	10
The Quality level 1 was not achieved.	0

2.17.2 Material Sourcing: other materials [NOT ASSESSED]

2.17.3 Social aspects of Material Sourcing [NOT ASSESSED]

Responsible sourcing of materials is an objective applicable to all material classes. This is particularly pressing when dealing with products supplied from emerging economies or where there are poor legal or regulatory controls in the supply chain. Responsible sourcing has a scope that should cover the full supply chain and management thereof, including material extraction, manufacture and processing, as well as product stewardship throughout the life cycle. The objectives it addresses should respond to social, economic and environmental principles. As the maturity of this agenda develops it is the expectation that the scope of this indicator will expand to include other material classes beyond timber.

Standardized European assessment methods for the topic of responsible materials sourcing are currently being discussed as part of the work of CEN/TC/350.

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Verification of use and certification for timber and wood products.

Verification must be provided for all timber and wood products used in non-negligible amounts, exemplified by products in the following (not exhaustive) list:

- frame elements
- roof beams, trusses, joists, rafters etc.
- cladding
- windows and window shutters
- doors
- flooring
- wall panelling
- products for construction site equipment and safety

Certification can be verified with the following documents:

- the certificate, which was verifiable issued by a certification authority accredited by the Forest Stewardship Council (FSC) or the Programme for Endorsement of Forest Certification Schemes (PEFC)
- the corresponding FSC or PEFC “chain of custody” certificate of trade

2. Mathematical verification of the proportion of FSC or PEFC-certified timber, timber products or timber materials as a percentage of total timber, timber products or timber materials (for example, windows, doors, floors, walls and stairs). Intermediate and final results must be presented separately and clearly. Information must also be given on building elements that include timber products on wood-based materials and the respective amounts.

5. Relation to other Indicators

Indicator 3.1 Building-related Life Cycle Costs (LCC)

6. Resources

DGNB 2009: 8 Sustainable use of resources/Wood

BNB 2011: 117 Sustainable logging/Wood

Forest Stewardship Council (FSC): <http://www.fsc.org/107.html>

Program for Endorsement of Forest Certification Schemes (PEFC): <http://www.pefc.org/>

7. Attachments

None

OPEN HOUSE

ASSESSMENT GUIDELINE

Economic Quality

- 3.1 **Building-related Life Cycle Costs (LCC)**
- 3.2 Value Stability

Note: Core indicator is in bold

Indicator 3.1 **Building related Life Cycle Costs (LCC)**

(adapted from EN 15459, EN ISO 15686-5)

Core Indicator

1. Objective

Life Cycle costing approach is an economic method to assist in the decision making process and to identify cost effectiveness of different design options and sensitivity of the cost resulting of the prices evolutions for products, services, energy and human operation.

This indicator supports the European Commission objective to increase the consideration for life-time costs of buildings rather than just the initial costs, including construction and demolition waste.¹

2. Assessment Methodology

The calculation of Life Cycle Costs (LCC) are presented in different standards

EN ISO 15686- 5 introduces main principles and list of costs/benefits related to the buildings

EN 15459 describes more precisely the Global costing for the construction and operation stages. This standard provides a calculation method for the economics of heating systems and other systems that are involved in the energy use of the building (building envelope, ventilation, etc.) . This standard applies to all types of buildings.

Assessment shall be carried out at any time of the building life cycle (form inception to end of life)

Note: EN 15643-3 presents the framework for development of LCC methodology applicable to buildings

The following sub-indicators will be assessed:

3.1.1 Life cycle costs

3.1.2 Whole Life cycle cost including externalities ²(NOT ASSESSED in this version)

¹ Roadmap to a Resource Efficient Europe

² For whole life costs, the methodology to calculated externalities is not yet fully approved for all items (e.g. use of local manpower, environmental costs, ...)

3. Calculation and Rating

3.1.1 Life cycle costs

Life cycle costs are presented from the point of view of the building owner.

The life cycle costs indicators are based on the modular approach (see Figure 2) from inception to the demolition of the building (Module A, B and C).

Note 1: module D 'Benefits and loads beyond the system boundary' (here, after demolition or change of use after refurbishment) is not considered for the economic aspects of the building.

Note 2: same modules are used for the environmental characteristics of the building products (EN 15804).

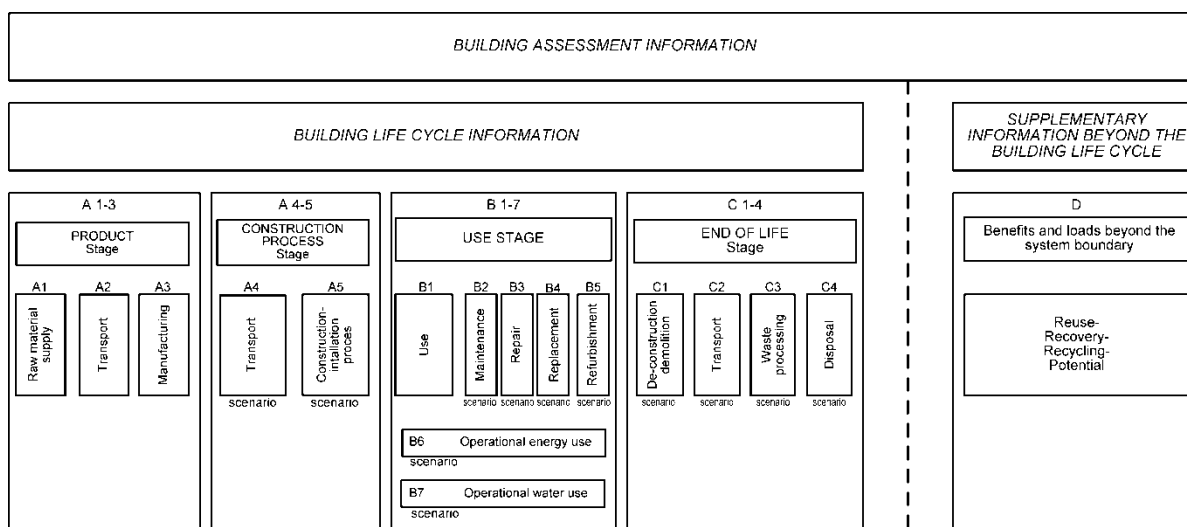


Figure 1 – Life Cycle of the building
(from EN 15978 – Environmental assessment of buildings – Calculation method)

For practical reasons the modular structure as developed in the calculation Excel sheet used has been adapted (Figure 3) for the different cost categories.

Building life cycle information		
Construction stage	Use Stage	End of life Stage
Design	Maintenance	Demolition
Land acquisition	Operation	Disposal
Site works	Repair	
Connection to the networks (energy, ICT, water)		
Building products acquisition and construction		
Temporary works		
Energy for construction	Energy	
Water for construction	Water	

Figure 2 – Costs categories

Construction stage

The definition and quantification of the products used for the construction are aligned with these defined for the calculation of the environmental indicators as presented in the OPEN HOUSE methodology and in the European standards developed by CEN TC 350 (EN 15978:2012; Sustainability in construction works - Environmental performance of buildings – Calculation method and EN 15643-4: 2011 Sustainability in construction works – Assessment of buildings – Part 4 Framework for the assessment of economic performance).

Use stage

For consistency with the Directive on Energy performance of buildings the incomes due to energy sales are introduced (as a negative cost).

Costs for maintenance and cleaning activities shall be aligned with the (scheduled or existing) management system of the building (or available contracts).

End of life stage

The costs for disposal are introduced in the calculation as a percentage of the buildings products costs (varying from 2% to 10%, depending on the type of process used for the demolition and the type of construction elements).

Lowest rate are used for light structure (wood) and high potential for disassembly and recyclability/reuse of material, whereas higher rate are used for concrete structure in urban area or when hazardous substances (asbestos, etc.) need specific care before disposal.

Data collection and quantification

For new buildings the quantification of the building (quantity of products or services) is aligned to the documents issued during the design stage (basic design and final design) and shall be consistent with information used for LCA calculation.

For existing building the costs arising from the point of time when the assessment is performed shall be consistent with the management of the building for maintenance and repair.

Principles of economic calculation using net present value factors

The costs that occur during the year 'i' of the life cycle of the building is weighting using the net present value factor NPV(i) with R representing the real interest market rate .

$$NPV (i) = \left(\frac{1}{1+R_i} \right)^i$$

The net present value factor is used to adapt the future costs to the moment when the economic assessment is performed.

Future costs are also dependant of the inflation rates that could be specific for human operation, products, energy and water.

Data are organised in different blocks financial data and types of costs occurring at the different period of time of the building life cycle.

Financial data

- inflation rate
- market interest rate
- discount rate which is introduced as a definite value to compare the value of money at different period
- net present value factor which is customised by building owner and represents its own choice to place investment in the defined building or in an alternative investment on financial market. Present value factor is always superior to market interest rate

Life Cycle Cost (C_G) represents the sum of present value of all costs (with reference to starting year). At the end of the calculation the deconstruction cost or the residual value of the components should be taken in account to calculate final costs.

Calculation may be run regarding any component j or considering for any year “i” the annual cost added to global investment. Formula (1) and table 1 explains the calculation method for global costs

$$C_G = C_I + \sum_j C_f(j) - \sum V_f(j) + \sum_{i=1}^T C_{a(i)} * \left(\frac{1}{1+R_i} \right)^i \quad (1)$$

$$\text{and } C_{a(i)} = C_I * (1+a)^i$$

C _G	Life Cycle Cost
C _i	Investment cost of component (or system j)
C _{f(i)}	Final costs for component (or system j)
V _{f(i)}	Final value of component j
C _{a(i)}	Annual costs on year I
a	Inflation rate for products, human activities or energy
$\left(\frac{1}{1+R_i} \right)^i$	Present value factor or actuating value with R _i as real interest rate of the year I

Table 1

Presentation of results

Results are presented in two formats:

Option 1- Value of the Life Cycle Costs for the period of calculation [€]

Option 2- Value per year and per unit related to the functional equivalent of the building [€/annum.m²]

The option 2 for the presentation of results illustrates the average yearly effort for construction, operation and demolition of the building.

For respect of confidential information the values can be harmonized using value of 100 for the initial construction costs (investment costs).

Figure 4 illustrates the presentation of the results according to option 2 and using the EXCEL tool provided with the OPEN HOUSE methodology

The results are issued from a concrete structured building (final energy used: 19 kWh/m².a).

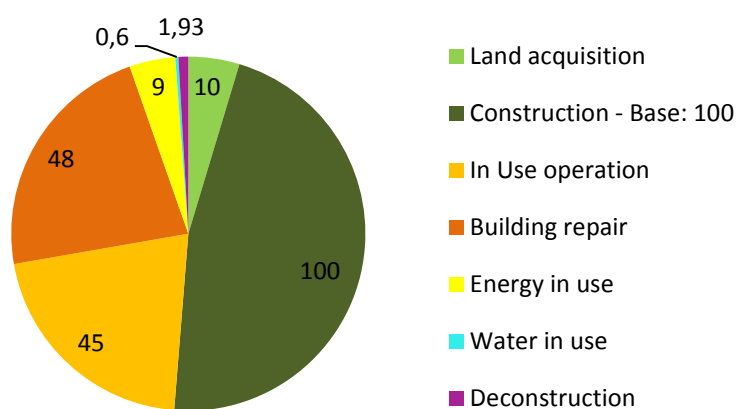


Figure 3 – Example of the cost repartition for a low energy office building

The choice for presentation was made accordingly to different modules describing the life cycle of the building (construction, in-use, end of life). For the in use stage the information has been separated for 'cleaning/maintenance' which are mainly influenced by human costs, 'repair' which is linked to the lifetime of products and 'energy and water use'.

Evaluation of results

The evaluation of the sub-indicator is based on three different requirements:

- a. Calculation completed for different life cycle stages (70 points)
- b. Adaptation of the service life of products to the assessed building (15 points)
- c. Type of data used for the assessment (15 points)

a. Calculation completed for different life cycle stages (70 points)

Performing the calculations for different life cycle stages attributes different amount of points as mentioned here:

Stage 1 Material and construction stage	30 points
Stage 2a In use operational costs	5 points
Stage 2b In use energy costs	20 points
Stage 2c In use water costs	10 points
Stage 3 Demolition costs	5 points

3.1.1.a Calculation completed for different life cycle stages	Points
Score achieved depending on the stages for which the calculation has been completed	0-70

b. Adaptation of the service life of products to the assessed building (15 points)

The evaluation is based on the fulfilment of the 5 following requirements

- Choice of products
- Maintenance characteristics
- Quality of construction
- Adaptation to indoor/outdoor conditions
- Users operation (training, ...)

3.1.1.b Adaptation of the service life of products to the assessed building	Points
All of five requirements are fulfilled	15
Four out of five requirements are fulfilled	12
Three out of five requirements are fulfilled	9
Two out of five requirements are fulfilled	6
One out of five requirements is fulfilled	3

c. Type of data used for the assessment (15 points)

3.1.1.c Type of data used for the assessment	Points
Specific data	15
Generic data	5

3.1.2 Whole life cycle costs including externalities (**NOT ASSESSED** in this version)

The Whole Life Cycle consider extra information based on the followings

- social aspects

The financial social aspects shall consider the impacts due the quality of the building on the performance of the users (productivity), on reduced costs for absenteeism.

- environmental aspects.

The environmental costs shall consider the costs due for CO₂ (based on average value of CO₂ emission trading) and the costs for selection and transportation of the waste generated based on different values for the inert and dangerous wastes. This last item emphasises the waste management system of the building and the selection of products and constructive solutions to reduce the quantity of waste generated. As an option (if values are known) the assessor shall consider the positive value of the materials exiting the building for recycling, re-use or energy recovery.

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

3.1.1 Life Cycle Costs

3.1.1.a LCC calculation (Excel sheet or other similar documents)

3.1.1.b List of products with relevant information (costs, service life, technical characteristics..)

3.1.1.c Specification of type of data used

5. Relation to other Indicators

LCA indicators

6. Resources

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

7. Attachments

1. EXCEL sheet for LCC calculation

Indicator 3.2 Value Stability

(adapted from DGNB/BNB)

1. Objective

The objective is to ensure a **high flexibility for different user requirements and future developments**. A globalized and international market requires high efficiency, flexibility and adaptability of new and existing construction. Whether a building has a high market value and generates a profit-making investment in the long-term depends on the buildings possibilities of alteration and extensions. To achieve a stable building value in the long-term, it must be possible to adjust the structure of a building regarding changing user demands and future developments (e.g. climate resp. demographic change or rising energy prices) with less effort and low costs. A building designed regarding sustainable criteria can be easily adapted to changing needs.

Flexibility and adaptability of the building structure over the entire lifecycle of a building has therefore a high impact on value stability.

2. Assessment Methodology

The assessment focuses on the building independently from the external economic situation. Indeed, the location cannot be influenced by any means from the construction process, and therefore parameters defining location's value stability are not taken in account here, even if they can play a great role in the sustainable use of the building. Evaluation of location is done separately.

The main aspects taken in account here for the value stability are:

- **Building adaptability and flexibility**
- **Resources dependency**
- **Building performance management**

Building adaptability and flexibility

Firstly, areas should be handled as economical as possible. Area efficiency is an index for the utilization of floor space inside buildings. A report by the German Society of Real Estate Funds (Deutsche Gesellschaft für Immobilienfonds) states that 2/3 of the project developers consider the factor area efficiency as a superior planning item. With reference to the augmentation of area efficiency the following goals for improvement can be presented:

1. Optimization regarding costs: decrease of construction and operational costs, avoidance of restricted use areas.
2. Environmental Optimization: reduction of the property environmental impacts during operation, by reducing the technical equipment required for heating, ventilation, and cooling. With increased area efficiency the sealing of natural soil can be reduced.
3. Contribution to optimization in the social sector: positive interaction in the working environment with well-proportioned areas and a clearly arranged design.

Secondly, the better a building can be converted with as little time and effort as possible, the better the attribute "Feasibility of Conversion" is evaluated. The globalized and international market demands high flexibility and adaptability. This is also reflected in the use of a building. A sustainable designed building can easily be adapted to changing requirements. Change of use can result from tenant/user change as well as from user reorganization. A high degree of sustainable building conversion feasibility is present if a change can be realized with low resource consumption

Resources dependency

With regard to energy and water dependency, it is a question of seeing how well a property can deal with the consequences of climate change as well as with rising energy and water prices. As far as energy is concerned, on the one hand it is a matter of energy efficiency, i.e. an energy consumption that is as low as possible for heating (heating and hot water) and cooling (on the basis of global warming the demand for cooling will increase in the summer). On the other hand, the dependency on energy sources or the expected energy costs of these will play a role. With regard to water dependency, low water consumption, the disposal of wastewater as well as collecting rain water will increase in importance.¹

Building performance management

The optimization of the performance of a building during its operation is essential to maintain the value of the building, because reducing running costs and improving its environmental performance.

Firstly, the life cycle of the building components can be extended thanks to an improved concept for cleaning and maintenance.

Secondly, the optimisation of the building performance requires well-informed facility managers and buildings users as well as monitoring of building performance and target settings for its improvement.

The following sub-indicators will be assessed:

3.2.1 Area efficiency

3.2.2 Conversion feasibility

3.2.3 Energy and water dependency

3.2.4 Building performance management

¹Source: Meins, Wallbaum et al. (2010). Sustainability and property valuation: a risk-based approach. Building Research & Information. Building Research & Information 2010, 38(3), 281-301

3. Calculation and Rating

3.2.1 Area Efficiency

The evaluation of the area efficiency is based on one sub-indicator which is the space efficiency factor. Its calculation corresponds to the proportion between usable floor area (UA) to total floor area (TFA) (in m^2/m^2).

When there are not existing national standards or methods, the calculation of this proportion will be done upon the ISO 9836:1992 “Definition and calculation of area and space indicators” (see annex 1 in attachments) OR European Commission Measuring Code².

The space efficiency factor S_{eff} is determined as follows:

$S_{eff} = UA$ (of all floor levels) / TFA , where:

S_{eff} Space efficiency factor

UA Usable area in [m^2]

TFA Total floor area in [m^2]

The result is rounded to the nearest hundredth. As S_{eff} increases, the building's economic, environmental and social performance ameliorates.

According to its S_{eff} , the building is awarded points, for Area Efficiency 2.14 indicator, as following:

2.14 Area Efficiency	Points
$S_{eff} \geq 0,75$	100
$S_{eff} \geq 0,72$	90
$S_{eff} \geq 0,69$	80
$S_{eff} \geq 0,66$	70
$S_{eff} \geq 0,63$	60
$S_{eff} \geq 0,60$	50
$S_{eff} \geq 0,56$	40
$S_{eff} \geq 0,52$	30
$S_{eff} \geq 0,48$	20
$S_{eff} \geq 0,44$	10
$S_{eff} < 0,44$	0

² European Commission Measuring Code: http://ec.europa.eu/oib/pdf/mesuring-code_en.pdf

3.2.2 Conversion feasibility

The conversion feasibility is evaluated with the following requirements:

- 3.2.2.a Building modularity
- 3.2.2.b Spatial structure
- 3.2.2.c Power and media supply
- 3.2.2.d Heating and water supply/disposal

3.2.2.a Building modularity

The evaluation is based on the indoor clearance height, which should be greater than 2.75 m in order to get the maximum points.

3.2.2.a Building modularity	Points
indoor height clearance > 2,75 m	25
indoor height clearance > 2,50 m	5
indoor height clearance < 2,50 m	0

3.2.2.b Spatial structure

The evaluation is based on 2 parts:

- 1. the feasibility of non-load transferring, room-separating elements to be added to, converted, removed without too much effort and with building operation continuing as normal,
- 2. the feasibility of non-load transferring, room-separating elements to be dismantled, and if there is a possibility of temporarily storing unnecessary elements.

3.2.2.b-1 Spatial structure	Points
Non-load transferring, room-separating elements can be added to, converted, or removed without too much effort and with uninterrupted building operation .	15
Non-load transferring, room-separating elements can be added to, converted, or removed without too much effort and with limited influence on building operation .	10
Non-load transferring, room-separating elements can be added to, converted, or removed without too much effort, but highly influence building operation .	5
Non-load transferring, room-separating elements cannot be added to, converted, or removed without too much effort.	0

3.2.2.b-2 Spatial structure	Points
Non-load transferring, room-separating elements can be dismantled and it is possible to store temporarily unnecessary elements.	10
Non-load transferring, room-separating elements cannot be dismantled and unnecessary elements cannot be stored temporarily.	0

3.2.2.c Power and media supply

The evaluation is based on the three following characteristics:

1. power and media conduits run to easily accessible supply shafts, cable ducts, or false floors and/or visibility of these lines
2. utilization of less than 80 % of the capacity of the supply shafts and ductwork for power and media conduits,
3. electric installation/building automation realized using a BUS system.

3.2.2.c Power and media supply	Points
All three characteristics are fulfilled	25
Two of three characteristics are fulfilled	15
One of the three characteristics is fulfilled	5
None of the three characteristics is fulfilled	0

3.2.2.d Heating and water supply/disposal

The evaluation is based on the following characteristics:

1. flexible distribution of the network and connections for heating and cooling water supply and removal so they don't have to be rerouted in the case of conversion and so a connection possibility exists for shared office spaces,
2. flexible distribution of the network and connections for ventilation and air conditioning so they don't have to be rerouted in the case of conversion and so a connection possibility exists for shared office spaces.

3.2.2.d Heating and water supply/disposal	Points
Two characteristics are fulfilled	25
One of the two characteristics is fulfilled	5
None of the two characteristics is fulfilled	0

3.2.3 Energy and Water dependency

The sub-indicator energy and water relies on:

- Energy demand stability, expressed via the quality of the building envelope
- Water use and wastewater disposal

The evaluation is based on the score achieved by both indicators:

- **4.6 Building shell**
- **1.11 Water and Waste Water**

according to the following method:

3.2.3 Energy and Water dependency	Points
If the score of both indicators is higher than 50 points, the achieved score is the average of the score of both indicators.	50-100
If the score of one indicator is lower than 50 points, the achieved score is the average of the score of both indicators, but cannot exceed 50 points.	10-50
If the score of one indicator is lower than 10 points, the achieved score is the average of the score of both indicators, but cannot exceed 10 points.	0-10

3.2.4 Building performance management

The evaluation is based on the score achieved by both indicators:

- **4.3 Cleaning and Maintenance**
- **5.9 Handover and Performance Evaluation**

according to the following method:

3.2.4 Building performance management	Points
If the score of both indicators is higher than 50 points, the achieved score is the average of the score of both indicators.	50-100
If the score of one indicator is lower than 50 points, the achieved score is the average of the score of both indicators, but cannot exceed 50 points.	10-50
If the score of one indicator is lower than 10 points, the achieved score is the average of the score of both indicators, but cannot exceed 10 points.	0-10

Weights of sub-indicators

Indicator 3.2	Weights
Sub-indicator 3.2.1 Area Efficiency	2
Sub-indicator 3.2.2 Conversion feasibility	4
Sub-indicator 3.2.3 Energy and Water dependency	1
Sub-indicator 3.2.4 Building performance management	1

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

3.2.1 Area Efficiency

Reproducible calculation of the space efficiency factor as a quotient of usable area (UA) and total floor area (TFA) in compliance with ISO 9836, European Commission Measuring Code or national standards/methods/regulations.

Drawings showing in detail the finished state of the building as regards usable area, structure elements, internal walls, circulation and services area and building envelope.

After construction, building's audit report stating that final design (and approved drawings) has been implemented in the building.

3.2.2 Conversion Feasibility:

3.2.2.a Building modularity

- Information on building modularity from relevant planning documents. This information usually consists of a typical floor plan and a cross-section of the plans for the supporting structure, including the following information:
 - degree of separation between building's primary and secondary structures
 - degree of floor plans' and façades' modularity and of modular structural engineering
 - load-transferring elements/systems in building
 - clearance height indoors.
- Description of modular structural engineering, e.g. from manufacturer data, and description of specific convertibility possibilities.

3.2.2.b Spatial structure

- Depiction of variable, non-load bearing, room-separating elements in the building with statements on possible extent of dismantling and operating expenses during conversion, planned temporary storage.
- Depiction of possibilities for temporarily storing elements.

3.2.2.c Power and media supply

- Information on how the power and media conduits are laid in the building reported in relevant excerpts from written and illustrated implementation documents.
- Calculation of capacity utilization of vertical and horizontal supply shafts and ductwork for power and media conduits and of remaining capacity for a representative share of these shafts and ducts.
- Description of electrical installation/building automation areas regulated by a BUS system with product and manufacturer information for the BUS system.

3.2.2.d Heating and water supply/disposal

- Description of conduit and connection distribution for heat, air conditioning, and water supply and removal with explanation of how they allow for a floor plan change without needing to be rerouted.

- Connection possibilities in the case of a floor plan change must be noted.
- Excerpts from the building services engineering plans that include the described distribution of conduits and connections must also be submitted.

3.2.3 Energy and Water dependency

Scores achieved in 4.6 Building Shell and 1.11 Water and Waste Water and calculation of the resulting score.

3.2.4 Building performance management

Scores achieved in 4.3 Cleaning and Maintenance and 5.9 Handover and Performance Evaluation, and calculation of the resulting score.

5. Relation to other Indicators

Indicator: 1.10 Total Primary Energy Demands and Percentage of Renewable Primary Energy

Indicator: 1.11 Water and Waste Water

6. Resources

1. Meins, Wallbaum et al. (2010). Sustainability and property valuation: a risk-based approach. Building Research & Information. Building Research & Information 2010, 38(3), 281-301.
2. Upgrading the flexibility of buildings, Rob P. Geraedts, CIB World Congress, April 2001
3. Recommendation SIA 112/1, 2004: Sustainable Building –Building Construction; Swiss Society of Engineers and Architects
4. DGNB 2012 ECO2.1 Flexibility and Conversion feasibility
5. BNB 2011 2.2.1 Flexibility and Suitability for third-party use
6. Six steps resulting in a flexibility index of the building
Source: LEnSE: Methodology Development towards a Label for Environmental, Social and Economic Buildings, Indicator: Increase Ease of Building Adaptability
 - **Building Extensions:** Ease with which a building can be extended, both vertically and horizontally.
 - **Support and infill:** Adaptability can only be achieved when a distinction is made between support and infill. The technical and functional lifetime of technical installations, building structure, carpentry, internal walls, etc. all differ.
 - **Bearing structure:** Both the horizontal grid of supporting members as well as the floor height determines the different functionalities that can be incorporated
 - **Building envelope:** The buildings are designed so that the following changes are easily achieved, without the need to alter the building structure or causing large scale disruption.
 - **Technical installations:** Building services are of increasing importance in building construction and are often 1/3 of the total building cost. Unfortunately, replacing or changing technical installations that have a shorter lifetime is often difficult.
 - **Infill:** Interior walls, suspended ceilings, doors, furniture, carpet, etc. often require removal when re-arranging the interior of a building. These changes should take place with the least disruption and damage to the bearing structure or remaining components as possible.

7. Attachments

Annex 1: Guidelines and definitions for the calculation of areas and space indicators according to ISO 9836

In defining area measurement, this standard uses the intra-muros and extra-muros concept. The wall centre method of measurement is not considered in this international standard.

According to ISO9836, horizontal and vertical surface areas are measured by their actual dimensions. Inclined planes are measured by their vertical projection onto an imaginary horizontal plane. The surface areas are expressed in square meters, to two decimal places.

Definitions met throughout the calculation are presented below:

Covered area: the area of ground covered by the building in its finished state. The covered area is determined by the vertical projection of the external dimensions of the building onto the ground. Constructions or part of constructions not projecting above the surface of the ground, external staircases, ramps, canopies, horizontal sun-shields, roof overhangs street lighting, area of outdoor facilities such as greenhouses, outhouses and conservatories are not included in the covered area.

Total floor area: the total floor area of a building is the total area of all floor levels. The total floor area of each level is obtained from the external dimensions of the enclosing elements, at floor height. Recesses and projections for structural or aesthetic purposes and profiling are not included if they do not alter the net floor area (see next). Covered floor areas which are not enclosed or are partially enclosed and have no enclosing elements are calculated according to the vertical projection of the outer limit of the covering components.

The total floor area is calculated separately for each floor level. Areas with varying storey height within one floor level are also calculated separately.

The total floor area is made up of the net floor area and the area taken up by the structure.

Intra-muros area: the intra-muros area is the total floor area less the area taken up by the external walls. This area is determined separately for each floor level. The intra-muros area includes the net floor area and the area taken up by the internal walls.

Net floor area: the net floor area is the area between enclosing elements. The net floor area is also determined separately for each floor level. It is calculated from the clear dimensions of the finished building at floor height, excluding skertings, thresholds, etc. Covered floor areas which are not enclosed, or only partially enclosed and have no enclosing elements are determined by the vertical projection of the outer limit of the covering components. Areas with varying storey height within one floor level (e.g. large halls, auditoria) are calculated separately.

Demountable components such as partitions, pipes ducts etc are included in the net floor area. The floor areas of structural elements, door and window recesses, and niches to recesses in the elements enclosing the spaces are not included in the net floor area.

