Tiles & Bricks Europe

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TBE PCR FOR CLAY CONSTRUCTION PRODUCTS

Guidance document for developing an EPD

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1. Introduction

All products generate impacts on the environment. Those impacts can take place at any phase of the production, transport, use or end-of-life of a product. All these stages together refer to the *life cycle* of a product. Construction products can generate environmental impacts from the moment raw materials are extracted from Earth, throughout the transport and manufacturing process, until the end-of-life (see Figure 1). The methodology to calculate the potential environmental impacts of the whole life cycle of a product, service and system is denominated Life Cycle Assessment (LCA).

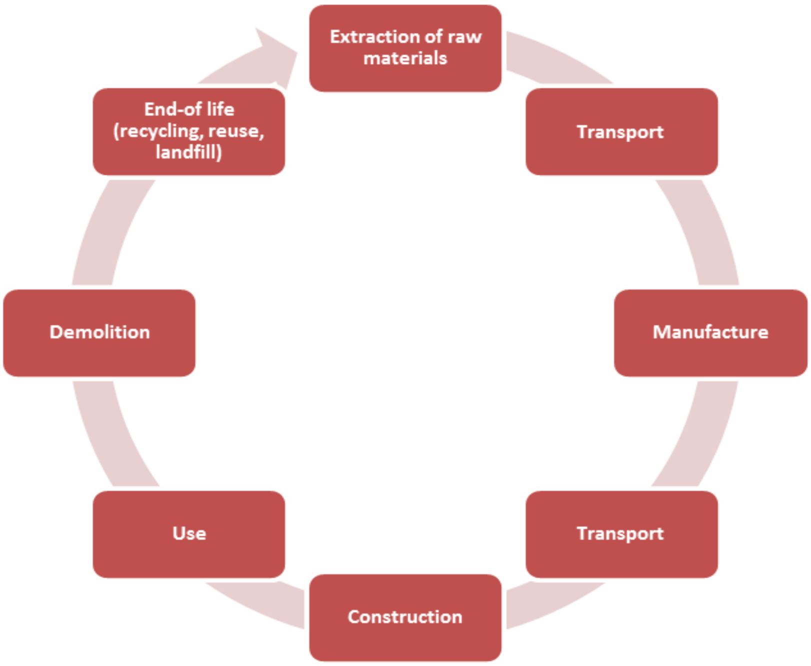

Figure 1- Life Cycle of a construction product

LCA is a tool to assess and quantify the potential environmental impacts by collecting and characterising the inputs (product, material or energy flow that enters a unit process) and outputs (product, material or energy flow that leaves a unit process) in different processes of the product's life cycle. The primary concept of the LCA methodology comes from the understanding that each product, process or activity generates impacts in the environment starting from the extraction of raw materials from Earth, throughout the manufacturing process, until the end-of-life of the product (recycling, reusing and landfilling). This approach is named cradle-to-grave LCA. Normally, a LCA study is carried out in accordance with the international standard ISO 14040 series. The European standard EN 15804:2012 is also based on these ISO standards.

The objective of this document is to provide the manufacturers of clay construction products, i.e. clay bricks, blocks, pavers and roof tiles, in all European Union (EU) Member States, with guidance for the development of Environmental Product Declarations (EPDs) of clay construction products based on a LCA approach.

EPDs can be used for different purposes. EPDs provide the manufacturer a good understanding of the types and causes of impacts related with their product and where in the product supply chain their major life cycle impact takes place. On the other hand, designers are often requesting EPDs of construction products that can be used as input for assessing the environmental performance of buildings.

In 2012, TBE identified a lack of harmonised PCR for the development of EPDs for clay construction products. With a common PCR, EPDs developed at national and/or European level will be based on the same guidelines and similar assumptions. The TBE PCR for clay construction products set harmonise guidelines and rules for the creation of a type III EPD of clay construction products and is based on the European horizontal harmonised standard, the *EN 15804:2012 - Sustainability of construction works – EPDs – Core rules for the product category of construction products*, which was developed in CEN/TC 350 “Sustainability of construction works”.

