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GUIDANCE DOCUMENT

INTRODUCTION

This Guidance document is intended to be read in conjunction with the Product Category Rules for Unreinforced Concrete produced for the WBCSD Cement Sustainability Initiative. Its aim is to explain the Product Category Rules (PCR) to a general audience and provide hypothetical examples of how it should be used in the concrete industry to aid its implementation.

HOW IS THIS DOCUMENT LAID OUT?

The Guidance is interspersed with the PCR, and highlighted in GREEN.

The PCR is based on EN 15804:2012. Where text has been taken directly from the version of the standard circulated for Final Enquiry, this text has been included in italics.

Terms and definitions are provided in Section 5, and Abbreviations are found in Section 6.

WHAT ARE ENVIRONMENTAL PRODUCT DECLARATIONS (EPD)?

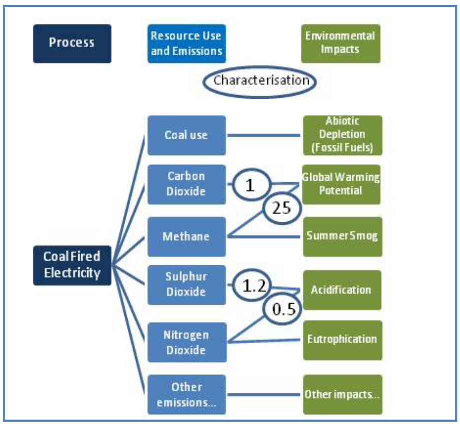
An Environmental Product Declaration (EPD) is a Type III environmental declaration as defined by ISO 14025:2006. It is a voluntary document that provides data in a predefined format, including information about the environmental impacts associated with the manufacturing of a product or system.

EPD are issued by a Program Operator, following rules known as Product Category Rules (PCR), which ensure that products are assessed in a consistent manner.

HOW IS AN EPD PRODUCED?

In order to produce an EPD, a Life Cycle Assessment (LCA) must be undertaken. An LCA is an evaluation of the environmental impacts of a product, which considers all the relevant stages in its life cycle, from extraction of raw materials (the “cradle”) to the disposal at the end of the product’s useful life (the “grave”). For intermediate products and final products where many scenarios may apply, the later life cycle stages are often excluded from the assessment and the resulting scope is referred to as “cradle to gate” or “cradle to site”.

The first step in completing an LCA is to obtain manufacturer’s data on their inputs (materials and energy) and outputs (products, wastes and emissions to air, water and land) of a process. This data is used to produce an LCA model, which when linked with LCA data for the “upstream” and “downstream” processes such as raw materials manufacture, energy production or waste treatment, produce a Life Cycle Inventory, which is a full list of the resource use and environmental emissions or environmental burdens.



These environmental burdens are then assigned to impact categories by applying technical or scientific coefficients known as characterisation factors. An example of this process is shown in Figure 0 1 for some impact categories. For instance, methane has 25 times the potential of CO_2 for Global Warming. The total impact of a product’s production can be calculated by summing the impacts of all emissions and resource uses. The number of impact categories provided by an EPD can vary depending on the PCR but this PCR assesses seven core environmental impact categories.

HOW RIGOROUS ARE EPD?

In order to meet the ISO 14025:2006 requirements, an EPD must give independently verified, quantitative information on the environmental effects of a product, based on data provided by the manufacturer. All EPD follow the ISO 14040 framework, an international standard that defines the underlying concepts of Life Cycle Assessment. EPD are verified by an external independent examiner, who has knowledge of LCA and the specific products. EPD aim to capture at least 98% of impacts, and should be representative of a year's production. It is accepted that there will be variation for a product produced at an individual time or factory compared to that annual average. Differences for key indicator results between EPD for products of less than 10% where there is limited shared background information cannot generally be considered to provide a definitive comparison, due to the uncertainties associated with the different upstream data and assumptions made for the products. However, for similar products, where background data is shared (for example the same upstream data for electricity, cement and aggregates is used), then much smaller differences between products can be considered relevant.

HOW CAN EPD BE USED?

The Environmental Product Declaration is a standardised document, which can used to communicate the potential environmental impacts associated with a product, but EPD may only be used to compare the environmental properties of several products or systems if they have the same function in the building or other construction works and are based on the same PCR – this is a requirement of the ISO standard for EPD. Particular attention should be paid to the declared unit of the EPD, as well as the properties of the product within the building or other construction works (insulation, strength, etc), in order to make a relevant comparison.

An EPD is essential for sustainable building certifications, for instance according to:

- DGNB – German Sustainable Building Certification Scheme: a building level LCA must be carried out, and IBU EPD can be used and are included in various calculation tools. Credits are given for building materials with low environmental impacts.
- BREEAM – UK Environmental Building Certification Scheme: uplift credits are available for products qualified by independently verified EPD.
- LEED – US Environmental Building Certification Scheme: Pilot Credits are available for products with LCA-based assessments – the most credits are available for independently verified, manufacturer- specific EPD.

GENERAL INTRODUCTION

The International EPD® System is based on a hierarchic approach following the international standards:

- ISO 9001, Quality management systems
- ISO 14001, Environmental management systems
- ISO 14040, LCA - Principles and procedures
- ISO 14044, LCA - Requirements and guidelines
- ISO 14025, Type III environmental declarations
- ISO 21930, Environmental declaration of building products
- EN 15804, Sustainability of construction works — Environmental product declarations

The General programme Instructions are based on these standards, as well as instructions for developing Product Category Rules (PCR).

The documentation to The International EPD® System includes three separate parts (www.environdec.com):

- Introduction, intended uses and key programme elements
- General Programme Instructions Supporting annexes
- Supporting annexes

This PCR document specifies further and adds additional minimum requirements on EPDs of the product group defined below complementary to the above mentioned general requirement documents. Principle programme elements concerning the Product Category Rules (PCR) included in The International EPD® System are presented below.

PURPOSE	ELEMENT IDENTIFICATION AND PRINCIPAL APPROACH
Complying with principles set in ISO 14025 on modularity and comparability	1. "Book-keeping LCA approach" 2. A Polluter-Pays (PP), allocation method
Simplifying work to develop Product Category Rules (PCR)	3. PCR Module Initiative (PMI) in order to structure PCR in modules according to international classification 4. PCR moderator for leadership and support of the PCR work
Secure international participation in PCR work	5. Global PCR Forum for open and transparent EPD stakeholder consultation
Facilitating, identification and collection of LCA-based information	6. Selective data quality approach for specific and generic data

Product Category Rules (PCR) are specified for specified information modules “gate-to-gate”, so called core modules. The structure and aggregation level of the core modules are defined by the United Nation Statistics Division - Classification Registry CPC codes (http://unstats.un.org). The PCR also provides rules for which methodology and data to use in the full LCA, i.e. life cycle parts up-streams and down-streams the core module.

The PCR also has requirements on the information given in the EPD, e.g. additional environmental information. A general requirement on the information in the EPD is that all information given in the EPD, mandatory and voluntary, shall be verifiable.

In the EPD, the environmental performance associated with each of the three life-cycle stages mentioned above are reported separately.

0 GENERAL INFORMATION

Date:	2013-02-12
Registration no:	PCR 2013:02
This PCR was prepared by:	WBCSD Cement Sustainability Initiative
Appointed PCR moderator:	Jane Anderson, PE International, j.anderson@pe-international.com
Open consultation period:	2012-09-11 until 2012-10-23
Valid within the following geographical representativeness:	Global
Valid until:	2018-02-12
More information on this PCR's website:	http://environdec.com/en/Product-Category-Rules/Detail/?Pcr=8108

1 SCOPE

1.1 GENERAL

Product Category Rules (PCR) are the underlying rules which are used to produce an Environmental Product Declaration. Environmental Product Declarations are known as EPD, and are an example of a Type III Environmental Label as defined in ISO Standard ISO 14020:2001, Environmental Labels and Declarations – General principles.

An EPD is a document which provides consistent, robust and independently verified data about the environmental impacts and aspects of a product or service. EPD are based on a process known as Life Cycle Assessment or LCA, and are governed by a number of International and European standards including ISO 14025:2006 for Type III EPD, ISO 21930:2007 for EPD for construction products and EN 15804, a European standard providing core rules for Product Category Rules for Construction Products which will be published in 2012. This PCR is intended to be compliant with all of these standards mentioned and has been based on EN 15804.

The PCR are the rules which specify in detail how a particular product category, such as unreinforced concrete, should be considered, to ensure that EPD for this product category are considered and calculated in the same way, and the results can therefore be considered as consistent.

This PCR covers the Product Category "unreinforced concrete", and can be applied to any unreinforced concrete product, including ready mix concrete, and precast concrete products such as blocks.

The PCR:

- defines the parameters, such as environment impact indicators (such as global warming potential) and inventory indicators (such as net freshwater consumption) to be declared and the way in which they are collated (i.e. – how they are considered and calculated) and reported,
- describes the stages of a concrete product's life cycle (such as extraction or manufacture or installation) which are considered in the EPD and which processes are to be included within each stage,
- defines rules for the provision of additional information about the product to enable further life cycle stages (such as transport to site or disposal) to be assessed,
- includes the rules (such as the system boundary, cut-offs and allocation rules) for calculating the Life Cycle Inventory (LCI) - this is the list of resources, outputs and emissions to air, water and land associated with the

product and the Life Cycle Impact Assessment (LCIA) - the environmental impacts resulting from the inventory) underlying the EPD, including the specification of the data quality (the age, representativeness and geography of datasets for upstream and downstream processes) to be applied,

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

EPD are intended to enable building or construction works level evaluation, and EPD can only be used to make product to product comparisons when the effect of the products at the building or construction works level, over the life cycle, has been considered. As a result, product to product comparisons using cradle to gate or cradle to site EPD can only be made in very limited circumstances, which are set out in the PCR.

The rules for reporting environmental and health information in relation to emissions to air, water and land from the product in use, the effect on “indoor air quality” and “run-off” or “eluate” are not yet defined, measured and reported in an agreed manner and standards are still being developed. As these issues relate to the phase of the life cycle after the product has been installed, at present, this is an area where the PCR is expected to develop in the future.

1.2 OBJECTIVE OF THIS PCR

This PCR is a set of specific rules, requirements and guidelines for developing Type III environmental declarations, known as Environmental Product Declarations (EPD) for the product category of unreinforced concrete.

An EPD according to this PCR will provide consistent and quantified environmental information for an unreinforced concrete product on a harmonized and scientific basis. This PCR is intended to be compliant with EN 15804 and therefore cradle to gate EPD produced in accordance with this PCR should be usable within Europe within any building or construction works level environmental assessment compliant with EN 15804 and/or EN 15978.

Europe has developed a suite of environmental standards through Technical Committee TC350. These include EN 15804 which sets out how to develop Product Category Rules for construction products and EN 15978 which sets out how to undertake building level assessment. These standards have been developed to overcome the barriers to trade which have been experienced with the use of various incompatible national EPD schemes. At the time of writing, the use of EPD and building or construction works level assessment is most advanced in Europe, and for this reason, EN 15804 has been chosen as the underlying standard. Work is on-going in North America and Australasia for example developing PCRs and building level assessments, and at present, we understand that these are looking to use EN 15804 as an underlying standard.

The purpose of an EPD in the construction sector is to provide the basis for assessing buildings and other construction works, and to assist in identifying those construction products which cause less stress to the environment considering the whole building life cycle.

Thus the objective of this PCR is to ensure:

- *the provision of verifiable and consistent data for an EPD, based on LCA;*
- *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.*

Declarations based on this PCR are not comparative assertions.

A comparative assertion is an environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function. An EPD does not make any statements that the product covered by the EPD is better or worse than any other product.

An EPD produced according to this PCR can be used to assess the impact of a building or construction works, using the data from many EPD in order to “build” the impact of the building or construction works.

1.3 TYPES OF EPD WITH RESPECT TO LIFE CYCLE STAGES COVERED

The LCA based information in an EPD provided by this PCR covers:

- The product stage. A product EPD covers raw material supply, transport, manufacturing and associated processes; this EPD is said to be “cradle to gate”.

Using terminology from EN 15804 a cradle to gate EPD uses information modules A1 to A3. An information module is EPD data for a specific life cycle phase and product, which can be used with other information modules for the product to cover the full life cycle, and can be combined with information modules for other products to provide information for product systems or building or construction works.

Additionally, EPD provided by this PCR may include LCA based information modules covering two further life cycle stages, known as “cradle to gate with options”:

- the transport to construction site stage (Information module A4 from EN 15804)
- the construction stage (Information module A5 from EN 15804).

The Cradle to gate stage must be included in any EPD, and should remain the same for a given manufacturing location, irrespective of where the product is used. The transport to construction site and construction stage modules may vary depending on where the product is delivered and how it is used in the building or construction works. For this reason, these information modules A4 and A5 are based on a scenario, for example, (e.g. the typical situation, or a common situation), and are optional, as they may not be appropriate for many customers as their scenario may be based on using the same product in a different situation.

EPD for other products or using other PCRs may provide LCA based information covering additional life cycle stages as follows:

- The product stage and selected further life cycle stage including the use phase (information modules B1 to B7 from EN15804), and end-of-life (information modules C1 to C4 from EN 15804). Although outside the system boundary, EPD may also provide information on the benefits of recycling and reuse beyond the system boundary (Information module D from EN 15804);
- The full life cycle of a product according to the system boundary (see 2.3.4). In this case the EPD covers the product manufacturing stage, transportation to the construction site, installation into the building or construction works, use and maintenance, replacements, demolition, waste processing for re-use, recovery, recycling and disposal, and disposal. Such a system boundary 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 a cradle to grave EPD, the benefits of recycling beyond the system boundary (information module D) may also be included.

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.

Guidance Examples: It is possible to have an EPD for a substance or preparation (e.g. cement), for a product (e.g. concrete block, concrete kerb or concrete slab), for a construction service (e.g. cleaning service as part of maintenance) and, for an assembly of products, and/or a construction element (e.g. wall).

1.4 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 of the product within the building or construction works .

The Cradle to Gate EPD as covered by this PCR are not provided in the context of a building or construction works and cannot be used to compare construction products and construction services unless the considerations below are met.

Comparisons are possible at the sub-building level, e.g. for assembled systems, components, or for products covering the cradle to gate life cycle stage if it is ensured that the comparison considers the products in the context of the entire building or construction works – this 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*

- *the processes and impacts of the excluded 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.

The client for the building or construction works will have provided a brief – this may say that they require a specific functionality for a particular part of the building or construction works – for example, that a meeting room needs a given acoustic performance and that the building needs to meet Passivhaus standards. In this case, the internal walls of the room will need to meet a given acoustic performance, but not a specific thermal performance. The external walls will need to meet both an acoustic and a thermal performance. Two concrete blocks, with different thermal performance, but which both met the client's brief in terms of acoustic performance, could be compared for use in the internal walls.

The difference between two products may appear significant at the product level, but may be insignificant in the building or construction works context.