The net floor area is divided into: (a) usable area, (b) services area, (c) circulation area

Area of structural elements: the area within the total floor area on a horizontal section at floor level of the enclosing elements (e.g. external and internal load-bearing walls) and the area of columns, pillars, piers, chimneys, partitions which cannot be entered. The area of structural elements is determined separately for each floor level. It is calculated from the dimensions of the finished building at floor height excluding skirtings, thresholds, plinths etc. Also included in the area of structural elements are the floor areas of door recesses, and recessed and niches in the enclosing elements. The area of structural elements may also be calculated as the difference between the total floor area and the net floor area.

Usable area: that part of the net floor area which corresponds to the purpose and use of the building. The usable area is determined separately for each floor level. Usable areas are classified according to the purpose of the building and the use to which they are put; they are usually divided into main usable areas and subsidiary usable areas.

Services area: the net floor area which accommodates technical installations, such as: (a) installations and pipes for the disposal of waste water, (b) water supply, (c) heating and hot water systems, (d) gas installations (other than for heating purposes) and installations for liquids, (e) electricity supply, generators, (f) ventilation, air-conditioning and cooling systems, (g) telephone switchboard apparatus, (h) lifts, escalators and conveyors and (i) any other central service installation. This area is also determined separately for each floor level.

Circulation area: the net area for circulation within the building (e.g. stair wells, corridors, internal ramps, waiting areas, escape balconies etc). It is determined separately for each floor level.

Building envelope area: this area is obtained from buildings or parts of buildings which are enclosed on all sides and covered, including those parts of the structure which are above the top level of the ground and those below it. Glazed areas are specified separately as parts of external wall areas or roof surfaces. Components of the building which are below the lowest floor level such as parts of the foundation, recessions and projections for aesthetic purposes such as pavement lights, external staircases, external ramps, canopies, horizontal sun-shields, roof overhangs, skylights, chimney stacks, etc

OPEN HOUSE

ASSESSMENT GUIDELINE

Technical Characteristics

- 4.3 Cleaning and maintenance
- 4.5 Noise Protection
- 4.6 **Quality of the building shell**
- 4.7 **Ease of Deconstruction, Recycling, and Dismantling**

Note: Core indicators are in bold

Indicator 4.3 Cleaning and Maintenance

(adapted from DGNB/BNB)

1. Objective

With targeted cleaning and maintenance, the used materials can be operated for the maximum useful lifetime. The ease of cleaning and maintenance of the structure has a high impact on the costs and the environment of a building during the operating phase, extending the life cycle of building elements by optimal maintenance. Areas that can be cleaned easily require lower expenditures on cleansers and cause lower cleaning costs and lower environmental impact.

2. Assessment Methodology

For the qualitative evaluation based on a checklist, the building is divided into the three following building component types:

- Load-bearing structure
- Non-load-bearing external structures, including windows and external doors
- Non-load-bearing interior structures

The technical implementation of each section is evaluated. By means of the technical parameters, it shall be identified whether a structure, based on its technical planning and construction, enables efficient cleaning and maintenance. The different sections of the construction are considered separately. Criteria for maintenance and for cleaning are queried.

The following sub-indicators will be assessed:

4.3.1 Load-bearing structure

4.3.2 Non-load-bearing external structures

4.3.3 Non-load-bearing interior structures

3. Calculation and Rating

4.3.1 Load-bearing structure – primary structure

4.3.1 Load-bearing structure – primary structure	Points
Parts of the primary structure relevant to maintenance are easily accessible for maintenance operations.	100
Parts of the primary structure relevant to maintenance are accessible for maintenance operations, after removing the attachment components .	50
Parts of the primary structure relevant to maintenance are accessible for maintenance operations, after difficult dismantling .	10
Parts of the primary structure relevant to maintenance are not accessible for maintenance operations.	0

4.3.2 Non-load-bearing external structures – glass surfaces

4.3.2 Non-load-bearing external structures – glass surfaces	Points
100% of the external glass surfaces are easily accessible. The upper edge of the floor to the upper edge of the glass surface = 2.5 m	100
More than 90% of the external glass surfaces are easily accessible. The upper edge of the floor to the upper edge of the glass surface = 2.5 m	50
Less than 90% of the external glass surfaces are easily accessible. The upper edge of the floor to the upper edge of the glass surface = 2.5 m. For the rest of the external glass surfaces, there are permanent cleaning catwalks or ladders installed.	10
More than 10% of the external glass surface is not easily accessible (basket cranes, climbing belts etc. are needed)	0

4.3.3 Non-load-bearing interior structures

4.3.3.a Non-load-bearing interior structures - flooring	Points
All of the trafficked area and more than 80% of the floor space is tolerant of light soiling (patterned, mottled or structured)	25
Only the trafficked area is tolerant of light soiling (patterned, mottled or structured)	10
No area is tolerant of light soiling (not patterned, mottled or structured)	0

4.3.3.b Non-load-bearing interior structures – dirt-catching zone	Points
In front of every entrance is an adequate dirt-catching zone of at least 4 m	25
In front of every entrance is an adequate dirt-catching zone of at least 2 m	10
No adequate dirt-catching zone	0

4.3.3.c Non-load-bearing interior structures – baseboards*	Points
All baseboards are mechanically secured to ensure constant protection against floor cleaning.	25
Baseboards are not mechanically secured	0

*See definition of baseboard in attachment

4.3.3.d Non-load-bearing interior structures - obstacles	Points
There are no inaccessible niches, empty spaces, dead angles, corners and columns in hallways and rooms	25
There are some inaccessible niches, empty spaces, dead angles, corners and columns in hallways and rooms	10
There are many inaccessible niches, empty spaces, dead angles, corners and columns in hallways and rooms	0

Weights of Sub-indicators

Indicator 4.3	Weight
Sub-indicator 4.3.1 Load-bearing structure	4
Sub-indicator 4.3.2 Non-load-bearing external structures	4
Sub-indicator 4.3.3 Non-load-bearing interior structures	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

4.3.1 Load-bearing structure

For the load-bearing structure, an overview of all primary structure components have to be provided, by indicating if these are relevant to maintenance and including a proof of accessibility for example in the form of detailed drawings.

4.3.2 Non-load-bearing external structures

For non-load bearing external structures, evidence of accessibility of all external glass surfaces with description of the height and distance from the upper edge of the floor and evidence of cleaning catwalk/ladders with information to the accessibility of glass surfaces from these and their height have to be provided.

4.3.3 Non-load-bearing interior structures

For non-load-bearing interior structures, following information have to be made available:

- Demonstration, e.g. in the form of photographs with reference to the floor plan, that the entire trafficked area and also 80% of the floor space are equipped with a patterned, mottled or structured flooring.
- Floor plan of the ground floor or photographic documentation showing measurements of building entrances and with information about flooring and soil-capture zones, such as grates and synthetic or natural fibre mats.
- Information about the baseboards in the floor area in form of drawings, description of building components, photographic documentation with corresponding tender documents specifying the type of connections (mechanical or glued).
- Evidence of the presence of obstacles, such as inaccessible corners, columns in rooms, niches, etc., on a floor plan.

5. Relation to other Indicators

Indicator 3.1 - LCC

6. Resources

DGNB - 40 Ease of cleaning and maintenance
BNB 2011 - 413 Cleaning and Maintenance

7. Attachments

Baseboard

Wikipedia: <http://en.wikipedia.org/wiki/Baseboard>

In architecture, a baseboard (also called skirting board, skirting, mopboard, floor molding, as well as base molding) is a (generally wooden) board covering the lowest part of an interior wall. Its purpose is to cover the joint between the wall surface and the floor.

It covers the uneven edge of flooring next to the wall; protects the wall from kicks, abrasion, and furniture; and can serve as a decorative molding.

Indicator 4.5 **Noise Protection**

(adapted from DGNB/BNB)

1. Objective

Noise has a big impact on the health and comfort of people, so that an appropriate noise protection should be achieved. Benefits of noise protection in office buildings are: avoiding the loss of concentration, protection of privacy and confidentiality, and consideration for people with limited hearing.

This supports the European Commission objective of designing construction works in such a way that noise perceived by the occupants or people nearby is kept down to a level that will not threaten their health and will allow them to sleep, rest and work in satisfactory conditions¹.

2. Assessment Methodology

Measures that exceed the minimum noise protection to the standard requirements lead to a better score. Exceeding of the standards shall be motivated. The quality of noise protection of building parts is determined from the certificate of noise protection or the quality of the specified building parts.

Compliance in accordance with the national standards or DIN 4109:1989 and DIN 4109/Supplement 2 are required.

The following sub-indicators will be assessed:

- 4.5.1 Airborne sound insulation with respect to exterior sound
- 4.5.2 Airborne sound insulation with respect to other working areas and to personal working areas (interior walls, ceilings, stairwell walls)
- 4.5.3 Insulation from impact sound with respect to other working areas and to personal working areas (ceilings, stairs, and stairway landings)
- 4.5.4 Insulation from sound created by building services (water system and other services)

¹ DIRECTIVE 89/106/EEC and its Interpretative document No. 5: Protection against noise

3. Calculation and Rating

4.5.1 Airborne sound insulation with respect to exterior sound

Compliance with the specific national standard or DIN 4109 is evaluated.

4.5.1 Airborne sound insulation with respect to exterior sound	Points
The national standard or DIN 4109 is exceeded by at least 1 dB.	100
The national standard or DIN 4109 is fulfilled.	10
The national standard or DIN 4109 is not fulfilled.	0

4.5.2 Airborne sound insulation with respect to other working areas and within a working area itself

Compliance with the specific national standard or DIN 4109/Supplement 2 is evaluated.

4.5.2 Airborne sound insulation with respect to other working areas and within a working area itself	Points
The national standard or DIN 4109/Supplement 2 is exceeded by at least 1 dB. (Airborne sound insulation with respect to other working areas and increased airborne sound insulation in personal working)	100
DIN 4109/Supplement 2 is fulfilled. (Airborne sound insulation with respect to other working areas and increased airborne sound insulation in personal working)	50
The national standard or DIN 4109 is fulfilled. (Airborne sound insulation with respect to other working areas)	10
The national standard or DIN 4109 is not fulfilled.	0

4.5.3 Impact sound insulation with respect to other working areas and to personal working areas

Compliance with the specific national standard or DIN 4109 is evaluated.

4.5.3 Impact sound insulation with respect to other working areas and to personal working areas	Points
The national standard or DIN 4109/Supplement 2 is exceeded by at least 1 dB. (Impact sound insulation with respect to other working areas and increased impact sound insulation with respect to personal working areas)	100
DIN 4109/Supplement 2 is fulfilled. (Impact sound insulation with respect to other working areas and increased impact sound insulation with respect to personal working areas)	50
The national standard or DIN 4109 is fulfilled. (Impact sound insulation with respect to other working areas)	10
The national standard or DIN 4109 is not fulfilled.	0

4.5.4 Insulation from sound created by building services

Compliance with the specific national standard or DIN 4109 is evaluated.

4.5.4 Insulation from sound created by building services	Points
The national standard or DIN 4109 is exceeded by at least 1 dB.	100
The national standard or DIN 4109 is fulfilled.	10
The national standard or DIN 4109 is not fulfilled.	0

Weights of Sub-indicators

Indicator 4.5	Weight
Sub-indicator 4.5.1 Airborne sound insulation with respect to exterior sound	4
Sub-indicator 4.5.2 Airborne sound insulation with respect to other working areas and to personal working areas	4
Sub-indicator 4.5.3 Insulation from impact sound with respect to other working areas and to personal working areas	4
Sub-indicator 4.5.4 Insulation from sound created by building services	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Basic and Quick Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

4.5.1 Airborne sound insulation with respect to exterior sound

Proof of surpassed requirements for airborne sound insulation with respect to external noise according to the specific national/local standards, if these are available. For example, in Germany, evidence that the airborne sound insulation values with respect to external noise specified in the national standard or DIN 4109 (English version) have been surpassed by at least 1 dB.

4.5.2 Airborne sound insulation with respect to other working areas and to personal working areas

Proof of surpassed requirements for airborne sound insulation according to the specific national/local standards, if these are available. For example, in Germany, evidence that the airborne sound insulation values specified in DIN 4109/Supplement 2 have been surpassed by at least 1 dB.

4.5.3 Insulation from impact sound with respect to other working areas and to personal working areas

Evidence that values for impact sound insulation with respect to other work areas have been surpassed according to the specific national/local standards, if these are available. For example, in Germany, separate proof that the values for impact sound insulation with respect to other work areas specified in DIN 4109 supplement 2 have been surpassed by at least 1 dB.

4.5.4 Insulation from sound created by building services (water system and other services)

Evidence that building's insulation from sound created by building services surpasses requirements according to the specific national/local standards, if these are available. For example, in Germany, evidence that the values for structure-borne sound insulation with respect to other works areas and to personal working areas specified in DIN 4109 (English version) have been surpassed by at least 1 dB(A).

5. Relation to other Indicators

Indicator 2.6 “Acoustic comfort”

Indicator 2.12 “Noise from building and Site”

6. Resources

DGNB 2009: 34 Sound Protection

BNB 2011: 4.1.1 Sound Insulation

DIN 4109:1989

DIN 4109/Supplement 2

7. Attachments

None

Indicator 4.6 **Building Shell**

(adapted from DGNB/BNB)

Core Indicator

1. Objective

The goal of this indicator is to minimize the heating and cooling demand to condition building areas, simultaneously ensuring a high thermal comfort and avoiding structural damages.

2. Assessment Methodology

Various input variables are necessary to evaluate this indicator. These variables are being described using the individual requirements for the components of the building envelope.

The following sub-indicators will be assessed:

4.6.1 Median thermal transmittance coefficients of building components \bar{U}

4.6.2 Thermal Bridges

4.6.3 Air permeability class (window air-tightness)

4.6.4 Amount of condensation inside the structure

4.6.5 Air exchange n_{50} and if necessary q_{50}

4.6.6 Solar heat protection

3. Calculation and Rating

4.6.1 Median thermal transmittance coefficients of building components \bar{U}

External building components and their thermal transmittance coefficients are evaluated. These data are reported in the energy certificate for buildings (implementation of the EPBD). For example in Germany the values of the reference building according to EnEV are taken into account.

List of external building components (can vary in accordance to the implementation of the EPBD in the specific country, here is the example of Germany):

- Opaque external building components
- Transparent external building components
- Curtain façade
- Glass roofs, rows of windows, skylights

Unit: W/m²K

4.6.1 Average thermal transmittance coefficients of building components \bar{U}	Points
Target values of specific country = approximately standard value – 40 % , e.g. components for Germany:	e.g. values for Germany:
1. Opaque external building components (not included in components of 3. and 4.)	< 0,20
2. Transparent external building components (not included in components of 3. and 4.)	< 1,30
3. Curtain facade	< 1,40
4. Glass roofs, rows of windows, skylights	< 2,20
Target values of specific country = approximately standard value – 20 % , e.g. components for Germany:	e.g. values for Germany:
1. Opaque external building components (not included in components of 3. and 4.)	< 0,28
2. Transparent external building components (not included in components of 3. and 4.)	< 1,50
3. Curtain facade	< 1,50
4. Glass roofs, rows of windows, skylights	< 2,60
Standard values of specific country, e.g. components for Germany:	e.g. values for Germany:
1. Opaque external building components (not included in components of 3. and 4.)	< 0,35
2. Transparent external building components (not included in components of 3. and 4.)	< 1,90
3. Curtain facade	< 1,90
4. Glass roofs, rows of windows, skylights	< 3,10
Higher values	0

4.6.2 Thermal Bridges

Information [related](#) to the existing thermal bridges.

4.6.2 Thermal Bridges	Points
Detailed calculations in accordance with EN ISO 10211: Thermal bridge adjustment < 0,01 W/m ² K	100
Compliance in accordance with EN ISO 13788: Thermal bridge adjustment < 0,05 W/m ² K	50
Information related to the existing thermal bridges is available: Thermal bridge adjustment < 0,10 W/m ² K	10
No information related to the existing thermal bridges is available.	0

4.6.3 Air permeability class (window air-tightness)

Window air-tightness in accordance with EN 12207.

4.6.3 Air permeability class (window air-tightness)	Points
Air permeability (interstitial air-tightness): Class 4	100
Air permeability (interstitial air-tightness): Class 3	70
Air permeability (interstitial air-tightness): Class 2	40
Air permeability (interstitial air-tightness): Class 1	10
No compliance with one of the Classes.	0

4.6.4 Amount of condensation inside the structure

Approval in accordance with EN ISO 13788 or transient heat and humidity determination process EN 15026.

4.6.4 Amount of condensation inside the structure	Points
Approval in accordance with EN ISO 13788 or transient heat and humidity determination process EN 15026.	100
No approval	0

4.6.5 Air exchange n_{50} and if necessary q_{50}

Measurement of the air exchange rate after the building is completed. EN 13829: 2001-02 (Procedure A)

4.6.5 Air exchange n_{50} and if necessary q_{50}		Points
<u>Buildings with an interior volume $\leq 1500 \text{ m}^3$</u>		
without ventilation systems: Air exchange rate n_{50} in h^{-1}	1,0	100
with ventilation systems: Air exchange rate n_{50} in h^{-1}	0,8	
<u>in addition, for buildings with an interior volume $> 1500 \text{ m}^3$</u>		
Air exchange with respect to external surface area q_{50}	2,0	
<hr/>		
<u>Buildings with an interior volume $\leq 1500 \text{ m}^3$</u>		
without ventilation systems: Air exchange rate n_{50} in h^{-1}	1,5	50
with ventilation systems: Air exchange rate n_{50} in h^{-1}	1,0	
<u>in addition, for buildings with an interior volume $> 1500 \text{ m}^3$</u>		
Air exchange with respect to external surface area q_{50}	2,5	
<hr/>		
<u>Buildings with an interior volume $\leq 1500 \text{ m}^3$</u>		
without ventilation systems: Air exchange rate n_{50} in h^{-1}	3,0	10
with ventilation systems: Air exchange rate n_{50} in h^{-1}	1,5	
<u>in addition, for buildings with an interior volume $> 1500 \text{ m}^3$</u>		
Air exchange with respect to external surface area q_{50}	3,0	
<hr/>		
No compliance.		0

4.6.6 Solar heat protection

Criteria to avoid overheating. Calculation of the Solar heating protection SHP (solar heating protection) in accordance to EN 13363.

$$SHP = f * g_{tot} * z$$

with:

f: share of windows area (windows area/building envelope area)

g: solar factor (g-value). It measures the percentage of heat that passes through the glass.

z: reduction factor for solar protection devices.

Standards values for z are included in the table 7 from DIN 4108 part 2 (see Attachments).

4.6.6 Solar heat protection		Points
Solar heating protection SHP	$\leq 0,12$	100
Solar heating protection SHP	$\leq 0,16$	10
Solar heating protection SHP	$> 0,16$	0

Weights of Sub-indicators

Indicator 4.6	Weight
Sub-indicator 4.6.1 Median thermal transmittance coefficients of building components \bar{U}	3
Sub-indicator 4.6.2 Thermal Bridges	1
Sub-indicator 4.6.3 Air permeability class (window air-tightness)	3
Sub-indicator 4.6.4 Amount of condensation inside the structure	2
Sub-indicator 4.6.5 Air exchange n50 and if necessary q50	1
Sub-indicator 4.6.6 Solar heat protection	1

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

4.6.1 Median thermal transmittance coefficients of building components \bar{U}

Thermal transmittance coefficients of external building components

4.6.2 Thermal Bridges

Approval or calculation of the thermal bridges

4.6.3 Air permeability class (window air-tightness)

Certificate of window air-tightness (EN 12207)

4.6.4 Amount of condensation inside the structure

Condensation determination (EN ISO 13788 or transient process)

4.6.5 Air exchange n_{50} and if necessary q_{50}

Documentation of the air-tightness measurements

4.6.6 Solar heat protection

Calculation of the SHP (Solar Heat Protection)

5. Relation to other Indicators

2.3 Thermal Comfort

2.4 Indoor Air Quality

5.7 Quality Assurance of Construction Execution

5.8 Commissioning

6. Resources

1. EN ISO 6946

2. EN ISO 10211

3. EN ISO 13788

4. EN 12207

5. EN 15026

6. EN 13829: 2001-02 (Procedure A)

7. DIN 4108-2

8. DGNB 2009: Quality of building envelope's with regard to heat and humidity

9. BNB 2011: 4.1.2 Heat Insulation and Protection against Condensate

7. Attachments

Standards values for reduction factor z according to DIN 4108 part 2:

Sun protection system	Reduction factor z		
	<i>Solar factor</i>		
	$g \leq 0,4$ <i>(sun protection glazing)</i>	$g > 0,4$	
	double	triple	double
Without Sun protection	1,00	1,00	1,00
Interior or between the glass panels			
white or high reflective surface with low transparency	0,65	0,70	0,65
bright colours or low transparency	0,75	0,80	0,75
dark colours or high transparency	0,90	0,90	0,85
Exterior			
<i>Folding shutter, roller blinds</i>			
folding shutter, roller blinds, 3/4 closed	0,35	0,30	0,30
folding shutter, roller blinds, closed	0,15	0,10	0,10
<i>Sunblind and curtains, rotating blades</i>			
sunblind and curtains, rotating blades, 45° blades position	0,30	0,25	0,25
sunblind and curtains, rotating blades, 10° blades position	0,20	0,15	0,15
awning, parallel to the glazing	0,30	0,25	0,25
canopy, awning, detached blades	0,55	0,50	0,50

Indicator 4.7 Ease of Deconstruction, Recycling, and Dismantling

(adapted from DGNB/BNB)

Core indicator

1. Objective

Goal of increasing the ease of deconstruction, recycling, and dismantling is the avoidance of waste, in particular by reducing its amount and hazard. Between 40% and 50% of waste in Europe can be assigned to the building sector. The amount of accumulated waste is to be reduced, and is to be led into recycling system. Due to the comparatively long expected useful lifetime, many of the materials that are used today will not accumulate as deconstruction material or potential waste until 50 or 100 years after construction. These materials can serve as important resources for future construction materials. The ability to recapture homogenous deconstruction materials and extract high-grade recycling materials is very important for the evaluation of ease of deconstruction and ease of recycling.

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 impact¹. The targets for the recycling of waste are: 50% of household waste and 70% for construction and demolition waste recycled by 2020².

2. Assessment Methodology

The ease of deconstruction, recycling and dismantling is evaluated qualitatively by considering the following characteristics of a building:

1. Building services
2. Non-structural (de)construction parts
3. Non-bearing carcass structure
4. Bearing carcass structure

The following sub-indicators will be assessed:

4.7.1 Effort for dismantling / disassembly

4.7.2 Effort for sorting/separation

4.7.3 Verification of the inclusion of a recycling/disposal concept with information about construction components in the certification application

¹ Taking sustainable use of resources forward: A Thematic Strategy on the prevention and recycling of waste COM(2005)666

² Directive 2008/98/EC on Waste

3. Calculation and Rating

4.7.1 Effort for dismantling / disassembly

Building components have to be listed and classified into ease of disassembly categories. The higher homogeneity of different building components, the higher feasibility of their dismantling.

4.7.1 Effort for dismantling / disassembly	Points
Disassembly requires very low effort: e. g. clamped joints, loose supports, simple snapping or bolted joints	100
Disassembly requires low effort: e. g. removal of filler material, removal of bolted clamps	70
Disassembly requires moderate effort: e. g. tearing up flooring, removal of poured sheathing elements	40
Disassembly requires high effort: e. g. demolition of adhesive coatings	10
Disassembly requires very high effort:	0

4.7.2 Effort for sorting/separation

Building components and materials have to be classified into categories of waste substances, demolition materials and construction waste on site. The following classes of building materials can be considered:

- Manufacturer-specific classes (roof systems, floor coverings, etc.)
- Metal classes (steel, aluminium, etc.)
- Mineral construction mixture waste
- Plaster waste
- Electrical wires and cables
- Plastic foams and foam insulation
- Solid timbers and raw wood

The easier building jointed materials can be separated, the higher the possibility to sort them.

4.7.2 Effort for sorting/separation	Points
Low effort for sorting/separating	100
Reasonable effort for sorting/separating	10
High effort for sorting/separating	0

"Low effort" means separation can be performed by personnel either manually or with simple tools. Examples are pulling off (such as of floor and wall coverings down to the separation layer), ripping out, and prying off.

A **"reasonable effort"** for separation requires machinery suitable for the disassembly work in addition to personnel. Examples are chipping, milling, sanding and the like.

A **"high effort"** for separation applies in two cases.

- When determining whether the effort is "reasonable", economic feasibility is also taken into consideration. While removal of residues on materials, such as screed on floor coverings and sealant on window frames is theoretically possible, for instance, in practice the great expense of time and money make such removal unrealistic.
 - Separation processes not possible on site are also considered unreasonable.
- High effort is always needed for materials and components dangerous for health and safety at deconstruction (asbestos, etc.).

4.7.3 Verification of the inclusion of a recycling/disposal concept with information about construction components

The evaluation of this indicator is done according to the level of management of the building components end of life stage, as defined in the design documentation.

4.7.3 Verification of the inclusion of a recycling/disposal concept with information about construction components	Points
A verifiable recycling/disposal plan dealing with the end of life for major building components is prepared	100
A verifiable recycling/disposal concept is prepared	50
A verifiable recycling/disposal concept is NOT prepared	0

Weights of Sub-indicators

Indicator 4.7	Weight
Sub-indicator 4.7.1 Effort for dismantling /disassembly	4
Sub-indicator 4.7.2 Effort for sorting/separation	4
Sub-indicator 4.7.3 Verification of the inclusion of a recycling/disposal concept with information about construction components	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Specific design documentation dealing with end of building's life, assessment report done by the designer and/or contractor or other **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values for major building components.

Complete Assessment

For 4.7.1 and 4.7.2, a copy of the **4.7 Excel tool** can be used to document the building components.

4.7.1 Effort for dismantling /disassembly

All of the building components and their layers if appropriate have to be accurately listed in a catalogue, by describing the degree of ease of dismantling and recycling in qualitative categories, such as very easily disassembled components, disassembly requires little, moderate, great or very considerable effort. This list should be as complete as possible.

4.7.2 Effort for sorting/separation

All of the building components and their layers have to be accurately listed in a catalogue, by describing the degree of ease of separation in qualitative categories, such as easy separation (i.e. performed by personnel either manually or with simple tools) of components, sorting requires reasonable (i.e. machinery required in addition to personnel) or unreasonable (i.e. extremely high expense of time and money) effort. This list should be as complete as possible.

4.7.3 Verification of the inclusion of a recycling/disposal concept with information about construction components

Recycling/disposal concept or plan (if available). This concept rules the organization and the financial responsibility for controlled dismantling and disposal throughout the life cycle of the building. In the concept, designers and/or planners estimate the quantity of waste and determine which parts of the construction can:

- be dismantled,
- be separated and collected on site,
- have to go to a sorting machine,
- the contractors have to dispose (builder-caused waste),
- the owners be legally responsible for disposing of (owner-caused waste).

5. Relation to other Indicators

2.17 Responsible Material Sourcing

2.18 Local material

6. Resources

1. Council Directive 89/106/EEC of 29 September 2003 on the approximation of laws and regulations of the Member States:
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1989L0106:20031120:en:PDF>
2. Regulation on the protection from hazardous substances of 23 December 2004 adapted to the Directive 98/24/EC: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31998L0024:EN:HTML>.
3. Regulation on Implementation of Directive 2002/44/EC (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:177:0013:0019:EN:PDF>) and Directive 2003/10/EC (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:042:0038:0044:EN:PDF>) on the protection of workers against risks from noise and vibrations of 6 March 2007.
4. DGNB 2009: Ease of dismantling and recycling
5. BNB 2011: 4.1.4 Dismantling, Separation and Utilisation

7. Attachments

4.7 Excel tool: list of building components and their layers classified by the degree of ease of dismantling and recycling, or the degree of ease of separation.

4.7 Ease of Deconstruction, Recycling and Dismantling

Num	building component/ layer	Layername	n.a.	4.7.1 Effort for dismantling /disassembly					Score
				very low effort	low effort	moderate effort	high effort	very high effort	
Type. Layer	building component catalogue			100	70	40	10	0	0
Final score				0 of 100 Points			0 Components		
331	Load bearing outside walls								
331.1	Type 1:								
331.1.1	Layer 1.1								
331.1.2	Layer 1.2								
331.1.3	Layer 1.3								
331.2	Type 2								
331.2.1	Layer 2.1								
331.2.2	Layer 2.2								
331.2.3	Layer 2.3								
331.3	Type 3								
331.3.1	Layer 3.1								
331.3.2	Layer 3.2								
331.3.3	Layer 3.3								
331.3.4	Layer 3.4								
331.4	Type 4								
331.4.1	Layer 4.1								
331.4.2	Layer 4.2								
331.4.3	Layer 4.3								
331.4.4	Layer 4.4								

Screenshot of the Excel tool

OPEN HOUSE

ASSESSMENT GUIDELINE

Process Quality

- 5.1 **Project Briefing Strategy**
- 5.2 Integral Planning
- 5.3 Building Performance Targets
- 5.4 Evidence of Sustainability during Bid Invitation and Awarding
- 5.5 **Construction Site impact/ Construction Process**
- 5.6 Quality of the Executing Contractors/Pre-Qualification
- 5.7 Quality Assurance of Construction Execution
- 5.8 **Commissioning**
- 5.9 Handover and Performance Evaluation

Note: Core indicators are in bold

Indicator 5.1 Project Briefing Strategy

(adapted from DGNB/BNB)

Core Indicator

1. Objective

Sustainability of buildings starts in the early planning phases and this indicator encourages the consideration of sustainability issues during the preparation and planning of the project.

