BS EN 15978:2011
Incorporating corrigendum November 2011

BSI Standards Publication

Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method

National foreword

This British Standard is the UK implementation of EN 15978:2011.

CEN Correction Notice 23 November 2011 provided a revised English language text, incorporating the following editoral corrections:

— in tables 6, 7, 8 and 9, B3 has been corrected to read 'Repair' and B4 has been corrected to read 'Replacement';
— two sentences have been added to the beginning of Clause 9.4.2.

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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 77403 4

ICS 91.040.99

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2011.

Amendments/corrigenda issued since publication

Date	Text affected
31 January 2012	Implementation of CEN Correction Notice 23 November 2011

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15978

November 2011

ICS 91.040.99

English Version

Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method

Contribution des ouvrages de construction au développement durable - Evaluation de la performance environnementale des bâtiments - Méthode de calcul

Nachhaltigkeit von Bauwerken - Bewertung der umweltbezogenen Qualität von Gebäuden - Berechnungsmethode

This European Standard was approved by CEN on 13 August 2011.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 15978:2011: E

Contents

Page

Foreword

This document (EN 15978:2011) 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 May 2012, and conflicting national standards shall be withdrawn at the latest by May 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The purpose of this European Standard is to provide calculation rules for the assessment of the environmental performance of new and existing buildings.

This European Standard is part of a suite of European Standards, Technical Specifications and Technical Reports for the assessment of the environmental performance of buildings that together support quantification of the contribution of the assessed building to sustainable construction and sustainable development.

The environmental performance of a building is only one aspect of its sustainability. The social and economic performance of the building are also aspects of sustainability that should be assessed as part of a sustainability assessment. These are described in the framework standards (EN 15643-1, -2, and EN 15643-3, -4).

NOTE The environmental assessment at building level requires information from products and services (EN 15804).

The evaluation of technical and functional performance is beyond the scope of this European Standard. Technical and functional characteristics are taken into account here by reference to the functional equivalent, which also forms a basis for comparison of the results of assessments.

This European Standard is intended to support the decision-making process and documentation of the assessment of the environmental performance of a building. Although the assessment results are based on realistic scenarios, they may not fully reflect the actual and future performance of the building. Figure 1 illustrates how the assessment of the environmental performance takes place within the concept of the sustainability assessment of buildings.

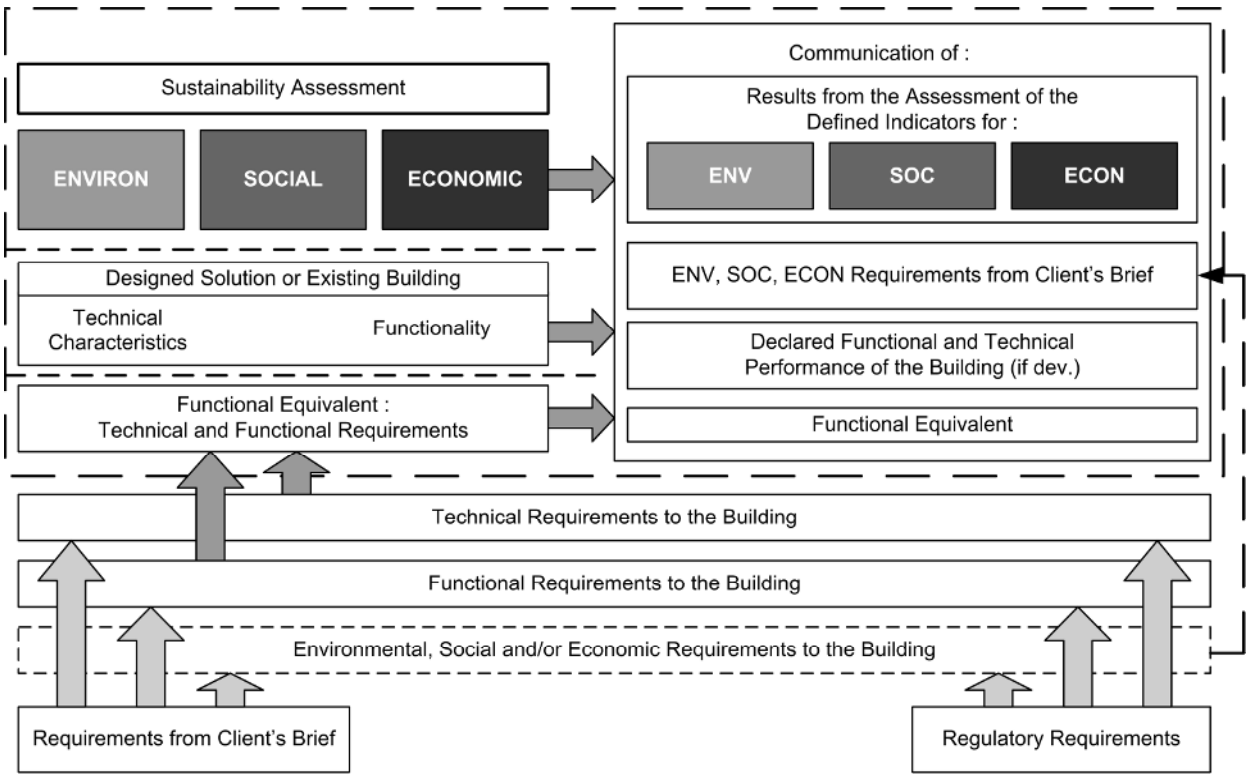

Figure 1 — Concept of sustainability assessment of buildings

In this European Standard, the assessment method for the quantitative evaluation of the environmental performance of the building is based on a life cycle approach. The general requirements for sustainability assessment of buildings are described in EN 15643-1 (the general framework standard). Other requirements for the assessment of environmental performance are given in EN 15643-2. Other standards developed by CEN/TC 350 in this area, and how they are related to this European Standard, are shown in Figure 2.

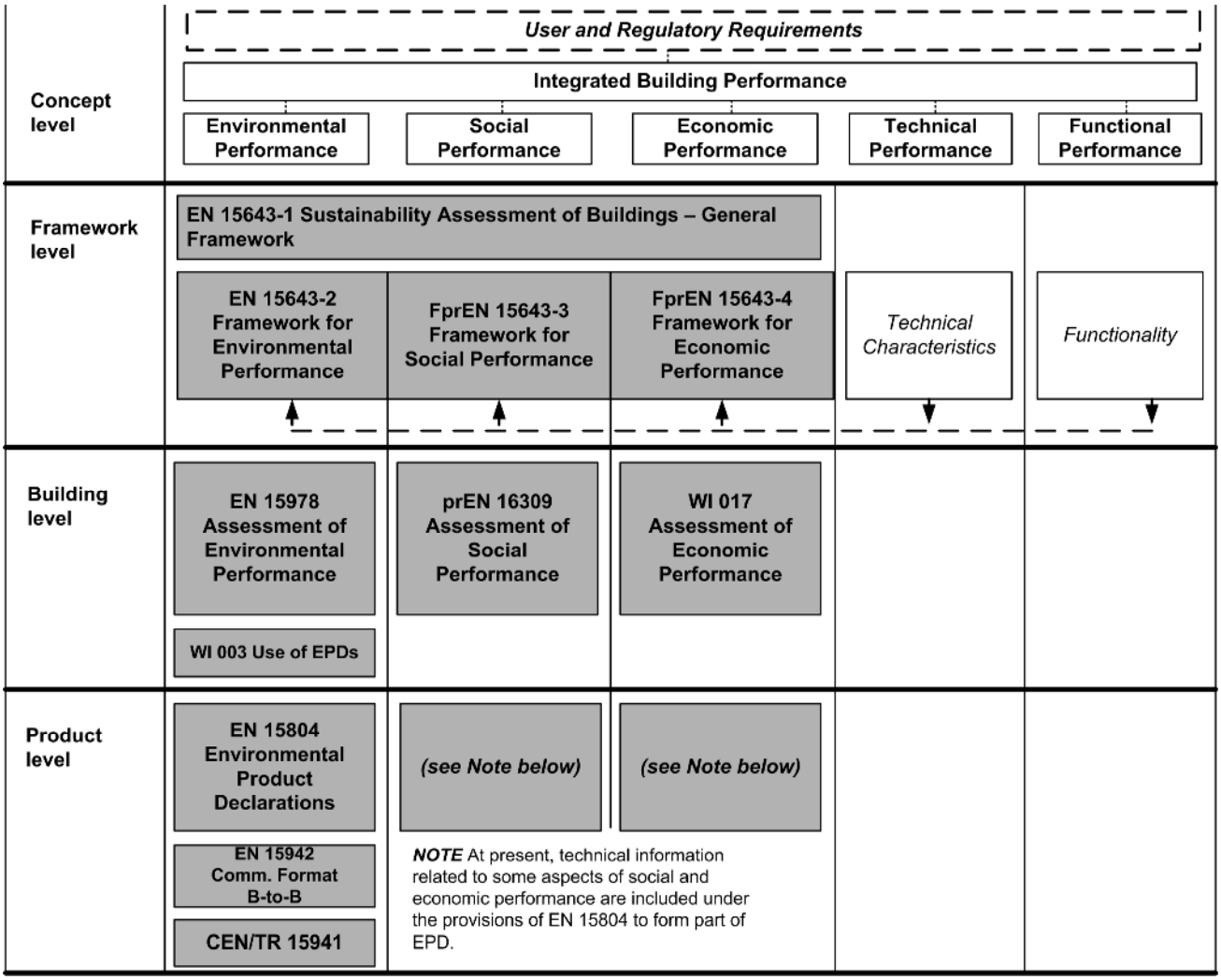

Figure 2 — Work program of CEN/TC 350

NOTE The grey boxes represent the work programme as presented in EN 15643-1.

1 Scope

This European Standard specifies the calculation method, based on Life Cycle Assessment (LCA) and other quantified environmental information, to assess the environmental performance of a building, and gives the means for the reporting and communication of the outcome of the assessment. The standard is applicable to new and existing buildings and refurbishment projects.

The standard gives:

— the description of the object of assessment;

— the system boundary that applies at the building level;

— the procedure to be used for the inventory analysis;

— the list of indicators and procedures for the calculations of these indicators;

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

— and the requirements for the data necessary for the calculation.

The approach to the assessment covers all stages of the building life cycle and is based on data obtained from Environmental Product Declarations (EPD), their "information modules" (EN 15804) and other information necessary and relevant for carrying out the assessment. The assessment includes all building related construction products, processes and services, used over the life cycle of the building.

The interpretation and value judgments of the results of the assessment are not within the scope of this European Standard.

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.

EN 15603, *Energy Performance of Buildings — Overall energy use and definition of energy ratings*

EN 15643-1, *Sustainability of construction works — Sustainability assessment of buildings — Part 1 General Framework*

EN 15643-2*, Sustainability of construction works - Assessment of buildings - Part 2: Framework for the assessment of environmental performance*

EN 15643-3*, Sustainability of construction works - Assessment of buildings - Part 3: Framework for the assessment of social performance*

EN 15643-4*, Sustainability of construction works - Assessment of buildings - Part 4: Framework for the assessment of economic performance*

EN 15804, *Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products*

ISO 15392, *Sustainability in Building Construction - General Principles*

ISO 15686-1:2010, *Building and constructed assets — Service life planning — Part 1: General principles*

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

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

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

3 Terms and definitions

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

3.1
building
construction works that have the provision of shelter for its occupants or contents as one of its main purposes and are usually enclosed and designed to stand permanently in one place

[ISO 6707-1:2004]

3.2
building fabric
all *construction products* that are fixed to the *building* in a permanent manner, so that the dismantling of the product changes the performance of the building and the dismantling or replacement of the product constitute construction operations

3.3
building-integrated technical system
installed technical equipment to support the operation of a *building*

NOTE This includes the *technical building system* and other systems e.g. for sanitation, security, fire safety, internal transport and building automation and control and IT communications, climate control systems and installations.

3.4
building site
specified area of land where a *building* is located or is defined to be located and *construction work* of the *building* and associated *external works* are or will be undertaken

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

3.5
component
construction product (3.6) manufactured as a distinct unit to serve a specific function or functions

[ISO 6707-1:2004]

3.6
construction product
item manufactured or processed for incorporation in construction works

3.7
construction work
activities of forming a *construction works* (3.8)

[ISO 6707-1:2004]

3.8
construction works
everything that is constructed or results from construction operations

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

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

3.9
design life
service life intended by the designer

[ISO 15686-1:2000]

3.10
environmental aspect
aspect of construction works, part of works, processes or services related to their life cycle that can cause change to the environment

NOTE 1 Examples for environmental aspects are: use of energy and mass flow, production and segregation of wastes, water use, land use, emissions to air.

NOTE 2 The examples added to the definition of environmental aspect in ISO 15392.

[ISO 21931-1:2010]

[EN 15643-1:2010]

3.11
environmental impact
change to the environment, whether adverse or beneficial, wholly or partially, resulting from environmental aspects

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

[ISO 21931-1:2010]

3.12
environmental performance
performance related to environmental impacts and environmental aspects

[ISO 15392:2008]

3.13
estimated service life
service life that a *building* or an *assembled system (part of works)* 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*

[EN 15643-1:2010]

3.14
functional equivalent
quantified *functional requirements* and/or *technical requirements* for a *building* or an *assembled system (part of works)* for use as a basis for comparison

NOTE Adapted from the definition in ISO 21931-1:2010.

3.15
functional performance
performance related to the *functionality* of the *construction works* or an *assembled system (part of works)*, which is required by the client and/or by *users* and/or by regulations

NOTE Adapted from the definition in EN 15643-1:2010.

3.16
functional requirement
type and level of *functionality* of a building or assembled system which is required by the client and/or by *users* and/or by regulations

NOTE Adapted from the definition in EN 15643-1:2010.

3.17
functionality
suitability or usefulness for a specific purpose or activity

[EN 15643-1:2010]

3.18
indicator
quantifiable value related to environmental impacts/aspects

[EN ISO 14044:2006]

3.19
life cycle
consecutive and interlinked stages in the life of the object under consideration

[EN 15643-1:2010]

3.20
maintenance
combination of all technical and associated administrative actions during the *service life* to retain a *building* or an assembled system (part of works) in a state in which it can perform its required functions

NOTE Adapted from the definition in ISO 15686-1, ISO 6707-1 and in CPD Guidance Paper F.

[EN 15643-1:2010]

3.21
operational energy use
energy use of the *building-integrated technical systems* during use and operation of the *building*

NOTE Adapted from the definition in EN 15643-1:2010.

3.22
operational water use
water use of the *building-integrated technical systems* and of the *user*, as needed for the technically and functionally defined operation of the *building*

NOTE Adapted from the definition in EN 15643-1:2010.

