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BSI Standards Publication

Sustainability of construction works — Assessment of buildings

Part 4: Framework for the assessment of economic performance

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee B/558, Sustainability of construction works.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 15643-4:2012) has been prepared by Technical Committee CEN/TC 350 “Sustainability of construction works”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2012, and conflicting national standards shall be withdrawn at the latest by July 2012.

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Introduction

This European Standard forms part of a series of European Standards, written by CEN/TC 350, that provide a system for the sustainability assessment of buildings using a life cycle approach. The sustainability assessment quantifies aspects and impacts to assess the environmental, social and economic performance of buildings using quantitative and qualitative indicators, both of which are measured without value judgments. The purpose of this series of standards is to enable comparability of the results of assessments. This series of European Standards does not set benchmarks or levels of performance.

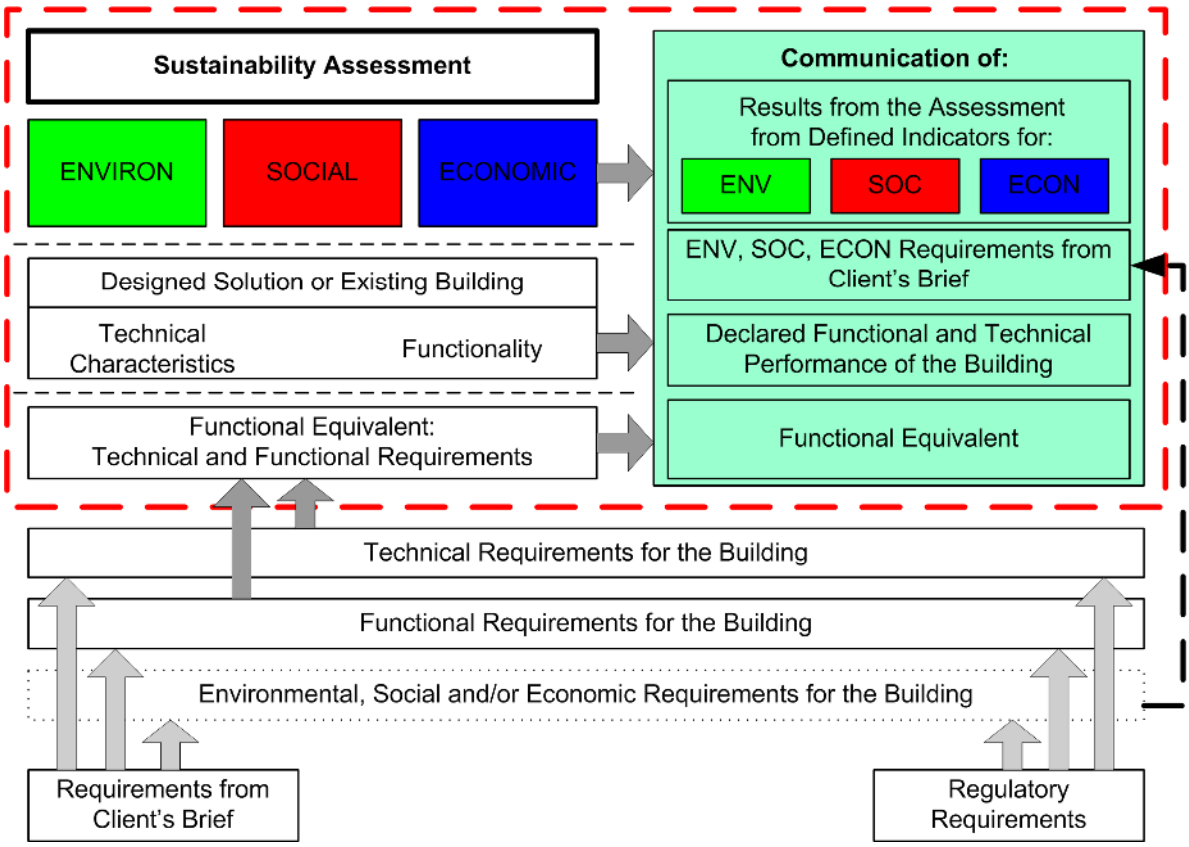
This series of standards will allow the sustainability assessment, i.e. the assessment of environmental, social and economic performance of a building, to be made concurrently and on an equal footing, on the basis of the same technical characteristics and functionality of the object of assessment.

The sustainability assessment of buildings uses different types of information. The results of a sustainability assessment of a building provide values for the different types of indicators, the related building scenarios, and on the lifecycle stages included in the assessment.

In carrying out assessments scenarios and a functional equivalent are determined at the building level Assessment at the building level means that the descriptive model of the building with the major technical and functional requirements has been defined in the client's brief or in the regulations, as illustrated in Figure 1 below. Assessments can be undertaken for the whole building, for parts of the building which can be used separately, or for elements of the building.

Although the evaluation of technical and functional performance is beyond the scope of this series of standards, the technical and functional characteristics are considered within this framework by reference to the functional equivalent. The functional equivalent takes into account the technical and functional requirements and forms the basis for comparisons of the results of the assessment.

Any particular demands for, or related to, the environmental, social and economic performance defined in the client's brief, or in regulations, may be declared and communicated. Figure 1 below shows how the functional equivalent, and the technical and functional characteristics that differ from those required, either by the client's brief or through regulations, are to be declared and communicated with the results of the assessment.