Improvement of the building's sustainability performance must begin in the planning and briefing phase, because in the design phase there is significant potential to optimise a sustainable building and early planning minimises the likelihood of changes to the building and the construction, and resultant impact on costs, allowing more time to financially plan and look for economical solutions.

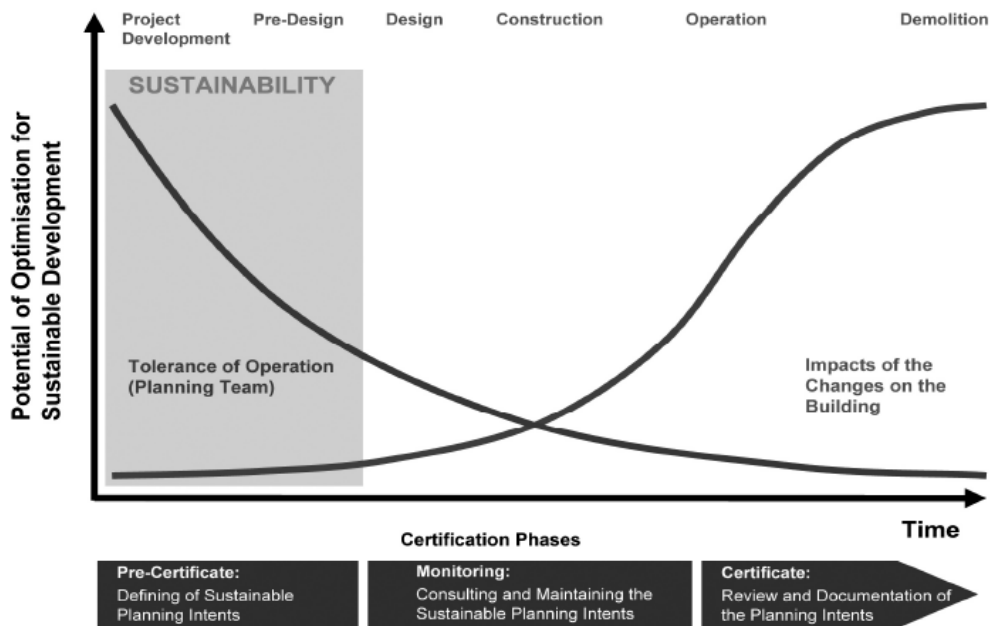


Fig. 1 Certification Process: Importance of the Project Development and Design

Source: Eßig, N.: OPEN HOUSE – INSTRUMENT FOR ASSESSING THE SUSTAINABILITY PERFORMANCE OF BUILDINGS IN EUROPE; proceedings of the CESB 2010, Prague;

2. Assessment Methodology

The indicator assesses the quality of the preparation and planning of the project. It should encourage teams and owners to identify the needs of the building, and its' owners and users, define targets and their implementation in construction, including aspects like: main goals of the project, time frame, budget frame, size of the building, characteristics of the site. One important resulting step is to define clear and achievable objectives on which all stakeholders agree.

In order to ensure a high quality design process, with insurance of execution of an integral and interdisciplinary planning, the planning process should follow the framework of an architectural competition.

The following sub-indicators will be assessed:

5.1.1 Project Brief

5.1.2 Architectural competition

3. Calculation and Rating

5.1.1 Project Brief

5.1.1 Project Brief	Points
A comprehensive brief was agreed in detail to outline building owner's needs in line with Appendix 1 of this criterion, or of similar scope. This may be in the form of a report, which states the project's intended approach, and the guidelines and strategies which the design and construction teams will seek to implement in design.	100
No design brief nor demand description or something comparable was conducted or can be evidenced.	0

5.1.2 Architectural competition

5.1.2 Architectural competition	Points
An architectural competition or other similar competition is prepared and takes place with special consideration of sustainable building. The jurors who award contracts and other experts (multidisciplinary) have experience in sustainable building. The sustainability of the design is a substantial part of the score of the competition entries (>40%).	100
No architectural competition or other similar competition is prepared and takes place with special consideration of sustainable building and/or no juror or other expert awarding the contract has experience in sustainable building	0

Weights of Sub-indicators

Indicator 5.1	Weight
Sub-indicator 5.1.1 Project Brief	3
Sub-indicator 5.1.2 Architectural competition	1

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

5.1.1 Design Brief

- Evidence that the brief was agreed with the design team, owner/occupier and any other relevant consultants. Documentation must be provided, such as a briefing report or a design intent statement, which contains a systematic description of the targets in accordance with any of the following:
 - Annex 1 of the BMVBS Guide
 - RIBA Stage A/B (pre-2013) or Stage 1 (2013) or similar.
 - Appendix A, listed below (based on OPEN HOUSE requirements)
- The report must have been dated previous to the final architectural design

5.1.2 Architectural Competition

Documentation of the selection of winner from competition. The documents must make the following clear in addition to providing general information, especially related to sustainable building:

- legal ramifications for project, if appropriate (e.g. in Germany GRW95, RPW 2008, etc.)
- type of competition (open, invitational, etc.)
- jury members and experience (CVs)
- proof of scoring/rating of entries

5. Relation to other Indicators

See OH indicators noted in the table in Appendix A

6. Resources

1. DGNB International

Criterion 43: Quality of project preparation

2. RIBA Stages of Work

RIBA Stages A-B Checklists (RIBA Stages 1 Preparation (2013 revision))

3. BNB: Bewertungssystem Nachhaltiges Bauen (Germany)

Criterion 5.1.1: Projektvorbereitung

www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_511.pdf

4. Agreement on objectives:

SIA 112-1

www.eco-bau.ch/resources/uploads/SIA_112-1_2005_d-Auszug.pdf

5. Annex 1 of the BMVBS Guide

www.nachhaltigesbauen.de/fileadmin/pdf/PDF_Leitfaden_Nachhaltiges_Bauen/Anlage_1.pdf

6. Architectural competition: UIA guide on international competitions:

www.uia-architectes.org/texte/english/Menu-7/UIAguideIC.html

7. Appendix A

1. Project description		7. Location and surroundings	
The main objectives of the project		Site Ecology	OH 1.7
Size & purpose		Light Pollution	OH 1.8
		Security	OH 2.2
2. Financial and time frame		Personal Transportation	OH 2.16
Schedule		Public Transportation	OH 6.3
Capital Budget		Traffic & Parking	
Lifecycle Costs	OH 3.1	8. Spaces, Uses and Environmental Requirements	
Value stability	OH 3.2	Lists of required uses/spaces	
Risks		Service Quality	OH 2.9
3. Laws, standards and regulations		Thermal Comfort	OH 2.3
Relevant legal restrictions for buildings		Indoor Air Quality	OH 2.4
Building legislation and regulations		Acoustic Comfort	OH 2.6
Relevant guidelines		Visual Comfort	OH 2.7
		9. Environmental Impact & Building Performance Targets	
4. Design Management Plan		Energy	OH 1.10
Integrated Team, qualifications & consultation plan	OH 5.2	Water	OH 1.11
		Daylight	OH 2.7
5. The building as a whole		Waste	OH 1.13
Characteristics of the building		10. Building Management	
Size & critical dimensions		Operational Comfort	OH 2.8
Requirement of external spaces		Energy Management Plan	OH 5.9
Flexibility for future uses	OH 3.2	11. Materials and Construction	
Cleaning and Maintenance	OH 4.3	Material Sourcing	OH 2.17
6. Accessibility Statement		Deconstruction and End of Life	OH 4.7
Barrier Free Design	OH 2.1		
Public Accessibility	OH 2.11		

Note on Appendix A:

The list, above, should be tailored to suit a given project. There are several resources listed which give alternative briefing outlines which could supplement the Open House list.

Indicator 5.2 **Integrated Planning**

(adapted from DGNB/BNB, LEED, BREEAM, SuPerBuildings)

1. **Objective**

Integrated Planning requires 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. Indeed, the adoption of an integrated design approach is a success factor for multi-criteria design optimisation and innovation with limited risks, and also makes operation phase easier and cost- effective.

Integrated planning covers the entire lifecycle of a building; from early project design until building's demolition. The realization of sustainable buildings requires improvement of planning quality as well as optimization of planning process. With conventional design processes there is a series of handoffs from the owner to the architects, from the architect to the contractor, from the contractor to the user. The problem with this model is that not relevant parties participate in the planning process and therefore their needs, areas of expertise or insights are not taken into account. In some cases, incompatible elements of the design are not discovered until late in the process when any change means additional cost in money and time. Therefore good communication and interaction between members of the planning team, the owner, the contractor, the project manager, various experts, the future users, etc is necessary from the conception to the completion of a project. This can be reached by using the method of participation.

Participation means close cooperation with different target groups and local community already on an early design stage. With participation a building project can be broad based and increase the acceptance for a project to a high level. An interdisciplinary design team considers the requirements of future users and other relevant stakeholders on an early stage on the design process and develops an integrated concept with a comprehensive sustainability strategy in order to reduce energy consumption and environmental pollution. Participation of future building users and other stakeholders, design, plan and deliver sustainable and functional buildings fit for purpose. These activities effect social, ecological as well as economic benefits.

2. **Assessment Methodology**

This indicator is made of a list of qualitative sub-indicators covering several phases of the planning process of a building, from concept design to operation.

The following sub-indicators will be assessed:

5.2.1 Multidisciplinary formation of the planning team

5.2.2 Qualification of the Integrated Project Team

5.2.3 Design Charrette / Preparation of consultation

5.2.4 Integrated planning process

5.2.5 Participation of future building users and other relevant stakeholders / Community impact consultation

3. Calculation and Rating

5.2.1 Multidisciplinary formation of the planning team

A Multidisciplinary formation of the planning team covers members and experts of the most important disciplines appropriate to the specific project type. This generally includes at least the categories design, structural, technical building equipment, and building physics.

Actively involve many as feasible but at least have a Sustainability Consultant guiding a team of at least 3 integrated project team members and at least 1 appropriate stakeholder in at least 3 phases of project design and construction process.

Examples: Integrated Project Team	Examples: Appropriate Stakeholders
<ul style="list-style-type: none"> – Sustainability Consultant (a professional with profound knowledge in the field of sustainability and planning process) – Architect/ building designer – Mechanical Engineer – Electrical Engineer – Structural engineer – Energy Designer – Equipment Planner – Acoustical Consultant – Telecommunications Designer – Controls Designer – Building science or performance testing – Green building or sustainable design consultant – Functional and space programmers – Interior designer – Lighting consultant – Commissioning agent – Civil engineering, landscape architecture, habitat restoration, or land planning – Construction Management or General Contractor – Life cycle cost analysis; construction cost estimating; 	<ul style="list-style-type: none"> – Owner or Owner’s Representative – Owner’s capital budget manager – User groups – Facility managers – Housekeeping staff – Community representatives – Local residents and volunteer group(s) – Local Trust – Staff groups or unions. – Local businesses – Community groups/associations – Local Authority and/or local education service providers. – Local government – Current / future building users – Neighbour – Local associations (for example disabled association)

5.2.1 Multidisciplinary formation of the planning team	Points
Actively involved: A Sustainability Consultant, a Construction Manager or General Contractor with at least 3 more integrated project team members and at least 2 appropriate stakeholders (e.g representative of the owner and future users) in at least 3 phases of project design and construction process.	100
Actively involved: A sustainability consultant with at least 3 integrated project team members and at least 1 appropriate stakeholder in at least 3 phases of project design and construction process.	50
Actively involved: 2 or less integrated project team members in at least 3 phases of project design and construction process.	0

5.2.2 Qualification of the Integrated Project Team

The qualification of the planning team is assessed based on membership of individual planners in for example architecture and engineering chambers (Examples: Switzerland: SIA Swiss Society of Engineers and Architects, Germany: Architektenkammer) or other qualified chambers or associations. Further education with focus on sustainability will be considered at the assessment of the qualification as well (e.g. education BREEAM assessor or DGNB auditor etc.).

5.2.2 Qualification of the Integrated Project Team	Points
The design team members are members in architectural and engineering chambers or other qualified chambers or associations AND can demonstrate further education with focus on sustainability.	100
The design team members are members in architectural and engineering chambers or other qualified chambers or associations.	50
The design team members are not members in architectural and engineering chambers or other qualified chambers or associations.	0

5.2.3 Design Charrette / Preparation of consultation

Conduct at least 1 full-day (respectively 2 half-day) workshop with the integrated project team and at least 3 appropriate stakeholders PLUS the owner/owner's representative early in the design process. The goal of the workshop shall be the integration of sustainable design strategies and stakeholder requirements across the entire building design, based on the expertise of all participants. (further information can be found in **Annex 1** in attachments)

5.2.3 Design Charrette / Preparation of consultation	Points
At least 2 full-day (resp. 4 half-day) or more workshops with the integrated project team and at least 3 appropriate stakeholders PLUS the owner/owner's representative	100
1 full-day (resp. 2 half-day) workshop with the integrated project team and at least 3 appropriate stakeholders PLUS the owner/owner's representative	50
No full-day workshop with the integrated project team and at least 3 appropriate stakeholders PLUS the owner/owner's representative	0

5.2.4 Integrated planning process

All targeted certification criteria are to be integrated into the planning. The coordinator needs to describe the certification criteria for the work phases from preliminary design to detailed design (construction) as well as site supervision for a successful integration of the certification criteria. Description of project phases can be found in **Annex 2**.

Conduct and document meetings with the integrated project team at least monthly to review project status, introduce new team members to project goals, discuss problems encountered, formulate solutions, review responsibilities, and identify next steps.

5.2.4-a. Integrated planning process: Meetings	Points
Meetings with the integrated project team at least twice per month or more often	50
Meetings with the integrated project team once per month	25
No meetings with the integrated project team	0

5.2.4-b. Integrated planning process : Integration of certification criteria	Points
Integration of certification criteria in at least 4 or more project phases	50
Integration of certification criteria in at least 3 project phases	25
Integration of certification criteria in 2 or less project phases	0

5.2.5 Participation of future building users and other relevant stakeholders /Community impact consultation

Planning of consultation and information events during the project:

- Did participation, consultative involvement, and a co-determination of the users take place? The inclusion of the future users into the design normally increases their acceptance and satisfaction.
- Was the public involved, were they informed and consulted, and could they participate?

5.2.5-a. Participation of future building users and other relevant stakeholders	Points
Participation, consultative involvement, and a co-determination of the users and other relevant stakeholders took place.	50
No involvement of future building users and other relevant stakeholders	0

5.2.5-b. Community impact consultation	Points
The public were involved, informed and consulted, and they could participate	50
No involvement of the public community	0

Weights of Sub-indicators

Indicator 5.2	Weight
Sub- indicator 5.2.1 Multidisciplinary formation of the planning team	4
Sub- indicator 5.2.2 Qualification of the Integrated Project Team	4
Sub- indicator 5.2.2 Qualification of the Integrated Project Team	4
Sub- indicator 5.2.3 Design Charrette / Preparation of consultation	4
Sub- indicator 5.2.4. Integrated planning process	4
Sub- indicator 5.2.5 Participation of future building users and other relevant stakeholders / Community impact consultation	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

5.2.1 Multidisciplinary formation of the planning team

- Evidence through copies of reports, minutes etc. for 3 different project phases which show the team members names, specialty and responsibilities (see Annex 1: example of confirmation letter) .

5.2.2 Qualification of the Integrated Project Team

- Signed statement from the architect or the project manager verifying the compliance with this requirement.
- Demonstration that planning team members' did attend to further education with focus on sustainability (copies of certificates...).

5.2.3 Design Charrette / Preparation of consultation

- Confirmation that the integrated project team and at least 3appropriate stakeholders PLUS the owner/owner's representative conducted one or more full-day (resp. half-day) workshops. Copy of reports, minutes etc.
- Workshop attendee list:
 - List of paid/contracted team members (participants of the design charette), along with the dates and location for meetings/participation/workshop agenda. Name of the office appointed, area of specialty, role of attendee and address.
 - List of appropriate stakeholders (participants of the design charette), along with the dates for meetings/construction/participation. Type of stakeholder (user, residential, public authority...), name of the organization appointed, role of attendee and address.
- A consultation plan setting out the process and the scope of the consultation.
- Summary report of workshop activities and results including list of decisions proposed during the design charrette, compared with the final design decisions.
- An integration process schedule (“roadmap”) that identifies initial responsibilities, deliverables, and

dates for managing the project scope by defining: what, when, and by whom outputs need to be produced through Schematic Design.

5.2.4 Integrated planning process

- Evidence of meetings with the integrated project team. Date, participants and results of meetings. Copy of reports, minutes etc.
- Evidence of integration of certification criteria in various project phases with short description of the results in each phase.

5.2.5 Participation of future building users and other relevant stakeholders / Community impact consultation

- Demonstration of user co-determination in the form of detailed result logs, comments etc.
- Evidence of informational public participation by means of posters, flyers, informational events, publications etc. in the form of excerpts from these publications.
- Evidence of consultative public participation in public discussion events, surveys, citizen meetings etc. in the form of detailed event logs, press articles, survey evaluations etc. and a depiction of implementation in the planning stage.
- Statistics of the consultation and information process
- Results of the consultation process
- List of stakeholder and community proposals that have influenced design.

5. Relation to other Indicators

5.1 Project Preparation

6. Resources

1. Switzerland

- Recommendation SIA 112/1, 2004: Sustainable Building –Building Construction; Swiss Society of Engineers and Architects

2. Germany

- “Bürogebäude mit Zukunft”, TÜV-Verlag
- HOAI § 15, WPH 2 to 5 and WPH 8
- Architektengesetz der einzelnen Länder sowie Satzungen der Architekten- und Ingenieurskammern
- www.partizipation.at/handbuch-oeffbet.html
- BNB 2011 5.1.2 Integrated Planning
- DGNB 2012 PRO1.2 Integrated planning

3. UK

- National Charrette Institute (www.charretteinstitute.org)
Non-profit educational institution that help communities achieve healthy transformation through collaborative planning processes that harnesses the talents and energies of all interested parties to create and support a buildable plan.
- Planning for Real (www.nifonline.org.uk)
Is a participative planning initiative.
- For a guide to neighbourhood renewal and various resources see: www.renewal.net
- Design Quality Indicator (www.dqi.org.uk)
Method to assess the design quality of buildings.
- Commission for Architecture and the Built Environment (www.cabe.org.uk)

4. USA

- ANSI/MTS 1.0 Whole Systems Integrated Process Guide (WSIP)-2007 for Sustainable Buildings & Communities®.
- Draft ANSI/MTS 2.0 Integrative Process Standard for Design and Construction of Sustainable Buildings and Communities (this document is intended as an updated improvement to Version 1.0 above.)

5. Potential Technologies & Strategies (LEED 2012)

- Reinforce corporate/institutional commitments to environmental health and community responsibility.
- Use cross discipline design, decision-making, and charrettes. Use goal-setting workshops and build a team approach to the project.
- Prepare checklists for points and strategies prior to beginning the design process; refer to the checklist at milestones during the design process.
- Engage owner, staff, contractors, user groups and community groups, educating them on the benefits of green design and bringing them into the design process at key points in the decision-making process.
- Participate in peer-to-peer information exchange and problem solving.
- Consider performance-based incentives in professional contracts that reward achievement of Integrative Design Goals and Project Vision.
- Contractually apportion professional fees to create specific line items for the Integrative Design Charrette and subsequent monitoring and follow-up meetings.
- Consider seeking foundation support for integrative design initiatives.

6. SuPerBuildings final report – 2012

www.vtt.fi/inf/pdf/technology/2012/T72.pdf

7. Attachments

Annex 1 5.2.1 Example of confirmation letter:

Address

Name
Street
City

Sender

Name
Street
City

Zurich, 15.09.2011

Concern:5.2.1 Integrated Project Team

Dear Sir or Madam

I confirm herewith that the following project team members were actively involved in at least 3 phases of project design and construction process of the project XY.

Members of Integrated Project Team					
Name	Company/ Organization	Address	Function	Area of specialty	Responsibility
Mr. Muster Frau	ETH Zurich	Wolfgang- Paul-Strasse 15 CH-Zurich	Research Assistent	Building certification systems (LEED, BREEAM)	Case studies
xy	xy	xy	consultant	Lighting	Planning & Installation of lighting systems
xy	xy	xy	architect	Sustainable construction	Design & planning of project building

Zurich, 15.09.2011

Signature

(Name, Function)

Appendages

- Copies of reports
- Copies of minutes

Annex 2: 5.2.3 Definition and explanation of the Design Charrette

Charrette

“Any collaborative session in which a group of designers drafts a solution to a design problem. The charrette has become a technique for consulting with all stakeholders. A charrette typically involves intense meetings, involving municipal officials, developers, and residents. A successful charrette promotes joint ownership of solutions and attempts to defuse typical confrontational attitudes between residents and developers. Charrettes tend to involve small groups, however the residents participating may not represent all the residents nor have the moral authority to represent them. Residents who do participate get early input into the planning process. For developers and municipal officials charrettes achieve community involvement, may satisfy consultation criteria, with the objective of avoiding costly legal battles.”

Design Charrettes

“A Design Charrette is an intensive, hands-on workshop that brings people from different disciplines and backgrounds together to explore design options for a particular area or site. Design Charrettes are 'a fun and innovative way to engage the public, especially in projects where there is a significant landscape, streetscape, or other interesting design element. Design Charrettes are public workshops that include community members, design professionals, and other project staff. Charrettes can take place in a single session or be spread out among two or three workshops. The goal of the charrette process is to capture the vision, values, and ideas of the community - with designers sketching to create alternatives and ideas as fast as they can be generated by the participants. Design charrettes are a good way to build positive enthusiasm and energy for your project and, at the same time, be responsive to the creativity of the community.' (Source: <http://www.contextsensitivesolutions.org>)

Used For: To bring citizens, decision-makers and designers together to build a new or alternative vision for an area or site through a creative process of team work and competition.

Suitable participants: Any, although the process relies on working with professional designers, planners or architects.”

Example activities during the workshop (Based on LEED):

- Introduction of participants to the fundamentals of integrated design.
- Align project team around project purpose and goals.
- Develop a project management plan that identifies responsibilities, deliverables, and dates for managing the project scope by defining: what, when, and by whom outputs need to be produced.
- Initiate documentation of the Owner’s Project Requirements (OPR) for Commissioning

Examples of consultation /Design Charrette issues (Based on BREEAM)

- Functionality, building quality and local impact (including aesthetics)
- Building user satisfaction/productivity
- Management and operational implications
- Maintenance resources/burdens
- Good and bad examples of buildings of the same type.
- Local traffic/transport impact.
- Opportunities for shared use of facilities and infrastructure with the community/*appropriate stakeholders*
- Consultation with the *relevant bodies* to confirm whether the building (or site) is classified as any of the following:
 - A Building of local architectural or historic interest referred to in a local authority development plan
 - A Building within an area of outstanding natural beauty and national parks
 - A Building/site that is within the curtilage of, or contains on site, a scheduled ancient monument
 - Buildings or sites with distinguishing local architectural characteristics
 - Buildings within areas of archaeological significance.

Annex 3 5.2.4 Description of the different Construction phases

Construction phases (Based on LEED):

1. **Pre-design:** information gathering, recognizing stakeholder needs, establishing project goals, site selection
2. **Schematic design:** explores several design options with the intent to establish an agreed project layout and scope of work.
3. **Design development:** process of spatial refinement and usually involves the first design of energy systems
4. **Construction documents:** carry design in detail level for all spaces, systems, and materials
5. **Bidding:** Establishing of costs and signing of contracts for construction services
6. **Construction:** Actual construction of the project. Commissioning near the end of construction (if systems are installed and operable).
7. **Substantial completion:** contractual benchmark that usually point at which a client could occupy a nearly completed space.
8. **Final completion**
9. **Certificate of occupancy:** official recognition by a local building department that a building conforms to applicable building and safety codes.

Stages of the project (Based on LEnSE)

- 1 Preliminary study
- 2 Preparation of the project
- 3 Invitation to tender
- 4 Construction phase
- 5 Preparation of the use

Indicator 5.3 Building Performance Targets

(adapted from DGNB/BNB)

1. Objective

Planning a sustainable building requires a complex approach to set and manage the targets. The definition of targets and strategies needs a consistent, systematic consideration of sustainability throughout the building's design, construction and management.

Optimisation of the design and delivery process is thus very important for the improvement of the building's sustainability performance.

It must begin already in the design phase, because at this project development phase, the potential of optimisation for a sustainable building is very high and the impacts of changes of the building and the construction costs are low.

2. Assessment Methodology

The optimisation of the planning is done mainly with quality assurance measures such as the examination of planning documents and variant comparisons and considerations of various options. The indicator will be measured qualitatively with sub-indicators.

The following subindicators will be assessed:

- 5.3.1 Energy target
- 5.3.2 Water target
- 5.3.3 Waste target
- 5.3.4 Optimisation of daylight and artificial lighting
- 5.3.5 Conversion, dismantling and recycling
- 5.3.6 Concept for ease of cleaning and maintenance

3. Calculation and Rating

The following indicators will be assessed qualitatively:

5.3.1 Energy target

Creation and implementation of energy targets, that covers the building operation as outlined in OPEN HOUSE indicators 1.9 & 1.10.

5.3.1 Energy Target	Points
Evidence of verifying the in-use energy performance, annually, for a full 3 years after construction	100
Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used	75
Evidence that key requirements for meeting the targets are explicit in tender documentation	50
Evidence that the targets have been rechecked and tracked in design	25
A performance target is defined according to the quality requirements of OH 1.9 & 1.10 and is integrated into a project brief (OH 5.1)	10
No creation and implementation of a primary energy target	0

5.3.2 Water target

Creation and implementation of a water target, that covers the building operation as outlined in OPEN HOUSE indicator 1.11.

5.3.2 Water target	Points
Evidence of verifying the in-use water targets, annually, for a full 3 years after construction	100
Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used	75
Evidence that key requirements for meeting the targets are explicit in tender documentation	50
Evidence that the targets/strategies have been rechecked and tracked in design	25
A performance target is defined according to the quality requirements of OH 1.11 and is integrated into a project brief (OH 5.1)	10
No creation and implementation of a water target	0

5.3.3 Waste target

Creation and implementation of a waste target, that covers the building operation as outlined in OPEN HOUSE indicator 1.13.

5.3.3 Waste target	Points
Evidence of reporting the in-use waste targets, annually, for a full 3 years after construction	100
Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used	75
Evidence that key requirements for meeting the targets are explicit in tender documentation	50
Evidence that the targets/strategies have been rechecked and tracked in design	25
A performance target is defined according to the quality requirements of OH 1.13 and is integrated into a project brief (OH 5.1)	10
No creation and implementation of a waste target	0

5.3.4 Optimisation of daylight and artificial lighting

Creating and optimisation of daylight and artificial lighting targets, in accordance with OPEN HOUSE indicator 2.7.

5.3.4 Optimisation of daylight and artificial lighting	Points
Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used	100
Evidence that key requirements for meeting the targets are explicit in tender documentation	75
Evidence that daylight simulation AND calculation of artificial lighting have been carried out in design	50
Evidence that daylight simulation OR calculation of artificial lighting have been carried out in design	25
A performance target is defined according to the quality requirements of OH 2.7 and is integrated into a project brief (OH 5.1)	10
No daylight or artificial lighting targets have been created or implemented	0

5.3.5 Conversion, dismantling and recycling

Creation and implementation of targets and strategies for conversion, dismantling and recycling, in accordance with OPEN HOUSE indicator 4.7.

5.3.5 Conversion, dismantling and recycling	Points
Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used	100
Evidence that key requirements for meeting the targets are explicit in tender documentation	50
A target and strategy is defined according to BOTH the quality requirements of OH 4.7 and 2.15, and is integrated into a project brief (OH 5.1)	10
No targets or strategies for deconstruction and conversion have been created or implemented	0

5.3.6 Concept for ease of cleaning and maintenance

Creation and implementation of targets and strategies for ease of cleaning and maintenance, in accordance with OPEN HOUSE indicator 4.3.

5.3.6 Concept for ease of cleaning and maintenance	Points
Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used	100
Evidence that key requirements for meeting the targets are explicit in tender documentation	50
A target and strategy is defined according to the quality requirements of OH 4.3, and is integrated into a project brief (OH 5.1)	10
No daylight or artificial lighting targets have been created or implemented	0

Weights of Sub-indicators

Indicator 5.3	Weight
Sub-indicator 5.3.1 Energy target	4
Sub-indicator 5.3.2 Water target	4
Sub-indicator 5.3.3 Waste target	4
Sub-indicator 5.3.4 Optimisation of daylight and artificial lighting	4
Sub-indicator 5.3.5 Conversion, dismantling and recycling	4
Sub-indicator 5.3.6 Concept for ease of cleaning and maintenance	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

5.3.1 Energy target

5.3.2 Water target

5.3.3 Waste target

To receive 100 points for all categories:

- Evidence of verifying the in-use performance of the key targets, annually, for a full 3 years after construction.
- Evidence that a monitoring plan for how to measure and report the waste, water and energy (in-use) was discussed and agreed with the building owners prior to occupation. (OH 5.9.3)
- construction.

To receive 75 points for all categories:

- Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used, such as site inspection reports and/or photographs.