3.23
recovery
waste treatment operation that serves a purpose in replacing other resources or prepares *waste* for such a use

NOTE Adapted from the definition in Directive 2008/98.

[EN 15643-1:2010]

3.24
recycling
any *recovery* operation by which waste materials are reprocessed into products, materials or substances either for the original purpose or other purposes

NOTE 1 Recycling operations include:

— *recycling* of organic substances;

— *recycling* of metals;

— *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 [EN 15643-1:2010].

3.25
reference study period
period over which the time-dependent characteristics of the object of assessment are analysed

NOTE In some cases, the reference study period may differ significantly from the design life of the building.

3.26
refurbishment
modification and improvements to an existing *building* in order to bring it up to an acceptable condition

[ISO 6707-1:2004]

[EN 15643-1:2010]

3.27
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]

[EN 15643-1:2010]

3.28
repair
returning an item to an acceptable condition through the renewal, replacement or mending of worn, damaged or degraded parts

[ISO 6707-1:2004]

[EN 15643-1:2010]

3.29
required service life
service life required by the client or through regulations

[EN 15643-1:2010]

3.30
re-use
any operation through which products or components that are not *waste* 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.

[EN 15643-1:2010]

3.31
scenario
collection of assumptions and information concerning an expected sequence of possible future events

[EN 15643-1:2010]

3.32
secondary material
any material recovered from a previous use or from waste which substitutes primary materials

NOTE 1 Secondary material is measured at the point where the secondary material enters the system from another system.

NOTE 2 Materials recovered from previous use or from waste from one product system and used as an input in another product system are secondary materials.

NOTE 3 Examples of secondary materials (to be measured at the system boundary) are recycled metal, crushed concrete, glass cullet, recycled wood chips, recycled plastic.

[EN 15643-1:2010]

3.33
service life
working life
period of time after installation during which a *building* or an assembled system (part of works) meets or exceeds the *technical requirements* and *functional requirements*

NOTE Adapted from the definition in ISO/DIS 15686-1:2008.

[EN 15643-1:2010]

3.34
system boundary
interface in the assessment between a *building* and its surroundings or other product systems

NOTE 1 System boundary defines what is included and what is not included in the assessment.

NOTE 2 Adapted from the definition in [EN 15643-1:2010].

3.35
technical building system
technical equipment for heating, cooling, ventilation, hot water, lighting or for a combination thereof

NOTE Adapted from the definition in the Energy Performance of Buildings Directive 2010/31.

[EN 15643-1:2010]

3.36
technical performance
performance related to the capability of a *construction works* or an *assembled system (part of works)* to fulfil its required functions under the intended use conditions

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

[EN 15643-1:2010]

3.37
technical requirement
type and level of technical characteristics of a *construction works* or an assembled system (part of works), which are required or are a consequence of the requirements made either by the client, and/or by the *users* and/or by regulations

NOTE Adapted from the definition in EN 15643-1:2010.

3.38
transparency
open, comprehensive and understandable presentation of information

[EN ISO 14044:2006]

[EN 15643-1:2010]

3.39
user
person or organisation for which a *building* is designed (including building owner, manager and occupants)

NOTE Adapted from the definition in ISO 6707-1.

[EN 15643-1:2010]

3.40
waste
substance or object which the holder discards or intends to discard, or is required to discard

NOTE Adapted from the definition in Directive 2008/98.

[EN 15643-1:2010]

4 Abbreviations

ADP_elements – Abiotic resource Depletion Potential for elements

ADP_fossil fuels - Abiotic resource Depletion Potential of fossil fuels

AP – Acidification Potential of land and water

EPD - Environmental Product Declaration

ESL - Estimated Service Life

GWP – Global Warming Potential

LCA - Life Cycle Assessment

LCI - Life Cycle Inventory

LCIA - Life Cycle Impact Assessment

ODP – Depletion Potential of stratospheric Ozone layer

PCR - Product Category Rules

POCP – Formation Potential of tropospheric Ozone Photochemical oxidants

ReqSL - Required Service Life

RSL - Reference Service Life

RSP - Reference Study Period

5 The process for setting up the calculations required for the assessment

In order to carry out and complete the calculations necessary for the assessment of environmental performance of buildings, the steps illustrated in Figure 3 shall be followed. This will help ensure that the essential information is gathered and processed according to the requirements of this European Standard. The clauses numbered in the right column that follow the diagram explain in more detail each step specified in the central column of the table below.

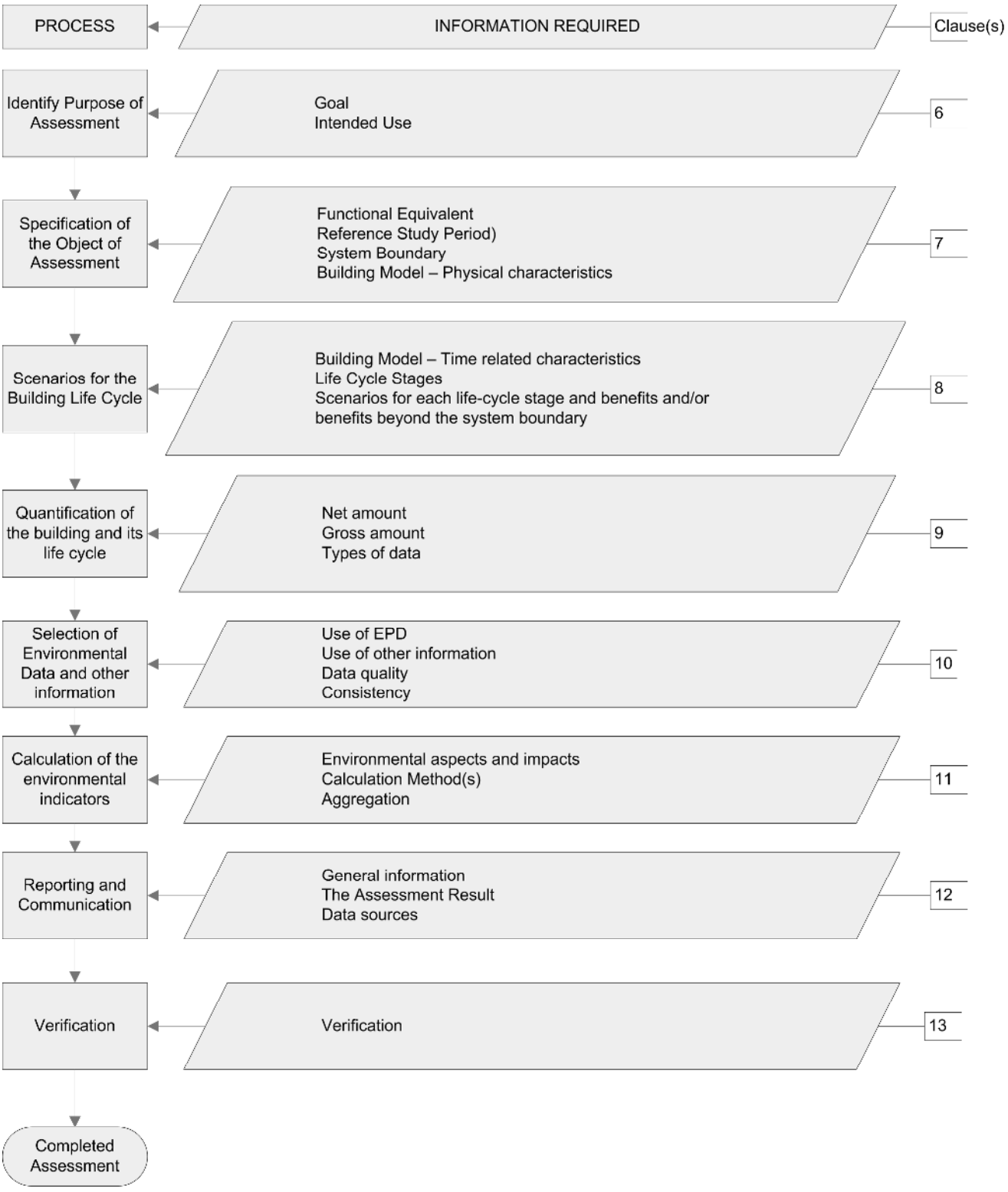

Figure 3 — Flowchart of the process for the assessment of the environmental performance

6 Purpose of the assessment

The purpose of the assessment is defined by the goal, the scope and the intended use of the assessment.

The goal of the assessment is to quantify the environmental performance of the object of assessment by means of the compilation of environmental information.

In order to calculate the environmental performance of a building in terms of environmental impacts and aspects, the scope and intended use of the assessment shall be defined, agreed and documented in accordance with the requirements of this European Standard before an assessment is carried out.

The scope of an assessment is represented by what is included in the assessment with respect to Clauses 7, 8, 9 and 10. Depending on the context, the intended use of the assessment may include the following:

a) assistance in a decision-making process, for example:

   — comparisons of the environmental performance of different design options;

   — comparisons of the environmental performance of refurbishment, reconstruction and/or new construction;

   — identification of the potential for environmental performance improvements;

b) declaring performance with respect to legal requirements;

c) documenting the environmental performance of a building for use in, for example:

   — certification;

   — declaring environmental performance;

   — labelling;

   — marketing;

d) support for policy development.

The scope and intended use determine the level of detail required of the environmental information, and of other data used in the calculations. However, the calculation method remains the same.

7 Specification of the object of assessment

7.1 General

The object of assessment is the building, including its foundations and external works within the curtilage of the building's site, over its life cycle. The curtilage used to characterise the site shall be consistent with the definition and intended use of the building.

NOTE 1 The site is identified as the physical space of land occupied by and attached to the building.

If the assessment is restricted to a part of a building or to an assembled system (part of works), or to a part of the life cycle, or if any relevant impacts or aspects are not addressed, this shall be documented, reported and reasons given.

NOTE 2 The environmental assessment of the building excludes permanent construction works outside of the curtilage of the site such as construction of infrastructure for communication, energy, water, waste and transportation. A building on a site which requires such construction works will generate environmental impacts other than those strictly related to the building. The assessment of these environmental impacts and aspects is outside of the scope of this European Standard.

The object of assessment shall be described in terms of its physical and time-dependent characteristics.

7.2 Functional equivalent

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 rationalised into a minimum description of the object of assessment.

Although assessments may be carried out on an individual object, they will in most instances form part of the process for the evaluation of decisions in relation to the object of assessment. This includes the decision whether to build new, or refurbish/reconstruct an existing building, the evaluation of the design options, locations, etc.

Comparisons between the results of assessments of buildings or assembled systems (part of works) - at the design stage or whenever the results are used - shall be made only on the basis of their functional equivalency. 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 equivalency of different options and building types to be determined and forms the basis for transparent and unbiased comparison. If the assessment results based on different functional equivalents are used for comparisons, then the basis for 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 unit of reference. 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.

NOTE 2 A common reference unit can be derived from the functional equivalent and be used to present the result of the indicators of the environmental assessment relative to the functional equivalent. A common reference unit may be dimensionless or qualified with a dimension (e.g. per m², per year, per employee, per room per year, per m² per year).

When combining separate assessments of environmental, social (see EN 15643-3) and economic (see EN 15643-4) performance in a sustainability assessment of the same object of assessment, the functional equivalent used in the assessments of the individual dimensions of sustainability shall be the same.

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.

NOTE 3 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.

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 regulation, 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 4 Eurocodes and ISO 15686-1 provide guidance on determining the design life of a building.

7.3 Reference study period

Assessments are carried out on the basis of a chosen reference study period.

The default value for the reference study period shall be the required service life of the building. Any deviations from this (see below) shall be clearly stated and reasons explained.

The reference study period may differ from the required service life given for the object of assessment (Figure 4) depending on the intended use of the assessment, or on regulatory requirements or national guidance. However, in all cases, the assessment is based on the building life cycle (Figure 6). Therefore, the values for impacts and aspects shall first be calculated for the required service life (see also Clause 8).

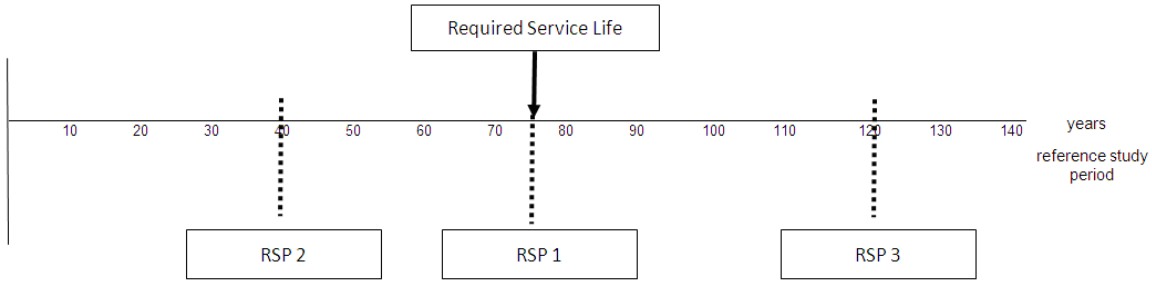

Figure 4 — Reference study period versus required service life of the assessed object

Figure 4 illustrates the three cases:

RSP 1: if the reference study period and required service life are the same, RSP/ReqSL = 1, the default value.

RSP 2: if the reference study period is shorter than the required service life, the quantified values of impacts and aspects for the use stage (modules B1 - B7) and benefits and loads presented in module D_B (see 7.4 and 8.8) that come from modules B1-B7, are adjusted by a factor RSP/ReqSL (see Figure 5).

RSP 3: if the reference study period is longer than the required service life, scenarios for refurbishment, or demolition and construction of an equivalent new building shall be developed. These scenarios shall provide for an extension of the service life which, when combined with the required service life of the object of assessment, is equal to or more than the reference study period. The full value of impacts and aspects for both the actual required service life and the extension to the service life shall be taken into account following the rules given above.

In all cases, the quantified values obtained for the product stage (modules A1, A2, A3, see Figure 6), the construction/process stage (modules A4, A5), and the end of life stage (modules C1 - C4) are independent of the value of the reference study period. The values for impacts and aspects for modules in the use stage (modules B1 - B7) are multiplied by the ratio of the reference study period to the required service life (RSP/ReqSL) as presented in figure 5. The loads and benefits reported in module D derived from the modules A (D_A), B (D_B) and C (D_C) are also scaled in the same way.

