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Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products

National foreword

This British Standard is the UK implementation of EN 15804:2012+A1:2013. It supersedes BS EN 15804:2012 which is withdrawn.

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

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

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Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

Contribution des ouvrages de construction au développement durable - Déclarations environnementales sur les produits - Règles régissant les catégories de produits de construction

Nachhaltigkeit von Bauwerken - Umweltproduktdeklarationen - Grundregeln für die Produktkategorie Bauprodukte

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Foreword

This document (EN 15804:2012+A1:2013) 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of an identical text or by endorsement, at the latest by May 2014, and conflicting national standards shall be withdrawn at the latest by May 2014.

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.

This document supersedes EN 15804:2012.

This document includes Amendment 1 approved by CEN on 2013-09-10.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

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

Introduction

This European standard provides core product category rules for all construction products and services. It provides a structure to ensure that all Environmental Product Declarations (EPD) of construction products, construction services and construction processes are derived, verified and presented in a harmonised way.

An EPD communicates verifiable, accurate, non-misleading environmental information for products and their applications, thereby supporting scientifically based, fair choices and stimulating the potential for market-driven continuous environmental improvement.

The standardisation process has taken place in accordance with EN ISO 14025. All common issues are covered horizontally for all product types in order to minimise vertical (branch specific) deviations.

EPD information is expressed in information modules, which allow easy organisation and expression of data packages throughout the life cycle of the product. The approach requires that the underlying data should be consistent, reproducible and comparable.

The EPD is expressed in a form that allows aggregation (addition) to provide complete information for buildings. This standard does not deal with aggregation at the building level nor does this standard describe the rules for applying EPD in a building assessment.

The standard deals with a limited number of quantifiable predetermined parameters. Future revisions may incorporate additional predetermined parameters.

This European Standard provides the means for developing a Type III environmental declaration of construction products and is part of a suite of standards that are intended to assess the sustainability of construction works.

This suite of standards includes:

— 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 15978, *Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method*;

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

— EN 15942, *Sustainability of construction works — Environmental product declarations — Communication formats: business to business*.

1 Scope

This European standard provides core product category rules (PCR) for Type III environmental declarations for any construction product and construction service.

NOTE The assessment of social and economic performances at product level is not covered by this standard.

The core PCR:

— defines the parameters to be declared and the way in which they are collated and reported,

— describes which stages of a product's life cycle are considered in the EPD and which processes are to be included in the life cycle stages,

— defines rules for the development of scenarios,

— includes the rules for calculating the Life Cycle Inventory and the Life Cycle Impact Assessment underlying the EPD, including the specification of the data quality to be applied,

— includes the rules for reporting predetermined, environmental and health information, that is not covered by LCA for a product, construction process and construction service where necessary,

— defines the conditions under which construction products can be compared based on the information provided by EPD.

For the EPD of construction services the same rules and requirements apply as for the EPD of construction products.

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.

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

EN 15942, *Sustainability of construction works — Environmental product declarations — Communication formats: business to business*

EN 15978, *Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method*

EN ISO 14025:2010, *Environmental labels and declarations — Type III environmental declarations — Principles and procedures (ISO 14025:2006)*

EN ISO 14044:2006, *Environmental management — Life cycle assessment — Requirements and guidelines (ISO 14044:2006)*

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

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

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

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

ISO 21930:2007, *Sustainability in building construction — Environmental declaration of building products*

3 Terms and definitions

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

3.1
additional technical information
information that forms part of the EPD by providing a basis for the development of scenarios

3.2
ancillary material
input material or product that is used by the unit process producing the product, but which does not constitute part of the product

[EN ISO 14040:2006]

3.3
average data
data representative of a product, product group or construction service, provided by more than one supplier

NOTE The product group or construction service can contain similar products or construction services.

3.4
comparative assertion
environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function

[EN ISO 14044:2006]

3.5
construction product
item manufactured or processed for incorporation in construction works

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

NOTE 2 Adapted from the definition in ISO 6707-1:2004 according to the recommendation of ISO/TC 59/AHG Terminology.

[EN 15643-1:2010]

3.6
construction service
activity that supports the construction process or subsequent maintenance

3.7
co-product
any of two or more marketable materials, products or fuels from the same unit process, but which is not the object of the assessment

NOTE Co-product, by-product and product have the same status and are used for identification of several distinguished flows of products from the same unit process. From co-product, by-product and product, waste is the only output to be distinguished as a non-product.

3.8
declared unit
quantity of a construction product for use as a reference unit in an EPD for an environmental declaration based on one or more information modules

EXAMPLE Mass (kg), volume (m^3).

NOTE Adapted from the definition in [A1] ISO 21930:2007 [A1].

3.9
construction element
part of a construction containing a defined combination of products

3.10
environmental performance
performance related to environmental impacts and environmental aspects

[ISO 15392:2008]

[ISO 21931-1:2010]

3.11
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.

3.12
functional unit
quantified performance of a product system for use as a reference unit

[EN ISO 14040:2006]

3.13
information module
compilation of data to be used as a basis for a Type III environmental declaration covering a unit process or a combination of unit processes that are part of the life cycle of a product

[EN ISO 14025:2010]

3.14
life cycle assessment
LCA
compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle

[EN ISO 14044:2006]

3.15
life cycle inventory analysis
LCI
phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle

[EN ISO 14040:2006]

3.16
non-renewable energy
energy from sources which are not defined as *renewable energy* sources

3.17
non-renewable resource
resource that exists in a finite amount that cannot be replenished on a human time scale

[ISO 21930:2007]

3.18
performance
expression relating to the magnitude of a particular aspect of the object of consideration relative to specified requirements, objectives or targets

NOTE Adapted from the definition in ISO 6707-1:2004 according to the draft recommendation of ISO/TC 59 Terminology.

3.19
product category
group of construction products that can fulfil equivalent functions

NOTE Adapted from EN ISO 14025:2010.

3.20
product category rules
PCR
set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories

[EN ISO 14025:2010]

3.21
product system
collection of unit processes with elementary and product flows, performing one or more defined functions, and which models the life cycle of a product

[EN ISO 14040:2006]

3.22
programme operator
body or bodies that conduct a Type III environmental declaration programme

NOTE A program operator can be a company or a group of companies, industrial sector or trade association, public authorities or agencies, or an independent scientific body or other organization.

3.23
renewable energy
energy from renewable non-fossil sources

EXAMPLES Wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

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

3.24
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, fertile soil.

[ISO 21930:2007]

3.25
reference service life
RSL
service life of a construction product which is known to be expected under a particular set, i.e., a reference set, of in-use conditions and which may form the basis of estimating the service life under other in-use conditions

[ISO 21930:2007]

3.26
reference service life data
RSL data
information that includes the reference service life and any qualitative or quantitative data describing the validity of the reference service life

EXAMPLE Typical data describing the validity of the RSL include the description of the component (3.10) for which it applies, the reference in-use conditions under which it applies, and its quality.

[ISO 15686-8:2008]

3.27
scenario
collection of assumptions and information concerning an expected sequence of possible future events

3.28
secondary fuel
fuel recovered from previous use or from waste which substitutes primary fuels

NOTE 1 Processes providing a secondary fuel are considered from the point where the secondary fuel enters the system from the previous system.

NOTE 2 Any combustible material recovered from previous use or from waste from the previous product system and used as a fuel in a following system is a secondary fuel.

NOTE 3 Examples for primary fuels are: coal, natural gas, biomass, etc.

NOTE 4 Examples for secondary fuels recovered from previous use or as waste are: solvents, wood, tyres, oil, animal fats.

3.29
secondary material
material recovered from 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 for secondary materials (to be measured at the system boundary) are recycled scrap metal, crushed concrete, glass cullet, recycled wood chips, recycled plastic.

3.30
specific data
data representative of a product, product group or construction service, provided by one supplier

3.31
third party
person or body that is recognized as being independent of the parties involved, as concerns the issues in question

NOTE "Parties involved" are usually supplier ("first party") and purchaser ("second party") interests.

[EN ISO 14024:2000]

3.32
type III environmental declaration
environmental declaration providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information

NOTE The calculation of predetermined parameters is based on the ISO 14040 series of standards, which is made up of ISO 14040, and ISO 14044. The selection of the predetermined parameters is based on ISO 21930 (adapted from ISO 14025).

3.33
upstream, downstream process
process(s) that either precedes (upstream) or follows (downstream) a given life cycle stage

3.34
waste
substance or object which the holder discards or intends or is required to discard

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

3.35
unit process
the smallest element considered in the life cycle inventory analysis for which input and output data are quantified

[EN ISO 14040:2006]

4 Abbreviations

EPD Environmental product declaration

PCR Product category rules

LCA Life cycle assessment

LCI Life cycle inventory analysis

LCIA Life cycle impact assessment

RSL Reference service life

ESL Estimated service life

EPBD Energy performance of buildings directive

〈A1〉

GWP Global warming potential

ODP Depletion potential of the stratospheric ozone layer

AP Acidification potential of soil and water

EP Eutrophication potential

POCP Formation potential of tropospheric ozone

ADP Abiotic depletion potential 〈A1〉

5 General aspects

5.1 Objective of the Core PCR

An EPD according to this standard provides quantified environmental information for a construction product or service on a harmonized and scientific basis. It also provides information on health related emissions to indoor air, soil and water during the use stage of the building. The purpose of an EPD in the construction sector is to provide the basis for assessing buildings and other construction works, and identifying those, which cause less stress to the environment.

Thus, the objective of the core PCR is to ensure:

— the provision of verifiable and consistent data for an EPD, based on LCA;

— the provision of verifiable and consistent product related technical data or scenarios for the assessment of the environmental performance of buildings;

— the provision of verifiable and consistent product related technical data or scenarios potentially related to the health of users for the assessment of the performance of buildings;

— that comparisons between construction products are carried out in the context of their application in the building;

— the communication of the environmental information of construction products from business to business;

— the basis, subject to additional requirements, for the communication of the environmental information of construction products to consumers.

Declarations based on this standard are not comparative assertions.

NOTE 〈A1〉 See definition 3.4 and ISO 14044:2006, 5.3 〈A1〉 for more information concerning LCA used for comparative assertion.

5.2 Types of EPD with respect to life cycle stages covered

The LCA based information in an EPD may cover (see Figure 1):

— The product stage only. Such an EPD covers raw material supply, transport, manufacturing and associated processes; this EPD is said to be “cradle to gate” and becomes an EPD based on information modules A1 to A3;

— 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 optional modules, e.g. end-of-life information modules C1 to C4. Information module D may be included in this EPD;

— The life cycle of a product according to the system boundary (see 6.3.4). In this case the EPD covers the product stage, installation into the building, use and maintenance, replacements, demolition, waste processing for re-use, recovery, recycling and disposal, and disposal and is said to be 'cradle to grave' and becomes an EPD of construction products based on a LCA, i.e. covering all information modules A1 to C4. In this EPD the information module D may be included.

NOTE 1 Information modules can supply information for processes for which there is no EPD available, e.g. a cleaning process.

NOTE 2 An information module may contain: the values of the pre-determined parameters and the technical information underlying their quantification, relevant technical information for further calculation of the environmental performance, scenarios for further calculation of the environmental performance.

NOTE 3 It is possible to have an EPD for a substance or preparation (e.g. cement), for a product (e.g. window), for a construction service (e.g. cleaning service as part of maintenance) and for an assemblage of products and/or a construction element (e.g. wall) for technical equipment (e.g. lift).

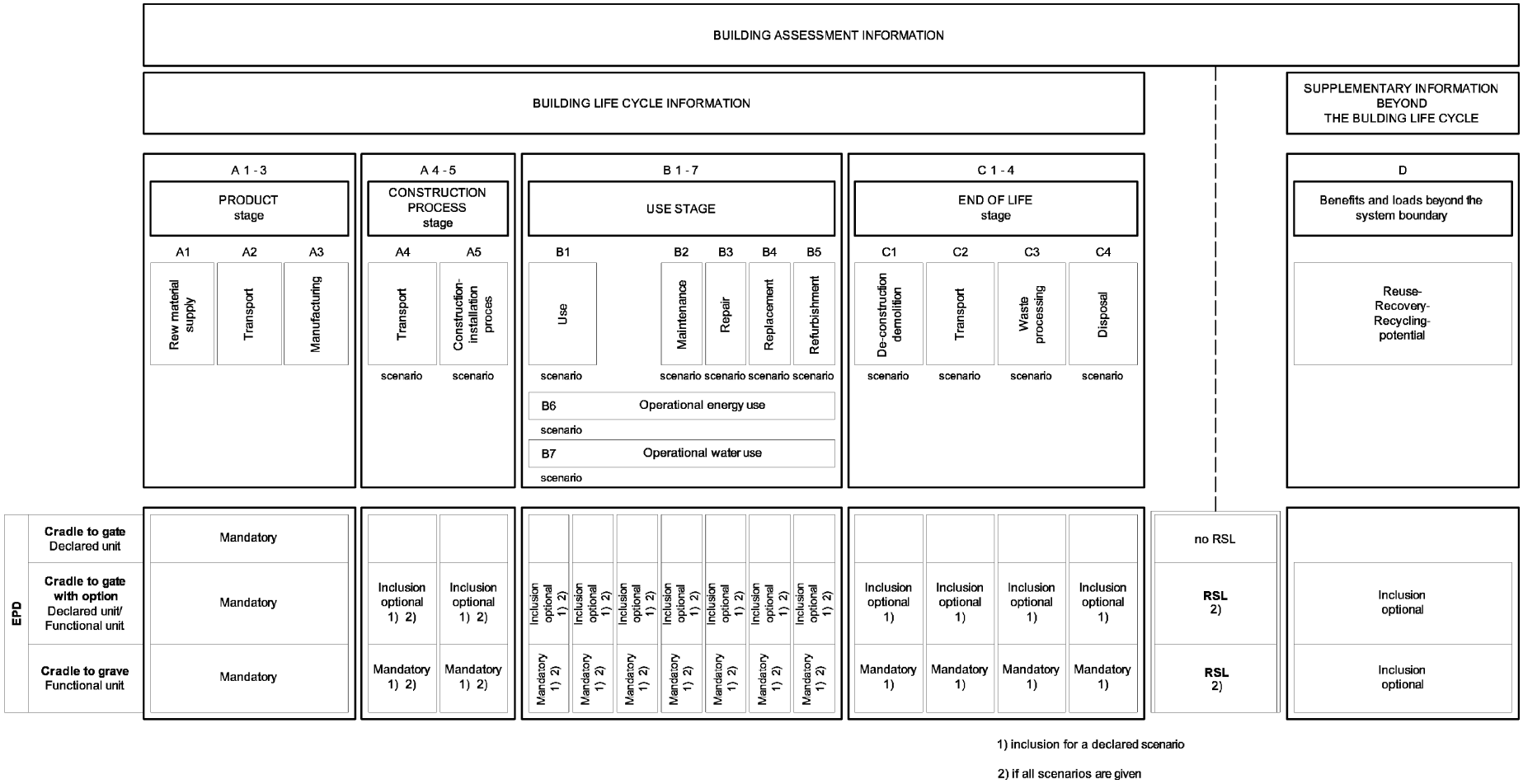


Figure 1 —Types of EPD with respect to life cycle stages covered and life cycle stages and modules for the building assessment

5.3 Comparability of EPD for construction products

In principle the comparison of products on the basis of their EPD is defined by the contribution they make to the environmental performance of the building. Consequently, comparison of the environmental performance of construction products using the EPD information shall be based on the product's use in and its impacts on the building, and shall consider the complete life cycle (all information modules).