To receive 50 points for all categories:

- Key specifications which are relevant to the Energy, Water and Waste targets

To receive 25 points for all categories:

- Interim design reports/drawings comparing initial targets from brief, to estimated performance, based on current design and specification.

To receive 10 points for all categories:

- The project brief see requirement for OH 5.1 quality indicator requirements for OH 1.10, 1.11, 1.13.

5.3.4 Optimisation of daylight and artificial lighting

To receive 100 points:

- Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used

To receive 75 points:

- Key specifications which are relevant to the lighting and daylighting, including commissioning of electric lighting

To receive 50 points:

- Interim design reports/calculations including both daylighting simulation and artificial lighting calculations.

To receive 25 points:

- Interim design reports/ calculations including either daylighting simulation or artificial lighting calculations.

To receive 10 points:

- The project brief see requirement for OH 5.1, and quality indicator requirements for OH 2.7

5.3.5 Conversion, dismantling and recycling

Proof of documentation that makes it possible to dismantle and recycle parts of the building.

To receive 100 points:

- Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used

To receive 50 points:

- Key specifications which are relevant to the deconstruction and end of life

To receive 10 points:

- The project brief see requirement for OH 5.1, and quality indicator requirements for OH 4.7 and 2.15.

5.3.6 Concept for ease of cleaning and maintenance

Proof of cleaning and maintenance concept which show practical functions.

To receive 100 points:

- Evidence that key requirements have been verified, post-construction, and that work has been completed according to specification or equivalently performing alternatives have been used

To receive 50 points:

- Key specifications which are relevant to the cleaning and maintenance.

To receive 10 points:

- The project brief see requirement for OH 5.1, and quality indicator requirements for OH 4.3.

5. Relation to other Indicators

1.9 Non-renewable primary energy demand / Abiotic Depletion Potential for Fossil Fuels

1.10 Total primary energy demand and percentage of renewable primary energy.

1.13 Waste

2.5 Water Quality

2.7 Visual Comfort

4.3 Cleaning and maintenance

2.15 Flexibility for Future Users

4.7 Ease of deconstruction, recycling and dismantling.

6. Resources

1. Soft Landings - <http://www.bsria.co.uk/services/design/soft-landings/guidance/>

2. DGNB International

Criterion 45: Optimisation and complexity of planning method

3. BNB: Bewertungssystem Nachhaltiges Bauen (Germany)

Criterion 5.1.3: Komplexität und Optimierung der Planung

http://www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_513.pdf

4. Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites (eighth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)

5. Construction Design and Management Regulations (UK)

6. Contents of the French Global (PGCSPS) and Particular (PPSPS) Health and Safety Plan

7. Attachments

None

Indicator 5.4 Evidence of Sustainability during Bid Invitation and Awarding

(adapted from DGNB/BNB)

1. Objective

This indicator is closely connected to general principles of green and sustainable procurement. The aim is to assess whether the sustainability issues have been (not, partly or comprehensively) specifically addressed through individual or general requirements (must and target values) and integrated in the bid invitation documents (call for tenders). Also, the aim is to assess whether these issues have been taken into account during awarding, i.e. in the process of selection of products and services providers. The target traced here is assuring that the products and services (or, the whole building) will meet also sustainability objectives, being evaluated and awarded (selected) not only on the basis of the lowest price offered.

2. Assessment Methodology

This indicator is qualitative. The method of assessment consists of an aggregation of sub-indicator values. The aggregated scoring ranges from 0 to 100. With regard to the actual case assessed further subdivisions (intermediate ranking) within the range of predefined values for sub-indicators are also possible. In this case the assessor must provide own explanation and justification of scoring.

The following sub-indicators will be assessed:

5.4.1 Integration of Sustainability Aspects during Bid Invitation

5.4.2 Integration of Sustainability Aspects during Awarding

The assessment comprises thorough checking of the documentation prepared for and used in the bid invitation and awarding processes (including the offer(s) delivered by bid participant(s)).

Evidence for assessment shall be provided by the investor/bid invitation organiser.

3. Calculation and Rating

5.4.1 Integration of Sustainability Aspects during Bid Invitation

Evidence for assessment shall be provided by the investor/bid invitation organiser. As a rule the document parts linked directly to the assessment topic shall be delivered. The assessor can at any stage require further documentation or explanation and can make random checks by studying the complete call for tenders or its relevant parts.

Table 1 : 5.4.1 Integration of Sustainability Aspects during Bid Invitation

5.4.1 Integration of Sustainability Aspects during Bid Invitation	Points
Sustainability aspects are clearly and comprehensively integrated in the call for tenders' documentation on the overall building level, and – where appropriate – also on the individual components' level. Additionally, there is a performance sheet prepared listing functional requirements/technical performances with an indication of basic (must) criteria and target criteria (bonus points during awarding).	100
Sustainability aspects are clearly and comprehensively integrated in the call for tenders' documentation on the overall building level, and – where appropriate – also on the individual components' level. Must criteria are explicitly stated.	70
Sustainability aspects are integrated in a general way on the overall building level. Some additional such requirements are descriptively stated for certain building components.	50
Sustainability aspects are partly integrated on the overall building level.	10
Sustainability is not addressed in the call for tenders.	0

5.4.2 Integration of Sustainability Aspects during Awarding

Evidence for assessment shall be provided by the investor/bid invitation organiser. As a rule the document parts linked directly to the assessment topic shall be delivered. The assessor can at any stage require further documentation or explanation and can make random checks by studying the complete proceedings (minutes) or relevant parts.

Table 2 : 5.4.2 Integration of Sustainability Aspects during Awarding

5.4.2 Integration of Sustainability Aspects during Awarding	Points
In addition to the sustainability elements defined for the actual topic of the call for tenders (sub-indicator 5.4.1) there is a set of (project-specific) requirements prepared addressing sustainability aspects linked to the (potential) contractor, e.g. products/services provider. It can comprise topics as company environmental policy and qualifications, organisation of production, waste management, transport means, employment policies etc. The criteria contained herein can be must and/or target ones (leading from exclusion to bonus points). These requirements are used in connection with other ones to gain an integral valuation of the offer. Their role and way of consideration are clearly described in the bid invitation documents.	100
The awarding process includes consideration of certain sustainability aspects connected to potential contractor companies.	50
The awarding is conditioned by an obligation by the (future) contractor to respect/comply with certain standards, i.e. respecting the min. tariff rates or prevention of child labour (see also 2.17).	10
Sustainability is not addressed in the awarding process.	0

Weights of Sub-indicators

Indicator 5.4	Weight
Sub- indicator 5.4.1 Integration of Sustainability Aspects during Bid Invitation	4
Sub- indicator 5.4.2 Integration of Sustainability Aspects during Awarding	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

5.4.1 Integration of Sustainability Aspects during Bid Invitation

Call for tenders and Relevant technical project documentation

Pertinent excerpts from calls for tenders, such as texts pertaining to specific services, additional technical preliminary comments, and special contractual terms demonstrating that the required sustainability aspects were integrated

5.4.2 Integration of Sustainability Aspects during Awarding

List of requirements (awarding) and Proceedings of the awarding process

A description of the way contractors were selected in order to demonstrate how the quality of services, regional added value, local job retention, and the enforcement of environmental and social standards (such as a ban on child labor) were assessed.

5. Relation to other Indicators

None

6. Resources

DGNB

- 46 Evidence of sustainable aspects in call for and awarding of tenders

BNB

- 5.1.4 Sustainability Issues in Tender and Placing

http://www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_514.pdf (in German)

EU documents directives and strategies including: European Strategy for Sustainable Development, Lead Market Initiative, Europe 2020 and Energy 2020, Recast of EPBD and Green Public Procurement.

7. Attachments

None

Indicator 5.5 Construction Site Impact / Construction Process

(adapted from BREEAM, DGNB/BNB)

Core Indicator

1. Objective

The effects of the construction site on the environment are to be minimized while simultaneously protecting the health of all participants.

This indicator supports the European Commission goal to protect workers from harmful levels of noise or to harmful external influences¹ (e.g. gases, vapours, dust). It also supports the objective of the increase to a minimum of 70 % by weight of the preparing for re-use, recycling and other material recovery - including backfilling operations using waste to substitute other materials - of non-hazardous construction and demolition waste².

2. Assessment Methodology

The qualitative evaluation of the construction site and construction process includes following criteria:

1. **Low-waste and recycling on construction site:** When buildings are constructed, altered, or demolished, rubbish, excavated soil, leftover materials, packing materials, old wood, etc. accumulate. This waste is to be avoided or salvaged. Waste that is neither avoidable nor salvageable should be ecologically disposed. Additionally, recycling strategies for the construction waste generated should be adequately considered.
2. **Low-noise construction site:** Permanent exposure to noise can lead to overstimulation of the nervous-system and, thereby, to health problems. In densely built areas, construction noise, after traffic noise, is the most significant noise source. Therefore, it is to be demonstrated that the construction noise does not exceed the general noise level, or that adequate measures are used to reduce it.
3. **Low-dust construction site:** Dust is normally generated while handling construction materials during numerous and varied work activities. An important contribution to the protection of persons is achieved by minimizing dust. Furthermore, the environment is to be protected from damages caused by materials.
4. **Environmental protection at the construction site:** Ecological features (natural areas, trees,..) shall be protected from damage. In addition, soil and groundwater shall be protected from hazardous materials deposits and other forbidden influences during the construction phase. Chemical impacts can occur through products and operating procedures by which gaseous-, liquid, or solid materials can end up in the ground. Further effects, such as excessive compacting, shall be avoided.

Announcement and bidding documents, documentations, or measurement records show the execution of the measures and adherence to the limit values defined in sub-indicators.

The following sub-indicators will be assessed:

5.5.1 Low-waste and recycling on construction site

5.5.2 Low-noise construction site

5.5.3 Low-dust construction site

5.5.4 Environmental protection at the construction site

¹ DIRECTIVE 92/57/EC: implementation of minimum safety and health requirements at temporary or mobile construction sites

² DIRECTIVE 2008/98/EC on waste

3. Calculation and Rating

5.5.1 Low-waste and recycling on construction site

5.5.1 Low-waste and recycling construction site	Points
<ul style="list-style-type: none"> - The minimum legal requirements in the national regulation were met - Furthermore, the people involved in the construction process were specifically trained in waste prevention. - The construction overseers ensured that material was separated and the various waste containers were used properly. - Construction materials were sorted into mineral waste, recyclable material, mixed construction waste, problematic substances, and waste containing asbestos. 	100
<ul style="list-style-type: none"> - The minimum legal requirements in the national regulation were met. - Construction materials were sorted into mineral waste, recyclable material, mixed construction waste, problematic substances, and waste containing asbestos. 	50
No special steps were taken to prevent, reuse, or properly dispose of waste.	0

5.5.2 Low-noise construction site

5.5.2 Low-noise construction site	Points
<p>The noise caused during construction must demonstrably and consistently be below the general noise level of the surroundings or it must be proven that the specifications in the call for tenders and bids were complied with.</p> <p>Measurements were conducted and documented to prove compliance.</p>	100
<p>The noise caused during construction must demonstrably and consistently be below the general noise level of the surroundings or it must be proven that the specifications in the call for tenders and bids were complied with.</p> <p>Compliance was checked and documented (test of low-noise construction equipment, compliance with protection times, etc.).</p>	50
The call for tenders and bid documents specify the requirements for noise protection within the legal framework.	10
No special steps were taken to prevent construction noise. The national regulation about noise pollution was not complied with.	0

5.5.3 Low-dust construction site

This sun-indicator evaluates the following specifications:

- machines and equipment have effective vacuum devices
- dust is completely collected where it is produced to the extent possible and disposed of without an environmental impact.
- when technically possible, dust has to be prevented from spreading to work areas that are still clean.
- dust is not allowed to pile up
- vacuum equipment, humidifiers or water are used to get rid of dust
- the equipment used to separate and collect dust has to be state-of-the-art.
- the equipment must be regularly serviced and inspected
- these measures fulfil the legal requirements

5.5.3 Low-dust construction site	Points
All these specifications were required in the call of tenders and included in the bid. Their enforcement is monitored and documented.	100
All these specifications were required in the call of tenders and included in the bid.	50
Nothing was prepared to prevent or reduce dust	0

5.5.4 Environmental protection at the construction site

The aim of this sub-indicator is to protect existing ecological features from substantial damage during site preparation and completion of construction works. Soil and groundwater contamination, must be prevented and substances, such as chemicals, that could endanger the soil, water and the environment should be avoided.

All existing features of ecological value surrounding the construction zone and site boundary area are adequately protected from damage during clearance, site preparation and construction activities as listed below:

- Trees of over 100 mm trunk diameter, and/or of significant ecological value, are protected by barriers. Barriers must prohibit construction works in the area between itself and the tree trunk.
- Minimum distance between tree trunk and barriers must be either the distance of branch spread or half tree height, whichever is the greater.
- In all cases trees must be protected from direct impact and from severance or asphyxiation of the roots.
- Hedges and natural areas requiring protection must either have barriers erected and be protected, or, when remote from site works or storage areas, be protected with a prohibition of construction activity in their vicinity.
- Watercourses and wetland areas are to be protected by cut-off ditches and site drainage to prevent run-off to natural watercourses (as this may cause pollution, silting or erosion).
- Soil must be protected from detrimental mechanical influences, such as unnecessary soil compaction, the mixing of different soil layers,

In all cases, the contractor is required to construct ecological protection prior to any preliminary site construction or preparation works (e.g. clearing of the site or erection of temporary site facilities).

These protections aim at preventing the following substances of the Risk and Safety Statements to come into contact with the environment.

Risk and Safety Statements includes:

- R 50 Very toxic for water organisms
- R 51 Toxic for water organisms
- R 52 Dangerous for water organisms
- R 53 Can have dangerous long-term effects on bodies of water
- R 54 Toxic for plants
- R 55 Toxic for animals
- R 56 Toxic for organisms in soil
- R 57 Toxic for bees
- R 58 Can have dangerous long-term effects on the environment
- R 59 Dangerous for the ozone layer

5.5.4 Environmental protection at the construction site	Points
<p>The documents for the call for tenders and bids expressly take account of environmental protection. Steps are taken to ensure that trees, water and soil are protected from chemical contamination, especially from the substances listed in the Risk and Safety Statements, or detrimental mechanical influence. Documentation from the construction management confirms environmental protection during the construction phase.</p>	100
<p>The documents for the call for tenders and bids expressly take account of environmental protection. Steps are taken to ensure that trees, water and soil are protected from chemical contamination, especially from the substances listed in the Risk and Safety Statements. Documentation from the construction management confirms environmental protection during the construction phase.</p>	50
<p>The documents for the call for tenders and bids expressly take account of environmental protection. Steps are taken to ensure that trees, water and soil are protected in accordance with national regulations.</p>	10
<p>No special actions are taken to protect the environment during construction phase.</p>	0

Weights of sub-indicators

Indicator 5.5	Weights
Sub-indicator 5.5.1 Low-waste and recycling on construction site	4
Sub-indicator 5.5.2 Low-noise construction site	4
Sub-indicator 5.5.3 Low-dust construction site	4
Sub-indicator 5.5.4 Environmental protection at the construction site	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

5.5.1 Low-waste construction site

1. Demonstration that waste was at least separated into mineral waste, recyclable material, mixed construction waste, problematic waste in the form of agreements with contractors and a central waste disposal firm.
2. Demonstration that the parties involved in the construction process were trained in waste prevention (training documents, certificates, etc.).
3. Demonstration of checks of material separation and the correct use of separate waste containers and containers for recycling purposes by construction overseers (logs of inspection of material separation).

5.5.2 Low-noise construction site

1. Presentation of specifications for noise protection in the documents for the call for tenders and bids.
2. Measurements of noise levels during construction or other proof that noise was prevented during construction.

5.5.3 Low-dust construction site

1. Presentation of requirements for dust prevention, in particular organizational and technical measures taken to prevent and safely dispose of dust in documents for the call for tenders and bids.
2. Proof that organizational and technical measures to prevent and safely dispose of dust were enforced by construction overseers, who produced logs.

5.5.4 Environmental protection at the construction site

Presentation of specifications for environmental protection in the documents for the call for tenders and bids. It must include requirement to protect all identified features of ecological value and the scope of protection measures required.

Proof that environmental protection was enforced, including chemical contamination, the separation of already contaminated soil, and protection against substances listed in the Risk Statements. Inspection logs offered by construction overseers or comparable log books provide proof.

Demonstration that soil was not unnecessarily compacted and different soil layers not mixed in the form of documents for digging, levelling, landscaping, etc.

5. Relation to other Indicators

Indicator 1.7 **Biodiversity and depletion of habitats**

Indicator 4.7 **Ease of Deconstruction, Recycling, and Dismantling**

6. Resources

DGNB 48 Construction Site / Construction Process

BREEAM LE 3 - Ecological Value of Site and Protection of Ecological Features

Risk and Safety Statements:

http://ec.europa.eu/environment/chemicals/dansub/pdfs/annex3_en.pdf

Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites:

<http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1992L0057:20070627:EN:PDF>

<http://www.ekt.bme.hu/CM-BSC-MSD/FIEC-Directive9257EEC.pdf>

Low-waste construction site

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives:

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:en:PDF>

Low-noise construction site

Directive 2000/14/EC of the European Parliament and of the Council of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors: http://ec.europa.eu/environment/noise/pdf/d0014_en.pdf

Low-dust construction site

Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC):

http://www2.unitar.org/cwm/publications/cbl/ghs/Documents_2ed/C_Regional_Documents/215_EU_Directive9824EC.pdf

BRE/EA publications ‘Control of Dust from Construction and Demolition Activities’ (BRE, 2003).

Pollution Control Guide Parts 1-5 (BRE, 2003).

Environmental protection at the construction site

Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control:

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:024:0008:0029:en:PDF>

Proposal for a European Parliament and Council Directive of 22 September 2006 setting out a framework for soil protection and amending Council Directive 2004/35/EC:

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:263:0009:0011:EN:PDF>

7. Attachments

None

Indicator 5.6 **Quality of the Executing Contractors** **Pre-Qualification**

(adapted from DGNB)

1. Objective

Pre-qualification, i.e. the exclusion of contractors from the bidding process when they don't fulfill the requirements given in a predetermined set of criteria is a frequently practiced procedure in many countries. In order to enhance the performance levels of selected contractors and to minimize failures in meeting client's objectives, several criteria must be taken into account and a consistent evaluation methodology must be applied.

The objective of the indicator is to assess the quality of executing contractors.

2. Assessment Methodology

This indicator verifies to which extend the pre-qualification was considered during contract award.

The following sub-indicator will be assessed:

5.6.1 Quality of Executing Contractors / Pre-Qualification

3. Calculation and Rating

5.6.1 Quality of Executing Contractors / Pre-Qualification	Points
The bidding firms were reviewed according to ISO 14001 or equal rules (such as the company's quality management) by the building owner or the building owner's representative.	100
Only contractors whose reliability, expertise, and high performance were confirmed using the standards of ISO 9001 received contracts OR The contractors' reliability, expertise, and high performance are known based on many years of collaboration	50
Contractors whose qualification was not confirmed received contracts	0

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

5.6.1 Quality of Executing Contractors / Pre-Qualification

Qualification of contractors

Demonstration of contractor eligibility

Demonstration of contractors' reliability, expertise, and high performance.

5. Relation to other Indicators

None

6. Resources

The Government Procurement Agreement (GPA):

http://www.wto.org/english/tratop_e/gproc_e/gp_gpa_e.htm

Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors:

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:134:0001:0113:en:PDF>

Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts:

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:134:0114:0240:en:PDF>

ISO 9001:2008 “Quality management systems - Requirements”:

http://www.iso.org/iso/catalogue_detail?csnumber=46486

ISO 14001:2004 “Environmental management systems - Requirements with guidance for use”:

http://www.iso.org/iso/catalogue_detail?csnumber=31807

<http://www.praxiom.com/iso-14001-2004.htm>

GUIDE TO THE COMMUNITY RULES ON PUBLIC WORKS CONTRACTS:

http://ec.europa.eu/internal_market/publicprocurement/docs/guidelines/works_en.pdf

7. Attachments

None

Indicator 5.7 **Quality Assurance of Construction Execution**

(adapted from DGNB/BNB)

1. Objective

The quality reached in the process of the construction execution shall be described, verified, and certified on the one hand to eliminate risks and deficiencies, and on the other hand to demonstrate the achieved quality to third parties. The following aspects are dealt with:

1. The goal of documenting the used and built-in materials, additives, and the systematic collection of the safety data sheets is to create documentation on important building data for a building user guide. A detailed documentation contributes toward facilitating rising upcoming processes during the building's life cycle.
2. Measurements and analyses (including measurements for determination of the air-tightness of the building's shell and of the quality of the noise protection) shall verify and document the reaching of the aimed-for qualities and target values.

2. Assessment Methodology

The evaluation takes into account the following sub-indicators:

5.7.1 Documentation of the materials, auxiliary materials, and safety data sheets

5.7.2 Measurements for quality control

3. Calculation and Rating

In a quality assessment, the assessor can take into account the project-specific features to make adjustments to the scoring system. These adjustments must be clearly justified and documented.

If the required documentation and proof for this sub-indicator cannot be provided during the auditing process, reasons must be given. If neither informative documentation nor plausible demonstration or justifiable reasons can be provided, no points are given.

5.7.1 Documentation of the materials, auxiliary materials, and safety data sheets

5.7.1 Documentation of the materials, auxiliary materials, and safety data sheets	Points
The materials used were comprehensively documented and compared to the ones planned, the required safety data sheets are available, and the documents have been compiled along with other documentation for the building in a building manual.	100
The materials used were comprehensively documented and compared to the ones planned, and the required safety data sheets are available.	75
No documentation about materials and substances used was compiled. There are no safety data sheets.	0

5.7.2 Measurements for quality control

Based on the large variety of measurement and test methods, three groups of quality assurance methods are considered to evaluate this sub-indicator:

- Procedures to measure the energy quality of a building (e.g. blower door test to measure air tightness or thermography)
- Procedures to measure the acoustical qualities of a building (e.g. checking the footfall sound insulation).
- Procedures to measure the building components quality relatively to moisture risk

5.7.2 Measurements for quality control	Points
Blower door measurements and measurements of footfall sound between internal walls and ceiling were taken or are planned. Demands on moisture safety and moisture safety in planning and building process are formulated and documented. Moisture critical constructions are identified and controlled during the building process. A building physic or moisture safety expert has been involved in the whole process. The results are to be comprehensively documented.	100
Blower door measurements AND measurements of footfall sound between internal walls were taken or are planned. Moisture critical constructions are identified and controlled during the building process. The results are to be comprehensively documented.	75
Blower door tests were conducted OR measurements of footfall sound between internal walls were taken or are planned. Moisture critical constructions are identified and controlled during the building process The results are to be comprehensively documented.	50
None of the measurements described above were conducted nor planned to support quality assurance.	0

If blower door measurements are not possible, other studies can be conducted to reach the full number of points (such as thermography). The same if footfall sound measurements are not possible.

These tests must be described.

Weights of sub-indicators

Indicator 5.7	Weights
Sub-indicator 5.7.1 Documentation of the materials, auxiliary materials, and safety data sheets	4
Sub-indicator 5.7.2 Measurements for quality control	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

5.7.1 Documentation of the materials, auxiliary materials, and safety data sheets

- Compilation of all product data sheets and safety data sheets in accordance with 91/155/EEC for all layers of the main building components (as for example DIN 276-1 “Building costs – Part 1: Building construction” in Germany) with an easy-to-follow data structure.
- Integration of the information on products used (product name, manufacturer, etc.) and building materials (key technical figures) in the building manual.

5.7.2 Measurements for quality control

- Checks on a building's energy quality by means of methods such as the blower door test or thermography
- Checks on a building's noise protection/acoustic quality by means of methods such as the footfall sound tests.
- Building physic expert report and photographic documentation

Note:

A blower door test is required for an assessment of the building envelope's heat and moisture protection quality in Indicator 4.6 Building Shell.

The documents listed for this sub-indicator only have to be presented if required by the scoring process

5. Relation to other Indicators

- 1.6 Risks from Materials
- 4.5 Noise Protection
- 4.6 Building Shell

6. Resources

Directive 91/155/EEC of 5 March 1991 defining and laying down the detailed arrangements for the system of specific information relating to dangerous preparations in implementation of Article 10 of Directive 88/379/EEC: <http://www.dehp-facts.com/upload/documents/webpage/document34.pdf>

DIN 276-1 Building costs – Part 1: Building construction

<http://www.beuth.de/cn/J01586CD9D7B736D60E87E40C4ECDA708.4/bGV2ZWw9dHBsLUxhbmdhbnplaWdlJnNtb2lkPTExMTA1MjY3NiZsYW5ndWFnZWlkPWVu.html>

DGNB - 50 Quality assurance for construction

BNB 2011 - 522 Quality Assurance of the Building Construction

7. Attachments

None

Indicator 5.8 Commissioning

(adapted from DGNB/BNB, BREEAM, LEED)

Core indicator

1. Objective

To assess to what extent the advanced commissioning process has been planned, organized, implemented and documented in the building life cycle and whether the commissioning outcomes have been used for systems improvements.

Commissioning is a process of preparing systems and setting them to work, verifying their performance and documenting results. The commissioning process will start at the planning phase and will end after one year of operation. Basic commissioning process is based on a commissioning plan developed during the planning phase with functional tests for all selected systems by independent third parties during the delivering period before buildings starts for operation phase.

If operation is subsequently optimized by adjusting the facility after 10-14 months of operation, the score is higher because changes in the facility can then take into account the initial operational phase. In a quality assessment, the assessor can take account of project specific features to make adjustments to the scoring system. These adjustments must be clearly justified and documented.

If the required documentation and proof for this criterion cannot be provided during the auditing process, reasons must be given.

Advanced commissioning is an organized and planned process which should be an integral part of the overall project quality assurance process. Advanced commissioning provides documented confirmation that building systems are planned, designed, installed, tested, and are capable of being operated, and maintained in compliance with the performance requirements, e.g. investor's project requirements, operational needs (definitive end-users) and other requirements related to building sustainability. The activities of the advanced commissioning should take place in all project stages in the whole building life cycle.

The scope of the building systems being commissioned depends on the building type, its complexity, technical and functional performance. Different voluntary or obligatory assessment schemes advocate or require that systems be commissioned. The scope of systems which are to be commissioned has to be defined in the commissioning planning process.

The OPEN HOUSE encourages the advanced commissioning of all systems and engineering services which are assessed or closely related to OPEN HOUSE indicators. The main building systems which can be commissioned are: HVAC & DHW, Building Assembly, Electrical, Plumbing, Building Automation and Communication, Protective, and Alarms Systems. Other systems can be commissioned if appropriate in regard to OPEN HOUSE methodology and assessment indicators. The results (performance tests results, commissioning checklists, measurements gathered etc.) might be used in other OH criteria as an input data if appropriate.

2. Assessment Methodology

The commissioning process and its performance will be assessed by reviewing different paper based or electronic documentation elaborated, accepted and used within the commissioning process. The main parties in the process which will have to provide evidence documentation are:

- Investor or his representative (consulting engineer etc.)
- Commissioning Authority (e.g. Commissioning Manager who leads, plans, schedules, and oversees the whole process, coordinates the commissioning team, and manages the interfaces with third parties if appropriate)
- Members of the commissioning team (representatives of other parties which will take part in commissioning activities, e.g. design professionals, contractor, subcontractors, manufacturers, suppliers, installers, supervisors, O&M¹team)
- Commissioning sub-contractors (specialists specialized for particular systems, tests or services (balancing, measurements...))

Documents, created by other parties (inspectors, administrative authorities, insurance organisations...) will also be taken into consideration.

The following sub-indicator will be assessed:

5.8.1 Commissioning process management and documentation

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¹ O&M: Operation and Maintenance

3. Calculation and Rating

5.8.1 Commissioning process management and documentation

Goal is to assess :

- to what extent the commissioning plan has been efficiently supported by commissioning process documents
- if the commissioning process has been implemented and its results documented
- that energy and resource optimization processes have been conducted in the first 14 months of use.

The basic purpose of building commissioning is to provide a quality-based process with documented confirmation that building systems are planned, designed, installed, tested, operated, and maintained in compliance with the building performance requirements. The commissioning process and its outcomes have to be documented and implemented according to these documents. **Commissioning related documents differ from country to country according to country specific practices and/or construction regulation.** In the OH assessment process different documents (contracts, procedures, plans, handbook, reports...) or their parts will be assessed when these documents have similar content or meaning as the following group of documents:

- Commissioning plan
- Commissioning process management
- Commissioning specifications
- Commissioning methods and procedures
- Commissioning outcome documents (reports, records, check lists..)
- Commissioning contractually agreements of the first 14 months

The Commissioning Plan and other documents describing the organization and the commissioning process are well defined by codes of practice for particular countries (for example CIBSE/BSRIA Commissioning Codes in UK) and should be tied to them if appropriate or required.

Commissioning plan (or other documents with similar content and meaning) should define the project (investor's) policy and requirements for commissioning, the systems to be commissioned (commissioning scope), an overall schedule of commissioning process activities, the roles and responsibilities for the commissioning team (including the commissioning authority), the structure of documents describing the process, the organization, communication and reporting procedures of the commissioning team, and the financial provisions for commissioning.