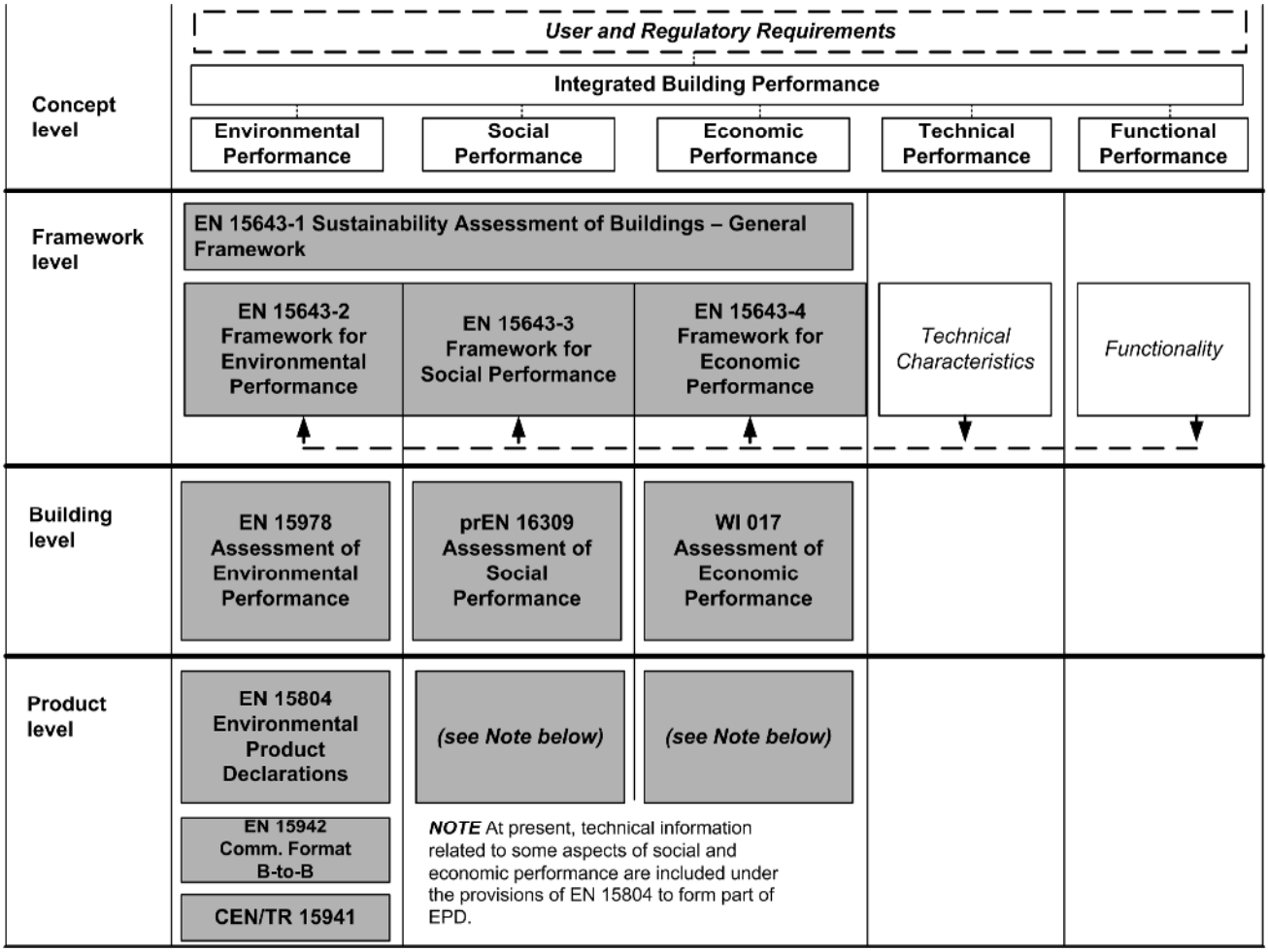


NOTE The outer box with the dotted line represents the area to be standardised by CEN/TC 350.

Figure 1 — Concept of sustainability assessment of buildings

In concept, the integrated building performance incorporates environmental, social and economic performance as well the technical and functional performance, and these are intrinsically related to each other, as illustrated in Figure 2 below. Although the assessment of technical and functional performance does not form part of this series of standards, their interrelationship with environmental, social and economic performance is a prerequisite for an assessment of sustainability performance of buildings and, therefore, is taken into account.

It is advisable to carry out an assessment at the earliest opportunity during the conceptual stages of a construction or refurbishment project such as in the sketch plan stage in order to provide a broad estimate of the environmental performance, social performance and economic performance. As the project evolves, the assessment may be periodically reviewed and updated to support decision-making. A final assessment (as built) should be carried out. The results of this final assessment can be used to inform all parties concerned.



NOTE The darkened boxes represent the current work programme of CEN/TC 350.

Figure 2 – Work programme of CEN/TC 350

This framework is Part 4 of the framework standards for sustainability assessment of buildings. The purpose of this EN 15643-4 is to provide a framework with principles, requirements and guidelines for the assessment of the economic performance of a building, as described at the "framework level" in above Figure 2.

The first revision of the general framework standard, EN 15643-1, is intended to combine all four parts of the standard into one framework standard. This will ensure simultaneous revision of the interlinked parts of the standard.

In the future, the assessment methodologies within this framework standard may be part of an overall assessment of integrated building performance. The assessment methodologies may also be extended to an assessment of the neighbourhoods and wider built environment.

1 Scope

This European Standard forms one part of a series of European Standards for the assessment of buildings and provides specific principles and requirements for the assessment of economic performance of buildings taking into account technical characteristics and functionality of a building. Assessment of economical performance is one aspect of sustainability assessment of buildings under the general framework of EN 15643-1.

The framework applies to all types of buildings and it is relevant for the assessment of the economic performance of new buildings over their life cycle, and of existing buildings over their remaining service life and end of life stage.

The economic performance assessment of a building addresses the life cycle costs and other economic aspects, all expressed through quantitative indicators. It excludes the economic risk assessment of a building and return on investment calculations

It includes economic aspects of a building relating to the built environment within the area of the building site, it does not include economic aspects beyond the area of the building site, e.g. such as economic impacts of construction of local infrastructure or economic impacts resulting from transportation of the users of the building or economic impacts of a construction project on local community.

The standards developed under this framework do not set the rules for how the different assessment methodologies may provide valuation methods nor do they prescribe levels, classes or benchmarks for measuring performance.

NOTE Valuation methods, levels, classes or benchmarks may be prescribed in the requirements for economic performance in the client's brief, building regulations, national standards, national codes of practice, building assessment and certification schemes, etc.

The rules for assessment of economic aspects of organizations, such as management systems, are not included within this framework. However, the consequences of decisions or actions that influence the economic performance of the object of assessment are taken into account.

2 Normative references

The following referenced documents are indispensable for the application 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 15392:2008, *Sustainability in building construction – General principles*

ISO 15686-1:2011, *Buildings and constructed assets – Service life planning – Part 1: General principles and framework*

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

ISO 15686-8:2008, *Buildings and constructed assets – Service-life planning – Part 8: Reference service life and service-life estimation*

ISO/TS 15686-9, *Buildings and constructed assets – Service-life planning – Part 9: Guidance on assessment of service-life data*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
assembled system
part of works
component (3.8) or a set of components incorporated in the **construction works** (3.11)

NOTE Adapted from the definitions in the Construction Products Directive (CPD) Guidance Paper C and from the definition of construction in ISO 6707-1.

3.2
brief
written document that states the **client's** (3.7) requirements for a construction project

[ISO 6707-2:1993]

3.3
building
construction works (3.11) that has the provision of shelter for its occupants or contents as one of its main purposes and is usually enclosed and designed to stand permanently in one place

[ISO 6707-1:2004]

3.4
building fabric
all **construction products** (3.9) that are fixed to the **building** (3.3) in a permanent manner, so that the dismantling of the product decreases the performance of the building and the dismantling or replacement of the product constitute construction operations

3.5
building site
specified area of land where a **building** (3.3) is located or is defined to be located and **construction work** (3.10) of the **building** (3.3) and associated **external works** (3.26) are undertaken

NOTE Adapted from the definition of site in ISO 6707-1.

3.6
built environment
collection of **buildings** (3.3), **external works** (3.26) (landscape area), infrastructure and other **construction works** (3.11) within an area

NOTE Adapted from the definition of environment in ISO 6707-1.

3.7
client
person or organization that requires a **building** (3.3) to be provided, altered or extended and is responsible for initiating and approving the **brief** (3.2)

[ISO 6707-1:2004]

3.8
component
construction product (3.9) manufactured as a distinct unit to serve a specific function or functions

[ISO 6707-1:2004]

3.9
construction product
item manufactured or processed for incorporation in **construction works** (3.11)

NOTE 1 Construction products are items supplied by a single responsible body.

NOTE 2 Adapted from the definition in ISO 6707-1 according to the recommendation of ISO/TC59/AHG Terminology.

3.10
construction work
activities of forming a **construction works** (3.11)

[ISO 6707-1:2004]

3.11
construction works
everything that is constructed or results from construction operations

NOTE 1 This covers both **building** (3.3) and civil engineering works, and both structural and non-structural elements.

NOTE 2 Adapted from the definition in ISO 6707-1.

3.12
decommissioning
activities that change a **building** (3.3) or an **assembled system (part of works)** (3.1) from an operational status to a non-operational status

3.13
delivered energy
total energy, expressed per energy carrier, supplied to the **technical building system** (3.65) through the system boundary to satisfy the uses taken into account (heating, cooling, ventilation, domestic hot water, lighting, appliances etc.) or to produce electricity

NOTE 1 For active solar and wind energy systems the incident solar radiation on solar panels or on solar collectors or the kinetic energy of wind is not part of the energy balance of the building. Renewable energy produced on site is part of the delivered energy.

NOTE 2 Delivered energy can be calculated for defined energy uses or it can be measured.

[EN 15603:2008]

3.14
design life
service life (3.57) intended by the designer

[ISO 15686-1]

3.15
disposal
waste (3.70) treatment operation other than **recovery** (3.47)

NOTE Adapted from the definition in Directive (2008/98/EC).