NOTE 1 EPD that are not in a building context are not tools to compare construction products and construction services.

NOTE 2 For the sustainability assessment of buildings comparisons of the environmental aspects and impacts need to be undertaken in conjunction with the social and economic aspects and impacts related to the building.

NOTE 3 For the interpretation of a comparison, benchmarks or reference values are needed. This standard does not set benchmarks or reference values.

Comparisons are possible at the sub-building level, e.g. for assembled systems, components, products for one or more life cycle stages. In such cases the principle that the basis for comparison of the assessment is the entire building, shall be maintained by ensuring that:

— the same functional requirements as defined by legislation or in the client's brief are met, and

— the environmental performance and technical performance of any assembled systems, components, or products excluded are the same, and

— the amounts of any material excluded are the same, and

— excluded processes or life cycle stages are the same, and

— the influence of the product systems on the operational aspects and impacts of the building are taken into account.

The information provided for such comparison shall be transparent to allow the purchaser or user to understand the limitations of comparability. A justification shall be given for any excluded aspects.

NOTE 4 The difference between two products may be insignificant in the building context.

Where an EPD does not cover all life cycle stages relevant for the comparison or if the assumptions underlying the scenario of a declared information module are not applicable in the building context, then investigations will be required to determine the environmental aspects and impacts of specific scenarios for the calculation of modules beyond the cradle to gate modules. These calculations shall be based on scenarios and conditions that are appropriate for the building as the object of assessment.

5.4 Additional information

In this core PCR the following two categories of information which are not derived from LCA are addressed:

— Additional technical information, describing technical conditions underlying scenarios and characterising the product's technical and functional performance during the optional life cycle stages "construction, use and the end of life" for any scenario based calculations of the LCA based parameters. See 7.3;

— Additional information on emissions to indoor air, soil and water during the use stage, describing release of dangerous substances into indoor air, soil and water which are not covered by LCIA. This additional information is required. See 7.4.

NOTE Information concerning health related emissions to indoor air, soil and water supports the social performance of buildings which is addressed in prEN 15643-3, *Sustainability of Construction Works —- Assessment of Buildings — Part 3: Framework for the assessment of social performance*.

5.5 Ownership, responsibility and liability for the EPD

A manufacturer or a group of manufacturers are the sole owners and have liability and responsibility for an EPD.

5.6 Communication formats

The communication format of the EPD shall be in accordance with EN 15942, *Sustainability of construction works — Environmental product declarations — Communication formats: business to business*.

6 Product Category Rules for LCA

6.1 Product category

The product category referred to in this standard includes all construction products and construction services for buildings and other construction works.

6.2 Life cycle stages and their information modules to be included

6.2.1 General

The environmental information of an EPD covering all life cycle stages (“cradle to grave”) shall be subdivided into the information module groups A1-A3, A4-A5, B1-B5, B6-B7, C1-C4 and module D. Only the declaration of the product stage modules, A1-A3, is required for compliance with this standard. The declaration of the modules of the other life cycle stages is optional.

Information modules within any of the life cycle stages are communicated depending on the types of EPD as specified in 5.2. They include impacts and aspects related to losses in the module in which the losses occur (i.e. production, transport, and waste processing and disposal of the lost waste products and materials).

6.2.2 A1-A3, Product stage, information modules

The product stage includes:

— A1, raw material extraction and processing, processing of secondary material input (e.g. recycling processes),

— A2, transport to the manufacturer,

— A3, manufacturing,

including provision of all materials, products and energy, as well as waste processing up to the end-of waste state (Clause 6.3.4.5 and Annex B) or disposal of final residues during the product stage.

Module A1, A2 and A3 may be declared as one aggregated module A1-3.

6.2.3 A4-A5, Construction process stage, information modules

The construction process stage includes:

— A4, transport to the building site;

— A5, installation into the building;

including provision of all materials, products and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the construction process stage. These information modules also

include all impacts and aspects related to any losses during this construction process stage (i.e. production, transport, and waste processing and disposal of the lost products and materials).

6.2.4 B1-B5, Use stage, information modules related to the building fabric

The use stage, related to the building fabric includes:

— B1, use or application of the installed product;

— B2, maintenance;

— B3, repair;

— B4, replacement;

— B5, refurbishment;

including provision and transport of all materials, products and related energy and water use, as well as waste processing up to the end-of-waste state or disposal of final residues during this part of the use stage. These information modules also include all impacts and aspects related to the losses during this part of the use stage (i.e. production, transport, and waste processing and disposal of the lost products and materials).

6.2.5 B6-B7, use stage, information modules related to the operation of the building

The use stage related to the operation of the building includes:

— B6, operational energy use (e.g. operation of heating system and other building related installed services);

— B7, operational water use;

These information modules include provision and transport of all materials, products, as well as energy and water provisions, waste processing up to the end-of-waste state or disposal of final residues during this part of the use stage.

6.2.6 C1-C4 End-of-life stage, information modules

The end-of-life stage includes:

— C1, de-construction, demolition:

— C2, transport to waste processing;

— C3, waste processing for reuse, recovery and/or recycling;

— C4, disposal;

including provision and all transport, provision of all materials, products and related energy and water use.

6.2.7 D, Benefits and loads beyond the system boundary, information module

Module D includes:

— D, reuse, recovery and/or recycling potentials, expressed as net impacts and benefits.

6.3 Calculation rules for the LCA

6.3.1 Functional unit

The functional unit defines the way in which the identified functions or performance characteristics of the product are quantified. The primary purpose of the functional unit is to provide a reference by which material flows (input and output data) of construction product's LCA results and any other information are normalized to produce data expressed on a common basis.

NOTE 1 Comparisons of construction products with the same functional unit follow the rules in 5.3.

The functional unit, used as the denominator provides the basis for the addition of material flows and environmental impacts for any of the life cycle stages and their modules for the construction product or construction service.

The functional unit of a construction product is based on:

— the quantified, relevant functional use or performance characteristics of the construction product when integrated into a building, taking into account the functional equivalent of the building;

— the product's Reference Service Life (RSL) (see 6.3.3) or required service life of the building (see EN 15978) under defined in-use conditions.

NOTE 2 Guidance on the development of a functional unit is given in EN ISO 14040:2006, 5.2.2.

NOTE 3 Guidance on describing in-use conditions is given in Product Standards and ISO 15686-1,-2, -7, -8.

NOTE 4 In this standard "addition" also means the calculation of environmental impacts of a building (EN 15978) by summation of the quantified impacts per indicator and per module of the construction products constituting the building (e.g. adding kg CO_2 equivalents for bricks + mortar + wall insulation+ concrete block + gypsum plaster +…, etc.). Limitations of the addition of indicator results across life cycle stages and their modules are described in 7.5.

6.3.2 Declared unit

The declared unit is used instead of the functional unit when the precise function of the product or scenarios at the building level is not stated or is unknown. The declared unit shall be applied when an EPD covers one or more life cycle stages as information modules, i.e. in the case of a "cradle to gate" EPD and "cradle to gate with options" EPD and when the EPD is not based on a full "cradle to grave" LCA. The declared unit provides a reference by means of which the material flows of the information module of a construction product are normalised (in a mathematical sense) to produce data, expressed on a common basis. It provides the reference for combining material flows attributed to the construction product and for combining environmental impacts for the selected stages of the construction product's incomplete life cycle (see Figure 1 and clause 7.5). The declared unit shall relate to the typical applications of products.

The declared unit in the EPD shall be one of the unit types listed below. A different unit may be declared for reasons that shall be explained and in such cases information shall be provided on how to convert this unit to one or more of the required unit types.

— An item, an assemblage of items, e.g. 1 brick, 1 window (〚A1〛 dimensions shall be specified 〚/A1〛);

— Mass (kg), e.g. 1 kg of cement;

— Length (m), e.g. 1 metre of pipe, 1 metre of a beam (dimensions shall be specified);

— Area (m^2), e.g. 1 square metre of wall elements, 1 square metre of roof elements (dimensions shall be specified);

— Volume (m^3), e.g. 1 cubic metre of timber, 1 cubic metre of ready-mixed concrete.

EXAMPLE If an EPD for an insulation material is declared in units of thermal resistance R_D (m^2K/W) in the building, then a conversion factor, e.g. to 1 kilogramme of material is required.

For the development of, for example, transport and disposal scenarios conversion factors to mass per declared unit shall be provided.

NOTE 1 Reasons for declaring units other than those listed include the need to use units normally used for design, planning, procurement and sale.

NOTE 2 CEN Technical Committees for product standards are expected to harmonise the declared unit to be used for their product families.

6.3.3 Reference service life (RSL)

RSL information to be declared in an EPD covering the use stage shall be provided by the manufacturer. The RSL shall refer to the declared technical and functional performance of the product within a building. It shall be established in accordance with any specific rules given in European product standards and shall take into account ISO 15686-1, -2, -7 and -8. Where European product standards provide guidance on deriving the RSL, such guidance shall have priority.

Information on the product's RSL requires specification of compatible scenarios for the product stage, construction process stage and use stage. RSL is dependent on the properties of the product and reference in-use conditions. These conditions shall be declared together with a RSL and it shall be stated that the RSL applies for the reference conditions only.

The RSL shall be verifiable.

Requirements and guidance on the estimation of service life are given in normative Annex A.

6.3.4 System boundaries

6.3.4.1 General

LCA is conducted by defining product systems as models describing the key elements of physical systems. The system boundary defines the unit processes to be included in the system model.

This clause specifies the boundary of the product system under study and in particular the boundary with any previous or subsequent product systems in the life of a building. It also specifies the processes that are to be included in each of the life cycle stages listed in 6.2 (according to Figure 1).

The modular set up of the LCA underlying an EPD (see Figure 1) allows easy organisation and expression of data packages throughout the life cycle of the product. This approach requires that the system boundaries for the life cycle stages and the information modules included are transparent, well defined and applicable to any construction product.

The setting of the system boundaries follows the two principles:

— The "modularity principle": Where processes influence the product's environmental performance during its life cycle, they shall be assigned to the module of the life cycle where they occur; all environmental aspects and impacts are declared in the life cycle stage where they appear;

— The "polluter pays principle": Processes of waste processing shall be assigned to the product system that generates the waste until the end-of-waste state is reached.

For instance:

— the "cradle to gate with options" information of a cleaning agent used for maintenance of the product is declared in the product's life cycle sub-module B2 "maintenance";

— The aspects and impacts of the construction process stage include the aspects and impacts due to any wastage of construction products during that stage, for example,. by cutting the product to size. The aspects and impacts of transport processes include the aspects and impacts due to any wastage of construction products during that stage, for example, due to breakage.

NOTE For reasons of transparency and traceability individual information modules describing services during the use stage, e.g. B2 maintenance, may be subdivided into information modules describing B2 in more detail, e.g. B.2.1: Product stage: environmental impacts due to provision of materials and energy for maintenance processes, B.2.2: Use stage: environmental aspects and impacts due to the maintenance processes, B.2.3: End-of-life stage: waste processing and waste transport for materials applied during maintenance.

6.3.4.2 Product stage

The product stage is an information module required to be included in the EPD. As illustrated in Figure 1 it includes the information modules A1 to A3. The system boundary with nature is set to include those processes that provide the material and energy inputs into the system and the following manufacturing, and transport processes up to the factory gate as well as the processing of any waste arising from those processes.

In the case of input of secondary materials or energy recovered from secondary fuels, the system boundary between the system under study and the previous system (providing the secondary materials) is set where outputs of the previous system, e.g. materials, products, building elements or energy, reach the end-of-waste state (see 6.3.4.5 and Annex B).

Flows leaving the system at the end-of-waste boundary of the product stage (A1-A3) shall be allocated as co-products (see 6.4.3.2). Loads and benefits from allocated co-products shall not be declared in Module D (see 6.3.4.6). If such a co-product allocation is not possible, other methods may be chosen and shall be justified. Therefore, as a general rule, potential loads or benefits from A1-A3 do not appear in module D.

The product stage includes:

— A1 Extraction and processing of raw materials (e.g. mining processes) and biomass production and processing (e.g. agricultural or forestry operations);

— A1 Reuse of products or materials from a previous product system;

— A1 Processing of secondary materials used as input for manufacturing the product, but not including those processes that are part of the waste processing in the previous product system;

— A1 Generation of electricity, steam and heat from primary energy resources, also including their extraction, refining and transport;

— A1 Energy recovery and other recovery processes from secondary fuels, but not including those processes that are part of waste processing in the previous product system;

— A2 Transportation up to the factory gate and internal transport;

— A3 Production of ancillary materials or pre-products;

— A3 Manufacturing of products and co-products;

— A3 Manufacturing of Packaging;

— A1-A3 processing up to the end-of-waste state or disposal of final residues including any packaging not leaving the factory gate with the product.

Regardless of the geographical coverage of a product system the rules for defining the end-of-waste state of this European standard apply.

NOTE The output of waste during this life cycle stage may reach the end-of-waste state when it complies with the conditions described in 6.3.4.5, end-of-life stage. They are then allocated as co-products as 6.4.3.2.

6.3.4.3 Construction stage

The construction process stage includes the optional information modules for:

— A4 Transportation from the production gate to the construction site;

— A4-A5 Storage of products, including the provision of heating, cooling, humidity control, etc.;

— A4-A5 wastage of construction products (additional production processes to compensate for the loss of wastage of products);

— A4-A5 waste processing of the waste from product packaging and product wastage during the construction processes up to the end-of-waste state or disposal of final residues;

— A5 Installation of the product into the building including manufacture and transportation of ancillary materials and any energy or water required for installation or operation of the construction site. It also includes on-site operations to the product.

6.3.4.4 Use stage

6.3.4.4.1 General

The use stage includes the optional information modules covering the period from the handover of the building or construction works to when it is deconstructed or demolished. The duration of the use stage of products may be different from the required service life of a building.

The use stage includes the use of construction products, equipment and services in their proper function. It also includes their use for protecting, conserving, moderating or controlling a building, e.g. modules describing the building operation through building related services such as heating, cooling, lighting, water supply and internal transport (provided e.g. by lifts and escalators). It also includes maintenance (including cleaning), repair, replacement and refurbishment.

