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Communication

OPEN HOUSE – a European methodology for assessing the sustainability of buildings

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Abstract: Due to the large impact of buildings on our society and environment, there is a need for the development of sustainable buildings. Currently exists no common consensus regarding the term “sustainability” in the building sector, but there are plenty of different approaches on the market. Based on these various methods, the objective of the research project OPEN HOUSE is the development and implementation of a common European transparent building assessment methodology.

Keywords: OPEN HOUSE, SuPerBuildings, LEED, BREEAM, DGNB, ISO TC 59/SC 17, CEN/TC 350

1. Introduction

Buildings have a large impact on the environment, economy and society in general: they consume 40% of the energy, produce 30% of the green house gas emissions, generate 25% of the solid waste, use 25% of the potable water, dissipate 12% of the land use and require up to 40% of the countries´ gross domestic product [1]. Furthermore people spend about 90% of their time in buildings, making it important to provide them with a healthy and comfortable indoor environment. For the management and implementation of all these aspects a lot of tools have been developed. Important examples are

methods of the first generation like the "British Research Establishments Environmental Assessment Method" (BREEAM) [2] in 1990 or the American label "Leadership in Energy and Environmental Design" (LEED) [3] in 1996, as well as methods of the second generation like the DGNB Certificate [4] 2009. These concepts differ from each other and nowadays worldwide as in Europe there is still no common understanding of the concept of sustainable building. With actual projects like OPEN HOUSE [5], SuPerBuildings [6] – both promoted by the European Commission – and the standards from ISO TC 59/SC 17 or CEN/TC 350 a process has been initialized to harmonize all these methods.

The approaches of the two projects OPEN HOUSE and SuPerBuildings are quite different and complement each other: OPEN HOUSE is based on a “bottom-up” approach in analyzing existing standards and assessment methods while SuPerBuildings is based on a “top-down” approach in trying to close the current gaps of existing methods and focus on the data validity and reliability of selected key indicators.

For the project OPEN HOUSE a European consortium of 20 stakeholders – large companies, high-tech SMEs, research organizations, policy makers – is working since February 2010 on the development of the OPEN HOUSE methodology.

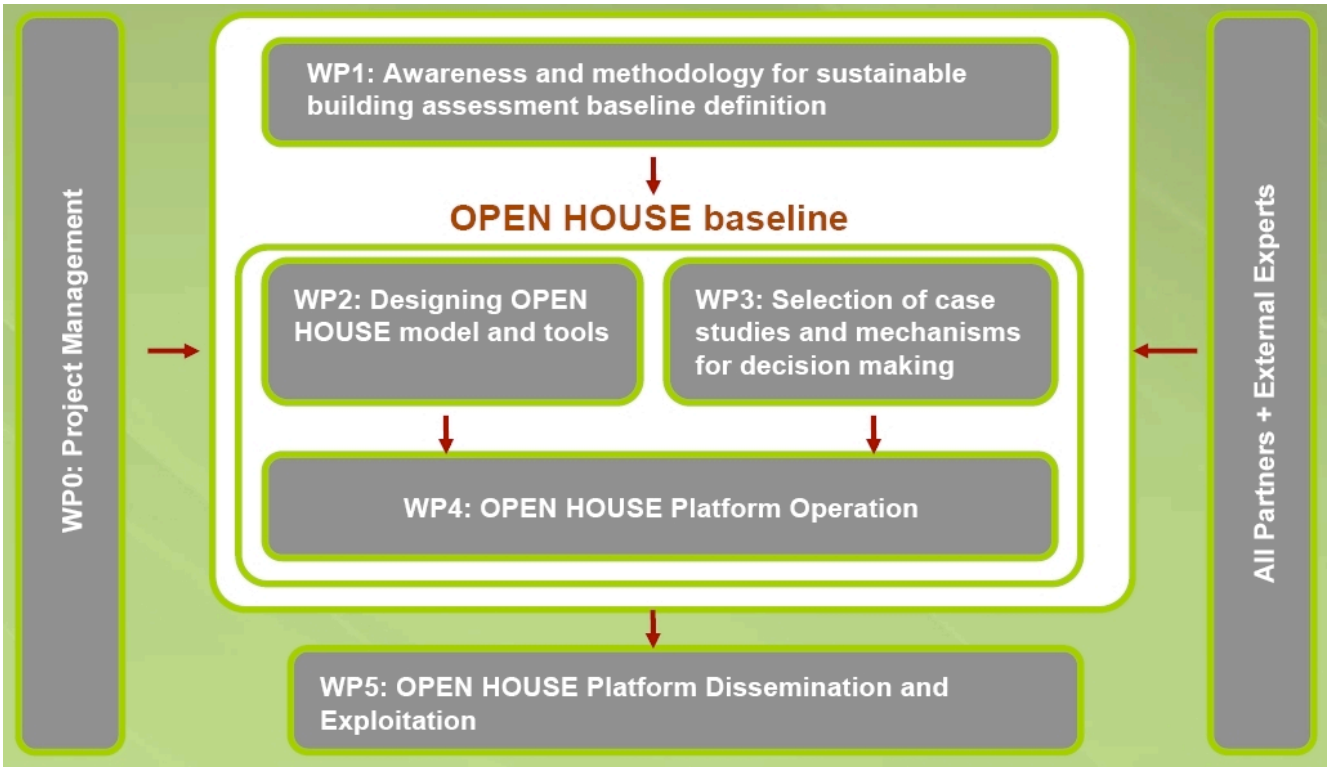
The main scientific and technical objectives of OPEN HOUSE are [7]:

- to define the OPEN HOUSE baseline: an open and transparent European platform for building sustainability
- to widely communicate the baseline concept and outline the mechanisms for interaction among the project and stakeholders
- to build up the OPEN HOUSE Platform: facilitating a pan EU effort towards a common view on building sustainability
- to pave the way for implementing and evaluating the methodology: selection of case studies and mechanisms for decision making

Mainly there are four steps for the development and implementation of the OPEN HOUSE methodology:

- awareness and methodology for a sustainable building assessment baseline definition
- designing OPEN HOUSE model and tools
- OPEN HOUSE Platform Operation
- OPEN HOUSE Platform Dissemination and Exploitation

Figure 1. OPEN HOUSE project structure



2. Results and Discussion

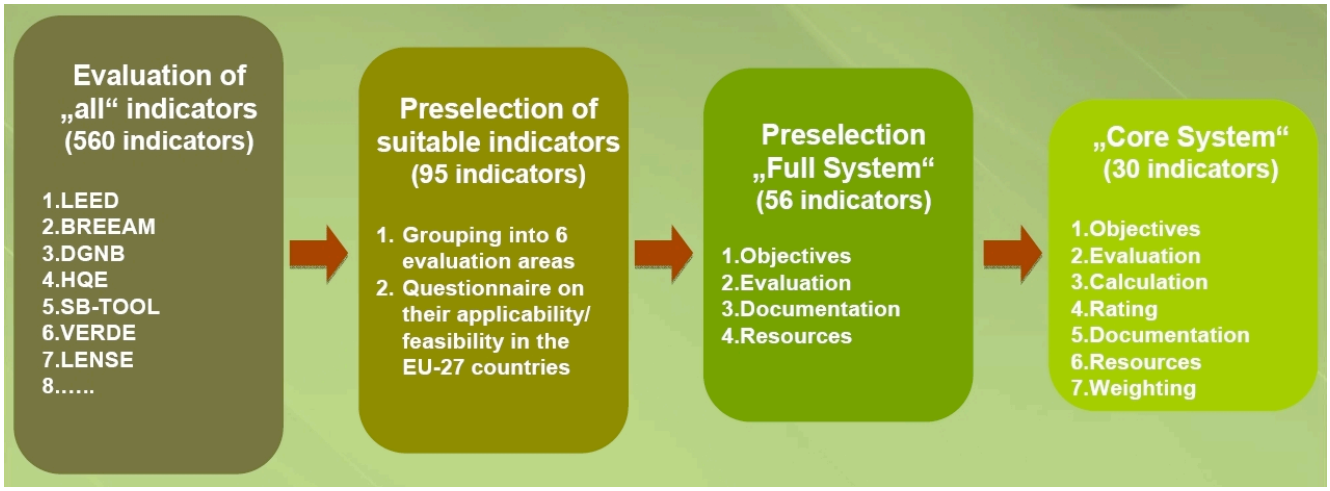
Currently the project reached its halftime. Existing methodologies, standards and guidelines have been analyzed and the OPEN HOUSE methodology baseline has been defined. Based on this results the OPEN HOUSE models and tools are in their design process: most importantly, the OPEN HOUSE assessment guideline and the OPEN HOUSE Platform which allows to accomplish the assessment online. Also a process started to mobilize public participation and spread out the OPEN HOUSE methodology baseline among stakeholders, standard bodies, business, the scientific community and other stakeholders. Therefore templates have been sent around to acquire buildings for case studies from all over Europe:

22 buildings will be analyzed with the OPEN HOUSE complete assessment and 46 with the OPEN HOUSE basic and quick sustainability assessment.

2.1. OPEN HOUSE development

In a first step, existing methodologies, standards and guidelines have been analyzed. Therefore a questionnaire has been sent out to the OPEN HOUSE consortium partners to identify assessment methods in their countries and from all over the world. Alltogether 37 international and 64 European assessment methods from over 50 countries have been identified. In the following process these assessment methods were analyzed and about 560 indicators measuring the sustainable performance of a building have been brought out.

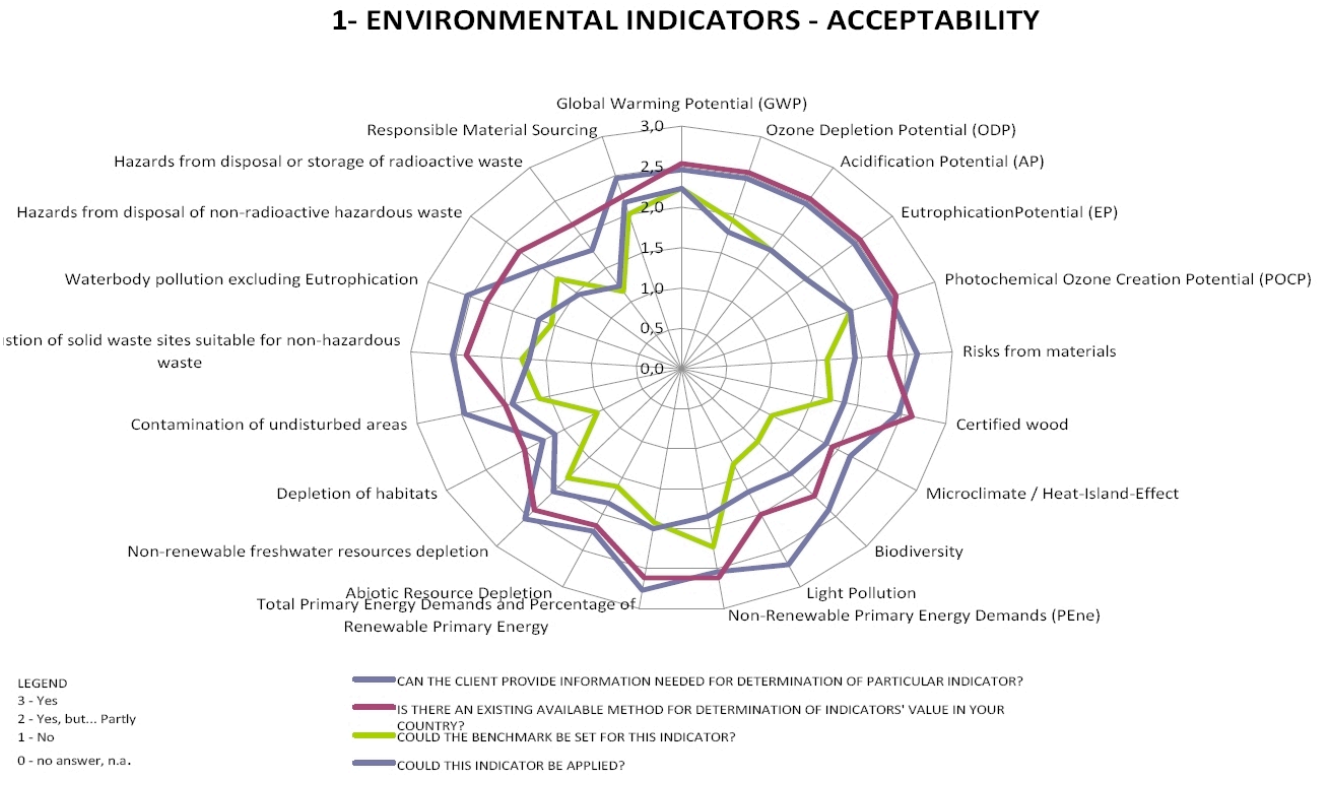
Figure 2. OPEN HOUSE selection of indicators