3.16
durability
ability to maintain the required **technical performance** (3.66) throughout the **service life** (3.57) subject to specified **maintenance** (3.40), under the influence of foreseeable actions

NOTE 1 Foreseeable actions are related to “normal” agents that could be expected to act on the works or parts thereof). Potential degradation agents include, for example, temperature, humidity, water, UV radiation, abrasion, chemical attack, biological attack, corrosion, weathering, frost, freeze-thaw and fatigue.

NOTE 2 Adapted from the definition on CPD Guidance Paper F and in ISO 6707-1.

3.17
economic aspect
aspect of **construction works** (3.11), **part of works** (3.1), processes or services related to their **life cycle** (3.34) that can cause change to economic conditions

[ISO 15392:2008]

3.18
economic impact
any change to the economic conditions, whether adverse or beneficial, wholly or partially resulting from **economic aspects** (3.17)

NOTE Derived from the definitions of impact and economic impact in ISO 15392.

3.19
economic performance
performance (3.45) related to **economic impacts** (3.18) and **economic aspects** (3.17)

[ISO 15392:2008]

3.20
energy carrier
substance or phenomenon that can be used to produce mechanical work or heat or to operate chemical or physical processes

NOTE Adapted from the definition in EN 15603:2008.

3.21
environmental aspect
aspect of **construction works** (3.11), **part of works** (3.1), processes or services related to their **life cycle** (3.34) that can cause change to the environment

EXAMPLES Use of energy and mass flow, production and segregation of wastes, water use, land use, emissions to air.

NOTE The examples added to the definition of environmental aspect in ISO 15392.

[ISO 21931-1:2010]

3.22
environmental impact
any change to the environment, whether adverse or beneficial, wholly or partially resulting from **environmental aspects** (3.21)

NOTE Derived from the definitions of impact and environmental impact in ISO 15392.

[ISO 21931-1:2010]

3.23
environmental performance
performance (3.45) related to **environmental impacts** (3.22) and **environmental aspects** (3.21)

[ISO 15392:2008]

[ISO 21931-1:2010]

3.24
environmental risk assessment
process of systematic estimation of the probability of a particular set of circumstances and its negative environmental consequences and process of comparing the estimation results against given criteria to determine their environmental significance

NOTE Adapted from ISO/IEC Guide 73.

3.25
estimated service life
service life (3.57) that a **building** (3.3) or an **assembled system (part of works)** (3.1) would be expected to have in a set of specific **in-use conditions** (3.33), determined from **reference service life data** (3.51) after taking into account any differences from the **reference in-use conditions** (3.49)

[ISO 15686-1:2011]

3.26
external works
construction works (3.11) external to the building structure but within the building's (3.3) site

3.27
financial value
aggregate of costs and revenues of **economic aspects** (3.17) expressed in monetary units

3.28
functional equivalent
quantified **functional requirements** (3.30) and/or **technical requirements** (3.67) for a **building** (3.3) or an **assembled system (part of works)** (3.1) for use as a basis for comparison

NOTE Adapted from ISO 21931-1:2010.

3.29
functional performance
performance (3.45) related to the **functionality** (3.31) of a construction works (3.11) or an **assembled system (part of works)** (3.1), which is required by the client (3.7), users (3.69) and/or by regulations

NOTE Adapted from the definition in ISO 15686-10

3.30
functional requirement
type and level of **functionality** (3.31) of a building or assembled system which is required by the client (3.7), **users** (3.69) and/or by regulations

NOTE Adapted from the definition in ISO 15686-10:2010.

3.31
functionality
suitability or usefulness for a specific purpose or activity

[ISO 15686-10:2010]

3.32
handover
step at which possession of the **construction works** (3.11) is surrendered to the **client** (3.7) upon completion with or without reservation

[ISO 6707-2:1993]

3.33
in-use condition
any circumstance that can impact the **performance** (3.45) of a **building** (3.3) or **assembled system (part of works**) (3.1) under normal use

[ISO 15686-8:2008]

3.34
life cycle
consecutive and interlinked stages in the life of the object under consideration

3.35
life cycle assessment
LCA
compilation and evaluation of the inputs, outputs and the potential **environmental impacts** (3.22) of a product system throughout its **life cycle** (3.34)

NOTE In this context a **building** (3.3) or **assembled system** is considered a "product" and a part of a “product system”.

[EN ISO 14044:2006]

3.36
life cycle cost
LCC
cost of a **building** (3.3) or **part of works** (3.1) throughout its **life cycle** (3.34), while fulfilling **technical requirements** (3.67) and **functional requirements** (3.30)

3.37
life cycle impact assessment
LCIA
phase of **life cycle assessment** (3.35) aimed at understanding and evaluating the magnitude and significance of the potential **environmental impacts** (3.22) for a product system throughout the **life cycle** (3.34) of the product

NOTE In this context, a **building** (3.3) or **assembled system** is considered a "product" and a part of a “product system”.

[EN ISO 14044:2006]

3.38
life cycle inventory analysis
LCI
phase of **life cycle assessment** (3.35) involving the compilation and quantification of inputs and outputs for a product throughout its **life cycle** (3.34)

NOTE In this context, a **building** or **assembled system** is considered a "product" and a part of a “product system”.

[EN ISO 14044:2006]

3.39
maintainability
ability of a **component** (3.8), an **assembled system (part of works)** (3.1) or construction works (3.11) to be retained in a state in which it can perform its required functions or be restored to such a state when a fault occurs

NOTE Adapted from the definition in ISO 6707-1.

3.40
maintenance
combination of all technical and associated administrative actions during the **service life** (3.57) to retain a **building** (3.3) or an **assembled system (part of works)** (3.1) in a state in which it can perform its required functions

NOTE 1 Maintenance includes cleaning, servicing, repainting, repairing, replacing parts of the **construction works** (3.11) where needed, etc. (Construction Products Directive Guidance Paper F).

NOTE 2 Adapted from the definition in ISO 15686-1 , ISO 6707-1 and in Construction Products Directive Guidance Paper F.

3.41
non-renewable energy
energy from sources which are not defined as renewable energy (3.53) sources

3.42
non-renewable resource
resource that exists in a finite amount that cannot be replenished on a human time scale

[ISO 21930:2007]

3.43
operational energy use
energy use of **technical building system** (3.65) during use and operation of the **building** (3.3)

3.44
operational water use
building related water use of **technical building system** (3.65) or **user** (3.69) during use and operation of the **building** (3.3)

3.45
performance
expression relating the magnitude of a particular aspect of the object of consideration relative to specified requirements, objectives and/or targets

NOTE Adapted from the definition in ISO 6707-1 according to the draft recommendation of ISO/TC59/AHG Terminology.

3.46
project specification
specification of **construction works** (3.11) for a specific project that prescribes the **construction work** (3.10) and the **construction products** (3.9) to be used and how they are to be applied

[ISO 6707-2:1993]

3.47
recovery
waste (3.70) treatment operation that serves a purpose in replacing other resources or prepares **waste** (3.70) for such a use

NOTE Adapted from the definition in Directive 2008/98/EC.

3.48
recycling
any recovery (3.47) operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes

NOTE 1 Recycling operations include:

— *Recycling* of organic substances which are not used as solvents (including composting and other biological transformation processes),

— *Recycling* of metals and metal compounds, and

— *Recycling* of other inorganic materials

as defined in Directive 2008/98 Annex II.

NOTE 2 Recycling does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations or other recovery operations as defined in Directive 2008/98 Annex II.

NOTE 3 Adapted from the definition in Directive 2008/98.

3.49
reference in-use conditions
in-use condition (3.33) under which the **reference service life data** (3.51) are valid

NOTE The reference **in-use conditions** (3.33) can be based upon information gathered through testing or from recorded performance and actual **service life** (3.57) data of a **component** (3.8).