Commissioning process management documents support the management of the commissioning process. The Commissioning process documents can be linked to codes of practice for particular countries and should be tied to them if appropriate or required. These documents should be systematically prepared, and verified by Commissioning authority or the commissioning team, regularly updated and filed. Documents should be available to appropriate members of the commissioning team (for example as electronic versions). It is suggested to use the following major Commissioning documents:

- **Commissioning programme** – defines a detailed schedule of the commissioning activities and their actual status through all project phases. For each commissioning and related activities different information has to be prepared or entered when commissioning progresses. For example short description and reference document(s) (e.g. commissioning specification, standard, practice, method...) and responsible for their elaboration, status of the activity (due date /in progress/finished), responsible party and other parties involved, preconditions to be met, results of implementation, reference to output document(s) (progress report, minutes of the meeting...). Detail commissioning programme should be integrated with the overall project schedule and

- updated according to the progress of overall project and commissioning activities, and according to the decisions of the commissioning team and/or commissioning authority
- **Commissioning log book** – enables formal recording of problems or concerns that have appeared or have been notified by commissioning team and/or other parties (for example commission subcontractors)
 - **Progress reports:** report the status of the commissioning process activities at defined milestones or according to investor's request
 - **Minutes of commissioning meetings:** commissioning team should meet on regular basis to discuss the working arrangements, activities completed and planned, and to support decision making within the commissioning process

Commissioning specifications define detailed technical and organizational requirements for various commissioning activities (works, services, tasks) related to particular system to be commissioned and or for specific commissioning activities if appropriate. Commissioning specification might be a standardised procedure (code of practice) tailored to particular system implemented in a building. Commissioning specification should define:

- Scope of commissioning (detailed description of the system and its interrelation with other systems)
- System's performance requirements (design data and drawings relevant to commissioning, other requirements related to sustainability of the building)
- Technical specifications: type and description of commissioning works and services in different project/commissioning phases (design brief review, static tests, performance tests, integrated system testing, seasonal commissioning), standards, codes of practice, regulation, methods, techniques and instruments to be used
- Organisational provisions for system's contractors, commissioning sub-contractors and other parties involved (third parties as statutory, administrative authorities for technical inspection, issuing of the user's permit, utility companies, insurance companies...)
- Requirements for preparation of the systems in different project/commissioning phases
- Requirements in regard the use, operating and maintenance (OH manuals, user guides)
- Acceptance criteria for completion of the commissioning process
- Requirements for commissioning reporting and commissioning outcome managements (the way how these outcomes will be used for improvements in the future).

Commissioning methods and working procedures: written protocols that define working steps, the methods, techniques and instruments to be used, personal to be informed, trained and controlled if needed, and expected outcomes (testing results, measurements, reports generated etc) for particular commissioning work, service, test conducted on particular building system in defined commissioning phase. The manufacturer's guidance should be taken into account, too. The commissioning methods and working procedures are tailored to different commission procedures, goals and actual systems being commissioned.

Commissioning outcome documents are different documents (paper based or electronic) which are resulting from the implementation of the commissioning activities. These documents are different reports, records, minutes of the meetings, test sheets, test results, checklists, statements etc. The templates for these documents should be prepared and accepted in advance.

5.8.1 Commissioning process management and documentation	Points
<p>The commissioning outcome documents (progress reports, minutes of the meeting, check lists, statements) clearly demonstrate that the commissioning activities - defined in plan and commissioning programme - have been implemented according to commissioning specifications, methods and procedures (consistency between process and process out coming documents). Commissioning plan, programme and other documents have been regularly and systematically updated and integrated with the overall project schedule.</p>	100
<p>Commissioning with subsequent adjustments and operational optimization was conducted or contractually agreed upon within the first 14 months of use. Complete documentation is available or contractually agreed upon.</p>	75
<p>All system components were subjected to a functional test by the contractors who installed them. The type, scope, and results of these functional tests are documented in the handover logs.</p>	50
<p>Documentation why commissioning for all system components have not been conducted with plausible reasons. Functional tests for individual facility components have been conducted</p>	10
<p>No Commissioning was conducted, nor were functional tests for individual facility components.</p>	0

4. Documentation Guidelines

Different paper based or electronic documents elaborated, accepted, used or resulted from the commissioning process will be used for the assessment purposes. Documents with different naming (agreements, procedures, plans, handbook, statements...) or their parts will be assessed when they have similar content or meaning as the documents described below and in the description of the OPEN HOUSE indicator. Additionally or on request, the applicants will have to provide descriptions of the commissioning process, actors involved, and activities done – if this is not described in the process documents. This will be needed when activities with similar goals are done as part of the extended construction supervision, or administrative procedures related to building acceptance or user permit acquisitions (activities beyond the standard requirements).

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

Documents related to particular finished building assuming that commissioning has been implemented as planned and according to defined scope.

- Evidence of the commissioned-focused review and verification of construction drawings and technical submittals
 - o Update of commissioning specifications, commissioning methods and procedures, tailored to designed and accepted solutions (manufacturers).
- Evidence of the off-site commissioning activities done before the start of installation works (factory performance testing, off—site visual tests, static testing, setting to work, performance testing on demo installations, factory testing, mock-up testing)
- Evidence of pre-commissioning activities (verification of installation works and static tests)
- Results of the performance testing of the building systems and of group of systems such as heating systems, ventilation, air conditioning, chilled water systems, building automation, lighting systems, hot water supply, sun shading systems and façade louvers for natural ventilation (performance tests results, commissioning checklists, measurements gathered...)
- Evidence of the integrated system testing
- Report back on system deficiencies, improvements done and re-testing results
- Commissioning and building logbooks
- Commissioning records and reports, records of acceptance of systems
- Documentations of third parties (building acceptance, user permits...), acquired certificates
- Evidence that the output of the commissioning was effectively used for planning and implementation of the systematic corrective measures for installed systems in use and operation phase
- Evidence that the commissioning results have been disseminated for future improvements or re-development of the systems, their functionality, and performance
- Report or contractual agreement for operational optimization and improvements
- Evidence on on-going process for energy management with reviews and optimization during the operation phase.

5. Relation to other Indicators

- 5.1 Quality of the Project's Preparation
- 5.2 Integrated Planning
- 5.6 Quality of the Executing Contractors/Pre-Qualification
- 5.7 Quality Assurance of Construction Execution
- 5.9 Monitoring, Use and Operation

6. Resources

1. Code of Practice for Project Management for Construction and Development, Chartered Institute of Building, 2010, Wiley-Blackwell, UK
2. A BSRIA guide: Commissioning Job Book, BSRIA, 2010, by Glen Hawkins
3. White Paper: Commissioning for Great Buildings, February 2005, Building Commissioning Association, US,
4. Best Practices in Commissioning Existing Buildings, Building Commissioning Association,
5. ACG Commissioning Guideline, www.commissioning.org
6. Whole Building Design Guide, Building commissioning, National Institute of Building sciences, US, www.wbdg.org/project/buildingcomm.php)
7. Smernica za naročila javnih gradenj (Guidelines for public tendering), The Slovenian Chamber of Engineers, 2011
8. DGNB 2009: indicator 51 Commissioning

7. Attachments

None.

Indicator 5.9

Handover and Performance Evaluation

(adapted from BREEAM, DGNB/BNB, LEED)

1. Objective

This indicator aims to cover many objectives. Firstly, it encourages to handover the building to the users and managers in a way that helps them operate and manage the building efficiently.

Moreover, it ensures the necessary information on the building is in order to make users and the building manager aware of the state of construction of the final building with respect to maintenance and operation. It also supports to provide users and building managers with appropriate “building manuals” promoting the efficient operation of the building itself.

One main objective is to optimize the actual performance of a building, independent of the inherent environmental quality of the building itself, based on the management policies, procedures and practices related to the operation of the building.

Overall this indicator should aid in ensuring the performance of a building during its operation, thus reducing running costs and improving its environmental performance.

2. Assessment Methodology

According to the “*Specifications Guide for Performance Monitoring Systems (jointly funded CEC PIER-DOE project 2007)*”, there are four key aspects of performance monitoring that have to be addressed:

- performance metrics
- measurement system requirements
- data acquisition and archiving
- data visualization and reporting

The monitoring will focus on the following categories: Energy, Water, Materials & Waste and also Occupant satisfaction. The handover and documentation should be focused on ensuring that operators and users understand the environmental features of the building.

Moreover, there is also a need to create conditions to optimize the use and the management of the building, with the verification of the adequacy and accuracy of data as well as clear instructions for users or facility managers.

The following sub-indicator will be assessed:

5.9.1 Handover & Documentation

5.9.2 Building Performance Improvement

3. Calculation and Rating

5.9.1 Handover & Documentation

This sub-indicator is divided in 4 different parts

- a. Induction and Training
- b. User manual (non-technical)
- c. Operation and Maintenance Information
- d. As-built Drawings

5.9.1.a. Induction and Training	Points
Training on operating the building efficiently is given to BOTH technical staff (facilities managers) and non-technical end users, covering all environmental strategies (lighting, ventilation, heating and cooling)	25
No project documentation is compiled.	0
5.9.1.b. End User manual (non-technical)	Points
A plain-language, illustrated user manual is compiled, including recommendations and information for users to minimize ecological footprint, covering all environmental strategies (lighting, ventilation, heating and cooling)	25
No manuals for facility managers nor users is compiled.	0
5.9.1.c. Operation and Maintenance Manuals (technical)	Points
Detailed instructions for maintenance, inspection, operation, and care are compiled and a maintenance and repairs plan was drawn up; these instructions are specified for individual target groups (facility manager, building services engineer, cleaners, security, etc.).	25
No technical instructions for use, maintenance, and care are compiled.	0
5.9.1.d. As-built drawings	Points
Plans for the building are updated and prepared for use by facility managers; like the evidence documentation and calculations, the plans correspond to the finished building. In particular, the national energy performance certificate was adjusted to reflect reality.	25
The plans do not correspond to the finished building.	0

5.9.2 Building Performance Improvement

The monitoring of Energy, Water and Waste is required under indicator 5.3:

- a. Energy: final energy consumption
- b. Water: water consumption
- c. Waste: waste production

Additional Monitoring can be carried out on

- d. Health & Well-being: occupant satisfaction

5.9.2a Evidence of continuous improvement in operation	Points
The building has can evidence a reduction in energy and water consumption, and waste production over the first three years.	50
The building has can evidence a reduction in EITHER energy consumption, OR water consumption, OR waste production over the first three years.	25
No reduction in energy and water consumption, and waste production can be evidenced	0

5.9.2b Environmental Certification	Points
The building has achieved both ISO50001 and ISO14001	25
The building has achieved either ISO50001 or ISO14001	10
No Environmental or energy management certification has been achieved	0

5.9.2c Feedback Improving design and delivery	Points
At least three organisations from the delivery team (architect, consultants, builders, subcontractors or client) can demonstrate that feedback from monitoring and evaluation has been communicated to their staff	25
Less than three organisations can evidence that feedback from monitoring has been communicated to their staff.	0

Weights of sub-indicators

Indicator 5.9	Weights
Sub-indicator 5.9.1 Handover & Documentation	4
Sub-indicator 5.9.2 Building Performance Improvement	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

5.9.1.a Training and Induction

Training on operating the building efficiently is given to BOTH technical staff (facilities managers) and non-technical end users, covering all environmental strategies (lighting, ventilation, heating and cooling)

- Agenda of the training sessions (may be different agendas for technical and non-technical staff)
- staff sign-in sheets from the training sessions

5.9.1.b. End User manual (non-technical)

A plain-language, illustrated user manual is compiled, including recommendations and information for users to minimize ecological footprint, covering all environmental strategies (lighting, ventilation, heating and cooling). Can be short (2-4 pages long) for simple buildings.

- Copy of non-technical manual

5.9.1.c. Operation and Maintenance Manuals (technical)

Compiled, detailed instructions for maintenance, inspection, operation, and care are compiled and a maintenance and repairs plan was drawn up; these instructions are specified for individual target groups (facility manager, building services engineer, cleaners, security, etc.).

5.9.1.d. As-built Drawings

The final plans and verification that they match the final construction in the form of a letter of confirmation from Architect or building inspector.

5.9.2a Evidence of continuous improvement in operation

The building has can evidence a reduction in energy and water consumption, and waste production over the first three years. Documentation must demonstrate a reduction from year 1 annual values to year 3.

- Annual energy consumption records, by fuel, for the first 3 years of occupation.
- Annual waste production records, by type, for the first 3 years of occupation
- Annual water consumption records, for the first 3 years of occupation

5.9.2b Environmental Certification

The building management/owners have achieved ISO50001 for energy management and ISO14001 for environmental management.

- Certificates of certification from ISO must be provided

5.9.2c Feedback Improving design and delivery

Members of the delivery team (architect, consultants, builders, subcontractors or client) can demonstrate that feedback from in-use monitoring and evaluation has been communicated to their staff. Evidence should include:

- internal presentations on post-occupancy monitoring to staff at the participating organisations which explain the results of post-occupancy monitoring that suggest improvements for future buildings and projects.
- staff sign-in sheet from the seminar/workshop

5. Relation to other Indicators

Indicator 5.8: Commissioning

6. Resources

1. CIBSE TM31 Logbook
2. ISO 14001:2004
3. ISO 50001:2011
4. BSRIA Soft Landings
5. Institute for Sustainability, Guide to BPE
<http://bob.instituteforsustainability.org.uk/knowledgebank/public/bpereport/Pages/default.aspx>
6. BREEAM IN USE, 2009
7. LEED FOR EXISTING BUILDINGS, OPERATION & MAINTENANCE, 2008
8. LEED FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS, 2009
9. DGNB, Criterion 47: Creation of conditions for an Optimal Use and Management
10. NBB, 2011, Criterion 5.1.5: Conditions for optimal management
11. A Specifications Guide for Performance Monitoring Systems
http://cbs.lbl.gov/performance-monitoring/specifications/pdf/PM%20Spec%20Guide%20Version%201_2007-03-23.pdf

7. Attachments

None

OPEN HOUSE

ASSESSMENT GUIDELINE

The Location

- 6.1 **Risks at the Site**
- 6.2 Circumstances at the Site
- 6.3 **Options for Transportation**
- 6.5 Access to amenities

Note: Core indicators are in bold

Indicator 6.1 Risks at the site

(adapted from DGNB/BNB, BREEAM, ESPON, HQE, LEED)

Core Indicator

1. Objective

The objective is to avoid the development of buildings, roads or parking areas in high-risky areas, in inappropriate areas and to reduce the risk resulting from ground, water and man-made-hazards.

2. Assessment Methodology

Several types of risks can be identified on a site:

- Those related to the ground, the geology, seismology, volcanism
- Those related to the weather, the climate
- Those related to human action, voluntary or not (man-made-hazards)

Those various hazard potentials at the site can be evaluated by using existing hazards and risk maps, results of the European Spatial Planning Observation Network (ESPON 2006), project 1.3.1. “The spatial effects and management of natural and technological hazards in general and in relation to climate change”

The following sub-indicators will be assessed:

Ground, geology, seismology, volcanism

6.1.1. Earthquakes

6.1.2. Landslides

6.1.3. Volcanic eruptions

6.1.4. Tsunamis

Weather / climate

6.1.5. Extreme temperatures

6.1.6. Forest fires

6.1.7. Drought

6.1.8. Floods

6.1.9. Storms

6.1.10. Avalanches

Man-made-hazards

6.1.11. Technological hazard/Chemical plants accidents

6.1.12. Technological hazard/Contaminant release and explosions

6.1.13. Technological hazard/Radioactive contamination from nuclear power plants accidents

For each sub-indicator, the hazard can be evaluated with a hazard map from ESPON. It can be very low, low, moderate, high or very high. The calculation and rating will be based on the level of importance.

However, it is recommended to use a local hazard map when it is available and use a similar scale for the scoring.

3. Calculation and Rating

Ground, geology, seismology, volcanism

6.1.1. Risk of Earthquakes (ESPON)

Hazard characterisation

Earthquakes are seismic movements of the solid earth that are mainly caused by tectonic activities. Most of the world's earthquakes occur in areas where large tectonic plates meet, but they may also occur within plates themselves. Earthquakes can also occur by other impacts, such as collapse of cavities underground.

Earthquake hazard map

The peak ground acceleration data from the Global Seismic Hazard Assessment Project (GSHAP) were used to produce an earthquake hazard map covering the whole of Europe.

Peak ground acceleration	Hazard class
0-4% g	Very low hazard
4-14% g	Low hazard
14-24% g	Medium hazard
24-40% g	High hazard
> 40% g	Very high hazard

This sub-indicator can be evaluated according to ESPON hazard map “earthquake hazard potential”.

6.1.1 Risk of earthquake	Points
Very low hazard	100
Low Hazard	75
Moderate Hazard	50
High Hazard	5
Very high Hazard	0

6.1.2. Risk of Landslides (ESPON)

Hazard characterisation

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. The ESPON Hazards project uses the general term "landslide" to express the hazard of gravity forced movement of material on a slope that could lead to potential structural damages and accidents.

Landslide hazard map

In order to develop a first overview map on the problem of landslides in European regions, the ESPON Hazards project developed a questionnaire that was sent to all geological surveys of Europe. Based on expert opinion, the geological surveys were asked to mark those NUTS 3 areas of their respective country or region that have the possibility of landslide hazards in general terms.

No or unknown landslide potential	1 Very low hazard
Landslide potential	5 Very high hazard

This sub-indicator can be evaluated according to ESPON hazard map “areas with landslide hazards”

6.1.2. Risk of landslides	Points
Low hazard	100
High hazard	0

6.1.3. Risk of volcanic eruptions (ESPON)

Hazard characterisation

A volcanic eruption is considered in this report as the arrival of solid products at the Earth's surface in the form of either the explosive ejection of fragmental material or the effusion of initially liquid lava.

Volcano hazard map

The volcano hazard map is based on all volcanoes with known eruption dates in Europe within the last 10 000 years that are marked on the Volcanic Eruption Map of Munich Re, compiled by the Global Smithsonian Institute. The hazard intensity classification is based on Munich Reinsurance Company's classes.

No eruptions	1 Very low hazard
The status of Holocene eruption is uncertain or Holocene activity is only hydrothermal	2 Low hazard
Last eruption before 1800 AD	3 Medium hazard
Last eruption after 1800 AD	4 High hazard
Volcanoes that are identified as being particularly dangerous by the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI).	5 Very high hazard

This sub-indicator can be evaluated according to ESPON hazard map "known volcanic eruptions".

6.1.3. Risk of volcanic eruptions	Points
Very low (no eruptions)	100
Low (eruption status uncertain)	75
Moderate (last eruption before 1800 AD)	50
High (last eruption after 1800 AD)	5
Very High (particularly hazardous volcanoes)	0

6.1.4. Risk of tsunamis (ESPON)

Hazard characterisation

Tsunamis are seismic waves caused by earthquakes, large landslides, volcanic activities and meteorite impacts.

The tsunami hazard map

The tsunami hazard map was derived from several international data sources (see reference list in the map). This map only shows the tsunamis hazard areas around the Mediterranean Sea.

Areas that have experienced tsunamis that resulted mainly from gravitational landslides (terrestrial landslides)	1 Very low hazard
Areas in close vicinity to tectonically active zones	3 Medium hazard
Areas in close vicinity to tectonically active zones that have already experienced tsunami runups from earthquakes, volcanoes and/or resulting (submarine) landslides	5 Very high hazard

This sub-indicator can be evaluated according to ESPON hazard map “historically recorded tsunami runups”

6.1.4.Risk of tsunami	Points
Very low hazard	100
Moderate hazard	50
Very high hazard	0

Weather / climate

6.1.5. Extreme temperatures (ESPON)

Hazard characterisation

Extreme temperatures are significantly higher or lower than the average temperature of a regional climate. Extreme heat can lead to strong health impacts that mostly affect the oldest and the youngest population. Extreme cold leads to a stronger use of heating systems, which can then lead to a shortage of energy and even power cuts.

Extreme temperatures hazard map

The extreme temperature map is based on data from the Swedish Meteorological and Hydrological Institute (SMHI) Rossby Centre's Regional Atmosphere-Ocean Model (RCAO). The data is based on a grid of 50x50km from the time span 1961-1990.

Mean = 2-2.75	2 Low hazard
Mean = 2.75-3.25	3 Moderate hazard
Mean = 3.25-3.50	4 High hazard

It can be evaluated according to ESPON hazard map “extreme temperature hazard map”.

6.1.5. Risk of extreme temperature	Points
Low hazard	100
Moderate Hazard	50
High hazard	0

6.1.6. Forest fires (ESPON)

Hazard characterisation

Forest fires (wild fires) can cause considerable damage in environmental terms, e.g. by the destruction of fauna and flora, and can cause human casualties. They also have serious economic implications on forestry, infrastructure and private property.

Forest fire hazard map

The forest fire hazard map developed by the ESPON Hazards project is a combination of vegetation zones and observed forest fires (ATSR, 1997 to 2003).

Observed forest fires per 1000 km ²	Hazard class	Biogeographic regions	Hazard class	Resulting sums	Resulting forest fire hazard classes
No forest fires	1	Alpine and Arctic	1	2-3	1 Very low hazard
1	2	Atlantic	2	4-5	2 Low hazard
2-5	3	Boreal	3	6-7	3 Medium hazard
6-10	4	Continental, Black Sea, Pannonian and Steppic	4	8-9	4 High hazard
>10	5	Mediterranean	5	10	5 Very high hazard

This sub-indicator can be evaluated according to ESPON hazard map “forest fire hazard”.

6.1.6. Risk of forest fire	Points
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0

6.1.7. Drought (ESPON)

Hazard characterisation

Droughts and long dry periods have led to serious power failures in Europe and in consequence to great economic losses in the industrial sector and tourism.

Map of potential drought indication

The assessment of potential drought is based on a map of precipitation deficits in regional basins

Amount of observed precipitation deficits 1904-1995	Hazard Class
2	1 Very Low
3-5 (no area with 4 droughts)	2 Low
6	3 Medium
7	4 High
8	5 Very high

It can be evaluated according to the hazard map “precipitation deficit as potential drought indicator”.

6.1.7. Risk of droughts	Points
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0

6.1.8. Floods (ESPON & BREEAM)

Hazard characterisation

Floods are high-water stages where water overflows its natural or artificial banks onto normally dry land, such as a river inundating its floodplain. Floods occur at more or less regular intervals in riverbeds and floodplains but also beyond them.

Large river flood events recurrence map in Europe

The assessment is based on a map of the frequency of flood in the time span of 1987-2002.

The probability of flooding of a flood zone can be assessed more precisely by *a flood map developed by the relevant national water authority, or where no flood maps are available, by a flood risk assessment of the site conducted by the relevant local authority.* (BREEAM, Pol 5 Flood risk)

If the risk of flood is considered as moderate, high or very high, the existence of attenuation measures can provide extra points:

Attenuation measures (BREEAM, Pol 5 Flood risk)

1. Where on-site attenuation measures are specified to ensure that:
 - a. The peak rate of run-off from the site to the watercourses (natural or municipal) is no greater for the developed site than it was for the pre-development site for all events up to the 100-year return period.
 - b. The additional predicted volume of rainwater discharge caused by the new development, for a 1 in 100 year event is entirely reduced using infiltration AND / OR is made available for use in the building as a replacement for potable water use in non-potable applications such as WC flushing.
2. Those measures must be designed using dynamic wave methods and in accordance with EN 752:2008 and EN 12056-3:2000.
3. The capacity of the attenuation measures must include an allowance for climate change.
4. Any residual additional rainwater volume that cannot be prevented from being discharged (reasons must be provided with supporting evidence), the peak discharge rate from the site should be reduced to:
 - a. The pre-development site's estimated mean annual flood flow rate (Q_{bar}); or
 - b. A minimum flow rate (litres per second)

This sub-indicator can be evaluated according to ESPON hazard map “flood recurrence” above.

6.1.8. Risk of flood	Points
Existence of attenuation measures (exclusively if the risk of flood = “moderate”, “high” or “very high”)	+25
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0

6.1.9. Storms (ESPON)

Hazard characterisation

According to the Munich Reinsurance Company, storms are world wide the highest reason for economic losses by natural hazards. Tropical cyclones occur only in European overseas territories, meanwhile tornados also occur locally in Europe, but these are seldom and difficult to predict. The most relevant storms for Europe are the so-called regional storms, i.e. winter storms. These regional storms are also the highest cause for economic and insured losses in Europe.

Storm Map

The storm hazard is represented according to the probability of occurrence, as reported by the Munich Reinsurance Group.

No or very seldom winter (tropical) storm probability	1 very low hazard
Medium to high winter (tropical) storm probability	3 medium hazard
High to very high winter (tropical) storm probability	5 Very high hazard

This sub-indicator can be evaluated according to ESPON hazard map “storms hazard”.

6.1.9. Risk of storms	Points
Very low hazard	100
Medium hazard	50
High/very high hazard	0

6.1.10. Avalanches (ESPON)

Hazard characterisation

An avalanche is a mass of snow, ice and debris sliding down a mountainside.

Avalanche hazard map

Avalanches are very local phenomena that occur only along certain slopes and valleys. The map does not display a general local frequency or probability, as this is not feasible due to changing weather conditions, i.e. avalanche maps have to be updated regularly.

Areas with no (or unknown) avalanche potential	1 Very low hazard
Areas with avalanche potential	5 Very high hazard

This sub-indicator can be evaluated according to ESPON hazard map “areas exposed for avalanches”.

6.1.10. Risk of avalanche	Points
Very low hazard	100
Very high hazard	0

Man-made-hazards

6.1.11. Technological hazard/Chemical plants accidents (ESPON)

Hazard characterisation

The most threatened areas are the industrial facility and its employees itself. In addition, the area around the facility is threatened by an emission from the facility to the wider area. The possible impact of a major accident is nearly impossible to forecast, as it depends on the type of accident, the physico-chemical components, the transporting media (air/water), the current weather conditions, the speed of recognition and reaction, etc.

Example map on major accident hazards, chemical production plants

The example map on major accident hazards is synthetic, as it displays the number of chemical production plants per km² per NUTS 3 level, regardless of the substances handled, the size of the plant or the particular safety record of a plant.

Share of chemical plants/km ² /NUTS 3 level	Hazard class
[Share]=0	1=Very low
[Share]>0and<0,000318	2=Low
[Share]=0,000318-0,000830	3=Moderate
[Share]=0,000831-0,002535	4=High
[Share]=0,002526-0,066781	5=Very high

This sub-indicator can be evaluated according to ESPON hazard map “density of chemical plants”.

6.1.11. Technological hazard/Chemical plants accidents	Points
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0

6.1.12. Technological hazard/Contaminant release and explosions (ESPON)

Hazard characterisation

All activities in oil production, processing, transport and storage pose hazards of contaminating the environment.

Oil processing, transport and storage hazard map

The overview map on oil production, processing, storage and transportation displays the main European maritime oil terminals, refineries, storage tanks and pipelines (CONCAWE, World Port Index). Oil platforms and shipping routes are no eligible source of information. Currently there is no information available on exact shipping routes and amounts, neither on types of transported oil.

Sum of refineries, oil harbours and pipelines	Hazard class
0	1 Very low hazard
3	2 Low hazard
4-6	3 Medium hazard
7-10	4 High
11-16	5 very high hazard

This sub-indicator can be evaluated according to ESPON hazard map “oil as technological hazard”

6.1.12. Technological hazard/ Contaminant release and explosions	Points
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0

6.1.13. Technological hazard/Radioactive contamination from nuclear power plants accidents (ESPON)

Hazard characterisation

The technological hazard related to nuclear power plants (NPPs) is special in many respects and needs to be treated accordingly. Firstly, the consequences of a large-scale nuclear accident have a big spatial extent, making all of Europe exposed to possible nuclear fallout. Secondly, the theoretical frequency of occurrence (probability) of such an accident is extremely small, less than once in two million years (Fortum, 1999).

Nuclear power plants hazard map

The nuclear power plant hazard map follows a synthetic approach based on the areas contaminated by the Chernobyl accident in 1986. The presented risk assessment for Europe's power plants is developed according to the experiences made after the accident in 1986. The areas around nuclear power plants are classified according to those areas most affected into the zones 1 (30km radius) and 2 (300km radius), i.e. the areas that have to be evacuated and those of mandatory resettlement, according to the International Communications Platform on the Longterm Consequences of the Chernobyl Disaster (Chernobyl.info).

Regions that do not intersect 300km radius	1 Very low hazard
Regions that intersect 300km radius	3 Medium hazard
Regions that intersect 30km radius	5 Very high hazard

It can be evaluated according to ESPON hazard map “the potential hazard of radioactive contamination”.

6.1.13. Technological hazard/ Radioactive contamination from nuclear power plants accidents	Points
Very low hazard	100
Moderate hazard	50
Very high hazard	0

Weights of Sub-indicators

Indicator 6.1	Weight
Sub-indicator 6.1.1. Earthquakes	2
Sub-indicator 6.1.2. Landslides	3
Sub-indicator 6.1.3. Volcanic eruptions	1
Sub-indicator 6.1.4. Tsunamis	1
Sub-indicator 6.1.5. Extreme temperatures	2
Sub-indicator 6.1.6. Forest fires	2
Sub-indicator 6.1.7. Drought	1
Sub-indicator 6.1.8. Floods	2
Sub-indicator 6.1.9. Storms	3
Sub-indicator 6.1.10. Avalanches	1
Sub-indicator 6.1.11. Technological hazard/Chemical plants accidents	2
Sub-indicator 6.1.12. Technological hazard/Contaminant release and explosions	2
Sub-indicator 6.1.13. Technological hazard/Radioactive contamination from nuclear power plants accidents	2

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

1. Hazard and risk maps on the ESPON Website www.espon.eu with specific information on the sub-indicators.
2. Other analytical sources, such as GIS data, meteorological maps, data from research institutes, etc., to better describe hazards and risks at a specific location.