These indicators were grouped to 95 indicators of the same topic and analyzed further whether they could be accepted, by sending out a questionnaire to the consortium partners. The questions adressed to the consortium partners were:

- Can the client provide information needed for the determination of a particular indicator?
- Is there an existing available method for the determination of indicators value in your country?
- Could the benchmark be set for this indicator?
- Could this indicator be applied?

Figure 3. Acceptability of indicators



As a result, 56 indicators for the OPEN HOUSE full system have been selected. Also 30 indicators for the OPEN HOUSE core system taking a high priority for sustainability and which should be preferably developed have been chosen.

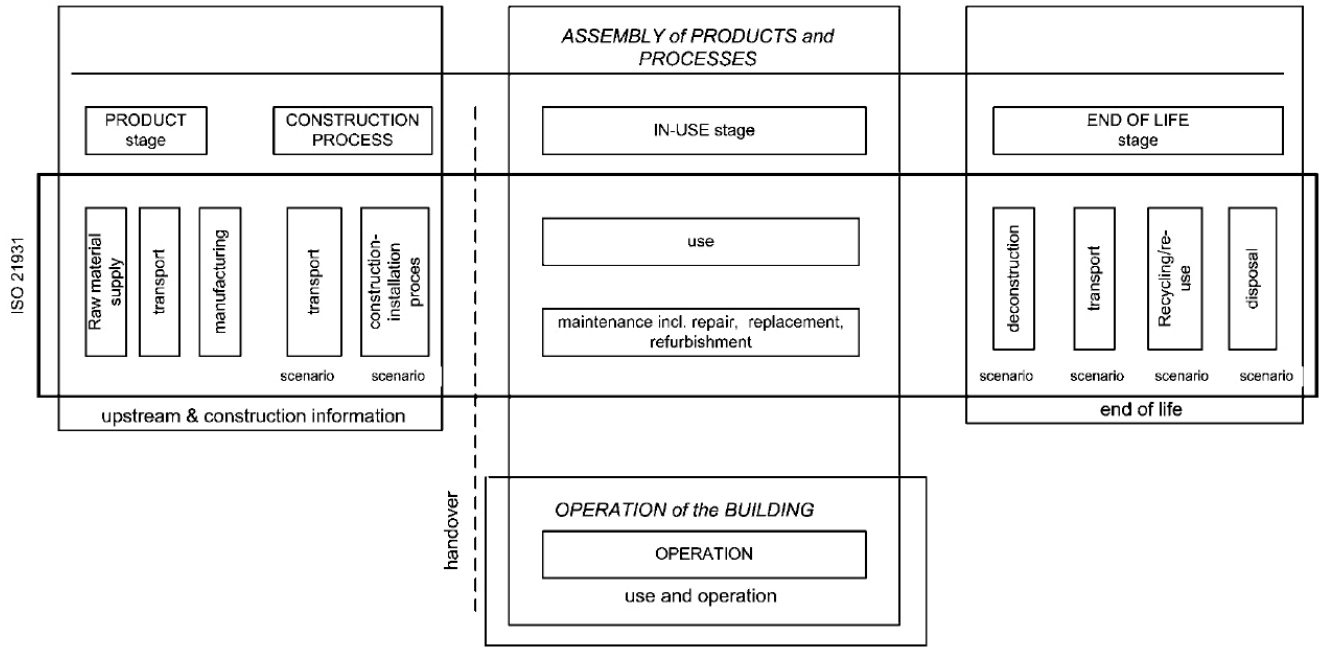
With the knowledge gained by the case studies and with the results from the SuPerBuildings project, these indicators will be revised in the later stage of the project. The target is one common set of indicators that are defining the sustainability of buildings for Europe.