As the EPD covered by this PCR do not cover all life cycle stages, then investigations will be required to determine the environmental aspects and impacts of specific scenarios for the impacts beyond the cradle to gate life cycle stage. These calculations shall be based on scenarios and conditions that are appropriate for the building or construction works as the object of assessment.

Guidance: Examples are provided below where two concrete blocks can or cannot be compared directly taking into account the requirements above:

Two concrete blocks, with different thermal resistances and/or thermal mass, used in an external wall: in this case, the two blocks may affect the amount of heat required for the building over its life in different ways and this would need to be taken into consideration for any comparison. Alternatively, additional materials to match the performance of the two products (if a particular performance is required from the client's brief) would need to be included in the comparison.

Two concrete blocks with different thermal resistance used in an internal wall: in this case, the difference in functionality would not alter the thermal performance of the building and the products could therefore be compared.

Two concrete floor slabs with different densities: in this case, the heavier floor slab may require stronger or deeper foundations, and this would need to be taken into consideration in any comparison of the two products.

Two concrete blocks, one using thin joint mortar, the other conventional: in this instance, the block and mortar would need to be considered as a system and the two systems would need to be compared.

Two concretes, one using expanded polystyrene (EPS) as an aggregate: these two concretes would have different End of Life Scenarios owing to their different constituents and this would need to be included in any comparison.

1.5 ADDITIONAL INFORMATION PROVIDED IN THE EPD

This PCR allows the provision of additional technical information which has not been derived from LCA and that forms part of the EPD by providing a basis for the development of scenarios. Such Additional Technical information describes technical conditions that could be used to develop scenarios and characterise the product's technical and functional performance during the excluded life cycle stages "Transport to site", "Construction", "Use" and the "End of life", for any scenario based calculations of the LCA based parameters. See also 4.2.

Two examples of the type of additional information that could be provided to enable the subsequent development of LCA for scenarios are included below.

Additional Information	**Typical transport to site for X Ltd's concrete blocks in UK**
Fuel type and consumption of vehicle or vehicle type used for transport e.g. long distance truck, boat etc.	Road, 28 tonne GLW, Diesel Litres/100km, EURO Class
Distance	120 km
Capacity utilisation (including empty returns)	70%

Bulk density of transported products	1800 kg/m^3
Volume capacity utilisation factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaged products)	1

Example of additional information on Transport to Construction Site Scenario:

Additional Information	**Typical Installation per m3 concrete**
Ancillary materials for installation (specified by material);	Formwork: 1 m^2 18mm plywood, 95% reuse rate
Net consumption of fresh water for installation	0.7 m^3
Other resource use for installation	n/a
Quantitative description of energy type (regional mix) and consumption during the installation process	Compaction: 0.2 MJ/m^3
Wastage of materials on the construction site before waste processing, generated by the product's installation (specified by type)	Product: 0.3 kg Formwork (plywood) 0.05m2 18mm plywood
Output materials (specified by type) as result of waste processing at the construction site e.g. of collection for recycling, for energy recovery, disposal (specified by route)	Product – reuse on site Formwork – energy recycling
Direct emissions to ambient air, soil and water	Any water used evaporates or is discharged to sewer.

The rules for reporting environmental and health information in relation to emissions to air, water and land from the product in use, the effect on "indoor air quality" and "run-off" or "eluate" are not yet defined, measured and reported in an agreed manner and standards are still being developed. At present therefore, the PCR does not provide for the provision of additional information regarding the "in use" life cycle stage, but this is an area where the PCR is expected to develop in the future.

European Standards Technical Committee CEN/TC 351 will be developing European standards to cover the testing and assessment of emissions from products to air, water and land during use, and once in place, these will be used within a future update of EN 15804 to report on these emissions during the use phase. These would be reported in Module B1 (from EN 15804), and additional information could be included in these modules to enable results to be provided for specific scenarios.

An additional aspect of information which could be covered in this part of the EPD is carbonation of concrete products. When poured concrete is curing, it reabsorbs some CO_2 from the atmosphere. Re-absorption is however small compared to the emissions from cement production. More CO_2 is absorbed throughout the lifetime of the concrete product, but very slowly. A recent study (ECRA 2008) has summarized the available published research results with respect to concrete recarbonation. Due to the present lack of accurate and quantifiable data, recarbonisation of cement and concrete is currently not part of this PCR. This may change in the future.

1.6 OWNERSHIP, RESPONSIBILITY AND LIABILITY FOR THE EPD

A manufacturer or a group of manufacturers producing an EPD to this PCR are the sole owners and have liability and responsibility for their EPD.

Guidance: Environmental information provided in the EPD is based on manufacturer declared data. The verifier will check the general plausibility of this data but the responsibility for providing data which is an accurate representation of the company's operations lies with the company. Manufacturers should be aware that competitors may challenge environmental data if they believe that the EPD is not based upon accurate data. All data provided as the basis of the EPD should be capable of substantiation and be verifiable if possible.

1.7 COMMUNICATION FORMATS

Any communication format of the EPD produced according to this PCR shall be in accordance with EN 15942, Sustainability of construction works — Environmental product declarations — Communication formats: business to business.

2 PRODUCT CATEGORY RULES FOR LCA

2.1 THE PRODUCT CATEGORY COVERED BY THIS PCR

The product category referred to in this PCR covers unreinforced concrete products for use in buildings and other construction works, including the following products:

- ready mixed concrete
- concrete blocks, but excluding aircrete
- concrete kerbstones
- mortar.

It does not cover reinforced concrete including fibre cement. For the purposes of this PCR, concrete is defined as "Material formed by mixing cement, coarse and fine aggregate and water, with or without the incorporation of admixtures or addition, which develops its properties by the hardening of the cement paste (cement and water)".

In accordance with the standard EN 206-1:2001, concrete is classified by:

- Compressive strength class.

For any compressive strength class, concrete must be defined by:

- Environmental exposure class.
- Slump class (optional).

Guidance Examples:

A concrete without reinforcement or embedded metal: in all exposures except where there is freeze/thaw, abrasion or chemical attack: may have a range of compressive strengths, for example of C12/15 or C30/37 and environmental exposure class X0.

A concrete used where it is exposed to significant attack from freeze-thaw cycles whilst wet, for example where it would be exposed to high water saturation, without de-icing agents, such as a horizontal concrete surface exposed to rain and freezing, may, for example, have a compressive strength of C30/37 and an environmental exposure class XF3.

2.2 LIFE CYCLE STAGES INCLUDED

2.2.1 GENERAL

The environmental information of EPD covered by this PCR covers the life cycle stage ("cradle to gate"), and optionally, the transport to site and construction stages.

The cradle to gate life cycle stage must be provided in the EPD and this, can, if required, be broken down into 3 life cycle stages using terminology from EN 15804:

- A1, raw material extraction and processing, processing of secondary material input (e.g. recycling processes),
- A2, transport to the manufacturer,
- A3, manufacturing, including impacts from direct energy generation and waste disposal related to the manufacturing process,

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

Guidance: A1 is associated with "upstream" processes using common LCA terminology, whereas A3 covers "gate to gate".

Information modules 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 waste from a process are included in the module in which the waste is produced).

Guidance: For a concrete manufacturer, the splitting of the cradle to gate stage into the three sub-stages may be useful to demonstrate that the major impact comes from the raw materials rather than the processes undertaken by the concrete manufacturer. Note that electricity generation impacts related to electricity use by a concrete manufacturer would be included within stage A1 as they are impacts which occur upstream of manufacture, whereas the impacts of burning fuels such as natural gas used by the manufacturer would be included within the manufacturing stage A3.

Concrete producers should note that they do have the ability to alter the impacts of the product stage A1 through decisions relating to mix design or/and the amount and type of electricity used for example.

2.2.2 PRODUCT STAGE A1

The product stage A1 includes, with the exception of ancillary materials and packaging used in the studied product manufacturing process, and transport of inputs to the studied manufacturing process, all extraction, energy production and manufacturing processes which occur upstream of the studied product manufacturing process, including:

- Extraction and processing of raw materials (e.g. mining processes) and biomass production and processing (e.g. agricultural or forestry operations) used as input for manufacturing the product;
- Extraction and processing of primary fuels used as input for manufacturing the product;
- Reuse of products or materials from a previous product system used as input for manufacturing the product, but not including those processes that are part of the waste processing of the previous product system until it reaches the end-of-waste state (see 2.3.4.5);
- 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 until it reaches the end-of-waste state;
- Generation of electricity, steam and heat used in the product manufacturing process, which have been generated offsite, also including their extraction, refining and transport;
- Energy recovery and other recovery processes from secondary fuels, that are used as input for manufacturing the product, but not including those processes that are part of waste processing in the previous product system until it reaches the end-of-waste state;
- Processing up to the end-of-waste state (see 2.3.4.5) and disposal of any final residues produced during any process stage included in A1;
- any transport of raw materials within the upstream supply chain, apart from the delivery of materials to the studied manufacturing process.

Guidance: Impacts from the extraction and manufacturing of ancillary materials and packaging materials are excluded from product stage A1 and are included in Product Stage A3 – this is based on the text of EN 15804.

Impacts from transport of all materials and fuel to the studied manufacturing process are included in product stage A2.

Example: For a concrete manufacturer, the impacts of the cement production process, including the extraction of limestone, transport of limestone to the cement manufacturer and the extraction, processing and use of energy in cement production would be included in A1. The impacts of electricity used by the concrete manufacturer, including extraction of fuels, electricity production and distribution, would be included in A1. The impacts of natural gas used by the concrete manufacturer, including extraction of gas, processing and distribution, and emissions from the combustion of gas would be included in A3. The transport of the cement to the concrete manufacturer would be included in A2.

2.2.3 PRODUCT STAGE A2

The product stage A2 includes all transport processes upstream and during the manufacturing process, but excluding transport of waste from the manufacturing process. Extraction and fuel processing impacts associated with transport would be included in this stage.

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

Guidance: Transport of manufacturing waste is included in Product stage A3.

Impacts of transport should be based on the typical delivery of products, taking account of the mode of transport (road, rail, water, air), vehicle type, fuel and efficiency, load, distance travelled and empty return journey. This will be most significant for the bulk materials used (aggregates) and the materials which come a considerable distance.

Product stage A3

Product stage A3 includes all manufacturing processes for the studied product, plus manufacturing of ancillary materials and pre-products, and packaging, plus any waste processing and transport of wastes to the end-of-waste state or disposal.

- A3 Production of ancillary materials or pre-products;
- A3 Manufacturing of products and co-products, including the combustion of any primary fuels used in the manufacturing process;
- A3 Manufacturing of Packaging;
- A1-A3 processing up to the end-of-waste state (see 2.3.4.5) or disposal of final residues including any packaging not leaving the factory gate with the product.

Guidance: The output of waste during this life cycle stage may reach the end-of-waste state when it complies with the conditions described in 2.3.4.5, end-of-waste state. They are then allocated as co-products as 2.3.5.3.

Product stage A3 most closely aligns with the Scope 1 emissions recorded by the Greenhouse Gas Protocol, however it covers all impacts, not just global warming/climate change. As with Scope 1, Product stage A3 does not include the upstream impacts from extracting and processing primary fuels, such as coal and natural gas – these are included in A1. The impacts associated with any electricity, heat, steam or secondary fuels used in manufacturing are included in Product Stage A1.

It should be noted that the scope of A1, A2 and A3 vary through the supply chain – for a limestone quarry, A3 would cover the extraction of the stone; for a cement plant, limestone extraction would be included in A1, transport to the plant in A2 and the cement kiln operation in A3; for a ready mix concrete plant, cement production would be included in A1, and A3 would just cover the mixing operation.

In order to simplify reporting of the results, each EPD can report the impact for each category as pre factory and factory impacts. This can be made by reporting the product stage A1 and A2 together (as pre-factory impact), and the product stage A3 separately (as factory impacts).

2.2.4 CONSTRUCTION STAGE – TRANSPORT TO SITE A4

The construction – transport to site process stage can be reported within the EPD based on the typical situation, and includes the optional information modules for:

- Transportation from the production gate to the construction site;
- Storage of products during the distribution phase from product gate to construction site, including the provision of heating, cooling, humidity control, etc.;
- Wastage of construction products (covering the relevant processes required to manufacture the material lost through the wastage of products);
- Waste Processing of the waste from product packaging and product wastage which occurs during the transport and distribution processes up to the end-of-waste state (see 2.3.4.5) or disposal of final residues
- Washing of vehicles if this is undertaken at a different location from the production site or the construction site.

Guidance : Impacts of transport should be based on the typical delivery of products, taking account of the mode of transport (road, rail, water, air), vehicle type, fuel and efficiency, load, distance travelled and empty return journey. This will be most significant for the bulk materials used (aggregates) and the materials which come a considerable distance.

Where, for example, concrete is wasted during the delivery operation – for example where it is over-ordered or significant concrete residues need to be cleaned from the lorry, then the manufacture of the material which is wasted, and the disposal of the material which is wasted need to be included within product stage A4.

Cleaning of vehicles which occurs at the concrete production factory would be included in Product stage A3. Cleaning of vehicles which occurs at the construction site would be included in Product Stage A5.

2.2.5 CONSTRUCTION STAGE – ON SITE PROCESSES A5

The Construction Stage – on site processes may be reported within the EPD based on the typical situation. If this stage is included in the EPD, it may include the optional information modules for:

- Storage of products, including the provision of heating, cooling, humidity control, etc.;
- Washing of vehicles undertaken on the construction site;
- The pumping of concrete to place it on site
- The cooling or heating of the concrete or the site to enable the concrete to cure
- The use of any water provided on site to mix the concrete or to enable the concrete to cure
- The net consumption of any formwork taking into account normal rates of reuse or recycling
- Any ancillary materials required for releasing concrete from formwork
- Any cleaning of equipment or formwork required
- Wastage of construction products on site (covering the relevant processes required to manufacture the material lost through the wastage of products);
- Waste Processing of the waste from product packaging and product wastage during the construction processes up to the end-of-waste state (see 2.3.4.5) or disposal of final residues;
- Installation of the product into the building or construction works 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.

Guidance: Data for general operations of the construction site (eg. site huts, scaffolding etc) should be considered at the building or construction works level and do not need to be included in the provision of a product level EPD. However, processes which directly relate to the concrete, for example, processes required to compact the concrete, provide a smooth surface (e.g. floating) or other processes required for the curing of the concrete should be modelled within this construction stage.

2.3 CALCULATION RULES FOR THE LCA

2.3.1 FUNCTIONAL UNIT

A functional unit, which needs to reflect the required functional performance of the product within the building or construction works over the full life cycle, can only be used for a cradle to grave EPD. The cradle to gate and cradle to site EPD covered by this PCR are based on a declared unit, although this includes some aspects of functionality.