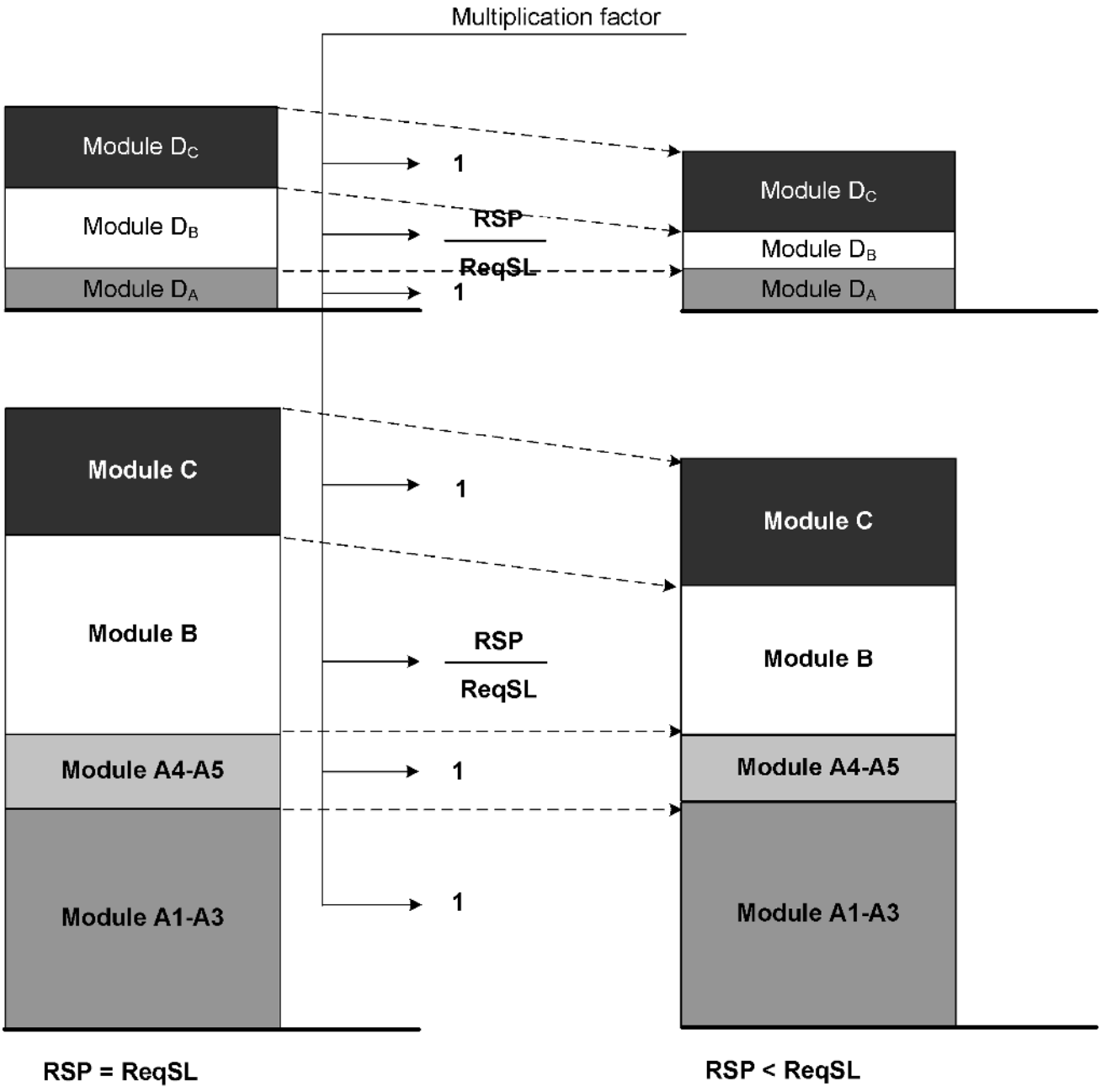

Figure 5 — Illustration of how the quantified impacts and aspects are adjusted for a reference study period that is less than the required service life (Case RSP 2)

7.4 System boundary

7.4.1 General

The system boundary determines the processes that are taken into account for the object of assessment. For a new building, the system boundary shall include the building life cycle as shown in Figure 6. For an existing building (or part thereof), the system boundary shall include all stages representing the remaining service life, and the end of life stage of the building.

In this context, the object of assessment is the building and its site. This includes all the upstream and downstream processes needed to establish and maintain the function(s) of the building, from the acquisition of

raw materials to their disposal or to the point where materials exit the system boundary either during or at the end of the building life cycle (see 7.4.5 and 7.4.6).

The setting of the system boundaries follows the “modularity principle”: Where processes influence the building’s environmental performance during its life cycle, they shall be assigned to the module in the life cycle where they occur.

EXAMPLE All impacts and aspects due to the replacement of a broken window pane in the use stage which include production, transport, use of ancillary materials, packaging waste and recycling are assigned to ‘Repair’, module B3.

Figure 6 illustrates the organisation of the different modules used for the assessment of the building and corresponds to the modular structure of information from EPD for construction products, processes and services according to EN 15804.

Modules A1 to C4 cover environmental impacts and aspects that are directly linked to processes and operations taking place within the system boundary of the building, while module D provides the net benefits relating to exported energy and secondary materials, secondary fuels or secondary products resulting from reuse, recycling and energy recovery that take place beyond the system boundary.

7.4.2 Boundary of the Product Stage (Modules A1 to A3)

The boundary for modules A1 to A3 covers the 'cradle to gate' processes for the materials and services used in the construction; the rules for determining their impacts and aspects are defined in EN 15804.

7.4.3 Boundaries of the Construction Process Stage (Modules A4 and A5)

7.4.3.1 General

The construction process stage covers the processes from the factory gate of the different construction products to the practical completion of the construction work.

The consideration of aspects and impacts of the manufacturing of capital goods (e.g. trucks, cranes,) shall be in accordance with Clause 9.4.3.

7.4.3.2 Boundary of the Transport to and from site (Module A4)

The boundary for module A4 shall include:

— transport of materials and products from the factory gate to the building site, including any transport, intermediate storage and distribution;

— transport of construction equipment (cranes, scaffolding, etc.) to and from the site;

NOTE Where construction equipment is often moved from one building site to the next, due to the building activity of a contractor, the average distance is taken into account. For hired equipment the actual distance for the transport to and from the building site is taken into account.

— all impacts and aspects related to losses due to the transportation (i.e. production, transport and waste management of the products and materials that are damaged or otherwise lost during transportation).

Transport of persons to and from the site shall not be included.

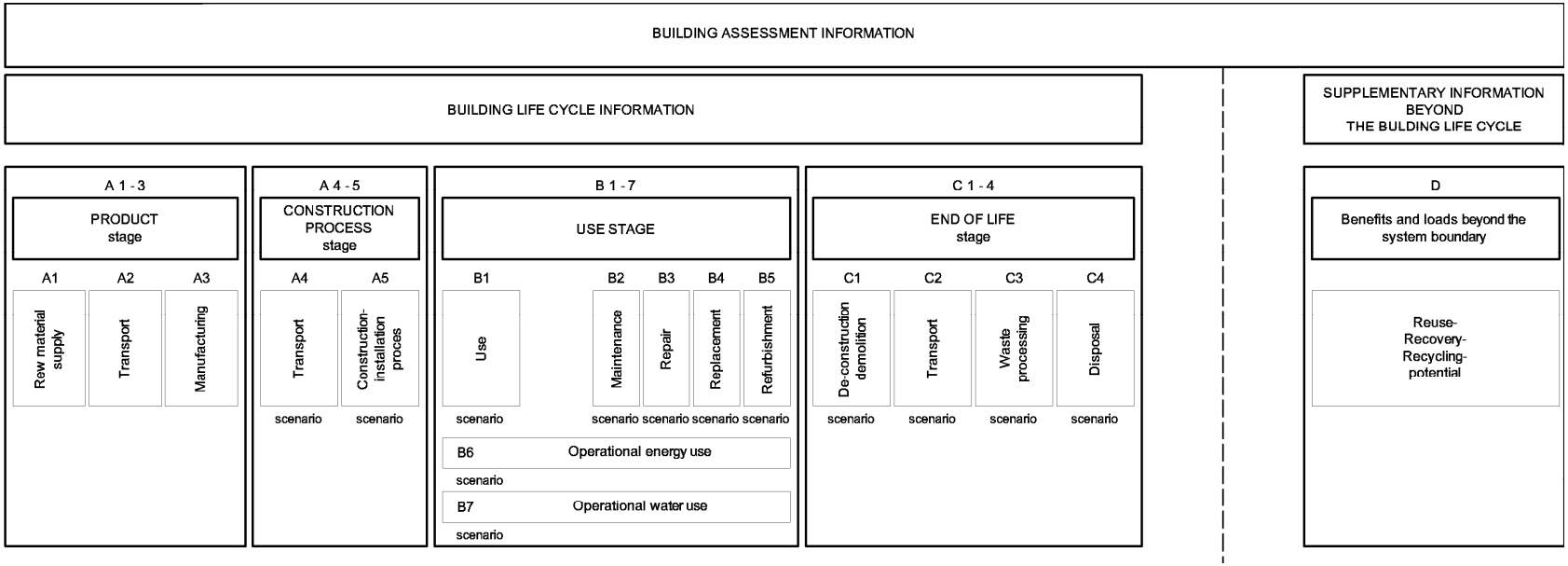

Figure 6 — Display of modular information for the different stages of the building assessment

7.4.3.3 Boundary of the construction installation process (Module A5)

The system boundary shall include the following process:

— ground works and landscaping;

— storage of products, including the provision of heating, cooling, humidity, etc.;

— transport of materials, products, waste and equipment within the site;

— temporary works, including temporary works located off-site as necessary for the construction installation process;

— on site production and transformation of a product;

— provision of heating, cooling, ventilation, humidity control etc. during the construction process;

— installation of the products into the building including ancillary materials not counted in the EPD of the products e.g. releasing agents in formworks for concrete, formworks discarded at the end of the project;

— water use for cooling of the construction machinery or on-site cleaning;

— waste management processes of other wastes generated on the construction site. This includes all processes (including transportation from the building site) until final disposal or until end of waste state is reached;

— production, transportation and waste management of products and materials lost during the construction and installation process.

7.4.4 Boundaries of the use stage (Modules B1 - B7)

7.4.4.1 General

The use stage covers the period from the practical completion of the construction work to the point of time when the building is deconstructed/demolished.

The system boundary includes the use of construction products and services for protecting, conserving, moderating or controlling the object of assessment, e.g. building services such as heating, cooling, lighting, water supply and internal transports (provided e.g. by lifts and escalators), and scenarios for maintenance including cleaning, operation and replacement of machinery.

The assessment shall include impacts and aspects of the building-integrated technical system and building-related furniture, fixtures and fittings. The system boundary for the assessment shall exclude impacts and aspects of the appliances and furniture, fixtures and fittings that are not building-related.

The impacts and aspects of appliances and furniture, fixtures and fittings that are not building-related may be assessed separately. Where this is the case, these impacts and aspects shall be recorded and reported and communicated separately.

NOTE 1 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 2 Building-related furniture, fixtures and fittings are products that are fixed to the building, so that the dismantling of the product decreases the performance of the building and the dismantling or replacement of the product constitute construction operations.

7.4.4.2 Boundary of the installed products in use (Module B1)

The boundary of module B1 encompasses the impacts and aspects arising from the normal (i.e. anticipated) conditions of use of components of the building.

EXAMPLE Release of substances from the facade, roof, floor covering and other surfaces (interior or exterior).

NOTE Until the standards from CEN/TC 351 are published, the information required for this module may not be available.

7.4.4.3 Boundary of maintenance (Module B2)

The boundary of maintenance shall include:

— the production and transportation of the components and ancillary products used for maintenance;

— all cleaning processes of the interior and exterior of the building;

— all processes 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.

EXAMPLE Painting work on window frames, doors, etc. and also the annual inspection and maintenance of the (oil or gas) boiler, replacement of filters in the heat recovery or air conditioner.

7.4.4.4 Boundary for repair (Module B3)

The boundary for repair shall include any repair processes to the building components during the use stage of the building.

The boundary for repair shall include:

— the production of the repaired part of component and ancillary products;

— the transportation of the repaired part of component and ancillary products, including production impacts and aspects of any losses of materials during transportation;

— the repair process of the repaired part of component and ancillary products;

— waste management of the removed part of the component and of ancillary products;

— the end of life stage of the removed part of the component and of ancillary products.

EXAMPLE For a window with a broken pane, this includes waste generated by the pane, production, transportation of a new pane and all impacts due to the repair process (rubber seal, etc.).

7.4.4.5 Boundary for replacement (Module B4)

The boundary for replacement shall include:

— the production of the replaced component and 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.

EXAMPLES Replacement of a roof beam, replacement of a partition wall, a complete covering of an existing roofing felt, or a complete renewal including removal of the existing roofing felt, replacement of a heating system or boiler, replacement of a window (frame, glass), etc.

7.4.4.6 Boundary for refurbishment (Module B5)

The boundary for refurbishment of a building shall include:

— 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.

EXAMPLES A major change of the internal layout (partitioning) and/or the building envelope, change of the technical systems related to heating, cooling or air conditioning, modifications for the purposes of a planned or expected change of use.

If a building is refurbished and the refurbishment was not taken into account at the outset, i.e. in any previous assessment, a new assessment should be carried out, particularly where the refurbishment changes the functional equivalent, (e.g. there is a change of building type, use, and/or required service life that was not planned or expected, i.e. typical for the building type). In such cases, the refurbishment will not have been included as module B5 in the first assessment. In the new assessment of the refurbished building, the environmental impacts and aspects of the refurbishment materials and reconstruction/installation processes are allocated to modules A1 to A5.

7.4.4.7 Boundary of the operational energy use (Module B6)

The boundary to be considered for the module B6 shall include energy used by building-integrated technical systems during the operation of the building.

NOTE 1 For practical reasons some simplifications of the setting of system boundaries for Module B6 are defined in this clause in order to:

— comply with the Energy Performance of Buildings Directive (2002/91/EC, 2010/31/EC) and its National implementations. The Energy Performance of Buildings Directive (EPBD) requires taking into account the energy supply by renewable energy generation units;

— follow the principles of modularity and 'polluter pays';

— ensure consistency between the standards dealing with environmental, economic and social aspects of sustainability according to the requirements of EN 15643-1:2010.

NOTE 2 A building may import energy for supply of the building’s energy demand but it may also generate energy and export (part of) that energy to another building or to a grid of energy distribution, e.g. the electricity network, the district or local heat network.

The energy use in the building refers to the activity and processes as presented in EN 15603. The energy performance of a building is determined on the basis of the calculated or the actual annual energy that is used in order to meet the different needs associated with defined uses of the building :

- heating;
- domestic hot water supply;
- air conditioning (cooling and humidification/de-humidification);
- ventilation;
- lighting;
- auxiliary energy used for pumps, control and automation.

The energy use of other building-integrated technical systems (e.g. lifts, escalators, safety and security installation and communication systems) necessary for the technical and functional performance of the building shall be included in B6 and reported and communicated separately (See Figure 7).

