PRODUCT CATEGORY RULES (PCR)
DATE 2025-01-22

LIQUID IMMERSED POWER TRANSFORMERS (>25MVA)

PRODUCT CATEGORY CLASSIFICATION: UN CPC 46121

PCR 2019:12
VERSION 1.0.4

VALID UNTIL: 2025-04-29

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1 INTRODUCTION

This document constitutes Product Category Rules (PCR) developed in the framework of the International EPD® System: a programme for type III environmental declarations[1] according to ISO 14025:2006. Environmental Product Declarations (EPD) are voluntary documents for a company or organisation to present transparent information about the life cycle environmental impact for their goods or services.

The rules for the overall administration and operation of the programme are the General Programme Instructions, publicly available at www.environdec.com. A PCR complements the General Programme Instructions and the standards by providing specific rules, requirements and guidelines for developing an EPD for one or more specific product categories (see Figure 1). A PCR should enable different practitioners using the PCR to generate consistent results when assessing products of the same product category.

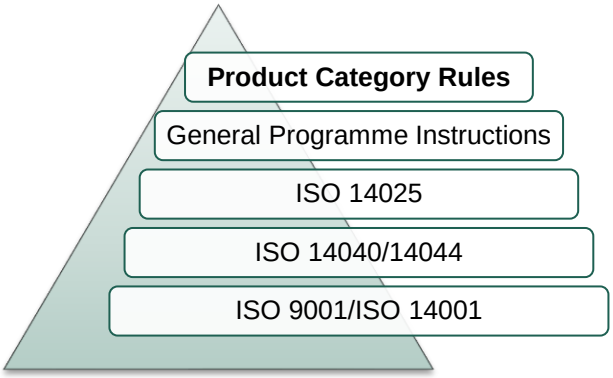

Figure 1 Illustration PCR in relation to the hierarchy of standards and other documents.

Within the present PCR, the following terminology is adopted:

- The term “shall” is used to indicate what is obligatory.
- The term “should” is used to indicate a recommendation, rather than a requirement.
- The term “may” or “can” is used to indicate an option that is permissible

For the definition of terms used in the document, see the normative standards.

A PCR is valid for a pre-determined period of time to ensure that it is updated at regular intervals. The latest version of the PCR is available via www.environdec.com. Stakeholder feedback on PCRs is very much encouraged. Any comments on this PCR document may be given via the PCR Forum at www.environdec.com or sent directly to the PCR moderator during its development or during the period of validity.

Any references to this document should include the PCR registration number, name and version.

The programme operator maintains the copyright of the document to ensure that it is possible to publish, update when necessary, and available to all organisations to develop and register EPDs. Stakeholders participating in PCR development should be acknowledged in the final document and on the website.

[1] Type III environmental declarations in the International EPD® System are referred to as EPD, Environmental Product Declarations.

2 GENERAL INFORMATION

2.1 ADMINISTRATIVE INFORMATION

Name:	Liquid immersed transformers (>25MVA)
Registration number and version:	2019:12, version 1.0.4
Programme:	The International EPD® System
Programme operator:	EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden. Website: www.environdec.com E-mail: info@environdec.com
PCR moderator:	Ing. Vito D'Incognito vdincognito@take-care.it
PCR Committee:	CESI S.p.a., Politecnico di Milano, Tamini S.r.l.
Date of publication and last revision:	2025-01-22 (Version 1.0.4) A version history is available in Section 8.
Valid until:	2025-04-29
Schedule for renewal:	A PCR is valid for a pre-determined period of time to ensure that it is updated at regular intervals. When the PCR is about to expire the PCR moderator shall initiate a discussion with the Secretariat how to proceed with updating the document and renewing its validity. A PCR document may be revised during its period of validity provided significant and well-justified proposals for changes or amendments are presented. See www.environdec.com for up-to-date information and the latest version.
Standards conformance:	▪ General Programme Instructions of the International EPD® System, version 3.0, based on ISO 14025 and ISO 14040/14044 ▪ PCR Basic Module, CPC Division 46 Electrical machinery and apparatus, version 3.01, dated 2018-11-06
PCR language(s):	This PCR was developed and is available in English. In case of translated versions the English version takes precedence in case of any discrepancies.

2.2 SCOPE OF PCR

2.2.1 PRODUCT CATEGORY DEFINITION AND DESCRIPTION

This document provides Product Category Rules (PCR) for the assessment of the environmental performance of liquid immersed power transformers during the life cycle and having the following power:

- Medium power transformer 25<P<40MVA and

- Large power transformer P>40MVA; and the declaration of this performance by an EPD.

The product category corresponds to a sub-set of UN CPC 46121 *Electrical transformers*.

This was developed in accordance with and complies with the General Programme Instruction of the International EPD® System, version 3.0, based on ISO 14025 and ISO 14040/14044. It is based on the requirements and guidelines given in "PCR Basic Module, CPC Division 46: Electrical machinery and apparatus", version 3.01 dated 2018-11-06.

The corresponding United Nation Statistics Division Hierarchy is the following one:

- Section: 4 - Metal products, machinery and equipment
  - Division: 46 - Electrical machinery and apparatus
    - Group: 461 - Electric motors, generators and transformers, and parts thereof
      - Class: 4612 - Electrical transformers, static converters and inductors
        - **Subclass: 46121 - Electrical transformers**

This code corresponds to the following:

- CPC Ver.2 code(s) 46121
- ISIC Rev.4 code(s) 2710
- HS 2012 code(s) 8504.21 - .34

For additional information about the product group: https://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=31&Lg=1&Co=46121.

The EPD shall include information about the manufacturing company/organization. The information may include manufacturing process related information, and environmental related information, such as the environmental management system information. The information may also include special issues which the company/organization would like to emphasize, such as certain environmental criteria or certification, or environmental safety and health related information.

The power/distribution transformers are electrical machineries used to convert the electrical voltage and current from the source into electrical voltage and current suitable for use by the users. A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction.

A varying current in one coil of the transformer produces a varying magnetic field, which in turn induces a voltage in a second coil. Power can be transferred between the two coils through the magnetic field, without a metallic connection between the two circuits.

The transformers are used in industrial, commercial and domestic front-end (excluding home use) applications, where there is a need to convert the source voltage or current into voltage and current more appropriate for users' needs. Transformers are used to increase or decrease the alternating voltages in electric power applications. Thus, the transformers play an important role of functional device in converting electrical voltage and current for the power grid.

A liquid immersed transformer consists of several parts and components, listed below.

The main components are the following (not exhaustive list):

- Coil/ Winding assembly,
- Core assembly,
- Tank,
- Insulating liquid.

The auxiliary/secondary components are the following (not exhaustive list):

- Bushings,
- Cooling system,
- On load tap changer / Off circuit tap changer,
- Accessories: (protective device monitoring equipment conditions, e.g., breather or pressure relief devices),
- Packing: gaskets, stop washers, valve, screw, etc.,
- Other: e.g., iron material,

- Packaging materials (e.g., pallets, plastic film, wooden boxes).