Guidance: At the point where concrete leaves the ready-mix plant or arrives at the construction site for example, it is still possible for the concrete to be used in a wide variety of different functions in the building or construction works – for example foundations, floor slabs, road pavement or pathways. In each of these functions, the service life and exposure of the concrete might be different, and potentially the end of life scenario for the concrete may also vary. Similarly, a concrete block could be used in an internal or external wall, with thin joint or normal mortar – both of these options will impact on the thermal performance of the block in the building or construction works. For Cradle to Gate and Cradle to Site EPD, the function of the product within the building or construction works is too uncertain and a functional unit, which needs to include information on the required functional performance of the product within the building or construction works over the full life cycle, is therefore inappropriate.

2.3.2 DECLARED UNIT

The declared unit is used instead of the functional unit when the precise function of the product or scenarios for the product at the building level is not stated or is unknown. 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. The declared unit shall relate to the typical applications of products.

Within this PCR, it is relevant for the products below to use the following declared units incorporating relevant aspects of functionality related to the potential purpose in the building or construction works to enable more useful and consistent comparison at the building or construction works level:

- Concrete: 1 m^3 of concrete with a given compressive strength class, environmental exposure class as per EN 206 or an equivalent stated national standard as relevant to the potential use of the product in the building or construction works (density shall be specified);
- Concrete Blocks: 1 block with a given strength (dimensions and density to be specified);
- Concrete Blockwork: 1 m^2 of blockwork with a given strength (dimensions and density shall be specified);
- Pipework: 1 metre of unreinforced pipework with a given capacity, (dimensions and mass shall be specified) (pipes are normally reinforced at diameters greater than 600 mm);
- Mortar: 1 cubic metre of concrete with a given strength (density shall be specified).

Guidance: see, for example, http://www.icjonline.com/views/POV_VRK.pdf for a review of national standards covering environmental exposure classes.

Thermal resistance, thermal mass, acoustic performance and other relevant performance information may also be relevant to the description of the declared unit.

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

If any non-mass based unit is used, then information such as density must be provided to allow the impact for 1 kg of product to be calculated.

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

2.3.3 RELATING DATA TO UNIT PROCESS AND DECLARED UNITS

An appropriate flow shall be determined for each unit process. The quantitative input and output data of the unit process shall be calculated in relation to this flow. Based on the flow chart and the flows between unit processes, the flows of all unit processes are related to the reference flow. The calculation should result in all system input and output data being referenced to the declared unit for the product.

Guidance: The reference flow is a given amount of the product covered by the EPD. This will be set by choosing the declared unit for the product and may be, for example, 1 m3 of ready mix concrete. For this product, we can consider the various processes (unit processes) which are used to provide inputs and treat outputs of the product system. An input unit process may be the production of cement – the flow for this unit process would be measured in kg, and the mass of cement used in the product system would be used to multiply the impacts associated with the production of 1 kg of cement by the amount of cement used. This is repeated for all the flows throughout the whole product system so that all impacts are accounted for in relation to the reference flow, the declared unit for the product.

2.3.4 SYSTEM BOUNDARIES

2.3.4.1. 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. This is most particularly relevant in setting the boundary between processes producing waste and processes using the waste.

Any approach must ensure that the system boundaries are transparent, well defined and applicable to any construction product. They must also be consistent, to ensure that if the system producing waste and the system using waste were both modelled, that there would be no double counting or undercounting of impacts.

The setting of the system boundaries follows these 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 (see 2.3.4.5).*

Guidance:

The "modularity" principle: For example, construction product packaging is disposed of on the construction site – the impacts of disposal must therefore be included in module A5 (construction site).

The "polluter pays principle": The system boundary must be set so that it is clear which impacts belong in which systems. For example, when a process, Process 1, creates waste, which is then recycled and used in another process, Process 2, the system boundary can be set at any point between the production of the waste and the use of the recycled material. If it is set at the production of waste, then all the impacts of recycling go to Process 2 using the recycled material, and none to Process 1, the waste producer. If it is set at the point where the recycled material is used, then all the impacts go to Process 1, and none to Process 2. Other system boundaries could be the point at which the output moves from a waste to a recycled product or the point at which Process 1 stops paying for waste treatment and Process 2 starts to pay for it. Another option is to take the impact of the waste treatment and recycling process, and to split the impact 50:50 (or some other split) between the two processes.

The system boundary needs to be defined between processes and nature, between processes and their wastes (pre-consumer recycling), and between processes and any post-consumer recycling at the end of life.

2.3.4.2. Boundary of the technosphere with nature

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 emissions to air, soil and water and the processing of any waste arising from those processes.

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.

Guidance: Where materials are extracted from nature (mining, quarrying, water extraction etc) the boundary of life cycle assessment is normally taken at the first point at which humans have an influence on the environment. For this reason, processes such as land clearance, removal of overburden etc need to be considered within the scope of the LCA, although their impact will be spread over all the material that is extracted as a result. When emissions are returned to nature, for example, emissions to air are released to the atmosphere, emissions to water are released to a river or lake and materials are released to land, then their impacts arising from this release to nature are tracked for a 100 year period.

For waste placed in landfill, then this system is not considered "nature", but the emissions from the landfill system over 100 years, for example from off-gassing, landfill gas recovery processes, leachate treatment, and any other emissions associated with the landfill will be considered.

Some LCA will take account of the emissions over 60,000 years from deposition in the landfill. This assumes that the landfill linings and systems will have collapsed, and that all material will return to nature. This timescale is not considered within this PCR.

2.3.4.3. Boundary between product systems

Where secondary materials, or energy recovered from secondary fuels are used, 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. wastes, by-products, end-of-life material or waste energy, reach the end-of-waste state (see 2.3.4.5).

For waste flows leaving the system under study and entering another system (e.g. because it is recycled or energy is recovered), the system boundary is also set at the end-of-waste state. This ensures consistency in methodology.

Guidance: some by-products or co-products may reach the end-of-waste state as soon as they are produced. In this situation, the system boundary is immediately after their production, and some allocation of impacts from the producing system to the receiving system may be required.

Example: A manufacturer may produce metal waste, for example which reaches the end-of-waste status as soon as it has been collected together. In this situation, it can be treated as a co-product with value, and impact can be allocated to this metal for recycling based on its value at the end-of-waste, compared to the value of other products produced.

2.3.4.4. System boundary for energy recovery processes

In some circumstances, energy recovery from waste may occur within the process under study. In this instance, the end-of-waste state is theoretically reached at some point within the energy recovery process, but within this PCR, the system boundary is set at the point that the wastes enter the energy recovery process. Any impacts which can be physically assigned to the energy recovery process, for example specific emissions from the combustion of the waste, can be separately identified within the EPD, but will be included within the impacts provided.

Guidance Example: Where a waste, such as whole tyres, is used for energy recovery within a cement kiln, the impacts of all waste processes (such as collection and transport) are within the automotive system until the whole tyres are put into the cement kiln. Non-biogenic CO_2 emissions from the tyres (which can be calculated from the non-biogenic carbon content of the tyres) can be recorded as a subset of the total CO_2 emissions within the LCI, and hence as a subset of the Global Warming Potential impact within the EPD.

2.3.4.5. End-of-waste state

Waste produced by a system reaches the end-of-waste state when it complies with all of the following criteria as shown in Figure 3-1 overleaf:

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

Guidance: 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 and 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 2008/98/EC, prevents the waste from reaching the end-of-waste state.

Guidance: http://publications.environment-agency.gov.uk/PDF/GEHO0411BTRD-E-E.pdf is guidance which has been published in the UK by the relevant National agency to explain how a waste can be determined as hazardous within the European Framework Directive, and is useful in providing sources to definitions of what are dangerous substances and the relevant threshold values and testing mechanisms for these. Please not any references to national legislation within the document are only relevant in the UK however.

This definition of the end-of-waste state is to be used in Europe and for products sold in Europe, and in any other location where there are no local rules. In other locations where the national rules differ, the local approach to end-of-waste state should be applicable.

Guidance Example : say a waste is produced in a country outside Europe which has different waste legislation, the criteria provided in 2.3.4.5 do not need to be used to define the end-of-waste state but the national rules can be used to define the end-of-waste state of the waste.

For use of waste or secondary material as a fuel, impacts from the burning of the fuel are included in the system whether the fuel is a considered a waste or to have reached the end-of-waste state, although emissions from waste can be separately identified.

In this situation, the total reported impacts will be the same irrespective of the national rules.

To ensure consistency with EN15804 for the treatment of secondary fuels which may be defined as a waste in different jurisdictions, in the regions where the fuels are not defined as waste, non-biogenic CO2 emissions will be included in the total indicator. In the regions where they are considered waste for energy recovery i.e alternative fuels, non-biogenic CO2 emissions will be included in the system boundary and can be reported as a sub-total of the total indicator. However, the energy for both secondary fuels and waste for energy recovery will be accounted for as “use of non-renewable secondary fuels”.

To ensure consistency with EN15804 for the treatment of input materials which may be defined as a waste or secondary material in different jurisdictions, in the regions where the materials are not defined as waste, allocation of impacts from the producing system to these inputs will be based on economic value. In the regions where the inputs are considered waste, allocation will not be considered and they will not have impacts from the producing system

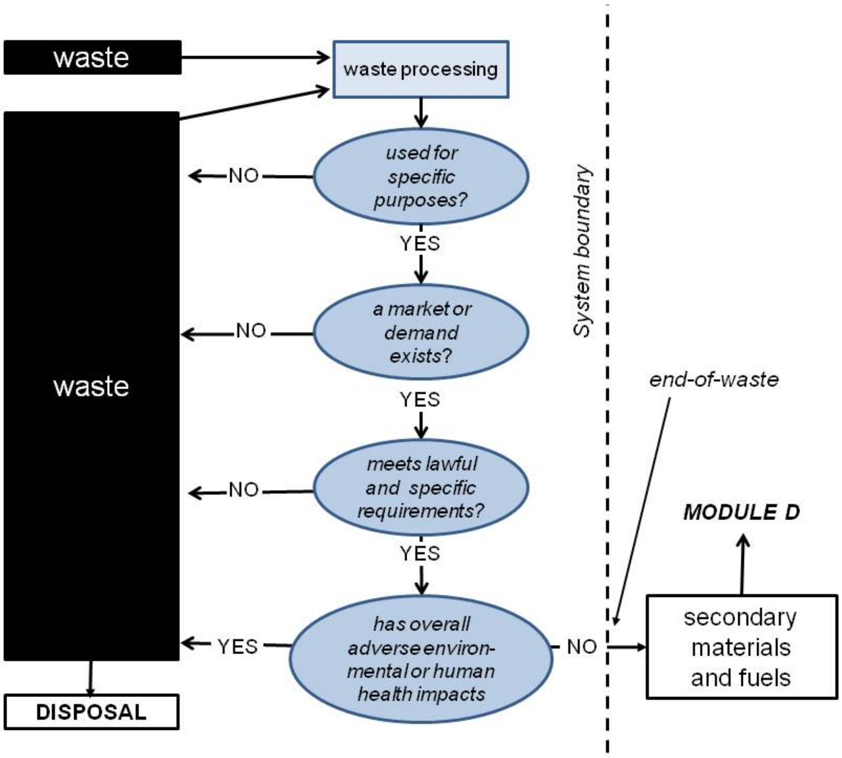


Figure 2 1: Decision-tree of for end-of-waste

Guidance: Having a positive economic value is only one criterion by which the end-of-waste state is judged. It is therefore possible for a substance to have a positive economic value but still be a waste, for example if it is considered hazardous.

2.3.5 ALLOCATION OF INPUT FLOWS AND OUTPUT EMISSIONS

2.3.5.1. General

Many industrial processes produce not just the intended product but co-products and by-products. Normally the material flows of inputs are not distributed between them 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 whenever possible. Where unavoidable, allocation should be considered carefully and the allocation method chosen should be justified.

In this PCR, the rules for allocation are based on the guidance given in EN 15804 6.5.3, which is based on the guidance in EN ISO 14044; however, the basic procedures and assumptions used in EN ISO 14044 have been refined in order to reflect the goal and scope of EN 15804 and EN 15643-2.

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 life cycle stage where they occur.

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.

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

In industrial processes there are often a wide variety of different types of materials produced in conjunction with the intended product. In business vocabulary, these are normally identified as by-products, co-products, intermediate products, non-core products or sub-products. In this PCR 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 PCR.

2.3.5.2. Co-product allocation

Co-products are any outputs of any product manufacturing system which leave the system boundary. These can be co-products which are intended to be made, co-products which are not intended to be made or any wastes from manufacturing which following processing reach the end-of-waste state are considered to leave the product system (see 2.3.5.3).

The impact of processing any waste output from the system must be included in the system until it reaches the end-of-waste state and leaves the system boundary. If an output never reaches the end-of-waste state, then its waste processing and disposal remains within the system boundary of the product. If it is not possible to consider the production of the main product on its own, in order to decide the impact associated with the product, and co-product(s) at the system boundary, the impact of the system needs to be allocated between them.

Guidance: In the context of coal fired electricity production, the main output is electricity, and other outputs from the system may include fuel ash, furnace bottom ash, flue gas desulphurization gypsum or recovered heat for example. In this context, electricity is the product, and the other outputs are co-products if they reach the end-of-waste state, or are never considered wastes.

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 which cannot be subdivided, but which generate a very low contribution to the overall revenue may be neglected.

Guidance: A block producer may manufacture two types of blocks on two separate lines. In this instance, it should be possible to avoid allocation by considering the actual inputs and outputs of each line, for example by using sub-meters to review the energy consumption, product mix to review the inputs, waste and production records to review the outputs. If the lines are not sub-metered, it is possible to allocate the energy used in the two lines using physical allocation, by considering the energy demand of the two lines, and the hours of operation. An aim of any physical allocation system should be to result in the impact that would occur if only one product was produced.

In the case of coal-fired electricity and fuel ash, it is not possible to produce one without the other, and therefore this can be considered as a joint co-production process. To decide if any impacts need to be allocated to the fuel ash, then a co-product allocation procedure needs to be followed.

Contributions to the overall revenue of the order of 1% or less are regarded as very low.

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.*

Where economic allocation is used to assess the impact of input materials being used within the product system, outputs from other systems which are not sold but given away or which the producer pays to dispose of, do not attract any burden from the production process to pass on to a further use. Outputs from manufacturing processes which are wastes but which reach the end-of-waste state where they have economic value, will attract a burden from their production system to pass on to a further use. Burdens for the further use will only be attracted from processes occurring once the end-of-waste state has been reached and will also be included in the system process using the secondary material.

Economic allocation for outputs of the studied product system will only be required where the outputs have reached the end-of-waste status and are sold. Where the revenue from such sales is very small, it can be ignored if required for simplicity of modelling.

Guidance: Where waste outputs leave the product system and enter another product system still as a waste at no cost to the next system, or at a cost to the waste producer, then no impacts from the waste producing system can be allocated to the next product system. In this instance, the next system is acting as a waste processing, waste recovery or waste disposal process.

Guidance Example: In many instances however it is not possible to produce only one of the products. For example, a quarry may produce both aggregate and dust, or stone blocks and aggregate and dust; or a BOF steelworks produces both steel and slags. In these instances, it is not possible to prevent the production of the unintended products, so allocation allows the impacts of producing all products to be split between the various products.