2.2. OPEN HOUSE baseline model and assessment methodology

Being an assessment methodology of the 2nd generation, OPEN HOUSE evaluates the building based on its whole life cycle. ISO 21931-1:2008 provides a model designating which life cycle stages should be taken into account:

- Product stage
- Construction process
- In-use stage
- End of life stage

Figure 4. Life cycle stages of a building according to ISO 21931-1:2008



Categories

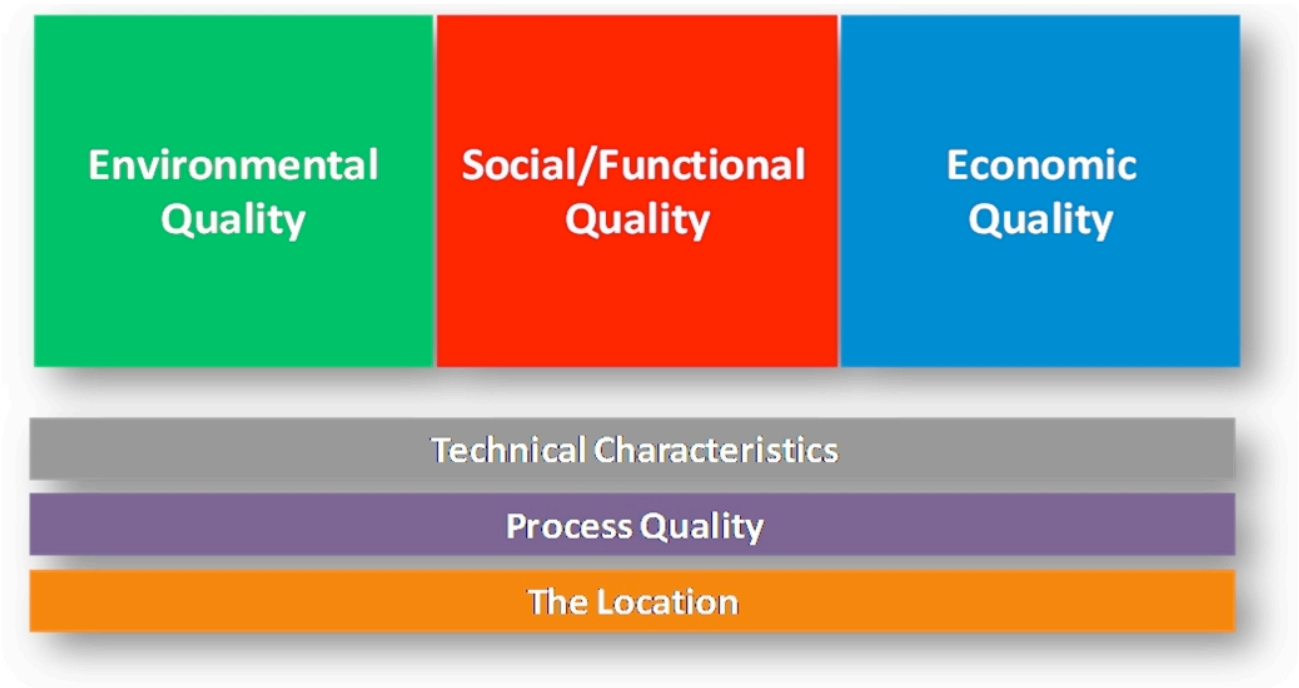
The OPEN HOUSE methodology is diversified into six categories: Environmental Quality, Social/Functional Quality, Economic Quality, Technical Characteristics, Process Quality and the Location.