[ISO 15686-8]

3.50
reference service life
RSL
service life (3.57) of a **construction product** (3.9) which is known to be expected under a particular set i.e. a reference set of **in-use conditions** (3.33) and which may form the basis of estimating the **service life** (3.57) under other **in-use conditions** (3.33)

[ISO 21930:2007]

3.51
reference service life data
RSL data
information that includes the **reference service life** (3.50) and any qualitative or quantitative data describing the validity of the **reference service life** (3.50)

EXAMPLE Typical data describing the validity of the **RSL** (3.50) include the description of the **component** (3.8) for which it applies, the **reference in-use conditions** (3.49) under which it applies, and its quality.

[ISO 15686-8]

3.52
refurbishment
modification and improvements to an existing **building** (3.3) in order to bring it up to an acceptable condition

[ISO 6707-1:2004]

3.53
renewable energy
energy from renewable non-fossil sources

EXAMPLES wind, solar (photovoltaic), solar thermal, geothermal, hydrothermal, wave and tidal energy, hydroelectric power, biomass, landfill gas, sewage treatment plant gas and biogases.

NOTE Adapted from the definition in Directive 2009/28/EC.

3.54
renewable resource
resource that is grown, naturally replenished or naturally cleansed, on a human time scale

NOTE A renewable resource is capable of being exhausted, but may last indefinitely with proper stewardship. Examples include:trees in forests, grasses in grassland and fertile soil.

[ISO 21930:2007]

3.55
required service life
service life (3.57) required by the **client** (3.7) or through regulation

3.56
re-use
any operation by which products or components that are not **waste** (3.70) are used again for the same purpose for which they were conceived or used for other purposes without reprocessing

NOTE Adapted from the definition in Directive 2008/98/EC.

3.57
service life
working life
period of time after installation during which a **building** (3.3) or an **assembled system (part of works)** (3.1) meets or exceeds the technical **performance** (3.66) and functional requirements (3.30)

[ISO 15686-1:2011]

3.58
sketch plan stage
stage at which alternative outline proposals are evaluated and a preferred solution produced sufficiently to obtain **client's** (3.7) approval

[ISO 6707-2:1993]

3.59
social aspect
aspect of **construction works** (3.11), **part of works** (3.1), processes or services related to their **life cycle** (3.34) that can cause change to society or quality of life

[ISO 15392:2008]

3.60
social impact
any change to society or quality of life, whether adverse or beneficial, wholly or partially resulting from **social aspects** (3.59)

NOTE Derived from the definitions of impact and social impact in ISO 15392.

3.61
social performance
performance (3.45) related to **social impacts** (3.60) and **social aspects** (3.59)

[ISO 15392:2008]

3.62
sustainability
ability of system to be maintained for the present and future generations

NOTE In this context, "system" comprises **environmental, social and economic aspects**.

3.63
sustainability assessment of buildings
combination of the assessments of **environmental performance** (3.23), **social performance** (3.61) and **economic performance** (3.19) taking into account the **technical requirements** (3.67) and **functional requirements** (3.30) of a **building** (3.3) or an **assembled system (part of works)** (3.1), expressed at the building level

3.64
system boundary
interface in the assessment between a **building** (3.3) and the environment or other product systems

NOTE System boundary defines what is included and what is not included in the assessment.

[ISO 21931-1:2010]

3.65
technical building system
technical equipment for heating, cooling, ventilation, hot water, lighting or for a combination thereof

3.66
technical performance
performance (3.45) related to the capability of a **construction works** (3.11) or an **assembled system (part of works)** (3.1) to fulfil its required functions under the intended use conditions

NOTE Derived from the definition of "building performance" in ISO 6707-1.

3.67
technical requirement
type and level of technical characteristics of a **construction works** (3.11) or an **assembled system (part of works)** (3.1), which are required or are a consequence of the requirements made by the client (3.7), users (3.69) and/or by regulations

3.68
transparency
open, comprehensive and understandable presentation of information

[EN ISO 14044:2006]

[ISO 21930:2007]

[ISO 21931-1:2010]

3.69
user
person or organization for which a **building** (3.3) is designed (including building owner, manager and occupants)

NOTE Adapted from the definition in ISO 6707-1:2004.

3.70
waste
substance or object which the holder discards or intends or is required to discard

NOTE Adapted from the definition in Directive (2008/98/EC).

4 Principles

4.1 General

The standards developed under this framework provide a European system for the assessment of economic performance of buildings based on a life cycle approach.

A building assessment system may comprise more than one methodological part: quantifying, analytical part(s) of the method and a valuation part(s) including value judgements. The standards within this framework only deal with the analytical part, and for this reason, these standards do not provide valuation methods and do not set levels, classes or benchmarks for any measure of performance.

NOTE Valuation systems and related calculation rules for aggregation of indicators may be defined in the national standards or schemes according to the national or local preferences.

The principles given in Clause 4 are developed into requirements for the assessment methods in Clause 5. Specific requirements for the calculation of the economic performance of buildings are defined in Clause 6.

The assessment methods shall be credible, transparent and systematic in order to achieve verifiability, transparency and comparability in the results of the assessment. The requirements for reporting and communication of the assessment results are given in 5.8.

The assessment method for economic performance of buildings given in the standards under this framework take into account performance aspects and impacts that can be expressed with quantifiable indicators, which are measured without value judgements and which lead to a clear result for each indicator.

4.2 Objective of economic performance assessment of the building

The objectives of the assessment are

— to identify the economic aspects and impacts of the building and its site,

— to enable the client, user and designer to make decisions and choices that will help to address the need for sustainability of buildings.

4.3 Approach to assessment of economic performance

According to the general principles of sustainability in building construction described in ISO 15392, all three dimensions of sustainability of buildings (environmental, social and economic) are necessary elements in a systemic approach to a sustainable assessment. Statements on the sustainability performance of a building shall address all three dimensions. This implies that when dealing with the sustainability assessment of a

building, all three dimensions of sustainability shall be included in an assessment of the building's performance, and communication shall be made accordingly. However, assessment of the individual dimensions of sustainability may also be undertaken separately, depending on the scope of assessment, in which case statements shall only be made for the separate assessment(s) — environmental, social, economic — actually carried out.

This framework includes two indicators of economic performance, as described in 6.2, cost and financial value. These indicators are represented in two approaches to the economic assessment.

1) Economic performance expressed in cost terms over the life cycle

   In this concept, the “lowest life cycle cost” building over its life cycle is the most economic one. This implies that the building variants do not differ with respect to their functionality nor with respect to any income streams produced by the building. This concept of economic performance does not include developments on the real estate market, only the cost related to the building over the life cycle. Therefore, only cost data needs to be gathered for this approach to economic assessment.

2) Economic performance expressed in terms of financial value over the life-cycle

   In this concept, the best financial value building is the most economic one, i.e. the building with the highest (discounted) revenue minus the cost over the life cycle. This concept is close to the income approach in property valuation and includes market-related revenue streams. Therefore, for this kind of economic assessment revenue data also needs to be gathered.

To link the results from environmental, economic and social performance assessments requires that their functional equivalent (see 5.3) is the same. By reference to the functional equivalent, the results of assessments can be presented in a systematic way. The functional equivalency (see 5.3) forms the basis for comparison at the building level.

4.4 Relevance of technical and functional requirements

The technical and functional requirements become fixed when they are prescribed in the client's brief or in the project specification. These requirements influence the results of the assessment and therefore need to be taken into account. How the technical and functional requirements of the building are taken into account in the description of the functional equivalent is given in 5.3.

NOTE The technical and functional requirements can include, for example, requirements on structural safety, fire safety, indoor air quality, security, adaptability, energy efficiency, accessibility, de-constructability, recyclability, maintainability, durability and service life of a building or an assembled system (part of works). Some of these technical and functional requirements are included in the social performance assessment categories.

