IEC TS 62282-9-102

Edition 1.0 2021-01

TECHNICAL SPECIFICATION

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Fuel cell technologies –
Part 9-102: Evaluation methodology for the environmental performance of fuel cell power systems based on life cycle thinking – Product category rules for environmental product declarations of stationary fuel cell power systems and alternative systems for residential applications

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INTERNATIONAL
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Part 9-102: Evaluation methodology for the environmental performance of fuel cell power systems based on life cycle thinking – Product category rules for environmental product declarations of stationary fuel cell power systems and alternative systems for residential applications

FOREWORD

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IEC TS 62282-9-102 has been prepared by IEC technical committee 105: Fuel cell technologies. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

DTS	Report on voting
105/797/DTS	105/813A/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 62282 series, published under the general title *Fuel cell technologies*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

In developing new or improved products, manufacturers pursue environmentally conscious designs and evaluate their efforts, for example, by adopting a life cycle assessment (LCA) approach, in order to improve the environmental performance and communicate it to consumers.

This part of IEC 62282 addresses core product category rules (PCR) for characterizing the environmental performance of stationary fuel cell combined heat and power (CHP) systems (defined as: generator systems that use one or more fuel cell stack(s) to generate electric power and heat) and alternative heat (and power) systems for residential applications based on life cycle thinking for communication to consumers. They primarily serve heating purposes. Alternative micro combined heat and power production (μCHP) systems (e.g. Stirling or internal combustion engines) and residential heating systems are also covered. All of these heating systems can be complemented with a peak boiler and/or a hot water storage tank. This shows that there are multiple possibilities to combine stationary fuel cell CHP systems and alternative heat (and power) systems in residential applications. This document is therefore written in a way to allow for an environmental product declaration (EPD) for each individual heat-related device to be established. If combined in a given home, this document also provides requirements and guidance on how to derive specific information on their joint environmental impacts based on the individual EPDs. Because the environmental implications of local infrastructures are known neither to the manufacturer nor to the installer, local infrastructures are not considered (i.e. the domestic heat distribution system and infrastructures for fuel supply (e.g. municipal natural gas network) or fuel storage (e.g. oil tank in situ or in the municipality)). District heating is beyond the scope of this document.

According to ISO 14025, a PCR is a set of specific rules, requirements and guidelines for developing Type III environmental declarations of one or more product categories, providing quantified environmental data. The PCR, and the resulting EPDs, are based on life cycle thinking in order to avoid an incomplete assessment of the systems in question and to identify environmental burden shifting among environmental impact categories and life cycle stages. The EPDs are accordingly generated using the principles, framework, methodologies and practices established by the ISO 14040 series of standards (i.e. ISO 14040 and ISO 14044).

The overall goal of the EPD of stationary fuel cell CHP systems and alternative systems for residential applications is to encourage the demand for, and supply of, those products that cause less burden on the environment, through communication of verified and accurate information that is not misleading, thereby stimulating the potential for market-driven continuous environmental improvement. This document focuses on residential applications, but can also be applied to applications in the tertiary sector.

This document is intended to be used by manufacturers of heat-related devices (including CHP generators) on a voluntary basis. The information provided is then used by consumers or installers.

The installation of a heating system (including CHP systems) individually or in combination with other heat-related devices (e.g. µCHP combined with a peak boiler and a hot water storage tank) depends on the heating demand of the consumer in a given home (in turn depending on e.g. the climate, and the size and insulation level of the building) and also on the consumer's technical preferences (e.g. CHP versus only heating, fuel cell CHP systems versus other systems). The environmental performance of an individual heat-related device or a combination thereof will therefore depend on the specific setting that the manufacturer cannot anticipate in the EPD of its heat-related device. It will, therefore, be the task of the installer of a heat-related device (including CHP generators), or a combination thereof, to adapt or integrate the information of the EPD(s) of the heat-related device(s) in order to provide information on the environmental performance of the overall heating systems that can potentially be installed in a given home. Neither will the manufacturers be necessarily able to know to which extent the devices run on biofuels (including on which kind of biofuel) and in particular whether the biofuels used can be regarded as carbon neutral. Therefore, the case of carbon neutrality of biofuels is not quantitatively dealt with in the EPD. However, it is discussed in the EPD so that the consumer or installer of a heat-related device can take potentially existing carbon neutrality into account.

NOTE At the time of publication of this document, a new ISO standard on "carbon neutrality" (ISO 14068) is under development.