This TBE guidance document summarises the basic principles that are described in the TBE PCR for the development of EPDs for clay construction products.

Moreover, if a manufacturer of clay construction products intends to develop an EPD for clay construction products then he/she is advised to contact the national and/or European associations and use the TBE PCR.

2. Terminology

When an EPD for a construction product is being developed, a number of specific terms and definitions are frequently used. Some of these concepts are described below.

Type III Environmental Product Declaration – EPD

Type III environmental declarations are clearly described in *ISO 14025:2006 – Environmental labels and declarations – Type III environmental declarations – Principles and procedures* and are commonly known as EPDs. In short, an EPD is a standardised and LCA based tool to quantify and communicate the environmental impacts of a product or service. EPD information is articulated in modules, allowing easy organisation and expression of the environmental impacts of a product throughout its full life cycle.

Product Category Rules – PCR

PCR is a technical document that establishes specific guidelines and rules for developing type III EPDs for one or more product categories. The European standard EN 15804:2012 defines the core rules for the product category of construction products. It also provides a structure to ensure that all EPDs of construction products and/or services are developed in a harmonised way.

Life cycle inventory analysis - LCI

Phase of the life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle (ISO 14040, 2006).

Life cycle impact assessment - LCIA

Phase of LCA aimed at understanding and evaluating the magnitude and significance the potential environmental impacts for a product system throughout the life cycle of the product (ISO 14040, 2006).

Functional unit

Quantified performance of a product system for use as a reference unit (ISO 14040, 2006).

System boundary

Set of criteria specifying which unit processes are part of a product system (ISO 14040, 2006).

Impact category

Class representing environmental issues of concern to which life cycle inventory analysis results may be assigned (ISO 14040, 2012).

Impact category indicator

Quantifiable representation of an impact category (ISO 14040, 2006).

Scenario

Collection of assumptions and information concerning an expected sequence of possible future events (EN 15804, 2012).

Waste
Substance or object which the holder discards or intends or is required to discard (EN 15804, 2012).

Reference Service Life
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 (EN 15804, 2012).

Programme operator
Body or bodies that conduct a type III environmental declaration programme. Note: a program operator can be a company or a group of companies, industrial sector or trade association, public authorities or agencies or an independent scientific body or other organisation (EN 15804, 2012).

3. Basic principles

The objective of the TBE PCR is to develop a common operational methodology that can be used across Europe for developing EPDs for construction clay products. As referred in Chapter 1, the TBE PCR is based on EN 15804:2012 and the EPD must have a mandatory cradle-to-grave LCA approach. The basic principles for performing an LCA study for clay construction products are described in this Chapter.

The TBE PCR has been developed on the basis of EN 15804.

Based on the TBE PCR, EPDs must have a mandatory cradle-to-grave LCA approach. This way it is possible to assess the potential environmental impacts of clay construction products across all life cycle stages, including raw materials, transport, manufacturing, use and end-of-life.

Cradle-to-grave EPDs assess the whole life cycle of products and could then comply with Basic Requirement 7 (BR7) for construction works of the Construction Products Regulation (CPR) if EPDs become a way to implement the BR7.

The TBE PCR is valid for all clay product groups that are listed below:

1. Clay roof tiles and fittings;
2. Protected clay masonry units and accessories;
3. Unprotected clay masonry units and accessories;
4. Clay claddings;
5. Clay pavers and accessory clay pavers;
6. Clay blocks for construction of floor and roof systems;
7. Clay blocks for chimney;
8. Clay blocks for lintels;
9. Ceramic roof boarding sarking (unit used for the supporting structure of roof tiles, manufactured predominantly from clay or other argillaceous materials with or without sand, or other additives fired at a sufficiently high temperature to achieve a ceramic bond).