With equal weight to each other, the three pillars of sustainability Environmental Quality, Social/Functional Quality and Economic Quality compose the main assessment.

Technical Characteristics and the Process Quality are modules, which are assessed separately.

Also the Location is assessed in an extra category, because the site can not be influenced by the design of the building.

Figure 5. OPEN HOUSE full system / core system



Full system / core system

The OPEN HOUSE full system includes a list of 56 indicators which are the outcomes from the previous research. The OPEN HOUSE core system is based on the OPEN HOUSE full system. For the core system the 30 most essential indicators were chosen in discussions among the partners.

Table 1. OPEN HOUSE full system / core system

Category	Nr.	Indicator	full system	core system
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)	■	■
	1.6	Risks from materials	■	
	1.7	Biodiversity and Depletion of Habitats	■	
	1.8	Light Pollution	■	
	1.9	Non-Renewable Primary Energy Demand (PEnr)	■	■
	1.10	Total Primary Energy Demand and Percentage of Renewable Primary Energy (Petot)	■	■
	1.11	Water and Waste Water	■	■
	1.12	Land use	■	■
	1.13	Waste	■	■
	1.14	Energy efficiency of building equipment (lifts, escalators etc.)	■	

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
	2.10	Electro Magnetic Pollution
	2.11	Public Accessibility
	2.12	Noise from Building and Site
	2.13	Quality of the Design and Urban Development of the building and Site
	2.14	Area Efficiency
	2.15	Conversion Feasibility
	2.16	Bicycle Comfort
	2.17	Responsible Material Sourcing
	2.18	Local Material

Economic Quality	3.1	Building-related Life Cycle Costs (LCC)
	3.2	Value Stability

Technical Characteristics	4.1	Fire Protection
	4.2	Durability of the structure and Robustness
	4.3	Cleaning and maintenance
	4.4	Resistance against hail, storm high water and earthquake
	4.5	Noise Protection
	4.6	Quality of the building shell
	4.7	Ease of Deconstruction, Recycling and Dismantling

Process Quality	5.1	Quality of the Project's Preparation
	5.2	Integrated Planning
	5.3	Optimization and Complexity of the Approach to Planning
	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	Monitoring, Use and Operation

The location	6.1	Risks at the Site
	6.2	Circumstances at the Site
	6.3	Options for Transportation
	6.4	Image and Condition of the Location and Neighbourhood
	6.5	Vicinity to amenities
	6.6	Adjacent Media, Infrastructure, Development