It is recognised that it may be difficult to separate all use stage processes and the connected aspects and impacts into these separate modules. However, any deviation from the categorisation of aspects and impacts into Modules B1-B5 and B6-B7 shall be transparently reported and justified.

6.3.4.4.2 B1-B5 Use stage information modules related to the building fabric:

— **B1 Use of the installed product** in terms of any emissions to the environment (not covered by B2-B7)

The module “use of the installed product” covers environmental aspects and impacts arising from components of the building and construction works during their normal (i.e. anticipated) use, which are assigned to module B1.

EXAMPLE 1 Release of substances from the facade, roof, floor covering and other surfaces (interior or exterior) to indoor air, soil or water.

NOTE 1 The EPD does not need to give this information if the horizontal standards on measurement of release of regulated dangerous substances from construction products using harmonised test methods according to the provisions of the respective technical committees for European product standards are not available, the EPD can lack this information.

— **B2 Maintenance**

The module “Maintenance” covers the combination of all planned technical and associated administrative actions during the service life to maintain the product installed in a building, in a construction works or its parts in a state in which it can perform its required functional and technical performance, as well as preserve the

aesthetic qualities of the product. This will include preventative and regular maintenance activity such as cleaning, and the planned servicing, replacement or mending of worn, damaged or degraded parts. Water and energy usage required for cleaning, as part of maintenance shall be included in this module, and not in modules B6 and B7.

NOTE 2 Maintenance, repair and replacement of a whole section of the building as part of a concerted programme for the building would be considered as refurbishment.

The boundary of “maintenance” shall include in addition:

— the production and transportation of any component and ancillary products used for maintenance, including cleaning;

— transportation of any waste from maintenance processes or from maintenance related transportation;

— the end-of-life processes of any waste from transportation and the maintenance process, including any part of the component and ancillary materials removed.

EXAMPLE 2 Painting work on window frames, doors, etc. as well as the annual inspection and maintenance of the (oil or gas) boiler, replacement of filters in the heat recovery or air conditioning system.

— **B3 repair**

The module “repair” covers a combination of all technical and associated administrative actions during the service life associated with corrective, responsive or reactive treatment of a construction product or its parts installed in the building or construction works to return it to an acceptable condition in which it can perform its required functional and technical performance. It also covers the preservation of the aesthetil qualities of the product. Replacement of a broken component or part due to damage should be assigned to “repair”, whereas replacement of a whole element due to damage should be assigned to the module ”replacement”.

The boundary for “repair” shall include:

a) repair process of the repaired part of a component including:

   1) the production of the repaired part of a component and of ancillary materials;

   2) use of related energy and water;

   3) the production and transport aspects and impacts of any wastage of materials during the repair process;

b) the transportation of the repaired part of component and ancillary materials, including production aspects and impacts of any waste of materials during the repair related transportation;

c) the-end-of-life processes of any waste from transportation and the repair process, including the part of the component and ancillary materials removed.

EXAMPLE 3 For a window with broken glass, this includes the production and transportation of new glass and packaging, and all impacts due to the repair process (rubber seal, water for cleaning, etc), and the end-of-life stage of the glass waste and any related packaging.

— **B4 Replacement**

The module “replacement” covers the combination of all technical and associated administrative actions during the service life associated with the return of a construction product to a condition in which it can perform its required functional or technical performance, by replacement of a whole construction element.

Replacement of a broken component or part due to damage should be included as “repair”, but replacement of a whole construction element due to damage should be considered as “replacement”. Replacement of a whole construction element as part of a concerted replacement programme for the building should be considered as “refurbishment”.

The boundary for “replacement” shall include:

— the production of the components and of ancillary materials used for replacement;

— replacement process, including related water and energy use and the production aspects and impacts of any waste of materials used during the replacement process;

— the transportation of the component and ancillary materials used for replacement, including production aspects and impacts of any losses of material damaged during transportation;

— the end-of-life processes of any losses suffered transportation and the replacement process, including the components and ancillary materials removed.

EXAMPLE 4 For a carpet being replaced at the end of its service life, this includes the production and transportation of the new carpet and packaging, and all impacts due to the replacement process (adhesive, vacuum cleaning etc), and the end of life stage of the original carpet, any waste from the installation of the replacement carpet, packaging waste and adhesive.

— **B5 Refurbishment**

The module ”refurbishment” covers the combination of all technical and associated administrative actions during the service life of a product associated with the return of a building or other construction works or their parts to a condition in which it can perform its required functions. These activities cover a concerted programme of maintenance, repair and/or replacement activity, across a significant part or whole section of the building.

Restoration activities should be included within refurbishment.

The boundary for refurbishment shall include:

— the production of the components and ancillary materials used for refurbishment;

— refurbishment process and related water and energy use including production aspects and impacts of any waste of materials used during the refurbishment process;

— the transportation of the component and ancillary materials used for refurbishment, including production aspects and impacts of any losses during transportation;

— the end-of-life processes of any losses suffered during transportation and the refurbishment process, including the components and ancillary materials removed.

6.3.4.4.3 B6 – B7 use stage information modules related to the operation of the building:

— **B6 Energy use to operate building integrated technical systems**

The boundary of the module “Energy use to operate building integrated technical systems’’ shall include energy use during the operation of the product (the integrated building technical system), together with its associated environmental aspects and impacts including processing and transportation of any waste arising on site from the use of energy.

Integrated building technical systems are installed technical equipment supporting operation of a building or construction works. This includes technical building systems for heating, cooling, ventilation, lighting, domestic hot water and other systems for sanitation, security, fire safety, internal transport and building automation and control and IT communications.

NOTE Guidance on the selection of standards to calculate operational energy use of technical building systems can be obtained from CEN/TR 15615, *Explanation of the general relationship between various European standards and the Energy Performance of Buildings Directive (EPBD) — Umbrella Document*.

Aspects related to the production, transportation and installation of equipment required to supply energy to the building shall be assigned to Modules A1-A5. Energy use during maintenance, repair, replacement or refurbishment activities for the equipment shall be assigned to Modules B2-B5. Aspects related to the waste processing and final disposal of equipment shall be assigned to Modules C1-C4.

— **B7 operational water use by building integrated technical systems**

The module "Operational water use by building integrated technical systems" covers the period from the handover of the building or construction works to when the building is deconstructed or demolished.

The boundary of the module “operational water use by building integrated technical systems“ shall include water use during the operation of the product (the building integrated technical system), together with its associated environmental aspects and impacts considering the life cycle of water including production and transportation and waste water treatment.

Building integrated technical systems are installed technical equipment to support operation of building. This includes technical building systems for cooling, ventilation, humidification, domestic hot water and other systems for sanitation, security, fire safety, internal transport.

6.3.4.5 End-of-life stage

The end-of-life stage of the construction product starts when it is replaced, dismantled or deconstructed from the building or construction works and does not provide any further functionality. It can also start at the end-of-life of the building, depending on choice of the product’s end-of-life scenario.

During the end-of-life stage of the product or 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 the following criteria:

— 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 criterion 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. 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, prevents the waste from reaching the end-of-waste state.

The end-of-life system boundary of the construction product system to module D is set where outputs, i.e. secondary materials or fuels, have reached the “end-of-waste” state (see 6.4.3).

The end-of-life stage includes the optional Information modules:

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

— C2 transportation of the discarded product 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 higher than 60 % without prejudice to existing legislation. Materials from which energy is recovered with an efficiency rate below 60% are not considered materials for energy recovery.

NOTE 2 Only when materials have reached the end-of-waste-state can they be considered as materials for energy recovery, provided the energy recovery process has an energy efficiency rate higher than 60%.

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

NOTE 3 In principle waste processing is part of the product system 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 system under study. However after having reached the “end-of-waste” state further processing may also be necessary in order to replace primary material or fuel input 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 product system under study, according to the “polluter pays principle”. If however this process generates energy such as heat and power from waste incineration or landfill 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.

6.3.4.6 Benefits and loads beyond the product system boundary in module D

Information module D aims at transparency for the environmental benefits or loads resulting from reusable products, recyclable materials and/or useful energy carriers leaving a product system e.g. as secondary materials or fuels.

Any declared net benefits and loads from net flows (for calculation of the net amounts see 6.4.3.3) leaving the product system that have not been allocated as co-products and that have passed the end-of-waste state shall be included in module D.

Avoided impacts from allocated co-products shall not be included in Module D.

The information in module D may contain technical information as well as the quantified predetermined LCA derived parameters. The quantified predetermined parameters shall be those described in Clause 7.

6.3.5 Criteria for the exclusion of inputs and outputs

Criteria for the exclusion of inputs and outputs (cut-off rules) in the LCA and information modules and any additional information are intended to support an efficient calculation procedure. They shall not be applied in order to hide data. Any application of the criteria for the exclusion of inputs and outputs shall be documented.

The following procedure shall be followed for the exclusion of inputs and outputs:

— All inputs and outputs to a (unit) process shall be included in the calculation, for which data are available. Data gaps may be filled by conservative assumptions with average or generic data. Any assumptions for such choices shall be documented;

— In case of insufficient input data or data gaps for a unit process, the cut-off criteria shall be 1 % of renewable and non-renewable primary energy usage and 1 % of the total mass input of that unit process. The total of neglected input flows per module, e.g. per module A1-A3, A4-A5, B1-B5, B6-B7, C1-C4 and module D (see Figure 1) shall be a maximum of 5 % of energy usage and mass. Conservative assumptions in combination with plausibility considerations and expert judgement can be used to demonstrate compliance with these criteria;

— Particular care should be taken to include material and energy flows known to have the potential to cause significant emissions into air and water or soil related to the environmental indicators of this standard. Conservative assumptions in combination with plausibility considerations and expert judgement can be used to demonstrate compliance with these criteria.

6.3.6 Selection of data

As a general rule, specific data derived from specific production processes or average data derived from specific production processes shall be the first choice as a basis for calculating an EPD. In addition the following rules apply:

— An EPD describing an average product shall be calculated using representative average data of the products declared by the EPD;

— An EPD describing a specific product shall be calculated using specific data for at least the processes the producer of the specific product has influence over. Generic data may be used for the processes the producer cannot influence e.g. processes dealing with the production of input commodities, e.g. raw material extraction or electricity generation, often referred to as upstream data (see Table 1);

— A specific EPD covering all life cycle stages (cradle to grave) may be calculated using generic data for some downstream processes e.g. waste incineration. For the sake of comparability the calculation of the use stage shall be based on the same additional technical information as is required in 7.3;

— The additional technical information for the development of scenarios of the building's life cycle stages shall be specific or specific average information, when an average product is declared;

— Documentation of technological, geographical and time related representativity for generic data shall be provided in the project report.

Table 1 — Application of generic and specific data

Modules	**Module A1-A3**		**A4 and A5**	**B1-B7**	**C1-C4**
	Production of commodities, raw materials	Product manufacture	Installation processes	Use processes	End-of-life processes
Process type	Upstream processes	Processes the manufacturer has influence over	Downstream processes		
Data type	Generic data	Manufacturer's average or specific data	Generic data		

NOTE Generic data is publicly available and may be average or specific. Normally it is used to describe upstream and downstream processes. See CEN/TR 15941, *Sustainability of construction works — Environmental product declarations — Methodology for selection and use of generic data*.

6.3.7 Data quality requirements

The quality of the data used to calculate an EPD shall be addressed in the project report (see Clause 8 and EN ISO 14044:2006, 4.2.3.6). In addition the following specific requirements apply for construction products:

— Data shall be as current as possible. Data sets used for calculations shall have been updated within the last 10 years for generic data and within the last 5 years for producer specific data;

— Data sets shall be based on 1 year averaged data; deviations shall be justified;

— The time period over which inputs to and outputs from the system shall be accounted for is 100 years from the year for which the data set is deemed representative. A longer time period shall be used if relevant;

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

— Generic data: Guidance for the selection and use of generic data is provided in CEN/TR 15941. Generic data shall be checked for plausibility;

— Data sets shall be complete according to the system boundary within the limits set by the criteria for the exclusion of inputs and outputs, (see 6.3.5).

NOTE For guidance on how to deal with data gaps refer to CEN/TR 15941 or Annex A for Reference Service Life.

6.3.8 Developing product level scenarios

Scenarios shall support the calculation of information modules covering processes that deal with any one or all of the life cycle stages of the construction product except for the required modules A1 to A3; scenarios shall support the assessment of the environmental performance of a building in its life cycle stages “construction, use stage, end-of-life” (see Figure 1).

Scenarios shall be provided only for the environmental assessment. A scenario shall be based on the relevant technical information defined in this standard (see 5.4 and 7.3, for additional information). The kind of technical information the scenario is based on, is described in 7.3. With the help of the scenario, the predetermined parameters of the EPD are derived by applying the calculation rules given in this standard.

A scenario shall be realistic and representative of one of the most probable alternatives. (If there are, e.g. three different applications, the most representative one, or all three scenarios shall be declared). Scenarios shall not include processes or procedures that are not in current use or which have not been demonstrated to be practical.

EXAMPLE 1 A recycling system is not practical if it includes a reference to a return system for which the logistics have not been established.

EXAMPLE 2 Energy recovery needs to be based on existing technology and current practice.

Scenarios are communicated in accordance with 5.4: for EPD that declare optional information modules, the additional technical information related to the scenarios underlying these modules are a required part of the information of the declared information modules.

6.3.9 Units

SI units shall be used. Basic units are: metre (m), kilogram (kg), molecular weight in grams (mol). With the exceptions noted below, all resources are expressed in kg.

Exceptions are:

— Resources used for energy input (primary energy), which are expressed as kWh or MJ, including renewable energy sources e.g. hydropower, wind power;

— Water use, which is expressed in m^3 (cubic metres)

— Temperature, which is expressed in degrees Celsius;

— Time, which is expressed in practical units depending on the assessment scale: minutes, hours, days, years.

6.4 Inventory analysis

6.4.1 Collecting data

Data collection shall follow the guidance provided in EN ISO 14044:2006, 4.3.2.

6.4.2 Calculation procedures

The calculation procedures described in EN ISO 14044 shall apply. The same calculation procedures shall be applied consistently throughout the study.

When transforming the inputs and outputs of combustible material into inputs and outputs of energy the net calorific value of fuels shall be applied according to scientifically based and accepted values specific to the combustible material.

6.4.3 Allocation of input flows and output emissions

6.4.3.1 General

Most industrial processes produce more than the intended product. Normally more than one input is needed to produce one product and sometimes products are co-produced with other products. As a rule the material flows between them are not distributed in a simple way. Intermediate and discarded products can be recycled to become inputs for other processes. When dealing with systems involving multiple products and recycling processes, allocation should be avoided as far as possible. Where unavoidable, allocation should be considered carefully and should be justified.