The LCA-based information in an EPD of a clay construction product shall cover all life cycle stages of the product as indicated below and in Figure 2.

1. **Product** (Modules A1-A3): corresponds to the production of clay construction products, including all the upstream processes of the product stage.
2. **Construction process** (Modules A4 and A5): transport to the building site and installation in the building.
3. **Use** (Modules B1-B7): it corresponds to the use of clay construction products in the building, as well as maintenance, repair, replacement, refurbishment. It also includes operational energy and water use in the building during the product use.
4. **End-of-life** (Modules C1-C4): this stage comprises all the actions and processes related to the demolition, transport, waste processing and disposal.
5. **Module D**: this module includes the environmental benefits of reuse and recycling potentials after the end of life stage.

TBE strongly recommends the use of module D. Module D is the stage where the manufacturer can benefit from the reuse and recycling processes. After the demolition phase, clay construction products are often reused (e.g. clay roof tiles) and/or recycled and used as raw materials (e.g. clay bricks and blocks).

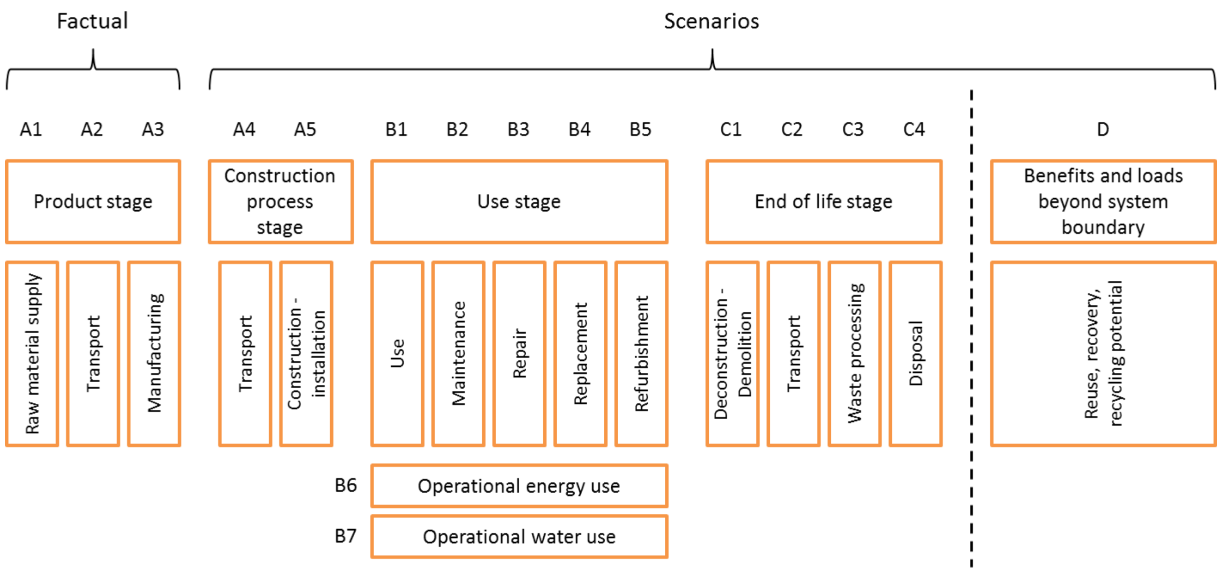

Figure 2 – Overview of the different information modules according to the EN 15804

Reference service life (RSL)

RSL information to be declared in an EPD covering the use stage shall be provided by the manufacturer.

For clay construction products, the RSL is 150 years. Studies have shown that clay construction products stand out with their high durability and prevail with no maintenance and a life span of 150 years and more.

Functional unit

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

The functional unit is defined as: 1 tonne of clay product with an expected average reference service life of 150 years.