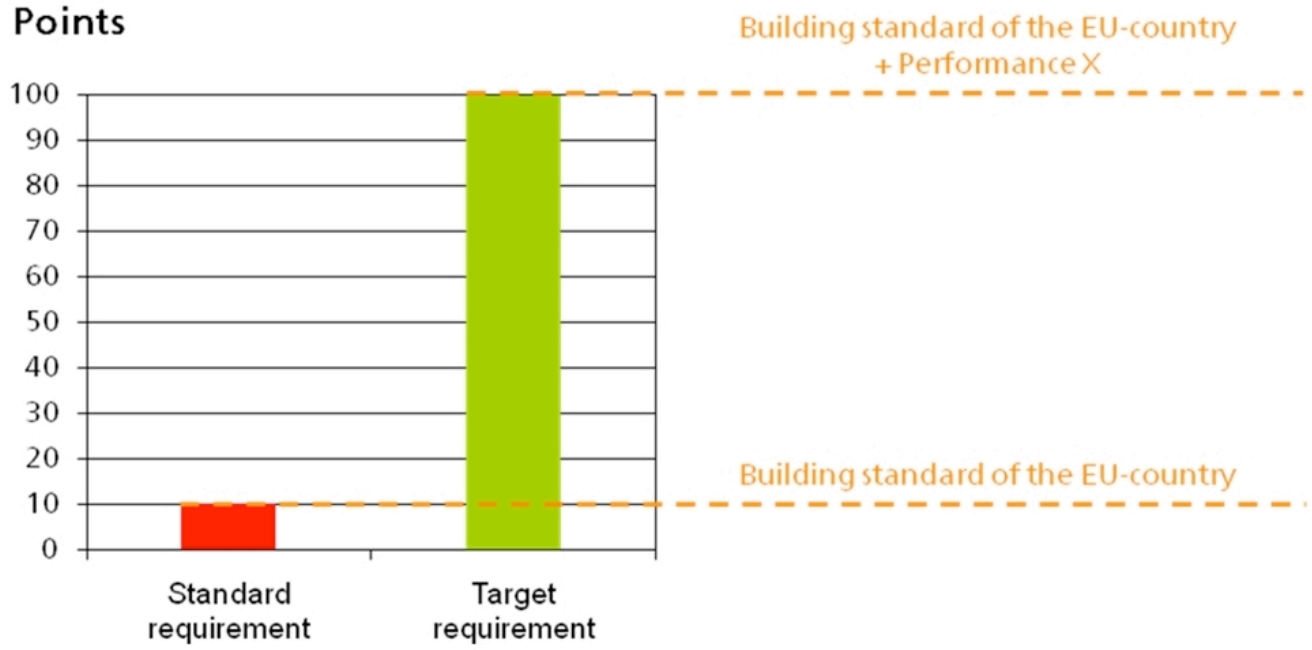
Indicators

For each of the 56 indicators an expert group has been established. Their responsibility was to develop the indicators with regard to the following topics:

1. Objectives
2. Assessment Methodology
3. Calculation and Rating
4. Documentation Guidelines
5. Relation to Other Indicators
6. Resources
7. Attachments

Each of the indicators can receive 100 points as a maximum as soon as a certain performance (target requirement) will be achieved. The building standard of the different European countries are the standard and vary. For this standard requirement 10 points will be achieved.

Figure 6. OPEN HOUSE full system / core system



Complete assessment / Basic and quick sustainability assessment

Two types of assessment can be accomplished [8]:

Basic and quick sustainability assessment

- sustainability experts who participated at the OPEN HOUSE assessment training are required
- for design phase and existing buildings
- gives a first idea of sustainability level and proposes actions to improve the level
- no stringent documentation needed, based on estimations, but must be reasonable
- the assessment is possible within several days and will be done in an assessment workshop

Complete assessment

- sustainability experts who participated at the OPEN HOUSE assessment training are required
- for operating and existing buildings (only buildings that are not older than 10 years are allowed for the case studies)
- widely accepted European sustainability label
- the assessment takes several weeks (assessment workshop and documentation)

System boundaries

For the whole life cycle of the building the following components will be assessed [9]:

- the complete building (inclusive foundations)
- the site of the building and all landscaping on the site
- the location and surrounding of the building

Weighting

The weighting system is splitted into two parts:

Weighting of indicators

Depending on the special needs of each country, the weighting factors for each indicator can be adjusted from 1 (less important) up to 5 (most important).

Weighting of categories

Categories can be weighted against each other in %. In the first version of the baseline methodology the three categories Environmental Quality, Social/Functional Quality and Economic Quality are weighted equally to each other with 33,33 %. Technical Characteristics, Process Quality and the Location are displayed in an extra note and are not part of the main assessment.

Table 2. OPEN HOUSE full system / core system (scoring example)