The following technical specification shall be included in an EPD:

- Transformer type, application, power rating and frequency;
- Transformer definition:
  - In this document “Medium power transformer” means a power transformer with a high voltage for equipment higher than 1 kV, but not exceeding 36 kV and a rated power equal or higher than 25 MVA but lower than 40 MVA;
  - “Large power transformer” means a power transformer with a high voltage for equipment exceeding 36 kV and a rated power equal or higher than 40 MVA;
- Information on the material and the weight of all the main components of a transformer;
- Type and amount of insulating liquid;
- Closed or sealed gas insulating system;
- Type of cooling and the electrical power of any cooling system required at no load.

The Transformers classification is in line with the current EU Regulation 548/2014. The PCR will be revised, according to the EPD Program Operator rules, any time a new version of applicable Regulation, from the EU commission is available.

Any claims made about the product must be verifiable.

In this group the following liquid immersed electrical products could be also included: shunt reactors, series reactors, phase shifting transformers, converter transformers, furnace transformers.

In any case the power transformer functionalities set shall be clearly declared in the LCA study and in the EPD document.

In the EPD, the following specific product information shall be given:

- The product category;
- The product UN CPC code;
- The product description (dimensions, weight, operating voltage, power dissipation, environmental working conditions, etc.) with possible reference to international standards;
- Main application/services supported;
- Main market sector (small/home office or residential) where the product is sold;
- Main geographical areas where the product is sold;
- Main characteristics;
- The actual distance between the producer’s site and user site in case of single Transformer manufacturing, or
- The actual distance between the producer’s site and the country distributor, in case of multiple transformers manufacturing.
- The place (country) of distribution (as this I relevant for the national electricity mix to be applied in the use phase).

In the EPD may be stated:

- Relevant Type I and Type II environmental labels awarded to the product;
- Accordance with the EU Ecodesign directive;
- Commission Regulation (EU) n. 548/2014.

Reference standards and regulation are the following:

- IEC 60076 series;
- IEC TR 62725:2013;
- IEEE C57.12.00;
- Commission Regulation (EU) n. 548/2014.
- EN 50588

- pr EN 50708-1-1 Power transformers Additional european requirements part 1-1 common part
- pr EN 50708-3-1 Power transformers Additional european requirements part 3-1 LPT

The PCR document is a living document publicly available on www.environdec.com. If relevant changes in the LCA methodology or in the technology for the product category occur, the document will be revised and any changes will be published on the website.

Any comments to this PCR document may be given on the PCR Forum on www.environdec.com or directly to the PCR moderator during the period of validity. The PCR Moderator should initiate a revision process before the validity time expires to give due time for announcing and collecting comments.

EPDs shall be based on the latest version of the PCR, and refer to the version number and date of the PCR used. The production of new PCR versions does not affect the certification period of EPDs that are already published.

2.2.2 GEOGRAPHICAL REGION

This PCR is applicable to be used globally.

In the related EPD any geographical restrictions or limitations should be indicated.

The data for the core module shall be representative for the actual production processes and representative for the site/region where the respective process is taking place.

2.2.3 EPD VALIDITY

An EPD based on this PCR shall be valid from its registration and publication at www.environdec.com and for a five year period starting from the date of the verification report (“approval date”), or until the EPD has been de-registered from the International EPD® System.

An EPD shall be updated and re-verified during its validity if changes in technology or other circumstances have led to:

- an increase of 10% or more of any of the indicators listed in Section 5.4.5.1,
- errors in the declared information, or
- significant changes to the declared product information, content declaration, or additional environmental information.

If such changes have occurred, but the EPD is not updated, the EPD owner shall contact the Secretariat to de-register the EPD.

3 PCR REVIEW AND BACKGROUND INFORMATION

This PCR was developed in accordance with the process described in the General Programme Instructions of the International EPD® System, including PCR review and open consultation.

3.1 PCR REVIEW

3.1.1 VERSION 1.0

PCR review panel:	The Technical Committee of the International EPD® System. A full list of members available on www.environdec.com. The review panel may be contacted via info@environdec.com. Members of the Technical Committee were requested to state any potential conflict of interest with the PCR moderator or PCR committee, and were excused from the review.
Chair of the PCR review:	Lars-Gunnar Lindfors
Review dates:	2018-01-30 until 2018-03-01 (following first open consultation) and 2019-10-01 until 2019-10-28 (following second open consultation).

3.2 OPEN CONSULTATION

3.2.1 VERSION 1.0

This PCR was available for open consultation from 2017-10-11 until 2017-12-06, during which any stakeholder was able to provide comments by posting on the PCR forum on www.environdec.com or by contacting the PCR moderator.

A second open consultation on an updated draft was held from 2019-05-27 until 2019-07-27.

Stakeholders were invited via e-mail or other means to take part in the open consultation, and were encouraged to forward the invitation to other relevant stakeholders.

3.3 EXISTING PCRS FOR THE PRODUCT CATEGORY

As part of the development of this PCR, existing PCRs were considered in order to avoid overlaps in scope. The existence of such documents was checked in the public PCR listings of the following programmes based on ISO 14025 or similar:

- International EPD® System. www.environdec.com.

The only previously existing document for the present product category was the expired Product-Specific Requirements “Liquid- or gas-filled and dry transformers within the range of <1000 MVA”[2]

3.4 REASONING FOR DEVELOPMENT OF PCR

The main motivation for developing this PCR arose in 2016, as CESI S.p.a., Politecnico di Milano and Tamini Trasformatori S.r.l. decided to collaborate for the submission of the PCR devoted to Electrical Transformers.

The only previous existing document was the PCR 2000:06[3] which was de-registered as the rules therein were very old. A new attempt to develop a PCR for “Liquid immersed and dry type transformers and shunt type reactors” was made in 2013-14 but the attempt failed after a draft was made available for open consultation in June 2014.

[2] Product-Specific Requirements “Liquid- or gas-filled and dry transformers within the range of <1000 MVA”, ver 1.1 issued by The Swedish Environmental Management Council, 2001-02-21.

No other similar documents developed by other EPD programme operators in the world could be found.

3.5 UNDERLYING STUDIES

Very few full LCAs of power transformers are available in the international literature. The only relevant works worth mentioning are the following. The methodological choices made during the development of this PCR (declared unit, system boundary, allocation methods, impact categories, data quality rules, etc.) were primarily based on the following underlying studies:

- Carlen et al. (2011) compare the environmental impact associated with the life cycle of dry-type and oil immersed distribution transformers (DTs) with amorphous metal core with respect to standard DTs. The LCA includes the raw material manufacturing, operation for 30 years, end of life handling and transports. The environmental impact from the assembly and disassembly of the DTs is minimal and not included. Calculations are based on 1000 kVA DTs. The loss values of the conventional transformers are selected according to CENELEC EN 50464-1 and HD538.1, the respective standards for oil-immersed and dry-type transformers specifying loss values. Identical values for load loss for conventional and amorphous are used.
- Wang et Bessède (2015) show an application of LCA on a 500 MVA power transformer installed in one Venezuelan 765 kV AC substation, which is manufactured in Alstom Grid. The system includes materials production, transportation, use and end of life (disposal) of the product. However, no processes relating to manufacturing of transformer are included. The adopted functional unit is so defined “Performing specified voltage transformation for 60 years”. In the system boundaries the packaging is not included. This type of transformer is manufactured in France, and it is installed in one substation in Venezuela, so the transportation phase is modelled as 1000 km by truck and 7000 km by ship. The use phase of a power transformer is defined as electrical energy losses during its designed expected life span of 60 years. The electrical energy losses vary with load current, and are determined by the same equation here adopted (see par. **Error! Reference source not found.**).