In this standard, the rules for allocation are based on the guidance given in EN ISO 14044:2006, 4.3.4. However, the basic procedures and assumptions used in EN ISO 14044 have been refined in order to reflect the goal and scope of this standard and EN 15643-2.

The use of upstream data, which does not respect the allocation principles described in this standard shall be clearly stated and justified in the project report. These data shall be in line with EN ISO 14044 allocation rules.

The principle of modularity shall be maintained. Where processes influence the product's environmental performance during its life cycle, they shall be assigned to the module in the life cycle where they occur (see Figure 1).

The sum of the allocated inputs and outputs of a unit process shall be equal to the inputs and outputs of the unit process before allocation. This means no double counting or omission of inputs or outputs through allocation is permitted.

6.4.3.2 Co-product allocation

Allocation shall be avoided as far as possible by dividing the unit process to be allocated into different sub-processes that can be allocated to the co-products and by collecting the input and output data related to these sub-processes.

— If a process can be sub-divided but respective data are not available, the inputs and outputs of the system under study should be partitioned between its different products or functions in a way which reflects the underlying physical relationships between them; i.e. they shall reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system;

In the case of joint co-production, where the processes cannot be sub-divided, allocation shall respect the main purpose of the processes studied, allocating all relevant products and functions appropriately. The purpose of a plant and therefore of the related processes is generally declared in its permit and should be taken into account. Processes generating a very low contribution to the overall revenue may be neglected. Joint co-product allocation shall be allocated as follows:

— Allocation shall be based on physical properties (e.g. mass, volume) when the difference in revenue from the co-products is low;

— In all other cases allocation shall be based on economic values;

— Material flows carrying specific inherent properties, e.g. energy content, elementary composition (e.g. biogenic carbon content), shall always be allocated reflecting the physical flows, irrespective of the allocation chosen for the process.

NOTE 1 Contributions to the overall revenue of the order of 1% or less is regarded as very low. A difference in revenue of more than 25 % is regarded as high.

NOTE 2 A common position on the definition on the most appropriate allocation rule needs to be defined together with other relevant sectors.

NOTE 3 Products and functions are the outputs and/or services provided by the process, having a positive economic value.

NOTE 4 In industrial processes there may be a wide variety of different types of materials produced in conjunction with the intended product. In business vocabulary, these may be identified as by-products, co-products, intermediate products, non-core products or sub-products. In this standard these terms are treated as being equivalent. However for the allocation of environmental aspects and impacts a distinction between co-products and products is made in this standard

6.4.3.3 Allocation procedure of reuse, recycling and recovery

The end-of-life system boundary of the construction product system is set where outputs of the system under study, e.g. materials, products or construction elements, have reached the end-of-waste state. Therefore, waste processing of the material flows (e.g. undergoing recovery or recycling processes) during any module of the product system (e.g. during the production stage, use stage or end-of-life stage) are included up to the system boundary of the respective module as defined above.

Where relevant (see 6.3.4.5 and 6.3.4.6), informative module D declares potential loads and benefits of secondary material, secondary fuel or recovered energy leaving the product system. Module D recognises the “design for reuse, recycling and recovery” concept for buildings by indicating the potential benefits of avoided future use of primary materials and fuels while taking into account the loads associated with the recycling and recovery processes beyond the system boundary.

NOTE 1 Module D also contains benefits from exported energy from waste disposal processes declared in module C4.

Where a secondary material or fuel crosses the system boundary e.g. at the end-of-waste state and if it substitutes another material or fuel in the following product system, the potential benefits or avoided loads can be calculated based on a specified scenario which is consistent with any other scenario for waste processing and is based on current average technology or practice.

If today’s average is not available for the quantification of potential benefits or avoided loads, a conservative approach shall be used.

In module D the net impacts are calculated as follows:

— by adding all output flows of a secondary material or fuel and subtracting all input flows of this secondary material or fuel from each sub-module first (e.g. B1-B5, C1-C4, etc.), then from the modules (e.g. B, C), and finally from the total product system thus arriving at net output flows of secondary material or fuel from the product system;

— by adding the impacts connected to the recycling or recovery processes from beyond the system boundary (after the end-of-waste state) up to the point of functional equivalence where the secondary material or energy substitutes primary production and subtracting the impacts resulting from the substituted production of the product or substituted generation of energy from primary sources;

— by applying a justified value-correction factor to reflect the difference in functional equivalence where the output flow does not reach the functional equivalence of the substituting process.

In module D substitution effects are calculated only for the resulting net output flow.

The amount of secondary material output, which is for all practical purposes able to replace one to one the input of secondary material as closed loop is allocated to the product system under study and not to module D.

NOTE 2 Avoided impacts from allocated co-products are not part of Module D information, see 6.3.4.6.

6.5 Impact assessment

〈A1〉 The impact assessment is carried out for the following impact categories:

— depletion of abiotic resources (fossil);

— depletion of abiotic resources (elements);

— acidification of soil and water;

— ozone depletion;

— global warming;

— eutrophication;

— photochemical ozone creation.

The characterisation factors for GWP, ODP, AP, EP, POCP and ADP given in Annex C shall be used.

NOTE 1 The 'accumulated exceedance' method for AP and EP recommended by JRC is considered not to be ready for standardization yet, because it needs a new regional set of characterisation factors, and because this method is not yet common practice with the stakeholders nor available in databases. The method using the reserve base for ADP elements recommended by JRC is not considered common practice.

If specific ADP fossil fuel values are known, these shall be used; any such use has to be stated.

Complementary and consistent factors may be used in order to achieve consistency between LCI data and available characterisation factors.

NOTE 2 It is considered good practice to identify LCI data which has no calculated environmental impact within the project report. This can help to identify the need for complementary and consistent characterisation factors for relevant LCI flows. 〈A1〉

7 Content of the EPD

7.1 Declaration of general information

The following items of general information are required and shall be declared in an EPD.

a) the name and address of the manufacturer(s);

b) the description of the construction product's use and the functional or declared unit of the construction product to which the data relates;

c) construction product identification by name (including any product code) and a simple visual representation of the construction product to which the data relates;

d) a description of the main product components and or materials;

NOTE 1 This description is intended to enable the user of the EPD to understand the composition of the product as delivered and also support safe and effective installation, use and disposal of the product.

e) name of the programme used and the programme operator's name and address and, if relevant logo and website;

f) the date the declaration was issued and the 5 year period of validity;

g) information on which stages are not considered, if the declaration is not based on an LCA covering all life cycle stages;

h) a statement that EPD of construction products may not be comparable if they do not comply with this standard, see also Clause 5.3;

i) in the case where an EPD is declared as an average environmental performance for a number of products a statement to that effect shall be included in the declaration together with a description of the range/ variability of the LCIA results if significant;

j) the site(s), manufacturer or group of manufacturers or those representing them for whom the EPD is representative;

k) the declaration of material content of the product shall list as a minimum substances contained in the product that are listed in the "Candidate List of Substances of Very High Concern for authorisation" when their content exceeds the limits for registration with the European Chemicals Agency;

NOTE 2 The source location of any safety data sheet can be provided.

NOTE 3 Substances of very high concern" are listed in the Candidate List of Substances of Very High Concern for Authorisation of the European Chemicals Agency.

l) information on where explanatory material may be obtained.

NOTE 4 Guidance on safe and effective installation, use and disposal of the product can be supplied.

In addition to the above-mentioned general information, Table 2 shall be completed and reproduced in the EPD.

Table 2 — Demonstration of verification

CEN standard [A1] EN 15804 [A1] serves as the core PCR [a]
[A1] Independent verification of the declaration and data [A1], according to EN ISO 14025:2010 ☐ internal ☐ external
(Where appropriate [b]) Third party verifier: <Name of the third party verifier>
[a] Product category rules [b] Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4).

[A1] NOTE EN 15942 makes reference to Figure 3 of FprEN 15804. Please note that this figure was converted to Table 2 in EN 15804:2012+A1:2013. [A1]

7.2 Declaration of environmental parameters derived from LCA

7.2.1 General

To illustrate the product system studied, the EPD shall contain a simple flow diagram of the processes included in the LCA. They shall be sub-divided at least into the life cycle stages of the product: production, and if applicable construction, use and end-of-life (see Figure 1). The stages may be further sub-divided.

7.2.2 Rules for declaring LCA information per module

In order to support the application of the modular information of an EPD in an environmental building assessment, it is necessary to provide information in a modular way.

NOTE The standard EN 15978 shows how modular information from EPD is used at the building level. The standard EN 15942 provides a communication format.

Module D may be addressed in any type of EPD.

The EPD shall specify which EPD-type is declared (see Figure 1):

— A “Cradle to Gate” EPD:

  For a “Cradle to Gate” EPD a declaration of the RSL is not possible. The RSL shall be declared as: “not specified”. Normally in this type of EPD module D is not declared;

— A“Cradle to Gate with Options” EPD:

  For a “Cradle to Gate with Options” EPD the declaration of the RSL is possible only if all scenarios for the modules A1-A3 and B1-B5 are given (see Figure 1);

— A “Cradle to Grave” EPD:

  For a “Cradle to Grave” EPD (life cycle declaration covering all modules in the stages A to C) a declaration of the RSL is required. See 6.3.3.

In some cases, certain modules may not be relevant to the environmental performance of a product. In such cases the irrelevant module shall be declared as “not relevant”. Such a declaration shall not be regarded as an indicator result of zero.

7.2.3 Parameters describing environmental impacts

The following information on environmental impacts is expressed with the impact category parameters of LCIA using characterisation factors. These predetermined parameters are required and shall be included in the EPD as follows:

Table 3 — Parameters describing environmental impacts

A1

Impact Category	Parameter	Unit (expressed per functional unit or per declared unit)
Depletion of abiotic resources-elements	Abiotic depletion potential (ADP-elements) for non fossil resources [a]	kg Sb equiv
Depletion of abiotic resources-fossil fuels	Abiotic depletion potential (ADP-fossil fuels) for fossil resources [a]	MJ, net calorific value
Acidification for soil and water	Acidification potential of soil and water, AP;	kg SO_2 equiv
Ozone Depletion	Depletion potential of the stratospheric ozone layer, ODP;	kg CFC 11 equiv
Global Warming	Global warming potential, GWP;	kg CO_2 equiv
Eutrophication	Eutrophication potential, EP;	kg $(PO_4)^{3-}$ equiv
Photochemical ozone creation	Formation potential of tropospheric ozone,, POCP;	kg Ethene equiv

[a] The abiotic depletion potential is calculated and declared in two different indicators:

- ADP-elements: include all non renewable, abiotic material resources (i.e. excepting fossil resources);
- ADP -fossil fuels include all fossil resources.

A1

NOTE 1 The indicator describing the depletion of abiotic resources is subject to further scientific development. The use of this indicator is intended to be reviewed during the revision of this standard

NOTE 2 Parameters describing emission of ionising radioactive radiation and its impact on human health and/or eco-systems on the LCA level are intended to be reviewed during the revision of this standard.

7.2.4 Parameters describing resource use

The following environmental parameters apply data based on the LCI. They describe the use of renewable and non renewable material resources, renewable and non renewable primary energy and water. They are required and shall be included in the EPD as follows:

Table 4 — Parameters describing resource use

Parameter	Unit(expressed per functional unit or per declared unit)
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	MJ, net calorific value
Use of non renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of non renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of secondary material	kg
Use of renewable secondary fuels	MJ, net calorific value
Use of non renewable secondary fuels	MJ, net calorific value
Net use of fresh water	m^3

NOTE In order to identify the input part of renewable/non renewable primary energy used as an energy carrier and not used as raw materials, the parameter “use of renewable/non renewable primary energy excluding renewable/non renewable primary energy resources used as raw materials” is considered and can be calculated as the difference between the total input of primary energy and the input of energy resources used as raw materials.

7.2.5 Other environmental information describing different waste categories and output flows

The parameters describing waste categories and other material flows are output flows derived from LCI. They are required and shall be included in the EPD as follows:

Table 5 — Other environmental information describing waste categories

Parameter	Unit(expressed per functional unit or per declared unit)
Hazardous waste disposed	kg
Non hazardous waste disposed	kg
Radioactive waste disposed	kg

NOTE The characteristics that render waste hazardous are described in existing applicable legislation, e.g. in the European Waste Framework Directive.

Table 6 — Other environmental information describing output flows

Parameter	Unit (expressed per functional unit or per declared unit)
Components for re-use	kg
Materials for recycling	kg
Materials for energy recovery	kg
Exported energy	MJ per energy carrier

NOTE 1 The parameters in Table 6 are also part of the additional information for scenarios at end-of-life, see 7.3.4, Table 12.

NOTE 2 The parameters in Table 6 are calculated on the gross amounts leaving the system boundary when they have reached the end-of-waste state as described in Annex B.

NOTE 3 The declaration of “components for re-use” and “materials for recycling”: fulfils the conditions of 6.3.4.5, end-of-life stage.

NOTE 4 The parameter “Materials for energy recovery” does not include materials for waste incineration. Waste incineration is a method of waste processing and is allocated within the system boundaries. Waste incineration plants have a lower energy efficiency rate than power stations using secondary fuels. Materials for energy recovery are based on thermal energy efficiency rate of the a power station not less than 60 % or 65 % for installations after 31st of December 2008 in order to be in line with the distinction made by the EC.

NOTE 5 Exported energy relates to energy exported from waste incineration and landfill.

7.3 Scenarios and additional technical information

7.3.1 General

Scenarios for certain life cycle stages should support the application of product related data in the corresponding life cycle stage of the building assessment.

Additional technical information as defined in 7.3, Table 7 to Table 12 supports the consistent development of scenarios by which the LCA derived parameters ▌A1⟩ defined in 7.2.3, 7.2.4 and 7.2.5 ⟨A1▐ of optional life cycle stages can be calculated and declared. Therefore, if optional life cycle stages, (e.g. end of life stage in a “cradle-to gate with options” EPD as described in Figure 1) are declared, the scenarios to which the calculated parameters relate shall be specified according to 7.3 and be included in the EPD.

If an EPD claims to cover all life cycle stages, all relevant optional modules shall be calculated for specified scenarios and the LCA derived parameters shall be declared.

For an EPD covering cradle to gate with options, the optional modules may be calculated and the LCA derived parameters may be declared. Alternatively, in the cradle to gate EPD, a manufacturer may choose to declare additional technical information without calculating optional life cycle stages to ensure proper understanding of a product’s function in a building and thus support proper scenario development at the building level.

Additional technical information is declared in the module, to which it refers (e.g. technical information about the use of a product in the appropriate use stage modules B.)

Any additional technical information shall be documented separately from the LCA derived parameters.

If additional technical information is not complete at the product level as specified in 7.3, this shall be stated.