NOTE 3 The energy use of other building-integrated technical systems is not covered by the Energy Performance of Buildings Directive

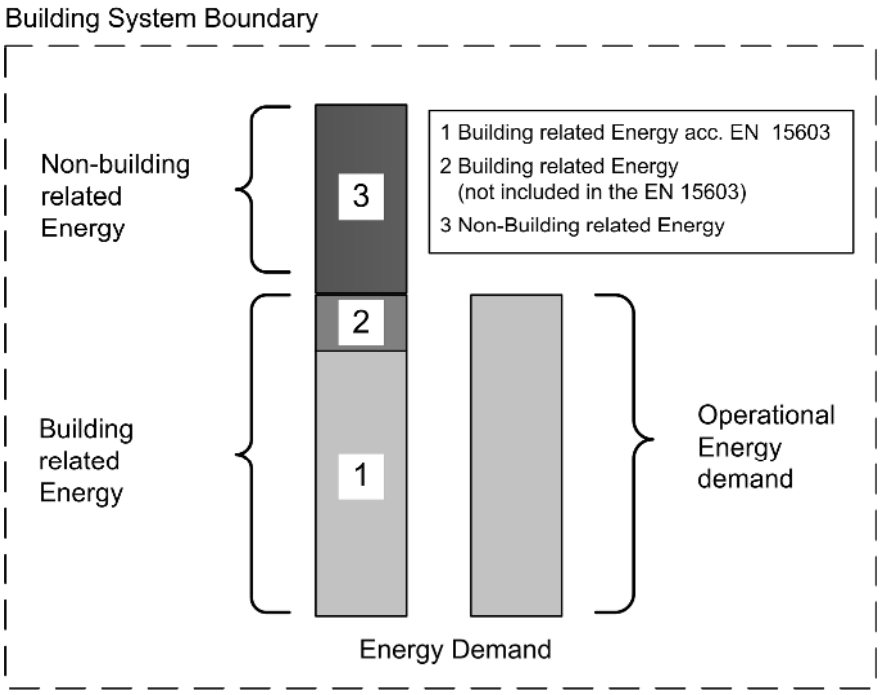

Figure 7 — Building system boundary for operational energy

If the energy use of appliances that are not building-related (plug-in appliances, e.g. computers, washing machines, refrigerators, audio, TV and production or process-related energy in the use of the building) is included within the energy calculation, then this shall be documented and reported and communicated separately.

All impacts and aspects related to the operational energy use are fully allocated to the building.

For reasons of simplification, the site generated energy that is used within the building, is assumed to satisfy firstly building-related energy demand and then the energy demand that is not building-related. Exported

energy shall not be deducted from the import of energy required to operate the building, but instead only the additional environmental benefits and loads resulting from the exported energy shall be reported in module D (Figure 8).

NOTE 4 This simplification is justified to align with the Energy Performance of Buildings Directive (2011/31/EC).

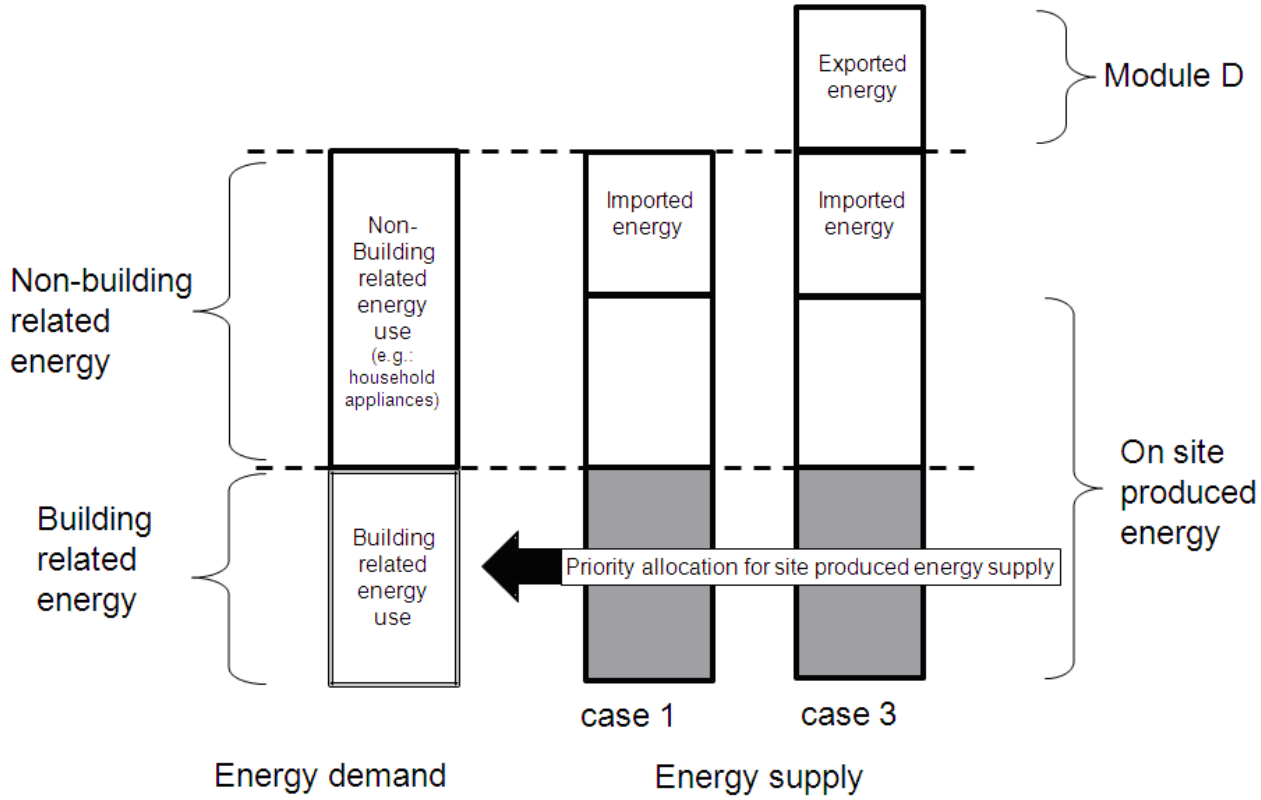

Figure 8 — Allocation of energy in case of produced energy for building related and non-building related energy use

All energy generating units located within the building's site shall be included in the assessment.

These energy units may generate energy both from renewable sources (e.g. photovoltaic cells, wind mills, solar thermal panels, ground or air source type heat pumps) and from non-renewable energy sources (gas boilers, CHP (Combined Heat Power), fuel cells, heat pumps).

NOTE 5 No distinction is made between energy production units that are part of the building fabric and energy production units that are not part of the building fabric and so do not perform any additional building function.

EXAMPLE Solar thermal panels or photovoltaic panels that are part of the building envelope, whether or not they have functions other than energy generation - e.g. providing protection against rain and wind penetration through the roof or facade - are part of the building assessment. In addition, a photovoltaic panel installed in the garden of the site and thus not being a part of the building envelope but delivering energy for the use in the building or as exported energy is part of the building assessment.

All impacts and aspects of the specified imported energy (either for the direct use or for generation of energy) shall be assigned in module B6.

The amount of exported energy is reflected in the indicator "Exported energy - [MJ]" which is declared in module B6.

NOTE 6 The exported energy exits the building system boundary free from environmental burden since all impacts and aspects are reported in module B6.

The net environmental benefits and/or loads of the energy exported beyond the building system boundary shall be reported in module D by calculating the substituted impacts and aspects from the most likely corresponding energy supply, based on current average technology and practice. Within module D the net benefits and/or loads (from substitution) of the exported energy shall be reported separately.

7.4.4.8 Boundary of the operational water use (Module B7)

Boundary of the operational water use shall include all water used and its treatment (pre- and post-use) during the normal operation of the building (excluding during maintenance, repair, replacement and refurbishment), together with associated environmental impacts and aspects. Module B7 covers the period from the handover of the construction works to the point in time when the building is deconstructed/demolished.

NOTE 1 Aspects related to the production, transportation, maintenance and disposal of equipment required to supply water to the building would be covered within modules B2-B5.

NOTE 2 Energy usage associated with providing domestic hot water and other water use related systems are included in module B6.

Module B7 shall include all building-integrated water-consuming processes of the building under operation such as processes for:

— drinking water;

— water for sanitation;

— domestic hot water;

— irrigation of associated landscape areas, green roofs, green walls;

— water for heating, cooling, ventilation and humidification;

— other specific water use of building-integrated systems e.g. fountains, swimming pools, saunas.

If water use of appliances that are not building-related (e.g. dishwashers, washing machines) is included within the assessment, this shall be reported and communicated separately.

7.4.5 Boundary of the end of life stage (Modules C1-C4)

7.4.5.1 General

The end-of-life stage of a building starts when the building is decommissioned and is not intended to have any further use. At this point, the building's demolition/deconstruction may be considered as a multi-output process that provides a source of materials, products and building elements that are to be discarded, recovered, recycled or reused. The scenarios for these end-of-life options for the products and materials determine the system boundary (see 7.4.2, 8.4 and 8.7). These scenarios shall only model processes that have proven to be economically and technically viable.

The building is deemed to have reached the end of its life when:

— all components and materials that were to be cleared from the site have been removed;

— the site is made ready for future re-use (i.e. cleared ready for new activity).

7.4.5.2 Boundary for the deconstruction (Module C1)

The boundary of the deconstruction process 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, dismantling and/or demolition.

7.4.5.3 Boundary for transport (Module C2)

The boundary shall include all impacts due to transportation to disposal and/or until the end-of-waste state is reached (see 7.4.5.4). This includes transport to and from possible intermediate storage/processing locations.

7.4.5.4 Boundary for waste processing for reuse, recovery or recycling (Module C3)

The boundary at the end of an end-of-life stage of the building to module D is set where the end-of-waste state of outputs, e.g. materials, products or building elements, is reached.

During the end-of-life stage of the building, all output from dismantling, deconstruction or demolition of the building, from maintenance, repair, replacement or refurbishing processes, all debris, all construction products, materials or construction elements, etc. leaving the building, are at first considered to be waste. This output however reaches the end-of-waste state when it complies with all of the following conditions:

— the recovered material, product or construction element is commonly used for specific purposes;

— a market or demand, identified e.g. by a positive economic value, exists for such a recovered material, product or construction element;

— the recovered material, product or construction element fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products;

— the use of the recovered material, product or construction element will not lead to overall adverse environmental or human health impacts.

NOTE 1 The “specific purpose” in this context is not restricted to the function of a certain product but can also be applied to a material serving as input to the production process of another product or of energy.

The criteria for “overall adverse environmental or human health impacts” shall refer to the limit values for pollutants set by regulations in place at the time of assessment and where necessary, shall take into account adverse environmental effects.

NOTE 2 The presence of any hazardous substances exceeding these limits in the waste or showing one or more properties as listed in existing applicable legislation, e.g. in the European Waste Framework Directive (2008/98/EC), prevents the waste from reaching the end-of-waste state.

The end-of-life stage includes the following modules:

C1 deconstruction, including dismantling or demolition, of the building, including initial on-site sorting of the materials;

C2 transportation of the discarded materials as part of the waste processing, e.g. to a recycling site and transportation of waste e.g. to final disposal;

C3 waste processing e.g. collection of waste fractions from the deconstruction and waste processing of material flows intended for reuse, recycling and energy recovery. Waste processing shall be modelled and the elementary flows shall be included in the inventory. Materials for energy recovery are identified based on the efficiency of energy recovery with a rate of 60 % or higher, without prejudice to existing legislation. Materials from which energy is recovered with an efficiency rate below 60 % are not considered materials for energy recovery;

C4 waste disposal including physical pre-treatment and management of the disposal site.

NOTE 3 In principle, waste processing is part of the building life cycle under study. In the case of materials leaving the system as secondary materials or fuels, such processes as collection and transport before the end-of-waste state are, as a rule, part of the waste processing of the building. However, after having reached the “end-of-waste” state further processing may also be necessary in order to replace primary material or energy from primary fuels in another product system. Such processes are considered to be beyond the system boundary and are assigned to module D. Secondary material having left the system can be declared as substituting primary production in module D, when it has reached functional equivalence of the substituted primary material.

Loads, (e.g. emissions) from waste disposal in module C4 are considered part of the building life cycle, according to the “polluter pays” principle. If however this process generates energy such as heat and power from waste incineration or land filling the potential benefits from utilisation of such energy in the next product system are assigned to module D and are calculated using current average substitution processes.

7.4.5.5 Boundary for the disposal (Module C4)

The boundary includes the possible post-transportation treatment that is necessary before disposal.

Module C4 quantifies all the environmental loads resulting from final disposal of materials (neutralisation, incineration with or without utilisation of energy, landfilling with or without utilisation of landfill gases, etc). Any environmental benefits from exported energy (i.e. through substitution) shall be reported into module D.

For some end-of-life processes such as land-filling, emissions can occur after the time period of the assessment. As a rule, a time period of 100 years is considered appropriate for such long-term processes.

7.4.6 Boundary for the benefits and loads beyond the system boundary (Module D)

Components for reuse and materials for recycling and energy recovery are considered as potential resources for future use.

Module D quantifies the net environmental benefits or loads resulting from reuse, recycling and energy recovery resulting from the net flows of materials and exported energy exiting the system boundary.

NOTE 1 Module D acknowledges the “design for reuse and recycling” concept. Module D provides information to help with transparency on the benefits and loads of processes beyond the system boundary of the object of assessment.

The information in module D may contain technical information as well as values for the predetermined indicators as listed in Clause 11.

Where a material flow exits the system boundary and has an economic value or has reached the end-of-waste stage and substitutes another product, then the impacts may be calculated and shall be based on:

— average existing technology;

— current practice;

— net impacts.

Net impacts are the impacts connected to the recycling process which substitutes primary production, minus the impacts producing the substituted primary product. For closed loop recycling only the net material flow exiting the system is used as the basis for calculating the avoided impacts.

NOTE 2 "Net" also means that we have to subtract input of secondary material (A) from output of secondary material in order to calculate net impact.

7.5 The building model

7.5.1 Purpose and information needed

The purpose of the building model is to enable the quantification of the mass and energy flows. This quantification should be organised in a structured way, an example of which is given in Annex A.

To facilitate the quantification the building is separated into:

— its constituent parts (all building elements, building components, building products, building materials);

— related processes such as transport, construction, maintenance, repair, replacement, end-of-life processes;

— operational use (energy, water).

The choice of the level of details depends on the goal and scope of the assessment and of the availability of data at the time the assessment is carried out (sketch plan, design, procurement and handover).

Furthermore, the information - whether it is detailed or aggregated - can be either generic, averaged or specific. The requirements for the type of data to be used are described in Clause 8.