[3] Product-Specific Requirements “Liquid- or gas-filled and dry transformers within the range of <1000 MVA”, ver 1.1 issued by The Swedish Environmental Management Council, 2001-02-21.

4 GOAL AND SCOPE, LIFE CYCLE INVENTORY AND LIFE CYCLE IMPACT ASSESSMENT

The goal of this section is to provide specific rules, requirements and guidelines for developing an EPD for the product category as defined in Section 2.2.1.

4.1 DECLARED UNIT

The declared unit is defined as the operation of the transformer during the reference service life calculated for one year.

The declared unit shall be stated in the EPD. The environmental impact shall be given per declared unit. A description of the function of the product should be included in the EPD®, if relevant.

In addition to declaring the results for one-year operation of the transformer, the results may also be declared for one-year operation of the transformer *per 1 MVA*, to facilitate comparison between units with different electric powers.

4.2 REFERENCE SERVICE LIFE (RSL)

The reference service life (RSL) should be 35 years, under the environmental and operating conditions as selected as best known average scenario. Load factor shall depend on the size of the unit (see guidance in Section 4.10.3.1), and average temperature shall be assumed to be 20°C. Monthly average temperature shall be assumed not exceed 30°C and maximum temperature shall be assumed not to exceed 40°C.

An RSL longer than 35 years can be accepted only on the base of proof or well-justified evidence.

4.3 SYSTEM BOUNDARY

The International EPD® System uses an approach where all attributional processes from “cradle to grave” should be included using the principle of “limited loss of information at the final product”. This is especially important in the case of business-to-consumer communication.

The scope of this PCR and EPDs based on it is cradle-to-grave.

4.3.1 LIFE CYCLE STAGES

For the purpose of different data quality rules and for the presentation of results, the life cycle of products is divided into three different life cycle stages:

- Upstream processes (from cradle-to-gate);
- Core processes (from gate-to-gate)
- Downstream processes (from gate-to-grave)

In the EPD, the environmental performance associated with each of the three life-cycle stages above shall be reported separately. The processes included in the scope of the PCR and belonging to each life cycle stage are described in Sections 4.3.1.1–4.3.1.3.

4.3.1.1. Upstream processes

The following attributional processes are part of the product system and classified as upstream processes:

- Extraction and production of raw material for all main transformer parts and components. Main parts, intermediate components (e.g., magnetic core, etc.), auxiliaries, accessories and support equipment produced by subcontractors are classified as upstream processes.
- Impacts due to the production of electricity and fuels used in the upstream module;
- Production of auxiliary products used (e.g., reels);

- Production of semi products used in the core process. In this particular case, a number of semi products and components are included in the overall production process (not exhaustive list):
  - core,
  - bushings,
  - tank,
  - metal parts,
  - insulated conductor,
  - cooling system,
  - tap changer,
  - accessories.
- Manufacturing of primary and secondary packaging.

The provided classification is adequate for the scope of this PCR as categories such magnetic core or tank could be realized in many different materials.

For the auxiliary/accessory items, the main component materials shall be considered.

Upstream processes not listed may also be included. All elementary flows at resource extraction shall be included, except for the flows that fall under the general cut-off rule in Section 4.5.

4.3.1.2. Core processes

The following attributional processes are part of the product system and classified as core processes:

- External transportation to the core processes;
- Manufacturing process for main parts and components;
- Preparation of the final product;
- Internal transportation within the f manufacturing plant;
- Assembly of the product unit;
- Testing in own establishment, if applicable;
- Maintenance (e.g. of the machines);
- Waste treatment of waste generated during manufacturing;
- Impacts due to the production of electricity and fuels used in the core module.

Manufacturing processes not listed may also be included. The production of the raw materials used for production of all product parts shall be included. A minimum of 99% of the total weight of the declared product including packaging shall be included.

The technical system shall not include:

- Manufacturing of production equipment, buildings and other capital goods;
- Business travel of personnel;
- Travel to and from work by personnel;
- Research and development activities.

4.3.1.3. Downstream processes

The following attributional processes are part of the product system and classified as downstream processes:

- Transportation from production site to the customer or an average retailer/distribution platform;
- Life time operation of the product including power losses;

- Maintenance, replacements of parts, during life time;
- End-of-life processes of any wasted part of the product;
- End-of-life processes of packaging waste.

4.3.2 OTHER BOUNDARY SETTING

4.3.2.1. Boundary towards nature

Boundaries to nature are defined as flows of material and energy resources from nature into the system. Emissions to air, water and soil cross the system boundary when they are emitted from or leaving the product system.

4.3.2.2. Boundaries in the life cycle

See Section 4.3.1. The EPD may present the information divided into additional sub-divisions.

4.3.2.3. Boundaries towards other technical systems

See Section 4.6.2.