The following tables are not exhaustive with respect to the examples or units and parameters given.

7.3.2 Construction process stage

7.3.2.1 A4, Transport to the building site

If additional technical information is provided in the EPD for transport from the production gate to the construction site, the following information shall be provided to specify the transport scenarios used or to support development of the scenarios at the building level:

Table 7 — Transport to the building site

Parameter	Unit (expressed per functional unit or per declared unit)
Fuel type and consumption of vehicle or vehicle type used for transport e.g. long distance truck, boat etc.	Litre of fuel type per distance or vehicle type, Commission Directive 2007/37/EC (European Emission Standard)
Distance	km
Capacity utilisation (including empty returns)	%
Bulk density of transported products	kg/m^3
Volume capacity utilisation factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaged products)	Not applicable

NOTE 1 As an alternative to the bulk density the weight and volume of transported products may be specified.

NOTE 2 With the bulk density and the volume capacity utilisation factor, (complex) logistic scenarios (e.g. taking onto account the type of vehicle, transport distance, empty returns) at the building level can be considered.

NOTE 3 For the assessment at the building level more complex logistics may have to be considered.

7.3.2.2 A5, Installation in the building

If additional technical information is provided in the EPD for installation in the building, the following information shall be provided to specify the product's installation scenarios or to support development of the scenarios describing the product's installation at the level of the building assessment:

Table 8 — Installation of the product in the building

Parameter	Unit (expressed per functional unit or per declared unit)
Ancillary materials for installation (specified by material);	kg or other units as appropriate
Water use	m^3
Other resource use	kg
Quantitative description of energy type (regional mix) and consumption during the installation process	kWh or MJ
Waste materials on the building site before waste processing, generated by the product's installation (specified by type)	kg
Output materials (specified by type) as result of waste processing at the building site e.g. of collection for recycling, for energy recovery, disposal (specified by route)	kg
Direct emissions to ambient air, soil and water	kg

7.3.3 B1-B7 use stage

7.3.3.1 B1-B5 use stage related to the building fabric

B1: Environmental aspects and impacts connected to the normal (i.e. anticipated) use of products, not including those related to energy and water use, which are dealt with in B6 and B7) e.g. release of substances from the facade, roof, floor covering, walls and other surfaces (interior or exterior) are reported as additional information (see 7.4).

B2-B5, if additional technical information is provided in the EPD for products requiring maintenance, repair, replacement, refurbishment the following information shall be provided to specify the scenarios or to support the development scenarios of these modules at the building level. Information given for Table 9 shall be consistent with the reference service life data given in Table 10:

Table 9 — use stage related to the building fabric

Parameter	Unit (expressed per functional unit or per declared unit)
B2 Maintenance	
Maintenance process	Description or source where description can be found
Maintenance cycle	Number per RSL or year [a]
Ancillary materials for maintenance, e.g. cleaning agent, specify materials	kg / cycle,
Waste material resulting from maintenance (specify materials)	kg
Net fresh water consumption during maintenance	m^3
Energy input during maintenance, e.g. vacuum cleaning, energy carrier type, e.g. electricity, and amount, if applicable and relevant	kWh
B3 Repair	
Repair process	Description or source where description can be found
Inspection process	Description or source where description can be found
Repair cycle	Number per RSL or year
Ancillary materials, e.g. lubricant, specify materials	kg or kg / cycle
Waste material resulting from repair, (specify materials)	kg
Net fresh water consumption during repair	m^3
Energy input during repair, e.g. crane activity, energy carrier type, e.g electricity, and amount	kWh / RSL, kWh / cycle
B4 Replacement	
Replacement cycle	Number per RSL or year
Energy input during replacement e.g. crane activity, energy carrier type, e.g. electricity and amount if applicable and relevant	kWh
Exchange of worn parts during the product's life cycle, e.g. zinc galvanised steel sheet, specify materials	kg

Table 9 — *(continued)*

Parameter	Unit (expressed per functional unit or per declared unit)
B5 Refurbishment	
Refurbishment process	Description or source where description can be found
Refurbishment cycle	Number per RSL or year
Energy input during refurbishment e.g. crane activity, energy carrier type, e.g. electricity, and amount if applicable and relevant	kWh
Material input for refurbishment, e.g. bricks, including ancillary materials for the refurbishment process e.g. lubricant, (specify materials)	kg or kg / cycle
Waste material resulting from refurbishment (specify materials)	kg
Further assumptions for scenario development, e.g. frequency and time period of use, number of occupants	Units as appropriate
[a] Not applicable if only B2 is declared.	

7.3.3.2 Reference service life

The description of the reference service life (see also Annex A) may be based on data collected as average data or at the beginning or end of the service life. The reference conditions for achieving the declared technical and functional performance and the declared reference service life shall include the reference service life data as described in Table 10, where relevant:

Table 10 — Reference Service Life

Parameter	Unit (expressed per functional unit or per declared unit)
Reference Service Life	Years
Declared product properties (at the gate) and finishes, etc.	Units as appropriate
Design application parameters (if instructed by the manufacturer), including the references to the appropriate practices and application codes	Units as appropriate
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Units as appropriate
Outdoor environment, (for outdoor applications), e.g. weathering, pollutants, UV and wind exposure, building orientation, shading, temperature	Units as appropriate
Indoor environment (for indoor applications), e.g. temperature, moisture, chemical exposure	Units as appropriate
Usage conditions, e.g. frequency of use, mechanical exposure	Units as appropriate
Maintenance e.g. required frequency, type and quality and replacement of components	Units as appropriate

7.3.3.3 B6, use of energy and B7, use of water

If additional technical information is provided in the EPD for building integrated technical systems using energy or water related to the operation of the building, the following information shall be provided to specify the scenarios or to support the development of the use of energy and use of water scenarios at the building level:

Table 11 — Use of energy and use of water

Parameter	Unit (expressed per functional unit or per declared unit)
Ancillary materials specified by material	kg or units as appropriate
Net fresh water consumption	m^3
Type of energy carrier, e.g. electricity, natural gas, district heating	kWh
Power output of equipment	kW
Characteristic performance, e.g. energy efficiency, emissions, variation of performance with capacity utilisation etc.	units as appropriate
Further assumptions for scenario development, e.g. frequency and period of use, number of occupants	units as appropriate

NOTE Guidance on the selection of standards to calculate operational energy use can be obtained from CEN/TR 15615, *Explanation of the general relationship between various European standards and the Energy Performance of Buildings Directive (EPBD) — Umbrella Document*.

7.3.4 End-of-life

If additional technical information is provided in the EPD about end-of-life processes, the following information shall be provided for all construction products to specify the end-of-life scenarios used or to support development of the end-of-life scenarios at the building level. Scenarios shall only model processes e.g. recycling systems that have been proven to be economically and technically viable.

Table 12 — End-of-life

Processes	Unit (expressed per functional unit or per declared unit of components products or materials and by type of material)
Collection process specified by type	kg collected separately
	kg collected with mixed construction waste
Recovery system specified by type	kg for re-use
	kg for recycling
	kg for energy recovery
Disposal specified by type	kg product or material for final deposition
Assumptions for scenario development, e.g. transportation	units as appropriate

7.4 Additional information on release of dangerous substances to indoor air, soil and water during the use stage

7.4.1 Indoor air

The following information shall be provided for products exposed to indoor air after their installation in buildings during the use stage in order to support use stage scenarios with respect to health at the building level:

— Emissions to indoor air, according to the horizontal standards on measurement of release of regulated dangerous substances from construction products using harmonised testing methods according to the provisions of the respective Technical Committees for European product standards, when available.

NOTE The EPD does not need to give this information if the horizontal standards on measurement of release of regulated dangerous substances from construction products using harmonised test methods according to the provisions of the respective technical committees for European product standards are not available.

7.4.2 Soil and water

The following information shall be provided for products exposed to soil and water after their installation in buildings during the use stage in order to support use stage scenarios for soil and water pollution at the building level:

— Release to soil and water according to the horizontal standards on measurement of release of regulated dangerous substances from construction products using harmonised testing methods according to the provisions of the respective Technical Committees for European product standards, when available.

NOTE The EPD does not need to give this information if the horizontal standards on measurement of release of regulated dangerous substances from construction products using harmonised test methods according to the provisions of the respective technical committees for European product standards are not available.

7.5 Aggregation of information modules

The indicators declared in the individual information modules of a product life cycle A1 to A5, B1 to B7, C1 to C4 and module D as described in Figure 1 shall not be added up in any combination of the individual information modules into a total or sub-total of the life cycle stages A, B, C or D. As an exception information modules A1, A2, and A3 may be aggregated.

8 Project report

8.1 General

The project report is the systematic and comprehensive summary of the project documentation supporting the verification of an EPD. The project report shall record that the LCA based information and the additional information as declared in the EPD meet the requirements of this European Standard. It shall be made available to the verifier with the requirements on confidentiality stated in EN ISO 14025.

The project report is not part of the public communication.

The project report should contain any data and information of importance for the data published in the EPD and as required in this European Standard. Special care is necessary to demonstrate in a transparent way how the data and information declared in the EPD results from the LCA study and how the reference RSL has been established.

NOTE In this context project means the LCA study on the declared product.

8.2 LCA-related elements of the project report

The results, data, methods, assumptions and limitations and conclusions of the LCA shall be completely and accurately reported without bias. They shall be transparent and presented in sufficient detail to allow independent verification and to permit an understanding of the complexities and trade-offs inherent in the LCA. The report should also allow the results and interpretation to be used in support of the data and additional information made available in the respective EPD.

The project report shall give the following,:

a) General aspects:

   1) commissioner of the LCA study, internal or external practitioner of the LCA study;

   2) date of report;

   3) statement that the study has been conducted according to the requirements of this standard;

b) Goal of the study:

   1) reasons for carrying out the study and its intended application and audience, i.e. providing information and data for an EPD for business-to-business and/or business-to-consumer communication;

c) Scope of the study:

   1) declared/functional unit, including:

      i) definition, including relevant technical specification(s);

      ii) calculation rule for averaging data e.g. when the declared/functional unit is defined for:

         1. a group of similar products produced by different suppliers or

         2. the same product produced at different production sites;

   2) system boundary according to the modular approach as outlined in Figure 1, including:

      i) omissions of life cycle stages, processes or data needs;

      ii) quantification of energy and material inputs and outputs, taking into account how plant-level data is allocated to the declared products;

      iii) assumptions about electricity production and other relevant background data;

   3) cut-off criteria for initial inclusion of inputs and outputs, including:

      i) description of the application of cut-off criteria and assumptions;

      ii) list of excluded processes;

d) Life cycle inventory analysis:

   1) qualitative/quantitative description of unit processes necessary to model the life cycle stages of the declared unit, taking into account the provisions of EN ISO 14025 regarding data confidentiality;

   2) sources of generic data or literature used to conduct the LCA;

   3) validation of data, including:

i) data quality assessment;

ii) treatment of missing data;

4) allocation principles and procedures, including:

i) documentation and justification of allocation procedures;

ii) uniform application of allocation procedures;

e) Life cycle impact assessment:

1) the LCIA procedures, calculations and results of the study;

2) the relationship of the LCIA results to the LCI results;

3) reference to all characterization models, characterization factors and methods used, as defined in this European Standard;

4) a statement that the LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks;

f) Life cycle interpretation:

1) the results;

2) assumptions and limitations associated with the interpretation of results as declared in the EPD, both methodology and data related;

3) the variance from the means of LCIA results should be described, if generic data are declared from several sources or for a range of similar products;

4) data quality assessment;

5) full transparency in terms of value-choices, rationales and expert judgements.

8.3 Documentation on additional information

The project report shall include any documentation on additional environmental information declared in the EPD as required in this standard. Such documentation on additional environmental information may include, e.g. as copies or references:

— laboratory results/measurements for the content declaration;

— laboratory results/measurement of functional/technical performance;

— documentation on declared technical information on life cycle stages that have not been considered in the LCA of the construction product and that will be used for the assessment of buildings (e.g. transport distances, RSL according to Annex A, energy consumption during use, cleaning cycles, etc.);

— laboratory results/measurements for the declaration of emissions to indoor air, soil and water during the product's use stage.

8.4 Data availability for verification

To facilitate verification it is considered good practice to make the following information available to the verifier, taking into account data confidentiality according to ISO 21930:2007, 7.4 and 9.1:

— analysis of material and energy flows to justify their inclusion or exclusion;

— quantitative description of unit processes that are defined to model processes and life cycle stages of the declared unit;

— attribution of process and life cycle data to datasets of an LCA-software (if used);

— LCIA results per modules of unit processes, e.g. structured according to life cycle stages;

— LCIA results per production plant/product if generic data is declared from several plants or for a range of similar products;

— documentation that substantiates the percentages or figures used for the calculations in the end-of-life scenario;

— documentation that substantiates the percentages and figures (number of cycles, prices, etc.) used for the calculations in the allocation procedure, if it differs from the PCR.

9 Verification and validity of an EPD

After verification an EPD is valid for a 5 year period from the date of issue, after which it shall be reviewed and verified. An EPD shall only be reassessed and updated as necessary to reflect changes in technology or other circumstances that could alter the content and accuracy of the declaration. An EPD does not have to be recalculated after 5 years, if the underlying data has not changed significantly.

The process for verification and establishing the validity of an EPD shall be in accordance with EN ISO 14025 and ISO 21930.

NOTE A reasonable change in the environmental performance of a product to be reported to the verifier is +/- 10% on any one of the declared parameters of the EPD (see Clause 7). Such a change may require an update of the EPD.

Annex A
(normative)

Requirements and guidance on the reference service life

A reference service life (RSL) can only be determined for a cradle to grave EPD or a Cradle to Gate EPD with options where modules A1-A5 and B1-B5 have been provided, see ISO 21930. If the service life is declared then the following principles shall apply. The manufacturer or producer of the construction product cannot be held responsible for the actual design of the building and the use and application of the product, environment, workmanship or use.

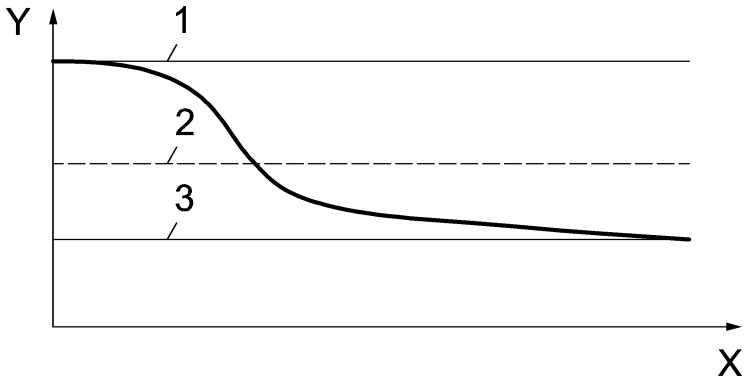
— The reference service life of a product can be based upon empirical, probabilistic, statistical, deemed to satisfy or research (scientific) data and shall always taking into account the intended use (description of use), see ISO 15686-1, -2, -7 and -8. This basis shall be mentioned in the EPD;

— If the manufacturer provides the RSL for the product then he shall take into account and shall describe in the EPD the intended use and declared functional performance(s) and the scenario. The estimate shall be transparent to allow for verification.

