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Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment —

Part 1: Buildings

Développement durable dans les bâtiments et les ouvrages de génie civil — Cadre méthodologique de l'évaluation au sens du développement durable des performances environnementales, sociales et économiques des ouvrages de construction —

Partie 1: Bâtiments

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 17, *Sustainability in buildings and civil engineering works*.

This second edition cancels and replaces the first edition (ISO 21931-1:2010), which has been technically revised.

The main changes are as follows:

— the scope has been expanded from a framework for methods of assessment of environmental performance to also include provisions related to methods for the assessment of economic and social performance of construction works, as an overall basis for sustainability assessment.

A list of all parts in the ISO 21931 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Buildings and constructed assets have an impact on sustainable development. Therefore, the internationally recognized Sustainable Development Goals (SDGs) formulated by the United Nations also apply to the construction and real estate industry. Amongst other things, the construction of sustainable and resilient buildings is required as part of targets towards sustainable cities and communities formulated in SDG 11. This goal is closely interrelated with the other SDGs. Both providers and buyers of real estate need clear characteristics and assessment criteria in order to evaluate, assess and communicate the contribution of buildings to sustainable development.

The provision and use of buildings in the sense of constructed shelters is a prerequisite for the residential sector, as well as for trade and industry. Buildings constitute both a living and working environment and affect the safety, comfort and performance of the user, as well as the quality of coexistence/life in a community. Aspects of urban integration and architectural design of buildings are important for the overall quality of the built environment: they can represent a cultural value. Buildings and constructed assets represent a high economic value both from a private, micro-economic and macro-economic point of view. Their construction and maintenance contribute to the preservation and creation of jobs, whereas the building-related negative effects on the environment contribute to external costs. The construction, use and maintenance of buildings are associated with significant energy and material flows, as well as adverse effects on the local and global environment. This includes health risks and risks to the environment. The type of design, construction and operation of buildings, together with the future construction of building stocks, have a great effect on sustainable development.

Against the background of climate change and the related SDG Goal 13 on Climate Action, and the importance of energy-saving, resource-saving, and healthy and cost-effective design, construction and management of buildings, there is a need for the creation of a basis for the assessment of environmental, social and economic performance; this is one purpose of this document. This document aims to bridge the gap between regional and national methods for the assessment of the environmental, social and economic performance of buildings, by providing a common framework for their expression. Practical, relevant rules and recommendations concerning methods for the assessment of the environmental, social and economic performance of buildings, which can exist on either a national or regional basis, can be examined and improved by the use of the framework of assessment, which is the basis of this document. Furthermore, general criteria for the determination and assessment of the environmental, social and economic performance of buildings are specified. These are derived from the areas of protection of sustainable development according to ISO 21929-1. The contribution of individual buildings to sustainable development can only be assessed if the technical and functional requirements are met and the results of the assessment of the environmental, social and economic performance are simultaneously and equally weighted.

Life-cycle-based approaches play an increasingly significant role for setting performance criteria within methods of assessment of environmental, social and economic performance of buildings. However, methods of assessment of the environmental, economic and social performance of buildings need to refer to limited criteria and seek a balance between rigour and practicality.

Target conflicts can occur when attempting to plan environmentally- and health-friendly buildings, which are characterized by a high user acceptance and are at the same time economically advantageous. These target conflicts can be identified through the combined analysis of ecological, social and economic aspects. Already in the planning phase, the consequences of decisions on the energy and material flows with resulting environmental impacts, on the life cycle costs as well as on the social performance can be identified and influenced. The effects of decisions on the size and shape, the construction method, the choice of materials or the energy sources, among others, can be analysed.

The subject of this document is the building on its site (curtilage) throughout its life cycle. This document can be used to support planning and decision-making for new constructions and refurbishment actions. This particularly affects the comparison of variants, the provision of information for sustainability assessment and certification systems, as well as the provision of information for funders, valuers, facility and portfolio managers, risk analysts and others.

Such assessments can also be used for benchmarking performance and monitoring progress towards improvement of performance; their communication provides a basis for demonstrating and communicating the result of efforts to improve environmental, social and economic performance in construction works.

This document aims at builders, planners and developers of sustainability assessment systems for individual buildings.

This document is one of a suite of documents dealing with sustainability in building construction, which includes ISO 21929-1, ISO 21930 and ISO 15392, along with the terminology of sustainability in building construction (ISO/TR 21932). The relationship among the documents is illustrated in Figure 1.

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Figure 1 — Suite of related documents for sustainability

Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment —

Part 1: Buildings

1 Scope

This document provides a general framework for improving the quality and comparability of methods for assessing the environmental, social and economic performance of construction works, and their combination as a basis for the sustainability assessment of buildings.

It identifies and describes issues to be taken into account in the development and use of methods of assessment of the environmental, social and economic characteristics, aspects and impacts of new or existing buildings. These relate to the building's design, production of construction products, materials and components, construction, operation, maintenance and refurbishment and end-of-life processes.

This document is applicable to the assessment of the building (or part thereof) and the external works within its site (curtilage).

NOTE The assessment of environmental, social and economic aspects related to the location of the building, such as those resulting from transportation of the users, can extend beyond the area of the building site.

This document does not set benchmarks or levels of performance relative to environmental, social and economic impacts and aspects.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6707-1, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

ISO 6707-2, *Buildings and civil engineering works — Vocabulary — Part 2: Contract and communication terms*

ISO 14050, *Environmental management — Vocabulary*

ISO 15686-1, *Buildings and constructed assets — Service life planning — Part 1: General principles and framework*

ISO 15686-2, *Buildings and constructed assets — Service life planning — Part 2: Service life prediction procedures*

ISO 15686-5, *Buildings and constructed assets — Service life planning — Part 5: Life-cycle costing*

ISO 15686-7, *Buildings and constructed assets — Service life planning — Part 7: Performance evaluation for feedback of service life data from practice*

ISO 15686-8, *Buildings and constructed assets — Service-life planning — Part 8: Reference service life and service-life estimation*

ISO 21678, *Sustainability in buildings and civil engineering works — Indicators and benchmarks — Principles, requirements and guidelines*

ISO 21930:2017, *Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services*

ISO/TR 21932, *Sustainability in buildings and civil engineering works — A review of terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1, ISO 6707-2, ISO 14050, ISO/TR 21932 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

NOTE Several of the listings below include terminology data from ISO 6707-1 and ISO 6707-2 for convenience and direct reference.

3.1 Terms relating to construction works and construction products

3.1.1
building
construction works (3.1.7) that has the provision of shelter for its occupants or contents as one of its main purposes, usually partially or totally enclosed and designed to stand permanently in one place

[SOURCE: ISO 6707-1:2020, 3.1.1.3, modified — Note 1 to entry has been removed.]

3.1.2
component
item manufactured as a distinct unit to serve a specific function or functions

Note 1 to entry: A building component is a part of a *building* (3.1.1), fulfilling specific requirements/functions (e.g. a window or a heating system). The *service life* (3.1.13) of a building component can be shorter than the full service life of the building. Building components are sometimes referred to as “building elements”.

Note 2 to entry: A product component is a part of a complex *construction product* (3.1.6), for example a seal of a window or a burner as part of a heating system, fulfilling specific requirements/functions. The service life of a product component can be shorter than the service life of the of the building or building element or the "complex" construction product.

[SOURCE: ISO 6707-1:2020, 3.4.1.3, modified — the reference to "product" has been replaced by "item" and two notes to entry have been added.]

3.1.3
assembly
set of related *components* (3.1.2) attached to each other

[SOURCE: ISO 6707-1:2020, 3.3.5.5]

3.1.4
brief
program, US
document that states the requirements for a project

[SOURCE: ISO 6707-2:2017, 3.2.18]

3.1.5
client
person or organization initiating and financing a project and approving the *brief* (3.1.4)

[SOURCE: ISO 6707-2:2017, 3.8.2]

3.1.6
construction product
item manufactured or processed for incorporation in a *building* (3.1.1)

Note 1 to entry: Construction products are items supplied by a single responsible body.

Note 2 to entry: In this document, unless otherwise designated, the term construction product is used for any good(s) or service(s) related to a building.

Note 3 to entry: *Assemblies* (3.1.3), construction elements and integrated technical systems, incorporated within the building can be considered construction products.

[SOURCE: ISO 21930:2017, 3.2.2, modified — The references to "construction works" have been replaced with "building(s)"; the reference to "construction assemblies" has been replaced with "assemblies".]

3.1.7
construction works
construction, US
everything that is constructed or results from construction operations

[SOURCE: ISO 6707-1:2020, 3.1.1.1, modified — Two notes to entry have been removed.]

3.1.8
constructed asset
anything of value that is constructed or results from construction operations

[SOURCE: ISO 20887:2020, 3.8]

3.1.9
design life
service life (3.1.13) intended by the designer

Note 1 to entry: As stated by the designer to the client to support specification decisions.

[SOURCE: ISO 15686-1:2011, 3.3, modified — The abbreviated term and the deprecated terms have been removed.]

3.1.10
estimated service life
service life (3.1.13) that a *building* (3.1.1) or parts of a building would be expected to have in a set of specific in-use conditions, determined from reference service life data after taking into account any differences from the reference in-use conditions

Note 1 to entry: The estimated service life is considered in the calculation of replacements at both the *construction product* (3.1.6) level and building level (B4) and refurbishment (B5) (see 5.4.2.3).

[SOURCE: ISO 15686-1:2011, 3.7, modified — The abbreviated term has been removed; Note 1 to entry has been added.]

3.1.11
required service life
service life (3.1.13) required by the client or through regulations

Note 1 to entry: The required service life is considered in the calculation of replacements at both the *construction product* (3.1.6) level and *building* (3.1.1) level (B4) and refurbishment (B5) (see 5.4.2.3).

[SOURCE: ISO 21930:2017, 3.2.14, modified — The reference to "construction works" has been replaced with "building".]

3.1.12
resilience
ability to resist, adapt to, or quickly recover from potentially disruptive events or conditions, whether natural or anthropogenic, in order to maintain or restore the intended service

3.1.13
service life
period of time after installation during which a *building* (3.1.1) or its component parts meet or exceed the *performance* (3.2.1) requirements

[SOURCE: ISO 15686-1:2011, 3.25, modified — The reference to "facility" has been replaced with "building".]

3.1.14
sustainable development
development that meets the environmental, social and economic needs of the present without compromising the ability of future generations to meet their own needs

[SOURCE: ISO Guide 82:2019, 3.2, modified — Note 1 to entry has been removed.]

3.1.15
disassembly
non-destructive taking-apart of a *construction works* (3.1.7) or *constructed asset* (3.1.8) into constituent materials or *components* (3.1.2)

Note 1 to entry: This *process* (3.3.17) can be applied to a *construction product* (3.1.6), system, component, or *assembly* (3.1.3).

[SOURCE: ISO 20887:2020, 3.12, modified — In Note 1 to entry, the reference to "product" has been replaced with "construction product"; the reference to "module" has been removed.]

3.1.16
adaptability
ability to be changed or modified to make suitable for a particular purpose

[SOURCE: ISO 6707-1:2020, 3.7.3.79]

3.1.17
convertibility
ability to accommodate a substantial change(s) in user needs by making modifications

[SOURCE: ISO 20887:2020, 3.10]

3.1.18
expandability
ability of a design or the characteristic of a system to accommodate a substantial change that supports or facilitates the addition of new space, features, capabilities and capacities

Note 1 to entry: Expandability is a form of scalability. Similarly, contraction can also be a beneficial capability that is a form of scalability.

[SOURCE: ISO 20887:2020, 3.16]

3.1.19
versatility
flexibility
ability to accommodate different functions with minor system changes

[SOURCE: ISO 20887:2020, 3.40, modified — The admitted term "flexibility" has been added.]

3.1.20
repair
returning a *construction product* (3.1.6) or *component* (3.1.2) to an acceptable condition through the renewal, *replacement,* (3.1.21) or mending of worn, damaged, or degraded parts

[SOURCE: ISO 6707-1:2020, 3.5.1.47, modified — The reference to “item” has been replaced by a reference to “construction product or component.”]

3.1.21
replacement
substitution of a *construction product* (3.1.6) or *component* (3.1.2) with one having identical characteristics

3.1.22
refurbishment
modification to a *building* (3.1.1) or *component* (3.1.2) in order to bring it up to an improved condition

Note 1 to entry: Refurbishment can include, for example, *retrofit* (3.1.23), *remodelling* (3.1.24), modernization, repurposing and the improvement of technical and functional performance.

3.1.23
retrofit
modification of an entity or system using parts developed or made available after the time of original manufacture or by other means with the objective of improving functionality

[SOURCE: ISO 6707-4:2021, 3.5.27]

3.1.24
remodelling
changing the structure or function of a *building* (3.1.1)

3.2 Terms relating to performance

3.2.1
performance
observed (or predicted) in-use behaviour of a *building* (3.1.1) in fulfilling (to fulfil) required functions under intended use conditions

Note 1 to entry: Behaviour in this context pertains to functional and technical requirements in use.