Environmental impact assessment

The impact assessment shall be carried out for the following mandatory parameters describing environmental impacts, resource use, waste categories and output flows (see Table 1, 2 and 3):

Table 1 – Overview of environmental impact categories according to EN 15804

Environmental impact categories according to EN 15804	
Parameter	**Unit**
Global warming potential, GWP;	kg CO_2 equiv
Depletion potential of the stratospheric ozone layer, ODP;	kg CFC 11 equiv
Acidification potential of soil and water, AP;	kg SO2 equiv
Eutrophication potential, EP;	kg (PO4)3- equiv
Formation potential of tropospheric ozone, POCP;	kg Ethene equiv
Abiotic depletion potential (ADP-elements) for non-fossil resources[a] Abiotic depletion potential (ADP-fossil fuels) for fossil resources[a]	kg Sb equiv 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*

Table 2 – Overview of parameters describing resource use

Parameters describing resource use (EN 15804)	
Parameter	**Unit**
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of secondary material	kg
Use of renewable secondary fuels	MJ, net calorific value
Use of non-renewable secondary fuels	MJ, net calorific value
Use of net fresh water	m^3

Table 3 - Overview of other environmental information describing different waste categories and output flows

Other environmental information describing waste categories (EN 15804)	
Parameter	**Unit**
Hazardous waste disposed	kg
Non-hazardous waste disposed	kg
Radioactive waste disposed	kg
Other environmental information describing output flows (EN 15804)	
Parameter	**Unit**
Components for re-use	kg
Materials for recycling	kg
Materials for energy recovery	kg
Exported energy	MJ per energy carrier

In addition to the above mentioned CEN/TC350 – EN15804 environmental indicators, the ceramic building sector strongly recommends to declare additional environmental impact categories in order to draw up an extensive and more complete environmental profile of building materials.

Table 4 presents the environmental indicators to be considered and the TBE recommendations on the environmental impact assessment methods to be used. Following the recent amendment on EN 15804, the ceramic building sector proposes, to preferably use the characterisation factors listed in *CML-IA version 4.1, dated October 2012*, if available for the considered indicator. If not, the ceramic building sector recommends using the 'recommended default method at midpoint level' in the ILCD-handbook (JRC and ies).

Table 4 – Additional environmental impact categories

Additional environmental impact categories				
		Environmental impact	**Unit**	**Recommended method**
Ecotoxicity		Marine ecotoxicity	kg 1,4 DB-eq	CML
		Freshwater ecotoxicity	kg 1,4 DB-eq	CML
		Terrestrial ecotoxicity	kg 1,4 DB-eq	CML
Human toxicity		Human toxicity (cancer effects)	kg 1,4 DB-eq	CML
		Human toxicity (non-cancer effects)	kg 1,4 DB-eq	CML
Land use	**Soil quality**	Soil organic matter, occupation	kg C deficit	Mila I canals
		Soil organic matter, transformation	kg C deficit	Mila I canals
	Biodiversity	Biodiversity, occupation	PDF*m^{2}year	Ecoindicator 99
		Biodiversity, transformation	PDF*m^{2}year	Ecoindicator 99

4. Default scenarios

In case the manufacturer does not possess the specific data for the construction process, use and end-of-life stages (Modules A4-A5, B and C, respectively), the TBE PCR provides recommendations that will help calculating the environmental impacts of these stages. These suggestions have been compiled and are depicted in the next sections of this guidance document.

4.1 Module A4 – transport of the clay construction product from the production gate to the building site

Below is presented the methodology and example for the module A4.

The average transport distance to the customer for a product from a plant should be defined. If data is available, the distance to the customer can be calculated as follows:

1. Extract from the delivery software the quantity in term of tons delivered to each customer during a given year.
2. Determine the distance between the factory and every customer and explain the type of transportation.
3. Calculate the number of tons delivered for a certain interval, for example each 25 km, until reaching the maximum distance.
4. If a statistical treatment is wanted, draw a bar chart with data expressing the percentage of quantity for each interval.
5. Calculate the mean distance to the customer in km.