4.5 Consideration of building life cycle

In fulfilling the technical and functional requirements specified for the building, economic impacts, which may be adverse or beneficial, and aspects are incurred which extend over the entire life cycle.

The aspects and impacts of a building that relate to its economical performance are influenced by actions taken throughout the entire life cycle of the building.

5 Requirements for assessment methods

5.1 General

The assessment methods within this framework shall (as far as possible) ensure that double counting of performance aspects and impacts is avoided.

5.2 Object of assessment and the system boundary

The object of assessment shall be the building, its foundations and external works within the area of the building's site (curtilage) and temporary works associated with the building's construction.

If the assessment is restricted to a part of the object of assessment or to a part of the life cycle, or if any relevant impacts are not addressed, this shall be documented, reported and justified.

NOTE 1 Economic impacts due to regulatory requirements relating to the infrastructure (energy and water supply, sewage systems and other utilities passing through the site) may be excluded from the assessment.

The system boundary for the assessment shall be defined in the scope of the assessment and shall take into account the requirements defined in this clause. The assessment shall include aspects and impacts of the building-integrated technical system and building-related furniture, fixtures and fittings. The system boundary for the assessment shall exclude aspects and impacts of the appliances and furniture, fixtures and fittings that are not building-related. Further requirements relating to the system boundary are given in 6.3.

NOTE 2 The aspects and impacts of appliances (see NOTE 3) and furniture, fixtures and fittings (see NOTE 4) that are not building-related may be assessed separately. Where this is the case, the aspects and impacts of the appliances and furniture, fixtures and fittings that are not building-related are recorded and reported separately.

NOTE 3 Appliances that are not building-related are domestic, commercial and industrial appliances and other non-building-related goods e.g. entertainment electronics, washing machines, refrigerators, cooking appliances, office electronics and appliances of industrial processes.

NOTE 4 Furniture, fixtures and fittings that are not building-related are products that are not fixed to the building, so that the dismantling of the product has no impact on the performance of the building and the dismantling or replacement of the product does not constitute construction operations.

NOTE 5 Sensitivity analysis can be used to describe the potential influence of the non-assessed aspects.

5.3 Functional equivalent — Requirements for basis for comparability

Comparisons between the results of assessments of buildings or assembled systems (part of works) - at design stage or whenever the results are used – shall only be made on the basis of their functional equivalence. This requires that the major functional requirements shall be described together with intended use and the relevant specific technical requirements. This description allows the functional equivalence of different options and building types to be determined and forms the basis for transparent and reasonable comparison. If assessment results based on different functional equivalents are used for comparisons, the basis and conditions for this comparison shall be made clear.

NOTE 1 If appropriate, the assessment results of the buildings that have different functional equivalents (e.g. design options for different types of buildings on the same site or the same types of buildings exposed to different conditions) can also be compared based on a common reference unit. The choice of the common reference unit for all buildings being compared depends on a specific requirement of a technical, functional, environmental, social or economic aspect, or combination thereof, which is common to all these buildings and is linked to their corresponding functional equivalents.

When combining separate assessment of environmental, social and economic performance for sustainability assessment the same functional equivalent shall be used for the assessment of each of the individual dimensions of sustainability.

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 and use (e.g. office, factory, etc.);

— pattern of use (e.g. occupancy);

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

— required service life.

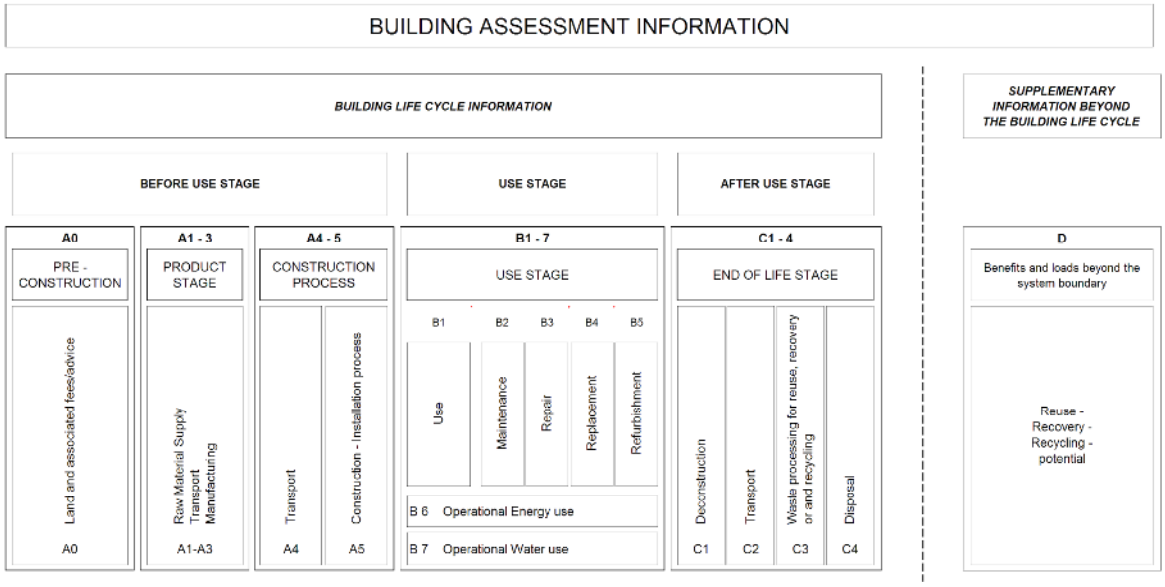
NOTE 2 Other specific requirements and exposure to climate and to other conditions from the immediate surroundings may be relevant for inclusion in the information on the functional equivalent.

5.4 Type of data and their assignment to the building life cycle

5.4.1 Assignment of data to the building life cycle

Aspects and impacts shall be assigned to the information modules of the building life cycle in which they occur. Figure 3 below illustrates the modular approach to the collection of information over the building life cycle.

For the assessment of the economic performance of a building the life cycle starts with the decision whether to build, refurbish, renew, extend, retain or demolish. It proceeds through the contractual arrangements for design and specification, procurement of products, construction work, handover for fit-out and use, commissioning, actual use and finally at the end decommissioning, deconstruction or demolition. Information from these decisions and activities is needed to assess the economic aspects and impacts of the building.



NOTE 1 For the purposes of the economic assessment, the Product Stage includes the assessment of pre-construction costs such as design fees etc., and also any land value which is included in the assessment

NOTE 2 The Use stage is one life cycle stage of the building. The Modules within the figure distinguish between economic impacts as a consequence of the building being in place (B1-B5) and operational energy and water supplied to the building (B6-B7), which are to be reported separately.

Figure 3 – Information modules applied in the assessment of economic performance of a building

To assess the economic performance of some projects, it is essential to include revenues in the assessment. For example, a building integrated renewable energy installation cannot be justified on economic performance

without taking into account revenue from the energy generated and any avoided energy costs arising from the renewable energy source.

The information allocated to the relevant modules (see above Figure 3) should be taken from appropriate sources, for example following the procedures in ISO 15686-5 or historical cost data.

NOTE The assessment standard for economic performance (see Annex A, WI 00350017) will describe the detailed calculation methods and appropriate sources of data for the economic indicators.

5.4.2 Economic aspects and impacts specific to the building

5.4.2.1 General

The assessment of the economic performance of a building shall incorporate all relevant information from Modules A to D, which may include the following:

— economic aspects and impacts at the Before Use Stage (Modules A0 and A1 – A5);

— economic aspects and impacts excluding the building in operation at the Use Stage (Modules B1 – B5);

— economic aspects and impacts of the building operational use (Modules B6 – B7);

— economic aspects and impacts at the End of Life (Modules C1 – C4 and D).