7.5.2 Description of the physical characteristics of the building

The description of the physical characteristics of the building shall include (but is not limited to) the building-related construction and technical equipment and services (see illustration in Annex A):

The shape and size of the building;

— number of storeys;

— the storey height, and overall dimensions (gross floor area);

— the structural frame and foundations;

— foundations;

— frame (beams, columns, slabs);

— non load-bearing elements;

— external walls;

— windows;

— roof;

— internal walls;

— doors and staircase(s);

— floor;

— ceiling;

— the technical systems;

— sanitary systems (water, waste water, piping, pump and fixed equipment);

— fixed fire-fighting systems;

— heating and hot water systems;

— mechanical ventilation and air conditioning;

— fixed lighting systems;

— communication and security systems;

— transportation inside the building (lifts, escalators);

— drainage system;

— the site construction;

— landscaping;

— external lighting;

— external parking;

— on-site drainage;

— water treatment systems.

8 Scenarios for defining the building life cycle

8.1 General

To provide the complete description of the object of assessment, time-related characteristics of the building need to be added to the physical description of the building (e.g. reference study period, service life, replacement period, working hours, pattern of use). This requires the development and use of appropriate scenarios representing assumptions (or, where known, real information) that can be applied to models for construction, use, and end-of-life stages (modules A4 to C4) of the object of assessment. If information on module D is communicated in a building assessment, scenarios are required to be defined at the building level. These scenarios are required to model loads and benefits for reuse, recycling and energy recovery.

The assessor shall ensure that the scenarios developed with respect to the boundaries defined in Clause 7, together with any underlying product information, are consistent with general scenarios defined at the building level.

Scenarios for the building modules A4 to C4 include information on the construction stage, use stage and end-of-life stage. Scenarios for the building module D include information on reuse, recycling and energy recovery.

The scenario for the use stage shall include information on the service life of the building and information on specified maintenance, repair, replacement, water and energy use and all activities with an environmental impact and aspects arising from the use of the building.

Information modules available from EPD shall be reviewed in order to determine if they are representative of the assessed building. If only “cradle to gate” EPD or “cradle to gate EPD with options” are available, information shall be added to supplement that which has been obtained from the EPD to complete all “cradle to grave” modules (Figure 6).

In order to provide full transparency, any change of, or adaptation from, the given information modules shall be reported.

8.2 Requirements for scenarios

The scenarios employed in an assessment shall be described and documented, making clear the assumptions used, the requirements for information and data, and the limits of their application in the context of the building and its life cycle. It should be clear from the assessment report whether information/data has been assumed, estimated or calculated, or is based on actual measurement. Sources of information shall be documented.

Scenarios should also distinguish and make clear when they relate to specific functions undertaken within the building (e.g. scenarios for lighting energy used in a theatre, or energy and water use associated with the use of a restaurant).

8.3 Time-related characteristics and associated scenarios

8.3.1 General

Time-related characteristics and associated scenarios include maintenance, replacement, cleaning and other periodic operations.

The cleaning, maintenance and replacement scenarios for all major items of plant, machinery, windows, wall and flooring finishes shall be described.

These scenarios shall take into account the following:

— client requirements (as expressed in the brief);

— service life planning according to principles defined in ISO 15686-1, -2, -7 and -8;

— requirements issued from EN 15804;

— manufacturers' information;

— pattern of use.

The scenarios may be refined as additional information and detail becomes known, and must be based on real-life data.

8.3.2 Climate conditions

Climate conditions that are compatible and consistent with those required under European legislation for other construction-related purposes (e.g. EN 15603) and representative of the location of the building, shall be used in the relevant scenarios.

8.3.3 Other specific requirements for scenarios

Other specific requirements may have to be considered in the description of the life cycle of the object of assessment. Such requirements can include building performance indicators defined by local regulation or in the client's brief, such as requirements for energy efficiency, fire safety, adaptability or seismic performance. These requirements have an influence on the design, choice of the type of the construction process and the selection of products.

8.4 Scenarios for the product stage (Modules A1 to A3)

Environmental information for the product stage is defined in the product EPD (see EN 15804).

When no EPD is available, scenarios for products shall be clearly defined from cradle to gate modules according to EN 15804. This includes any products, construction assembly of pre-fabricated products or any combination of these.

8.5 Scenarios for the construction process stage (Modules A4-A5)

Scenarios for the construction process stage cover the period from the factory gate of the different construction products to the practical completion of the construction work. The scenarios shall define for any elementary operation described within the boundaries of the construction stage. The transport of products (ready for construction), materials, services and equipment to and from the building site - module A4 - the construction process (in-situ construction, off-site construction assembly of pre-fabricated products or any combination of these) - module A5 - including if significant and relevant:

— ground works and landscaping;

— transport of materials, products, waste and equipment within the site;

— construction process;

— product installation, including ancillary products and not counted in the EPD of the products;

EXAMPLE 1 Releasing agents in formworks for concrete (synthetic oil), formworks discarded at the end of the project, water use for cooling of the construction machinery, on-site cleaning, etc.

EXAMPLE 2 The scenarios specify the assumptions or adaptation made to the EPD of construction products with respect to the application technology of their installation: mechanically fixed, glued, welded. It includes the specifications or assumptions on the energy use, water use and waste generated in the application process if not given or if not directly applicable for the building scenario. It also includes information on energy use required for on-site equipment (e.g. cranes, vacuum equipment, scissor lifts, scaffolding elevators, heating, cooling).

— temporary works;

EXAMPLE 3 Temporary stabilisation or supporting structures for neighbouring buildings, temporary pumps for groundwater, fences, etc. used during the construction stage.

— waste management.

Information issued for building handover shall be collected in order to be used, if necessary, for the environmental management system of the building.

8.6 Scenarios for Use stage (modules B1 to B7)

8.6.1 General

The building scenarios for the use stage shall describe all activities with a relevant environmental impact arising from the operation of the building, including the building systems and building management activities associated with the object of assessment.

Scenarios should be based on the existing regulations, client’s requirements, or accepted code of practice.

The scenarios that shall be included in an assessment of use stage of the building life cycle require consideration of the following:

— building management activities that include maintenance and repair and cleaning;

— use of energy for heating, cooling, lighting, domestic hot water and controls;

— use of water for operational use;

— maintenance activities.

If the object of assessment provides energy for use outside of its boundaries, the management activities (maintenance, repair and cleaning) of the relevant equipment for energy production shall be allocated in accordance with rules defined in 7.4.4.7.

The use stage assessment scenarios should exclude any activities associated only with building functions and/or business activities.

8.6.2 Scenario related to use stage (except energy and water) - Module B1

The scenario shall define the internal and external conditions for the object of assessment. These conditions influence the impacts related to the characteristics of the products in their application (e.g. release of substances into the environment depends on pattern of use, humidity, air velocity, and temperature).

8.6.3 Scenarios for maintenance, repair, replacement - Module B2, B3 and B4

These scenarios shall take into account the following:

— client requirements as expressed in the brief (example: maintenance every five years or no maintenance);

— service life planning according to ISO 15686-1, -2, -7 and -8;

— requirements issued from EN 15804;

— manufacturers' information;

— pattern of use.

Other examples of processes connected to construction products within the system boundaries are maintenance or processes for replacement of protective surfaces e.g. flooring or wallpaper.

The scenarios should be based on statistical data or normative data or, in the case of an existing building, based on real-life data.

Different scenarios based upon predefined or default values or based on statistical comparison may be defined.

EXAMPLE A window could be replaced either when its functionality is failing (e.g. 2 % failure rate every year after 10 years) or at a predefined time period (30 years).

8.6.4 Scenarios for refurbishment - Module B5

The scenarios for refurbishment of the building, building elements and/or technical equipment shall be developed where details of planned refurbishment are known to the assessor. If no requirements for refurbishment are stated in the client's brief, the scenarios for refurbishment shall be typical for the type of building being assessed.

The scenario for refurbishment shall describe all activities with environmental impacts and aspects arising from the refurbishment process, in accordance with the system boundary described in 7.4.4.6.

Where refurbishment is done or planned in conjunction with a change of use (i.e. changes the functional equivalent), the impacts and aspects relating to the new functional equivalent shall be taken into account for the remainder of the required service life, and for the end of life.

8.6.5 Scenarios for operational energy use - Module B6

The scenarios for energy use shall include (but not be limited to) energy consumed by use of the following systems: heating, cooling, ventilation, domestic hot water, lighting and control. For this, default scenarios for the energy use shall be obtained from EN 15603.

If additional energy uses are included, the scenarios attached to these additional energy uses (process) shall be documented and reported separately.

The assessment of energy use may be based on alternative methods for energy modelling and scenarios for the pattern of use, which shall be described and documented.

For building-related energy production, the scenarios used shall take account of the priority given to, and the distribution of the generated energy - i.e. whether it is for use within the object of assessment or exported for use by others (see Figure 8).

The scenario for module B6 shall specify per energy carrier the imported energy used to satisfy the specified demand and per energy carrier the energy that is exported. The scenario shall specify how the imported and exported energy flows are quantified (e.g. the solar panel specifications, including quantifying the amount of energy produced on site and how much of this is exported).

8.6.6 Scenarios for operational water use (Module B7)

The water use scenario shall include (but not be limited to) the consumption of potable water for sanitary purposes, and should consider other water use directly related to the object of assessment (e.g. drinking water, swimming pool, watering of landscaped areas) where possible, or appropriate.

These scenarios shall also take into account and justify any reduction of potable water use through the use of the rainwater harvesting, water recycling and/or other sources. These amounts may be reported separately as additional information.

Scenarios should consider both the water input and output flows for waste water treatment.

The scenarios should be based on statistical data, normative data, or on real-life data where available.

8.7 Scenarios for the end of life stage (Modules C1 to C4)

8.7.1 General

The scenarios shall describe the processes used during the end of life stage in accordance with the system boundary for the end of life stage as described in 7.4.5.

8.7.2 Scenarios for deconstruction - Module C1

The scenarios for dismantling and deconstruction shall be restricted to the on-site process and activities.

It shall describe all the relevant processes that are assumed to be necessary for the deconstruction of building including initial on-site sorting of the materials, according to the cut-off rules (see 9.4.3).

8.7.3 Scenarios for transport - Module C2

Scenarios for transport shall specify for any category of materials or products, the type of transport used, distances travelled and fuel consumption required for their movement from the site for disposal or to the system boundary for materials leaving the system for reuse, recycling and energy recovery.

8.7.4 Scenarios for waste processing for reuse, recycling and energy recovery - Module C3

The scenarios shall describe all waste treatment processes: for example, sorting, preparatory processes for reuse, recycling and energy recovery, up to the moment where the output from dismantling, deconstruction or demolition of the building or construction works ceases to be waste. These processes may also generate materials for disposal and are assigned to module C3.

These scenarios shall be based only on solutions and technologies that have been proven to be economically and technically viable.

8.7.5 Scenarios for disposal - Module C4

The scenarios shall include any processes (neutralisation, incineration with or without utilisation of energy, land filling with or without utilisation of landfill gases, etc.), or activities (packaging) necessary before final disposal where not covered in modules C1 to C3, as well as the final disposal itself.

8.8 Scenarios for benefits and loads beyond the system boundary - Module D

The scenarios for reuse, recovery and recycling potentials outside of the system boundary of the object of assessment describe the processes that lead to future substitution of resources.

If relevant and available, module D addresses the net environmental benefits or loads resulting from reuse, recycling and energy recovery. Hence, module D shall be fully consistent with all the scenarios developed for the various life cycle stages and modules. Hence, indicators in module D shall report the net avoided environmental burdens resulting from the flows exiting the system (i.e. mainly from modules A5 and C3) minus the flows entering the system (i.e. mainly module A1). Rules to calculate module D are given in EN 15804.

9 Quantification of the building and its life cycle

9.1 General

The quantification of all material and products is determined based upon the design description of the object of assessment (new building or refurbishment of an existing building) or with the actual quantities (existing buildings, post-refurbishment) and the scenarios for each module of the life cycle of the object of assessment.

9.2 Specification net amount

The net amount of units is specified according to the design drawing and/or the as-built (and operated) situation, and corresponds to the net units of products, materials, components and elements that all together constitute the building.

9.3 Accounting for the gross amount

9.3.1 General

The assessment shall take into account the gross amount of material and products used to form the object of assessment. Account shall be taken of the ‘losses’ that occur as a result of a number of factors, including:

— loss/damage in transit;

— loss/damage on-site;

— losses in normal processing of products, materials components, etc. on site;

— design losses due to dimensional relationship in the design and product dimensions;

— requirements for ordering minimum quantities.

These losses are accounted for in the requirements for setting the system boundary of each module according to Clause 7 and through scenarios according to Clause 8.

9.3.2 Components that will not be replaced under defined conditions

No replacements are required when the Estimated Service Life (ESL) of the installed products, structural element(s) or component (foundations, column, beam), meets or exceeds the required service life of the building.

9.3.3 Replaceable components and number of replacements

For all components or elements that may be repaired or replaced, the ESL and information on processes for repair, replacement and disposal has to be defined. This shall be established in accordance with ISO 15686-1 and -8.

The number of replacements for products, components, elements, used in the building is directly linked to its estimated service life (ESL). Only a full number of replacements (no partial replacements) is allowed; in the case of a partial number of replacements resulting from the estimated service life of the component and the reference study period of the building, the value obtained is rounded up; Equation (1) gives the number of replacement(s) $N_R(j)$ for products, component or element j as a function of the required service life of the building ReqSL.

$$NR\ (j) = E\ [ReqSL\ /\ ESL(j)\ -1] \quad (1)$$

where

E[ReqSL/(ESL(j)]	is the function that rounds up function ReqSL /(ESL(j) to the higher integer value;
ESL(j)	is the estimated service life for product j;
$N_R(j)$	is the number of replacements for product j;
ReqSL	is the required service life of the building.

If, after the last scheduled replacement of a product, the remaining service life of the building is short in proportion to the estimated service life of the installed product, the actual likelihood of this scheduled replacement should be taken into account. The consideration of the likelihood of the replacement shall take into account the required technical and functional performance for the product.

Example for a reference study period of 80 years:

— for a roof with an estimated service life of 30 years, the theoretical value for the number of replacements is (80/30) – 1 = 1,667. The rounded up integer value of 1,667 is 2. For the calculation of the environmental impacts, two replacements will be taken into account (after 30 years and after 60 years). Replacement is excluded after 60 years, because the remaining period from 60 to 80 years is less than the estimated service life of the product and for a roof further replacement is unlikely;

— for windows with an estimated service life of 25 years the calculation of the number of replacements (80/25) – 1 = 2,2 would be rounded up to 3 replacements, accordingly to Equation (1). However, for the calculation of the environmental impacts, only two replacements may be taken into account (after 25 years and after 50 years) as the

third replacement, which would normally take place after 75 years, is unlikely to be carried out in practice. In this case, the maintenance scenario have been adapted accordingly;

— for a boiler with an estimated service life of 25 years, the calculation of the number of replacements (80/25) – 1 = 2,2 is rounded up to 3 replacements. For the calculation of the environmental impact, three replacements are taken into account because of the importance of the functioning of the heating system.