Guidance: Comparison of revenue from products should be undertaken using the market value per common unit of production (e.g. kg or MJ), based on normal pricing units and long term averages (3 or 5 years) if prices fluctuate. A difference in revenue of more than 25 % is regarded as high. Market value of co-products may change over time, but it is the relation between them over time that is relevant, not the actual values. The actual overall revenue may be sensitive, but it is the % of revenue which is required for allocation. Rather than data for the whole plant, it could be considered at the cost of 1 kWh electricity and the cost of the resulting fuel ash etc. It may be clear, for instance, if the fuel ash is not a waste, that its relative value is less than 1% of the cost of the electricity.

Where co-products have incompatible units, e.g. mass and energy, then it is essential to use economic allocation.

Wherever possible, market value data should be obtained via the supplier of the waste or secondary material or a relevant local trade association. If this data is not provided, in many situations an estimate can be made of the values of the different co- products, goods and services, including waste processing services if relative values cannot be obtained from the suppliers. Market prices are the basic data to be used. If markets prices are not known there are several reliable sources on many product prices, including historical prices and expected prices in terms of futures. The web is a unique source of price data. Hundreds of web sites on most commonly traded products are available now. The relevant search term for market price is “fob”, free on board, at the location of the supplier, without insurance or transport. The other price type is ‘cif’, stating a specific place of deliverance like “cif Chicago” for the price of slag as delivered in Chicago.

Sources of relevant and appropriate data will vary depending on material and location, and should be considered on a case specific basis.

Physical properties such as sequestered carbon and calorific value remain a property of the material and cannot be allocated.

Guidance: For example, the energy used to process logs into sawn lumber, sawdust and bark can be allocated between the 3 product flows, but the sequestered carbon within and calorific value of each co-product remains a physical property of each product flow.

The appropriate allocation procedure considered within this PCR for the following co-products or by-products which can be used within concrete production are provided below:

For any co-product or by-product or waste which is transported and used at no cost to the concrete producer, no allocation is required. The material is free of impact at the concrete factory gate.

Guidance: In effect, if a co-product has no value then economic allocation will allocate no impact to it – we can therefore say that no allocation is required and the material is free of impact at the concrete factory gate.

For any co-product or by-product where the concrete producer is only paying for transport: no allocation of its production process is necessary; transport impacts are allocated to the concrete production.

Outside of Europe, agreements between industries on the allocation of impacts to co-products or wastes may be well established. In these cases, this PCR will respect these agreements though the Project Verification Report should provide information on the agreement.

Guidance Example: There is already an agreement between the steel and cement industries regarding the allocation of impact to slag in Japan – in this instance no impact from steel production is transferred to the slag based on this agreement. Within Japan therefore, according to this PCR, slag will have no impact from the steel production process, irrespective of its waste status or value.

For any co-products or by-products where the concrete producer is paying for the raw material – see the examples below showing how allocation should be considered.

Granulated blast-furnace slag and air-cooled slag when they have reached the end of waste state – by economic value from pig iron produced in the blast-furnace. If not available, the ratio of the price of liquid slag to pig iron can be estimated by the ratio of the price of granulated slag versus steel billet.

- Zinc (or ISF) slag when it has reached the end of waste state – by economic value from zinc production
- Outputs from coal fired electricity power stations (fly ash, furnace bottom ash and cenospheres where they have reached the end-of-waste state) – by economic value from coal fired electricity production
- Incinerator ash which has reached the end-of-waste state – by economic value from waste treatment and incineration processes
- Foundry sand which has reached the end of waste state – by economic value from casting production
- Silica fume which has reached the end of waste state – by economic value from ferrosilicon or elemental silicon production
- China clay stent and sand which has reached the end of waste state – by economic value from china clay production
- Slate aggregate which has reached the end of waste state – by economic value from slate quarrying
- Oil shale which has reached the end of waste state – by economic value from oil

Guidance Note that in some locations, these co- or by-products may not have reached the end- of- waste state or may have reached the end -of -waste state but be available at no cost to the concrete producer, in which case no allocation will be required (if the co-product has no value then no impact would be allocated on an economic basis).

Guidance Example: Fly ash is a by-product from coal fired electricity production and may be sold to ‘ash managers’ who process and sell it to concrete producers. If the ash is sold to ash managers, then the value at the first point of sale is taken, and the impacts of the processing they undertake are within the concrete system boundary. If the fly ash is processed by the electricity producer, then sold directly to the concrete industry, then this cost would be taken for economic allocation. If the fly ash has no value and is given to the concrete industry, then no impact from the electricity production process is allocated to the concrete industry. The transport impacts from the transport of the “free” fly ash will be taken by whichever system pays for the transport.

2.3.5.3. Treatment of co-products produced during the product stage

Co-products or by-products which have never been waste are allocated as co-products at the gate of the product stage process which has produced them, using allocation procedures set out in 2.3.5.22.3.5.3.

Wastes from any production process in stages A1-A3 and the resulting impacts associated with their transport, treatment and processing are considered within the system boundary of the process producing the waste, until they reach the end-of-waste state. At this point, if they have an economic value then they can be considered as co-products of the process producing the waste and impact from that system can be allocated to them.

2.3.5.4. Treatment of co-products or by-products used during the product stage

Co-products or by-products from other products systems used during the product system bring impacts allocated from their previous system, using the allocation procedures set out in 2.3.5.5, plus any impacts arising within the system boundary. The system boundary for co-products or by-products which have never been wastes is set at the gate of the process that produced them. The system boundary for co-products or by-products which have been wastes is set at the point they reach the end-of-waste state (see 2.3.4.5).

2.3.5.5. Treatment of materials recovered from previous use (post-consumer waste)

No impacts are allocated over the system boundary from previous use for post-consumer material that is recycled or reused. This is the same for concrete after use at the system boundary – no impacts will be allocated over to any subsequent recycling. Impacts associated with any waste treatment or processes before the post-consumer material reaches the end-of-waste state are attributed to the system producing the post-consumer waste. All impacts occurring after the end-of-waste state is reached are attributed to the system using the post-consumer waste. For waste which has not reached the end-of-waste state, see 2.3.5.6.

Examples of post-consumer materials used in concrete and its supply chain which have reached the end-of-waste state are: glass cullet, recycled aggregate, recycled concrete aggregate. These materials will be free of impact from their first use. Impacts will only come from any processes after they reach the end-of-waste state.

2.3.5.6. Energy recovery of waste from other systems

Some wastes have not reached the end-of waste state before they become inputs to the production process where their inherent energy is recovered. In this case, the production process is acting as a waste treatment process for the waste, and theoretically the impacts of this treatment process should be part of the system that produced the waste. However, because of concerns that

- the interpretation of end-of-waste varies from location to location,
- emissions from the energy recovery of waste cannot easily be separated from the emissions from the use of other fuels,
- consistent results are obtained, aligned to the WBCSD CSI carbon reporting guidelines and
- to maintain a conservative approach,

within the WBCSD CSI PCR, the impacts from the energy recovery of waste will be included within the system boundary, but any indicators, particularly Global Warming Potential, which can be separately calculated for the energy recovery of wastes used as alternative fuels, can be reported as a sub-total of the total indicator.

Guidance Example: If waste oil is an input in the cement kiln, the CO_2 emissions from the waste oil can be separately identified, based on the carbon content of the waste oil, and the SO_2 emissions from the Sulphur content of the waste oil and both can be reported as a sub-total as below.

Impact Category	Unit	Impact per m^3 concrete
Global warming potential, GWP (TOTAL) - Global warming potential from energy recovery of wastes	kg CO_2 equiv	240 (64 kg CO_2 eq. (27%) from energy recovery from wastes used as alternative fuels)
Depletion potential of the stratospheric ozone layer, ODP;	kg CFC- $_{11}$ equiv	0.003
Acidification potential of soil and water, AP (TOTAL) - Acidification potential of soil and water from energy recovery of wastes	kg SO_2 equiv	1.7 (0.31 kg SO2 eq. (18%) from energy recovery from wastes used as alternative fuels)

Examples of wastes which are used in this way might include whole waste tyres or hazardous wastes which have not reached the end-of-waste state when they are used – for example when they are burnt in the cement kiln.

Impacts associated with any waste treatment or processes before the post-consumer material reaches the end-of-waste state are attributed to the system producing the post-consumer waste. All impacts occurring after the end-of-waste state is reached are attributed to the system using the post-consumer waste.

Guidance Examples: For the combustion of materials not considered to have reached the end-of-waste state, at a minimum, carbon dioxide emissions and any other emissions which can be accurately estimated for the burning of the waste should be attributed to the system producing the waste, not the system using the waste. For other emissions, co-product allocation based on the value of the waste treatment function could be considered, but revenue from this type of waste treatment is normally extremely low relative to other revenue from manufacturing, so these other emissions can be considered within the system boundary for the purposes of this PCR.

2.3.5.7. Treatment of biogenic carbon

Biogenic carbon is the carbon taken up and incorporated within biomass during growth (also known as sequestered carbon) and which can be released during decomposition or combustion at the end of life. Biogenic carbon uptake is considered as the net uptake of CO_2 within the system boundary over the 100 years before the biomass is harvested (see 2.3.4.2**Fel! Hittar inte referenskälla.**) and can therefore be calculated from the carbon content of the biomass. Biogenic carbon release is considered from the combustion of biomass at the end of life, and from its behaviour in landfill over 100 years from deposition (see 2.3.4.2).

Sequestered carbon is considered as an inherent physical property of the biomass and cannot be allocated by other mechanisms (see 2.3.5.2**Fel! Hittar inte referenskälla.**).

Land use change must be considered where relevant (see 2.6.2).

Guidance: For biomass used as a fuel, the biogenic carbon released during combustion will match the biogenic carbon uptake during growth. This biogenic carbon can either be modelled on both sides (as an uptake and emission which will balance each other) or the biogenic uptake and emission can both be ignored. In either instance, there may be other carbon emissions from extraction, processing and transport which will need to be considered and which can be allocated.

Unsustainably harvested timber would be associated with land use change (release of soil based carbon) which must be considered in the assessment. Sustainable harvested timber is not associated with land use change (see 2.6.2).

2.3.5.8. 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 use of cut-off 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, unless otherwise stated in this PCR.*

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 for the stages "cradle through construction" 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 use significant resources or cause significant emissions into air and water or soil related to the environmental indicators of this PCR.

Conservative assumptions in combination with plausibility considerations and expert judgment can be used to demonstrate compliance with these criteria.

2.3.5.9. Capital equipment and infrastructure

The contribution of capital equipment and infrastructure is not normally considered in LCA as the share of impact of this equipment per unit of production almost always falls below the study's cut-off criteria. It is not included here unless it is significant, in accordance with the data cut-off rule. Maintenance of equipment is likewise not included in the LCA with the exception of regularly consumed items such as mould oil which are included in the inventory based on the average amount used per year if they exceed the thresholds defined in the cut-off rules.

Guidance Examples: The machines and equipment that are used in factories, and the factories themselves have an impact in their manufacture and disposal. However, this impact is generally very small in comparison to the impact of the product that they produce over their life time. The operation of machines and equipment, and operation of factories (heating and lighting) is included within the scope.

2.3.5.10. Head office activity, marketing, sales etc

All energy used in factories and factory support offices is included. The impacts associated with company management, marketing and sales activities which may be located either within factory sites or at other locations may be excluded from the assessment.

2.3.6 UNITS

SI units shall be used. Basic units include: metre (m), kilogram (kg), and moles (mol) (an amount of chemical substance). Derived SI units include kg/m³ or MJ (kg.m^2/s^2) for example. For very small or very large quantities, SI prefixes such as "kilo" or "milli" can be used, eg. kilometre for transport distances or millimetre for product thicknesses.

All resources flows with the exception of energy and water consumption are expressed in kg.

- Resources used for energy input (primary energy) are expressed as kWh or MJ, including renewable energy sources e.g. hydropower, wind power;
- Water consumption which is reported in m^3.

Exceptions are:

- Temperature, which is expressed in degrees Celsius;
- Time, which is expressed in practical units depending on the assessment scale: minutes, hours, days, years.

2.4 INVENTORY ANALYSIS

2.4.1 COLLECTING DATA

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

> *EN ISO 14044:2006, 4.3.2 The qualitative and quantitative data for inclusion in the inventory shall be collected for each unit process that is included within the system boundary. The collected data, whether measured, calculated or estimated, are utilized to quantify the inputs and outputs of a unit process. When data have been collected from public sources, the source shall be referenced. For those data that may be significant for the conclusions of the study, details about the relevant data collection process, the time when data have been collected, and further information about data quality indicators shall be referenced. If such data do not meet the data quality requirements, this shall be stated. To decrease the risk of misunderstandings (e.g. resulting in double counting when validating or reusing the data collected), a description of each unit process shall be recorded. Since data collection may span several reporting locations and published references, measures should be taken to reach uniform and consistent understanding of the product systems to be modelled.*
>
> *EN ISO 14044:2006 4.3.2.2 These measures should include the following:*
>
> - *drawing unspecific process flow diagrams that outline all the unit processes to be modelled, including their interrelationships;*
> - *describing each unit process in detail with respect to factors influencing inputs and outputs;*
> - *listing of flows and relevant data for operating conditions associated with each unit process;*
> - *developing a list that specifies the units used;*
> - *describing the data collection and calculation techniques needed for all data;*
> - *providing instructions to document clearly any special cases, irregularities or other items associated with the data provided.*

2.4.2 CALCULATION PROCEDURES

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

Guidance Example: Over a year, a concrete plant may, amongst other inputs, use 12000 kWh of grid electricity to make all its concrete (20,000 m^3 total production), and 3000 tonnes of aggregate to make 2000 m^3 of a specific type of concrete, eg GEN 1. The different concretes are produced in a similar manner and therefore the amount of electricity will be the same for a m^3 of each. The amount of aggregate will vary for each type of concrete and therefore needs to be calculated for the specific volume of concrete produced, on the basis of the mix design. The reference unit for both the typical and specific concrete produced will be 1 m^3. The inputs need to be calculated on the basis of the reference unit, so the plant will use 12000/20000 = 0.6 kWh = 2.16 MJ of grid electricity per m^3 of any concrete, and 3000/2000 = 1.5 tonnes = 1500 kg of aggregate per m^3 of GEN 1 concrete. Once this initial input inventory has been calculated, the inventory needs to be linked to LCI datasets for the input materials. The LCI datasets are provided for a relevant reference unit, for example from the ELCD (http://lca.jrc.ec.europa.eu/lcainfohub/datasetList.vm) electricity data is provided per 3.6 MJ and crushed stone per kg; if units do not correspond data must be converted. LCI data for 3.6 MJ of grid electricity therefore needs to be multiplied by the use of electricity (in MJ/3.6) for 1 m^3 of concrete (the reference unit). So the dataset for 1 MJ electricity will be multiplied by 2.16/3.6 = 0.6 and the dataset for 1 kg of aggregate by 1500.