A declared RSL shall be related to the declared functional technical performance and to any maintenance or repair necessary to provide the declared performance during the declared RSL or provided Estimated Service Life (ESL). The declared technical performance may be based on specifications for determination or calculation of this performance given in the relevant harmonised European standards. These performances may be defined as initial, average or minimum levels. See Figure A.1 and A.2.

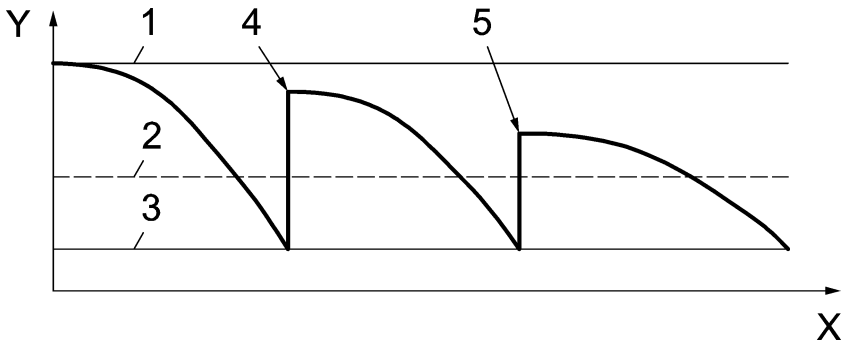
NOTE 1 The declared technical performance may be the input for calculations beyond this standard. However the outcome in terms of RSL will be input for the requirements in this standard.

EXAMPLE The thermal performance of a window, insulation, a heating boiler, etc. will impact on the energy use of the building in the use stage. This energy use, its emissions and waste are contributing to the environmental aspects and impacts of the building in the use stage. The RSL of the window, insulation, the heating boiler, etc. needs to be linked to the product's performance in order to provide consistency in the calculation model.



Key
X RSL
Y functional performance
1 initial
2 average
3 minimum

Figure A.1 — Type of declared technical and functional performance and RSL



Key
X RSL
Y technical and functional performance
1 initial
2 average
3 minimum
4 maintenance/ repair
5 maintenance/ repair

Figure A.2 — Type of declared technical and functional performance, repair/maintenance during RSL

The RSL is dependent on the properties of the product and specific in-use conditions. These conditions shall be declared together with a RSL and it shall be stated that the RSL only applies to these specific conditions.

The description of the technical and functional performance of a product is required for the European technical specifications for construction products. This description may be based on data collected as average data or at the beginning or end of the service life. The reference conditions for achieving the declared technical and functional performance and the declared reference service life shall include the following, where relevant:

— declared product properties (at the gate) and those of any finishes, etc.;

— design application parameters (if instructed by the manufacturer), including references to any appropriate requirements and application codes;

— an assumed quality of work,;

— external environment, (for outdoor applications), e.g. weathering, pollutants, UV and wind exposure, building orientation, shading, temperature;

— internal environment (for indoor applications), e.g. temperature, moisture, chemical exposure;

— usage conditions, e.g. frequency of use, mechanical exposure;

— maintenance, e.g. required frequency, type and quality and replacement of replaceable components.

In many cases the Estimated Service Life (ESL) of the building depends on whether its components are replaceable or repairable. Normally the ESL of a building depends on the service life of the load bearing product or construction element which is not replaceable or repairable.

The RSL of a construction element (e.g. a window) declared in the EPD is dependent on the service life of its individual components (handle, hinge, etc.) and may be determined by the component with the lowest service life. It also depends on whether the single components of the construction element are replaceable or repairable.

RSL data is normally based on direct testing or both direct and indirect data acquisition (see ISO 15686-2, ISO 15686-8 and ISO/TS 15686-9 and "Guidance Paper F, Durability and the Construction Products Directive"). Direct data acquisition may be based on:

— field exposure;

— inspection of buildings and their components;

— experimental buildings;

— in-use exposure.

In some cases for products for which direct data are not available indirect methods may be used for establishing RSL:

— correlated to data for existing products of a similar type with similar functions having similar use and exposure conditions;

— comparative data obtained by testing the products of a similar type and similar function for similar uses and exposure conditions, in accordance with EN product test standards.

NOTE 2 ISO/TS 15686-9 refers to procedures that may be divided into two groups, direct and indirect tests.

Direct testing – the achievement of a certain level of performance in a test of a particular property is recognised as being direct evidence of expected service life (e.g. abrasion, fatigue, closing, and impact tests).

Indirect (proxy) testing – the measurement of “proxy” characteristics that can be correlated to actual performance and hence service life (e.g. porosity for freeze-thaw resistance and hardness for abrasion resistance).

Tests may be either:

— Natural weathering/ageing tests, which either give a direct indication of service life (e.g. corrosion tests) or enable normal performance tests to be carried out after treatment, thus allowing the likely degradation under in-use conditions to be determined;

— Accelerated weathering/ageing tests, in which the normal ageing process is speeded up to reduce the duration of the test. Care is needed to ensure that degradation mechanisms are just accelerated and not significantly altered in such tests.

Tests may be long-term or short-term, or a combination of both.

Long-term tests may include:

a) field exposure;

b) exposure in experimental buildings.

Short-term tests may include:

c) accelerated short-term tests;

d) short-term in-use exposures.

Annex B
(informative)

Waste

B.1 End-of-waste

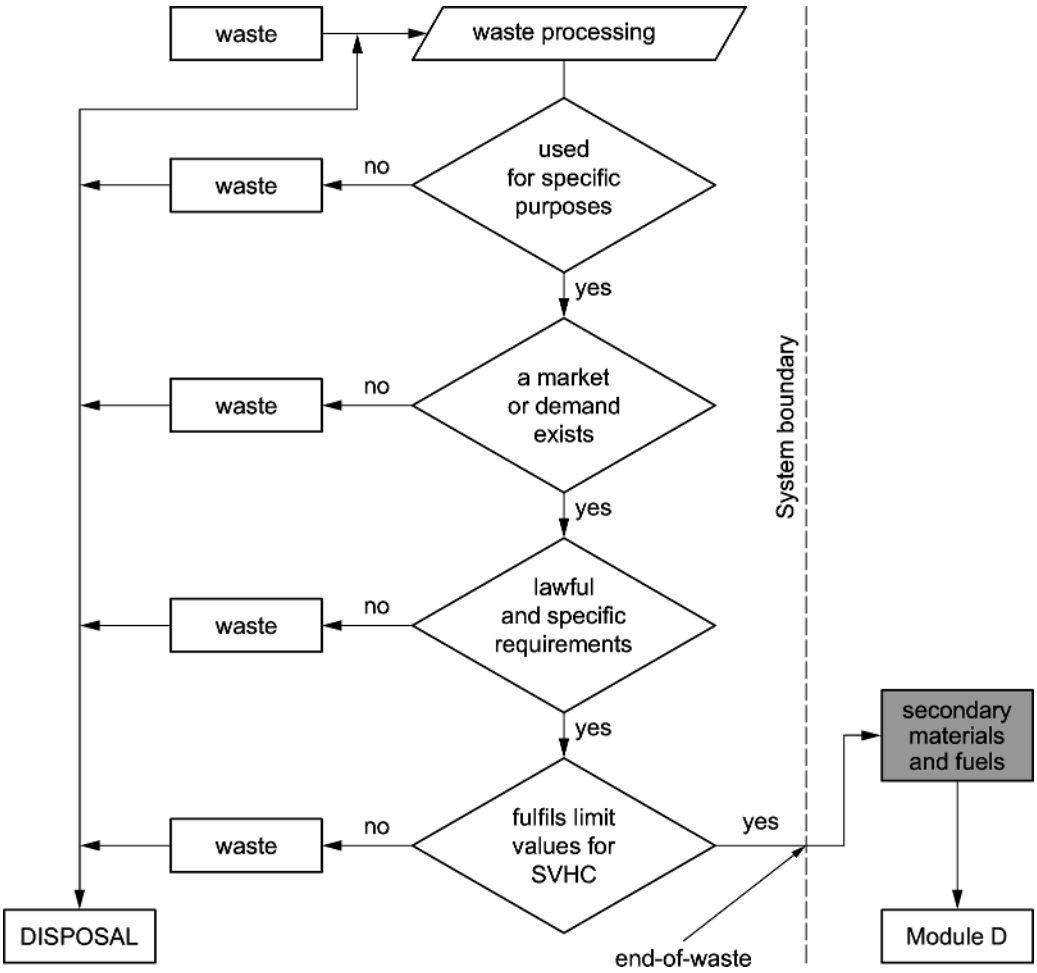


Figure B.1 — Decision-tree for end-of-waste

B.2 Properties of hazardous waste for Table 5

The characteristic that render waste hazardous are described in existing applicable legislation, e.g. in the European Waste Framework Directive.

A1

Annex C
(normative)

Characterisation factors for GWP, ODP, AP, EP, POCP and ADP

The characterisation factors listed in the following tables are taken from CML –IA version 4.1, dated October 2012 (Institute of Environmental Sciences Faculty of Science University of Leiden, Netherlands) with the permission of CML – © all rights reserved and identified as “baseline”.

Table C.1 — Characterisation factors concerning abiotic depletion (fossil fuels)

Substance	CAS No.	Group	Initial emission or extraction	Unit	Characterisation factor MJ
coal hard (27.91 MJ/kg)	coal hard	fossil fuel	resources	kg	**27,91**
coal soft, lignite (13.96 MJ/kg)	coal soft	fossil fuel	resources	kg	**13,96**
natural gas (38.84 MJ/m3)	8006-14-2	fossil fuel	resources	m3	**38,84**
oil crude (41.87 MJ/kg)	8012-95-1	fossil fuel	resources	kg	**41,87**
NOTE Source of LCIA model: See Table C.8.					

Table C.2 — Characterisation factors concerning abiotic depletion for non fossil resources

Substance	CAS No.	Group	Initial emission or extraction	Unit	Characterisation factor kg antimony eq.
aluminium (Al)	7429-90-5	element	resources	kg	**1,09E-09**
antimony (Sb)	7440-36-0	element	resources	kg	**1,00E+00**
arsenic (As)	7440-38-2	element	resources	kg	**2,97E-03**
barium (Ba)	7440-39-3	element	resources	kg	**6,04E-06**
beryllium (Be)	7440-41-7	element	resources	kg	**1,26E-05**
bismuth (Bi)	7440-69-9	element	resources	kg	**4,11E-02**
boron (B)	7440-42-8	element	resources	kg	**4,27E-03**
bromine (Br)	7726-95-6	element	resources	kg	**4,39E-03**
cadmium (Cd)	7440-43-9	element	resources	kg	**1,57E-01**
chlorine (Cl)	7782-50-5	element	resources	kg	**2,71E-05**
chromium (Cr)	7440-47-3	element	resources	kg	**4,43E-04**
cobalt (Co)	7440-48-4	element	resources	kg	**1,57E-05**
copper (Cu)	7440-50-8	element	resources	kg	**1,37E-03**
gallium (Ga)	7440-55-3	element	resources	kg	**1,46E-07**
germanium (Ge)	7440-56-4	element	resources	kg	**6,52E-07**
gold (Au)	7440-57-5	element	resources	kg	**5,20E+01**
indium (In)	7440-74-6	element	resources	kg	**6,89E-03**
iodine (I2)	7553-56-2	element	resources	kg	**2,50E-02**
iron (Fe)	7439-89-6	element	resources	kg	**5,24E-08**
kalium (K;potassium)	7440-09-7	element	resources	kg	**1,60E-08**
lead (Pb)	7439-92-1	element	resources	kg	**6,34E-03**
lithium (Li)	7439-93-2	element	resources	kg	**1,15E-05**
magnesium (Mg)	7439-95-4	element	resources	kg	**2,02E-09**
manganese (Mn)	7439-96-5	element	resources	kg	**2,54E-06**

mercury (Hg)	7439-97-6	element	resources	kg	**9,22^{E}-02**
molybdenum (Mo)	7439-98-7	element	resources	kg	**1,78^{E}-02**
nickel (Ni)	7440-02-0	element	resources	kg	**6,53^{E}-05**
niobium (Nb)	7440-03-1	element	resources	kg	**1,93^{E}-05**
palladium (Pd)	7440-05-3	element	resources	kg	**5,71^{E}-01**
phosphorus (P)	7723-14-0	element	resources	kg	**5,52^{E}-06**
platinum (Pt)	7440-06-4	element	resources	kg	**2,22^{E}+00**
rhenium (Re)	7440-15-5	element	resources	kg	**6,03^{E}-01**
selenium (Se)	7782-49-2	element	resources	kg	**1,94^{E}-01**
silicium (Si; silicon)	7440-21-3	element	resources	kg	**1,40^{E}-11**
silver (Ag)	7440-22-4	element	resources	kg	**1,18^{E}+00**
sodium (Na)	7440-23-5	element	resources	kg	**5,50^{E}-08**
strontium (Sr)	7440-24-6	element	resources	kg	**7,07^{E}-07**
sulfur (S)	7704-34-9	element	resources	kg	**1,93^{E}-04**
tantalum (Ta)	7440-25-7	element	resources	kg	**4,06^{E}-05**
tellurium (Te)	13494-80-9	element	resources	kg	**4,07^{E}+01**
thallium (Tl)	7440-28-0	element	resources	kg	**2,43^{E}-05**
tin (Sn)	7440-31-5	element	resources	kg	**1,62^{E}-02**
titanium (Ti)	7440-32-6	element	resources	kg	**2,79^{E}-08**
tungsten (W); wolfram	7440-33-7	element	resources	kg	**4,52^{E}-03**
uranium (U)	7440-61-1	element	resources	kg	**1,40^{E}-03**
vanadium (V)	7440-62-2	element	resources	kg	**7,70^{E}-07**
yttrium (Y)	7440-65-5	element	resources	kg	**5,69^{E}-07**
zinc (Zn)	7440-66-6	element	resources	kg	**5,38^{E}-04**
zirconium (Zr)	7440-67-7	element	resources	kg	**5,44^{E}-06**

NOTE Source of LCIA model: See Table C.8.