The number of replacement for the components or products is applied in the respective modules where they occur (replacement or refurbishment).

9.4 Type of data for the assessment

9.4.1 General

The degree of confidence that can be placed on the results and in the assessment will depend upon the level of precision and detail provided in the data and the information used to represent the object of assessment.

The choice of data type depends on:

— the scope and intended use of the assessment;

— when the object of assessment is assessed within the decision-making process (sketch, final design, construction, in-use);

— the availability of information;

— the importance of the data in relation to the overall importance of the study.

Assessments should be made using data and information that most precisely represents the object of assessment and the time of the assessment.

This information may be given in different forms:

— aggregated data, either for the object of assessment as a whole (e.g. volume, height, floor area, energy, consumption, water consumption) or for major components (e.g. walls, floors, roofs);

— product/material specific data for components (e.g. bricks, plaster, flooring, windows, fixtures and finishes).

In turn, these may be represented by:

— generic data that is typical of the types of structure and materials used;

— average data combined from different manufacturers or production sites for the same product;

— collective data that is determined according to the requirements of EN 15804 and which will allow an EPD to be established for a type or a category of similar products;

— information that is specific to the manufacturers' components and/or products used in the construction;

— specific detailed information (i.e. a full bill of quantities, dimensions, etc.) for the actual products and components used and directly measured information for utilities and services (energy, water demand, waste, etc.) as built and operated.

Table 1 presents the type of data that may be used at different stages of the assessment for quantification of the gross amounts.

Table 1 — Type of data (informative)

Preferred data	Point of the time of the assessment				
	Inception/ Concept design	Detailed design	Construction	Use stage	End of life of the building
Generic data	X	X	X	X	X
Aggregated data	X	X			
Average data	X	X	X	X	X
Product collective data	O	x	x	X	x
Product average data	O	X	X	X	X
Product specific data	O	X	X	X	X
Model scenarios for use stage	X	X	X	X	
Measured data			X	X	X
Other data	O	O	O	O	O
NOTE Cross represents the preferred use of data - Circle represents alternative sources if available.					

9.4.2 Data quality and demands for completeness

The specific requirements expressed in EN 15801 are applicable. The quality of the data used for the assessment shall be addressed in the assessment report (Clause 12). The data and information used shall be complete in its representation of the object of assessment in terms of quantification.

NOTE Key figures for the type and characteristics of buildings (e.g. area or mass per m^2) can be used to help the verification process in terms of completeness.

9.4.3 Criteria for the exclusion of inputs and outputs

The assessment shall represent accurately the quantification of the building (according to 7.5.2) and scenarios used (according to 8.4 to 8.7) at the time of the assessment (e.g. concept stage, basic design stage, detailed design stage, as built).

The criteria for the exclusion of inputs and outputs for the environmental indicators based on this description of the object of assessment shall follow the rules according to EN 15804.

9.5 Quantification specific to operational energy use

The quantification of the impacts and aspects of operational energy is a direct result of the calculation of the energy used during the use stage of the building according to EN 15603 and shall be derived from the EPD of the different energy carriers or LCA databases (see 7.5.3).

NOTE Values of the environmental indicators derived from LCA methodology may differ from the conversion factors presented in EN 15603 and EN 15217 for primary energy and CO_2 emission.

The energy delivered for use is counted separately for each of the different energy carriers (electricity, gas, etc.) supplied to the building for use in heating, cooling, hot water, lighting, building automation and control systems and other integrated systems as defined in 7.4.4.7.

When energy (heat, electricity) is generated on site, any surplus that is exported for use off site should be counted separately. This also includes the energy that is used for on-site energy production (e.g. from photovoltaic cells, wind turbines, biomass, cogeneration, fuel cells). The exported energy is considered as an additional function of the building therefore the impacts are allocated according to the rules presented in 7.4.4.7 (see also Figure 7and 8.

9.6 Quantification specific to operational water use

The quantification of the impacts and aspects of the operational fresh water use is a direct result of the calculation of the water used during the use stage of the building, and is derived from the EPD of the water suppliers or from LCA databases.

The information related to systems designed for local use of recycled water and rainwater shall be taken into account where it can be demonstrated that it decreases the demand for potable water. To provide complete information, the environmental impacts of the on-site water supply/processing systems shall include that from the components needed for that supply/processing (e.g. rainwater collectors, pumps, purifiers).

The water outputs must be calculated and their impacts considered using the EPD of wastewater treatment (collective equipments or on-site treatment).

10 Selection of environmental data and other information - Use of Environmental Product Declaration(s)

10.1 General

EPD provide quantified information of environmental impacts and aspects for products and services for use in the assessment of the environmental performance of a building.

NOTE In the following, the principles applied in relation to the term “product” also apply to data relating to processes and services.

At the building level, the data need to address the full life cycle of the product in the context of the building (see Figure 6). However, the LCA-based information found in an EPD may represent one of the following:

a) **The product stage alone.** Such an EPD covers raw material supply, transports, manufacturing and associated processes; this EPD is said to be ‘cradle to gate’ and becomes an EPD based on information modules (A.1 to A.3). The declaration of the product stage is mandatory according to EN 15804.

b) **The product stage and selected further life cycle stages.** Such an EPD is said to be ‘cradle to gate with options’ and becomes an EPD based on information modules (A1 to A3 plus other selected modules based on specified scenarios).

c) **The life cycle of a product.** In this case the EPD covers the product stage, installation into the building, use and maintenance, replacements, demolition, waste processing and disposal, i.e. it is based on LCA-covering information required for modules A1 to C4. Modules A4 to C4 are based on specified scenarios).

d) **Module D** provides information on the loads and benefits from reuse, recycling and recovery beyond the system boundary.

According to the requirements of EN 15804 the EPD should provide:

— the product name (or form of identification); a description of the product, and the intended application (use);

— numerical values determined for the impact, input and output indicators listed in Clause 11 at least for modules A1-A3;

— additional technical information to ensure proper understanding of a product’s function in a building by supporting scenario development at the building level.

The product data used for the building assessment should also identify the following:

— the information necessary to define the estimated service life of the product in the context of the building;

— additional technical data necessary for assessment at the building level.

Where relevant data for the building assessment is missing from an EPD, data may be taken from other sources provided that its relevance and appropriateness can be justified, in which case this shall be documented with reasons explained. Data shall be in line with general principles expressed in EN 15804.

If information is missing or is inappropriate (e.g. for scenarios), the assessor shall complete the information needed for the assessment of the building. (See guidance in CEN/TR 15941). The assessor shall use, where available, the additional technical information provided by the manufacturer of the product as a basis for completion of the assessment (e.g. for transportation given in tonnes.km and losses that occur during the construction phase).

10.2 Scenarios for the building

10.2.1 General

To provide the complete description of the object of assessment, geographic and time related characteristics (e.g. reference study period, service life, replacement period, working hours, pattern of use, etc.) need to be added to the physical description of the building. This requires the development and use of appropriate scenarios representing assumptions (or, where known, real information) that can be applied to models for product, construction, use, and end-of-life stages of the object of assessment.

10.2.2 Adaptation of cradle to gate (product stage) information

If a specific or representative EPD in accordance with the requirements of EN 15804 is available for the product which is used in the building, no amendment shall be made to the product stage information module (A1 to A3).

If no such EPD is available or the EPD is not complete for the product which is used in the building, the product stage information modules (A1 to A3) of available generic (not specific) EPD or a data set of a similar product may be used and adapted to create a new data set to reflect the actual situation as closely as possible.

Such a data set shall be made only on the basis of suitably reliable and accurate information available for both products.

In making such adaptations, assumptions shall not simply default to the best case but shall conservatively represent a realistic condition.

10.2.3 Adaptation from gate to grave information (Modules A4 to C4) and Module D

Scenarios for the building modules A4 to C4 and module D (Figure 2) include information on the construction stage, use stage and end of life stage. Requirements for the development of these scenarios are given in Clause 8.

Any scenarios incorporated in the EPD and/or other information used for the assessment should be checked for consistency with the scenarios for the building.

Where differences occur, it is still possible to take consistent information from an EPD (e.g. cradle to gate information from a cradle to grave EPD) and apply other appropriate scenarios at the building level (e.g. gate to grave). Examples are adaptation of transportation distance or maintenance scenarios.

To obtain “cradle to grave” information modules representative for the assessed building, information can be added to supplement that which is obtained from “cradle to gate” EPD. This information is obtained using generic information sources (specific or average), or the information from a specific EPD.

In order to provide full transparency, any change of, or adaptation from, the given information modules shall be reported.

10.3 Data quality

If the environmental data used are in accordance with the requirements of EN 15804 then they are deemed to meet the requirements for data quality of this standard. If the environmental data are from other sources for which it has not been established that it is in accordance with EN 15804 then the following minimum data quality requirements apply:

— data should be as current as possible. Validation of the data shall not be older than 10 years;

— dataset for calculations should be based on one-year averaged data if relevant; reasons for a different assessment period shall be listed;

— emissions from disposal processes shall be accounted for at least 100 years;

— emissions that occur beyond 100 years should be inventoried in a dataset as separate 'long-term' elementary flows and included in the impact assessment if relevant;

— data shall have been checked for plausibility and compliance with the rules of EN 15804;

— the technological coverage shall reflect the physical reality for the declared product or product group;

— the geographical coverage shall be representative of the region where the production is located.

The significance of the influence of the data chosen for the building assessment shall be determined (e.g. through a sensitivity analysis) and reported.

10.4 Consistency

EPD information can be available on an aggregated level for a building part, for a building element, for a building component, or on the level of the product or material, depending on availability of information.

The scenarios and system boundaries of the data used should be consistent at the building level and shall be relevant to the building that is the object of assessment.

The data used shall be complete in its representation of the building or other information in terms of quantification.

11 Calculation of the environmental indicators

11.1 Environmental impacts and aspects and related indicators

11.1.1 General

Indicators used in this clause represent the quantified environmental impacts and aspects caused by the object of assessment during its whole life cycle.

The standard does not present any methodology for the aggregation of the individual indicators presented below.

NOTE The following environmental indicators have been chosen on the basis that there are agreed calculation methods for the indicators referred to in this European Standard. Other indicators, for which there is no scientifically agreed calculation method within the context of LCA - e.g. human toxicity, eco-toxicity, biodiversity, land use - are not included.

11.1.2 Indicators describing environmental impacts

The following environmental information on impacts is expressed with the impact category indicators of LCIA using characterisation factors according to EN 15804. These predetermined indicators shall be included in the assessment as follows:

Table 2 — Indicators describing environmental impacts

Indicator	Unit
Global warming potential, GWP	kg CO_2 equiv
Depletion potential of the stratospheric ozone layer, ODP;	kg CFC 11 equiv
Acidification potential of land and water; AP;	kg SO^{2-} equiv
Eutrophication potential, EP;	kg $(PO_4)^{3-}$ equiv
Formation potential of tropospheric ozone photochemical oxidants, POCP;	kg Ethene equiv
Abiotic Resource Depletion Potential for elements; ADP_elements	kg Sb equiv
Abiotic Resource Depletion Potential of fossil fuels ADP_fossil fuels	MJ, net calorific value

NOTE Indicators describing emission of ionising radiation and their impact on human health and/or eco-systems on LCA level are intended for consideration during the revision of this European Standard.

11.1.3 Indicators describing resource use

The following environmental indicators apply data based on input flows of the LCI. They describe use of renewable and non-renewable primary energy and water resources. They shall be included in the assessment as follows:

Table 3 — Indicators describing resource use

Indicator	Unit
Use of renewable primary energy excluding energy resources used as raw material	MJ, net calorific value
Use of renewable primary energy resources used as raw material	MJ, net calorific value
Use of non-renewable primary energy excluding primary energy resources used as raw material	MJ, net calorific value
Use of non-renewable primary energy resources used as raw material	MJ, net calorific value
Use of secondary material	kg
Use of renewable secondary fuels	MJ
Use of non-renewable secondary fuels	MJ
Net use of fresh water	m^3

NOTE Information can be provided on the percentage of material from sustainably managed sources.

11.1.4 Indicators describing additional environmental information

The indicators describing waste categories and output flows derived from scenarios and LCI shall be included in the assessment as follows:

Table 4 — Indicators describing waste categories

Indicator	Unit
Hazardous waste disposed	kg
Non-hazardous waste disposed	kg
Radioactive waste disposed	kg

Table 5 — Indicators describing the output flows leaving the system

Indicator	Unit
Components for re-use	kg
Materials for recycling	kg
Materials for energy recovery (not being waste incineration)	kg
Exported energy	MJ for each energy carrier

The indicators of Table 4 shall be based on the gross amounts leaving the building system boundary as output flows.

The indicator of “Non-hazardous waste disposed” includes waste deposited into permanent storage, e.g. to landfill, and waste disposed of by incineration.

The construction and demolition waste fulfilling the legal requirements for energy recovery shall be assigned to the indicator “Materials for energy recovery”.

NOTE See Annex I and Annex II of the EU Waste Framework Directive (2008/98/EC)

11.2 Calculation methods

The values for each of the above-mentioned indicators are calculated for each module in the life cycle stages based on a matrix calculation routine as illustrated in Figure 9.