5.4.2.2 Economic aspects and impacts at the Before Use Stage (Modules A0 and A1 – A5)

Module A0 includes costs incurred prior to the product and construction stages such as site costs and related professional services.

NOTE The environmental and social frameworks address physical impacts which start at Module A1. Module A0 addresses intangible costs.

— Costs directly related to the purchase or rental of the site;

— cost of products supplied at factory gate ready for construction;

— costs incurred between factory and site;

— professional fees – any fees paid to the project team for work on the project, including feasibility, planning and design;

— temporary and enabling works: activities to clear and prepare the building site for construction and to provide infrastructure and services (gas, electricity and water) within the site of the building;

— construction of asset – all aspects of the procurement and construction of the building, including directly associated parking within the immediate site;

— initial adaptation or fit out of asset – fitting out or modification of new buildings;

— landscaping, external works on the curtilage;

— taxes and other costs related to permission to build;

— subsidies and incentives.

5.4.2.3 Economic aspects and impacts excluding the building in operation at the Use Stage (Modules B1 – B5)

— Building-related insurance costs;

— leases and rentals payable to third parties;

— cyclical regulatory costs;

— taxes;

— subsidies and incentives;

— revenue from sale of asset or elements, but not part of a final disposal;

— third party income during operation;

— repairs and replacement of minor components/small areas;

— replacement or refurbishment of major systems and components;

— adaptation or subsequent fit out of asset – fitting out or modification of existing buildings;

— cleaning;

— grounds maintenance;

— redecoration;

— disposal Inspections at end of lease period (excluding end of life final disposal);

— end of lease;

— planned adaptation or planned refurbishment of asset in use;

— building-related facility management costs.

NOTE the economic impact of waste handling due to these activities is included in the module where it occurs. The bulleted list in 5.4.2.4 address operational energy and water costs, which includes waste disposal and not just the supply of energy or fuel and water.

5.4.2.4 Economic aspects and impacts of the building operational use (Modules B6 – B7)

— Operational energy costs (default is for usage as defined by EPBD related standards);

— operational water costs;

— taxes;

— subsidies and incentives.

Within the framework of sustainability assessment, this European Standard is limited to the assessment of economic performance of a building. There may be other costs associated with the construction or operation of a building which are outside this framework.

Operational energy use related cost information should be taken from the relevant input modules of information for the calculations of delivered energy use for heating, cooling, ventilation, hot water, lighting and building automation and control, in accordance with the EN standard package for assessment of energy performance of buildings, and other sources, as appropriate. Cost information on the delivered energy relating to the costs specific to operational energy use should be taken from the relevant sources according to the requirements of the assessment standard for economic performance (see Annex A, WI 00350017).

Operational water use related cost information should be taken from the relevant input modules of information for the calculations of supplied water for users of the building and other sources as appropriate. Cost information on the supplied water relating to the costs specific to operational water use, should be taken from the relevant sources according to the requirements of the assessment standard for economic performance (see Annex A, WI 00350017).

NOTE For examples of costs see Annex B Table B2.

5.4.2.5 Economic aspects and impacts at the End of Life (Modules C1 – C4 and D)

— Deconstruction/ dismantling, demolition;

— all transport costs associated with the process of deconstruction and disposal of the built asset;

— fees & taxes;

— costs and/or revenues from reuse, recycling, and energy recovery at end of life;

— revenue from sale land.

5.4.3 Scenarios

Assessments shall be established on the basis of specified scenarios that represent the building life cycle. The applied scenarios shall be described or referenced in the assessment report and made available for communication. The scenarios shall be realistic and representative and in accordance with the technical and functional requirements as given in the functional equivalent (see 5.3).

Information relating to the object of assessment and the functional and technical requirements shall be taken from the client's brief, the regulatory requirements and from the project specification. In order to achieve compatible assessments between environmental, social and economic performance of a building, equivalent quantities and specifications for the assembly of products, and equivalent scenarios shall be used.

The estimated service life of a building or assembled system (part of works) shall be established in accordance with European product standards and with ISO 15686-1, ISO 15686-7, ISO 15686-8 and ISO/TS 15686-9.

5.5 Requirements for data quality in the assessment of economic performance

The data quality in terms of accuracy, precision, completeness and representativeness of cost information on products, processes and services for the assessment of economic performance of buildings shall be in accordance with the requirements of the assessment standard for economic performance (see Annex A, WI 00350017).

NOTE The assessment standard for economic performance (see Annex A, WI 00350017) will describe the detailed calculation methods and appropriate sources of data for the economic indicators.

5.6 Requirements for verification

Cost information and the results of the assessment of the economic performance shall be verifiable according to the requirements of the assessment standard for economic performance (see Annex A, WI 00350017).

5.7 Transparency of the assessment methods

The standards within this framework describing assessment methods shall define the requirements for transparency of data, methodologies, results and communication. Applied scenarios shall be defined and modelled explicitly and made available for communication.

5.8 Requirements for reporting and communication

5.8.1 General

The assessment report is the systematic and comprehensive summary of the assessment documentation supporting the communication. The assessment report shall contain any information of importance to the content of the communication.

In the context of this series of European Standards, communication is regarded as presentation of information from the assessment report to any third party.

Reporting and communication shall be accurate, verifiable, relevant and not misleading or deceptive.

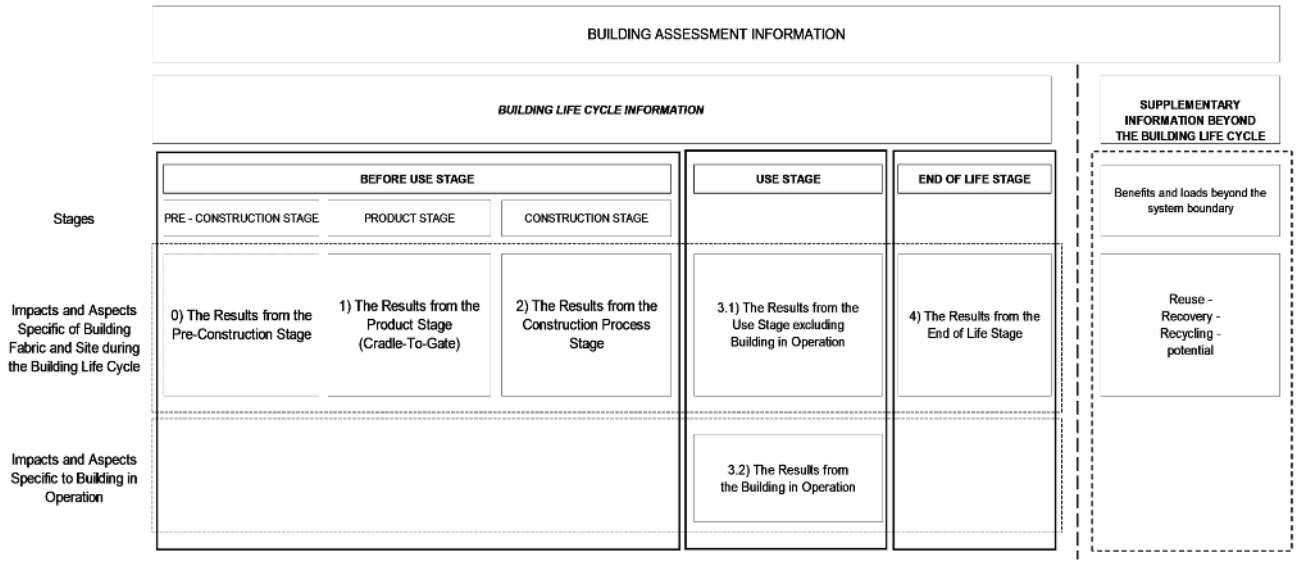
5.8.2 Results of the assessment

5.8.2.1 General

To ensure that the results of the assessment of economic performance of a building or an assembled system (part of works) can be understood and interpreted in a transparent and systematic way, the results of the assessments shall be reported and communicated according to the information groups as defined in 5.8.2.2 and 5.8.2.3 (see Figure 4 below).