For the use of 3.6 MJ French Grid Electricity, 0.159 MJ of energy from Crude Oil are used as a resource and 0.134 kg Carbon Dioxide are emitted amongst other inventory, so 2.16 MJ will use 0.0954 MJ crude oil and produce 0.0804 kg Carbon Dioxide.

For crushed stone, cradle to gate production of 1 kg uses 1.103 kg calcium carbonate as a resource from nature, and produces 0.013 kg Carbon Dioxide amongst other inventory, so 1500 kg will use 1654.5 kg calcium carbonate as a resource and produces 19.59 kg Carbon Dioxide.

Once all inputs and outputs have been linked with all the relevant LCI flows, the inventory can be aggregated to calculate the total resources and emissions from the production of 1 m³ of typical concrete or 1 m³ of the specific concrete, eg GEN 1.

The next stage of the LCA calculation is to assess which resources and emissions are linked to which environmental indicators, a process known as "classification". For example carbon dioxide causes Global Warming impacts. For each impact and flow, the degree to which a reference flow causes the impact is used to "characterise" the impacts, with characterisation factors being published for various impact categories. For example, the IPCC publish Global Warming Potentials which are used to characterise the Global Warming impact of greenhouse gases – Carbon dioxide has a factor of 1, methane of 25 with the 100 year timeframe used within this PCR.

Once all the resource and emissions flows have been classified and characterised for each indicator category used in the EPD, the results for each item of inventory are added to give the total for each indicator for 1 m³ of typical concrete.

Note: Most LCA software will include the classification and characterisation data required by this PCR and undertake many of these processes automatically.

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.

Guidance: Net calorific value (NCV) or Lower Heating Value (LHV) of fuels are routinely measured at plant level. It is important to note that the applied heating value always has to match the status of the fuel, especially with respect to the correct moisture content during its weighing (e.g. raw coal or dried coal). Normally the lower heating value is determined from a dried sample. Subsequently a moisture correction has to be applied to the result, correcting the mass reference from the dried sample back to the original moisture content of the fuel as it is consumed or weighed.

For the conversion of higher heating values (HHV or gross calorific value GCV) to LHV the equation defined in the 2006 IPCC Guidelines4 (Vol. II, Section 1.4.1.2, Box 1.1) can be applied. [Taken from WBCSD CSI "The Cement CO_2 and Energy Protocol".

Guidance Examples: When determining the elementary flows associated with production, the actual production mix should be used whenever possible, in order to reflect the various types of resources that are consumed. As an example, for the production and delivery of electricity, account shall be taken of the electricity mix, the efficiencies of fuel combustion, conversion, transmission and distribution losses.

All calculation procedures shall be explicitly documented in the Project Verification Report and the assumptions made shall be clearly stated and explained.

> *EN ISO 14044:2006, Care should be taken when aggregating the inputs and outputs in the product system. The level of aggregation shall be consistent with the goal of the study. Data should only be aggregated if they are related to equivalent substances and to similar environmental impacts. If more detailed aggregation rules are required, they should be explained in the goal and scope definition phase of the study or should be left to a subsequent impact assessment phase.*

Guidance: Aggregating data occurs when, for example, the products of a number of concrete plants are considered within a single EPD. In this case, the data can either be aggregated vertically, by calculating the impacts of each site separately using their own supply chain data and combining the data based on weighted production; or it can be aggregated horizontally, for example by calculating the typical impacts of cement plants used by the concrete plants, and then using this data within the an assessment of all the concrete plants. Horizontal aggregation may be less accurate if, for example, the distribution of cement plants used does not match the production of the cement plants so that the weighted average is incorrect, but where national or trade association study is being undertaken should produce similar results..

2.4.3 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 mean 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);
- 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 representativeness for generic data shall be provided in the Project Verification Report.

Table 1: Application of generic and specific data

MODULES	***Module A1-A3***	
	Production of commodities, raw materials	*Product manufacture*
Process type	*Upstream processes*	*Processes the manufacturer has influence over*
Data type	*Generic data*	*Manufacturer's average or specific data*

Guidance: 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.

2.4.4 DATA QUALITY REQUIREMENTS

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

- *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; any 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.*

Guidance: For waste disposal processes such as landfill, emissions to nature shall be measured for 100 years from the point of disposal.

Guidance: For virgin biomass based products, the system will include all inputs and outputs from the product system for 100 years before the point of harvest (e.g. for Timber) or the normal agricultural crop cycle if this is shorter.

- *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 2.3.5.3).*

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

Guidance: A check on data validity shall be conducted during the process of data collection to confirm and provide evidence that the data quality requirements for the intended application have been fulfilled. Validation may involve establishing, for example, mass balances, energy balances and/or comparative analyses of release factors. As each unit process obeys the laws of conservation of mass and energy, mass and energy balances provide a useful check on the validity of a unit process description. Obvious anomalies in the data resulting from such validation procedures require alternative data that do comply with the data selection rules.

2.5 TYPES OF EPD

2.5.1 EPD COVERING MORE THAN ONE PRODUCT

In cases where several similar products are produced by a site or company, the PCR offers the possibility for similar products to be grouped as an average product in the same EPD. In this case a mass weighted average of production should be used to calculate the average for the product group.

In the case that the difference of the environmental impacts between the products is higher than 10 %, information on the range of variation should be provided as per section 3.1 j).

Guidance Example: Manufacturer X may produce a range of products which are very similar – for example solid and hollow blocks of different sizes. They can provide an EPD with a single set of values to cover the range of products. In case the difference of the environmental between the products is higher than 10 % the producer should provide information in the EPD to convey the range of impact across the product range – for example by giving information such as +10% -13% for each indicator, or by giving the standard deviation for each indicator. This range only applies to the variation between the different products, not to the uncertainty associated with any individual dataset.

2.5.2 SECTOR EPD

It is also possible to create a so-called Sector EPD which enables the possibility to present average data for a whole industrial branch in a well-defined geographical area.

Where a group of manufacturers are declaring performance using a single sector EPD, then a mass weighted average of production should be used to calculate the average for the product or product group.

Where the average for a product group is provided, information on the range of variation should be provided as per section 3.1 j).

Guidance Example: A regional trade association may provide a sector EPD for the range of concrete products that are produced. In this case, the range can be covered by a single set of values, but information should be provided in the EPD to convey the range of impact across the product range – for example by giving information such as +10% -13% for each indicator, or by giving the standard deviation for each indicator. This range only applies to the variation between the different plants providing data, not to the uncertainty associated with any individual dataset.

2.6 OTHER ASPECTS

2.6.1 ELECTRICITY

Where electricity is generated on-site, then specific data for the inputs and emissions should be used. If electricity is sourced from the national grid, then the LCI associated with the national grid where the life cycle stage occurs shall be used. When a supplier of electricity can deliver a specific electricity product and guarantee that the electricity sale and the associated emissions are not double counted, the data for that electricity shall be used for the product studied. When the supplier of electricity does not provide specific data for the specific electricity product, then use of the national grid should be taken.

If specific life cycle data on a process within the energy supply system are difficult to access, data from recognized databases may be used.

The treatment of electricity should be documented.

Guidance: If electricity is generated on site, then data for inputs and emissions should be collected as part of the overall site data collection.

Although primary data should be used for the emissions from the power generated, the installations with onsite-power generation (other than Waste Heat Recovery), should be considered as indirect emission (included in module A1) to allow comparison.

If supplier specific data is used, any additional data, such as the inclusion of upstream processes, e.g. associated with any fuel extraction, processing and transport, or other default emissions, must be considered to ensure the data used is cradle to gate data covering all relevant emissions and resources, comparable in scope to national data sets.

Where a country does not have a single national electricity grid but has several unconnected grids, the relevant grid from which the power is obtained should be used.

Where a national grid is part of a larger regional grid, national data, taking into account imports and exports (if significant) to the regional grid should be used.

Guidance: Regarding double-counting, generator-specific emission factors for electricity used in a process could be used when:

- the process used the electricity (or used an equivalent amount of electricity of the same type to that generated), and another process did not claim the generator-specific emission factors for that electricity; and
- the generator-specific electricity production does not influence the emission factors of any other process or organization.

In some countries, parts of the electricity from renewable energy sources might already be sold/exported as “green” electricity, and should thus be excluded from the mix to avoid double counting.

Some "green certificates" are sold without coupling to the electricity, which might lead to double counting.

Guidance Examples: If a manufacturer had PV on their roof, if they use all the output in their plant and never export any to the grid or other users then the LCA may use a model of LCA for PV electricity for the quantity of electricity obtained from these PV panels. If, however, they sell the PV electricity to the grid or other users, then they cannot benefit from this “sold” electricity. Grid sourced green electricity can only be included if it can be demonstrated that they are the only company claiming this benefit (i.e. that the grid is not greener as a result, or other users are also “buying” the same electricity through other types of tariffs (possible in the UK).

2.6.2 LAND USE CHANGE

When significant, the GHG emissions and removals occurring as a result of direct land use change (dLUC) shall be assessed in accordance with internationally recognized methods such as the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories and included in the life cycle inventory. Land use change GHG emissions and removals shall be documented separately in the Project Verification Report. If site-specific data are applied, they should be transparently documented in the Project Verification Report.

Guidance: If land use change occurs at the start of a long term process, for example quarrying activity over many years, then the impact should be considered over the total production of the quarry and included if significant.

Guidance Examples: Land use change may occasionally occur when forestry is cleared for quarrying, or when timber is illegally harvested as a fuel. Illegal forest clearance or use of timber which is harvested illegally must take into account the land use change impact associated with such a change of use. This will mean that additional impacts associated with land use change will be included, alongside the consideration of biogenic carbon uptake and biogenic carbon emission at end of life if timber is used as fuel.

2.7 IMPACT ASSESSMENT

2.7.1 ENVIRONMENTAL IMPACT CATEGORIES

The impact assessment shall be carried out for the following environmental impact categories:

- *global warming;*
- *ozone depletion;*
- *acidification of land and water;*
- *eutrophication;*
- *photochemical ozone creation;*

- *depletion of abiotic resources (elements);*
- *depletion of abiotic resources (fossil).*

These should be calculated using characterisation factors recommended in regionally accepted impact assessment methods. In Europe, the latest CML baseline indicators should be used. The US Environment Protection Agency (EPA) recommends methods used in TRACI while in Australia, the Building Products Innovation Council (BPIC) has published applicable impact assessment methods for that region.

Guidance:

In Europe, the latest baseline characterisation factors shall be taken from CML (Institute of Environmental Sciences Faculty of Science University of Leiden, Netherlands). The characterisation factors for ADP-fossil fuels are the net calorific values at the point of extraction of the fossil fuels. CML characterisation factors can be downloaded at http://cml.leiden.edu/software/data-cmlia.html or are available in many commercial LCA softwares.

In the US, TRACI (US EPA Tool for the Reduction and Assessment of Chemical and other environmental Impacts) uses specific methodology and units for the assessment of acidification (mole H^+ equiv), Eutrophication (k N equiv) and Smog Creation Potential (kg O_3 equiv). See http://www.epa.gov/nrmrl/std/sab/traci/

In Australia, the BPIC/ICIP project has recommended indicators, and some indicator methodologies for the life cycle assessment of construction products in Australia. The recommended indicators are described in http://www.bpic.asn.au/_literature_79925/Life_Cycle_Impact_Assessment_-_Part_1_Classification_and_Characterisation.

In addition to these, other regionally accepted impact categories may be reported if required.

2.7.2 USE OF NET FRESH WATER

2.7.2.1. Water inventory

Data related to water which represent elementary flows and technical flows may be directly collected from unit processes or derived from LCA data for upstream processes, e.g. electricity or waste for further processing.

Generally categories of data related to each elementary flow and technical flow for inputs and outputs should include:

a) Quantities of water withdrawn (used) and discharged:
   - mass, or volume (e.g. water entering and leaving the unit process);

b) Water withdrawal of fresh water and non-fresh water:

   Source of water withdrawn (used) for elementary flows (resource types), e.g.:
   - rainwater;
   - surface water (water from rivers, lakes, ponds…);
   - groundwater (renewable, excluding fossil water), and
   - fossil water (non-renewable groundwater);
   - sea water;
   - brackish water;

   Source of water withdrawn (and used) for technical flows:
   - municipal water supply system

c) Water discharge of fresh water and non-fresh water:

   Fresh water discharge by receiving body: Ocean, surface, well, of-site water treatment

   Non-fresh water discharge by receiving body: Ocean, surface, well, of-site water treatment

d) Emission of water: evaporation water, evapotranspiration water
e) water quality parameters:

- e.g. chemical, physical (e.g. thermal), and biological characteristics;

f) Forms of water use:

- different forms of water consumption, e.g. evaporation, evapotranspiration, product integration, discharge into different drainage basins or the sea;

g) Geographical location of water withdrawal and return;

- information on the physical location of water withdrawal and return (as site-specific as possible) or assignment of the physical locations to a category derived from an appropriate classification of drainage basins or regions;

The water inventory shall include inputs and outputs from each unit process being part of the system to be studied. Any discrepancies in the inventory balance shall be explained.

Guidance: Information on location is required so that in the future when robust methods are in place, it will be possible to determine any related environmental condition indicator (e.g. water stress, local level of social development, etc.) of the area where the water use takes place.

At present, only very few robust methods to develop impact assessment for water consumption are available which relate to water consumption on a watershed level (drainage basin level). Methods considering water consumption on the level of water bodies (e.g. withdrawal of groundwater and discharge of this groundwater to surface water) are only in development. Therefore, the EPD only provides aggregated data on net fresh water consumption. It is recognized that in future this aspect of methodology will need further development and for this reason, data on the geographical location should be recorded. A small selection of local/regional water scarcity assessment measures is already available and these could be used to report on the environmental impacts of water consumption as additional information.

Tap water and purified waste water are not elementary flows but intermediate flows from a process within the technosphere (“technical flows”, e.g. from a water treatment plant) . Use of tap water or purified water will bring burdens from the treatment and distribution process.

Where electricity is generated on-site, then specific data for the inputs and emissions should be used. Only in the case of the Waste Heat Recovery (WHR), the water consumption would be considered as being integrated within the process.

2.7.2.2. Net fresh water consumption

Net fresh water consumption describes the amount of fresh water withdrawn for which release back to the source of origin (e.g. drainage basin or sea).does not occur. Net fresh water consumption is calculated as the difference between the sum of water withdrawals of fresh water and the sum of water discharges stemming from fresh water, including amounts of fresh water lost by evaporation, evapotranspiration, product integration and release to a different source of origin (e.g. different drainage basin or sea). Fresh water consumption includes the following water resource types reported for each unit process:

- rainwater;
- surface water;
- groundwater (excluding fossil water), and
- fossil water.

The net fresh water consumption for a unit process is the sum of the calculated water consumption for four fresh water types. The net fresh water consumption for a group of processes or a product is the sum of the net fresh water consumption for all the upstream unit processes.