4.4 SYSTEM DIAGRAM

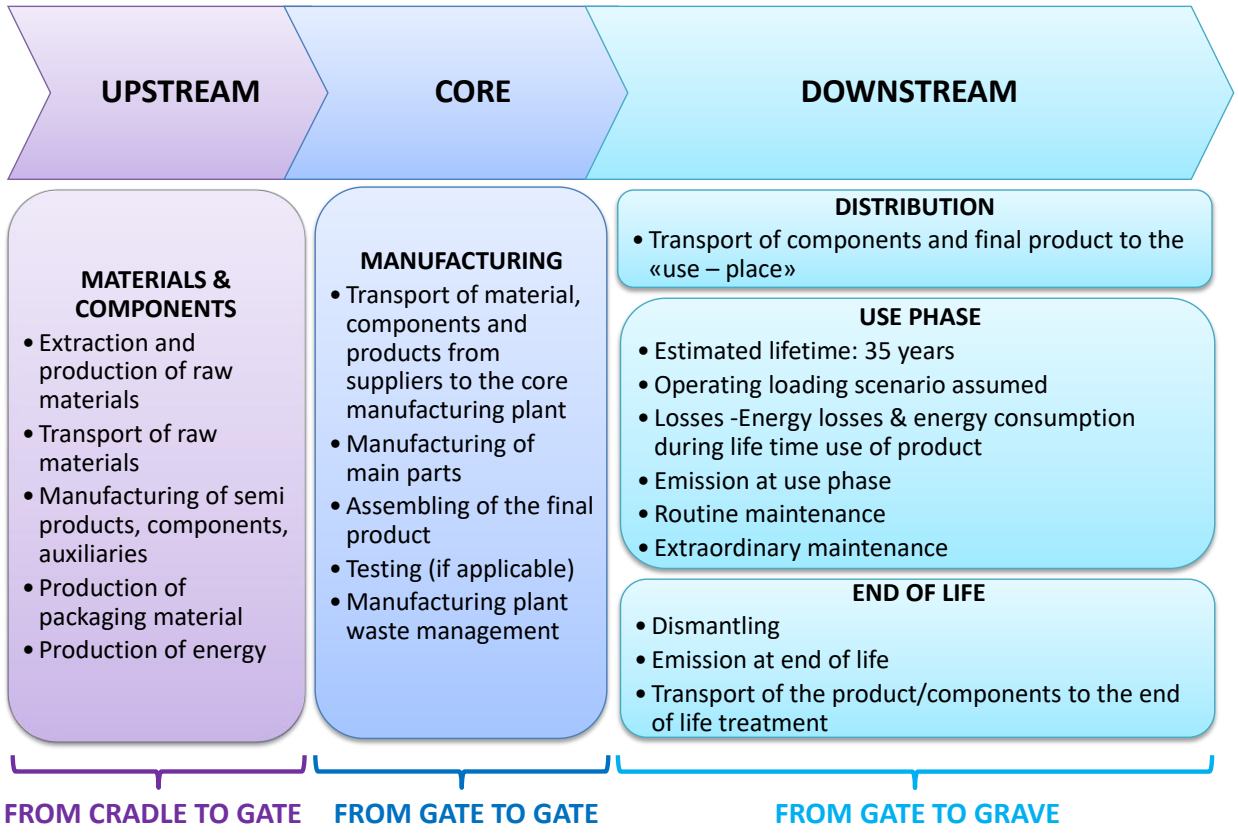

Figure 2 System diagram illustrating the processes that are included in the product system, divided into upstream, core and downstream processes. It should be indicated if any omissions of life cycle stages are made in order to make the EPD® cover the full cradle-to-grave perspective.

The expected life span of the Transformer is set at 35 years.

It is the responsibility of the manufacturer to assess the expected transformer life span using the applicable regulation and standards giving calculation algorithms for correlating the insulating paper characteristics to the load conditions.

4.5 CUT-OFF RULES

Data for elementary flows to and from the product system contributing to a minimum of 99% of the declared environmental impacts shall be included (not including processes that are explicitly outside the system boundary as described in Section 4.3).

The check for cut-off rules in a satisfactory way is through the combination of expert judgment based on experience of similar product systems and a sensitivity analysis in which it is possible to understand how the un-investigated input or output could affect the final results. This sensitivity analysis cannot be based on specific data, selected generic data or proxy data adhering to the data quality requirements – because if such data is available, it should be included in the LCA.

4.6 ALLOCATION RULES

4.6.1 CO-PRODUCT ALLOCATION

The following step-wise procedure shall be applied for multifunctional products and multiproduct processes:

1. Allocation shall be avoided, if possible, by dividing the unit process into two or more sub-processes and collecting the environmental data related to these sub-processes.
2. If allocation cannot be avoided, the inputs and outputs of the system shall be partitioned between its different products or functions in a way that reflects the underlying physical relationships between them; i.e. they should reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system.
3. If not possible, allocation problems shall be solved by economic allocation. In this case, a sensitivity analysis shall be performed in the LCA report.

4.6.2 REUSE, RECYCLING, AND RECOVERY

In the framework of the International EPD® System, the methodological choices for allocation for reuse, recycling and recovery have been set according to the polluter pays principle (PPP). This means that the generator of the waste shall carry the full environmental impact until the point in the product's life cycle at which the waste is transported to a scrapyard or the gate of a waste processing plant (collection site). The subsequent user of the waste shall carry the environmental impact from the processing and refinement of the waste but not the environmental impact caused in the "earlier" life cycles. See the General Programme Instruction for further information and examples.

4.7 DATA QUALITY REQUIREMENTS

An LCA calculation requires two different kinds of information:

- data related to the **environmental aspects** of the considered system (such materials or energy flows that enter the production system). These data usually come from the company that is performing the LCA calculation.
- data related to the **life cycle impacts** of the material or energy flows that enter the production system. These data usually come from databases.

Data on environmental aspects shall be as specific as possible and shall be representative of the studied process.

Data on the life cycle of materials or energy inputs are classified into three categories – specific data, selected generic data, and proxy data, defined as follows:

- **specific data** (also referred to as "primary data" or "site-specific data") – data gathered from the actual manufacturing plant where product-specific processes are carried out, and data from other parts of the life cycle traced to the specific product system under study, e.g. materials or electricity provided by a contracted supplier that is able to provide data for the actual delivered services, transportation that takes place based on actual fuel consumption, and related emissions, etc.,
- **generic data** (sometimes referred to as "secondary data"), divided into**:**

- **selected generic data** – data from commonly available data sources (e.g. commercial databases and free databases) that fulfil prescribed data quality characteristics for precision, completeness, and,
- **proxy data** – data from commonly available data sources (e.g. commercial databases and free databases) that do not fulfil all of the data quality characteristics of "selected generic data".

As a general rule, specific data shall always be used, if available, after performing a data quality assessment. It is mandatory to use specific data for the core processes as defined above. For the upstream processes, downstream processes, and infrastructure, generic data may also be used if specific data are not available.

Any data used should preferably represent average values for a specific reference year. However, the way these data are generated could vary, e.g. over time, and in such cases they should have the form of a representative annual average value for a specified reference period. Such deviations should be declared.

4.7.1 RULES FOR USING GENERIC DATA

The attributional LCA approach in the International EPD® System forms the basic prerequisites for selecting generic data. To allow the classification of generic data as "selected generic data", they shall fulfil selected prescribed characteristics for precision, completeness, and representativeness (temporal, geographical, and technological), such as:

- the reference year must be as current as possible and preferably assessed to be representative for at least the validity period of the EPD,
- the cut-off criteria to be met on the level of the modelled product system are the qualitative coverage of at least 99% of energy, mass, and overall environmental relevance of the flows,
- completeness in which the inventory data set should, in principle, cover all elementary flows that contribute to a relevant degree of the impact categories, and
- the representativeness of the resulting inventory in the given temporal, technological, and geographical reference should, as a general principle, be better than ±5% of the environmental impact of fully representative data.

If selected generic data that meets the requirements of the International EPD® System are not available as the necessary input data, proxy data may be used and documented. The environmental impacts associated with proxy data shall not exceed 10% of the overall environmental impact from the product system.

The EPD may include a data quality declaration to demonstrate the share of specific data, selected generic data and proxy data for the environmental impacts.

4.8 RECOMMENDED DATABASES FOR GENERIC DATA

No recommended databases for generic data are provided.

4.9 IMPACT CATEGORIES AND IMPACT ASSESSMENT

The EPD shall declare the default impact categories as described in the General Programme Instructions as well as the additional impact category listed in section 5.4.5 along with its recommended characterisation method. The characterisation models and factors to use for the default impact categories are available on www.environdec.com and shall be updated on a regular basis based on the latest developments in LCA methodology and ensuring the market stability of EPDs. The source and version of the characterisation models and the factors used shall be reported in the EPD. Alternative regional life cycle impact assessment methods and characterisation factors are allowed to be calculated and displayed in addition to the default list. If so, the EPD shall contain an explanation of the difference between the different sets of indicators, as they may appear to the reader to display duplicate information.