Primary Quality	OPEN HOUSE Full System Indicators	Points indicator	Points maximal	Degree of performance indicator	Indicator Weighting	Category Weighting	Degree of performance overall
Environmental Quality	1.1 Global Warming Potential (GWP)	67	100	**67%**	1	**33%**	**66%**
	1.2 Ozone Depletion Potential (ODP)	50	100	**50%**	1		
	1.3 Acidification Potential (AP)	10	100	**10%**	1		
	1.4 EutrophicationPotential (EP)	0	100	**0%**	1		
	1.5 Photochemical Ozone Creation Potential (POCP)	25	100	**25%**	1		
	1.6 Risks from materials	100	100	**100%**	1		
	1.7 Biodiversity and Depletion of Habitats	100	100	**100%**	1		
	1.8 Light Pollution	75	100	**75%**	1		
	1.9 Non-Renewable Primary Energy Demand (PEnr)	50	100	**50%**	1		
	1.10 Total Primary Energy Demand and Percentage of Renewable Primary Energy	100	100	**100%**	1		
	1.11 Water and Waste Water	100	100	**100%**	1		
	1.12 Land use	10	100	**10%**	1		
	1.13 Waste	25	100	**25%**	1		
	1.14 Energy efficiency of building equipment (lifts, escalators etc.)	25	100	**25%**	1		
Social / Functional Quality	2.1 Barrier-free Accessibility	100	100	**100%**	1	**33%**	
	2.2 Personal Safety and Security of Users	55	100	**55%**	1		
	2.3 Thermal Comfort	100	100	**100%**	1		
	2.4 Indoor Air Quality	75	100	**75%**	1		
	2.5 Water Quality	25	100	**25%**	1		
	2.6 Acoustic Comfort	75	100	**75%**	1		
	2.7 Visual Comfort	50	100	**50%**	1		
	2.8 Operation Comfort	65	100	**65%**	1		
	2.9 Service Quality	20	100	**20%**	1		
	2.10 Electro Magnetic Pollution	10	100	**10%**	1		
	2.11 Public Accessibility	0	100	**0%**	1		
	2.12 Noise from Building and Site	0	100	**0%**	1		
	2.13 Quality of the Design and Urban Development of the building and Site	0	100	**0%**	1		
	2.14 Area Efficiency	25	100	**25%**	1		
	2.15 Conversion Feasibility	50	100	**50%**	1		
	2.16 Bicycle Comfort	100	100	**100%**	1		
	2.17 Responsible Material Sourcing	100	100	**100%**	1		
	2.18 Local Material	100	100	**100%**	1		
Economic Quality	3.1 Building-related Life Cycle Costs (LCC)	85	100	**85%**	1	**33%**	
	3.2 Value Stability	100	100	**100%**	1		
Technical Characteristics	4.1 Fire Protection	0	100	**0%**	1		**56%**
	4.2 Durability of the structure and Robustness	75	100	**75%**	1		
	4.3 Cleaning and maintenance	25	100	**25%**	1		
	4.4 Resistance against hail, storm high water and earthquake	75	100	**75%**	1		
	4.5 Noise Protection	50	100	**50%**	1		
	4.6 Quality of the building shell	65	100	**65%**	1		
	4.7 Ease of Deconstruction, Recycling, and Dismantling	100	100	**100%**	1		
Process Quality	5.1 Quality of the Project's Preparation	0	100	**0%**	1		**46%**
	5.2 Integral Planning	100	100	**100%**	1		
	5.3 Optimization and Complexity of the Approach to Planning	75	100	**75%**	1		
	5.4 Evidence of Sustainability during Bid Invitation and Awarding	25	100	**25%**	1		
	5.5 Construction Site impact/ Construction Process	75	100	**75%**	1		
	5.6 Quality of the Executing Contractors/Pre-Qualification	50	100	**50%**	1		
	5.7 Quality Assurance of Construction Execution	65	100	**65%**	1		
	5.8 Commissioning	20	100	**20%**	1		
	5.9 Monitoring, Use and Operation	0	100	**0%**	1		
The location	6.1 Risks at the Site	75	100	**75%**	1		**55%**
	6.2 Circumstances at the Site	0	100	**0%**	1		
	6.3 Options for Transportation	25	100	**25%**	1		
	6.4 Image and Condition of the Location and Neighbourhood	50	100	**50%**	1		
	6.5 Vicinity to amenities	100	100	**100%**	1		
	6.6 Adjacent Media, Infrastructure, Development	80	100	**80%**	1		

3. Conclusions

Together with the outcomes from the partner project SuPerBuildings and due to the cooperation with other stakeholders (e.g. SB Alliance), the OPEN HOUSE methodology is evolving into a strong tool which helps to shift the market towards sustainable buildings.

In the next step the OPEN HOUSE methodology will be tested in 68 case studies all over Europe. The hereby gained experience will further contribute to improving the methodology.

Figure 7. Submitted buildings for the case studies

Conflict of Interest

"The authors declare no conflict of interest".

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