Where additional impacts resulting from non-building-related appliances as described in 5.2 are included in the assessment, these shall be reported and communicated separately and without aggregation. The possible aggregation of the groups of information defined in 5.8.2.2 and 5.8.2.3 shall be clearly separated from the assessment results as additional information. The aggregation of the groups of information defined in 5.8.2.2 and 5.8.2.3 can be done only if the building life cycle is covered in the assessment without omitting any stages of the building life cycle.

When the results of assessment are communicated to a third party or made publicly available, the indicators to be communicated shall be taken from the defined indicators given in the assessment standard for economic performance (see Annex A, WI 00350017). The results of possible further aggregation of these indicators shall be clearly separated from the assessment results as additional information.



NOTE For the purposes of the economic assessment, the Before Use Stage includes the assessment of costs incurred prior to the product and construction stages such as site costs and related professional services.

Figure 4 — Organisation of the result of the assessment to be communicated in accordance with the life cycle stages and the normative groups of information

The results of the assessments shall be organised in the following two main groups:

— impacts specific to building life cycle excluding operational energy and water use (see 5.8.2.2);

— impacts specific to operational energy and water use (see 5.8.2.3).

5.8.2.2 Impacts specific to building life cycle excluding operational energy and water use

The performance results caused by the impacts specific to building life cycle excluding operational energy and water use shall be organised to the following four groups of information:

— results from economic performance from the pre-construction stage, including costs incurred prior to the product and construction stages such as site costs and related professional services;

— results from economic performance from the product stage and construction stage, including planning and design before the handover of the building;

— results from economic performance from the use stage (after the handover of the building) excluding operational energy and water use (see box 3.1 in Figure 4);

— results from economic performance from the end of life stage of the building (see box 4 in Figure 4);

5.8.2.3 Impacts specific to operational energy and water use

Impacts specific to the operational energy and water use concern the building as a “mechanism”, which uses energy for heating, cooling, domestic hot water and ventilation, together with associated controls, lighting, lifts and other forms of internal transport and uses water to serve users of the building. Impacts specific to the operational energy and water use start to occur after the handover of the building and last until the beginning of the end of life stage of the building.

The results from assessment of the economic aspects and impacts specific to operational energy and water use shall be grouped together (see box 3.2 in Figure 4).

The economic aspects and impacts specific to operational energy use shall be subdivided as results from

— heating, cooling, ventilation, hot water and lighting,

— other building integrated technical systems,

— appliances that are not building-related, if assessed.

The economic aspects and impacts specific to operational water use shall be subdivided as results from

— building integrated technical systems,

— appliances that are not building-related, if assessed.

5.8.2.4 Benefits and loads beyond the building life cycle

The results for aspects and impacts resulting from further re-use, recycling, energy recovery and other recovery operations beyond the building life cycle may be included as supplementary information. If included, this shall be grouped as information on re-use, recovery and recycling potential (see the box on supplementary information in above Figure 4).

5.8.3 Functional equivalent

The functional equivalent shall be included in the assessment report and declared as part of the communication.

5.8.4 Economic requirements from client's brief and/or regulations

If, in addition to the technical and functional requirements given in the functional equivalent, there are economic requirements that are given in the client's brief or result from regulations they shall be included in the assessment report and declared as part of the communication.

5.8.5 Declared technical and functional performance

The assessment report and communication shall include information on the main technical characteristics and functionality of the building that deviates from the technical and functional requirements given in the functional equivalent.

6 Requirements for calculation methods for assessment of economic performance of buildings

6.1 Overview of the methodology for assessment of economic performance of buildings

The assessment of the economic performance of a building shall apply measures of the quantified economic aspects and impacts of the building over the life cycle on the basis of cost and financial value.

In order to support the assessment of environmental performance of buildings, the series of standards within this framework shall provide

— the description of the object to be assessed (the building or product system),

— the system boundary that applies at the building level,

— the indicators and calculation procedures to be used,

— the requirements for the necessary data for the assessment,

— the requirements for presentation of the results in reporting and communication.

The standards shall not include the interpretation and valuation of the results of the assessment, which are not within the scope of this series of European Standards. The indicators should be performance based.

NOTE The assessment standard for economic performance (see Annex A, WI 00350017) will describe the detailed calculation methods for the economic indicators defined in 6.2. It will take into account ISO 15686-5, EN 15459 and the results of an EC DG ENTR study on life cycle costing, and will provide specific requirements for the system boundary.

6.2 Economic indicators

The economic indicators listed in Annex C shall be used to describe the economic performance of buildings over their life cycle (see 4.5):

The informative Annex D provides a list of possible indicators which may be included in future revisions to this part.

6.3 Specific requirements for system boundary for assessment of economic performance of buildings

The system boundary for the assessment of economic performance of a building shall start from the beginning of the planning of the development, acquisition or refurbishment of a building or from the start of assessment of any existing building and include the life cycle of the building.

Annex A
(informative)

Work programme of CEN/TC 350

According to the work programme of CEN/TC 350, the following documents are prepared by CEN/TC 350:

— WI 00350006, CEN/TR 15941, "*Sustainability of construction works – Environmental product declarations – Methodology for selection and use of generic data*", prepared by CEN/TC 350/WG3

— WI 00350008, EN 15643-3, "*Sustainability of construction works – Assessment of buildings – Part 3: Framework for the assessment of social performance*", prepared by CEN/TC 350/WG5

— WI 00350009, EN 15643-4, "*Sustainability of construction works – Assessment of buildings – Part 4: Framework for the assessment of economic performance*", prepared by CEN/TC 350/WG4

— WI 00350010, EN 15643-2, "*Sustainability of construction works – Assessment of buildings – Part 2: Framework for the assessment of environmental performance*", prepared by CEN/TC 350/TG

— WI 00350011, EN 15978, "*Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method*", prepared by CEN/TC 350/WG1

— WI 00350012, EN 15643-1, "*Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework*", prepared by CEN/TC 350/TG

— WI 00350013, EN 15942, "*Sustainability of construction works – Environmental product declarations – Communication formats business-to-business*", prepared by CEN/TC 350/WG3

— WI 00350014, "*Sustainability of construction works – Environmental product declarations – Communication formats – Business to Consumer*", prepared by CEN/TC 350/WG3

— WI 00350015, prEN 16309, "*Sustainability of construction works – Assessment of social performance of buildings – Methods*", prepared by CEN/TC 350/WG5

— WI 00350016, EN 15804, "*Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products*", prepared by CEN/TC 350/WG3

— WI 00350017, "*Sustainability of construction works – Assessment of economic performance of buildings – Methods*", prepared by CEN/TC 350/WG4

Annex B
(informative)

Economic aspects of building performance through the life cycle of the building

Table B.1 — CEN/TC 350 life cycle stage — Before use stage (Modules A0 — A5)

Cost/Income category	Costs included in category	Examples of costs
Life-Cycle Cost (LCC)		
For assessments carried out before the development site is selected; where the site has already been selected, this element is not required (A0)	Site costs Costs include purchase or rental costs.	Cost of the site on which the building stands
Product Stage (A1-A3)	Aggregated cost of products supplied at factory gate ready for construction	
Transport to Site (A4)	Costs incurred between factory and site	
Professional Fee (A0-A5) (where these are not included in the construction costs)	Professional fees – any fees paid to the project team for work on the project, including feasibility, planning and design	Project and engineering
Construction – feasibility, planning, design and construction (A5) including commissioning and handover	Temporary and enabling works: activities to prepare the building site for construction and to provide infrastructure and services (gas, electricity and water) within the site of the building	Site clearance, etc, where required and not covered within land costs
	Construction of asset – all aspects of the procurement and construction of the building, including directly associated parking within the immediate site	Including infrastructure, labour, products, fixtures, fitting-out, commissioning, valuation and handover, security systems. Need to cover the people/equipment issue for security
Fit Out (A5)	Initial adaptation or fit out of asset – fitting out or modification of new buildings	Including infrastructure, fixtures, fitting-out, commissioning, within the curtilage and handover (excluding unfixed furniture and non-building equipment)
Landscaping (A5)	Landscaping, external works on the curtilage	Costs for external works such as lawn, trees on the land within the curtilage of the building and is not covered within the construction costs