4.10 OTHER CALCULATION RULES AND SCENARIOS

4.10.1 UPSTREAM PROCESSES

The following requirements apply to the upstream processes:

- Data referring to processes and activities upstream in the supply chain, over which an organisation has a direct management control, shall be specific and collected on site.
- Data referring to contractors supplying main parts or main auxiliaries should be asked for from the contractor as specific data, as well as infrastructure, if relevant.
- Transport of main parts and components along the supply-chain to a distribution point (e.g. a stockroom or warehouse) where the final delivery to the manufacturer can take place should be based on the actual transportation mode, distance from the supplier and vehicle load.
- In case specific data are lacking, selected generic data may be used. If this is also lacking, proxy data may be used.
- For the electricity used in the upstream processes, electricity production impacts shall be accounted for in this priority when specific data are used in the upstream processes:

    1. Specific electricity mix as generated, or purchased, from an electricity supplier, demonstrated by a Guarantee of Origin (or similar, where reliability, traceability, and the avoidance of double-counting are ensured) as provided by the electricity supplier. If no specific mix is purchased, the residual electricity mix from the electricity supplier shall be used.[4]
    2. National residual electricity mix or residual electricity mix on the market
    3. National electricity production mix/electricity mix on the market (preferably residual mix, otherwise national electricity production mix).

    The mix of electricity used in upstream processes shall be documented in the EPD, where relevant.

4.10.2 CORE PROCESSES

The following requirements apply to the core processes:

- Specific data shall be used for the assembly of the product and for the manufacture of main parts as well as for on-site generation of steam, heat, electricity, etc., where relevant.
- For the electricity used in the core processes, electricity production impacts shall be accounted for in this priority:

    1. Specific electricity mix as generated, or purchased, from an electricity supplier, demonstrated by a Guarantee of Origin (or similar, where reliability, traceability, and the avoidance of double-counting are ensured) as provided by the electricity supplier. If no specific mix is purchased, the residual electricity mix from the electricity supplier shall be used.[5]
    2. National residual electricity mix or residual electricity mix on the market
    3. National electricity production mix/electricity mix on the market (preferably residual mix, otherwise national electricity production mix).

    The mix of electricity used in the core processes shall be documented in the EPD, where relevant.
- Transport from the final delivery point of raw materials, chemicals, main parts, and components (see above regarding upstream processes) to the manufacturing plant/place of service provision should be based on the actual transportation mode, distance from the supplier, and vehicle load, if available.
- Waste treatment processes of manufacturing waste should be based on specific data, if available.

4.10.3 DOWNSTREAM PROCESSES

The following requirements apply to the downstream processes:

- Data for the use stage are usually based on scenarios, but specific data should be used when available and relevant.
- Use phase:

[4] The residual electricity mix is the mix when all contract-specific electricity that has been sold to other customers has been subtracted from the total production mix of the electricity supplier.

[5] The residual electricity mix is the mix when all contract-specific electricity that has been sold to other customers has been subtracted from the total production mix of the electricity supplier.

- Data on the pollutant emissions from the use stage should be based on documented tests, verified studies in conjunction with average or typical product use, or recommendations concerning suitable product use. Whenever applicable, test methods shall be internationally recognised.
- The use of electricity in the region/country where the product is used (as specified in the geographical scope of the EPD) shall be accounted for in the following priority:

1. National residual electricity mix or residual mix on the market
2. National electricity production mix or electricity mix on the market

The mix of electricity used in the downstream processes shall be documented in the EPD, where relevant.

- The transport of the product to the customer shall be described in the reference PCR, which should reflect the actual situation to the best extent possible. The following priority should be used:

1. Actual transportation distances and types.
2. Calculated as the average distance of a product of that product type transported by different means of transport modes.
3. Calculated as a fixed long transport, such as 1 000 km transport by lorry or 10 000 km by sea freight, according to product

- Scenarios for the end-of-life stage shall be technically and economically practicable and compliant with current regulations in the relevant geographical region based on the geographical scope of the EPD. Key assumptions regarding the end-of-life stage scenario shall be documented.

Events, with a very low probability like transformer explosion, are excluded from the inventory.

4.10.3.1. Use phase

- Load loss (PL) means the absorbed active power at rated frequency and reference temperature associated with a pair of windings when the rated current is flowing through the line terminal(s) of one of the windings and the terminals of the other windings are in short-circuit with any winding fitted with tapping.
- No load loss (PnoL) means the active power absorbed at rated frequency when the transformer is energised and the secondary circuit is open.
- The average life time of the transformer is assumed to be 35 years.
- The total energy consumption shall include any cooling system required at no load.
- Energy consumption during use is calculated as a sum of no-load and load losses as guaranteed/stamped by manufacturer. Measurements of load and no load losses are made according to IEC 60076-1 [17].
- Total losses are calculated through the following formula:

$$P[kWh] = (P_L[kW] * (T_L[\%])^2 + P_{noL}[kW] + P_{aux}[kW]) * T_{noL}[\%] * Y[h]$$

P	The total losses over a set life time Y
P_L	Total load losses at 75°C reference temperature at rated tap
T_L	The average load over time, % of rated power
P_{noL}	No load losses
T_{noL}	The average time energized, connected, % time
P_{aux}	Auxiliary losses from cooling equipment at no load
Y	life time of the transformer at operation 24 hours/day (35 years=8766*35=306810 h)

Standard T_L & T_{noL} if not specified by customer:

Small power units: T_L=50% & T_{noL}=100%
Medium power units: T_L=50% & T_{noL}=100%
Large power Transmission/Distribution units: T_L=70% & T_{noL}=100%
Large power GSU units: T_L=90% & T_{noL}=95%

The formula given above are referred to the standard IEC 60076-1;

the applied ratio is:

use the actual using condition if known;

use the worst-case approach (maximum load condition) if the actual using condition are unknown.

The calculate efficiency shall respect the minimum efficiency value provided by the Eco-Design EU Regulation in force; such statement is mandatory for the European Transformer producers and is recommended for the other producers.

5 CONTENT AND FORMAT OF EPD

EPDs based on this PCR shall contain the information described in this section. Flexibility is allowed in the formatting and layout provided that the EPD still includes the prescribed information. A generic template for EPDs is available via www.environdec.com

As a general rule the EPD content:

- shall be in line with the requirements and guidelines in ISO 14020 (Environmental labels and declarations - General principles),
- shall be verifiable, accurate, relevant and not misleading, and
- shall not include rating, judgements or direct comparison with other products.

An EPD should be made with a reasonable number of pages for the intended audience and use.

5.1 EPD LANGUAGES

EPDs should be published in English, but may also be published in additional languages. If the EPD is not available in English, it shall contain an executive summary in English including the main content of the EPD. This summary is part of the EPD and thus subject to the same verification procedure.

5.2 UNITS AND QUANTITIES

The following requirements apply for units and quantities:

- The International System of Units (SI units) shall be used, e.g., kilograms (kg), Joules (J) and metres (m). Reasonable multiples of SI units may be decided in the PCR to improve readability, e.g., grams (g) or megajoules (MJ). The following exceptions apply:
  - Resources used for energy input (primary energy) should be expressed as kilowatt-hours (kWh) or megajoules (MJ), including renewable energy sources, e.g., hydropower, wind power and geothermal power.
  - Water use should be expressed in cubic metres (m^3)
  - Temperature should be expressed in degrees Celsius (°C),
  - Time should be expressed in the units most practical, e.g., seconds, minutes, hours, days or years.
- Three significant figures[6] should be adopted for all results. The number of significant digits shall be appropriate and consistent.
- The thousand separator and decimal mark in the EPD shall follow one of the following styles (a number with six significant figures shown for illustration):
  - SI style (French version): 1 234,56
  - SI style (English version): 1 234.56

  In case of potential confusion or intended use of the EPD in markets where different symbols are used, the EPD shall state what symbols are used for thousand separator and decimal mark.
- Dates and times presented in the EPD should follow the format in ISO 8601. For years, the prescribed format is YYYY-MM-DD, e.g., 2017-03-26 for March 26th, 2017.
- The result tables shall:
  - Only contain values or the letters “INA” (Indicator Not Assessed). It is not possible to specify INA for mandatory indicators. INA shall only be used for voluntary parameters that are not quantified because no data is available.[7]
  - Contain no blank cells, hyphens, less than or greater than signs or letters (except “INA”).