[SOURCE: ISO 15392:2019, 3.20, modified — The expression "in-use" has been added; the reference to "construction works, construction product or construction service" has been replaced with "building"; in Note 1 to entry, the reference to "performance" has been replaced with "behaviour".]

3.2.2
functional equivalent
quantified functional requirements and/or technical requirements for a *building* (3.1.1) for use as a reference basis for comparison

3.2.3
economic aspect
characteristic of a *building* (3.1.1), part(s) of a building, *processes* (3.3.17) or services related to its *life cycle* (3.3.1) that can cause a change to cost and/or economic value

[SOURCE: ISO 15392:2019, 3.12, modified — The references to "construction works" have been replaced with "building" in the singular; the reference to "economic conditions" has been replaced with "cost and/or economic value".]

3.2.4
economic impact
<mid-point assessment> change to the economy, whether adverse or beneficial, wholly or partially resulting from *economic aspects* (3.2.3)

Note 1 to entry: Derived from the definitions of "impact" and "economic impact" in ISO 15392 and delimited to a *life cycle costing* (3.3.4) method focussed on mid-points.

3.2.5
economic impact
<end-point assessment> result of a change to the economy, whether adverse or beneficial, wholly or partially resulting from *economic aspects* (3.2.3)

Note 1 to entry: Derived from the definitions of "impact" and "economic impact" in ISO 15392 and delimited to a *life cycle costing* (3.3.4) method focussed on end-points.

3.2.6
economic performance
performance (3.2.1) of a *building* (3.1.1) relating to its *economic aspects* (3.2.3) and *economic impacts* (3.2.4) (3.2.5)

3.2.7
environmental aspect
characteristic of a *building* (3.1.1), part(s) of a building, *processes* (3.3.17) or services related to its *life cycle* (3.3.1) that can cause a change to the *environment* (3.3.20)

[SOURCE: ISO 15392:2019, 3.13, modified — The references to "construction works" have been replaced with "building" in the singular.]

3.2.8
environmental impact
<mid-point assessment> change to the *environment* (3.3.20), whether adverse or beneficial, wholly or partially resulting from *environmental aspects* (3.2.7)

Note 1 to entry: Derived from the definitions of "impact" and "environmental impact" in ISO 15392 and delimited to LCIA (life cycle impact assessment) methods focussed on mid-points.

3.2.9
environmental impact
<end-point assessment> result of a change to the *environment* (3.3.20), whether adverse or beneficial, wholly or partially resulting from *environmental aspects* (3.2.7)

Note 1 to entry: Derived from the definitions of "impact" and "environmental impact" in ISO 15392 and delimited to LCIA (life cycle impact assessment) methods focussed on end-points.

3.2.10
environmental performance
performance (3.2.1) of a *building* (3.1.1) related to its *environmental aspects* (3.2.7) and *environmental impacts* (3.2.8) (3.2.9)

Note 1 to entry: The environmental performance is influenced by all *processes* (3.3.17) related to the *life cycle* (3.3.1) of the building.

Note 2 to entry: Environmental performance can be expressed either quantitatively or qualitatively with reference to *performance requirements* (ISO 6707-1:2020, 3.7.1.12) or possibly relative to a scale of values or a *benchmark* (3.2.16).

Note 3 to entry: Module D also shows additional supplementary information regarding environmental performance (potential environmental impacts and aspects) related to the energy and mass flows beyond the *system boundary* (3.3.12).

[SOURCE: ISO 15392:2019, 3.16, modified — The references to "building" and Notes 2 and 3 to entry have been added.]

3.2.11
social aspect
characteristic of a *building* (3.1.1), part(s) of a building, *processes* (3.3.17) or services related to its *life cycle* (3.3.1) that can cause a change to society or quality of life

[SOURCE: ISO 15392:2019, 3.14, modified — The references to "construction works" have been replaced with "building" in the singular.]

3.2.12
social impact
<mid-point assessment> change to society or quality of life, whether adverse or beneficial, wholly or partially resulting from *social aspects* (3.2.11)

Note 1 to entry: Derived from the definitions of "impact" and "social impact" in ISO 15392 and delimited to assessment methods focussed on mid-points.

3.2.13
social impact
<end-point assessment> result of a change to society or quality of life, whether adverse or beneficial, wholly or partially resulting from *social aspects* (3.2.11)

Note 1 to entry: Derived from the definitions of "impact" and "social impact" in ISO 15392 and delimited to assessment methods focussed on end-points.

3.2.14
social performance
performance (3.2.1) of a *building* (3.1.1) relating to its *social aspects* (3.2.11) and *social impacts* (3.2.12) (3.2.13)

3.2.15
benchmarking
process (3.3.17) of collecting, analysing and relating *performance* (3.2.1) data of comparable *buildings* (3.1.1) or other types of *construction works* (3.1.7)

Note 1 to entry: Benchmarking is typically used for evaluating and comparing performance between or within objects of consideration.

[SOURCE: ISO 21678:2020, 3.1]

3.2.16
benchmark
reference point against which comparisons can be made

[SOURCE: ISO 21678:2020, 3.2]

3.3 Terms relating to life cycle approaches

3.3.1
life cycle
all consecutive and interlinked stages in the life of the object under consideration

Note 1 to entry: For consideration of *environmental impacts* (3.2.8) (3.2.9) and *environmental aspects* (3.2.7), the life cycle comprises all stages, from raw material acquisition or generation of natural resources to end-of-life.

Note 2 to entry: For consideration of *economic impacts* (3.2.4) (3.2.5) and *economic aspects* (3.2.3), in terms of costs, the life cycle comprises all stages from pre-construction to end-of-life.

Note 3 to entry: For consideration of *social impacts* (3.2.12) (3.2.13) and *social aspects* (3.2.9) of the life cycle, it comprises all stages from pre-construction to end-of-life.

[SOURCE: ISO 15392:2019, 3.19, modified — In Note 2 to entry, "construction to decommissioning" has been replaced with "pre-construction to end-of-life"; the reference to "period of analysis" and ISO 15686-5 has been removed; Note 3 to entry has been added.]

3.3.2
life cycle assessment
LCA
compilation and evaluation of the inputs, outputs and the potential *environmental impacts* (3.2.8) (3.2.9) of a product system throughout its *life cycle* (3.3.1)

[SOURCE: ISO 14040:2006, 3.2]

3.3.3
life cycle cost
LCC
cost of a whole *building* (3.1.1), structure or unit of *construction works* (3.1.5) or its parts throughout its *life cycle* (3.3.1), while fulfilling the *performance* (3.2.1) requirements

[SOURCE: ISO 15686-5:2017, 3.1.7, modified — The reference to "asset" has been replaced with "whole building, structure or unit of construction works".]

3.3.4
life cycle costing
methodology for systematic economic evaluation of *life cycle costs* (3.3.3) over a *period of analysis* (3.3.14), as defined in the agreed scope

Note 1 to entry: Life cycle costing can address a period of analysis that covers the entire *life cycle* (3.3.1) or (a) selected stage(s) or periods of interest thereof.

[SOURCE: ISO 15686-5:2017, 3.1.8]

3.3.5
external cost
cost associated with an asset that is not reflected in the cash flow between provider and consumer

Note 1 to entry: External costs, collectively, are related to negative *externalities* (3.3.10).

Note 2 to entry: These costs may include business staffing, productivity and user costs, and *environmental costs* (3.3.6) and other *social costs* (3.3.9); these can be taken into account in a *life cycle cost* (3.3.3) analysis but are to be explicitly identified.

Note 3 to entry: Adapted from the definition of "external costs" in ISO 15686-5:2017, 3.1.6.

3.3.6
environmental cost
external cost (3.3.5) caused by damage to the *environment* (3.3.20) associated with the *construction works* (3.1.7) imposed on external parties or the society

Note 1 to entry: These costs are types of negative *externalities* (3.3.10) (external costs).

3.3.7
discount rate
factor or rate reflecting the time value of money that is used to convert cash flows occurring at different times to a common time

[SOURCE: ISO 15686-5:2017, 3.3.1, modified — Note 1 to entry has been removed.]

3.3.8
social discount rate
SDR
discount rate (3.3.7) that takes into account the cost of a particular *constructed asset* (3.1.8) under consideration from the perspective of future generations

Note 1 to entry: Social discount rates (SDRs) are used to put a present value on costs and benefits that will occur at a later date. Typical social discounts rates are lower than market-driven discount rates.

Note 2 to entry: Social discount rates are important in calculating the benefits and costs of long-term future impacts such as future climate change. Because carbon dioxide has a very long residence time in the atmosphere, it is necessary to value the impacts of today's emissions centuries into the future.

3.3.9
social cost
external cost (3.3.5) caused by damage to society associated with the *construction works* (3.1.7) imposed on external parties or the society

Note 1 to entry: These costs are types of negative *externalities* (3.3.10) (external costs).

3.3.10
externality
quantifiable *external cost* (3.3.5) or external benefit that occurs when the actions of organizations and individuals have an effect on parties other than themselves

Note 1 to entry: Externalities are positive if their effects are benefits to other people and negative, or external costs, if the external effects are costs on other people. There may be external costs and benefits from both production and consumption. Adding the externality to the private cost/benefit gives the total *social cost* (3.3.9) or benefit.

[SOURCE: ISO 15686-5:2017, 3.4.4, modified — The reference to "cost or benefit" has been replaced with "external cost or external benefit"; the EXAMPLE has been removed.]

3.3.11
gate
point at which the *construction product* (3.1.6) or material leaves the factory before it becomes an input into a subsequent manufacturing *process* (3.3.17) or before it is transported to the distributor, another factory or a construction site

3.3.12
system boundary
boundary representing physical, *process* (3.3.17), temporal and geographical limits of the stages of the *building* (3.1.1) *life cycle* (3.3.1) included in an assessment

Note 1 to entry: Although outside the system boundary, loads and benefits related to module D may be included in an assessment as additional supplementary information (see 5.4.2.5).

[SOURCE: ISO 21931-2:2019, 3.31, modified — The reference to "what is included and what is not included' has been replaced with "the stages of the building life cycle included"; Note 1 to entry has been added.]

3.3.13
transparency
open, comprehensive and understandable presentation of information

[SOURCE: ISO 14040:2006, 3.7]

3.3.14
reference study period
period of analysis
period of time over which relevant aspects and impacts of the *building* (3.1.1) are analysed

Note 1 to entry: The reference study period is determined by the client.

Note 2 to entry: In the case of an economic assessment, it is the *life cycle costs* (3.3.3) or *whole-life costs* (3.3.15) that are analysed.

Note 3 to entry: The term 'period of analysis' is used more often in an economic context

[SOURCE: ISO 21931-2:2019, 3.23, modified — The reference to "civil engineering works" has been replaced with "building"; an admitted term and Notes 2 and 3 to entry have been added.]

3.3.15
whole-life cost
WLC
all significant and relevant initial and future costs and economic benefits (e.g. revenues) of an asset, throughout its *life cycle* (3.3.1), while fulfilling the *performance* (3.2.1) requirements

Note 1 to entry: Whole-life cost also considers income which allows for profitability considerations/profitability analyses from the owner/investor point of view.

[SOURCE: ISO 15686-5:2017, 3.1.14, modified — The reference to "benefits" has been replaced with "economic benefits (e.g. revenues)" and Note 1 to entry has been added.]

3.3.16
whole-life costing
methodology for systematic economic consideration of all *whole-life costs* (3.3.15) and benefits over a *period of analysis* (3.3.14), as defined in the agreed scope

Note 1 to entry: The projected costs or benefits may include *external costs* (3.3.5) (including, for example, finance, business costs, income from land sale, user costs).

Note 2 to entry: Whole-life costing can address a period of analysis that covers the entire *life cycle* (3.3.1) or (a) selected stage(s) or periods of interest thereof.

Note 3 to entry: This definition is to be contrasted with that for *life cycle costing* (3.3.4).

[SOURCE: ISO 15686-5:2017, 3.1.15]

3.3.17
process
series of operations performed to achieve a desired result

3.3.18
downstream process
process (3.3.17) that is carried out after the designated process in the stream of relevant processes

3.3.19
upstream process
process (3.3.17) carried out before the designated process in the stream of relevant processes

3.3.20
environment
surroundings in which a person(s) operates, including air, water, land, natural resources, flora, fauna, humans and their interrelationships

Note 1 to entry: Surroundings can extend from within an organization to the local, regional and global system.

Note 2 to entry: Surroundings can be described in terms of biodiversity, ecosystems, climate or other characteristics.

[SOURCE: ISO 14001:2015, 3.2.1, modified — The reference in the definition to "an organization" has been replaced with "a person(s)".]