If no specific transport distances are available, default values from national systems defined in the Annex 2 (page 93) of the TBE PCR can be used.

For a sectorial EPD, it is possible to provide the mean value of a representative factory. It is also possible to provide the mean value of several plants. This scenario only applies to the domestic market.

If no specific transport distances are available, default values from national systems can be used as defined in the Annex 2 (page 93) of the TBE PCR.

These default values were obtained through: (1) internal national industry assessment; (2) national regulations; (3) national research studies or (4) EPD data collection.

4.2 Module A5 – installation of clay construction product into the building

The environmental impact related to the storage of clay construction products at the construction site is considered negligible. For the treatment of packaging waste, either country specific scenarios or a European average scenario can be used. For packaging materials, the European scenario for the end of life of the package can be used as described in Table 2 of the TBE PCR document (page 28) if no National scenarios are available. These scenarios are also applicable for the packaging waste that is generated at product stage level.

Ceramic building products

In general terms, installation of ceramic products at the building site is mainly manually and it requires little or negligible use of energy or water. Storage of clay products at the building site requires no special care apart from normal good health and safety site practice. The nature of the material does not create significant issues when cutting and shaping which do not produce hazardous waste. The unused products deriving from these operations can be recycled within the building site. When this is not possible, it should be counted as construction waste and the total amount shall be reported.

If specific data is not available, the following default scenario shall be used: the default values for any loss of materials during the installation phase on the building site is set equal to 3% in mass for blocks, 3% for facing bricks and pavers and 2% in mass for roof tiles.

Moreover, the default transport scenarios for the packaging waste together with the scenarios for waste disposal should be used in the module A5. These scenarios are presented in Table 4 of the TBE PCR document (see page 33).

4.3 Module B – use stage

Clay construction products do not generate environmental impacts during the use phase. Furthermore, construction products require no maintenance, repair, replacement, refurbishment and operational energy and water use.

In general, Modules B1, B2, B3, B4, B5, B6 and B7 do not generate relevant environmental impacts and therefore they can be neglected.

4.4 Module C1 - deconstruction, demolition stage

Taking into account the long reference service life of the clay product (150 years), the reference study period for the building may be shorter than this period. Note: the residual value of the clay products should be taken into account on the building level if the study period is shorter than 150 years.

In general, the environmental impacts generated in the module C1 are very low and hence can be ignored.

4.5 Module C2 – transport to waste processing

As a general approach, data regarding the transportation distances of the waste are collected for each LCA onsite. However, if this information is not available the distances illustrated in Table 5 of the TBE PCR document (page 38) can be used for clay construction product EPD development purposes.

4.6 Module C3 - waste processing for reuse, recovery and/or recycling

As a general approach, national scenarios for the end-of-life (EOL) stage should be used, if no specific data is available. However, if national EOL scenarios are also not available, it is proposed to use the European default EOL scenarios, which are presented in the Table 6 of the TBE PCR document (page 39).

4.7 Module C4 - disposal

As a general approach, national scenarios for EOL stage should be used, if no other data is available. However, if this information is not available, it is proposed to use European default EOL scenario, presented in Table 6.

4.8 Module D

Module D aims at transparency for the environmental benefits or loads resulting from reusable products, recyclable materials and/or useful energy carriers leaving a product system e.g. as secondary materials or fuels. It applies after the end of waste state. Where relevant, informative module D declares potential loads and benefits of secondary material, secondary fuel or recovered energy leaving the product system. Module D recognizes the "design for reuse, recycling and recovery" concept for buildings by indicating the potential benefits of avoided future use of primary materials and fuels while taking into account the loads associated with the recycling and recovery processes beyond the system boundary.