Guidance Examples:

Quarry dewatering: If quarry water is just pumped from the quarry and placed in the river then this does not need to be accounted for as water use or consumption. Nevertheless, where evaporation may occur (particularly in hot climates), the share of evaporative loss should be considered for quarry water from ground water resources temporarily stored in artificial open ponds/lagoons or water storage facilities. Consequently, this evaporated quarry water should actually be reported as water consumption.

Rain and storm water: Rain and storm water used on the site should be reported (on input and output side) to facilitate sound water balances.

Recycled water: Recycled water stored in an open pool or a settlement lagoon may be subject to evaporation (particularly in hot climates). Thus, the evaporative loss of stored recycled water should be considered in the water balance as water consumption. On the input side, this loss is accounted for by additional fresh water withdrawals.

Guidance: Estimated evaporation can be used when consumption from this route is considered to be significant and accurate quantities are not available. The following document may be helpful in providing calculation of estimates: US EPA "Risk Management Program Guidance for Site Consequence Analysis" which can be downloaded from http://www.epa.gov/oem/docs/chem/oca-chps.pdf.

3 CONTENT OF THE EPD

3.1 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 declared unit of the construction product to which the data relates;*

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

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

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

e) a content declaration of the product covering relevant materials and substances. The gross weight of material shall be declared in the EPD at a minimum of 99%.

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 (SVHC) for authorisation" when their content exceeds 0.1 weight-% of the product. SVHC are listed by European Chemicals Agency and includes the Candidate List of SVHC (see http://echa.europa.eu/chem_data/authorisation_process/candidate_list_table_en.asp).

An optional detailed list of the product's substances, including CAS number, environmental class and health class, may be included in the product content declaration. It is also recommended to include substances' functions in the product (e.g., pigment, preservative, etc.).

Guidance: The source location of any safety data sheet can be provided.

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

Guidance: The EPD program or programs where this PCR will be registered have not yet been decided.

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

h) *A statement that the EPD only covers the Cradle to Gate stage, or the Cradle to Gate plus construction stage, because other stages are very dependent on particular scenarios and are better developed for specific building or construction works.*

i) *a statement that EPD of construction products may not be comparable if they do not comply with the requirements of comparability set in EN 15804;*

j) *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;*

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

l) *information on where explanatory material may be obtained.*

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

The PCR UN CPC 375 serves as the PCR for this EPD
Independent verification of the declaration, according to ISO 14025:2006 ☐ *internal* ☐ *external*
Independent Verifier: *<Name and Organisation of the Independent verifier>*

Independent verifiers, whether internal or external to the organization, shall not have been involved in the execution of the LCA or the development of the declaration, and shall not have conflicts of interests resulting from their position in the organisation.

Guidance: Independent verification is essential for any form of external communication.

3.2 DECLARATION OF ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

3.2.1 GENERAL

To illustrate the product system studied, the EPD shall contain a simple flow diagram of the processes included in the

An example of a process flow diagram for a cement kiln taken from WBCSD CSI Cement CO2 and Energy Protocol is included below.

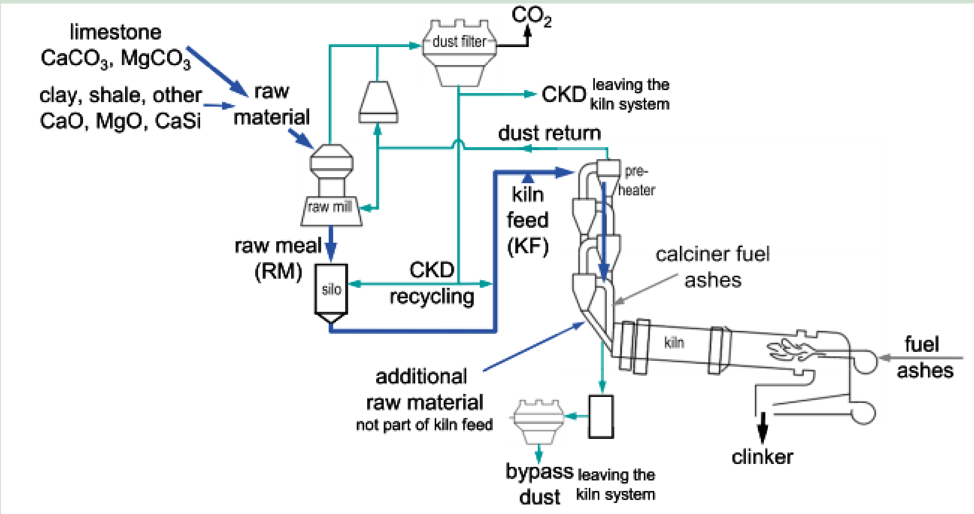


Figure 3-1: Example of a cement process flow diagram.

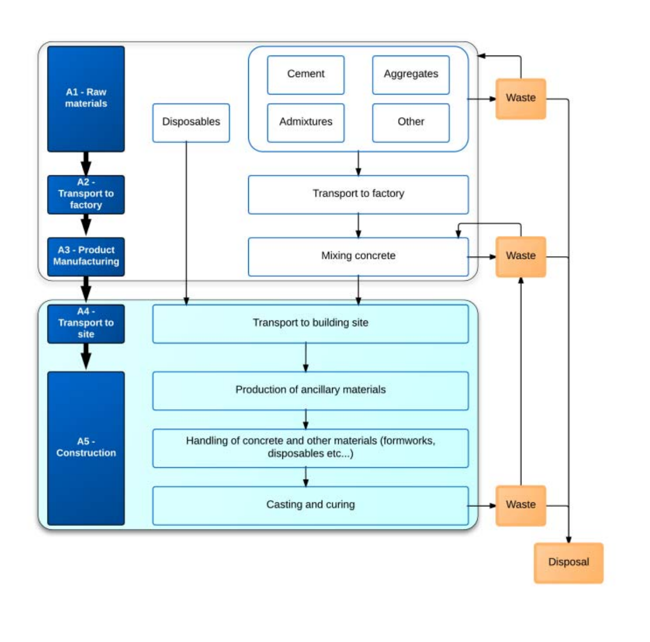


Figure 3-2: Example of a ready-mixed concrete process flow diagram

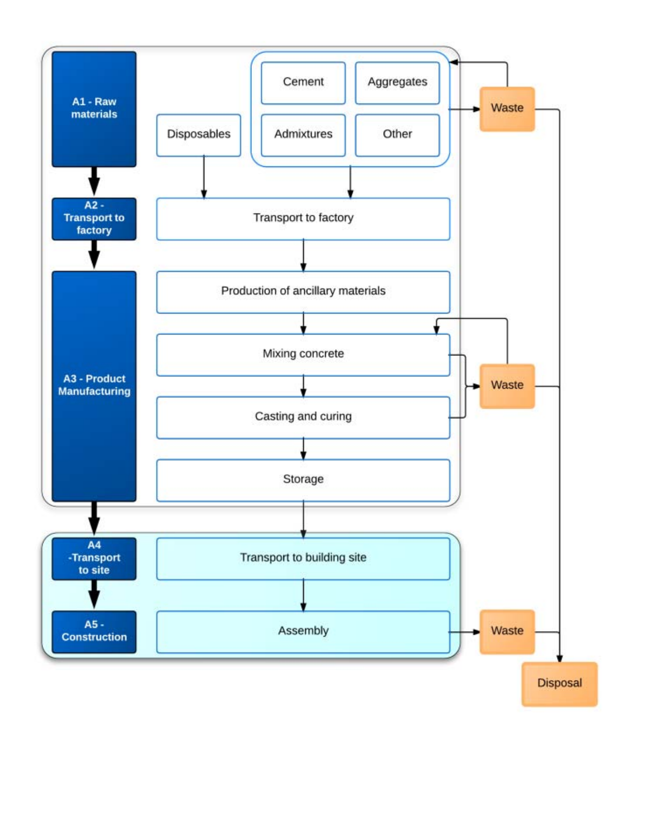


Figure 3-3: Example of a precast concrete process flow diagram

3.2.2 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

Impact Category	***Parameter***	***Parameter unit expressed per functional/declared unit***
Global Warming	*Global warming potential, GWP (100 years). Characterisation Factors: International Panel for Climate Change 4th Assessment Report, 2007.*	*kg CO_2 equiv*
Ozone Depletion	*Depletion potential of the stratospheric ozone layer, ODP;*	*kg CFC 11 equiv*
Acidification for soil and water	*Acidification potential of soil and water, AP;*	*mol H+ equiv/kg SO_2 equiv*
Eutrophication	*Eutrophication potential, EP;*	*mol N equiv/kg PO4 equiv*
Photochemical ozone creation	*Formation potential of tropospheric ozone, POCP;*	*kg NMVOC equiv/kg Ethene equiv*
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*

[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.*

Guidance: Regionally accepted publications carry details of these indicators and source documents for characterisation factors. Brief descriptions, for the specific case of Europe, are provided below.

Abiotic Depletion Potential (ADP) (elements): impact from the depletion of scarce non-renewable resources such as metals, expressed in comparison to the element antimony.

Characterisation factors based on the ultimate reserves are provided 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. Baseline factors using the ultimate reserve have also been included in CML-IA which can be downloaded at http://cml.leiden.edu/software/data-cmlia.html.

Abiotic Depletion Potential (ADP) (fossil): impact from depletion of fossil fuel resources such as oil or natural gas, expressed using their net calorific value.

Characterisation factors are based on the net calorific value of the fossil fuel resource. Indicative factors have been included in CML-IA and can be downloaded at http://cml.leiden.edu/software/data-cmlia.html.

Global Warming Potential (GWP): global warming impact of greenhouse gases such as Carbon Dioxide (CO_2), measured using the equivalent CO_2 emission over a 100 year time horizon.

Characterisation factors are provided in Table 2.14 of the IPCC 4th Assessment Report which can be viewed at http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html. These factors are also included in the CML-IA baseline indicators (http://cml.leiden.edu/software/data-cmlia.html).

Ozone Depletion Potential (ODP): relative impact that the product can cause to the stratospheric ozone layer, compared to an emission of trichlorodifluoromethane (CFC-11), using a 100 year timescale.

Characterisation factors are provided in 'Scientific Assessment of Ozone Depletion: 1998' World Meteorological Organization Global Ozone Research and Monitoring Project - Report No. 44. The executive summary of this report is located at

http://www.esrl.noaa.gov/csd/assessments/ozone/1998/executive_summary.html but characterisation factors cannot be downloaded there. These factors are included in CML-IA baseline indicators (http://cml.leiden.edu/software/data-cmlia.html).

Acidification Potential (AP): increase of soil and water acidity that the product can cause, measured in kg of Sulphur Dioxide equivalent.

Characterisation factors are provided by 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. These factors are included in CML-IA baseline indicators (http://cml.leiden.edu/software/data-cmlia.html).

Eutrophication Potential (EP): impact of nutrification by nitrogen and phosphorus to aquatic and terrestrial ecosystems, for example through algal blooms, disturbing the balance between species, measured in moles of Nitrogen equivalence.

Characterisation factors are provided by 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. These factors are included in CML-IA baseline indicators (http://cml.leiden.edu/software/data-cmlia.html).

Photochemical Ozone Creation Potential (POCP): also known as summer smog, the impact from oxidizing of volatile compounds in the presence of nitrogen oxides (NOx) which frees ozone in the low atmosphere, measured relative to Ethene (C2H4).

Characterisation factors are provided 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 and 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. Atmosperic Environment, 32. p 2429-2441. These factors are included in CML-IA baseline indicators (http://cml.leiden.edu/software/data-cmlia.html).

Commercial LCA software also implement many of these life cycle impact assessment methodologies.

3.2.3 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	***Parameter unit expressed per functional/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	*MJ, net calorific value*

Parameter	Parameter unit expressed per functional/declared unit
materials	
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
Use of net fresh water	m^3

Guidance: 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.

Net fresh water has been considered equivalent to the concept of consumption of fresh water used in the developing ISO Standard 14046 for water footprinting. A description of the calculation of consumption of net fresh water based on this developing Standard is provided in 2.7.2.

It is also possible to report fresh water consumption at a more granular level covering levels of water stress and/or by different water type. Recommended water stress indicators for geographical areas are available for download from the website http://www.ifu.ethz.ch/ESD/data/.

Guidance: Brief descriptions of these indicators are provided below.

Primary energy (or embodied energy): total energy resources required to manufacture the product. Non-renewable energy derives from fossil fuels and uranium, and renewable energy from biomass, wind, solar or hydraulic sources.

Water consumption (or embodied water): water used in the production process, which can be a significant proportion of the total footprint. It does not take into account any aspect of geographical scarcity.

Where relevant, these indicators may also provide data on the impacts associated with the use of energy recovery from waste – see 2.3.5.6.

3.2.4 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	Parameter unit expressed per functional/declared unit
Hazardous waste disposed	kg
Non- hazardous waste disposed	kg
Radioactive waste disposed	kg

Guidance:

Hazardous waste: hazardous waste that needs special treatment (excluding radioactive waste).

Non-hazardous waste: includes

Overburden: includes dust, spoil and other waste from raw materials extraction.

Municipal waste: waste treated in municipal disposal scheme

Radioactive waste: covers all level of radioactivity, essentially waste from nuclear power plants

Table 6 — Other environmental information describing output flows

Parameter	***Parameter unit expressed per functional/declared unit***
Components for re-use	*kg*
Materials for recycling	*kg*
Materials for energy recovery	*kg*
Exported energy	*MJ per energy carrier*

Guidance: 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 2.3.4.5.

These parameters may also have had impact allocated to them according to the allocation procedures defined in 2.3.5.3.

The declaration of “components for re-use” and “materials for recycling”: fulfils the conditions of 4.2.5, end-of-life stage.

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 plants using secondary fuels. Materials for energy recovery are based on thermal energy efficiency rate of the a power plant 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.

Exported energy relates to energy exported from waste incineration and landfill. Other energy exported from the system is not reported.

The characteristics that render waste hazardous are described in existing applicable legislation, e.g. in the European Waste Framework Directive 2008/98/EC.

3.3 SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

3.3.1 SUPPORTING PRODUCT LEVEL SCENARIOS

To enable building or construction works level assessment, scenarios can be used to model relevant life cycle stages. Information to support the calculation of scenarios that deal with any one or all of the life cycle stages of the construction product after manufacturing can be provided as part of the EPD, covering “transport to site, construction, use stage, end-of-life” (see Figure 3-2)**Fel! Hittar inte referenskälla.**.

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 three scenarios can be declared). Scenarios shall not include processes or procedures that are not in current use or which have not been demonstrated to be practical.

Guidance: Energy recovery needs to be based on existing technology and current practice.