[6] Significant figures are those digits that carry meaning contributing to its precision. For example with two significant digits, the result of 123.45 shall be displayed as 120, and 0.12345 shall be displayed as 0.12. In scientific notation, these two examples would be displayed as $1.2*10^2$ and $1.2*10^{-2}$.

[7] This requirement does not intend to give guidance on what indicators are mandated (“shall”) or voluntary.

- Use the value 0 only for parameters that have been calculated to be zero.
- Footnotes shall be used to explain any limitation to the result value.

5.3 USE OF IMAGES IN EPD

Images used in the EPD, especially pictures featured on the cover page, may in themselves be interpreted as an environmental claim. Images such as trees, mountains, wildlife that are not related to the declared product should therefore be used with caution and in compliance with national legislation and best available practices in the markets in which the EPD is intended to be used.

5.4 EPD REPORTING FORMAT

The reporting format of the EPD shall include the following sections:

- Cover page (see Section 5.4.1)
- Programme information (see Section 5.4.2)
- Product information (see Section 5.4.3)
- Content declaration (see Section 5.4.4)
- Environmental performance (see Section 5.4.5)
- Additional environmental information (see Section 5.4.6)
- References (see Section 5.4.9)

The following information shall be included, when applicable:

- Information related to Sector EPDs (see Section 5.4.7)
- Differences versus previous versions (see Section 5.4.8)
- Executive summary in English (see Section 5.4.10)

5.4.1 COVER PAGE

The cover page shall include:

- Product name and image,
- Name and logotype of EPD owner,
- The text “Environmental Product Declaration” and/or “EPD”
- *Programme: The International EPD® System, www.environdec.com,*
- *Programme operator: EPD International AB*
- Logotype of the International EPD® System,
- EPD registration number as issued by the programme operator[8],
- *Date of publication (issue): 20XX-YY-ZZ,*
- *Date of revision: 20XX-YY-ZZ*, when applicable,
- *Date of validity; 20XX-YY-ZZ*
- A note that “*An EPD should provide current information, and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com*.”

[8] The EPD shall not include a “registration number” if such is provided by the certification body, as this may be confused with the registration number issued by the programme operator.

- A statement of conformity with ISO 14025,

5.4.2 PROGRAMME INFORMATION

The programme information section of the EPD shall include:

- Address of programme operator: *EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden, E-mail: info@environdec.com*
- The following mandatory statement from ISO 14025: "*EPDs within the same product category but from different programmes may not be comparable*."
- A statement that the EPD owner has the sole ownership, liability and responsibility of the EPD
- Information about verification[9] and reference PCR in a table with the following format and contents:

Product category rules (PCR): *<PCR name, registration number, etc.*
PCR review was conducted by: *<name and organisation of the review chair, and information on how to contact the chair through the programme operator>*
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☐ EPD verification
Third party verifier: *<name, organisation and signature of the third party verifier>* *In case of certification bodies:* Accredited by: *<name of the accreditation body and accreditation number, if applicable>.* *In case of individual verifiers:* Approved by: The International EPD® System Technical Committee, supported by the Secretariat
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☐ No

5.4.3 PRODUCT INFORMATION

The product information section of the EPD shall include:

- Address and contact information to EPD owner,
- Description of the organisation. This may include information on products- or management system-related certifications (e.g. ISO 14024 Type I environmental labels, ISO 9001- and 14001-certificates and EMAS-registrations) and other relevant work the organisation wants to communicate (e.g. SA 8000, supply-chain management and social responsibility),
- Name and location of production site,
- Product identification by name, and an unambiguous identification of the product by standards, concessions or other means,
- Identification of the product according to the UN CPC scheme system. Other relevant codes for product classification may also be included, e.g.
  - Common Procurement Vocabulary (CPV),
  - United Nations Standard Products and Services Code® (UNSPSC),

[9] If the EPD has been verified by an approved individual verifier who has received contractual assistance from a certification body that is not accredited, this certification body shall not be included in this table.

- Classification of Products by Activity (NACE/CPA) or
- Australian and New Zealand Standard Industrial Classification (ANZSIC),

- Description of the product, its application/intended use and technical functions, e.g. expected service life time,
- Geographical scope of the EPD, i.e., for which geographical location(s) of use and end-of-life the product's performance has been calculated,
- Declared unit,
- Reference service life (RSL), if applicable,
- Declaration of the year(s) covered by the data used for the LCA calculation and other relevant reference years,
- Reference to the main database(s) for generic data and LCA software used, if relevant,
- System diagram of the processes included in the LCA, divided into the life cycle stages,
- Description if the EPD system boundary is "cradle-to-gate", "cradle-to-gate with options" or "cradle-to-grave",
- Information on which life cycle stages are not considered (if any), with a justification of the omission,
- Relevant websites for more information or explanatory materials.

This section may also include:

- Name and contact information of organisation carrying out the underlying LCA study,
- Additional information about the underlying LCA-based information, such as assumptions, cut-off rules, data quality and allocation.
- Technical description of the product in terms of functional characteristics, main product components and or materials, expected service life time etc.,
- Description of the intended use of the product,

5.4.4 CONTENT DECLARATION

The content declaration shall have the form of a list of materials and chemical substances including information on their environmental and hazardous properties. The gross weight of material shall be declared in the EPD at a minimum of 99 % of one unit of product.

Information on the hazardous properties of materials and chemical substances should follow the requirements given in the latest revision of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS)[10], issued by United Nations or national or regional applications of the GHS.

The content declaration shall be in accordance with the following standard and regulation:

IEC 62474 Material Declaration for Products of and for the Electrotechnical Industry

In addition, the following regulations should be used for EPDs intended to be used in the European Union:

- Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures;
- RoHS (2002/95/EC) and by RoHS 2 Directive (2011/65/EU);
- REACH Regulation EC No1907/2006, Annex XIV and XVII would be priority to be concerned;
- Regulation (EC) No 850/2004 with its amendments on Persistent organic pollutants (POPs) requirements.

In any case, all materials/substances submitted to legal requirements shall be listed.

Content of regulated substances within the geographical regions for which the EPD is valid shall be declared as well as the geographical validity of the EPD.

[10] The GHS document is available on www.unece.org.

5.4.4.1. Information about recycled materials

When a product is made in whole or in part with recycled materials, the provenience of the materials (pre-consumer or post-consumer) shall be presented in the EPD as part of the content declaration.