3.4 Terms relating to resources and materials

3.4.1
renewable resource
resource that is grown, naturally replenished or cleansed on a human time scale

EXAMPLE Trees in forests, grasses in grasslands and fertile soil, wind.

Note 1 to entry: A renewable resource is capable of being exhausted but can last indefinitely with proper stewardship.

Note 2 to entry: Activities that occur in the technosphere such as recycling are not considered natural replenishment or cleansing.

Note 3 to entry: In this context, human time scale refers to the typical lifetime of a human rather than the time humans have been in existence.

[SOURCE: ISO 21930:2017, 3.6.2]

3.4.2
non-renewable resource
resource that exists in a fixed amount that cannot be naturally replenished or cleansed on a human time scale

Note 1 to entry: Activities that occur in the technosphere such as recycling are not considered natural replenishment or cleansing.

Note 2 to entry: In this context, human time scale refers to the typical lifetime of a human rather than the time humans have been in existence.

[SOURCE: ISO 21930:2017, 3.6.3, modified — Note 3 to entry has been removed.]

3.4.3
exported energy
energy (3.4.4), expressed per *energy carrier* (3.4.5), delivered by the technical building systems through the *system boundary* (3.3.12) and used outside the system boundary

Note 1 to entry: It can be specified by generation types [e.g. combined heat and power (CHP), photovoltaic (PV)] in order to apply different weighting factors.

Note 2 to entry: The term “exported utilities” is used in this document to describe utilities, such as electricity, water, heat, which may be exported.

[SOURCE: ISO 16745-1:2017, 3.9, modified — Note 2 to entry has been added.]

3.4.4
energy
capacity for doing work; having several forms that may be transformed from one to another, such as thermal (heat), mechanical (work), electrical, or chemical

[SOURCE: ISO 16745-1:2017, 3.6]

3.4.5
energy carrier
substance or phenomenon that can be used to produce mechanical work or heat, or to operate chemical or physical *processes* (3.3.17)[SOURCE: ISO 16745-1:2017, 3.7, modified — Notes 1 and 2 to entry have been removed.]

[SOURCE: ISO 16745-1:2017, 3.7, modified — Notes 1 and 2 to entry have been removed.]

3.4.6
recovery
waste treatment operation that serves a purpose in replacing other resources or prepares waste for such a use

[SOURCE: ISO/TS 21929-2:2015, 3.32]

3.4.7
recycling
any *recovery* (3.4.6) operation by which *waste* (3.4.8) materials are reprocessed into products, materials or substances whether for the original or other purposes

[SOURCE: ISO/TS 21929-2:2015, 3.33]

3.4.8
waste
substances or objects that the original holder has disposed of or intends to or is required to dispose of

Note 1 to entry: In this part of ISO 21929 this concept is not confined to hazardous waste.

Note 2 to entry: Adapted from the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* (22 March 1989), Article 2 Definitions, Item 1. The wording has been simplified and the reference to national law as the basis for any requirements has been removed.

[SOURCE: ISO 21929-1:2011, 3.37]

3.5 Miscellaneous terms

3.5.1
sustainability assessment
assessment of the contribution of a *building* (3.1.1)/*constructed asset* (3.1.8) to the *sustainable development* (3.1.14) including the compliance with its management rules, based on the results of an *environmental* (3.2.8), *social* (3.2.11) and *economic performance* (3.2.6) assessment and under the precondition of fulfilment of technical, functional, legal and other requirements, expressed in the *client's* (3.1.5) *brief* (3.1.4)

Note 1 to entry: Environmental, social and economic performance are of equal importance. For new designs, the assessment is based on *scenario*-related (3.5.5) calculations; for existing buildings, the assessment is based partially on measurements of the building in use and surveys among its users.

3.5.2
area of concern
aspect(s) of the economy, the *environment* (3.3.20) or the society that can be impacted by *construction works* (3.1.7), goods or services

EXAMPLE Asset value, cultural heritage, resources, human health and comfort, social infrastructure.

[SOURCE: ISO 15392:2019, 3.3, modified — The two admitted terms have been removed and the preferred term has been singularized.]

3.5.3
disposal
<end-of-life> transformation of the state of a *building* (3.1.1) or facility that is no longer of use

Note 1 to entry: Transformation can include, either individually or in some combination, the decommissioning, deconstruction, recycling and demolition of the object of assessment.

[SOURCE: ISO/TR 15686-11:2014, 3.1.26.2, modified — In Note 1 to entry, the reference to "object of consideration" has been replaced with "object of assessment".]

3.5.4
disposal
<status change> transfer of ownership of, or responsibility for, the object of assessment

[SOURCE: ISO/TR 15686-11:2014, 3.1.26.1, modified — The reference to "object of consideration" has been replaced with "object of assessment".]

3.5.5
scenario
collection of assumptions and information relevant to possible future events

[SOURCE: ISO 21930:2017, 3.1.8]

3.5.6
stakeholder
interested party
person or organization that can affect, be affected by, or perceive itself to be affected by a decision or activity

EXAMPLE Customers, communities, suppliers, regulators, non-governmental organizations, investors and employees.

[SOURCE: ISO 15392:2019, 3.23, modified — An additional preferred term has been added.]

3.5.7
neighbourhood
local *environment* (3.3.20) in the vicinity of the object of assessment

Note 1 to entry: "*Neighbourhoods are the spatial units in which face-to-face social interactions occur — the personal settings and situations where residents seek to realise common values, socialise youth, and maintain effective social control.*"[33]

4 Principles and application

This document follows the principles set out in ISO 15392, and shall be used in conjunction with ISO 21930, it also follows the principles of the ISO 14020 family of International Standards, which includes ISO 14020, ISO 14021, as well as ISO 14040, ISO 14044 and ISO 15686-1. Where this document contains more specific requirements, it seeks to complement these other documents. Where the requirements of this document go beyond the requirements of these International Standards, the requirements of this document apply.

5 The object of assessment

5.1 General

5.1.1 Perspectives on a building

This clause deals with the description of the object of assessment, taking into account the different perspectives of various stakeholders, where the building can be some or all of the following:

— a place in which to live, work or socialize;

— a part of the built environment;

— an end-use product and an integrated assembly of products;

— an economic asset;

— a project to be managed from its inception to end-of-life;

— a system in operation;

— a place for shelter and protection of contents;

— an object that embodies cultural value;

— intentionally designed as either an enduring asset or for a short-term purpose.

Methodologies for the assessment of the contribution of a building to sustainable development and its related external works need to explicitly define the methods used to assess and take into account the impacts and aspects of the building.

5.1.2 A building as a place in which to live, work or socialize

This perspective primarily reflects social aspects.

A building is a place to work and live. A building is not erected to an end in itself but to serve the fulfilment of functional requirements and different users' needs at various levels.

Type and extent and the fulfilment of functional requirements are verified as well as the impacts on safety, health, comfort and satisfaction of occupants and users.

Over the use stage, a building provides conditions for its users that are appropriate for living, working, studying or undertaking leisure or other social activities. These conditions are expressed as technical and functional requirements, which include aspects related to the indoor environment of the building. These requirements become fixed when they are prescribed in the client's brief or in the project specification.

The environmental, economic and social performance of a building is influenced by user behaviour. When the method is used for a design-stage assessment, scenarios of user behaviour are needed (see 6.4). In the case of existing buildings, monitoring data and/or survey results for buildings in operation can be used, although in the absence of such data, or where there is a planned change of user activity, it is necessary to use scenarios for the design-stage assessment.

Location-related aspects of a building used as a place in which to live, work or socialize may be part of the assessment of the environmental, social and economic performance of the building.

The environmental, social and economic assessment of location-related aspects, such as those resulting from transportation of the users, may extend beyond the area of the building site.

5.1.3 A building as a part of the built environment

This perspective reflects the interrelationship between environmental, social and economic aspects.

The built environment is the physical expression of human activity and can be seen as a physical/material designed space. Elements of the built environment are buildings, settlements, infrastructures or artificial landscapes. These form part of a broader community that serves the needs of users at different levels, such as shelter, safety and access to services, based on the diverse abilities of users. Issues of cultural value and quality of design and town planning are generally allocated to the quality of the built environment.

5.1.4 A building as an end-use product and an integrated assembly of products

This perspective primarily reflects environmental and economic aspects.

The building (including its technical systems) is considered as a physical product, constituting an integrated assembly of construction products and components. These are manufactured, used,

disassembled and disposed of, according to their service life. The related energy- and mass-flows as well as impacts on the environment are recorded and assessed.

NOTE From this perspective the building is a “material bank” that can be a source of secondary materials (e.g. urban mining). This can be supported by a strategy of designing for disassembly (see ISO 20887).

During use, some construction products and components need to be maintained. The environmental and economic performance of a building is directly related to impacts caused by the maintenance of the building components or products during their service life, and also includes consideration of refurbishment and end-of-life scenarios. The environmental and economic impacts of maintenance and repair of components and products, which can occur at any time during their life cycle, and the replacement at the end of their service life, has relevance for the assessment of environmental performance of the complete building.

Building design and the choice of construction products and components used take into consideration, and are based on, the project-specific requirements. This view results in a description of the building characteristics and the examination of the fulfilment of technical requirements.

5.1.5 A building as an economic asset

This perspective primarily reflects economic aspects.

Buildings are a form of asset class for direct or indirect investment of capital. In the life cycle of the building, monetary flows occur. The recording and assessment of such monetary flows is the basis for either life cycle costing or whole-life costing. In the analysis of cost and revenue through the life cycle, monetary flows can be assigned to different actors for cost-benefit analysis.

In considering cost-effectiveness, the mapping of monetary flows is dependent on the economic perspective of the stakeholder. In the context of this document, economic performance assessment considers primarily the perspective of society.

The different technical, functional and sustainability-related features and characteristics of the building may affect:

— its economic value and the related value retention or growth;

— the financial risk; and

— financing and insurance conditions.

NOTE Asset value is an area of concern in the context of the economic dimension of sustainable development.

5.1.6 A building as a project to be managed from its inception to end-of-life

This perspective reflects the interrelationship between environmental, social and economic aspects as related to the quality and execution of management of the asset as an extended project from its inception to end-of-life.

The preparation, realization, operation and disposal of buildings involves the performance of management tasks in support of and coordination of planning, design, construction, management, dismantling and disposal processes. This is the task of project management in a broader sense that incorporates the full life cycle of the building.

Project management in a broader sense generally distinguishes between the following main phases:

— definition and design;

— execution, realization;

— operation, monitoring;

— redevelopment/exit.

NOTE Project management in the narrower sense focuses on the phases of preparation, planning, construction, commissioning and handover. The facility management focuses on the coordination of technical, commercial and infrastructural tasks in the operating and use phase. A controlled management of operations during the end-of-life stage such as disassembly, reuse, recycling, or any other treatment can be part of a management process in a broader sense.

5.1.7 A building as a system in operation

This perspective reflects the interrelationship between environmental, social and economic aspects as related to the quality of operation and facility management processes.

Use of a building can be seen as a process that is closely linked to management tasks. The quality of the processes of operation and management of a building has an impact on its environmental, social and economic performance as well as its technical and functional performance. Therefore, it is recommended to describe and assess the quality of such processes in addition to the performance of the building.

5.1.8 A place for shelter and protection of contents

Throughout its operation during the use stage, a building provides a number of services to its users, which can include conditions appropriate for living, working, studying, or storage and protection of contents, as well as the provision of health care or leisure activities. The provision of these services results in environmental, economic and social impacts.

5.1.9 A building as an object that embodies cultural value

This perspective primarily reflects social aspects.

The aspect of the architectural quality of a building is a measure of the success of designers and builders in the architectural synthesis of the objectives of the programme and the values and constraints of all kinds, e.g. cultural, historical, urban, aesthetic, serviceability, functional, technical, regulatory and normative.

The existing built environment reflects culture and history, both at a local and national level.

Historic buildings as listed monuments reflect cultural values with respect to human skills in terms of design, construction and art. They often shelter artefacts of the same quality and contribute to the well-being of the society and the maintenance of the cultural identity of individuals.

Social-assessment-related cultural value of new buildings is affected by the degree of recognition of protected historical quality of existing buildings.

The interrelationship between protected historical monuments and new buildings influences the assessment of social quality of buildings as well as the quality of design and urban planning.

5.1.10 A building as either an enduring or short-term asset

5.1.10.1 General

This perspective reflects the interrelationship between environmental, social and economic aspects.

The life of a building can be between a few years or less and 100 years or more, depending on the type of building and use.

5.1.10.2 An enduring asset

Buildings generally have a long life compared to other goods/objects. The building is an assembly of construction products and components whose life can be:

— identical to that of the building (e.g. the shell and core);

— shorter than that of the building (e.g. services, fixtures and fittings); or

— significantly shorter than that of the building (e.g. carpets, paint work and other finishes).

The service life of components is limited by their physical characteristics and the degree of stress. The service life of the structure can be extended by maintenance, repair and replacement. The economic life (viability) of the building is influenced by the demand for its use and cost-effectiveness.