Guidance examples: *A recycling system is not practical if it includes a reference to a return system for which the logistics have not been established.*

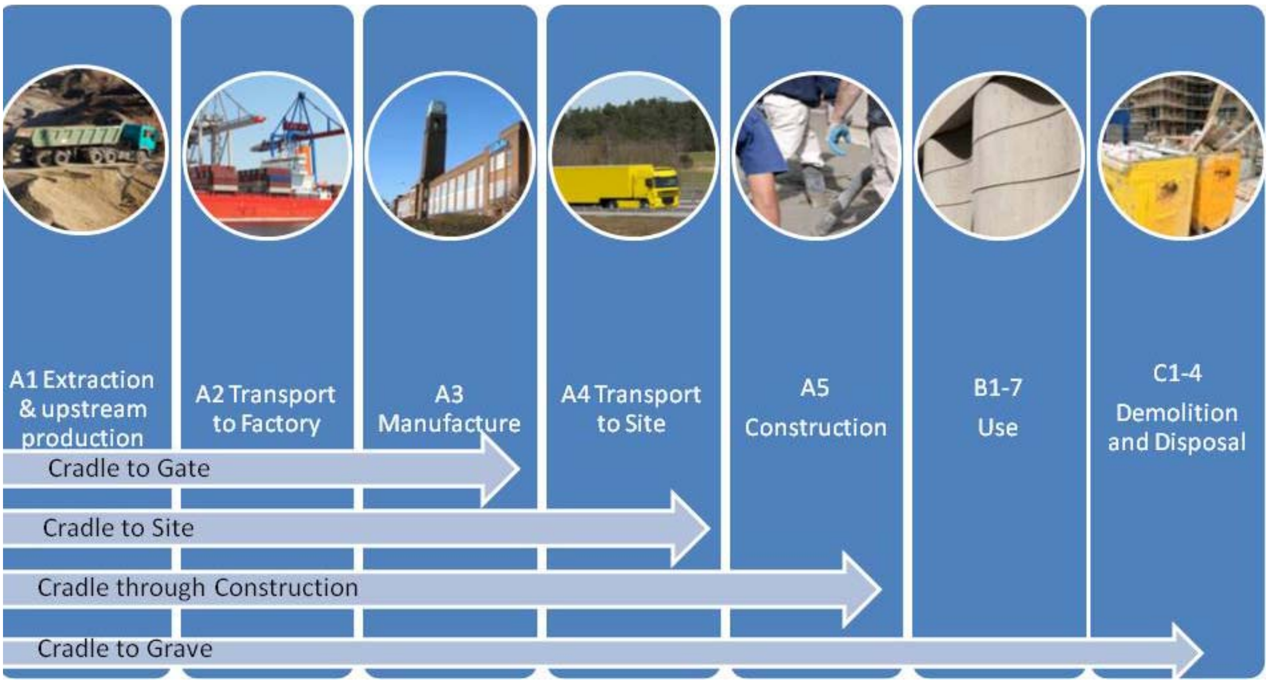


Figure 3-2. Life Cycle Stages described by this PCR.

3.3.2 GENERAL

Scenarios for further 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 Table 7 to Table 12 supports the consistent development of scenarios by which the LCA derived parameters for further life cycle stages can be calculated and declared. To support the development of such scenarios, this PCR provides the information which can be provided optionally for products to enable consistent evaluation.

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

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 3.3, this shall be stated.

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

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

3.3.3 CONSTRUCTION PROCESS STAGE

3.3.3.1. A4, Transport to the construction site

If product stage A4 is declared, or 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 support development of the scenarios at the building or construction works level:

Table 7 — Typical transport to the construction site

Parameter	***Parameter unit expressed per functional/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*

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

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.

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

3.3.3.2. A5, Installation in the building or construction works

If additional technical information is provided in the EPD for installation in or onto 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:

This should cover, for example typical materials and energy required for formwork, pumping, installation, or treatment of concrete to assist curing (heating or cooling, use of water) and treatment to address the surface of the concrete. These are to be provided to allow the installation phase impacts to be calculated dependent on the actual building or construction works situation.

Table 8 — Typical Installation of the product in the building B1-B7 use stage

Parameter	***Unit (expressed per functional/declared unit)***
Ancillary materials for installation (specified by material);	*kg or other units as appropriate*
Net consumption of fresh water for installation	*m3*
Other resource use for installation	*kg*
Quantitative description of energy type (regional mix) and consumption during the installation process	*kWh or MJ*
Wastage of 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,	*kg*

Parameter	*Unit (expressed per functional/declared unit)*
disposal (specified by route)	
Direct emissions to ambient air, soil and water	*kg*

3.3.3.3. B1-B5 use stage related to the building fabric

The provision of additional technical information to support the calculation of life cycle modules B1-B7 at the building level is optional and if included must be based on typical scenarios which must be described.

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 4.3).

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 9:

Table 9 — use stage related to the building fabric

Parameter	***Parameter unit expressed per functional/declared unit***
B2 Maintenance	
Maintenance process	*Description or source where description can be found*
Maintenance cycle	*Number per RSL or year**
Ancillary materials for maintenance, (e.g. cleaning agent, specify materials)	*kg / cycle,*
Wastage material during maintenance (specify materials)	*kg*
Net fresh water consumption during maintenance	*m3*
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*
Wastage material during repair, (specify materials)	*kg*
Net fresh water consumption during repair	*m3*
energy input during repair (e.g. crane activity), energy carrier type e.g. electricity, and amount	*kWh / RSL, kWh / cycle*

Parameter	*Parameter unit expressed per functional/declared unit*
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*
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*
Wastage material during refurbishment, (specify materials)	*kg*
Further assumptions for scenario development, (e.g. frequency and time period of use, number of occupants)	*units as appropriate*
*	*not applicable if only B2 is declared*

3.3.3.4. Reference service life

Guidance: This PCR does not cover the use phase of the product and therefore the declaration of the RSL is not required. The EPD can however include information related to the calculation of the RSL as additional information.

The description of the reference service life 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	*Parameter unit expressed per functional/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;	*Units as appropriate*

Parameter	*Parameter unit expressed per functional/declared unit*
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 replaceable components.	*Units as appropriate*

3.3.4 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 — Typical End-of-life

Processes	*Parameter unit expressed per functional/declared unit of components, products or materials (specified 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*

3.4 AGGREGATION OF INFORMATION MODULES

Information modules A1, A2, and A3 may be aggregated or provided as 3 separate modules.

4 PROJECT VERIFICATION REPORT

4.1 GENERAL

The Project Verification Report is the systematic and comprehensive summary of the project documentation supporting the verification of an EPD. It is assembled by the party producing the EPD and submitted to a verifier nominated by the EPD Scheme. The Project Verification Report is used to demonstrate that the LCA based information and the additional information that are declared in the EPD meet the requirements of this PCR. It is essential in the Project Verification Report to demonstrate in a transparent way how the data and information declared in the EPD results from the LCA study.

The Project Verification Report has to be made available to the verifier with the requirements on confidentiality stated in EN ISO 14025.

The Project Verification Report is not communicated externally (other than to the Verifier) unless the manufacturer wants to do so.

Guidance Examples: The Project Verification Report is produced at the same time and by the same party as the EPD and provided by them to the verifier to facilitate verification. The format of the Project Verification Report may be determined by the program operator.

4.2 LCA-RELATED ELEMENTS OF THE PROJECT VERIFICATION 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 Verification 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 unit, including:

i) definition, including relevant technical specification(s) (see 2.3.2),

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

1. *the same product produced at different production sites (see* 2.5.2*) or*
2. *a group of similar products produced by different suppliers (see 2.5.2).*

2) system boundary (see 2.3.4) according to the modular approach, 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; and

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

3) cut-off criteria for initial inclusion of inputs and outputs (see 2.3.5.3), 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;

Guidance: ISO 14025 states the following:

Product-specific data are often confidential because of

- competitive business requirements,
- proprietary information covered by intellectual property rights, or
- similar legal restrictions.

Such confidential data are not required to be made public. The declaration typically only provides data aggregated over all or relevant stages of the life cycle. Business data identified as confidential that is provided for the independent verification process shall be kept confidential.

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

*3) validation of data (see 2.4.3,***Fel! Hittar inte referenskälla.** *and 2.4.4), including:*

i) data quality assessment; and

4) treatment of missing data;

5) allocation principles and procedures (see **Fel! Hittar inte referenskälla.***), including:*

i) documentation and justification of allocation procedures; and

ii) demonstration that uniform application of allocation procedures;

*e) Life cycle impact assessment (see 3.2***Fel! Hittar inte referenskälla.***):*

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 mean of each 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 judgments.

4.3 DOCUMENTATION ON ADDITIONAL INFORMATION

The Project Verification Report shall include any documentation to support any additional environmental information declared in the EPD as required in this standard.

Guidance: Such documentation could include the following, e.g. as copies or as links to 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 , energy consumption during use, cleaning cycles, etc.).

4.4 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.

4.5 VERIFICATION AND VALIDITY OF AN EPD

After verification an EPD is valid for a 5 year period from the date of issue.

After 5 years, the EPD shall be reviewed. 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 reassessed after 5 years if the underlying data has not changed significantly. In either case, the EPD will need to be verified again to have a further 5 year period of validity.

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

Guidance: 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.

5 TERMS AND DEFINITIONS

The following definitions are provided for terms used in the PCR and Guidance.

1.1. ***additional technical information****: information that forms part of the EPD by providing a basis for the development of scenarios*
Guidance example: An example of the type of additional technical information which could be provided in an EPD for concrete is the diesel required to pump 1 m3 of concrete 10 metres vertically upward. This information could then be used by someone developing a Building LCA to generate the impact, by taking the volume of concrete and the average height that it needs to be raised to calculate the total amount of diesel needed on site for pumping concrete.

1.2. alternative fuels: alternative fuels (AF) are typically derived from wastes and therefore, without this use, would have to be disposed of in some other way, usually by landfilling or incineration. Alternative fuels serve as a substitute for conventional fossil fuels. They include fossil fuel-based or non biogenic fractions, such as, waste oil and plastics, and biomass fractions, such as waste wood and sewage sludge.

1.3. ***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]*
Guidance example: An example of an ancillary material used in the production of concrete would be formwork, as it does not constitute part of the final product.

1.4. ***average data****: data representative of a product, product group or construction service, provided by more than one supplier*
Guidance: The product group or construction service can contain similar products or construction services. For example, an EPD could be provided for individual products such as a particular compressive strength of hollow or solid dense block products, or for dense concrete blocks as a product group, covering all the relevant products within that group.
Note that EPD may be produced for one or more products produced by one supplier (see 2.5.1), or for a product, products or product group produced by more than one supplier (eg. a trade association) (see 2.5.2), and that different rules apply to these situations and how the results should be reported.

1.5. **building** : construction works that has the provision of shelter for its occupants or contents as one of its main purposes and is usually enclosed and designed to stand permanently in one place [ISO 6707-1:2004]

1.6. **by-product**: secondary substances produced by an industrial process (ISO/DIS 13315-1)
Guidance example: An example of a by-product would be fuel ash produced within a coal fired power station. By implication, a by-product is a waste which has been recycled or a co-product with very low value. See also 2.9 Co-product.

1.7. ***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]*
Guidance there are rules within the Life Cycle Assessment Standards (ISO 14040:2006, 14044:2006) which prevent the use of comparative assertions unless the underlying life cycle assessment study has been peer reviewed by experts. This ensures that the goal and scope of the study supports the comparison of the products undertaken and that there is robust and consistent data used to support the comparison, and the products and/or services compared have the same functionality. EPD in themselves are not comparative assertions, as they only provide information on the impact of the product covered by the EPD. EPD can only be used to compare solutions when the function of the products within the building or construction works, and their impact over the life cycle has been considered. This is covered further in Section 4.3.

1.8. **concrete demolition waste** : concrete generated in demolition of concrete structures (ISO/DIS 13315-1)

1.9. **construction element**: part of a construction containing a defined combination of products
Guidance example: An example of a construction element would be a concrete ground floor slab, or a concrete blockwork cavity wall.

1.10. ***construction product****: item manufactured or processed for incorporation in construction works*
Guidance: construction products are supplied by a single responsible body – where individual construction products are supplied separately to site and combined together there, they are known as a construction assembly, assembled system or construction element.

1.11. ***construction service****: activity that supports the construction process or subsequent maintenance*
Guidance example: An example of a construction service would be the excavation of foundations or erection of formwork or scaffolding.

1.12. **construction works**: everything that is constructed or results from construction operations
Guidance: This covers both building (3.3) and civil engineering works, and both structural and non-structural elements. [Adapted from the definition in ISO 6707-1:2004].

1.13. ***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*
Guidance: 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.

1.14. ***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*
Guidance examples: Mass (kg) or volume (m³). [Adapted from ISO 21930:2007]
Other examples of declared units used of EPD of concrete are provided in 2.3.2**Fel! Hittar inte referenskälla.**.

1.15. **direct land use change (dLUC)**: change in human use or management of land at the location of the production, use or disposal of raw materials, intermediate and final products or wastes in the product system (From ISO 14067 CD3)
Guidance Examples: Opening or closing quarries or factories may result in land use change, eg. from forest to quarry, with consequential impacts in terms of greenhouse gas emissions. Section 2.6.2 covers how any significant land use change should be considered.

1.16. **drainage basin** : area that captures water in any form, such as rain, snow or dew and drains it to a common water body (from WD ISO 14046)
Guidance: Drainage basins can be identified by tracing a line along the highest elevations between two areas on a map, i.e. drainage divides, that determine the direction the water will flow. Sometimes the terms “watershed”, “drainage area”, “catchment basin”, “catchment area” or “river basin” are used for this concept. Groundwater drainage basin not necessarily reflects surface drainage basin.

1.17. **end-of-waste state**: Point at which waste can no longer be considered waste.
Guidance: A definition of the end-of-waste state is provided in 2.3.4.5. This is drawn from the European Waste Framework Directive. However, the end-of-waste state as defined does not ensure a consistency of application which WBCSD CSI would like to see, to ensure comparability and consistency of EPD. This is demonstrated because, a) there are differences in interpretation and implementation of this directive in each European state, b) the directive does not pertain outside of Europe, c) there are differences in the economic values of wastes , by-products and co-products in different locations, and d) different states have introduced protocols to define the qualities of material which has reached the end-of-waste state.
For the purposes of this PCR, WBCSD CSI are therefore providing guidance on the point at which wastes should be considered to reach the end-of-waste state wherever they are produced, and whatever their legal status in that location. This guidance is based on a “conservative” principle – so that the end-of-waste state is identified, if there is more than one point, at the point where the benefit to concrete producers is minimised,

rather than maximized.
Guidance examples:
An example of the end-of-waste state for concrete demolition waste is the point in the process from the demolition of the building through to the eventual use of the recycled concrete aggregate, at which the material moves from being a waste to a product. In this instance, it is defined as the point at which the material has been crushed and can be used as a product.
An example of the end-of-waste state of waste tyres, used as a fuel, is as follows:
waste tyres, put whole into the cement kiln – product is a waste when it enters the kiln.
waste tyres, shredded and steel reinforcement recovered before putting into the cement kiln – product reaches end-of-waste state when it has been prepared as a secondary fuel.

1.18. **environmental declaration**: claim which indicates the environmental aspects of a product or service
ISO 14020:2001 sets out 3 types of environmental declarations:
- Type I, known as ecolabels, prescribed in ISO 14024: 2006, and covering schemes such as the EU Ecolabel or Blauer Engel.
- Type II, self declared environmental claims, described in ISO 14021:2006, and covering claims such as recycled content, recyclable, reduced energy consumption etc.
- Type III, Environmental Declarations, described in ISO 14025: 2006 and covering construction EPD as further described in ISO 21930:2007.