Table C.3 — Characterisation factors concerning acidification potential of soil and water

Substance	CAS No.	Group	Initial emission or extraction	Unit	Characterisation factor kg SO2 eq.
ammonia	7664-41-7	inorganic	air	kg	**1,60^{E}+00**
nitrogen dioxide	10102-44-0	inorganic	air	kg	**5,00^{E}-01**
nitrogen mono oxide	10102-43-9	inorganic	air	kg	**7,60^{E}-01**
nitrogen oxides (as NO2)	11104-93-1	inorganic	air	kg	**5,00^{E}-01**
sulphur dioxide	7446-09-5	inorganic	air	kg	**1,20^{E}+00**
NOTE Source of LCIA model: See Table C.8.					

Table C.4 — Characterisation factors concerning depletion potential of the stratospheric ozone layer

Substance	CAS No.	Group	Initial emission or extraction	Unit	Characterisation factor kg CFC-11 eq.
1,1,1-trichloroethane	71-55-6	halogenated nonaromatic	air	kg	**1,2^{E}-01**
CFC-11	75-69-4	halogenated nonaromatic	air	kg	**1,00^{E}+00**
CFC-113	76-13-1	halogenated nonaromatic	air	kg	**1,00^{E}+00**
CFC-114	76-14-2	halogenated nonaromatic	air	kg	**9,40^{E}-01**
CFC-115	76-15-3	halogenated nonaromatic	air	kg	**4,40^{E}-01**
CFC-12	75-71-8	halogenated nonaromatic	air	kg	**1,00^{E}+00**
HALON (HALON 2401)	124-72-1	halogenated nonaromatic	air	kg	**2,50^{E}-01**
HBFC-1201	1511-62-2	halogenated nonaromatic	air	kg	**1,40^{E}+00**
HALON-1202	75-61-6	halogenated nonaromatic	air	kg	**1,30^{E}+00**
HALON-1211	353-59-3	halogenated nonaromatic	air	kg	**6,00^{E}+00**

HALON-1301	75-63-8	halogenated nonaromatic	air	kg	**1,20^{E}+01**
HBFC-2311	151-67-7	halogenated nonaromatic	air	kg	**1,40^{E}-01**
HBFC-2401 (HALON)	124-72-1 (bis)	halogenated nonaromatic	air	kg	**2,50^{E}-01**
HALON-2402	25497-30-7	halogenated nonaromatic	air	kg	**6,00^{E}+00**
HCFC-123	306-83-2	halogenated nonaromatic	air	kg	**2,00^{E}-02**
HCFC-124	2837-89-0	halogenated nonaromatic	air	kg	**2,00^{E}-02**
HCFC-141b	1717-00-6	halogenated nonaromatic	air	kg	**1,20^{E}-01**
HCFC-142b	75-68-3	halogenated nonaromatic	air	kg	**7,00^{E}-02**
HCFC-22	75-45-6	halogenated nonaromatic	air	kg	**5,00^{E}-02**
HCFC-225ca	422-56-0	halogenated nonaromatic	air	kg	**2,00^{E}-02**
HCFC-225cb	507-55-1	halogenated nonaromatic	air	kg	**3,00^{E}-02**
methyl Chloride	74-87-3	halogenated nonaromatic	air	kg	**2,00^{E}-02**
methylbromide	74-83-9	pesticide	air	kg	**3,8^{E}-01**
tetrachloromethane	56-23-5	halogenated nonaromatic	air	kg	**7,3^{E}-01**

NOTE Source of LCIA model: See Table C.8.

Table C.5 — Characterisation factors concerning global warming potential

Substance	CAS No.	Group	Initial emission or extraction	Unit	Characterisation factor kg CO2 eq.
1,1,1-trichloroethane	71-55-6	halogenated nonaromatic	air	kg	**1,5E+02**
carbon dioxide	124-38-9	inorganic	air	kg	**1,0E+00**
CFC-11	75-69-4	halogenated nonaromatic	air	kg	**4,8E+03**
CFC-113	76-13-1	halogenated nonaromatic	air	kg	**6,1E+03**
CFC-114	76-14-2	halogenated nonaromatic	air	kg	**1,0E+04**
CFC-115	76-15-3	halogenated nonaromatic	air	kg	**7,4E+03**
CFC-12	75-71-8	halogenated nonaromatic	air	kg	**1,1E+04**
CFC-13	75-72-9	halogenated nonaromatic	air	kg	**1,4E+04**
dichloromethane	75-09-2	halogenated nonaromatic	air	kg	**8,7E+00**
dinitrogen oxide	10024-97-2	inorganic	air	kg	**3,0E+02**
HALON-1211	353-59-3	halogenated nonaromatic	air	kg	**1,9E+03**
HALON-1301	75-63-8	halogenated nonaromatic	air	kg	**7,1E+03**
HALON-2402	25497-30-7	halogenated nonaromatic	air	kg	**1,6E+03**
HCFC-123	306-83-2	halogenated nonaromatic	air	kg	**7,7E+01**
HCFC-124	2837-89-0	halogenated nonaromatic	air	kg	**6,1E+02**
HCFC-141b	1717-00-6	halogenated nonaromatic	air	kg	**7,3E+02**
HCFC-142b	75-68-3	halogenated nonaromatic	air	kg	**2,3E+03**
HCFC-22	75-45-6	halogenated nonaromatic	air	kg	**1,8E+03**
HCFC-225ca	422-56-0	halogenated nonaromatic	air	kg	**1,2E+02**
HCFC-225cb	507-55-1	halogenated nonaromatic	air	kg	**6,0E+02**
HFC-125	354-33-6	halogenated nonaromatic	air	kg	**3,5E+03**
HFC-134a	811-97-2	halogenated nonaromatic	air	kg	**1,4E+03**
HFC-143a	420-46-2	halogenated nonaromatic	air	kg	**4,5E+03**
HFC-152a	75-37-6	halogenated nonaromatic	air	kg	**1,2E+02**
HFC-227ea	431-89-0	halogenated nonaromatic	air	kg	**3,2E+03**

HFC-23	75-46-7	halogenated nonaromatic	air	kg	**1,5E+04**
HFC-236fa	690-39-1	halogenated nonaromatic	air	kg	**9,8E+03**
HFC-32	75-10-5	halogenated nonaromatic	air	kg	**6,8E+02**
HFC-43-10mee	138495-42-8	halogenated nonaromatic	air	kg	**1,6E+03**
methane	74-82-8	nonaromatic (alkane)	air	kg	**2,5E+01**
methyl Chloride	74-87-3	halogenated nonaromatic	air	kg	**1,3E+01**
methylbromide	74-83-9	pesticide	air	kg	**5,0E+00**
perfluorobutane	355-25-9	halogenated nonaromatic	air	kg	**8,9E+03**
perfluorocyclobutane	115-25-3	halogenated nonaromatic	air	kg	**1,0E+04**
perfluoroethane	76-16-4	halogenated nonaromatic	air	kg	**1,2E+04**
perfluorohexane	355-42-0	halogenated nonaromatic	air	kg	**9,3E+03**
perfluoromethane	75-73-0	halogenated nonaromatic	air	kg	**7,4E+03**
perfluoropropane	76-19-7	halogenated nonaromatic	air	kg	**8,8E+03**
sulphur hexafluoride	2551-62-4	inorganic	air	kg	**2,3E+04**
tetrachloromethane	56-23-5	halogenated nonaromatic	air	kg	**1,4E+03**
HFC-245fa	460-73-1		air	kg	**1,0E+03**
HFE-125	3822-68-2		air	kg	**1,5E+04**
HFE-134	1691-17-4		air	kg	**6,3E+03**
HFE-143a	421-14-7		air	kg	**7,6E+02**
HCFE-235da2	HCFE235da2		air	kg	**3,5E+02**
HFE-245cb2	HFE245cb2		air	kg	**7,1E+02**
HFE-245fa2	HFE245fa2		air	kg	**6,6E+02**
HFE-254cb2	HFE254cb2		air	kg	**3,6E+02**
HFE-347mcc3	HFE347mcc3		air	kg	**5,8E+02**
NF3	7783-54-2		air	kg	**1,7E+04**
HFE-356pcc3	HFE-356pcc3		air	kg	**1,1E+02**
PFC-4-1-12	594-91-2		air	kg	**9,2E+03**
PFC-9-1-18	60433-11-6		air	kg	**7,5E+03**
trifluoromethyl sulphur pentafluoride	trifluoromethyl sulphur		air	kg	**1,8E+04**

	pentafluoride				
HFE-347pcf2	HFE-347pcf2		air	kg	**5,8^{E}+02**
(HFE-7100)	(HFE-7100)		air	kg	**3,0^{E}+02**
HFE-569sf2	HFE-569sf2		air	kg	**5,9^{E}+01**
HFE-43-10pccc124 (H-Galden1040x)	HFE-43-10pccc124 (H-Galden1040x)		air	kg	**1,9^{E}+03**
HFE-236ca12 (HG-10)	HFE-236ca12 (HG-10)		air	kg	**2,8^{E}+03**
HFE-338pcc13 (HG-01)	HFE-338pcc13 (HG-01)		air	kg	**1,5^{E}+03**
PFPMIE	PFPMIE		air	kg	**1,0^{E}+04**
NOTE Source of LCIA model: See Table C.8.					

Table C.6 — Characterisation factors concerning eutrophication potential

Substance	CAS No.	Group	Initial emission or extraction	Unit	Characterisation factor kg $PO4_{-3}$ eq.
ammonia	7664-41-7	inorganic	air	kg	**3,50E-01**
ammonium	14798-03-9	inorganic	air	kg	**3,30E-01**
dinitrogen oxide	10024-97-2	inorganic	air	kg	**2,70E-01**
nitrate	14797-55-8	inorganic	air	kg	**1,00E-01**
nitric acid	7697-37-2	inorganic	air	kg	**1,00E-01**
nitrogen	7727-37-9	inorganic	air	kg	**4,20E-01**
nitrogen dioxide	10102-44-0	inorganic	air	kg	**1,30E-01**
nitrogen mono oxide	10102-43-9	inorganic	air	kg	**2,00E-01**
nitrogen oxides (as NO2)	11104-93-1	inorganic	air	kg	**1,30E-01**
phosphate	14265-44-2	inorganic	air	kg	**1,00E+00**
phosphoric acid	7664-38-2	inorganic	air	kg	**9,70E-01**
phosphorus	7723-14-0	inorganic	air	kg	**3,06E+00**
ammonia	7664-41-7	inorganic	fresh water	kg	**3,50E-01**
ammonium	14798-03-9	inorganic	fresh water	kg	**3,30E-01**
chemical oxigen demand (COD)	COD		fresh water	kg	**2,20E-02**
nitrate	14797-55-8	inorganic	fresh water	kg	**1,00E-01**
nitric acid	7697-37-2	inorganic	fresh water	kg	**1,00E-01**
nitrite	14797-65-0	inorganic	fresh water	kg	**1,00E-01**
nitrogen	7727-37-9	inorganic	fresh water	kg	**4,20E-01**
phosphate	14265-44-2	inorganic	fresh water	kg	**1,00E+00**
phosphoric acid	7664-38-2	inorganic	fresh water	kg	**9,70E-01**
phosphorus	7723-14-0	inorganic	fresh water	kg	**3,06E+00**
ammonia	7664-41-7	inorganic	marine water	kg	**3,50E-01**
ammonium	14798-03-9	inorganic	marine water	kg	**3,30E-01**

chemical oxigen demand (COD)	COD		marine water	kg	**2,20E-02**
nitrate	14797-55-8	inorganic	marine water	kg	**1,00E-01**
nitric acid	7697-37-2	inorganic	marine water	kg	**1,00E-01**
nitrite	14797-65-0	inorganic	marine water	kg	**1,00E-01**
nitrogen	7727-37-9	inorganic	marine water	kg	**4,20E-01**
phosphate	14265-44-2	inorganic	marine water	kg	**1,00E+00**
phosphoric acid	7664-38-2	inorganic	marine water	kg	**9,70E-01**
phosphorus	7723-14-0	inorganic	marine water	kg	**3,06E+00**
ammonia	7664-41-7	inorganic	agric. soil	kg	**3,50E-01**
ammonium	14798-03-9	inorganic	agric. soil	kg	**3,30E-01**
nitrate	14797-55-8	inorganic	agric. soil	kg	**1,00E-01**
nitric acid	7697-37-2	inorganic	agric. soil	kg	**1,00E-01**
nitrogen	7727-37-9	inorganic	agric. soil	kg	**4,20E-01**
phosphate	14265-44-2	inorganic	agric. soil	kg	**1,00E+00**
phosphoric acid	7664-38-2	inorganic	agric. soil	kg	**9,70E-01**
phosphorus	7723-14-0	inorganic	agric. soil	kg	**3,06E+00**
ammonia	7664-41-7	inorganic	indus. soil	kg	**3,50E-01**
ammonium	14798-03-9	inorganic	indus. soil	kg	**3,30E-01**
nitrate	14797-55-8	inorganic	indus. soil	kg	**1,00E-01**
nitric acid	7697-37-2	inorganic	indus. soil	kg	**1,00E-01**
nitrogen	7727-37-9	inorganic	indus. soil	kg	**4,20E-01**
phosphate	14265-44-2	inorganic	indus. soil	kg	**1,00E+00**
phosphoric acid	7664-38-2	inorganic	indus. soil	kg	**9,70E-01**
phosphorus	7723-14-0	inorganic	indus. soil	kg	**3,06E+00**
phosphorus(V)oxide (P2O5)	1314-56-3	inorganic	air	kg	**1,34E+00**
phosphorus(V)oxide (P2O5)	1314-56-3	inorganic	fresh water	kg	**1,34E+00**
phosphorus(V)oxide (P2O5)	1314-56-3	inorganic	marine water	kg	**1,34E+00**

phosphorus(V)oxide (P2O5)	1314-56-3	inorganic	agric. soil	kg	**1,34^{E}+00**
phosphorus(V)oxide (P2O5)	1314-56-3	inorganic	indus. soil	kg	**1,34^{E}+00**
NOTE Source of LCIA model: See Table C.8.					