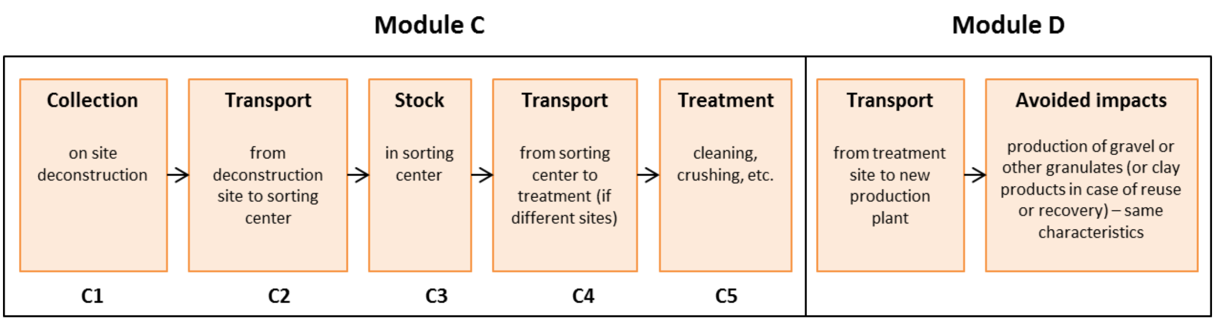

Figure 3 – Boundaries between module C and module D for recycling and reuse of clay products

In the TBE PCR for clay construction products some examples for calculating Module D are given:

1. Demolished masonry units that can be crushed (recycling process) and used as secondary raw material in the production of masonry units (see Annex 4 of the TBE PCR);
2. Demolition bricks that can be recycled towards raw material for another application: roadwork and concrete aggregates (see Annex 4 of the TBE PCR);
3. Roof tiles that are reused after the deconstruction stage (see below).

Example 3: roof tiles that are reused after the deconstruction stage

Because of the long service life and appreciated appearance, roof tiles are often reused in practice. Used roof tiles are removed during the 'end of life stage' of a building and transported to a storage site or immediately reused in a new building. Module D indicates the potential benefits of avoided use of new produced roof tiles while taking into account the loads associated with the transport and possible needed cleaning processes beyond the system boundary.

In example 3 a reuse rate of 90% is considered. For a declared unit of 1 ton of roof tiles this results in a (net) production of 900 kg of reused roof tiles for a building (see Figure 4).