5. Relation to other Indicators

4.4 Resistance against hail, storm high water and earthquake.

6. Resources

Website of ESPON (European Spatial Planning Observation Network) where all hazards and risk maps presented in this document are kept up to date, i.e. www.espon.eu

Website of RMS, which is the world's leading provider of products, services, and expertise for the quantification and management of catastrophe risk, i.e. www.rms.com
www.preventionweb.net

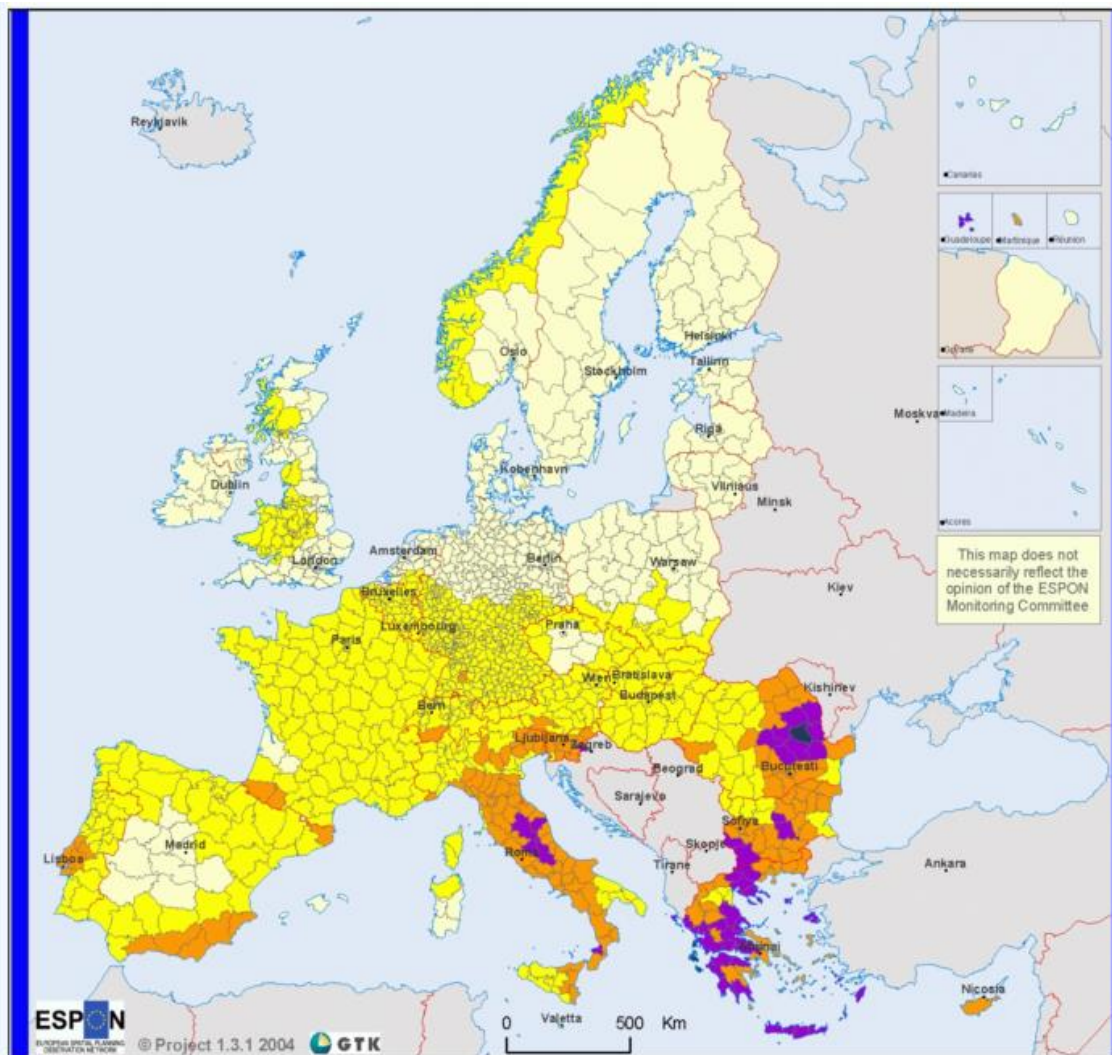
BREEAM Europe Commercial 2009 Assessor Manual (Issue Pollution 5: Flood risk)

LEED Reference Guide for Green Building Design and Construction 2009 Edition

HQE Guide Pratique du référentiel pour la qualité environnementale des bâtiments

7. Attachments

ESPON Maps



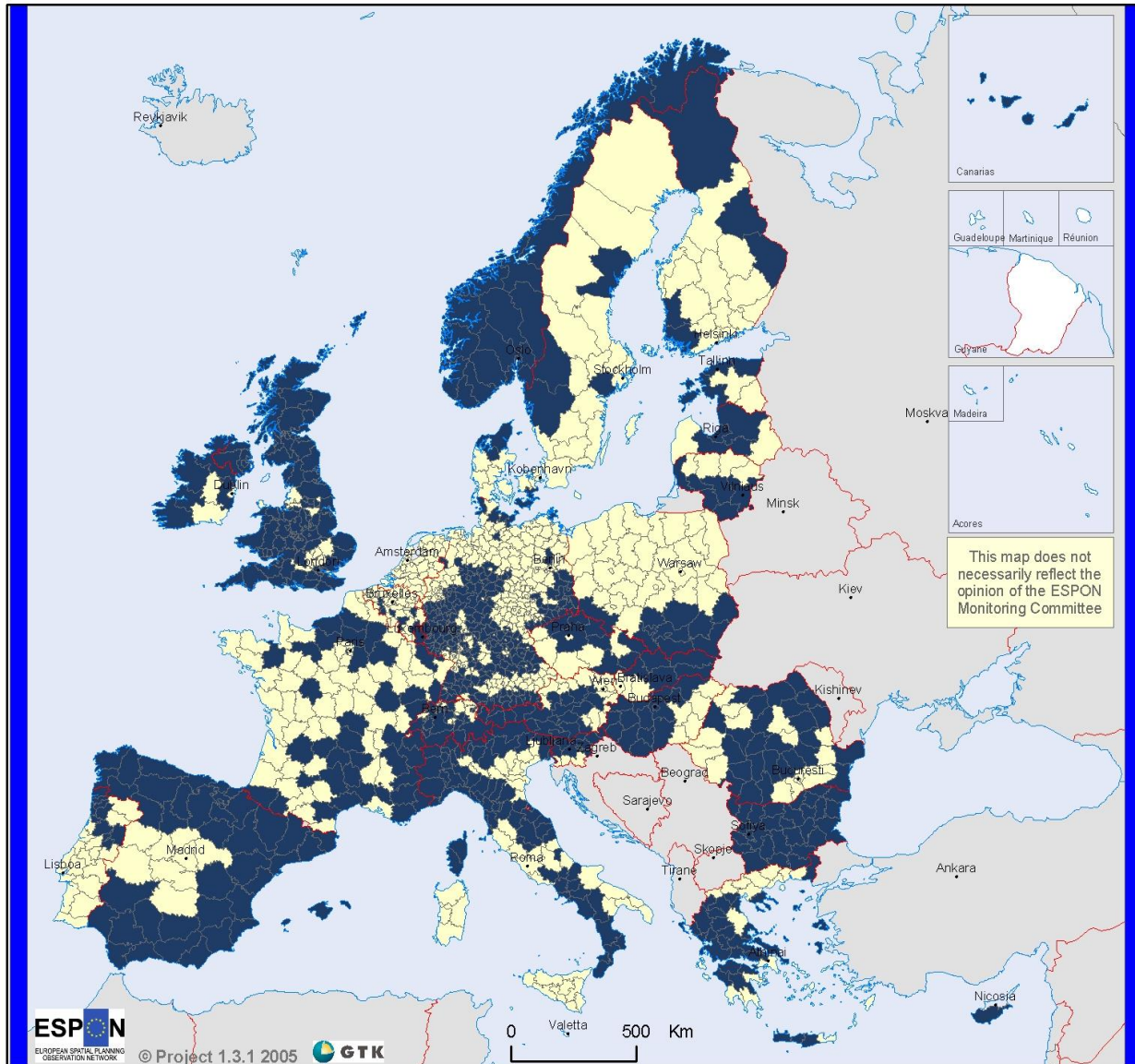
Earthquake hazard potential

Potential classification

- Very low hazard
- Low hazard
- Moderate hazard
- High hazard
- Very high hazard
- Non ESPON space

Origin of the data: EuroGeographics Association for the administrative boundaries
Pga data Global Seismic Hazard Assessment Program
Source: ESPON Data Base

The classification is based on the average value of pga/acceleration of gravity (%) in a NUTS 3 area.



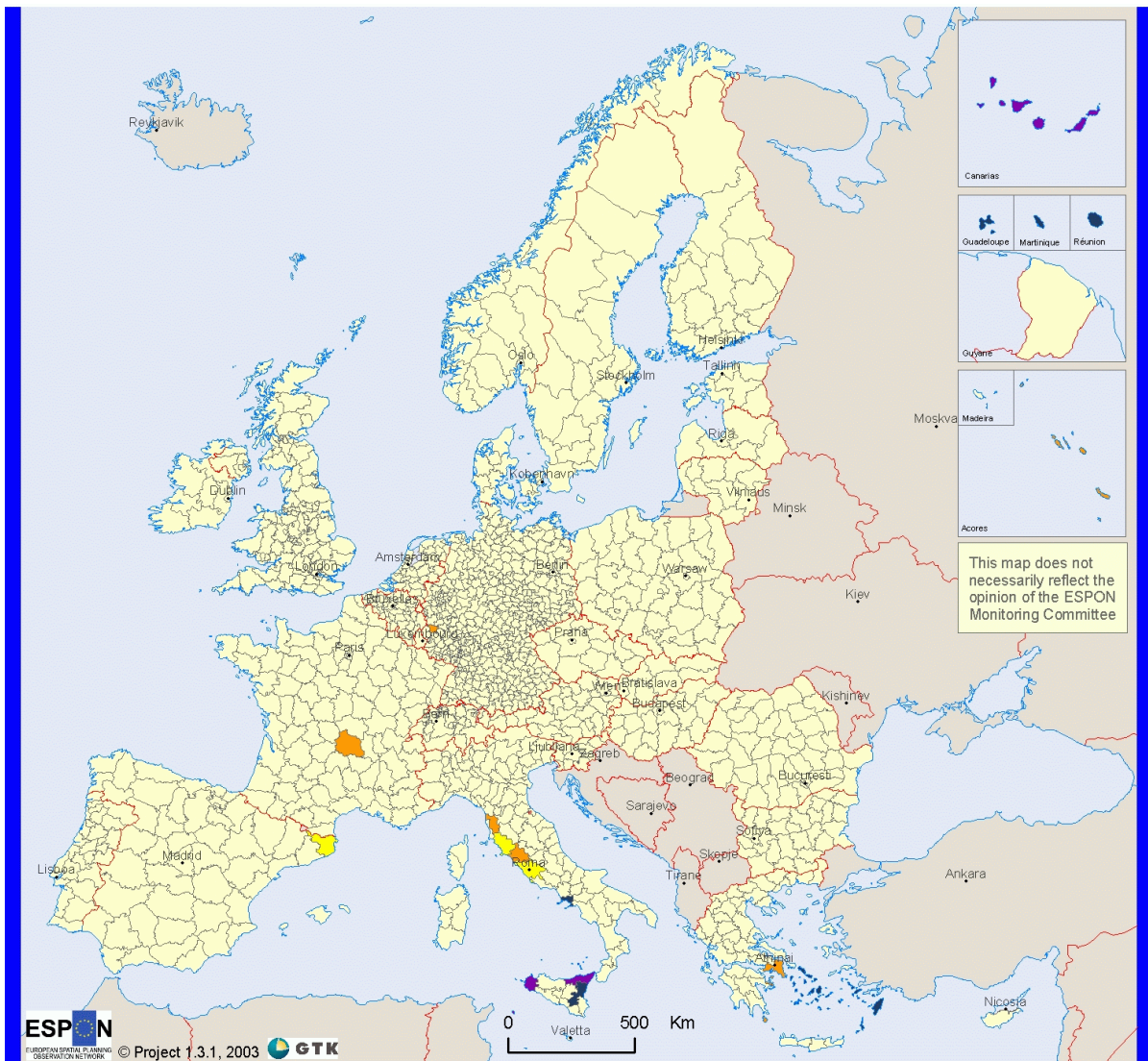
This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

Areas with landslide hazard

- Low hazard
- High hazard
- Nodata
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
Source: ESPON Data Base

Areas with landslide hazards, based on national expert opinion of European Geological Surveys.

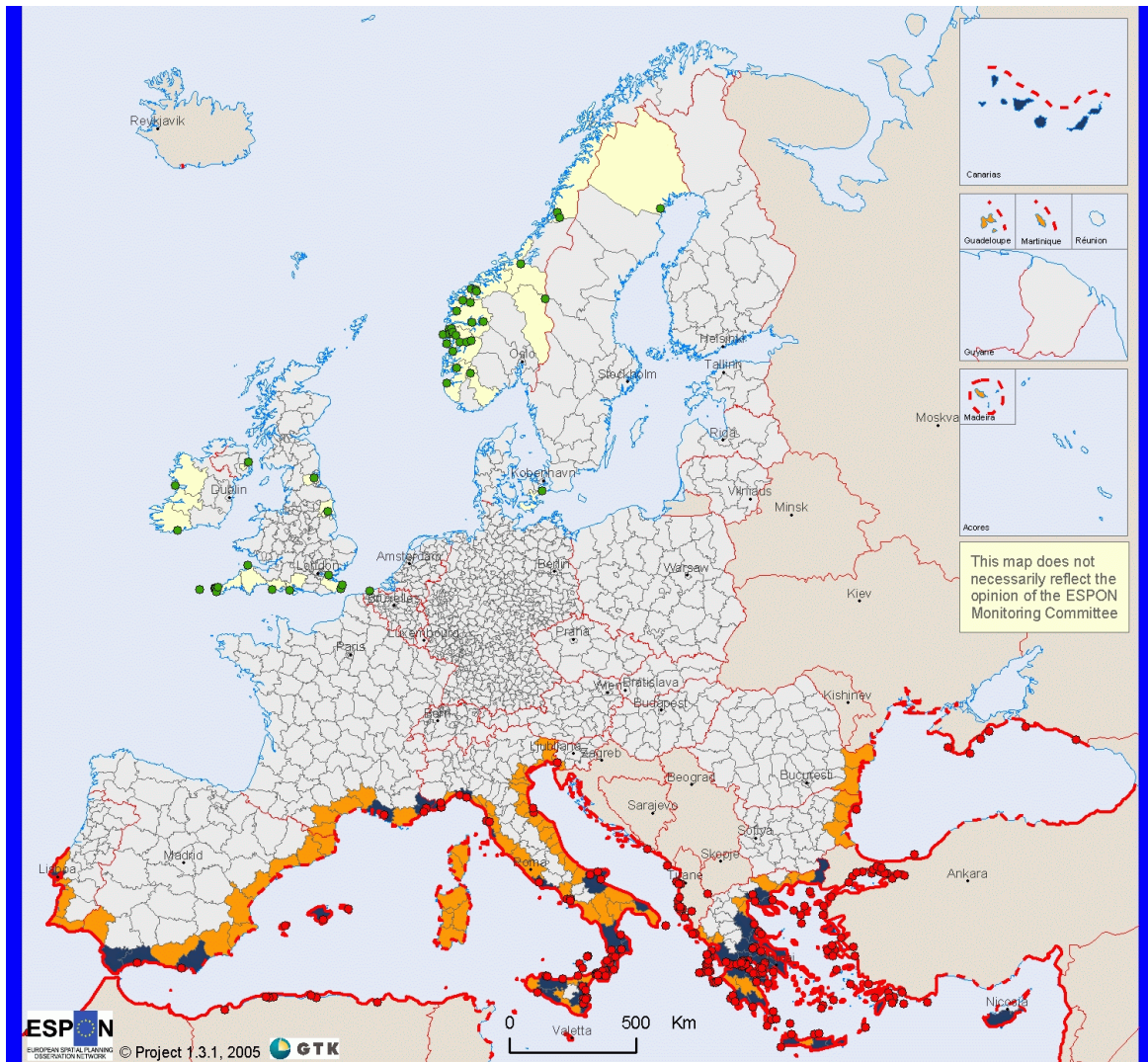


Known volcanic eruptions

- No eruptions
- The status of eruption is uncertain
- Last eruption before 1800 AD
- Last eruption after 1800 AD
- Particularly hazardous volcanoes
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
Volcanic Eruptions: Smithsonian Institute, Global Volcanism Program
Risk classification: Munich Re Group
Source: ESPON Data Base

This map is based on known volcanic eruptions during the last 10 000 years, and the risk classification is based on the time when the last eruption has occurred. The most dangerous volcanoes are identified by International Association of Vulcanology and Chemistry of the Earth's Interior (IAVCEI).



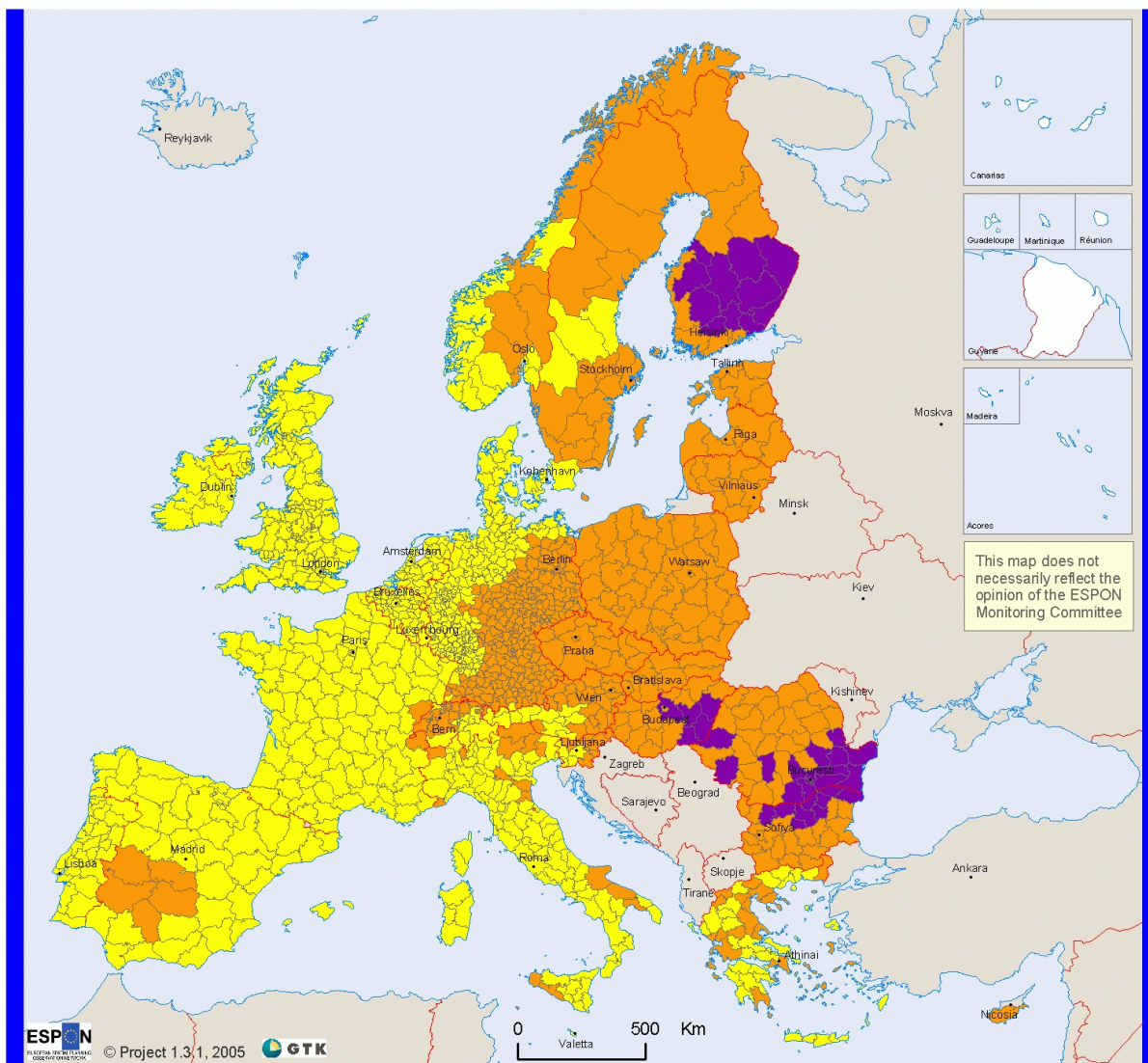
Historically recorded tsunami runups

- Earthquake/volcano/submarine landslide associated
- Terrestrial landslide associated

Tsunami hazard potential

- Probable tsunami hazard areas
- Tsunami hazard areas
- EspoN space
- Regions experienced landslide associated tsunami
- Tsunami potential coastal areas close tectonically active zones
- Regions experienced earthquake/volcano/landslide associated tsunami
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
 Northern coast of Africa and Spain: Hébert, 2003
 Greece: Institute of Geodynamics, National Observatory of Athens
 Spain: Instituto Geográfico Nacional
 Italy: Istituto Nazionale di Geofisica e Vulcanologia, Roma
 World Tsunami data: National Geophysical Data Center (NGDC)
 World Map of Natural Hazards: Munich Reinsurance Company
 Source: ESPON Data Base

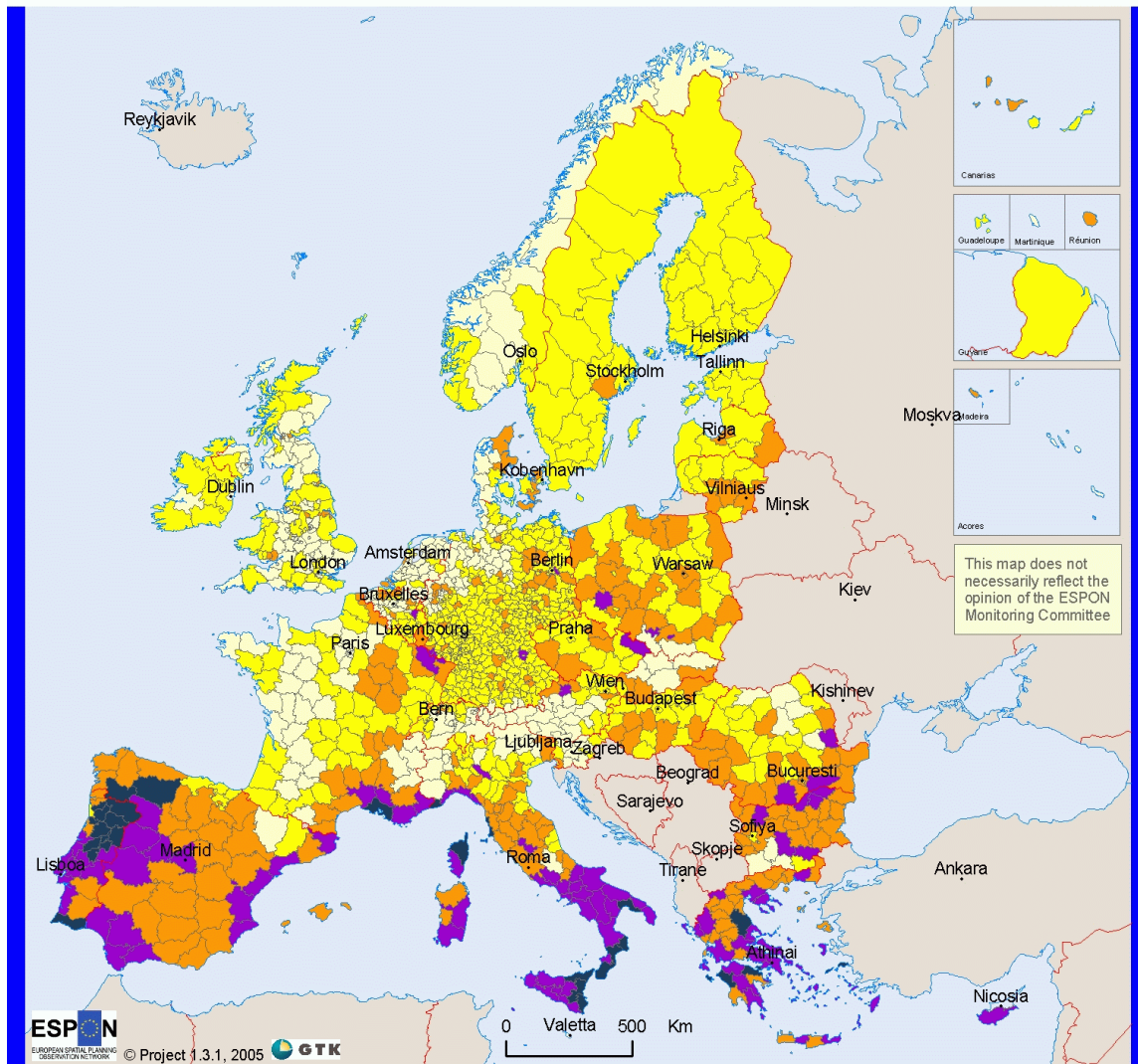


Extreme temperature hazard

- Low hazard
- Moderate hazard
- High hazard
- No data

Origin of the data: © EuroGeographics Association for the administrative boundaries
Rossby Centre RCO model
Source: ESPON Data Base

All the values of the four indicators (hot days, heat waves, cold days and cold waves) are classified in five categories. This map shows the mean of those four indicators.



Canaries
Guadeloupe Martinique Réunion
Guiana
Madeira
Azores
This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

Forest fire hazard

- Very low
- Low
- Moderate
- High
- Very high
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
Forest fires years 1997-2003: ESA
Biogeographic regions: EEA
Source: ESPON Data Base

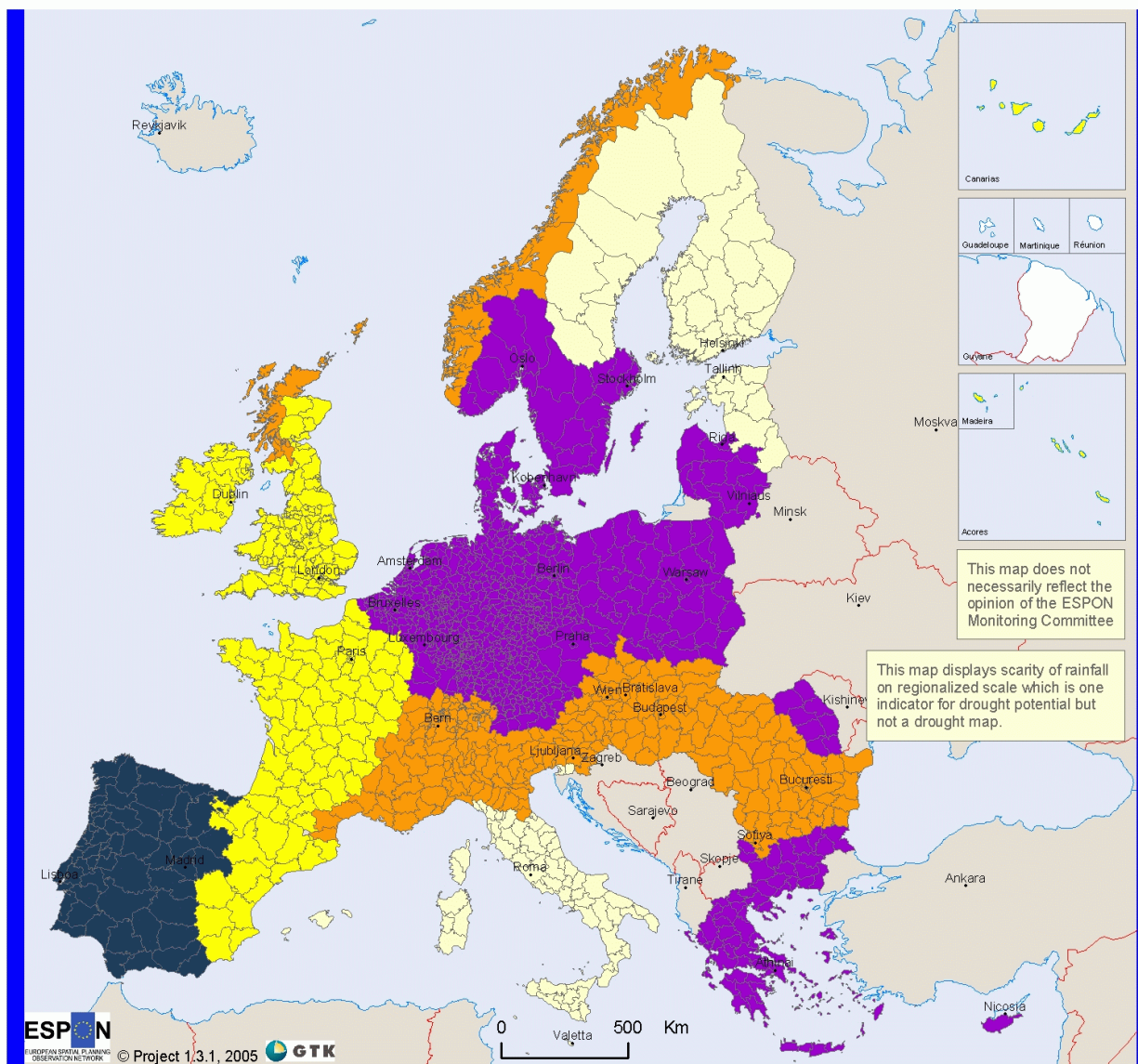
The classification of the forest fire hazard is based on a combination of the numbers of observed fires per 1000 sq. km 1997-2003 (ESA) and the biogeographic regions map of Europe (EEA).