To avoid any misunderstanding about which material may be considered “recycled material”, the guidance given in ISO 14021 shall be taken into account. In brief, the standard states that:

- only pre-consumer or post-consumer materials (scraps) shall be considered in the accounting of the recycled materials, and
- materials coming from scrap reutilisation (such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it) shall not be considered as recycled content.

5.4.5 ENVIRONMENTAL PERFORMANCE

5.4.5.1. Environmental impacts

The EPD shall declare the environmental impact indicators, per declared unit and per life cycle stage, using the default impact categories, characterisation models and factors available on www.environdec.com/impact-categories. The source and version of the characterisation models and the factors used shall be reported in the EPD. The indicators may also, in a separate results table, be scaled to 1 MVA, see Section 4.1.

Alternative regional life cycle impact assessment methods and characterisation factors are allowed to be calculated and displayed in addition to the default list. If so, the EPD shall contain an explanation of the difference between the different sets of indicators, as they may appear to the reader to display duplicate information.

The following potential environmental impacts may be voluntary calculated and reported in the EPD®:

- Emission of ozone-depleting gases (expressed as the sum of ozone-depleting potential in mass of CFC 11-equivalents, 20 years, according to the CML 2001 baseline Ozone Layer Depletion Potential - ODP steady state);
- Land use (expressed as mass of C deficit, represents the impact related to the use of soil); the method suggested for the indicator calculation is Mila i Canals et al., 200710. This method considers Soil Organic Matter (SOM) as a soil quality indicator. SOM is qualified as a keystone soil quality indicator, especially for assessing the impacts on fertile land use (agriculture and forestry systems). It influences properties like buffer capacity, soil structure and fertility.

References for the source and version characterisation models and factors used shall be reported in the EPD.

5.4.5.2. SPECIFICATION FOR GWP CALCULATIONS

This section is adopted from the General Programme Instructions, Section A.9.

GHG EMISSIONS AND REMOVALS

Both emissions to the atmosphere and removals from the atmosphere shall be accounted for the assessment of the overall GHG emissions of the product being assessed. This assessment shall include the gases arising from both fossil and biogenic sources for all products, with the exception of human food and animal feed products.

To report information about biogenic CO2 removal and emissions in the EPD is not necessary. If reported, emissions and removals of biogenic carbon shall be reported separately to the climate impact of other greenhouse gases.

CARBON SEQUESTRATION

Where some or all removed carbon will not be emitted to the atmosphere within the 100-year assessment period, the portion of carbon not emitted to the atmosphere during that period shall be treated as stored carbon. Following issues shall be taken into account:

- carbon storage might arise where biogenic carbon forms part or all of a product (e.g. wood fibre in a table), or where atmospheric carbon is taken up by a product over its life cycle (e.g. cement)
- While forest management activities might result in additional carbon storage in managed forests through the retention of forest biomass, this potential source of storage is not included in the scope of the International EPD® System.

OFFSETTING

GHG emissions offset mechanism shall not be used at any point in the assessment of the GHG emissions of the product. The organisation could declare its participation to some offsetting program in the other information section of the EPD® or single issue EPD.

5.4.5.3. Use of resources

The indicators for resource use based on the life cycle inventory (LCI) listed in Table 1 shall be declared per declared unit, and per life cycle stage. The indicators may also, in a separate results table, be scaled to 1 MVA, see Section 4.1.

PARAMETER		UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value				
	Used as raw materials	MJ, net calorific value				
	TOTAL	MJ, net calorific value				
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value				
	Used as raw materials	MJ, net calorific value				
	TOTAL	MJ, net calorific value				
Secondary material		kg				
Renewable secondary fuels		MJ, net calorific value				
Non-renewable secondary fuels		MJ, net calorific value				
Net use of fresh water		m^3				

Table 1 Indicators describing use of primary and secondary resources.

Notes:

- In order to identify the primary energy used as an energy carrier (and not used as raw materials), the parameter may be calculated as the difference between the total input of primary energy and the input of energy resources used as raw materials.
- Energy content of biomass used for feed or food purposes shall not be considered.
- The net use of fresh water does not constitute a “water footprint” as potential environmental impacts due to the water use in different geographical locations is not captured. For this indicator:
  - Evaporation, transpiration, product integration, release into different drainage basins or the sea, displacement of water from one water resource type to another water resource type within a drainage basin (e.g. from groundwater to surface water) is included.
  - In-stream water use is not included.
  - For water used in closed loop processes (such as cooling system) and in power generation only the net water consumption (such as reintegration of water losses) should be considered.
  - Seawater shall not be included[11].

[11] It may be relevant to include seawater if it is used to obtain energy from it, or it is the only source of water in a definite site. This may be displayed separately, e.g. as “seawater for desalinization”.

- Tap water or treated water (e.g. from a water treatment plant), or wastewater that is not directly released in the environment (e.g. sent to a wastewater treatment plant) are not elementary water flows, but intermediate flows from a process within the technosphere.
- Additional transparency in terms of geographical location, type of water resource (e.g. groundwater, surface water), water quality and temporal aspects may be included as additional information.

5.4.5.4. Waste production and output flows

Waste generated along the whole life cycle production chains shall be treated following the technical specifications described in the General Programme Instructions. When the amount of waste or the output flows is from the life cycle inventory (LCI) are declared, the indicators in Table 2 and Table 3 shall be reported per declared unit, and per life cycle stage. The indicators may also, in a separate results table, be scaled to 1 MVA, see Section 4.1.

PARAMETER	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Hazardous waste disposed	kg				
Non-hazardous waste disposed	kg				
Radioactive waste disposed	kg				

Table 2 Indicators describing waste production.

PARAMETER	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Components for reuse	kg				
Material for recycling	kg				
Materials for energy recovery	kg				
Exported energy, electricity	MJ				
Exported energy, thermal	MJ				

Table 3 Indicators describing output flows.

Notes:

- The parameters are calculated on the gross amounts leaving the system boundary of the product system in the LCI. If e.g. there is no gross amount of “exported energy, electricity” leaving the system boundary, this indicator is set to zero,
- The parameter “Materials for energy recovery” does not include materials for waste incineration. Waste incineration is a method of waste processing, when R1<60% (European Guideline on R1 energy interpretation), and is allocated within the system boundary.
- In case there are never any flows of these types leaving the system boundary for a product category, the indicators may be removed by the PCR.

5.4.5.5. Other environmental indicators

The following indicator per declared unit shall be reported in the EPD, divided into core, upstream and downstream module:

- Toxic emissions, measured as Human Toxicity Potential (CML2011, HTP inf.), [kg DCB eq.]

5.4.6 ADDITIONAL INFORMATION

The recycling information shall include information such as disassembly instructions, which parts/components are suitable for recycling or not suitable for recycling in the light of IEC 62635:2012 [23].

The peak efficiency index should be specified, according to:

- Annex II of COMMISSION REGULATION (EU) No 548/2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers [12].

- EN 50629:2015 Energy performance of large power transformers (Um > 36 kV or Sr ≥ 40 MVA) [9].

Additional environmental information may be included in the EPD even if not directly derived from the LCA or the LCI, e.g. impact on biodiversity, impact on health, hazard and risk assessment, etc. Also, information regarding recommended internal polices and behaviours (e.g. employer activities) to mitigate environmental impacts, certification programmes, activities addressed to Social Responsibility, etc., may be added.