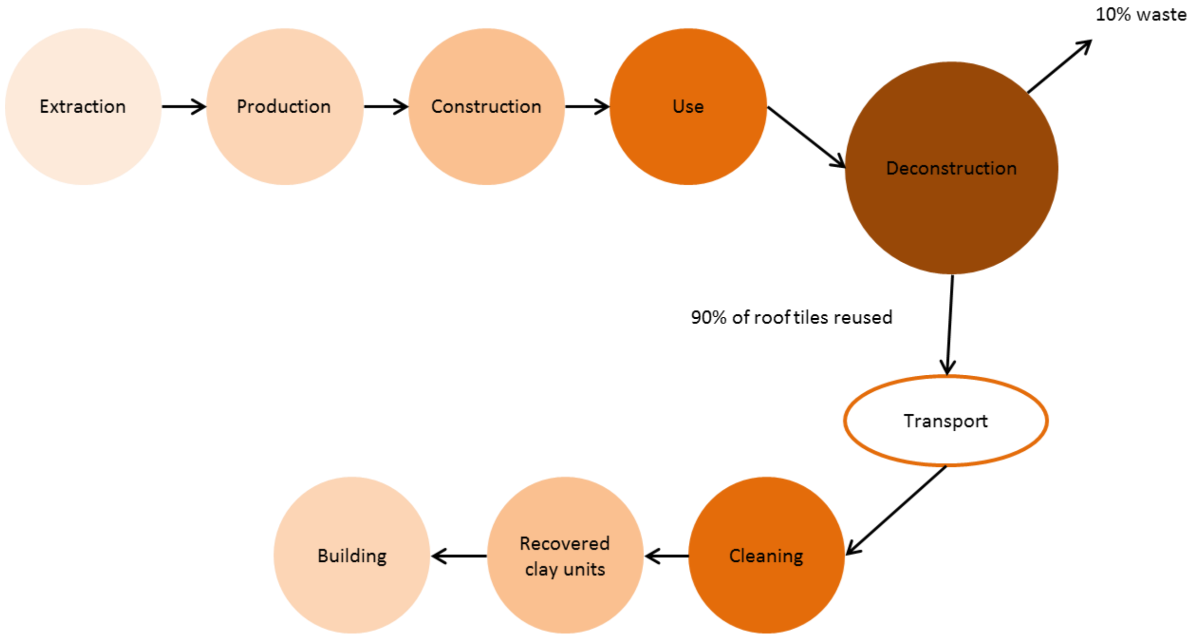

Figure 4: Reused roof tiles after the deconstruction stage

5. Data collection

The objective of this Chapter of the TBE guidance document is to provide guidelines on how to collect input and output data and to illustrate the nature of the information that can be collected.

In order to develop an EPD of a clay construction product, the manufacturer shall collect input and output data from its production plant and ideally insert it into a LCA software. There are several softwares to support LCA activities. Such softwares (SimaPro, Gabi, etc) allow LCA practitioners to quickly compile and assess the environmental impacts of products, processes or services based on a cradle-to-grave approach and its material's database is very extensive.

A1 Raw materials supply phase

For this module, the manufacturer shall collect the data regarding the extraction of clay and sand. Normally, the manufacturer only possesses information about the quantity of primary raw materials (e.g. clay and sand extracted), water and ancillary materials (colorants, pigments, glazes, englobes, etc). The producer shall collect this data that will be needed for the LCA modelling process. In this case, generic data can be used from the LCA software for this phase.

A2 Transport phase

In the A2 transport phase, the manufacturer of clay construction products shall collect data concerning the transport of raw materials (clay and sand) from the quarry to the manufacturing plant. The manufacturer shall compile information regarding:

1. The distance from the clay quarry to the plant (km);
2. Fuel type consumption of vehicle or vehicle type used for transport;
3. The truck capacity (tonnes);
4. Load (tonnes);
5. The return (empty or full).

A3 Manufacturing phase

In the A3 manufacturing phase, the producer of clay construction products shall collect data regarding the manufacturing of clay construction products.

The producer shall compile the following input data:

- √ **Raw materials**
- √ **Transport**
- √ **Electricity consumption**
- √ **Water use**
- √ **Fuel consumption for the operation of the kiln (e.g. natural gas, oil, etc)**
- √ **Ancillary materials**
- √ **Packaging products (e.g. wooden pallets, cardboard, plastic film)**

The manufacturer shall also collect the following output data:

- √ **Emissions to air**
- √ **Emissions to water**
- √ **Emissions to soil**
- √ **Waste**
- √ **Packaging waste**
- √ **Other emissions**
- √ **Co-products**
- √ **Final clay construction product**

A summary of all life cycle stages, for various clay construction products, with all modules and flows can be found below in Figure 5.