The number of observed fire per 1000 sq.km 1997-2003:

- 1 = No forest fires
- 2 = <1 observed fire
- 3 = 1-5 fires
- 4 = 5-10 fires
- 5 = >10 fires

Biogeographic regions:

- 1 = Alpine and Arctic,
- 2 = Atlantic,
- 3 = Boreal,
- 4 = Continental, Black sea, Pannonian and Steppic,
- 5 = Mediterranean

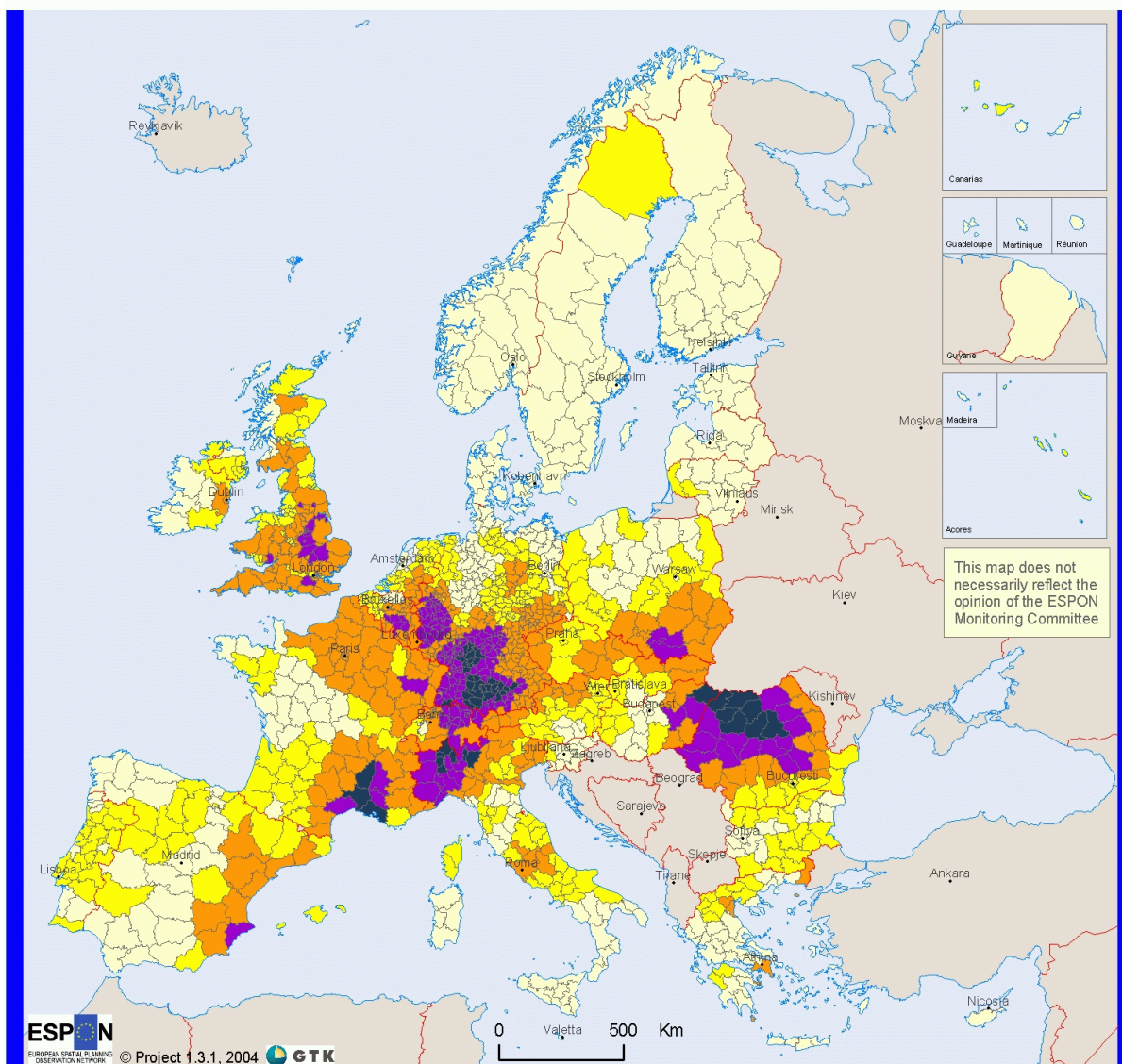


Precipitation deficit as potential drought indication

- No data
- Very low
- Low
- Moderate
- High
- Very high
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
ARIDE final report (2001)
Source: ESPON Data Base

Precipitation deficit in regional basins as potential drought indication. Based on scarcity of rainfall in regionalised Europe. Total number of events on European basins 1904-1995. Based on Alvarez & Estrela 2001 (ARIDE final report) p. 88-91.



Flood recurrence

- Very low
- Low
- Moderate
- High
- Very high
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
Large flood areas © Dartmouth Flood Observatory
Flood areas © ESA - Earth observation - Earth online
Rhine Atlas 2001 IKRS-CIPR-ICBR

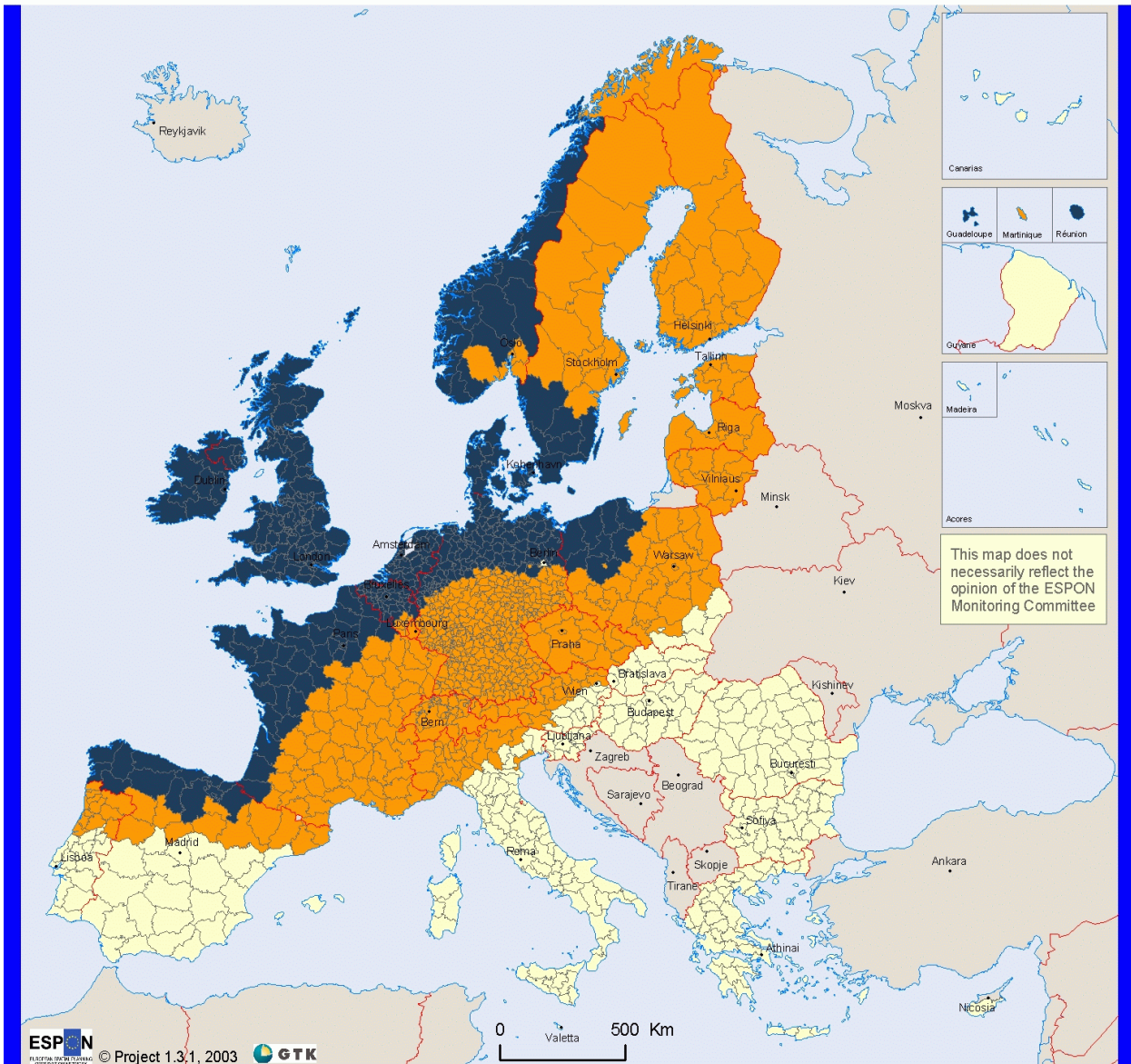
Source: **ESPON Data Base**

This map shows the hazard recurrence based on average number of large flood events on NUTS 3 level during 1987-2002. Each NUTS3 region has been given an average of the large flood event that fall inside it. To the first class "Very low hazard intensity" only the regions without large flood events are included.

Flood intensity

Average value of flooding events on NUTS 3 area

- Very low hazard 0
- Low hazard 1
- Moderate hazard >1 - <=2
- High hazard >2 - <=3
- Very high hazard >3

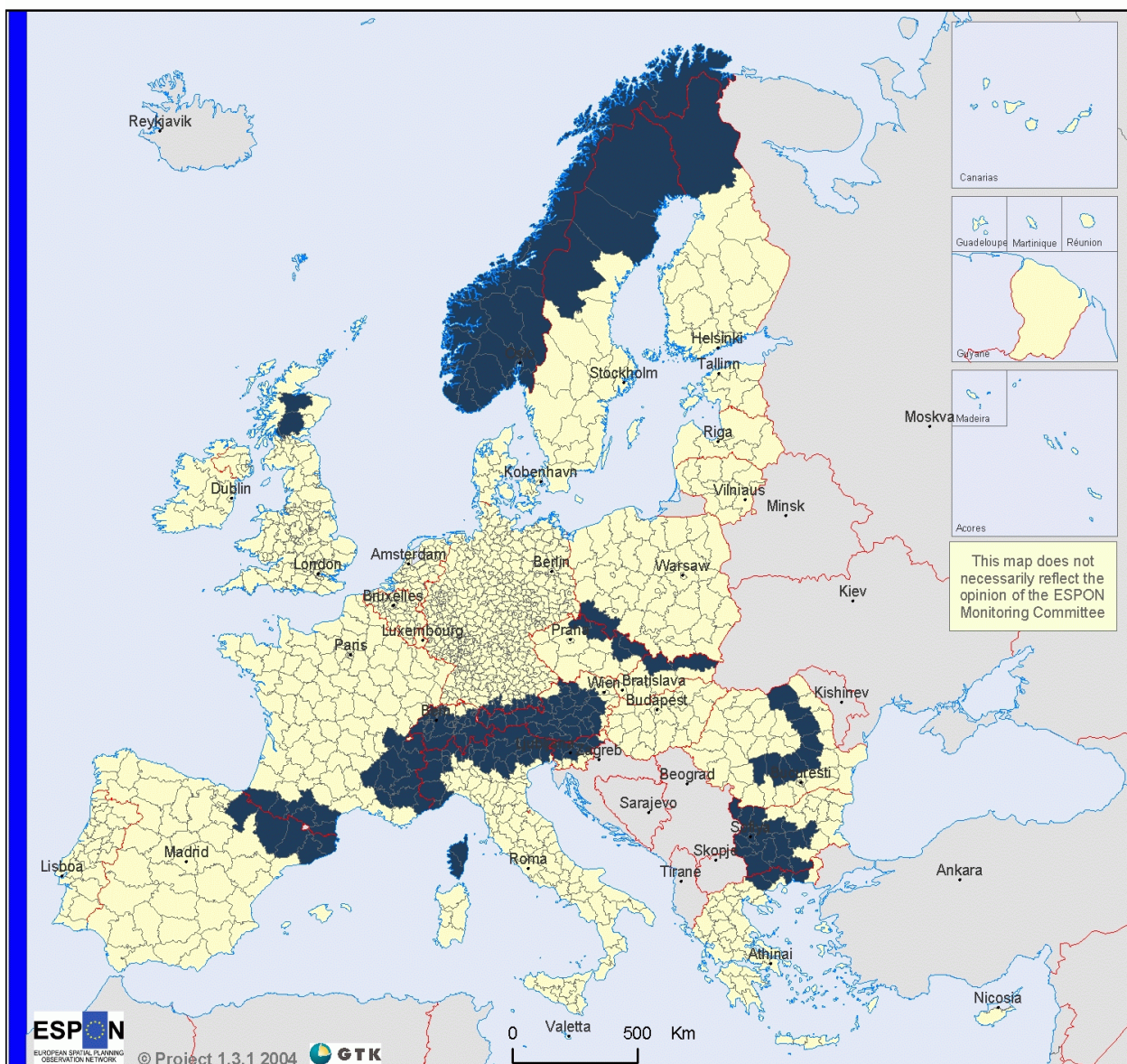


Storm hazard

- Very low probability for winter or tropical storms
- Medium - high probability
- High - very high probability
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
Winter and tropical storms © Munich Re
Source: ESPON Data Base

This map presents the approximate probability of having winter storms and tropical storms in Europe.



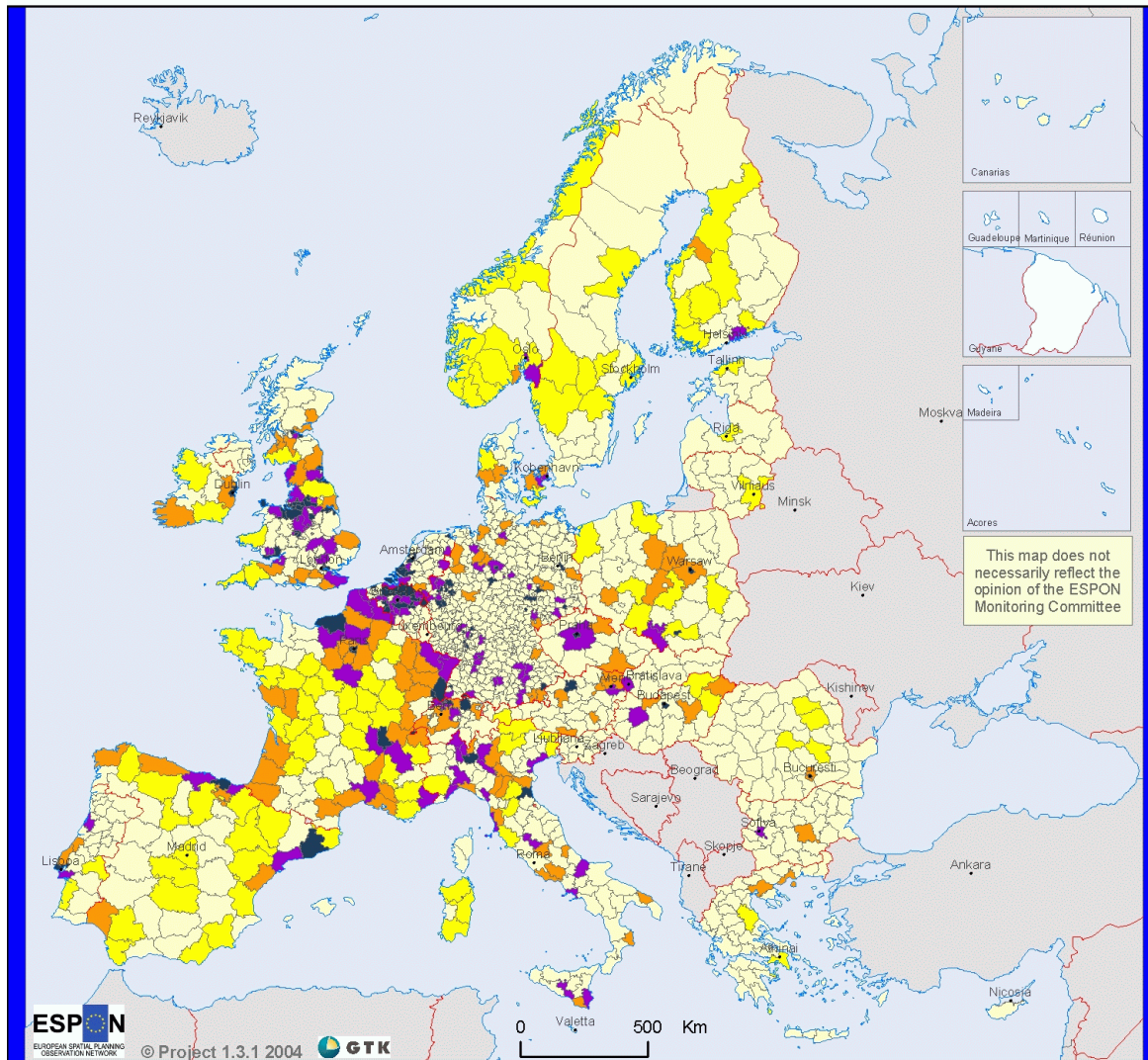
Areas exposed for avalanches

- No avalanches
- Avalanches
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
European avalanche services
USGS DTM

Source: ESPON Data Base

European avalanche services covers the data of United Kingdom, Spain, France, Italy, Slovenia and Austria. Information about the other countries where analysed by using the USGS digital elevation model.



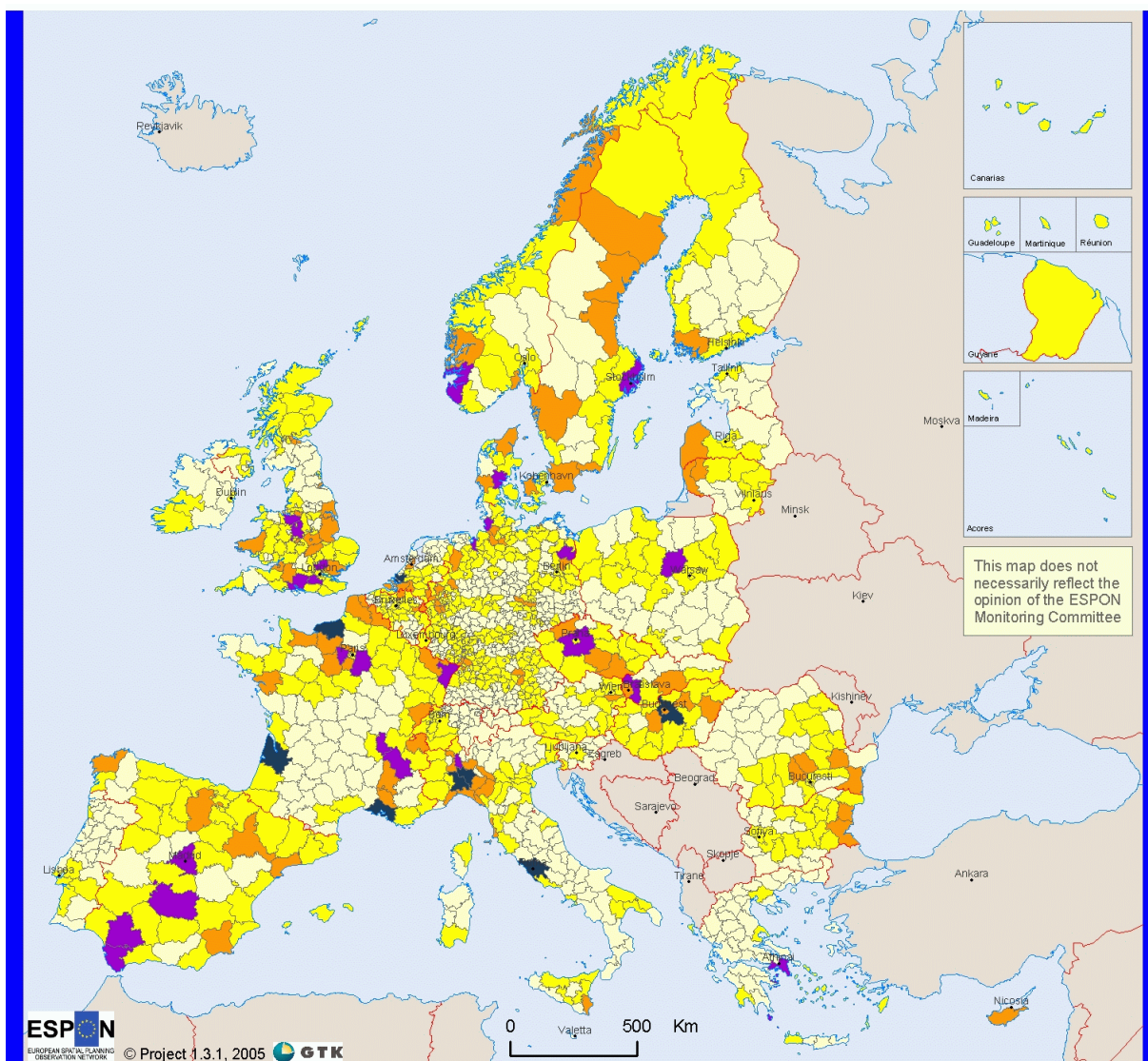
This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

Density of chemical plants (NUTS3)

- Very low density
- Low density
- Moderate density
- High density
- Very high density
- No data
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
European Pollutant Emission Register (EPER)
<http://www.kompass.com>
Source: ESPON Data Base

The degree of hazard potential depends on the number of chemical plants per km² in NUTS3 region.



ESPON
EUROPEAN SPATIAL PLANNING
OBSERVATION NETWORK
© Project 1.3.1, 2005
GTK

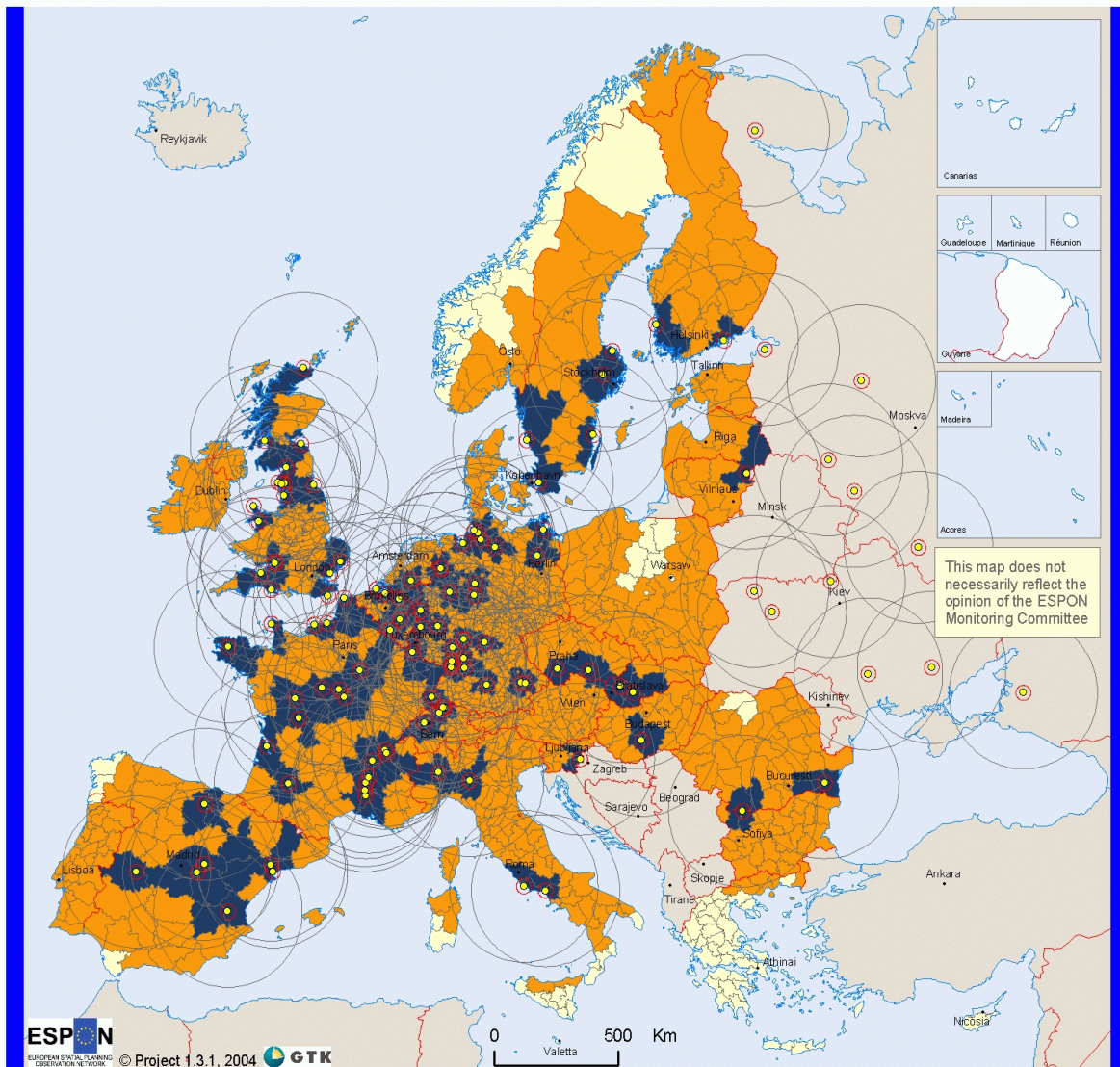
Oil as technological hazard

- Very low
- Low
- Moderate
- High
- Very high
- Non ESPON space

Origin of the data: © EuroGeographics Association for the administrative boundaries
Refineries, oil depots and pipelines © CONCAWE
Oil terminals © World port index 2000

Source: ESPON Data Base

This map shows the volume of oil production and transport related activities in Europe. Each NUTS3 region has been given a sum of the following activities: amount of refineries, depots, oil terminals and pipelines. Residual NUTS3 regions are classified as very low, indicating the ubiquitous hazard of oil pollution due to transportation by road, rail or ship.



The potential hazard of radioactive contamination on NUTS 3 level

Origin of the data: © EuroGeographics Association for the administrative boundaries
Nuclear Power Plant © Nuke Data Base System, Ljubljana, Slovenia
Eurostat GISCO

Source: ESPON Data Base

- Nuclear power plant
- Area to be evacuated (radius 30km)
- Area with a possible severe caesium 137 contamination (radius 300km)
- Distance of a nuclear power plant**
- Areas outside 300 km radius
- >30 km and <300 km (indirectly affected areas)
- <30 km (directly affected areas)
- No data
- Non ESPON space

The potential hazard of radioactive contamination in case of a nuclear fallout (based on experiences made after the Chernobyl accident in 1986).

Indicator 6.2 Circumstances at the site

(adapted from BREEAM, DGNB/BNB, LEED, EN 13779)

1. Objective

The objective is to assess the conditions at the site which can have a determining effect on the health and well-being of people (stress, reduced productivity, long term health problems).

This supports the European Commission objectives to avoid, prevent or reduce harmful effects of poor ambient air quality¹ and environmental noise² on human health and the environment as a whole.

2. Assessment Methodology

The outdoor air quality has a direct impact on the social sustainability of a site. It is an important aspect of the external environment affecting the health and comfort of building occupants and influencing decision making for the adoption of ventilation strategies. The following sources of external pollution are identified:

- Highways and the main access roads on the assessed site.
 - Car parks and delivery/vehicle waiting bays
 - Other building exhausts, including exhausts from building services plant industrial/agricultural processes
- The concentration of key pollutants will therefore be assessed.

Noise is one of the most pressing environmental problems in urban areas. 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 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's 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)

Urban Heat Island Effect is defined as thermal gradient differences between developed and undeveloped areas. It leads to increased cooling requirements for buildings in urban areas and also to poor comfort conditions in outdoor spaces. The additional required energy to support the higher cooling loads results in more air pollution, greater resource extraction impacts and higher costs. Reducing or mitigating urban heat islands can counter these negative effects and result in more sustainable buildings apart from a more pleasant urban lifestyle. Urban Heat Island Effect is caused by the removal of vegetation and its replacement with asphalt and concrete roads, buildings and other structures. This phenomenon is linked with the morphology of cities and with the prevailing construction materials.