FUEL CELL TECHNOLOGIES –

Part 9-102: Evaluation methodology for the environmental performance of fuel cell power systems based on life cycle thinking – Product category rules for environmental product declarations of stationary fuel cell power systems and alternative systems for residential applications

1 Scope

This part of IEC 62282 provides a set of specific rules, requirements and guidelines (i.e. so-called product category rules (PCR) according to ISO 14025 and thus in line with ISO 14040 and ISO 14044) for characterizing the environmental performance of stationary fuel cell combined heat and power (CHP) systems, and alternative systems for residential applications based on life cycle thinking primarily for communication to consumers. The environmental performance of a system is communicated to the consumer and the installer by means of an environmental product declaration (EPD).

This document covers stationary fuel cell CHP systems and alternative heat (and power) systems for residential applications that primarily serve heating purposes. The systems can be complemented with a hot water storage tank and one or more additional heat generators. The systems are connected to the electricity grid. The environmental performance is characterized in an EPD for each individual heat-related device or CHP generator separately. This document also describes how the environmental performance of a given combination of heat-related devices (including CHP generators) is characterized based on the environmental performance of its individual components. The domestic heat distribution system, district heating, or local infrastructures for fuel supply or for fuel storage are not considered.

This document focuses on residential applications, but can also be used to assess applications in the tertiary or service sector.

This document does not override, or in any way change, legally required environmental information, claims or labelling, or any other applicable legal requirements.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14020:2000, *Environmental labels and declarations – General principles*

ISO 14021:2016, *Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling)*

ISO 14025:2006, *Environmental labels and declarations – Type III environmental declarations – Principles and procedures*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
fuel cell stack
assembly of cells, separators, cooling plates, manifolds and a supporting structure that electrochemically converts, typically, hydrogen-rich gas and air reactants to DC power, heat and other reaction products

[SOURCE: IEC 60050-485:2020, 485-06-01]

3.2
combined heat and power
CHP
simultaneous generation of thermal and electric energy in one process

[SOURCE: IEC 62282-3-400:2016, 3.1.19]

3.3
CHP generator
system that produces thermal and electric energy

[SOURCE: IEC 62282-3-400:2016, 3.1.21, modified – "includes a fuel cell power system producing" replaced by "produces"; "and is the preferential source of heat" and Note 1 to entry deleted.]

3.4
fuel cell combined heat and power system
fuel cell CHP system
device consisting of one or more fuel cell stack(s) that is intended to simultaneously produce both electric power and heat

Note 1 to entry: The configuration of a fuel cell CHP system neither includes a supplementary heat generator nor a hot water storage tank. As a result, it is not necessarily identical to a fuel cell cogeneration system as defined in IEC 60050-485.

3.5
heat generator
system that produces thermal energy

3.6
domestic hot water
water delivered by a heat generator or a CHP generator, raised to a certain temperature in order to use it for domestic needs, such as kitchen, bathroom

[SOURCE: IEC 62282-3-400:2016, 3.1.37, modified – "the small fuel cell CHP appliance" replaced by "a heat generator or a CHP generator".]

3.7
heat-related device
device that can generate, store, transfer or control thermal energy

Note 1 to entry: For the purposes of this document, the transfer function is generally not included.

Note 2 to entry: CHP generators are also considered as heat-related devices.

3.8
functional unit
quantified performance of a product system for use as a reference unit

[SOURCE: ISO 14040:2006, 3.20]

3.9
reference flow
measure of the outputs from processes in a given product system required to fulfil the function expressed by the functional unit

[SOURCE: ISO 14040:2006, 3.29]

3.10
foreground system
element of the life cycle of a product that is specific to it

Note 1 to entry: The foreground system notably comprises the manufacturing, use and end-of-life of the product.

3.11
background system
element of the life cycle of a product that is not specific to it

EXAMPLE Material supply for constructing the manufacturing site or machinery used.

3.12
elementary flow
material or energy entering the system being studied that has been drawn from the environment without previous human transformation, or material or energy leaving the system being studied that is released into the environment without subsequent human transformation

[SOURCE: ISO 14040:2006, 3.12]

3.13
environmental aspect
element of an organization's activities or products or services that interacts or can interact with the environment

Note 1 to entry: An environmental aspect can cause (an) environmental impact(s). A significant environmental aspect is one that has or can have one or more significant environmental impact(s).

[SOURCE: ISO 14001:2015, 3.2.2, modified – Note 2 to entry deleted.]

3.14
environmental impact
change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects

[SOURCE: ISO 14001:2015, 3.2.4]

3.15
impact category
class representing environmental issues of concern to which life cycle inventory analysis results may be assigned

[SOURCE: ISO 14040:2006, 3.39]

3.16
characterization factor
factor derived from a characterization model which is applied to convert an assigned life cycle inventory analysis result to the common unit of the category indicator

Note 1 to entry: The common unit allows calculation of the category indicator result.