NOTE 1 Economic life refers to the period of time after occupancy during which a building meets or exceeds the building owner's economic performance requirements.

Maintenance, repair and replacement processes are accompanied by costs as well as energy and material flows, which have effects on the local and global environment. This shall be taken into account when modelling the life cycle and determining the economic and environmental performance. The ability of a building and its components to be maintained and repaired influences aspects of the social performance.

Over their life, buildings can have to be adapted (potentially several times) to changing conditions related to use, market and/or environment in order to maintain the quality of their functional performance.

NOTE 2 Designing for adaptability that goes beyond the essential requirements of a building can provide additional benefits that can be exploited to meet future needs.

NOTE 3 When proposing upgrading, refurbishment or conversion measures for existing buildings, it is important to consider/diagnose the contamination of the building and its components with pollutants and potentially dangerous substances from former use, and to determine the service life and suitability for retention of the parts of the building that will remain.

NOTE 4 Initial construction costs and the previous financial expenses for maintenance can be taken into account in the appraisal as part of economic performance.

NOTE 5 In the context of adaptation/refurbishment of a building, energy and material flows that have already occurred in the life of a building are generally disregarded in the determination and assessment of the environmental performance of the adapted/refurbished existing building.

NOTE 6 The necessity and likelihood of a future adaptation can be discussed and defined in the design stage of new constructions and refurbishment projects; see ISO 20887.

5.1.10.3 An asset for a short-term purpose

There are situations where the need for a building to be designed as an enduring asset is not relevant to the building's required service life, which is specified by the client. With assets that are constructed for a short-term purpose, the building can, but will not necessarily, have a long life relative to other goods/objects.

In a building intended for a short-term purpose, the assembly of construction products and components, as well as services, fixtures and fittings, can have a service life as long as that of the main building, e.g. the shell and core. In some cases of a short-term required service life, even the service life of internal finishes, such as carpets and paint work, can be as long as (or longer than) the service life of the building.

In such cases, there can be little to no need for the service life of the structure to be extended by regular maintenance and, more than likely, the structure is not expected to have a need for any repair or replacement of parts or components. The economic value/life in the case of "short-term asset" is primarily influenced by the specific purpose for which it has been conceived, and not for its long-term use and cost-effectiveness.

Without the need for maintenance, repair and replacement processes, and in light of the intended "shorter" life cycle, such designs should take into account the ability of the building to be relocated and reused or deconstructed and its components recovered.

Over their short service life, such buildings are unlikely to be adapted during use, in light of their "single-purpose" nature. However, for such designs that can be deconstructed, they should be able to accommodate multiple uses and applications for future "short-term" designs.

If the structure is intended to have multiple uses the energy and material flows that are attributed to the structure shall be shared across each use, together with any additional energy and material flows required to re-establish its functionality for the next use.

NOTE In the context of deconstruction and reuse of a "single-purpose" structure, energy and material flows that have already occurred in the "initial" life of the building are generally disregarded in the determination and assessment of the environmental performance of the subsequent use of the structure.

5.2 System boundary

The declaration of a system boundary shall indicate the physical (e.g. the object of assessment), temporal, processes and geographical limits which are included and excluded in the assessment as related to the objectives of the assessment.

If possible, the method of assessment should include the whole building, its services, related external works and its site, for its entire life cycle, including upstream and downstream processes (see Annex A). In practice, however, the system boundary for the assessment is determined by the intended use of the assessment, the users and stakeholders, the stages of the building life cycle to which the method is applied, and the assumptions underlying the assessment.

For the sustainability assessment of buildings, clear indication of the system boundary shall be given, such that the extent to which the different aspects, parts, processes and services of the building are involved in the assessment is clearly defined. When the assessment is restricted to a part of a building or a part of the life cycle, or if any relevant issue is not addressed, this shall be documented and justified in the description of the method and/or in the assessment report (see Clause 9).

Where comparisons are made between the results from different methods of assessment, it shall be ensured that the physical scope, temporal scope and energy and mass flows considered within the system boundary of the assessment methods are the same (see 6.5).

5.3 Functional equivalent

A building or a part of a building can have a number of possible functions. The functional equivalent is a representation of the required technical characteristics and functionalities of the building. It is the means by which the characteristics of the building are rationalized into a minimum description of the object of assessment.

The purpose of a functional equivalent is to provide a basis to ensure comparability of the assessment results of different buildings and design solutions; it is the reference parameter in the determination of environmental, social and economic performance and is instrumental in the quantification of contribution of building to sustainable development. The functional equivalent of a building may take account of various user requirements.

The function or functions that serve as the basis for the assessment shall be specified. The functional equivalent of a building or an assembled system (part of works) shall include, but is not limited to, information on the following aspects:

— building type (e.g. office, factory);

— relevant technical and functional requirements (e.g. the regulatory and client's specific requirements);

— pattern of use (e.g. occupancy);

— required service life.

A common reference unit shall be derived from the functional equivalent and used to present the result of the assessment relative to the functional equivalent. The common reference unit may be dimensionless or qualified with a dimension (e.g. per square meter, per year, per employee, per room, and combinations of these such as per square meter per year, per room per year) as appropriate.

NOTE 1 Other specific requirements and exposure to climate and to other conditions from the immediate surroundings can be relevant for inclusion in the information on the functional equivalent.

The client's brief and regulations may provide information for defining the functional equivalent. Where this is not the case, the assessment shall include the assumptions made, the scenarios and the sources of information used by the assessor.

Where no required service life is specified by the client or by regulations, the design life may be used. If the design life is used (which can be longer than the required service life), how it is derived shall be described, e.g. determined on the basis of empirical, probabilistic or statistical data.

NOTE 2 Eurocodes and ISO 15686-1 provide guidance on determining the design life of a building.

When combining separate assessments of environmental, social and economic performance in a sustainability assessment of the same object of assessment, the functional equivalent used shall be the same.

5.4 The building life cycle

5.4.1 General

As consequences of building characteristics described in 5.1, the life cycle of buildings may be looked at from different perspectives as illustrated by Figure 2:

— the perspective of energy- and mass flow (physical model);

— the perspective of monetary flow and economic aspects;

— the perspective of social aspects;

— the perspective of project management (operational and management processes).

Although the assessments of environmental, social and economic performance of a building have different starting and end points, and may be carried out separately, for a full sustainability assessment, each of these perspectives needs to be considered in parallel in order to satisfy all assessment tasks (see 6.5).

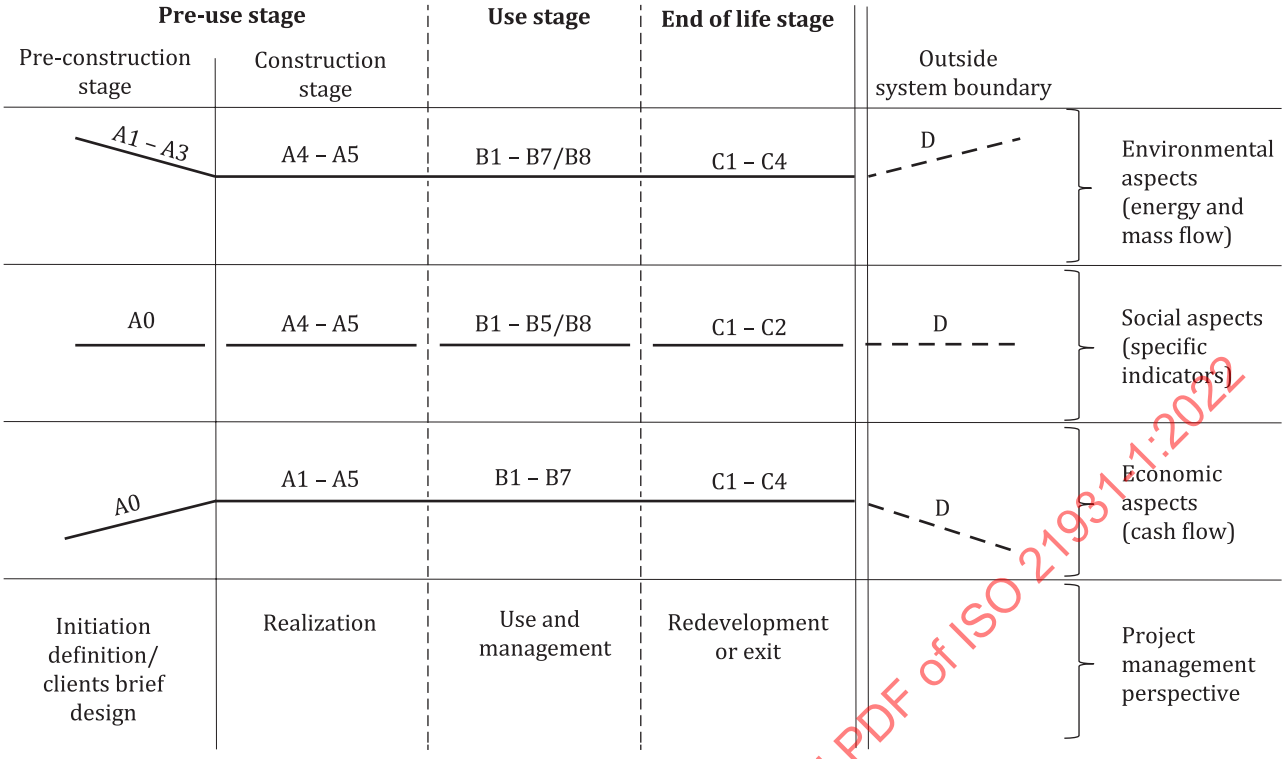


Figure 2 — The building life cycle from different perspectives

For the description of the life cycle of buildings, the life cycle stages are distinguished as follows:

— A: pre-use;

— B: use;

— C: end-of-life.

Beyond the life cycle (i.e. end-of-life) and life cycle assessment (LCA) system boundary of the building, supplementary information that may also be considered within the building assessment is presented as module D: additional supplementary information on potential benefits and loads.

5.4.2 The use of modules in the building assessment

5.4.2.1 General

Figures 3 and 4 show complementary representations of the modules that are used to collect, structure and provide data for the purposes of the assessment.

Figure 3 illustrates the information modules as they occur through the life cycle within the system boundary and module D, with additional supplementary information on potential loads and benefits beyond the system boundary of net flows from reuse, recycling, energy recovery and exported utilities, e.g. exported energy, exported potable water.

Each module represents a set of activities as described in 5.4.2.2 to 5.4.2.5.

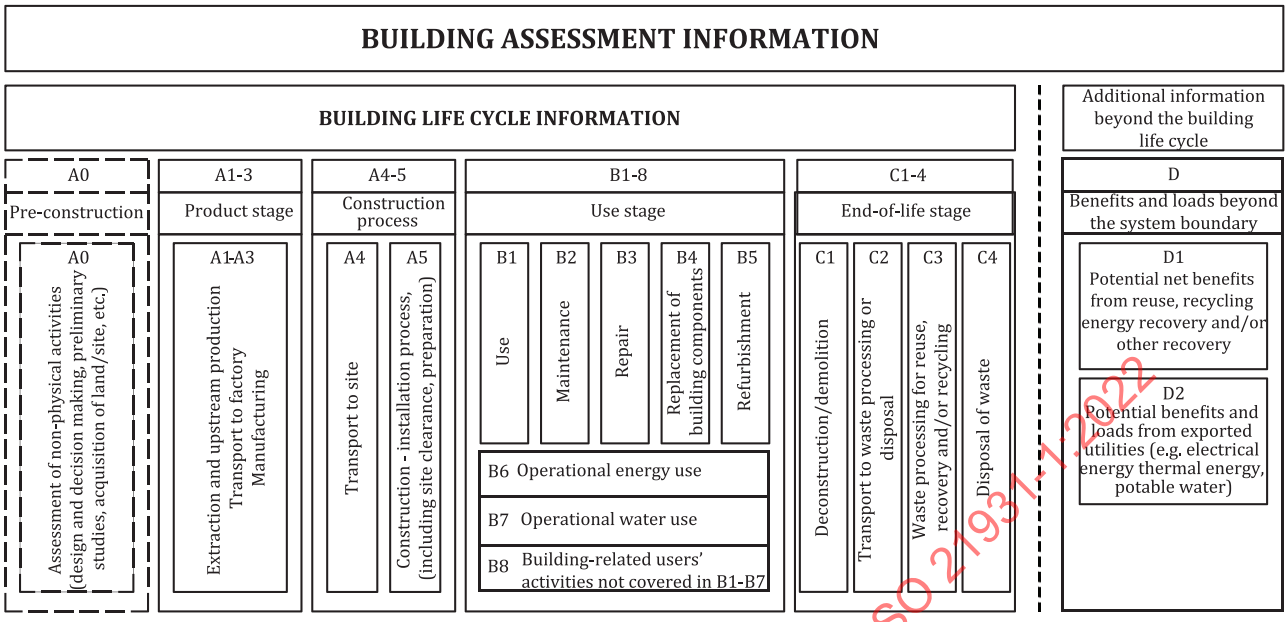


Figure 3 — Life cycle information modules and module D

5.4.2.2 A – pre-use stage: information modules A0 to A5

These information modules cover all activities from pre-construction to practical completion/handover of the constructed building.