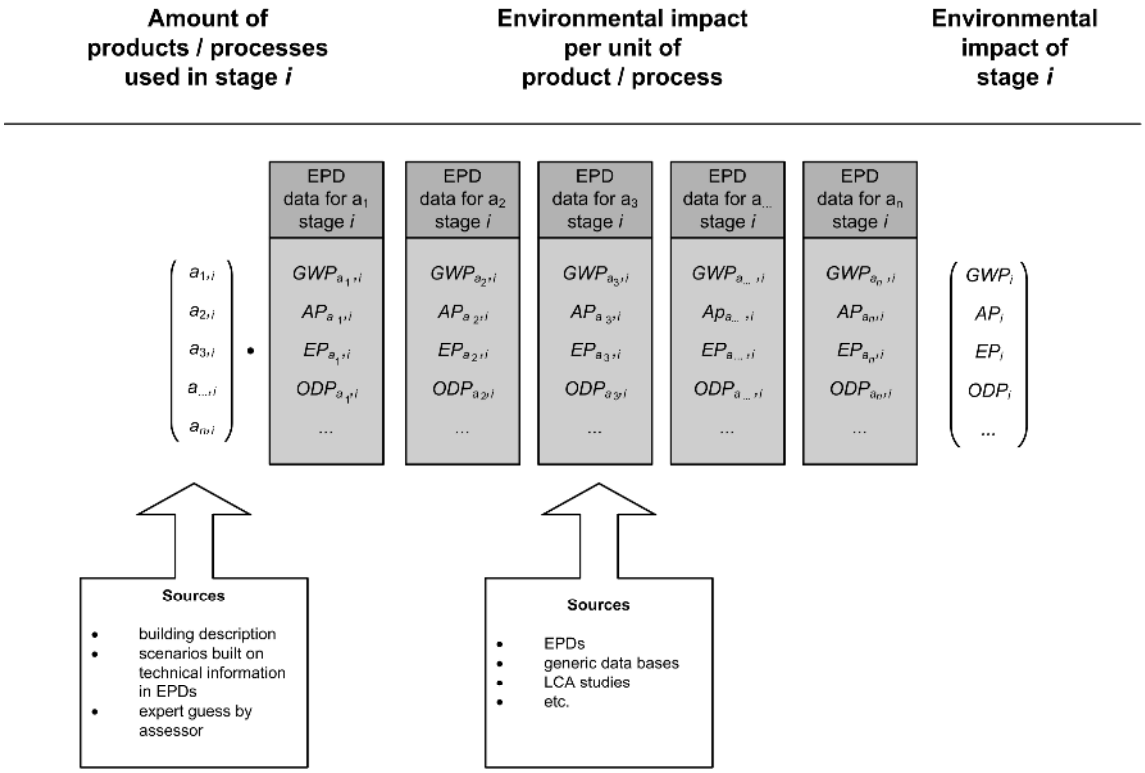

Figure 9 — Principle of the matrix calculation of the environmental impacts for module *i* of the building life cycle and relevant data sources

For *i* = [A1 to A3, A4, A5, B1, B2, B3, B4, B5, B6, B7, C1, C2, C3, C4] and [D]

The basic principle of this matrix calculation routine consists of multiplying each product and service quantified in a module of the life cycle of the building (as outlined in Clause 9) with its respective value for any environmental indicator (Equations (2) and (3)).

$$EP_{\mathrm{i}} = \vec{a}_{\mathrm{j}} \times M \tag{2}$$

where

EP_{i} is the indicator value of the module *i* of the building;

$\vec{a}_{\mathrm{j}}$ is the vector containing the gross amounts of all products and services used in the module *j* of the building;

M is the matrix containing in its columns the environmental indicator values per unit of all products and services used in the module *i* of the building.

Equation (3) exemplifies the resulting calculation routine for the quantification of the *GWP* of stage *i*:

$$GWP_{\mathrm{i}} = a_{1,\mathrm{i}} \times GWP_{\mathrm{a1,i}} + a_{2,\mathrm{i}} \times GWP_{\mathrm{a_2,i}} + a_{3,\mathrm{i}} \times GWP_{\mathrm{a_3,i}} + ... + a_{\mathrm{N,i}} \times GWP_{\mathrm{a_N,i}} \tag{3}$$

where

GWP_{i} is the global warming potential quantified for the module *i* of the building;

$a_{n,i}$ is the gross amount of product or service *n* used in the module *i* of the building (*n* = 1, 2, 3, …, *N*);

$GWP_{a_n,i}$ is the global warming potential of product or service *n* used in the module *i* of the building (*n* = 1, 2, 3, …, *N*).

The same calculation routine applies to all indicators listed in Clause 11.

12 Reporting of the assessment of results

12.1 General information on the assessment

The environmental performance of a building represents only one aspect of the contribution to sustainability as presented in ISO 15392 and in the general framework EN 15643-1.

The basis of the assessment is the transparency and traceability of information used for the different options and choices of the assessor during all the calculation process.

The environmental performance of buildings can be presented by documents and visual aids. The findings of all results shall be traceable and transparent. This requires that information be presented in sufficient detail to allow the reader to assess the quality of the information.

Reporting of the assessment shall include (but not be limited to) the following information and/or assumptions regarding:

— purpose of the assessment (intended use and scope);

— identification of building (address, etc.);

— client for assessment;

— name and qualification of the assessor;

— assessment method including version number and reference;

— point of assessment in the building's life cycle;

— period for which the assessment is valid;

— date of assessment;

— statement regarding verification of the assessment;

— name and qualification of the verifier, if verification is applied.

12.2 General information on the object of assessment

a) Functional equivalent:

— 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;

b) Reference study period;

c) It may also include other building information, for example:

- technical type of building (structural type);
- year of commissioning;
- year(s) of refurbishment;
- for each operational area:
  - design number of building occupants;
  - design occupancy schedule;
  - heating, cooling and ventilation system and hot water service system;
  - lighting system;
  - power and communication systems.

12.3 Statement of boundaries and scenarios used in the assessment

For the building under assessment the relevant assumptions and scenarios according to Clause 8 shall be stated in the documentation.

12.4 Data sources

Data sources, type and quality of data used shall be reported.

12.5 List of indicators used for assessment and expression of results

The results of the environmental assessment of the building shall be reported and presented as structured list, according to the scenarios used for the assessment.

For each module of the life cycle, values shall be reported for all indicators of Clause 11 that have been determined in the assessment.

If any module contains only partial information, this shall be clearly stated and reasons for omitting this information shall be given.

Indicators that have not been determined shall be reported as INA (Indicator Not Assessed) and reasons for omitting this information shall be given.

If a module is excluded, the module shall be stated as MNA (module not assessed) and reasons for omitting this information shall be given.

The results for impacts and aspects resulting from reuse, recycling and energy recovery and other recovery operations beyond the building life cycle (i.e. the system boundary) may be included as information in module D.

Table 6 illustrates such a principle of reporting.

Table 6 — Table of results - environmental impacts

Indicators for environmental impacts	Unit Indicator	Modules A1 to A5		Modules B1 to B7							Modules C1 to C4				Module D
		Product stage (A1-3)	Construction Stage (A4-5)	Use stage							End of life stage				Benefits and loads beyond the system boundary
				Building in use					Energy use B6	Water use B7	Deconstruction / demolition	Transportation	Waste processing	disposal	Re-use Recycling Recovery potential
				Use of products B1	Maintenance B2	Repair B3	Replacement B4	Refurbishment B5							
Global warming potential, GWP	kg CO_2 equiv														
Depletion potential of the stratospheric ozone layer, ODP	kg CFC 11 equiv														
Acidification potential of land and water; AP	kg SO_2 equiv														
Eutrophication potential, EP	kg $(PO_4)^{3-}$ equiv														
Formation potential of tropospheric ozone photochemical oxidants, POCP	kg Ethene equiv														
Abiotic Resource Depletion Potential, ADP elements	kg Sb equiv														
Abiotic Resource Depletion Potential, ADP fossil fuels	MJ														

Table 7 — Table of results – resource use

Indicators for environmental impacts	Unit Indicator	Modules A1 to A5		Modules B1 to B7							Modules C1 to C4				Module D
		Product stage (A1-3)	Construction Stage (A4-5)	Use stage							End of life stage				Benefits and loads beyond the system boundary
				Building in use					Energy use B6	Water use B7	Deconstruction / demolition	Transportation	Waste processing	disposal	Re-use Recycling Recovery potential
				Use of products B1	Maintenance B2	Repair B3	Replacement B4	Refurbishment B5							
Use of renewable primary energy excluding energy resources used as raw material	MJ, net calorific value														
Use of renewable primary energy resources used as raw material	MJ, net calorific value														
Use of non-renewable primary energy excluding primary energy resources used as raw material	MJ, net calorific value														
Use of non-renewable primary energy resources used as raw material	MJ, net calorific value														
Use of secondary material	kg														
Use of renewable secondary fuels	MJ														
Use of non-renewable secondary fuels	MJ														
Use of net fresh water	m3														

Table 8 — Table of results – waste categories

Indicators for environmental impacts	Unit Indicator	Modules A1 to A5		Modules B1 to B7							Modules C1 to C4				Module D
		Product stage (A1-3)	Construction Stage (A4-5)	Use stage							End of life stage				Benefits and loads beyond the system boundary
				Building in use					Energy use B6	Water use B7	Deconstruction / demolition	Transportation	Waste processing	disposal	Re-use Recycling Recovery potential
				Use of products B1	Maintenance B2	Repair B3	Replacement B4	Refurbishment B5							
Non hazardous waste to disposal	kg														
Hazardous waste to disposal	kg														
Radioactive waste	kg														

Table 9 — Table of results – output flows

Indicators for environmental impacts	Unit Indicator	Modules A1 to A5		Modules B1 to B7							Modules C1 to C4				Module D
		Product stage (A1-3)	Construction Stage (A4-5)	Use stage							End of life stage				Benefits and loads beyond the system boundary
				Building in use					Energy use B6	Water use B7	Deconstruction / demolition	Transportation	Waste processing	disposal	Re-use Recycling Recovery potential
				Use of products B1	Maintenance B2	Repair B3	Replacement B4	Refurbishment B5							
Components for reuse	kg														
Material for recycling	kg														
Material for energy recovery	kg														
Exported energy	MJ														

12.6 Communication of assessment results

The communication of results of the environmental assessment shall be based on and be limited to the report in accordance with 12.5.

The communication from the report may be simplified according to the following rules:

— the communication may be limited to a selection of indicators;

— results shall be presented separately for all the building life cycle stages and for module D;

— within each of the building life cycle stages (see Figure 6), the results per indicator may be summed provided that values for the indicator are determined for each module within that stage;

— if values have not been determined for all modules of a life cycle stage, the results shall be presented separately for each module of that stage, and those modules for which no values are determined shall be shown as Module Not Assessed (MNA).

— if relevant information is provided at the product level on Module D, this information should be reported.

NOTE In addition, the results may be presented graphically to assist communication.

13 Verification of results

In order to be verifiable, all information used, options, or decisions taken shall be presented in a transparent manner.

If there is need for verification of the assessment, a verification procedure shall be applied.

The verification shall include (but is not limited to) the following:

— consistency between the purpose of assessment and boundaries and scenarios used;

— traceability of data used for the products;

— conformity of data with requirements of EN 15804;

— consistency between the scenarios that apply at building level with those use for the product;

— completeness and justification of completeness for the quantification at the building level.

The competence of the verifier shall be stated in the verification procedure.

Annex A
(informative)

Building description

Figure A.1 illustrates part of a building model presenting different levels of aggregation, from the product level to the building element level.

NOTE The figure does not cover all product and elements embedded in the building.

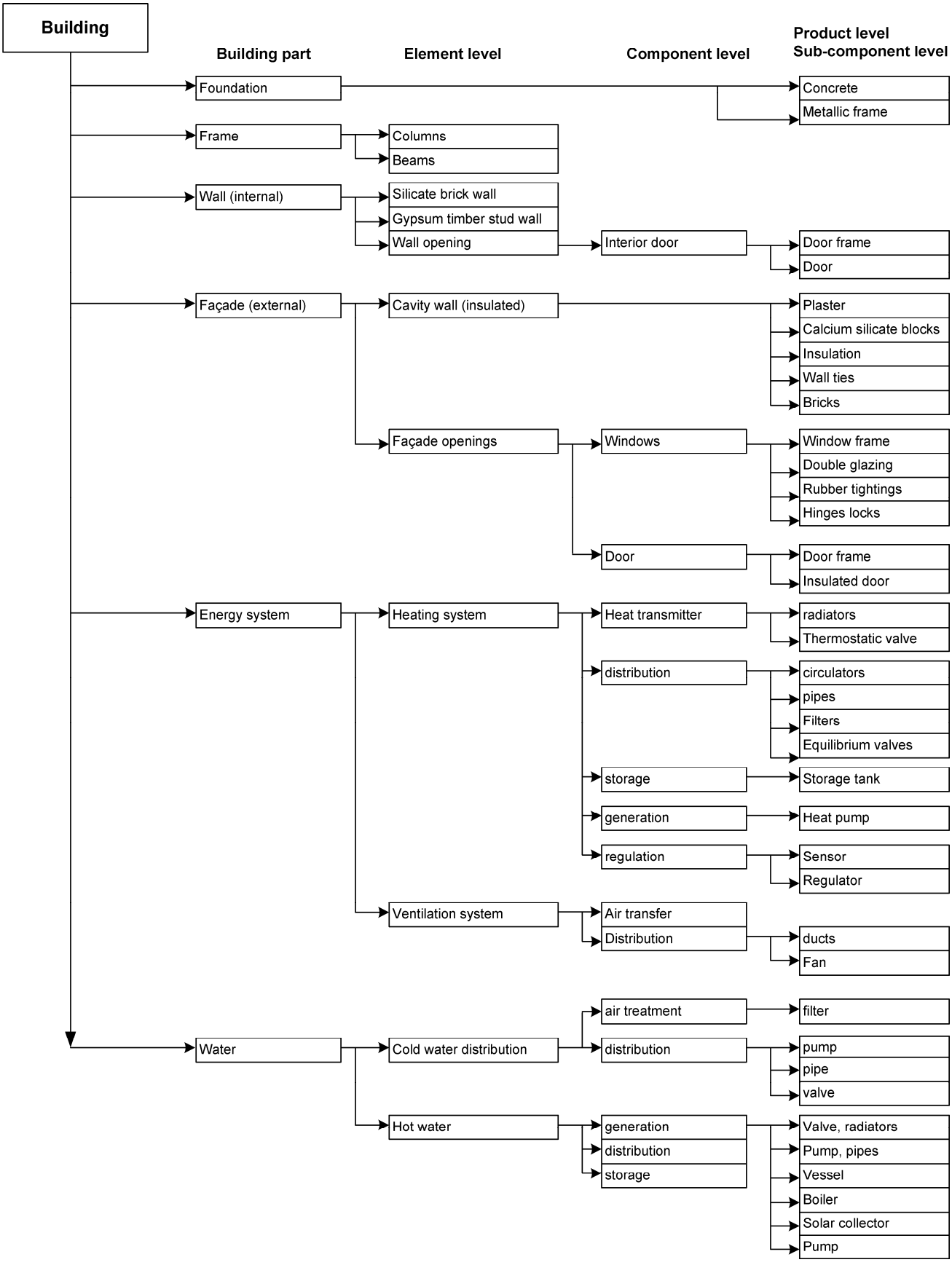

Figure A.1 — Example of a structuring of building information using the different level of aggregation

Annex B
(informative)

Exported energy - Case studies

B.1 General

Annex B provides some practical case studies of imported and exported energy, which are always based on the annual energy input and output flows.

The description of the type and application/installation of the energy producing unit(s) shall be well defined in all cases.