1.19. **environmental performance**: *performance related to environmental impacts and environmental aspects [ISO 15392:2008]. [ISO 21931-1:2010]*
Guidance example: The environmental performance of the building is the environmental impact that it has as a result of its construction, operation, demolition and disposal. It is important to understand that different materials can have considerably different effects on the environmental performance of a building. For example, in terms of building operation, concrete materials can impact on the thermal mass or thermal inertia of the building, the air-tightness of the building and the thermal resistance of the building. Additionally, construction products such as concrete can affect the design of other parts of the building – for example the weight of materials used in a wall could affect the mass of foundations required; the thickness of the wall could affect the building footprint or the useable floor area of the building; a material which has a fair-faced finish does not have to use an additional surface finish treatment such as plasterboard and paint.
Impacts associated with the use of construction materials and services within the building or construction works are calculated on the basis of information provided in EPD. Most countries have also defined standardized mechanisms to calculate or estimate the impact of building operation from energy and water use – these may however not equate to actual energy and water consumption due to differences in the real and theoretical operation of the building.

1.20. **Environmental Product Declaration (EPD):** a Type III environmental declaration

1.21. ***fossil water****: water that has remained sealed in an aquifer for a long period of time (hundreds to millions years of time) (from WD ISO 14046). Also known as paleowater.*
Fossil water is a non-renewable resource or renewable only over long geological periods. Water can rest underground in "fossil aquifers" for thousands or even millions of years. When changes in the surrounding geology seal the aquifer off from further replenishing from precipitation, the water becomes trapped within, and is known as fossil water.

1.22. ***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*
Guidance: as this PCR only covers the cradle to gate or site stages of the construction life cycle, it is not possible to consider a functional equivalent, as this needs to take into account the full life cycle including the use stage and end of life.

1.23. ***functional unit****: quantified performance of a product system for use as a reference unit [EN ISO 14040:2006]*
Guidance: as this PCR only covers the cradle to gate or site stages of the construction life cycle, it is not

possible to define a functional unit, as this needs to take into account the full life cycle including the use stage and end of life. As a cradle to gate or cradle to site EPD, the declared unit is all that can be used.

1.24. **greenhouse gas removal, GHG removal** : total mass of a greenhouse gas removed from the atmosphere over a specified period of time [ISO 14064-1:2006, 2.6]

1.25. **groundwater** : water contained in aquifers which are strata in which the water is contained in the porous voids (from WD ISO 14046)

1.26. **independent verifier**: Independent verifiers, whether internal or external to the organization, shall not have been involved in the execution of the LCA or the development of the declaration, and shall not have conflicts of interests resulting from their position in the organization. (ISO 14025 2006 8.2.1)
Guidance: EPD require independent verification. The verifier could be from the manufacturer, an LCA practitioner that has undertaken the EPD for the manufacturer, could be appointed by an EPD program or chosen from a list of approved verifiers, but it is essential that the verifier can demonstrate their independence from the study, or any conflict of interest in relation to their position vis a vis those undertaking the study – for example that they do not manage the staff undertaking the study or have responsibility for the quality of their work. From this point of view, an independent verifier appointed by an EPD program or chosen from a list of approved verifiers offers the most confidence in terms of external communications.

1.27. ***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]*
Guidance example: Data on the typical impacts of transport to site for a concrete product may be provided as an information module (A4 within the terminology of EN 15804). This provides the LCA data (environmental impact and inventory indicators) and the data underlying the scenario used, for example the type of vehicle, distance travelled, load carried, empty returns etc.

1.28. ***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]*
Guidance: LCA is governed by the ISO standards ISO 14040:2006 and ISO 14044:2006 which set out the framework for undertaking any LCA studies.

1.29. ***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*]
Guidance: Life Cycle Inventory is a list of all the raw material resources, at the point at which they are extracted from nature, i.e. crude oil, iron ore, limestone rock etc, and all the emissions to air, water or land, associated with a given system. Each item in the inventory is known as a "burden". The Inventory is produced by tracing all resource use and emissions "upstream" through the supply chain from manufacture to where man first has an influence on the environment, and "downstream", eg. through waste treatment and disposal. Life Cycle Inventory data needs further processing, known as Impact Assessment, to "classify" the environmental impacts each resource use or emission cause, and to "characterize" the size of the impact from each burden.

1.30. ***non-renewable energy**: energy from sources which are not defined as renewable energy sources*
Guidance examples: fossil fuels and uranium are examples of non-renewable energy sources which cannot be replenished on a human timescale.

1.31. ***non-renewable resource**: resource that exists in a finite amount that cannot be replenished on a human time scale [ISO 21930:2007]*
Guidance examples: limestone, sand and gravel, marine dredged aggregate and other extracted stones are examples of non-renewable resources.

1.32. ***performance** : expression relating to the magnitude of a particular aspect of the object of consideration relative to specified requirements, objectives or targets*

1.33. ***product category***: *group of construction products that can fulfil equivalent functions*
Guidance: This PCR covers the product category unreinforced concrete, and includes various products such ready mix concrete, concrete blocks, mortars and renders.

1.34. ***product category rules (PCR)*** *: set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories*
Guidance: A PCR is provided to ensure that manufacturers using the same PCR can produce Environmental Product Declarations (EPD) which are robust, independently verified, consistent and can be used at the building or construction works level to assess the impact of the building or construction works to compare different products taking account of their influence on the building or construction works .
This PCR for unreinforced concrete, by providing detailed rules, requires and guidelines, and by giving explanations and examples, should minimize the opportunity for interpretation within the document, and is intended to ensure that anyone using it and assessing the same product would produce a repeatable and comparable result.

1.35. ***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]*
Guidance: The cradle to gate product system for ready-mix concrete for example would take into account the manufacture of the raw materials required, transport to the ready mix plant and production of the concrete. To extend the product system to the site, transport processes and associated washing of lorries must be considered for example. To further include installation on site, any processes associated with pumping the concrete, use of formwork, any activities to ensure curing or to produce the required surface qualities must be included in the product system. This PCR does not extend beyond installation on site, but to model the full life cycle, maintenance and refurbishment processes, and demolition and any associated waste treatment and disposal processes would need to be considered.

1.36. ***programme operator***: *body or bodies that conduct a Type III environmental declaration programme*
Guidance: A programme 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.
Guidance Examples: Programme Operators producing EPD for construction products include the Insitut Bau und Umwelt (IBU) (www.bau-umwelt.de), the International EPD® Scheme (www.environdec.com) and certification bodies such as Underwriters Laboratories (http://www.ulenvironment.com) and BRE Global (www.greenbooklive.com).

1.37. ***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]*

1.38. ***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*
Guidance example: Typical data describing the validity of the RSL include the description of the component for which it applies, the reference in-use conditions under which it applies, and its quality. [ISO 15686-8:2008.
Guidance: as the PCR only applies for cradle to gate or cradle to site assessments, it is not necessary within the EPD to consider or report the reference service life.

1.39. ***renewable energy***: *energy from renewable non-fossil sources*
Guidance: energy which is generated from renewable resources is considered to be renewable.
Guidance examples: Wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

1.40. ***renewable resource***: *resource that is grown, naturally replenished or naturally cleansed, on a human time scale*
Guidance: 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]

If a resource is harvest unsustainably then it cannot be regarded as a renewable resource – for example timber from illegal logging is not a renewable resource.

1.41. **returned water**: water that returns after use to a water body (from WD ISO 14046)
Guidance: The quality, quantity, temperature and point of return to a water body compared to pre-withdrawal conditions can be different.
Guidance Example: Water which is withdrawn from a river or lake for use in a cooling system may be returned after use back to the same river or lake. This is returned water.

1.42. ***scenario****: collection of assumptions and information concerning an expected sequence of possible future events*
Guidance: Scenarios are required to enable assessment of stages of the life cycle which will occur in the future. This is because the future is unknown. Within EPD, scenarios should be based on what is known to currently occur now, rather than on what is estimated will happen in the future. For example, a scenario for the life cycle stage A4 – transport to site, might provide the typical distance that the product travels to the customer in a given country, the mode of the transport (road/rail etc), the vehicle type, load and empty lading %. The scenario should explain the basis of this data – for example that it is the mean or modal average data. This scenario information can be used to calculate the impacts of this scenario for inclusion within the EPD, or can just be included as additional information. For those using the EPD, the scenario can be reviewed to see if it is appropriate for the actual situation being considered. If the site is double the distance for example, then the impacts, if calculated, can be doubled. Alternatively, if the impact of transport is seen to be insignificant compared to the impacts of manufacture, then it could be ignored.

1.43. ***secondary fuel****: fuel recovered from previous use or from waste which substitutes primary fuels*
Guidance: Processes providing a secondary fuel are considered from the point where the secondary fuel enters the system from the previous system.
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.
Guidance examples for primary fuels are: coal, natural gas, biomass, etc.
Guidance examples for secondary fuels recovered from previous use or as waste are: used solvents, used wood, used tyres, used oil, waste animal fats.
It should be noted that secondary fuels may not have reached the end-of-waste state before use – for example waste tyres recovered for use whole within a cement kiln. The term, secondary fuel, therefore does not have any impact on the treatment of the fuel. Use of secondary fuels (whether they have reached the end-of-waste state or not, are reported as an inventory indicator.

1.44. ***secondary material****: material recovered from previous use or from waste which substitutes primary materials*
Guidance: Secondary material is measured at the point where the secondary material enters the system from another system.
Materials recovered from previous use or from waste from one product system and used as an input in another product system are secondary materials – at the point of use, they may not have reached the end-of-waste state.
Guidance Examples: Examples for secondary materials (to be measured at the system boundary) are crushed concrete, glass cullet, pulverized fuel ash.

1.45. ***specific data*** *: data representative of a product, product group or construction service, provided by one supplier*
Guidance Examples: the data provided by a factory regarding their actual energy consumption, raw materials inputs, transport of raw materials, amount and destination of wastes, emissions and outputs are specific data. This is sometimes also known as primary data. The other type of data is secondary or generic data – this is data provided by a trade association, from a national survey or report or industry report, or a database and is based on data from more than one supplier or from an estimation of the data.

1.46. **surface water** : all water you can see as overland flow, rivers and lakes excluding sea water (from WD ISO 14046)

1.47. ***third party*** *: person or body that is recognized as being independent of the parties involved, as concerns the issues in question*
Guidance: "Parties involved" are usually supplier ("first party") and purchaser ("second party") interests. [EN ISO 14024:2000]
Other ISO standards, for example, ISO 9001, talk about "second party" being any party with an interest in the supplier, for example, a stakeholder. Third party verification is only required for business to consumer communication – for business to business communication (i.e. between a supplier and specifier, or supplier and contractor or supplier and client), the only requirement is that the verifier is competent and independent.

1.48. ***type III environmental declaration****: environmental declaration providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information, which has been independently verified.*
Guidance: The calculation of predetermined parameters is based on prEN 15804, which itself has been based on the ISO 14040 series of standards, which is made up of ISO 14040, and ISO 14044, and ISO 21930.

1.49. ***upstream, downstream process****: process(s) that either precedes (upstream) or follows (downstream) a given life cycle stage.*
Guidance: A manufacturer provides specific data about their use of energy, input materials and wastes. Upstream data is used to describe all the processes occurring before the manufacturer's process, for example the extraction of resources, the generation of energy and manufacture of input materials and their transport. Downstream data is used to describe all the processes occurring after the manufacturer's process, for example transport, treatment and/or disposal of wastes, transport of products, and their use and end of life product stages.

1.50. ***waste****: substance or object which the holder discards or intends or is required to discard*
Guidance: this definition is adapted from the definition in the European Waste Framework Directive 2008/98/EC.
Guidance Examples: to be covered once agreed end-of-waste state.

1.51. **water consumption**: water withdrawal where release back to the source of origin does not occur, e.g. because of evaporation, evapotranspiration, product integration or discharge into a different drainage basin or the sea (from WD ISO 14046)
Guidance: The granularity of the source of origin needs to be defined in the goal and scope.
Guidance Examples:
Evaporation: Water is withdrawn and subsequently evaporates into the atmosphere, for example when it is lost from a cooling operation; when it is used for dust suppression of stockpiles or quarries. Once the water has evaporated, it becomes part of the wider water cycle and could return to a waterbody anywhere in the world. From this point of view, it is considered as water consumed.
Evapotranspiration: Water is taken up by plants or other biomass and is released to the atmosphere via evapotranspiration. Natural evapotranspiration, for example from wild planting as a result of rainfall, is not considered water consumption. However the use of water for irrigation and the water lost from evapotranspiration from planting (eg. lawns) are considered water consumption. This type of water consumption is unlikely to be an issue for the concrete industry.
Product integration (sometimes known as embedded water): this is the water which is remains in the product when it leaves the factory gate. For concrete, this is both the water making up the moisture content and the water which is chemically integrated with the cement. To all intents and purposes, this water is no longer available and is therefore considered as consumed.

1.52. **water scarcity** : parameter which describes to which extent water use exceeds the natural generation of water in an area, e.g. a drainage basin (from WD ISO 14046)
Guidance: Water scarcity occurs where there are insufficient water resources to satisfy environmental water

requirements and human water demands.
Guidance Examples http://www.fao.org/nr/water/art/2007/scarcity.html shows an illustration of water scarcity across the globe.

1.53. **water use** : any use of water by human activity, including agriculture, industry, energy production, public sector and households, including in-stream or in-situ uses such as fishing, recreation, transportation and waste disposal (from WD ISO 14046)
Guidance : Water use encompasses any process or activity which makes use of water. This can cover "off-stream" water use, where the water is removed from its watercourse, for example water which is used by an activity, such as the water which is used to mix concrete, or to clean truck wheels, or to dampen materials such as sand heaps or the use of water in a cooling or cleaning process, where the water is extracted and recirculated and may be returned to source. It also covers "in-stream water", which is water used within a watercourse, for example the use of water as a transport media for boats; the use of water by a fisherman; the use of water in a process such as hydroelectric power generation, both in providing potential energy and by turning the turbines; or the use of water to dilute effluents, for example in a river.
Note that water use and water consumption are very different.

1.54. **water withdrawal**: anthropogenic removal of water from any water body, either permanently or temporarily (from WD ISO 14046)
Guidance: Sometimes, the term "water abstraction" is used for this concept.
Water withdrawal encompasses consumption and borrowing (where water is withdrawn but returned to the same water body with no change in quality) and where withdrawal water is returned to the same water body with a change in quality.
Water withdrawal is equivalent to "offstream" water use.

6 ABBREVIATIONS

EPD	Environmental product declaration
GHG	Greenhouse gas
ISO	International Standards Organisation
PCR	Product category rules
LCA	Life cycle assessment
LCI	Life cycle inventory analysis
LCIA	Life cycle impact assessment
RSL	Reference service life