— Module A0: pre-construction stage (excluding the product stage – see modules A1 to A3)

  This module covers activities and the related cost of pre-planning, planning and design, decision-making, budget and target setting, environmental impact assessment, and risk assessment of site development, stakeholders' engagement, preliminary technical studies, and surveys and land/site acquisition costs, planning and design costs.

  Module A0 also covers the assessment of social aspects related to stakeholder involvement and engagement as a process.

— Modules A1 to A3: product stage

  Modules A1 to A3 cover the "cradle to gate" processes (material extraction, transport, manufacturing and acquisition) for the materials and services used in the manufacturing.

— Modules A4 and A5: construction process stage

  Modules A4 and A5 cover the processes from the factory gate of the different construction products to the practical completion of the construction work up to the point of final handover, including transportation of materials to site (A4), clearing the site of pre-existing construction works, partial deconstruction in case of refurbishment, pre-construction works such as geotechnical surveys, preliminary drilling, and construction work (A5).

5.4.2.3 B – use stage: information modules B1 to B8

These information modules within the use stage cover the period from the practical completion of the construction work to the point of time when the building is deconstructed/demolished.

— Module B1: use

Module B1 encompasses the impacts and aspects arising from the normal (i.e. anticipated) conditions of use of the components of the building. This includes use or the application of the installed components of the building, but not the energy use of the whole building.

— Module B2: maintenance

Module B2 encompasses all processes, including transportation of component and cleaning, for maintaining the functional and technical performance of the building fabric and building-integrated technical systems, as well as aesthetic qualities of the building's interior and exterior components. It includes energy use, water use and waste production for these processes.

— Module B3: repair

Module B3 includes any repair or replacement to construction products and/or product components to restore them to their original condition during the use stage of the building. This includes all processes in the production of a repaired or replaced product component and associated ancillary products; the transportation of the component and ancillary products, including production impacts and aspects of any losses of materials during transportation; the repair or replacement process of the replaced components and ancillary products; waste management of the removed component and of ancillary products; the end-of-life stage of the removed component and of ancillary products.

— Module B4: replacement

Module B4 includes all processes in the production of a replaced building component and associated ancillary products; the transportation of the replaced component and ancillary products, including production impacts and aspects of any losses of materials during transportation; the replacement process of the replaced components and ancillary products; waste management of the removed component and of ancillary products; the end-of-life stage of the removed component and of ancillary products.

NOTE 1 Module B4 is related to planned replacements as part of a maintenance strategy/programme.

— Module B5: refurbishment

Module B5 includes all processes in a planned refurbishment (which may include changes to the structure and/or function) of a building, including production of the new building components; transportation of the new building components (including production of any materials lost during transportation); construction as part of the refurbishment process; (including production of any material lost during refurbishment); waste management of the refurbishment process; the end-of-life stage of replaced building components.

When, as part of the scenarios used for the project, there is included a planned future refurbishment of the building, the consequences for ongoing use of the building (e.g. for the all 'subsequent' use stage B modules) shall be considered.

When a refurbishment is being considered which was not part of the original scenarios for the building, a new assessment for the refurbished building shall be undertaken.

NOTE 2 Refurbishment can include, for example, remodelling, retrofit, modernization, repurposing and the improvement of technical and functional performance.

— Module B6: operational energy use

Module B6 includes energy used by building-integrated technical systems during the operation of the building (e.g. operation of heating system and other building related installed services).

Integrated technical systems are installed technical equipment that support the operation of a building. This includes technical systems for heating, cooling, ventilation, lighting, domestic hot water and other systems for sanitation, security, fire safety, internal transport, building automation and control and information technology (IT) communications.

This includes generation, distribution and use of energy during the operation of the product (the integrated technical system), together with its associated aspects and impacts including processing and transportation of any waste arising on site from the use of energy.

NOTE 3 This goes beyond traditional calculation of energy demand according to ISO 50001

NOTE 4 Use of energy for heating of domestic water is assigned to B6, while consumption of freshwater associated with use of hot water is assigned to B7.

If relevant for the product group, aspects related to the production of integrated technical systems equipment shall be assigned to information modules A1 to A3, for example radiators, boiler, or ventilation system. Aspects related to transportation and installation of integrated technical systems equipment shall be assigned to information modules A4 to A5. Energy use and other impacts during maintenance, repair, replacement or refurbishment activities for the equipment shall be assigned to information modules B2 to B5. Aspects related to the waste processing and final disposal of equipment shall be assigned to information modules C1 to C4.

— Module B7: operational water use

Module B7 includes all water used during the normal operation of the building (excluding water used during repair, replacement and refurbishment), during the period from the handover of the building to when it is deconstructed or demolished. This includes aspects and impacts considering the life cycle of water including production and transportation and waste-water treatment.

— Module B8: users' activities

Module B8 provides (as optional additional information) information covering aspects and impacts associated with the users' use of the building, during its normal operation and only for the building's intended use, and that is not represented in the modules B1 to B7 of the building (e.g. transportation of people to and from the building for work).

NOTE 5 For practical reasons it is possible to combine maintenance (B2) and repair (B3) for assessment and reporting purposes.

5.4.2.4 C – end-of-life stage: information modules C1 to C4

The information modules within the end-of-life stage cover from the point in time at which the building is decommissioned and is not intended to have any further use.

— Module C1: deconstruction

Module C1 includes on-site operations and operations undertaken in temporary works located off-site as necessary for the deconstruction processes after decommissioning up to and including on-site deconstruction, disassembly and/or demolition. On-site or off-site remediation processes shall be included where appropriate according to the end-of-life scenario.

— Module C2: transport

Module C2 includes all impacts due to transportation from the deconstruction site to the point where the system boundary is reached, including transportation to points of re-use, recycling and energy recovery, or final disposal.

— Module C3: waste processing

Module C3 includes processing of waste for reuse, recycling or energy recovery and/or other recovery.

— Module C4: disposal

Module C4 quantifies all the environmental loads resulting from final disposal of materials (neutralization, incineration with or without utilization of energy, landfilling with or without utilization of landfill gases, etc.).

5.4.2.5 D – benefits and loads beyond the building life cycle and system boundary: module D

Module D provides additional supplementary information on the benefits or loads beyond the system boundary resulting from:

— net flows from re-use, recycling, energy recovery and other recovery operations of materials and substances expressed as D1;

— exported utilities [e.g. exported energy, (e.g. electrical or thermal energy) and potable water] beyond the system boundary, expressed as D2.

Module D may be used to display the remaining residual value of the property and possible follow-up costs.

5.4.3 The life cycle of building components

Figure 4 shows an alternative view of the building life cycle information modules from the perspective of the building as a whole. The horizontal axis represents the building through its life cycle stages A to C (from conception to disposal), and module D. The vertical axis represents the same life cycle model from the perspective of the building's components. The latter is of specific importance in cases where the life cycle of components is shorter than the life cycle of the entire building (the impacts and aspects of which need to be taken into account each time a building element/component or product is replaced) and how this contributes to the total results calculated.

NOTE 1 The manufacturing of building products and components and their deconstruction, removal and disposal, is not only related to the beginning of the building's life cycle and its end-of-life, but also to the replacement of building components during the use stage.

NOTE 2 There can be one or more substitutions of a building component during the service life of a building.

— A substitution using a building component with identical characteristics is considered a replacement. The results for impacts and aspects for each replacement are recorded in module B4.

— A substitution using a building component with improved characteristics is considered a refurbishment. The results for impacts and aspects for refurbishment are recorded in module B5.

— The substitution (replacement) of a part of a building component is considered a repair. The results for impacts and aspects for repair are recorded in module B3.

NOTE 3 The loads and benefits from the reuse, recycling and/or energy recovery of the replaced building components, or one of its parts are recorded in module D (see 5.4.2.5).

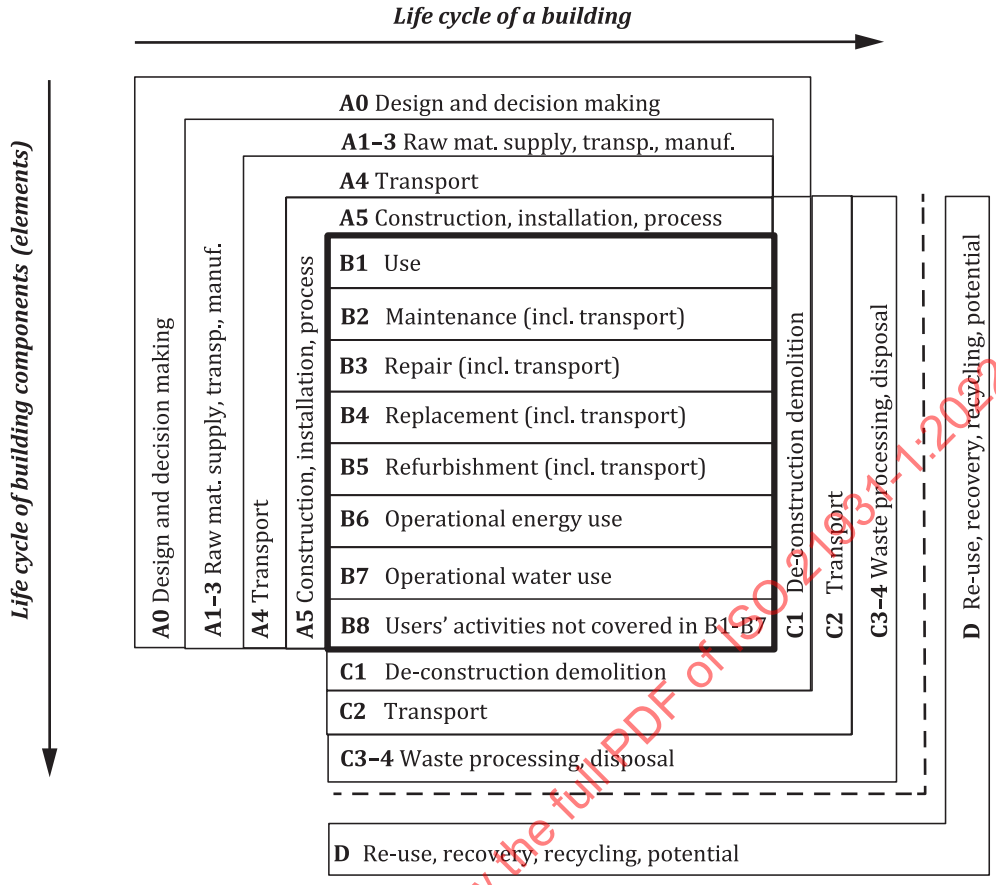


Figure 4 — The building and building component-related life cycle

5.5 Relevance of local contexts

The environmental, social and economic performance of a building is influenced by the characteristics of the climatic, social, economic and cultural context of the nation, region and site in which the building is located.

Therefore, it is important to take into account information on the local context with respect to:

— the process of performance assessment;

— the result of performance assessment;

— the interpretation of performance assessment.

Information on local climate, environmental risks, infrastructure and social values and the related trends shall be considered and should be included in additional information where not otherwise indicated as a requirement in this document.

This information need refers to local climate conditions (e.g. wind loads, heavy rain events, very low temperatures), situation in infrastructure (e.g. availability of district heating) and local risks (e.g. earthquakes, flooding). Also, social specifics (e.g. local system of cultural values) shall be taken into account during the interpretation of assessment results.

The fact that the building as an object of assessment can have a long service life means that potential changes with respect to change in climate or trends in society (e.g. tiny houses) may be predicted to

assess whether the building assessed is able to fulfil the requirements now or in future (see 6.5.2.3 on adaptability).

NOTE The characteristics and relevance of local contexts make the co-existence of regional and national methods for the assessment of the environmental, social and economic performance of buildings possible, provided the methods align with the framework described in this document.

6 Framework for methods of assessment

6.1 General

The assessment of the contribution of buildings to sustainable development requires the parallel assessment of the environmental, social and economic issues that are of concern.

This clause gives minimum requirements and additional recommendations for consideration in the development, understanding, implementation and improvement of the methods of assessment.

Some issues are considered mandatory for the assessment and shall be included in the assessment method. Other issues may be excluded from an assessment method when a justification is presented in the documentation of the assessment method.

NOTE For example, where the issue is already a precondition of law or where the market has already excluded products related to some environmental impact, therefore the risk of having those impacts in the construction of a new building is very low.

Although assessments may be carried out on building elements or components within a building, such assessments in most instances form part of a process for the evaluation of decisions (such as whether to build new buildings, or refurbish/reconstruct an existing building, or evaluate the design options, locations) in relation to the building as the overall object of assessment.