The following cases define the interpretation principles expressed in 7.4.4.7:

B.2 Case 1

(see Figure B.1)

The energy production unit is delivering all of its produced energy to the building and is complementing the imported energy:

All environmental impacts and aspects from: production, transport, installation (A1-A5), use, maintenance, repair, replacement (B1-B5) and from end-of-life (C1-C4) of the energy production unit are fully allocated to the building.

All environmental impacts and aspects related to the operational energy use (site produced and imported) of the module B6 are fully allocated to the building.

NOTE This is the case, for example, for a fuel-based heating system which is intended to satisfy the energy demand of the building or for an electricity generator providing electricity to the building which is not connected to the electricity grid.

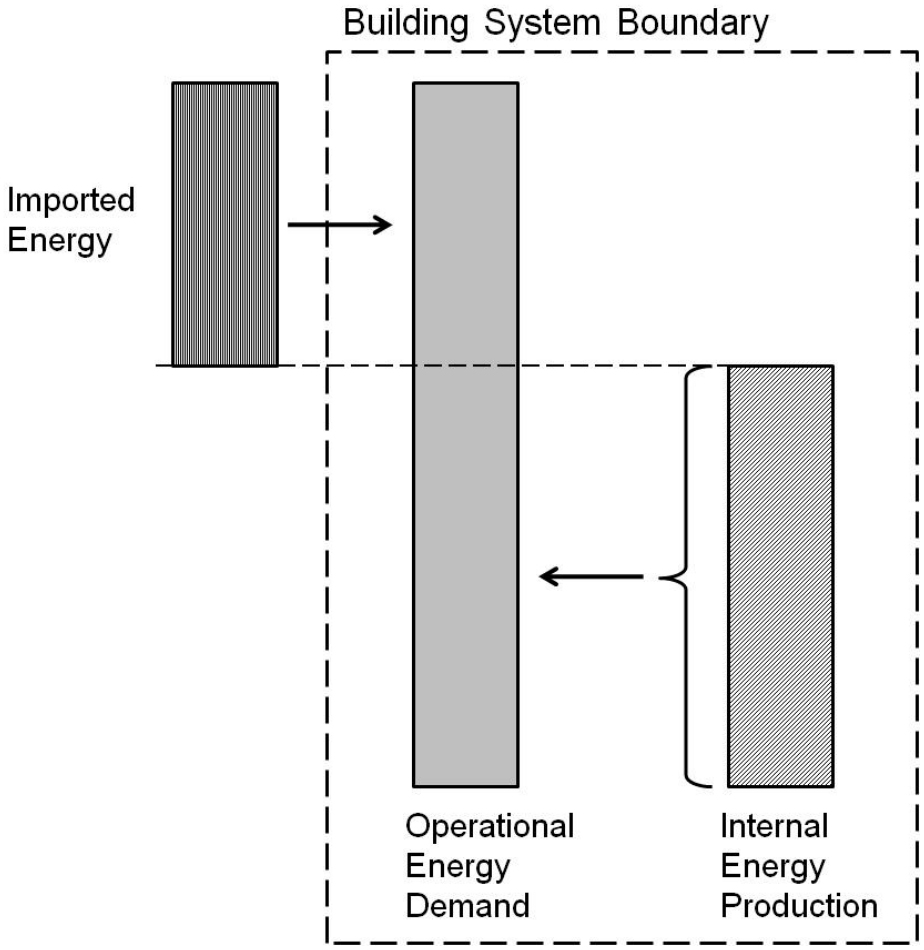

Figure B.1 — Scenario for energy use, supply and import (Case 1)

B.3 Case 2

(see Figure B.2)

The energy production unit is exporting the energy that is surplus to the building's needs. No energy is imported.

The scenario shall specify the amount (annual average) of energy that is exported.

All environmental impacts and aspects from: production, transport, installation (A1-A5), use, maintenance, repair, replacement (B1-B5) and from end-of-life (C1-C4) of the energy production unit are fully allocated to the building.

All environmental impacts and aspects of the imported and of the generated energy are fully allocated to the building and reported in module B6.

The benefits of the exported energy, substituting energy beyond the building system, are reported in module D.

NOTE This is, for example, the case for a central heating system aiming at satisfying the thermal energy demand of the building and which can also provide thermal energy to surrounding facilities which are not included in the system boundary.

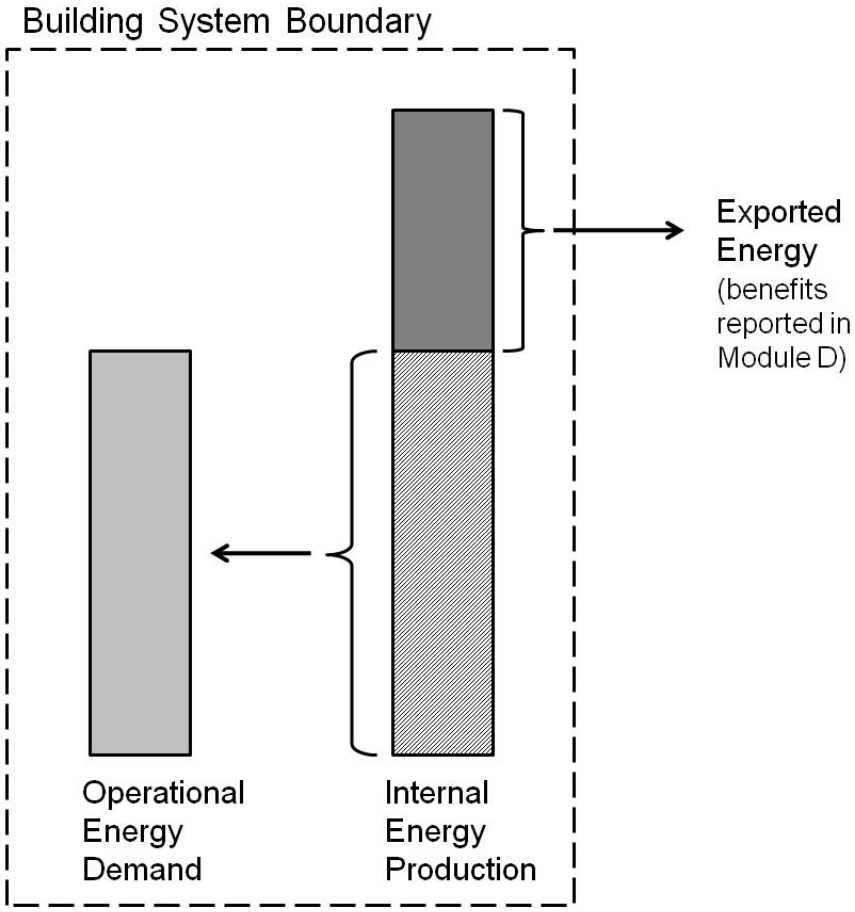

Figure B.2 — Scenario for energy use and export (Case 2)

B.4 Case 3

(see Figure B.3)

In addition to imported energy, there is energy production on the building site that is used in part for the building and the remainder exported.

The scenario shall specify for each energy carrier, the imported energy, the total amount of energy produced on site, the proportions used in the building and exported.

All environmental impacts and aspects from: production, transport, installation (A1-A5), from use, maintenance, repair, replacement (B1-B5) and from end-of-life (C1-C4) of the energy production unit are fully allocated to the building.

All environmental impacts and aspects of the imported energy and of the site generated energy are fully allocated to the building and reported in module B6.

All environmental impacts and aspects of the imported energy are fully allocated to the building and reported in module B6.

The benefits of the exported energy, substituting energy beyond the building system, are reported in module D.

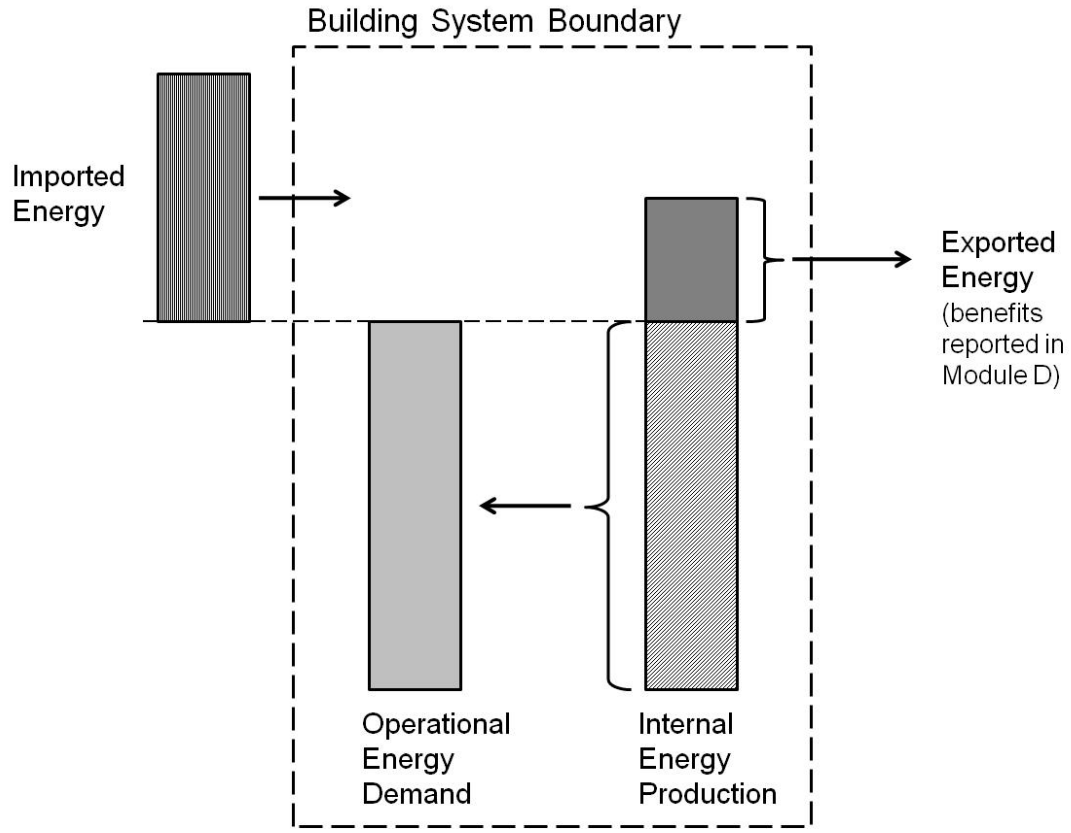

Figure B.3 — scenario for energy use, supply and export (Case 3)

NOTE This applies to intermittent electricity sources such as photovoltaic cells or wind turbines. Owing to their intermittent nature, only a fraction of the electricity production is used within the building, even if the electricity generated annually is lower than the overall electricity demand of the building.

B.5 Case 4

(see Figure B.4)

The energy production unit is not delivering energy for use in the building or within the building curtilage; all site-produced energy is exported and the full energy demand of the building is covered by imported energy.

For the energy-producing unit that may or may not be part of the building envelope and also fulfilling other technical and functional characteristics of the building, all related impacts and aspects from production, transport, installation (A1-A5), from use, maintenance, repair, replacement (B1-B5) and from end-of-life (C1-C4) are part of the building assessment.

All environmental impacts and aspects of the imported and of the site-generated energy are fully allocated to the building and reported in module B6.

The benefits of the exported energy, substituting energy beyond the building system, are reported in module D.

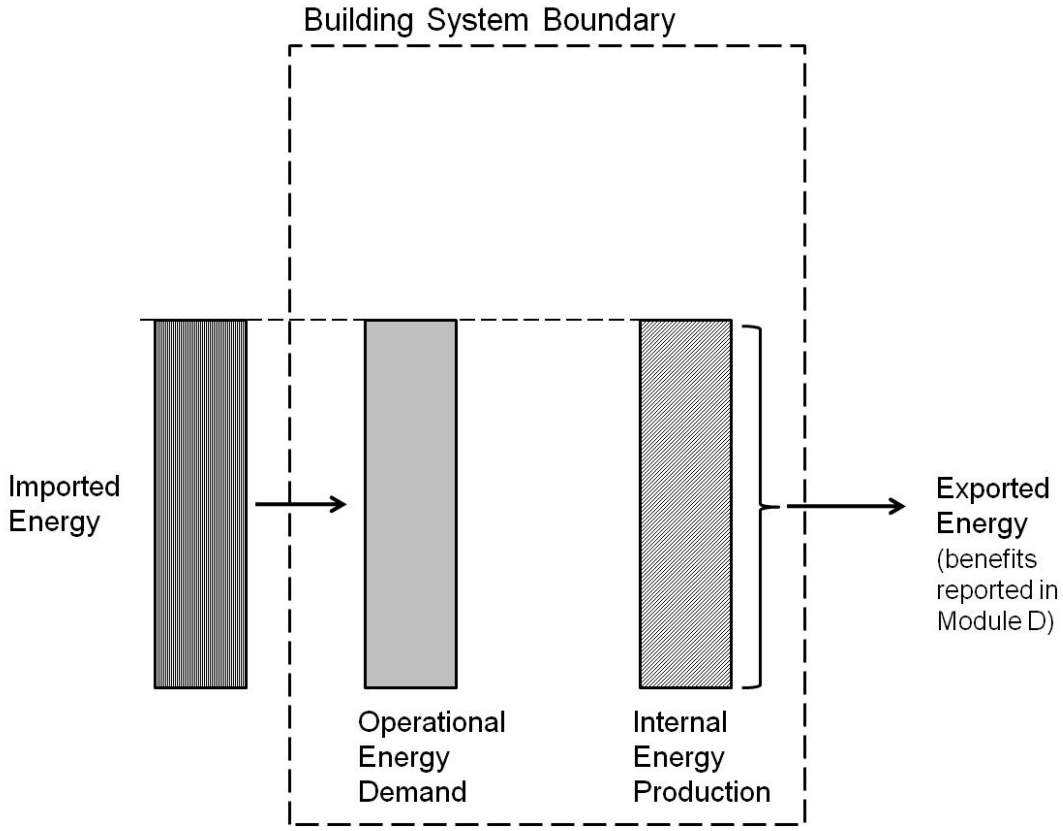

Figure B.4 — Scenario as all site-produced energy is exported

Bibliography

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

[2] EN 15942, *Sustainability of construction works — Environmental product declarations — Communication format business to business*

[3] CEN/TR 15941, *Sustainability of construction works — Environmental product declarations — Methodology for selection and use of generic data*

[4] ISO 16814, *Building environment design — Indoor air quality — Methods for expressing the quality of indoor air for human occupancy*

[5] EPD, *The International EPD Cooperation (IEC) — Supporting Annexes for Environmental Products —* Version 1.0 dated 2008-02-29

[6] ELCD – *European Reference Life Cycle Database*

[7] ILCD handbook – *International Reference Life Cycle Data System*

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™