5.4.7 INFORMATION RELATED TO SECTOR EPDS

For sector EPDs, the following information shall also be included:

- a list of the contributing manufacturers that the Sector EPD covers,
- a description of how the selection of the sites/products has been done and how the average has been determined, and
- a statement that the document covers average values for an entire or partial product category (specifying the percentage of representativeness) and, hence, the declared product is an average that is not available for purchase on the market.

5.4.8 DIFFERENCES VERSUS PREVIOUS VERSIONS

For EPDs that have been updated, the following information shall also be included:

- a description of the differences versus previously published versions, e.g. a description of the percentage change in results and the main reason for the change;
- a revision date on the cover page

5.4.9 REFERENCES

A reference list shall be included, including references to the General Programme Instructions (including version number), the PCR used (registration number, name, CPC code and version number), the underlying LCA report, and other documents that verify and complement the EPD®. The source and version of the characterisation models and the factors used shall be reported in the EPD.

5.4.10 EXECUTIVE SUMMARY IN ENGLISH

For EPDs published in another language than English, an executive summary in English shall be included.

The executive summary should contain relevant summarised information related to the programme, product, environmental performance, additional information, information related to sector EPDs, references and differences versus previous versions.

6 GLOSSARY

CFC	Chlorofluorocarbon
CO_2	Carbon dioxide
CPC	Central Product Classification (United Nation Statistics Division - Classification Registry)
DU	Declared Unit
EAA	European Aluminium Association
EC	European Commission
ELCD	European reference Life Cycle Database
EMAS	Eco-Management and Audit Scheme
EPD	Environmental Product Declaration
ErP	Energy Related Product
EU	European Union
GPI	General Programme Instructions
GWP	Global Warming Potential
IEC	International Electrotechnical Commission
IISI	International Iron and Steel Institute
IP	Internet Protocol
ISO	International Organization for Standardization
JRC	Joint Research Centre
kg	kilogram
LCA	Life Cycle Assessment
NREL	National Renewable Energy Laboratory
PCR	Product Category Rules
POP	Persistent organic pollutants
PP	Polluter-pays
QoS	Quality of Service
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RoHS	Restriction of Hazardous Substances
SI	The International System of Units
SO_2	Sulphur dioxide
TR	Technical Report
TS	Technical Specification
UN	United Nations

7 REFERENCES

[1] ANIE ENERGIA I trasformatori dei produttori associati ad ANIE

[2] ANIE ENERGIA Progettazione ecocompatibile dei trasformatori

[3] Carlen Martin (2011) Life cycle assessment of dry-type and oil-immersed distribution transformers with amorphous metal core CIRED 2011 – Paper 1145

[4] CEI 0-9;Ab 2014-10- Environmental aspects - Inclusion in electrotechnical product standards

[5] CEI 0-8;Ab 2014-10 - Introductory Guidelines for Life Cycle Assessment in Electrotechnology

[6] CEI EN 62430 2011-03 - Environmentally conscious design for electrical and electronic products

[7] CEN (2013), EN 15804:2012+A1:2013, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

[8] CENELEC EN 50464-1 - Three-phase oil-immersed distribution transformers 50 Hz, from 50 kVA to 2 500 kVA with highest voltage for equipment not exceeding 36 kV —Part 1: General requirements

[9] EN 50629:2015 Energy performance of large power transformers (Um > 36 kV or Sr ≥ 40 MVA)

[10] EPD International (2017) General Programme Instructions for the International EPD® System. Version 3.0, dated 2017-12-11. www.environdec.com

[11] EU Directive 2009/125/EC Establishing a framework for the setting of ecodesign requirements for energy-related products

[12] EU Directive 2014/548/EC Transformers Ecodesign

[13] Executive Order (D.Lgs) of the Italian Government - 16 February 2011, n. 15

[14] Guidance for Product Category Rule Development (2013), Ingwersen, W., Subramanian, V., editors. Product Category Rule Guidance Development Initiative. Version 1.0. http://www.pcrguidance.org

[15] ICT FOOTPRINT https://ictfootprint.eu/ European Framework Initiative for Energy & Environmental Efficiency in the ICT Sector

[16] IEC 60076:2015 OC Online collection ed 1.0 - Power transformers

[17] IEC 60076-1:2011 ed 3.0 “Power transformers - Part 1: General”

[18] IEC 60076-10-1: 2016 ed 2.0 “Power transformers - Part 10-1: Determination of sound levels - Application guide”

[19] IEC 60076-15:2015 ed 2.0 “Power transformers - Part 15: Gas-filled power transformers”

[20] IEC 62271-1:2007+AMD1:2011 CSV ed1.1 “High-voltage switchgear and controlgear - Part 1: Common specifications”

[21] IEC 62474:2012 - Material Declaration for Products of and for the Electrotechnical Industry.

[22] IEC TR 62725:2013 Analysis of quantification methodologies of greenhouse gas emissions for electrical and electronic products and systems

[23] IEC/TR 62635:2012 ver 1.0 “Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment”

[24] IEEE C57.12.00 - Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

[25] ISO (2000), ISO 14020:2000, Environmental labels and declarations – General principles

[26] ISO (2006a), ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures

[27] ISO (2006b), ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework

[28] ISO (2006c), ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines

[29] ISO (2014), ISO 14046:2014, Environmental management – Water footprint – Principles, requirements and guidelines

[30] ISO (2013), ISO/TS 14067:2013, Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification and communication

[31] ISO (2017), ISO 21930:2017, Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services

[32] ISO 10656:2016 Resistance welding equipment -- Transformers -- Integrated transformers for welding guns

[33] ISO 22829:2007 Resistance welding -- Transformer-rectifier for welding guns with integrated transformers -- Transformer-rectifier units operating at 1000 Hz frequency

[34] ISO 5826:2014 Resistance welding equipment -- Transformers -- General specifications applicable to all transformers

[35] ISO (2004), ISO 8601:2004 Data elements and interchange formats – Information interchange – Representation of dates and times

[36] Product-Specific Requirements “Liquid- or gas-filled and dry transformers within the range of <1000 MVA”, ver 1.1 issued by The Swedish Environmental Management Council, 2001-02-21.

[37] UN CPC code hierarchy (https://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=31&Lg=1&Co=46121)

[38] Wang, W., Bessède, J.-L. (2014) Life cycle assessment of equipment for electricity transmission and distribution networks

8 VERSION HISTORY OF PCR

VERSION 1.0, 2019-10-29

Original version of this PCR.

VERSION 1.01, 2019-11-15

Cover image added.

VERSION 1.02, 2020-12-17

- Added recommendation in Section 4.1 to declare results also per 1 MVA. This led to additions also to Sections 5.4.5.1, 5.4.5.3, and 5.4.5.4.
- Changes in Section 4.2 on load factor, to make the guidance consistent with Section 4.10.3.1.
- Removed table in Section 5.4.5.1. Instead a reference is now made to www.environdec.com/impact-categories, where the latest version of the default list of environmental impact indicators and methods are available.
- Editorial changes.

VERSION 1.0.3, 2023-09-05

- Prolonged validity with 1 year because of the initiation of an updating process.

VERSION 1.0.4, 2025-01-22

- Prolonged validity with another six months because of a delay in the updating process.