In addition, some aspects and impacts may be excluded from an assessment if not relevant to the purpose of the assessment. Exclusions shall be recorded in the assessment report.

6.2 Assessment method documentation

The documentation of the assessment shall identify:

— the body responsible for the development and the maintenance of the method;

— details of stakeholder involvement in the development and validation of the method;

— processes and procedures for the delivery of the assessment (e.g. workflow, training, communication); and

— as appropriate, any national/regional/organizational means of recognition of the method and/or its accreditation.

The documentation for the method of assessment shall clearly describe:

— the purpose of the assessment (6.3);

— the statement of assumptions and scenarios (6.4);

— the structured list of issues related to the areas of concern included in the assessment (6.5);

— the method(s) for the quantification of the environmental, social and economic performance of the building (Clause 7);

— all sources of information (generic and specific databases, etc.) (7.2.1);

— an evaluation and interpretation process (Clause 8);

— reporting requirements for the results of the assessment (Clause 9).

6.3 Purpose of assessment

The reasons for the assessment can vary, depending on the circumstances. A method for the assessment of a building provides a means for the measurement and evaluation of impacts of a building. Such information may be used to support the decision-making process for a range of different scenarios, such as:

— the procurement of a building;

— the analysis of the environmental, social and economic aspects of an existing building;

— the design and construction of a new building;

— improving the operation of an existing building during the operating phase;

— designing for retrofit and refurbishment during the operating phase;

— the deconstruction and disposal of the building at the end of the operating phase;

— the analysis of performance of an existing building.

Such an assessment may also be used for communicating the environmental, economic and/or social performance to third parties (e.g. banks, insurance companies), the benchmarking of performance and monitoring the progress towards the improvement of performance.

NOTE 1 For examples of the possible relationships between the options listed and the life cycle stages, see Annex A.

NOTE 2 Information regarding principles and requirements for the development and use of benchmarks when assessing the economic, social and/or environmental performance of buildings and other constructed assets can be found in ISO 21678.

6.4 Statement of assumptions and scenarios

The method of assessment shall apply a fixed set of assumptions and scenarios, offer the user a choice between several default assumptions and scenarios or offer the user a free definition of assumptions and scenarios, or any combination thereof.

The documentation of the assessment method shall include statements regarding the general assumptions and scenarios used.

NOTE At different points in the life of a building project, it is possible for assumptions to be made. For example, at the concept stage, it is possible to find that there is little information of the proposed details of a building, and many assumptions can be required. As the project progresses, the details become refined and assumptions can be replaced by specific information.

6.5 The structured list of issues related to the areas of concern included in the assessment

6.5.1 Environmental issues

6.5.1.1 General

The issues used to assess the environmental performance of a building should be presented as structured lists in the documentation for the assessment method.

The issues shall include:

— potential environmental impacts (global, regional and local); and

— environmental aspects.

In addition, the issues should include those related to the management processes for construction, delivery, operation and maintenance.

The list of environmental issues may include both qualitative and quantitative information.

NOTE The issues listed in the assessment method documentation can be used as the basis for assessment criteria.

6.5.1.2 Environmental impacts

6.5.1.2.1 Global and interregional environmental impacts

The potential environmental impacts that shall be included in the assessment method are:

— climate change;

— depletion of the stratospheric ozone layer;

— acidification of land and water sources;

— eutrophication;

— formation of tropospheric ozone (photochemical oxidants).

The assessment method should include, where information is available:

— resource depletion;

— human toxicity.

NOTE Expressing calculated or measured greenhouse gas (GHG) emissions as "carbon performance" (as a measure of "climate change") is a sub-category of environmental performance. Carbon performance is not a replacement for the full assessment of environmental performance.

6.5.1.2.2 Local environmental impacts

The following environmental impacts on the building site and its local surroundings shall be included in the assessment method:

— local impacts on biodiversity and ecology (flora and fauna);

— load on local infrastructure (such as services and sewerage system);

— effects on the local microclimate;

— impact on surface drainage.

6.5.1.3 Environmental aspects

6.5.1.3.1 General

The following environmental aspects shall be included in the assessment method.

— Use of renewable and non-renewable resources, which shall include:

  — the use of non-renewable primary energy resources;

  — the use of non-renewable material resources;

  — the use of renewable primary energy resources;

  - the use of renewable material resources; and
  - consumption of freshwater.
- Production and segregation of waste for disposal, which shall include:
  - hazardous waste; and
  - non-hazardous waste.
- Land use related to the building site.

Consumption of freshwater should include the amount and type of water.

NOTE Expressing calculated or measured use of energy as "energy performance" is a sub-category of environmental performance. Energy performance is not a replacement for the full assessment of environmental performance.

6.5.1.3.2 Local environmental aspects

The following environmental aspects (not covered by the impacts listed in 6.5.1.2.2) of the building and its site shall be considered and should be included in the assessment method:

- emission to air;
- emission to surface water and ground water;
- emission to soil.

6.5.2 Social issues

6.5.2.1 General

The issues used to assess the social performance of a building should be presented as structured lists in the documentation for the assessment method.

The social aspects shall be considered from the point of view of the characteristics of the building and how these affect and/or can be influenced/controlled by its users:

- occupant;
- tenant;
- employee and employer (individual/institutional);
- visitor;
- local neighbourhood;
- community (e.g. village, town, city);
- society.

The aspects to be assessed are listed in Table 1 and described in 6.5.2.2 to 6.5.2.8.

Table 1 — Social performance assessment framework — Building related aspects, user- and control system-related aspects

Building related aspects	User- and control system-related aspects
a) Accessibility (6.5.2.2) — accessibility to the building and its services — access to external services b) Adaptability (6.5.2.3) — versatility — convertibility — expandability — modifiability c) Health and wellbeing characteristics (6.5.2.4) — thermal comfort — indoor air quality — acoustics — visual comfort — spatial characteristics — water quality — safety in use — intensity of electromagnetic fields d) Impacts on neighbourhood (6.5.2.5) — noise — emissions — glare/overshadowing — shocks/vibrations — localized wind effects e) Safety and security (6.5.2.6) — Resilience against — climate change — exceptional actions (earthquake, volcanic eruptions, explosions, fire and impacts from vehicles) — interruptions of utility supply — Personal safety and security against intruders and vandalism	a) Health and wellbeing characteristics (6.5.2.4) — thermal comfort — indoor air quality — visual comfort b) Impacts on neighbourhood (6.5.2.5) — emissions c) Safety and security (6.5.2.6) — security against intruders and vandalism

Table 1 *(continued)*

Building related aspects	User- and control system-related aspects
f) Maintainability (6.5.2.7) — serviceability — constructability and deconstructability g) Architectural quality (6.5.2.8)	

6.5.2.2 Accessibility

The following accessibility-related characteristics shall be included in the assessment method:

— accessibility to the building and its internal services for people, including those with additional needs;

— accessibility of the building by public and private modes of transportation;

— access from the building to green space and open areas;

— access to other user-relevant basic services where appropriate (e.g. ATMs).

6.5.2.3 Adaptability

Social aspects of adaptability include the provisions in the building that allow it to be modified to make it suitable for a particular purpose, which may be a change of use or adaptation of its current use.

For the assessment of the social aspects of adaptability, the following aspects shall be considered and should be included in the assessment method.

— Versatility:
  — the building's ability to accommodate individual user requirements;
  — the ability to accommodate multiples uses with the same building envelope.
— Convertibility:
  — the building's ability to accommodate the change of user requirements;
  — the ability of the usable space to be converted easily to other uses;
  — the building's ability to accommodate technical changes to allow for conversion.
— Expandability:
  — the ability to add floor space without major alteration to the foundation and structural system;
  — the building's ability to accommodate technical changes to allow for expansion.
— Modifiability:
  — the building's ability to be modified in response to future external events, such as climate change;
  — the building's ability to be modified to other changes to the local environment.

NOTE Designing in response to a potential future event can be done in two ways:

— designing the building to be resilient and able to resist now the projected consequences of the future event (see 6.5.2.6); or

— designing the building to be able to be adapted at a later date to resist the consequence of the projected future events.

The former can increase present construction costs and potential environmental impacts, the latter can increase some design costs now but would defer the materials cost to a later date, avoiding those material costs and potential environmental impacts until they are needed, and extending the socially beneficial use of the building.

For example, for climate change this means the ability to be adapted to withstand the loadings that can arise from increased intensity and frequency of, for example, strong winds, snow, rain, flooding, solar radiation intensity, cold temperatures, changes to groundwater and soil conditions.

6.5.2.4 Health and wellbeing related characteristics

The following health and wellbeing-related characteristics shall be included in the assessment method.

— Thermal comfort:

  — fabric-related aspects of thermal characteristics such as air temperature, mean-radiant temperature, vapour pressure, humidity and movement (velocity);

  — user- and control system-related aspects such as the level of controllability by-the-user of the thermal characteristics in each zone/room.

    NOTE 1 Thermal comfort is also influenced by clothing and activity level of occupants (variable factors), which are difficult to predict.

— Indoor air quality:

  — fabric-related aspects of indoor air quality;

  — ventilation (rate of ventilation and air distribution patterns, CO_2 concentration);

  — sources of hazardous substances (e.g. CO, formaldehyde, particulates, VOCs, radon), odour, and mould;

    NOTE 2 The building fabric aspect of indoor air quality depends on a wide range of factors, e.g. the construction products used (the types, quantities and where they are situated in the building), the user behaviour, outdoor conditions, the ventilation conditions. The indoor air quality can also depend on the presence of other products (furniture, fixtures and fittings, floor coverings, etc.) that are not building-related.

  — user- and control system-related aspects – the level of controllability of the indoor air quality per room and of the building.

— Acoustics:

  — sound insulation against impact and airborne sounds from sources within a building or from an adjoining building;

  — sound levels from service equipment such as sanitary and ventilation systems and other sources of ambient noise;

  — room acoustics (e.g. sound absorption, reverberation time);

  — sound insulation against airborne sound from sources and sound levels present outside the building (e.g. from traffic, aircraft).

    NOTE 3 The aspect of acoustic characteristics depends on the airborne and impact sound insulation of separating walls and floors and that of any partitions, the sound insulation of the external envelope, the noise level, including that from service equipment, and the reverberation time.

— Visual comfort:

  — fabric-related aspects of visual comfort:

    — visual connection with the outside world;

    — amount of daylight contribution;

    — amount of artificial light;

    — protection against sunlight/glare/reflection;

    — user- and control system-related aspects of visual comfort: the level of controllability of the visual comfort of individual rooms and of the building as a whole.

    NOTE 4 A sufficient illumination level has a positive influence on concentration and productivity of users of a building. Light is also an important factor related to safety and the sense of security.

— Spatial characteristics:

  The assessment of spatial characteristics shall be related to the number of occupants and the pattern of use. The following building fabric-related characteristics shall be considered: sufficiency of space for intended use, e.g. number and floor area of all rooms, floor to ceiling height, number and floor area of sanitary facilities, storage (including waste storage), outdoor space, connecting space (halls, landings, stairs, corridors, foyers, etc.).

— Water quality: the physical, chemical and biological characteristics of water with respect to its suitability to and for intended use.

— Safety in use: the usability of the building while limiting the potential risk of tripping, falling and other types of accidents.

6.5.2.5 Impacts on neighbourhood

For the assessment of the category impacts on the neighbourhood, the following aspects shall be considered and should be included in the assessment method:

— noise - emitted sound pressure level;

— emissions to outdoor air, soil and water, i.e. contribution to pollution from particulates (e.g. dust and smoke), odour, water (e.g. droplets from air conditioning, water from gutters and downpipes), heat (e.g. exhaust from air conditioning, heat pumps);

  NOTE Emissions of pollutants to air, soil and water are covered in the environmental assessment, however emissions from a building to the outdoors can have a direct impact on the neighbourhood.

— glare (i.e. night-time glare, daytime glare) and overshadowing;

— light emissions at night;

— shocks/vibrations (i.e. vibrations emitted from the building);

— localized wind effects;

— the health and safety of neighbours during construction and deconstruction of the building.

6.5.2.6 Safety and security

Safety and security are a measure of the capacity of a building to resist projected current and future loadings from rain, heavy wind, snow, flooding, fire, earthquake, accidental explosion, landslides, etc., as well as security from criminality and security from disruption of utility supply. It is a measure of

the building's ability to provide safe and secure shelter against exceptional events that have a potential impact on:

— the safety for its users and occupants,

— the building's ability to maintain its function and appearance,

and to minimize any disruption as a result of these exceptional events.

The following aspects of safety and security shall be considered and should be included in the assessment method.

— Resilience against:

  — climate change:

    The aspects relating to climate change are the resistance and serviceability performance, including characteristics such as ultimate strength, deflection and stability, to withstand loadings exceeding the minimum design levels. These anticipated loadings should account for projected changes in weather patterns and extreme events based on accepted climate change models applicable to the geographic region in question.