Table B.1 — CEN/TC 350 life cycle stage — Before use stage (Modules A1 — A5) *(continued)*

Cost/Income category	Costs included in category	Examples of costs
(A1-A5)	Taxes and other costs related to permission to build	Taxes on construction goods and services (e.g. VAT.) Costs incurred to obtain permission to build, e.g. provision of additional facilities for community benefit as a condition of building
(A1-A5)	Subsidies and incentives	Incomes related to renewable energy, and energy efficiency measures installed on the building, including loans

Table B.2 — CEN/TC 350 life cycle stage — Use stage (Modules B1 — B7)

Cost/Income category	Costs included in category	Examples of costs
Operation and Maintenance (B2)	Building-related facility management costs	Costs for regular and routine activities such as inspections, caretaking, management of planned service contract, products or materials used for mentioned activities Professional Service
Operation and Maintenance (B2)	Building-related insurance costs	Building owner and/or occupiers
Operation and Maintenance (B2)	Leases and Rentals payable to third parties	Leases and rents, excluding land rental (ground rent)
Operation and Maintenance (B2)	Cyclical regulatory costs	Fire, access inspections declarations relating to energy performance etc.
Operational energy use (B6)	Energy costs (default is for usage as defined by EPBD related standards)	Including fuel and electricity for heating, cooling, power, domestic hot water and lighting costs (as defined by EPBD)
Operational water use (B7)	Water related costs	Including, water and sewerage costs
Operation and Maintenance (B2)	Taxes	Rates, local charges, environmental taxes
Operation and Maintenance (B2)	Subsidies and incentives	Incomes related to renewable energy, emissions, energy efficiency measures on the building, including loans
Replacement (B4)	Revenue from sale of asset or elements, but not part of a final disposal	Revenue from re-use, recycling, energy recovery of interest in salvaged materials

Table B.2 — CEN/TC 350 life cycle stage — Use stage (Modules B1 — B7) *(continued)*

Cost/Income category	Costs included in category	Examples of costs
Operation and Maintenance (B2)	Third party income during operation	Rent and service charges to third parties
Operation and Maintenance (B2)	Other economic aspects	Available for use if required
Repair (B3)	Repairs and replacement of minor components/small areas	Defined by value size of area, contract terms
Replacement (B4)	Replacement of major systems and components	Including associated design and project management
Operation and maintenance (B2)	Cleaning	Regular or cyclical cleaning and periodic specific cleaning of the building
Operation and Maintenance (B2)	Grounds maintenance Needs defining to be consistent with the environmental assessment	Within defined site area
	Redecoration	Including regular periodic and specific decoration
	Taxes	Taxes on maintenance goods and services
Operation and Maintenance (B2)	Disposal Inspections at end of lease period (excluding end of life final disposal)	Final condition inspections to identify remedial works required at end of leasehold period
Operation and Maintenance (B2)	End of lease	Reinstatement End of Lease inspections
Refurbishment (B5)	Planned Adaptation or planned refurbishment of asset in use	Including infrastructure, fitting out commissioning, validation and handover

Table B.3 — CEN/TC 350 life cycle stage — End of life (Modules C1 — C4 and D)

Cost/revenue category	Costs/revenues included in category	Examples of costs/revenues
Deconstruction (C1)	Deconstruction/ Dismantling Demolition	End of life inspection, decommissioning, planning Reinstatement of site to meet contractual requirements, Site cleanup
Transport (C2)	All transport costs associated with the process of deconstruction and disposal of the built asset	On-site transport, transport of materials from site to first place of storage or disposal. NOTE See discussions from WG1.
End of life (C1 - C4)	Fees &Taxes	Taxes on goods and services Landfill and other disposal costs
Waste processing for re-use, recovery and or recycling((C3)	Costs from re-use, recycling and energy recovery at end of life	Costs from re-use, recycling, energy recovery of interest in salvaged materials such metals, aggregates, timber, plastics, etc.
Recycling (D)	Revenue from sale land	Revenue from disposal of interest in land

Annex C
(informative)

Economic indicators

C.1 Indicators included in the current versions of standards

The following economic indicators shall be used to describe the economic performance of buildings over their life cycle (see 4.5).

C.1.1 Cost: Economic performance expressed in cost terms over the life cycle (see 4.3, item 1)).

C.1.2 Financial value: Economic performance expressed in terms of financial value over the life-cycle (see 4.3, item 2)).

Annex D
(informative)

Potential Economic indicators

D.1 Further indicators used in the current practice

The following list includes other economic indicators that are used in current practice. They do not have an agreed basis yet for European standardization at this point in time, but are proposed as a basis for future development of the standard. The list is to be seen as a suggestion, which is neither definitive nor complete.

D.1.1 Ratio of market value to capital cost: calculation of ratio of market value to capital cost at point of completion.

D.1.2 Indicators for future proofing long-term value/ stability of economic value:

a) Assessment option 1: property rating techniques (similar to credit rating procedures applied within the financial services industry). The rating influences the expected long-term value.

b) Assessment option 2: financial scenario analyses and/or so-called Monte-Carlo-Simulations; modelling expected deviation from the building's current value under varying future conditions.

D.1.3 Indicators representing economic risk: Assessing risks is essentially the same as assessing stability of value, just from another point of view. It is therefore assessed by the same methods described under C.2.4.

D.1.4 External costs: Some countries have cost factors that allow the factoring in of CO_2 related costs or health related costs resulting from the construction of a building or consequential environmental impacts.

D.1.5 Consequential economic aspects: **The following aspects can be used in order to express value or risk relevant aspects without measuring long-term value or risk per se:**

— level of energy efficiency (related to risk of high energy cost);

— provisions for future adaptability to changes of use or use by others (flexible use of space; e.g. commercial buildings laid out on a grid system, housing with non-use-specific ("use-neutral") rooms; e.g. rooms of similar sizes);

— designing for retrofitting (e.g. oversizing ducts);

— risks inherent to the location;

— accessibility issues;

— spacial efficiency (ratio of net area to gross area – N.B. these are defined differently in different EU countries).

Bibliography

[1] EN 12464-1, *Light and lighting – Lighting of work places – Part 1: Indoor work places*

[2] EN 13032-1, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 1: Measurement and file format*

[3] EN 13032-2, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 2: Presentation of data for indoor and outdoor work places*

[4] EN 13032-3, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 3: Presentation of data for emergency lighting of work places*

[5] EN 13465, *Ventilation for buildings – Calculation methods for the determination of air flow rates in dwellings*

[6] EN 15193, *Energy performance of buildings – Energy requirements for lighting*

[7] EN 15217, *Energy performance of buildings – Methods for expressing energy performance and for energy certification of buildings*

[8] EN 15232, *Energy performance of buildings – Impact of Building Automation, Controls and Building Management*

[9] EN 15241, *Ventilation for buildings – Calculation methods for energy losses due to ventilation and infiltration in commercial buildings*

[10] EN 15242, *Ventilation for buildings – Calculation methods for the determination of air flow rates in buildings including infiltration*

[11] EN 15243, *Ventilation for buildings – Calculation of room temperatures and of load and energy for buildings with room conditioning systems*

[12] EN 15251, *Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics*

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