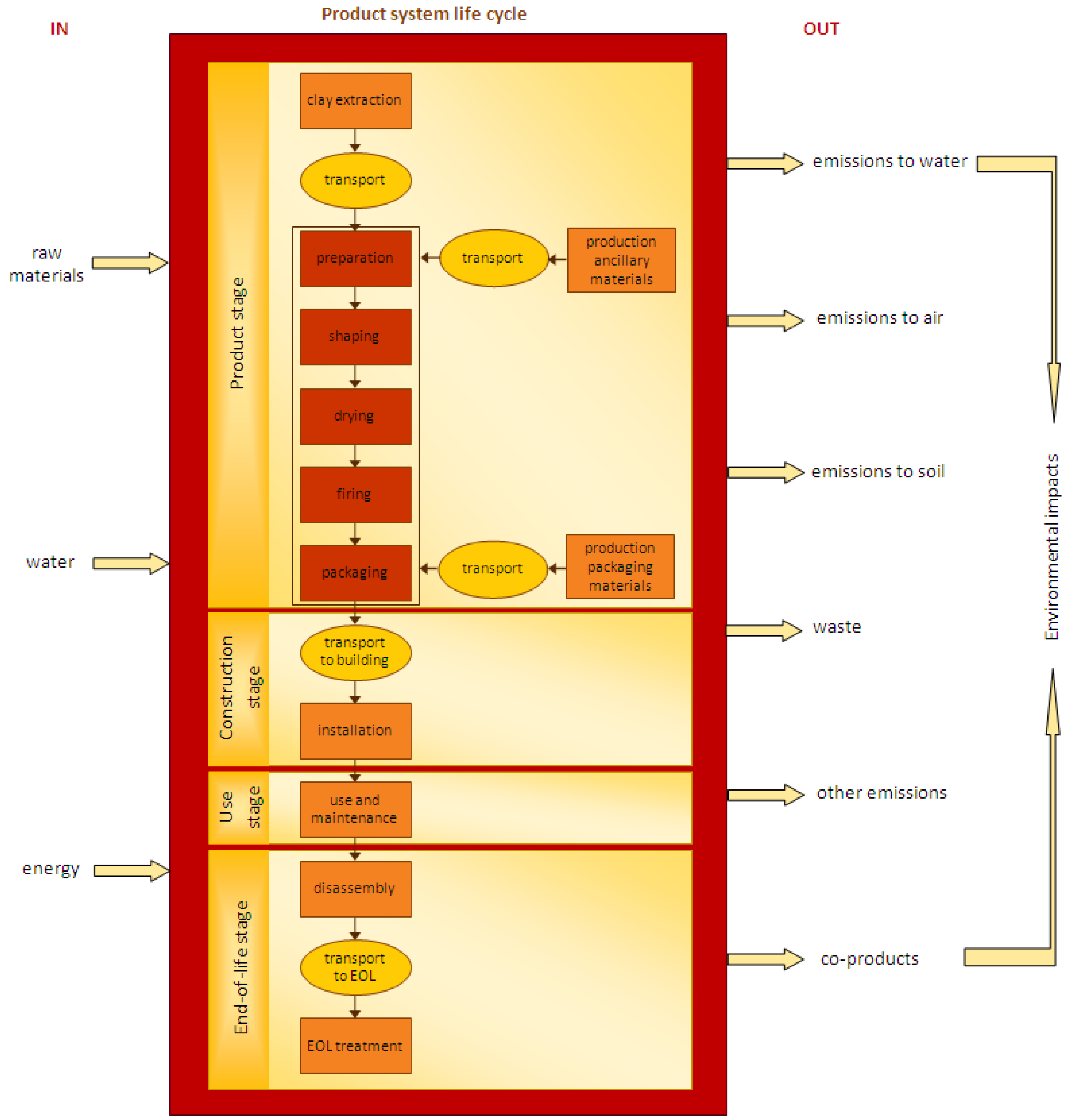

Figure 5 – System boundaries and input and output flow for the LCA of clay construction products from cradle-to-grave

6. About TBE

Tiles & Bricks Europe represents industry associations and companies from 22 European Union Member States plus Norway, Russia and Switzerland. The association promotes the interests of the clay brick and tile industry in Europe. It provides a forum for its members to exchange information on technical development, sustainable construction, climate change, resource efficiency and other emerging issues.

TBE, founded in Zurich in 1952, is a full member of Cerame-Unie, the European Ceramic Industry Association.

Our products

Clay bricks, blocks, roof tiles and pavers are durable, affordable and provide comfortable, safe and healthy homes to millions of people. They combine traditional architectural heritage with innovative and future-oriented construction methods. Clay products offer valuable solutions to save energy and reduce greenhouse gas emissions in the building sector.

Tiles & Bricks Europe

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