  — exceptional actions:

    The aspects relating to exceptional actions assess a building's resistance and serviceability performance (protection/strength/ deflection/stability/safety) against exceptional loads derived from one-off events, e.g. earthquakes, explosions, fire and traffic impacts and their consequential effects (e.g. projectiles, toxic gases, breaking glass).

  — interruptions of utility supply:

    The capacity of the building to maintain its functions and services in case of interruptions of utility supply shall be assessed, including the presence of:

    — back-up equipment for heating and electricity;

    — free and safe movement inside of the building and building evacuation in case of interruption of electricity;

    — measures to use services manually in case of interruption of electricity.

NOTE 1 See also 6.5.2.3 on adaptability.

— Personal safety and security against intruders, vandalism and other intentional actions

  This aspect assesses the capacity of the building to resist forced entry and deliberate damage as well as to satisfy the users' need to feel safe and secure.

  — Building-fabric-related aspects of personal safety and security against intruders. This may include provision of high-security locking systems; well-illuminated pathways for the time of their use with clear lines of sight; barriers against deliberate traffic intrusion; impact resistance of the building envelope to protect against vandalism; protection of the building envelope against arson; secure waste-storage to minimize risks of vandalism/arson; graffiti-resistant surfaces.

  — User- and control-system-related aspects of personal safety and security against intruders and vandalism; the level of controllability of the personal safety and security against intruders and vandalism including alarm and surveillance systems (preferably linked to the police or other approved agents); motion-sensitive illumination.

— The safety of workers and occupants during construction, refurbishment and deconstruction of the building.

Minimum requirements for life safety and loads resulting from wind, snow, earthquake, fire and explosions are generally specified in regulated national/regional building codes. Assessment against the essential requirements of such codes is not required, however, where a building design/construction exceeds the requirements of such codes, details should be included in the assessment.

NOTE 2 In the interest of transparency, if the measures included do not exceed the requirements of national/regional building codes, the inclusion of a statement in the assessment report that the essential legal requirements have been met can be helpful.

6.5.2.7 Maintainability

This aspect assesses the consequences on users, neighbours and the neighbourhood of the maintenance activities (including cleaning, planned repair, replacement and refurbishment) needed to retain the building in a state in which it can perform its required functions or to restore its technical performance when a fault occurs.

The following social aspects of maintainability shall be considered and should be included in the assessment method:

— the frequency and duration of maintenance;

— the accessibility and removability of building components;

— short-, medium- and long-term effects of maintenance activities on:

  — health, safety and comfort for the users (e.g. effects on air quality, noise; magnitude and duration);

  — health and safety of workers and neighbours;

  — the usability of the building during maintenance periods (e.g. as a ratio of expected maintenance and cleaning duration causing disruption to days of normal use).

When included in the assessment method, the assessment shall be based on the estimated service life as determined in accordance with specific rules of product standards and shall take into account rules and guidance given in ISO 15686-1, ISO 15686-2, ISO 15686-7 and ISO 15686-8 and relevant scenarios.

6.5.2.8 Architectural quality

The social aspects related to architectural quality of a building should be assessed. This aspect is a measure of the success of designers and builders in the architectural synthesis of the objectives of the construction project and the values and constraints of all kinds, e.g. cultural, urban, aesthetic, serviceability, functional, technical, regulatory and normative.

The following aspects of architectural quality shall be considered and should be included in the assessment method:

— integration and harmony of the building with the surroundings;

— impact of a new building or renovation of an existing building on the cultural value of a site, neighbourhood, local heritage and built environment;

NOTE In this context, renovation refers to modification and improvements to an existing building, including refurbishment, in order to bring it up to an acceptable condition.

— consideration during the planning and design phases of the requirements of various interested parties for architectural quality.

When included in the assessment method, the size, importance and architectural and social relevance of the building or the development should be taken into account when defining the assessment procedure and complexity. In some cases, being in accordance with local building and urban planning regulations

is sufficient. In other cases, processes such as expert assessment, architectural competitions or stakeholder commissions can be required.

6.5.3 Economic issues

6.5.3.1 General

For economic assessment, the starting point shall be the assessment of life cycle costs and, if applicable, whole life costs according to ISO 15686-5.

In most cases, as a first step, economic assessment is undertaken without considerations of external costs, in which case the basis for assessment shall be life cycle costs.

As a second step, for private sector projects, external cost should be included, if possible and appropriate. The inclusion of external costs is strongly recommended for public sector projects and any other parties interested in a macroeconomic perspective.

Under specific conditions (e.g. when a building is rented and/or generates income) the following economic aspects of a building should be considered in addition, if possible and appropriate:

— whole-life cost (without external cost);

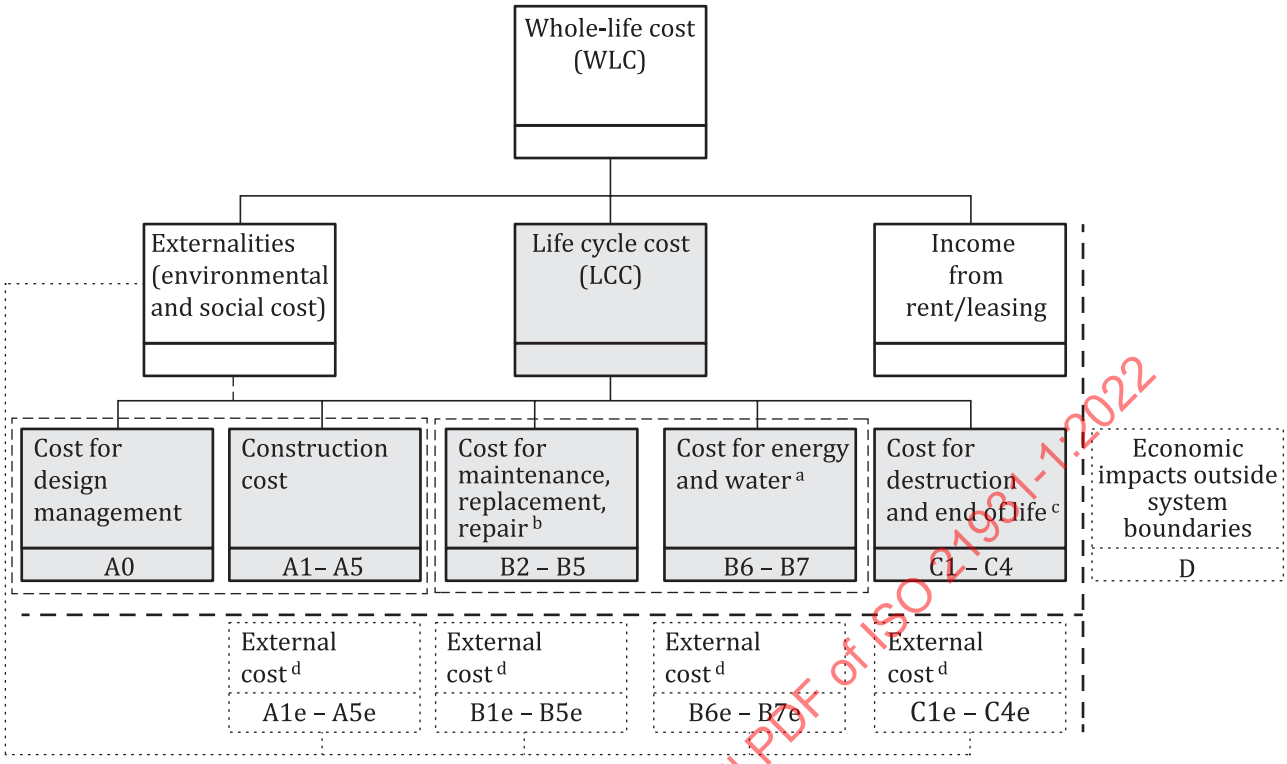
— whole-life cost (including external cost);

— potential impact on financial risk and economic value (market value) (see 6.5.3.4).

For economic performance assessment, the reference study period for determining the life cycle costs and the life cycle for environmental performance assessment shall be the same. When the reference study period deviates from the life cycle, this shall be justified.

6.5.3.2 Information modules

Information modules taken into account during the calculation of life cycle costs are represented in Figure 5.



Key

a Income from energy to third parties as negative cost.

b Replacement = A1-A5+C1-C4 (and income from recycling as negative cost).

c Income from recycling as a negative cost.

d Based on damage cost approach, avoidance cost approach and/or willingness to pay approach[30]-[32].

Figure 5 — Life cycle cost (LCC) and whole-life cost (WLC) calculation

Economic effects on third parties, that occur outside the system boundaries of a building, its life cycle respectively, may be described as additional supplementary information (module D).

6.5.3.3 Life cycle costs and whole-life costs

6.5.3.3.1 General

The following life cycle costs shall be taken into account in accordance with ISO 15686-5:

— initial cost (pre-use stage; information modules A0 to A5);

— operational/running cost (use stage; information modules B1 to B7);

— disassembly, demolition, disposal cost (end-of-life stage; information modules C1 to C4).

WLC encompasses in addition to the life cycle costs:

— disbursements;

— all receipts (payments) occurring during the life cycle.

6.5.3.3.2 Choice of discount rate

One relevant input parameter for the calculation of life cycle costs is the discount rate.

By using this parameter, future payments are discounted for at the beginning of the period under review. There are different options for the choice of the discount rate.

From a sustainability perspective, as a minimum, a social discount rate shall be included as part of the economic assessment method and shall be declared and justified.

In addition, one or more of the following market-related discount rates may also be used in the assessment:

— risk based;

— conditions of financing;

— third party specifications or conventions.

NOTE Social discount rates (SDRs) are used to put a present value on costs and benefits that will occur at a later date. For example, in the context of climate change policymaking, they are considered very important for working out how much today's society can invest in trying to limit the impacts of climate change in the future. In other words, they calculate how much guarding against future carbon emissions is worth it to the current generation, weighing up the benefits future generations would experience against the costs that today's society would have to bear.

6.5.3.3.3 LCC calculation

The results of LCC calculation shall be declared as net present value of all payments. Additionally, all payments (expenses, disbursements) should be presented in a structured list, e.g. in the style of a complete financial plan per year of the period under review.

Earnings ("deposits") from delivery of energy to third parties and the sale of components or secondary material shall be considered as "negative costs".

For maintenance costs, allocation of payments to single years shall be based upon the maintenance plan. The scenarios for maintenance shall be documented and shall be based on the maintenance plan where available. The scenarios shall specify the point of time for maintenance, taking into account the service life and replacement cycles of critical construction products and components.

6.5.3.3.4 External cost (externalities)

The energy and material flows over the life cycle of buildings cause external effects (externalities) on society and the local and global environment. Often, these external effects are not attributed financially to the party from which they originated, and therefore, are not taken into account during financial decision-making. In the case of adverse external effects, damage is caused that leads to costs for third parties or society. The cost of the damage that results from external effects is referred to as social, environmental or external costs.

The basis for the determination of environmental costs is the monetarization of adverse potential environmental impacts.

The basis for the determination of environmental costs is the monetarization of the consequences of potential adverse environmental impact expressed as a damage cost.

In the case of greenhouse gas emissions, the external cost of one unit of greenhouse gases (e.g. cost per tonne of CO_2 equivalent) may be based on:

— prices for certificates;

— conventions;

— ranges expressed in the literature.

NOTE 1 One approach to determining external costs is to link up with life cycle assessment results. Respective quantitative information on impacts on the global and local environment can be multiplied by the corresponding cost of damage per unit of global and local environmental impact. These can be taken from the literature or published conventions, indicated in an explanatory text and justified.

NOTE 2 It is possible to internalize external costs via taxes (e.g. carbon tax). In such cases the taxes become part of the real cash flow and they are no longer part of the external costs. They become part of the cost in the life cycle costing and cost-benefit calculations.

If external costs are not already taken into account by other means (e.g. price surcharges, taxes, levies, costs for the purchase of certificates), external costs may also be included in an optional second assessment of life cycle cost, as separately imputed cost elements. the inclusion of environmental costs is strongly recommended for macroeconomic and public sector projects.

NOTE 3 The imputed external cost is the difference between the full external cost and the part covered by the taxes levied and recorded in the direct costs.

It shall be declared whether, where (life cycle stage / module) and how (analysis approach and source) external costs were included in life cycle costing. It shall be declared which external effects have been taken into account (in the case of environmental costs: climate change, land use change, acidification, etc., in the case of social costs: decrease in productivity, increase in health costs etc.).

When considering external costs, a sensitivity analysis with a lower and upper value should be performed.

6.5.3.4 Potential impact on financial risk and economic value (market value)

If empirical evidence is available, the impact of environmental, economic and social performance characteristics of a building on the financial risk and/or economic value (market value) shall be taken into account, using appropriate risk assessment or appraisal methods.