Strong electromagnetic fields (EMFs) of about 50 to 60 cycles per second (hertz, or Hz) and the related electromagnetic radiation (EMR) are harmful to us. Long-term exposure may aggravate any existing health

¹ DIRECTIVE 2008/50/EC

² DIRECTIVE 2002/49/EC

problems or diseases and may cause or intensify especially lack of energy or fatigue, irritability, aggression, hyperactivity, sleep disorders and emotional instability. Increasing numbers of individuals are becoming hypersensitive to EMR; many can feel the electricity going through the body and may experience disabling symptoms such as convulsions, memory problems and depression. Chronic exposure to high levels of EMR, especially while asleep, is a constant drain on our vitality. It creates chronic stress, which interferes with the regeneration and healing that normally takes place during a good night's sleep. Aim of this sub-indicator is to take in account the impacts of the electromagnetic pollution at the location.

This supports the European Commission objective to introduce measures protecting workers from the risks associated with electromagnetic fields, owing to their effects on the health and safety of workers³.

The following sub-indicators will be assessed:

- 6.2.1 Outdoor Air Quality**
- 6.2.2 Ambient Noise Level**
- 6.2.3 Soil and building plot contamination**
- 6.2.4 Urban Heat Island Effect**
- 6.2.5 Electromagnetic Pollution**

³ DIRECTIVE 2004/40/EG

3. Calculation and Rating

6.2.1 Outdoor Air Quality

Examine the concentration of the following (based on records and published measurements for the area):

- Ozone O₃
- Nitrogen Dioxide NO₂
- Sulfur Dioxide SO₂
- Particulates PM₁₀

Outdoor air (ODA) quality to be classified according to EN 13779: 2007

ODA 1: clean air, which may be only partly, charged dust

ODA 2: outside air with high concentrations of dust or particulate matter and/or gaseous contaminants

ODA 3: outside air at very high concentrations of dust or particulate matter and/or gaseous contaminants

ODA 1 applies where the WHO (2005) guidelines and any National air quality standards or regulations for outdoor air are fulfilled.

ODA 2 applies where pollutant concentrations exceed the WHO guidelines or any National air quality standards or regulations for outdoor air by a factor of up to 1,5.

ODA 3 applies where pollutant concentrations exceed the WHO guidelines or any National air quality standards or regulations for outdoor air by a factor greater than 1,5.

Key Pollutants	Limit Concentration levels						
	O ₃ (µg/m ³)	NO ₂ (µg/m ³)		SO ₂ (µg/m ³)		PM ₁₀ (µg/m ³)	
WHO (2005)	8-hour mean	1-hour mean	Annual mean	10-min mean	24-hour mean	24-hour mean	Annual mean
ODA 1	100	200	40	500	20	50	20
ODA 2	< 150	< 300	< 60	< 750	< 30	< 75	< 30
ODA 3	> 150	> 300	> 60	> 750	> 30	> 75	> 30

6.2.1 Outdoor Air Quality	Points
Outdoor air is classified ODA 1. WHO (2005) guidelines and any National air quality standards or regulations for outdoor air are fulfilled, OR Outdoor air is Classified ODA2 with at least one pollutant concentration exceeding the WHO guidelines or any National air quality standards or regulations for outdoor air by factor of up to 1,5 BUT: a) For mechanically ventilated buildings: the air intakes are over 20m from sources of external pollution b) For naturally ventilated buildings: openable windows/ ventilators are over 10m from sources of external air pollution.	100
Outdoor air is classified ODA 2. At least one pollutant concentration exceeds the WHO guidelines or any National air quality standards or regulations for outdoor air by a factor of up to 1,5	75
Outdoor air is classified ODA 3. At least one pollutant concentration exceeds the WHO guidelines or any National air quality standards or regulations for outdoor air by a factor greater than 1,5 BUT: a) For mechanically ventilated buildings: the air intakes are over 20m from sources of external pollution b) For naturally ventilated buildings: openable windows/ ventilators are over 10m from sources of external air pollution	50
Outdoor air is classified ODA 3. At least one pollutant concentration exceeds the WHO guidelines or any National air quality standards or regulations for outdoor air by a factor greater than 1,5 .	0

6.2.2 Ambient Noise Levels

Sources of noise close to the site to be identified and their distance from the site to be measured.

Noise maps – where available- are to be used.

The evaluation is based on the classification of the site location based on ambient noise levels according to the following table (adapted from BNB 2011)

Level	Site characterization	Noise level
1.1	rural	<= 55 dB
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

When ambient noise levels exceed 60 dB, possible attenuation measures are:

1. Orientation of quiet spaces away from external noise sources (zoning)
2. Creation of buffer zones between external noise sources and building envelope (vegetation, double skin facades, etc.) or creation of Noise barriers around the site.
3. Location of openings away from ambient noise sources
4. Avoidance of through-the-wall, package terminal air conditioners (PTAC)
5. **Ensuring a sound- attenuating building envelope (roof, external walls, windows and doors)**

6.2.2 Ambient Noise Levels	Points
Compliant with level 1.1, 2.1 or 3.1 depending on location	100
Compliant with level 1.2, 2.2 or 3.2 depending on location, with a sound – attenuating building envelope and at least 2 of the 4 remaining attenuation measures taken	80
Compliant with level 1.2, 2.2 or 3.2 depending on location with a sound-attenuating building envelop ensured	60
Compliant with level 1.2, 2.2 or 3.2 depending on location	50
Not compliant with levels, with a sound attenuating building envelope and at least 2 of the 4 remaining attenuation measures taken	30
Not compliant with levels but with a sound-attenuating building envelope ensured	10
Not compliant with levels and no attenuation measures taken	0

6.2.3 Soil and building plot contamination

A competent Contaminated Land Specialist (see definition in annex 3) should carry out a robust site investigation, risk assessment and appraisal.

Where the site investigation, risk assessment and appraisal above has determined that the site was significantly contaminated, the client or contractor confirms that remediation of the site will be carried out in accordance with the recommended remediation strategy and its implementation plan as set out by the Contaminated Land Specialist and any relevant national or other legislation.

Contaminated sites can be defined in several ways. One possible definition could be based on the exceedance of established limits in concentrations of hazardous chemicals. However, common limits are unlikely to be established at the European level since they may be strongly influenced by local soil and geological properties.

As a consequence, for this indicator, a working definition based on the concept of impact levels (see table below) has been adopted by the European Environment Agency (EEA), in agreement with member countries. In particular, contaminated sites are sites where soil contamination poses significant negative effects on human health and ecosystems (levels 2 and 3), while potentially contaminated sites are sites where soil contamination is suspected to pose significant negative effects on human health and ecosystems (site investigation has not been completed).

Table - Definition of impact levels

Level	Long Definition	Brief Definition
Level 0	Sites that do not pose any negative effects to human health or the environment; ' related environmental media can be used multi-functionally	no impacts; no restrictions
Level 1	Sites where related environmental media have tolerable contamination levels and which do not pose significant negative effects to human health or the environment, monitoring maybe necessary; ' related environmental media can be used multi-functionally	minor impacts (tolerable contamination); no restrictions; monitoring
Level 2	Sites that pose significant negative effects to human health or the environment if the use of the related environmental media changes to a more sensitive one, monitoring maybe necessary; ' limited use of related environmental media	no significant impacts under current use of environmental media, restricted use only
Level 3	Sites that pose significant negative effects to human health or the environment under current use of related environmental media; ' activities as regards risk reduction needed.	Significant impacts, activities needed

When the soil report is not available, evaluation can be based on the likelihood of contamination.

6.2.3 Soil and building plot contamination	Points
The soil report is available and leads to a level 0 impact	100
The soil report is available, leads to a level 1 impact AND remediation of the site has been carried out accordingly	75
The soil report is available and leads to a level 1 impact OR The soil report is not available but the contamination is unlikely	50
The soil report is available and leads to a level 2 or 3 impact AND remediation of the site has been carried out accordingly	25
The soil report is available and leads to a level 2 or 3 impact OR The soil report is not available but the contamination is possible	0

6.2.4 Urban Heat Island Effect

Measures to reduce Heat Island Effects:

If applicable, when site is located in an urban area, the following measures can be applied:

Roof Areas

1. Use roofing materials with a solar reflectance index (SRI) equal or greater than the values in the table below for a minimum of 75% of the roof surface.

Roofing materials having a lower SRI value than those listed below may be used if the weighted rooftop SRI average meets the following criteria:

$$\frac{\text{Roof Meeting Minimum SRI}}{\text{Total Roof Area}} \times \frac{\text{SRI of Installed Roof}}{\text{Required SRI}} \geq 75\%$$

Roof type	Slope	SRI
Low-sloped roof	≤ 2:12	78
Steep- sloped roof	> 2:12	29

2. Install a vegetated roof that covers at least 50% of the roof area

3. Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:

$$\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$$

Roof type	Slope	SRI
Low-sloped roof	≤ 2:12	78
Steep- sloped roof	> 2:12	29

Non Roof Areas

1. Use any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Provide shade from trees
- Provide shade from structures covered by solar panels
- Provide shade from architectural devices or structures that have an SRI of at least 29
- Use hardscape materials with an SRI of at least 29
- Use an open-grid pavement system (at least 50% pervious)

2. Place a minimum of 50% of parking spaces under cover. Any roof used to shade or cover parking must have an SRI of at least 29, be a vegetated green roof or be covered by solar panels.

3. Install a vertical garden in at least 50% of the building's facades.

6.2.4 Urban Heat Island Effect	Points
1 out of 3 measures is implemented for Roof Areas AND 1 out of 3 measures is implemented for Non Roof Areas	100
1 out of 3 measures is implemented for Roof Areas	75
1 out of 3 measures is implemented for Non Roof Areas	50
None of the measures is implemented	0

6.2.5 Electromagnetic Pollution

The evaluation is performed using measured values. If no measurements have been made, an estimate based on the local environmental situation should be performed.

Maximum values specified in the national ordinance concerning electromagnetic fields or Directive 2004/40/EG should be complied with.

If measurements are available:

International Commission on Non-Ionizing Radiation Protection (ICNIRP) recommendations as regards basic restrictions for time varying electric and magnetic fields for frequencies up to 10 GHz

Exposure Characteristics	Frequency Range	Current Density for head and trunk (mA/m ²) (rms)	Whole body average SAR ⁴ (W/kg)	Localized SAR (head and trunk) (W/kg)	Localized SAR (limbs) (W/kg)
Occupational Exposure ⁵	Up to 1Hz	40	-	-	-
	1-4 Hz	40/f	-	-	-
	4Hz -1kHz	10	-	-	-
	1-100kHz	f/100	-	-	-
	100kHz-10MHz	f/100	0.4	10	20
	10mHz-10gHz	-	0.4	10	20
General Public exposure	Up to 1Hz	8	-	-	-
	1-4 Hz	8/f	-	-	-
	4Hz -1kHz	2	-	-	-
	1-100kHz	f/500	-	-	-
	100kHz-10MHz	f/500	0.08	2	4
	10mHz -10gHz	-	0.08	2	4

⁴ **SAR: Specific Absorption Rate** is a measure of the rate at which energy is absorbed by the body when exposed to a radio frequency (RF) electromagnetic field; although, it can also refer to absorption of other forms of energy by tissue, including ultrasound. It is defined as the power absorbed per mass of tissue and has units of watts per kilogram (W/kg). SAR is usually averaged either over the whole body, or over a small sample volume (typically 1 g or 10 g of tissue). The value cited is then the maximum level measured in the body part studied over the stated volume or mass.

⁵ **Occupational exposure.** All exposure to EMF experienced by individuals in the course of performing their work

6.2.5.a Electro Magnetic Pollution (with measurements)	Points
75% below national, ICNIRP or other international restrictions	100
30% below national, ICNIRP or other international restrictions	50
Below national, ICNIRP or other international restrictions	10
Not respecting national, ICNIRP or other international restrictions	0

OR

If measurements are not available:

an estimation based on local environmental situation should be conducted as follows.

Most common sources of man-made electromagnetic pollution are the following activities/equipment:

- Telecommunications/broadcasting (TV, mobile telephony networks, mobile and wireless communication technologies etc.)
- Medical applications (MRI, etc.)
- Industrial and domestic applications (microwave ovens, dielectric heating etc.)
- Safety applications, navigation, radar (marine radar, air traffic control etc.)
- New and emerging technologies(wireless LANs, Bluetooth etc)

6.2.5.b Electro Magnetic Pollution (without measurements)	Points
No man-made sources of electromagnetic pollution inside or in great proximity to the building	100
Existence of wireless LANs or Bluetooth technologies covering 0-20% of building's gross area	60
Existence of wireless LANs or Bluetooth technologies covering 20-100% building's gross area	50
Existence of domestic electromagnetic pollution sources such as microwave ovens, dielectric heating etc at 0-50% of building's gross area	40
Existence of domestic electromagnetic pollution sources such as microwave ovens, dielectric heating etc at 50-100% of building's gross area	30
Existence of mobile telephony antennas in a 300m radius	20
Extensive use of telecommunication-mobile and wireless-or broadcasting technologies inside the building	10
Existence of medical applications such as MRI, X-ray units or safety applications such as navigation/radar systems, air traffic control, marine radars etc inside or in very close proximity to the building	0

The worst case determines the final score of the sub-indicator.

Weights of Sub-indicators

Indicator 6.2	Weight
Sub-indicator 6.2.1 Outdoor Air Quality	4
Sub-indicator 6.2.2 Ambient Noise Level	4
Sub-indicator 6.2.3 Soil and Building Plot contamination	4
Sub-indicator 6.2.4 Urban Heat Island Effect	4
Sub-indicator 6.2.5 Electromagnetic Pollution	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

6.2.1. Outdoor Air Quality

Professional air quality assessment, including documentation of current data for the building sites' Air Quality (with reference to the source)

Evidence documentation for attenuation measures

A marked-up proposed site plan and section highlighting:

- Locations of intakes, extracts, openable windows, ventilators.
- Vegetated areas with plants and high- trees and existing or proposed sources of external pollution

6.2.2 Ambient Noise Level

Documentation of current data on noise pollution at the building site (noise map) with reference to the source. Professional classification in a noise category in accordance with the indicator.

Population density information and classification in accordance with the indicator: rural, provincial, metropolitan

Evidence documentation for attenuation measures

A marked- up proposed site plan highlighting:

- Location of major noise sources in relation to the building
- Location of “quiet areas” in relation to major noise sources
- Location of buffer zones and noise barriers

Certification of the ambient noise protection offered by window systems

Certification of the ambient noise insulation offered by external envelope systems.

6.2.3 Soil and Building Plot contamination

Where applicable, a copy of the specialist's land contamination report confirming:

- The degree, type and sources of site contamination.
- The classification into impact level according to EEA
- The options for remediating the site.

Existing site plan(s) showing:

- Location of areas contaminated and to be remediated in relation to any proposed development.

A letter from the main contractor or remediation contractor confirming:

- The remediation strategy for the site.
- Summary details of the implementation plan.

If a contractor has not yet been appointed, a letter from the client, or their representative confirming:

- That the appointed contractor will undertake necessary remediation works to mitigate the risks identified in the specialist report.

6.2.4 Urban Heat Island Effect

Documentation of the implementation of the different measures when applicable:

Roof Areas:

- Prepare drawings to show that total roof area and the areas of reflective materials or vegetated roof systems
- List the roofing products with their SRI values and slopes; retain product specifications
- Narrative for special circumstances.

Non Roof Areas:

- Prepare drawings indicating the implemented measures
- List the hardscape materials with their SRI values

6.2.5 Electromagnetic Pollution

- Measurements in accordance with article 4 of Directive 2004/40/EG or with the national regulations. These can also be provided by local specific research institutes.

- Professional estimate of electrical, magnetic and electromagnetic fields present in the surrounding area of the building.

5. Relation to other Indicators

Indicator 2.4: Indoor Air Quality

Indicator 4.5: Noise Protection

Indicator 6.4: Image and Condition of the Location and Neighbourhood

6. Resources

LEED Sustainable Sites Credit 7.1: Heat Island Effect—Non Roof

LEED Sustainable Sites Credit 7.2: Heat Island Effect—Roof

EN 13779:2007: Ventilation for non-residential buildings – Performance requirements for ventilation and room-conditioning systems

WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide

Global update 2005 – Summary of risk Assessment

http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf

EEA Progress in Management of contaminated sites

<http://www.eea.europa.eu/data-and-maps/indicators/progress-in-management-of-contaminated-sites>

7. Attachments

Annex 6.2.3 Soil and Building plot contamination - Relevant definition

Contaminated land specialist: an individual achieving all the following items:

1. Holds a degree or equivalent qualification in chemistry, environmental impact assessment or a related subject. Other related subjects that are deemed to be appropriate are:
2. Has a minimum of three years relevant experience (within the last five years) in site investigation, risk assessment and appraisal. Such experience must clearly demonstrate a practical knowledge of site investigation methodologies and understanding of remediation techniques as well as national and European legislation on the subject; including, acting in an advisory capacity to provide recommendations for remediation. Examples of relevant experience are: environmental impact assessments.

Indicator 6.3 Options for Transportation

(adapted from BREEAM, DGNB/BNB, LEED)

Core Indicator

1. Objective

As good accessibility to transportation systems (especially low carbon schemes) has positive influence on the environmental performance of the building. The aim of this indicator is to define the effective and shortest distance in metres from a main building entrance to local public means of transportation.

This supports the European Commission objective of increasing the quality, accessibility and reliability of transport services, inter alia due to the ageing of the population and the need to promote public transport¹.

By 2050, key goals include:

- No more conventionally-fuelled cars in cities.
- A 50% shift of medium distance intercity passenger and freight journeys from road to rail and waterborne transport.
- All of which will contribute to a 60% cut in transport emissions by the middle of the century.

2. Assessment Methodology

The time necessary to reach the nearest option for transportation, such as bus or rapid city train stop, by considering the shortest distance is evaluated in metres. Particularly valuable are low emission transportation options, replacing existing less pro-environmental means of transport (e.g. electric buses replacing fossil-fuelled buses or city bicycle scheme encouraging to stop using other transportation modes in favour of bicycle). Therefore, a separate sub-indicator is assigned to them.

The following sub-indicators will be assessed:

6.3.1 Accessibility of the nearest railroad station from a main building entrance

6.3.2 Accessibility of the nearest public local transportation stop (bus, rapid city train, tram, metro)

6.3.3 Availability of modern low emission transport options: city bicycle scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines

6.3.4 Availability of walking and bicycle paths

¹ White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

3. Calculation and Rating

6.3.1 Accessibility of the nearest railroad station from a main building entrance

6.3.1 Accessibility of the nearest railroad station from a main building entrance in metres	Points
< 300 m	100
300 - 500 m	75
500 - 800 m	50
800 - 1200 m	25
>1200 m	0

6.3.2 Accessibility of the nearest public local transportation stop from a main building entrance

6.3.2 Accessibility of the nearest public local transportation stop from a main building entrance in metres	Points
<150 m	100
150 - 300 m	75
300 - 500 m	50
500 - 1000 m	25
>1000 m	0

6.3.3 Availability of modern low emission transport options: city bicycle scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines

The evaluation of this indicator depends on the existence of city bicycle scheme, car club scheme (see definition in attachment), charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines within radius of 1 km from the building.

6.3.3 Availability of modern low emission transport options: city bicycle scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines within radius of 1 km from the building	Points
4 options	100
3 options	75
2 options	50
1 option	25
0 options	0

6.3.4 Availability of walking and bicycle paths

6.3.4 Availability of walking and bicycle paths	Points
The location lies along a developed network of walkway and bicycle paths.	100
The location lies along a developed network of walkway and bicycle paths are not developed yet but in planning.	50
The location has average accessibility by foot or bicycle	10
The location is practically impossible or impracticable to reach by either foot or bicycle (e.g. industrial area, freeway rest area, etc.).	0

Weights of Sub-indicators

Indicator 6.3	Weight
Sub-indicator 6.3.1 Accessibility of the nearest railroad station from a main building entrance	3
Sub-indicator 6.3.2 Accessibility of the nearest public local transportation stop (bus, rapid city train, tram, metro)	3
Sub-indicator 6.3.3 Availability of modern low emission transport options: city bicycle scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines	3
Sub-indicator 6.3.4 Availability of walking and bicycle Paths	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Letter of commitment or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

6.3.1 Accessibility of the nearest railroad station from a main building entrance and
6.3.2 Accessibility of the nearest public local transportation stop (bus, rapid city train, tram, metro)
Maps with description of travel distances to transportation systems.

6.3.3 Availability of modern low emission transport options: city bicycle scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines
Evidence of existence and accessibility of low emission transport options where the building is located; if not yet existing, level of development or planning status of such options.

6.3.4 Availability of walking and bicycle paths
Evidence of accessibility, the level of development or planning status of foot and bicycle paths to the location.

5. Relation to other Indicators

Indicator 2.16 Provision for bicycle amenities

6. Resources

1. DGNB International Criterion 59: Connection to Transportation
2. BNB Criterion 614 Public Transport Connections
3. BREEAM Criterion Tra 3 - Alternative modes of transport
4. LEED Criterion Credit 4.1: Alternative Transportation – Public Transportation Access

7. Attachments

Relevant definition:

a **car club** is an organization which makes available cars to hire from dedicated parking places to those members of the public who are club members. Vehicle bookings are made on-line or by telephone and access to the vehicle is made via card. Car club members generally pay an annual subscription fee and a hourly hire charge which is higher than longer term car hire but lower than a taxi.

Indicator 6.5 Access to Amenities

(adapted from BREEAM, DGNB/BNB, LEED)

1. Objective

The aim of this indicator is to measure the number and the vicinity of key amenities to the assessed building. Although this indicator relates to the site, it addresses social issues. The overall purpose is to reward community connectivity thereby helping reduce transport-related emissions and traffic congestion and promoting communal life.

2. Assessment Methodology

A list of amenities is identified and categorized (see below the 9 sub-indicators). The distance and the number of the available facilities of each category are assessed. Points are given for the type and number of facilities of each amenity weighted by the distance to the building.

The following sub-indicators will be assessed:

- 6.5.1 Access to **Gastronomy facilities**
- 6.5.2 Access to **Local Supply facilities**
- 6.5.3 Access to **Parks and Open Spaces**
- 6.5.4 Access to **Education facilities**
- 6.5.5 Access to **Public Administration facilities**
- 6.5.6 Access to **Medical Care facilities**
- 6.5.7 Access to **Sport facilities**
- 6.5.8 Access to **Leisure facilities**
- 6.5.9 Access to **Services**

3. Calculation and Rating

6.5.1 Access to Gastronomy facilities

Gastronomy: Restaurants, bars, cafes, snack stands, bakeries, etc. (Gastronomy facilities within the building's boundaries are also taken into account)

6.5.1 Vicinity to Gastronomy facilities	Points
2 facilities of different type in max 300m distance or 3 facilities of different type in max 500m distance or 4 facilities of different type in max 750m distance	100
1 facility in max 300m distance or 2 facilities of different type in max 500m distance or 3 facilities of different type in max 750m distance	75
1 facility in max 500m distance or 2 facilities of different type in max 750m distance	50
1 facility in max 750m distance	10
No facilities in less than 750m distance	0

6.5.2 Access to Local Supply facilities

Local Supply: Supermarkets, grocery stores, drug stores, street markets, etc (Local Supply facilities within the building's boundaries are also taken into account)

6.5.2 Access to Local Supply facilities	Points
2 facilities of different type in max 300m distance or 3 facilities of different type in max 500m distance or 4 facilities of different type in max 750m distance	100
1 facility in max 300m distance or 2 facilities of different type in max 500m distance or 3 facilities of different type in max 750m distance	75
1 facility in max 500m distance or 2 facilities in max 750m distance	50
1 facility in max 750m distance	10
No facilities in less than 750m distance	0

6.5.3 Access to Parks and Open Spaces

Parks and Open Spaces: Parks, accessible gardens, recreation areas, green zones, water bodies, etc. (Parks and Open Spaces within the building's plot are also taken into account)

6.5.3 Access to Parks and Open Spaces	Points
1 Park or Open Space in sight or 2 Parks or Open Spaces in max 500m distance	100
1 Park or Open Space in max 500m or 2 Parks or Open Spaces in max 500m distance	75
1 Park or Open Space in max 750m distance or 2 Parks or Open Spaces in max 1000m distance	50
1 Park or Open Space in max 1000m distance	10
No Parks/ Open Spaces in up to 1000m distance	0

6.5.4 Access to Education facilities

Education: Schools, universities, nurseries and day-care centres. (Education facilities within the building's boundaries are also taken into account)

6.5.4 Access to Education facilities	Points
2 facilities of different type in max 500m distance or 3 facilities of different type in max 1000m distance	100
1 facility in max 500m distance or 2 facilities (of different type) in max 1000m distance or 3 facilities (of different type) in max 1500m distance	75
1 facility in max 1000m distance or 2 facilities (of different type) in max 1500m distance	50
1 facility in max 1500m distance	10
No facilities in less than 1500m distance	0

6.5.5 Access to Public Administration facilities

Public administration: Town halls, offices, citizen service centres, and other public facilities (Public Administration facilities within the building's boundaries are also taken into account)

6.5.5 Access to Public Administration facilities	Points
2 facilities of different type in max 500m distance or 3 facilities of different type in max 1000m distance	100
1 facility in max 500m distance or 2 facilities of different type in max 1000m distance or 3 facilities of different type in max 1500m distance	75
1 facility in max 1000m distance or 2 facilities of different type in max 1500m distance	50
1 facility in max 1500m distance	10
No facilities in less than 1500m distance	0

6.5.6 Access to Medical Care facilities

Medical care: Physicians, pharmacies, hospitals, rehabilitation clinics, physiotherapists, medical practitioners, laboratories, nursing homes, etc (Medical Care facilities within the building's boundaries are also taken into account)

6.5.6 Access to Medical Care facilities	Points
2 facilities of different type in max 500m distance or 3 facilities of different type in max 1000m distance	100
1 facility in max 500m distance or 2 facilities of different type in max 1000m distance or 3 facilities of different type in max 1500m distance	75
1 facility in max 1000m distance or 2 facilities of different type in max 1500m distance	50
1 facility in max 1500m distance	10
No facilities in less than 1500m distance	0

6.5.7 Access to Sport facilities

Sport facilities: Health clubs, gyms and courts, spas, sports clubs, skating tracks, etc (Sport facilities within the building or the building's plot are also taken into account)

6.5.7 Access to Sport facilities	Points
2 facilities of different type in max 500m distance or 3 facilities of different type in max 1000m distance	100
1 facility in max 500m distance or 2 facilities of different type in max 1000m distance or 3 facilities in max 1500m distance	75
1 facility in max 1000m distance or 2 facilities of different type in max 1500m distance	50
1 facility in max 1500m distance	10
No facilities in less than 1500m distances	0

6.5.8 Access to Leisure facilities

Leisure: Arts and culture (cinemas, galleries, theatres), libraries, bowling and billiards centres, dance schools, wellness centres, etc. (Leisure facilities within the building's boundaries are also taken into account)

6.5.8 Access to Leisure facilities	Points
2 facilities of different type in max 500m distance or 3 facilities of different type in max 1000m distance	100
1 facility in max 500m distance or 2 facilities of different type in max 1000m distance or 3 facilities of different type in max 1500m distance	75
1 facility in max 1000m distance or 2 facilities of different type in max 1500m distance	50
1 facility in max 1500m distance	10
No facilities in less than 1500m distance	0

6.5.9 Access to Services

Services: Post offices, banks, elderly care, child care, pet care, flower shops, washing/ drying place, copy/ printing centres, etc (Services within the building's boundaries are also taken into account)

6.5.9 Access to Services	Points
2 facilities of different type in max 500m distance or 3 facilities of different type in max 1000m distance	100
1 facility in max 500m distance or 2 facilities of different type in max 1000m distance or 3 facilities of different type in max 1500m distance	75
1 facility in max 1000m distance or 2 facilities of different type in max 1500m distance	50
1 facility in max 1500m distance	10
No facilities in less than 1500m distance	0

Weights of Sub-indicators

Indicator 6.5	Weight
Sub-indicator 6.5.1 Access to Gastronomy facilities	4
Sub-indicator 6.5.2 Access to Local Supply facilities	4
Sub-indicator 6.5.3 Access to Parks and Open Spaces	4
Sub-indicator 6.5.4 Access to Education facilities	4
Sub-indicator 6.5.5 Access to Public Administration facilities	4
Sub-indicator 6.5.6 Access to Medical Care facilities	4
Sub-indicator 6.5.7 Access to Sport facilities	3
Sub-indicator 6.5.8 Access to Leisure facilities	2
Sub-indicator 6.5.9 Access to Services	4

4. Documentation Guidelines

The following documents will be needed to assess the building:

Quick & Basic Assessment

Signed letter stating the availability of amenities or **easily and quickly** accessible documentation for the required evidence (see Complete Assessment), e.g. reasonable estimations for intended/expected values.

Complete Assessment

Marked-up site plan or map highlighting:

- Location of assessed building
- Location, type and number of amenities
- The distance to the amenities
- Plan/map scale

Where the amenities do not currently exist, but are due to be developed, a letter from the client/developer confirming:

- The location and type of amenities to be provided
- The timescale for development of the amenities

5. Relation to other Indicators

6.4: Image and Condition of the Location and Neighbourhood

6. Resources

DGNB - 60 Proximity to use-specific facilities

BNB - 615 Vicinity to Use-Specific Services

www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_615.pdf

BREEAM EU 2009: - Tra 2 - Proximity to amenities

LEED NC 2009: - Development Density and Community Connectivity

7. Attachments

None