Table C.7 — Characterisation factors concerning formation potential of tropospheric ozone

Substance	CAS No.	Group	Initial emission or extraction	Unit	Characterisation factor kg ethylene eq.
1,1,1-trichloroethane	71-55-6	halogenated nonaromatic	air	kg	**9,0^{E}-03**
1,2,3-trimethyl benzene	526-73-8	halogenated aromatic	air	kg	**1,27^{E}+00**
1,2,4-trimethylbenzene	95-63-6	halogenated aromatic	air	kg	**1,28^{E}+00**
1,3,5-trimethylbenzene	108-67-8	aromatic	air	kg	**1,38^{E}+00**
1,3-butadiene	106-99-0	nonaromatic (alkene)	air	kg	**8,51^{E}-01**
1-butanol	71-36-3	nonaromatic (alcohol)	air	kg	**6,20^{E}-01**
1-butene	106-98-9	nonaromatic (alkane)	air	kg	**1,08^{E}+00**
1-butoxypropanol	57018-52-7	nonaromatic (alcohol)	air	kg	**4,63^{E}-01**
1-butyl acetate	123-86-4	nonaromatic (ester)	air	kg	**2,69^{E}-01**
1-hexene	592-41-6	nonaromatic (alkene)	air	kg	**8,74^{E}-01**
1-methoxy-2-propanol	107-98-2	nonaromatic (alcohol)	air	kg	**3,55^{E}-01**
1-pentene	109-67-1	nonaromatic (alkene)	air	kg	**9,77^{E}-01**
1-propanol	71-23-8	nonaromatic (alcohol)	air	kg	**5,61^{E}-01**
1-propyl benzene	103-65-1	aromatic	air	kg	**6,36^{E}-01**
1-propylacetate	109-60-4	nonaromatic (ester)	air	kg	**2,82^{E}-01**
1-undecane	1120-21-4	nonaromatic (alkane)	air	kg	**3,84^{E}-01**
2,2-dimethylbutane	75-83-2	nonaromatic (alkane)	air	kg	**2,41^{E}-01**
2.3- dimethylbutane	79-29-8	nonaromatic (alkane)	air	kg	**5,41^{E}-01**
2-butanone	78-93-3	nonaromatic (ketone)	air	kg	**3,73^{E}-01**
2-butoxy-ethanol	111-76-2	nonaromatic (alkane)	air	kg	**4,83^{E}-01**
2-ethoxy-ethanol	110-80-5	nonaromatic (alcohol)	air	kg	**3,86^{E}-01**

2-methoxy-ethanol	109-86-4	nonaromatic (alcohol)	air	kg	**3,07E-01**
2-methyl-1-butene	563-46-2	nonaromatic (alkene)	air	kg	**7,71E-01**
2-methyl-2-butene	513-35-9	nonaromatic (alkene)	air	kg	**8,42E-01**
2-methylbutan-1-ol	137-32-6	nonaromatic (alcohol)	air	kg	**4,89E-01**
2-methylbutan-2-ol	75-85-4	nonaromatic (alcohol)	air	kg	**2,28E-01**
2-methylhexane	591-76-4	nonaromatic (alkane)	air	kg	**4,11E-01**
2-methylpentane	107-83-5	nonaromatic (alkane)	air	kg	**4,20E-01**
3,5-diethyltoluene	25550-13-4	aromatic	air	kg	**1,30E+00**
3,5-dimethylethylbenzene	934-74-7	aromatic	air	kg	**1,32E+00**
3-methyl-1-butene	563-45-1	nonaromatic (alkene)	air	kg	**6,71E-01**
3-methylbutan-1-ol	123-51-3	nonaromatic (alcohol)	air	kg	**4,33E-01**
3-methylbutan-2-ol	598-75-4	nonaromatic (alcohol)	air	kg	**4,06E-01**
3-methylhexane	589-34-4	nonaromatic (alkane)	air	kg	**3,64E-01**
3-methylpentane	96-14-0	nonaromatic (alkane)	air	kg	**4,79E-01**
3-pentanol	584-02-1	nonaromatic (alcohol)	air	kg	**5,95E-01**
acetaldehyde	75-07-0	nonaromatic (alkane)	air	kg	**6,41E-01**
acetic acid	64-19-7	nonaromatic (carboxylic acid)	air	kg	**9,70E-02**
acetone	67-64-1	nonaromatic (ketone)	air	kg	**9,40E-02**
acetylene	74-86-2	nonaromatic (alkyne)	air	kg	**8,50E-02**
benzaldehyde	100-52-7	aromatic	air	kg	**-9,20E-02**
benzene	71-43-2	aromatic	air	kg	**2,18E-01**
butane	106-97-8	nonaromatic (alkane)	air	kg	**3,52E-01**
butyraldehyde	123-72-8	nonaromatic (aldehyde)	air	kg	**7,95E-01**
carbon monoxide	630-08-0	inorganic	air	kg	**2,70E-02**
cis-2-butene	590-18-1	nonaromatic (alkene)	air	kg	**1,15E+00**
cis-2-hexene	cis-2-Hexene	nonaromatic (alkene)	air	kg	**1,07E+00**
cis-2-pentene	627-20-3	nonaromatic (alkene)	air	kg	**1,12E+00**
cis-dichloroethene	156-59-2	halogenated nonaromatic	air	kg	**4,47E-01**

cyclohexane	110-82-7	nonaromatic (alkane)	air	kg	**2,90^{E}-01**
cyclohexanol	108-93-0	nonaromatic (alcohol)	air	kg	**5,18^{E}-01**
cyclohexanone	108-94-1	nonaromatic (alkane)	air	kg	**2,99^{E}-01**
decane	124-18-5	nonaromatic (alkane)	air	kg	**3,84^{E}-01**
diacetone alcohol	123-42-2	nonaromatic (alcohol)	air	kg	**3,07^{E}-01**
dichloromethane	75-09-2	halogenated nonaromatic	air	kg	**6,8^{E}-02**
diethyl ether	60-29-7	nonaromatic (ether)	air	kg	**4,45^{E}-01**
diethylketone	96-22-0	nonaromatic (ketone)	air	kg	**4,14^{E}-01**
diisopropylether	108-20-3	nonaromatic (ether)	air	kg	**3,98^{E}-01**
dimethoxy methane	109-87-5		air	kg	**1,64^{E}-01**
dimethyl carbonate	616-38-6		air	kg	**2,50^{E}-02**
dimethyl ether	115-10-6	nonaromatic (ether)	air	kg	**1,89^{E}-01**
dodecane	112-40-3	nonaromatic (alkane)	air	kg	**3,57^{E}-01**
ethane	74-84-0	nonaromatic (alkane)	air	kg	**1,23^{E}-01**
ethanol	64-17-5	nonaromatic (alcohol)	air	kg	**3,99^{E}-01**
ethyl acetate	141-78-6	nonaromatic (ester)	air	kg	**2,09^{E}-01**
ethyl- *trans*-butyl ether	637-92-3 0	nonaromatic (ether)	air	kg	**2,44^{E}-01**
ethylbenzene	100-41-4	aromatic	air	kg	**7,3^{E}-01**
ethylene	74-85-1	nonaromatic (alkene)	air	kg	**1,0^{E}+00**
ethylene glycol	107-21-1	nonaromatic (ester)	air	kg	**3,73^{E}-01**
formaldehyde	50-00-0	nonaromatic (aldehyde)	air	kg	**5,19^{E}-01**
formic acid	64-18-6	nonaromatic (carboxylic acid)	air	kg	**3,20^{E}-02**
heptane	142-82-5	nonaromatic (alkane)	air	kg	**4,94^{E}-01**
hexan-2-one	591-78-6	nonaromatic (ketone)	air	kg	**5,72^{E}-01**
hexan-3-one	589-38-8	nonaromatic (ketone)	air	kg	**5,99^{E}-01**
hexane	110-54-3	nonaromatic (alkane)	air	kg	**4,82^{E}-01**
*iso*butane	75-28-5	nonaromatic (alkane)	air	kg	**3,07^{E}-01**
*iso*butanol	78-83-1	nonaromatic (alcohol)	air	kg	**3,60^{E}-01**
*iso*butene	115-11-7	nonaromatic (alkene)	air	kg	**6,27^{E}-01**

*iso*butyraldehyde	78-84-2	nonaromatic (aldehyde)	air	kg	**5,14^{E}-01**
*iso*pentane	78-78-4	nonaromatic (alkane)	air	kg	**4,05^{E}-01**
*iso*prene	78-79-5	nonaromatic (alkene)	air	kg	**1,09^{E}+00**
*iso*propanol	67-63-0	nonaromatic (alcohol)	air	kg	**1,88^{E}-01**
*iso*propyl acetate	108-21-4	nonaromatic (ester)	air	kg	**2,11^{E}-01**
*iso*propyl benzene	98-82-8	aromatic	air	kg	**5,00^{E}-01**
meta-Ethyltoluene	620-14-4	aromatic	air	kg	**1,02^{E}+00**
meta-Xylene	108-38-3	aromatic	air	kg	**1,11^{E}+00**
methane	74-82-8	nonaromatic (alkane)	air	kg	**6,00^{E}-03**
methanol	67-56-1	nonaromatic (alcohol)	air	kg	**1,40^{E}-01**
methyl acetate	79-20-9	nonaromatic (ester)	air	kg	**5,90^{E}-02**
methyl chloride	74-87-3	halogenated nonaromatic	air	kg	**5,00^{E}-03**
methyl formate	107-31-3	nonaromatic (ester)	air	kg	**2,70^{E}-02**
methyl *Iso*butyl ketone	108-10-1	nonaromatic (ketone)	air	kg	**4,90^{E}-01**
methyl propyl ketone	107-87-9	nonaromatic (ketone)	air	kg	**5,48^{E}-01**
methyl *tert*-butyl ether	1634-04-4	nonaromatic (ether)	air	kg	**1,75^{E}-01**
methyl *tert*-butylketone	75-97-8	nonaromatic (ketone)	air	kg	**3,23^{E}-01**
methyl-isopropylketone	563-80-4	nonaromatic (ketone)	air	kg	**3,64^{E}-01**
neopentane	463-82-1	nonaromatic (alkane)	air	kg	**1,73^{E}-01**
nitrogen dioxide	10102-44-0	inorganic	air	kg	**2,8^{E}-02**
nitrogen mono oxide	10102-43-9	inorganic	air	kg	**-4,27^{E}-01**
nonane	111-84-2	nonaromatic (alkane)	air	kg	**4,14^{E}-01**
octane	111-65-9	nonaromatic (alkane)	air	kg	**4,53^{E}-01**
ortho-ethyltoluene	611-14-3	aromatic	air	kg	**8,98^{E}-01**
ortho-xylene	95-47-6	aromatic	air	kg	**1,05^{E}+00**
para-ethyltoluene	622-96-8	aromatic	air	kg	**9,06^{E}-01**
para-xylene	106-42-3	aromatic	air	kg	**1,01^{E}+00**
pentanaldehyde	Pentanaldehyde	nonaromatic (aldehyde)	air	kg	**7,65^{E}-01**

pentane	109-66-0	nonaromatic (alkane)	air	kg	**3,95^{E}-01**
propane	74-98-6	nonaromatic (alkane)	air	kg	**1,76^{E}-01**
propanoic acid	79-09-4	nonaromatic (carboxylic acid)	air	kg	**1,50^{E}-01**
propionaldehyde	123-38-6	nonaromatic (aldehyde)	air	kg	**7,98^{E}-01**
propylene	115-07-1	nonaromatic (alkene)	air	kg	**1,12^{E}+00**
propylene glycol	57-55-6	nonaromatic (ester)	air	kg	**4,57^{E}-01**
sec-butanol	78-92-2	nonaromatic (alcohol)	air	kg	**4,00^{E}-01**
sec-butyl acetate	105-46-4	nonaromatic (ester)	air	kg	**2,75^{E}-01**
styrene	100-42-5	aromatic	air	kg	**1,42^{E}-01**
sulphur dioxide	7446-09-5	inorganic	air	kg	**4,8^{E}-02**
tertiary-butanol	75-65-0	nonaromatic (alcohol)	air	kg	**1,06^{E}-01**
tertiary-butyl acetate	540-88-5	nonaromatic (ester)	air	kg	**5,30^{E}-02**
tetrachloroethylene	127-18-4	halogenated nonaromatic	air	kg	**2,9^{E}-02**
toluene	108-88-3	aromatic	air	kg	**6,37^{E}-01**
trans-2-butene	624-64-6	nonaromatic (alkene)	air	kg	**1,13^{E}+00**
trans-2-hexene	4050-45-7	nonaromatic (alkene)	air	kg	**1,07^{E}+00**
trans-2-pentene	646-04-8	nonaromatic (alkene)	air	kg	**1,12^{E}+00**
trans-dichloroethene	156-60-5	halogenated nonaromatic	air	kg	**3,92^{E}-01**
trichloroethylene	79-01-6	halogenatednonaromatic	air	kg	**3,25^{E}-01**
trichloromethane	67-66-3	halogenated nonaromatic	air	kg	**2,3^{E}-02**
NOTE Sources of LCIA model: See Table C.8.					

Table C.8 — Sources for life-cycle impact assessment (LCIA) models

characterisation factors	LCIA models
GWP (100-years time horizon)	Global Warming Potential for a 100-year time horizon as in IPCC: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment. Report of the Intergovernmental Panel on Climate Change. [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]
POCP	Jenkin, M.E. & G.D. Hayman, 1999: Photochemical ozone creation potentials for oxygenated volatile organic compounds: sensitivity to variations in kinetic and mechanistic parameters. Atmospheric Environment 33: 1775-1293. Derwent, R.G., M.E. Jenkin, S.M. Saunders & M.J. Pilling, 1998. Photochemical ozone creation potentials for organic compounds in Northwest Europe calculated with a master chemical mechanism. Atmospheric Environment, 32. p 2429-2441.
ODP (steady state)	Ozone Depletion Potentials for Steady-state as in WMO (World Meteorological Organisation): Scientific assessment of ozone depletion. Global Ozone Research and Monitoring Project Reports. 2003
AP (average Europe total)	Acidification Potentials for average Europe total as in Huijbregts, M., 1999b: Life cycle impact assessment of acidifying and eutrophying air pollutants. Calculation of equivalency factors with RAINS-LCA. Interfaculty Department of Environmental Science, Faculty of Environmental Science, University of Amsterdam, The Netherlands.
EP	Heijungs, R., J. Guinée, G. Huppes, R.M. Lankreijer, H.A. Udo de Haes, A. Wegener Sleeswijk, A.M.M. Ansems, P.G. Eggels, R. van Duin, H.P. de Goede, 1992: Environmental Life Cycle
ADP fossil (ultimate ultimate reserves) ADP non fossil (ultimate ultimate reserves)	Abiotic Resource Depletion Potentials for ultimate ultimate reserves as in Oers, L.F.C.M., van & Koning, A., de & Guinée, J.B. & Huppes, G., 2002. Abiotic resource depletion in LCA: improving characterisation factors for abiotic depletion as recommended in the new Dutch LCA Handbook. Delft: Ministry of Transport, Public Works and Water Management.

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[11] ISO 15392:2008, *Sustainability in building construction — General principles*

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

[13] ISO 21931-1:2010, *Sustainability in building construction — Framework for methods of assessment of the environmental performance of construction works — Part 1: Buildings*

[14] European Directive 2007/37/EC European Emission Standard

[15] European Waste Framework Directive: Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

[16] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

[17] Guidance paper F, Durability and the Construction Products Directive

[18] EUROSTAT 2001

[19] European Life Cycle Data Base http://lca.jrc.ec.europa.eu/lcainfohub/index.vm

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