If there is no empirical evidence in the local market available, a description of the relevant sustainability characteristics should be documented and added to the economic risk assessment or appraisal reports as additional information, using a defined structure of information.

Typical positive impacts on risk rating and appraisal can be a result of:

— lower energy cost including carbon tax;

— lower vacancy risk;

— improved marketability and rentability;

— higher income / higher rent level;

— lower finance and insurance cost.

All such impacts shall be checked based on the local market conditions.

6.5.4 Issues related to the management processes for construction, delivery, operation and maintenance

6.5.4.1 General

The management process information should be consistent with and support the assumptions and scenarios used in the assessment.

The assessment of contribution to sustainable development is not only influenced by the quality of the building itself, but also by the management processes for the design, construction, delivery, operation and maintenance and end-of-life of the building.

The management processes for the issues related to the design, construction, delivery, operation, maintenance and end-of-life of a building described in 6.5.4.2 to 6.5.4.5 should be included in the assessment.

6.5.4.2 Quality management

Specific measures taken to ensure and enhance quality should be assessed. This assessment should include, but is not limited to:

— documented implementation of a quality management system (e.g. a quality management system that meets the requirements of ISO 9001), which includes consideration of:
  — work (i.e. the quality of a piece of work or quality imparted to a product),
  — service life planning,
  — customers' and users' satisfaction;
— documented implementation of a facility management system for the use stage (e.g. ISO 41001).

6.5.4.3 Environmental management

Specific measures taken to protect the environment should be assessed. This assessment should include, but is not limited to, documented implementation of an environmental management system (e.g. an environmental management system that meets the requirements of ISO 14001), which includes consideration of:

— building- and operation-related waste production and disposal;
— reuse, recycling, and recovery of materials;
— pollution emissions;
— water use;
— wastewater treatment;
— repair, conservation and replacement of products used in the building;
— conservation and enhancement of the site environment to promote biodiversity;
— environmental emergencies;
— energy type and use.

NOTE ISO 50001 provides requirements for energy management systems.

6.5.4.4 Occupational health and safety

Although health and safety at work is highly regulated in many countries, specific management measures taken to ensure and enhance health and safety should be assessed. This assessment should include, but is not limited to, documented implementation of an environmental management system (e.g. a health and safety management system that meets the requirements of ISO 45001), which includes consideration of:

— specific health and safety training for workers and contractors;
— hazard identification and assessment of health and safety risks and opportunities;
— the setting of health and safety objectives and plans to achieve them;
— health and safety performance evaluation.

6.5.4.5 Social responsibility

Specific measures taken that demonstrate social responsibility shall be assessed. This assessment should include, but is not limited to, the consideration and the application of the following processes:

— responsible sourcing (see Annex B for specific provisions when responsible sourcing is included):
  — sourcing and traceability of materials;
  — sourcing and traceability of services;
— respecting human rights;
— providing good labour practices;
— providing fair operating practices;
— stakeholder involvement (see Annex C for specific provisions when stakeholder involvement is included);
— addressing consumer issues and interests;
— handling of complaints and redress.

6.5.5 Additional issues

Additional issues may be selected. In such cases, they shall be clearly described in the description of the method and/or the assessment report. Double counting shall be avoided.

7 Methods for quantification

7.1 General

The measurement of the contribution of buildings to sustainable development requires indicators for the environmental, social or economic issues selected (see 6.5.1, 6.5.2 and 6.5.3). Indicators may be qualitative or quantitative.

Methods for quantification of the contribution of buildings to sustainable development are composed of a methodology to:

— measure by specific issues, and
— aggregate the results of measurement from multiple issues.

Qualitative contribution can be expressed in a quantitative way by several means, such as rating or scoring. The evaluation of qualitative contribution, which has no direct means for quantification, can be made by consensus or by agreement.

Indicators of qualitative contribution should be selected by the feasibility of collecting information. For example, in case of a new building, qualitative contribution is evaluated by prediction/simulation-based information taken from initial design. As for an existing building, some qualitative contribution is evaluated by collecting information and data collected in operation and/or from the users of the building.

Assessment criteria may include quantifiable indicators and/or other information depending on:

— the use of the building;
— the environmental, social or economic context of the building;

— technological data collectability (e.g. manual collection, autonomous collection from deployed sensors through information network);

— social data aggregability (e.g. degree of consensus on privacy protection, avoidance of conflict of interest among stakeholders).

Subject to the aims and objectives of the assessment, the environmental, social and economic performance of a building shall be expressed by absolute values. In addition, relative values may be used alongside the absolute values. Relative values refer to given contexts and should reflect regionally relevant benchmarks, as appropriate (see 5.5).

7.2 Information for the assessment

7.2.1 Sources

Performance assessment of buildings is based on the availability of information on the products, processes and services included in the assessment.

The sources of information that can be used in the assessment shall be clearly indicated in the documentation of the assessment method and shall be accessible to the relevant and responsible parties using the assessment.

The sources of the information shall be indicated, i.e. whether it is from measurements, qualitative judgments, general data from reference documents or calculated values.

The sources of information may include generic as well as specific databases. Sources of information may include, but are not limited to:

— checklists and questionnaires;

— design documentation (including service life);

— the bill of materials/quantities;

— environmental product declaration(s);

— life cycle inventories;

— static or dynamic models of building characteristics (e.g. thermal, acoustic);

— various types of measurement (resource use, concentrations, etc.);

— cost data;

— construction, use and deconstruction scenarios.

In the case of environmental performance, the assessment of buildings may utilize environmental product declarations (EPD), based on the product category rules (PCRs) for construction products, as defined in ISO 21930. If a product category rule conforming to ISO 21930 does not exist for a given construction product, LCI/LCIA data may be used if an LCA is performed according to ISO 21930.

Information from EPD should be used with care. The EPD for products used shall be consistent with that of the building being assessed, and the information and scenarios employed in the assessment shall cover all stages of the building's life cycle.

Wherever possible, relevant information about an assessment of an existing building should be based on a field survey and measurement. If such data are not available, generic data appropriate to the building from reference documents may be used.

NOTE Data used in the assessment of a building can include:

— data related to and describing the building and its life cycle;

— data related to products and services used;

— reference data;

— data related to converting building activity and processes into environmental, social and economic impacts.

7.2.2 Quality

The quality of data used for the assessment influences the results. Data should be accurate, complete, relevant in time and location, consistent and valid. Where available, the assessment shall use data specific to the building under consideration.

The assessment methodology shall provide requirements and guidance on how the quality of data necessary for the assessment is defined and verified. Data may be tested and managed through the use of sensitivity analysis (for a given range of possible values) and/or probabilistic analysis (where there is a well-understood distribution of possible values).

All data used shall be verifiable.

7.3 Traceability and transparency

Information regarding the assessment method and result of the assessment shall be transparent and traceable. Transparency encompasses the presentation of information in a manner that is open, comprehensive and understandable.

Methods for the assessment shall clearly indicate the way in which the results have been derived in order to make it possible to trace them back to the original data. This implies that the method of assessment shall indicate the way in which the method was verified and validated and ensure consistency of the results of assessment by providing traceability of the measuring process.

7.4 Multi-effects and double counting

Double counting shall be avoided in order to prevent distortion of the assessment results.

In terms of multi-effects and the impact chain, single characteristics of a building can have impacts on more than one of the three dimensions of sustainability in parallel. Taking these multi-effects into account is not considered as a form of double counting (see Annex D).

NOTE Aspects that are linked to one dimension of sustainability can lead to follow-on effects in other dimensions due to the existence of consequential impact chains. These consequential impacts/follow-on effects are generally not taken into account (see EXAMPLE 3).

EXAMPLE 1 Avoidance of the use of chloro-fluorocarbons (CFCs) has the multiple effect of preventing ozone layer depletion as well as reducing global warming.

EXAMPLE 2 For aspects relating to energy use, the potential environmental impacts are generally related to the energy- and mass-flows and the effects on the global and local environment; while the economic impacts (costs of energy) are included in life cycle costing, and the social impacts, such as aspects relating to thermal comfort, are included in the social performance assessment.

EXAMPLE 3 Low levels of thermal performance can increase energy use and/or cost of energy which can subsequently result in a decision to move out of a building to a new location, with consequential economic loss or social disruption, which are effects not normally forming part of an assessment.

7.5 Using performance levels

A scale of values with performance levels may be used within the assessment approach to evaluate indicator results. Performance levels shall be documented and justified in accordance with ISO 21678.

The performance levels in their function as benchmarks should be expressed in terms of limit values, reference values and target values (see Figure 6). These may be related to building codes/regulations,

user requirements and evaluation of conditions in the area where the building is located, or target setting based on science-based target and planetary boundaries (a top down approach), e.g. a global carbon budget derived from the load bearing capacity of the global ecosystem.

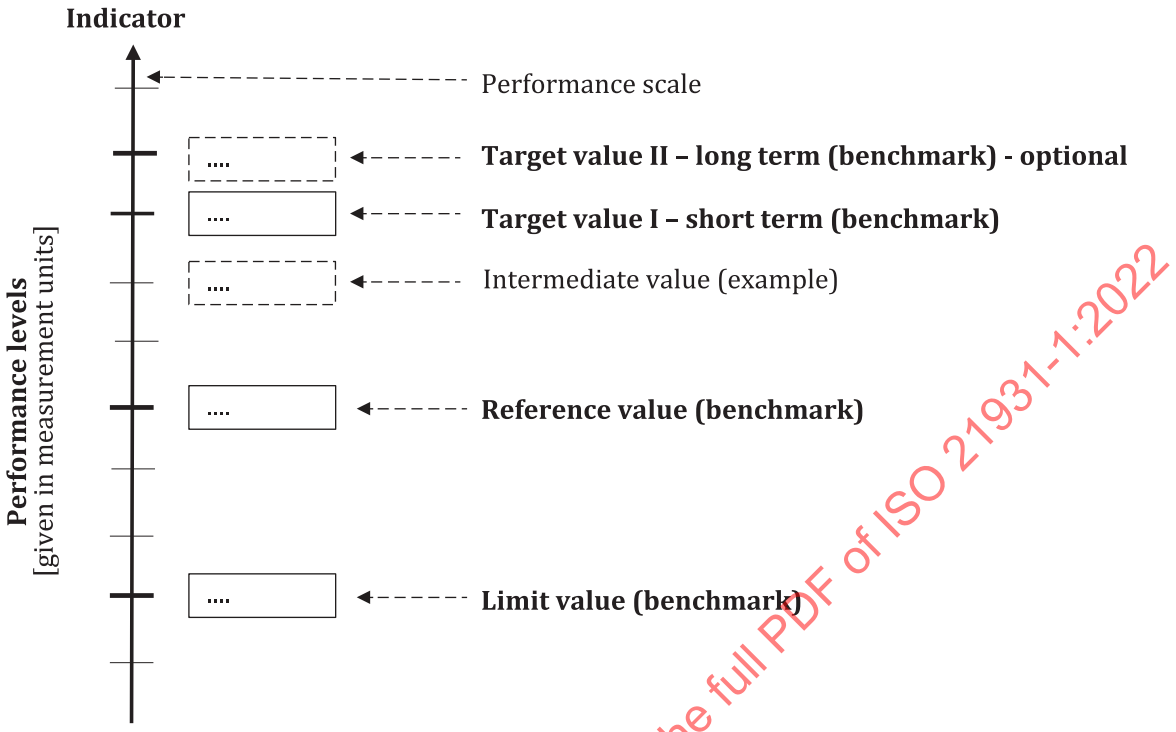


Figure 6 — Limit, reference and target values representing benchmarks in the system of performance levels as part of a performance scale for one selected indicator

Quantitative information may be referred to as a predefined performance level. In such a case, the reason or basis for setting the performance level shall be clearly documented.

7.6 Weighting and aggregation

The assessed contribution relating to a specific category of environmental, social and economic issues (6.5.1, 6.5.2 and 6.5.3) may be aggregated from the values of indicators representing multiple categories.

Where aggregation is used, conversion/weighting factors shall be documented.

NOTE 1 Weighting can be used if such conversion factors are not available.

Aggregation methodologies shall, where appropriate, use conversion factors that comply with scientific or engineering principles. These principles are applicable to any level of aggregation.

The method used to aggregate the results of measurement by indicators representing multiple categories shall be clearly stated.

An assessment method that uses aggregated indicators for the assessment results either implicitly or explicitly includes a weighting system. The underlying process that supports weighting shall be based, as a minimum, on the differences in the relative importance of the indicator categories and shall be documented.

The weighting system can vary according to national, regional or local contexts and conditions, and should provide a method for addressing such variances, which shall be documented and justified. Both the explicit and implicit weighting shall be explained, and explicit weighting factors shall be listed in the assessment method documentation.

NOTE 2 ISO 14044:2006, 4.4.3.4 provides guidance on weighting where LCA indicators are used.