[SOURCE: ISO 14040:2006, 3.37]

3.17
primary data
information determined by direct measurement, estimation or calculation for the foreground system

3.18
secondary data
information obtained from sources other than primary data (3.17)

Note 1 to entry: Sources can include reports, websites, books, databases, journal articles, broadcasts, etc.

[SOURCE: ISO 14064-1:2018, 3.2.4, modified – "data" replaced by "information", Note 1 to entry replaced by a new Note 1 to entry.]

3.19
product category
group of products that can fulfil equivalent functions

[SOURCE: ISO 14025:2006, 3.12]

3.20
environmental label
environmental declaration
claim which indicates the environmental aspects of a product or service

Note 1 to entry: An environmental label or declaration may take the form of a statement, symbol or graphic on a product or package label, in product literature, in technical bulletins, in advertising or in publicity, amongst other things.

[SOURCE: ISO 14020:2000, 2.1]

3.21
Type III environmental declaration
environmental performance declaration
environmental declaration providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information

Note 1 to entry: The predetermined parameters are based on the ISO 14040 series of standards, which is made up of ISO 14040 and ISO 14044.

Note 2 to entry: The additional environmental information may be quantitative or qualitative.

Note 3 to entry: In the practice of developing Type III environmental declarations, programmes or their declarations are referred to by various names such as Eco-Leaf, eco-profile, environmental declaration of product, environmental product declaration (EPD), environmental performance declaration and environmental profile.

[SOURCE: ISO 14025:2006, 3.2, modified – Second preferred term "environmental performance declaration" and Note 3 to entry added.]

3.22
product category rules
PCR
set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories

[SOURCE: ISO 14025:2006, 3.5]

4 Principles

4.1 Accuracy

Aim for accuracy by minimizing uncertainty and eliminating bias towards a particular perspective.

4.2 Completeness

Ensure that all significant information is included in such a way that no other relevant information needs to be added and no additional information will change the results significantly.

4.3 Consistency

Ensure that assumptions, methods and data are applied in the same way throughout the process of creating the EPD and are consistent with the goal and scope.

4.4 Relevance

Ensure that sources, time-related, spatial and technological coverage and representativeness of data, and methods used (e.g. for data estimation) are appropriate for the process of creating the EPD.

4.5 Transparency

Ensure documentation is comprehensive, understandable and not misleading to the largest extent possible, including procedures, data sources, tools, assumptions, extrapolations, simplifications, cut-offs and their justifications in order to allow verifiers to gain confidence in the results presented in the EPD and the underlying report and facilitate replicability of the analysis.

4.6 Voluntary nature

The development and use of the EPD is voluntary.

4.7 Units to be used

The International System of Units shall be used. For a better understanding, reasonable multiples can be used.

Units that are not part of the International System of Units may be used in the case of:

– kWh for electricity, heat and hot water energy content;
– kW (or multiples hereof: e.g. MW, GW) for power.

4.8 Quantities to be provided

When reporting LCA results, a minimum of two and a maximum of three significant digits shall be indicated.

5 Product group

5.1 General

The product group in the scope of this PCR consists of heat-related devices for residential applications. It includes fuel cell CHP systems, other kinds of CHP generators, stand-alone and additional heat generators and hot water storage tanks.

Mobile applications, heat-related devices exclusively serving cooling purposes and the domestic heat distribution system are not included.

5.2 Combination of heat-related devices

If several heat-related devices for residential applications are combined, the information requirements in 5.3 shall be provided by the respective manufacturer for each heat-related device or CHP generator separately (e.g. fuel cell µCHP and back-up boiler).

5.3 Product and manufacturing company specification

The following properties and characteristics of the heat-related device or CHP generator for residential applications shall be documented:

– short description of the heat-related device or CHP generator;
– trade name;
– manufacturer name and production site of the heat-related device or CHP generator for residential applications;
– type of electrolyte used if the heat-related device or CHP generator for residential applications is a fuel cell;
– primary functions (e.g. production of electricity, hot water and/or space heating);
– electrical power (rated or peak output) if the system produces electricity;
– thermal power (rated output);
– electrical efficiency as an average over the system's lifetime in accordance with the market-specific operation conditions as shown in Table 1 if the system produces electricity; it shall be specified whether the electrical efficiency was determined based on the higher or on the lower heating value;
– thermal efficiency as an average over the system's lifetime; it shall be specified whether the thermal efficiency was determined based on the higher or the lower heating value;
– rated voltage if applicable;
– rated current if applicable;
– coefficient of performance as an average over the system's lifetime in accordance with the market-specific operation conditions as shown in Table 1 if the heat-related device is a heat pump;
– range of temperatures and operating temperature (including outlet temperature) if applicable;
– weight;
– dimensions;
– expected service life that amongst other things depends on the expected operation profile and the heat/power demand.

The way in which average efficiencies that are representative over a system's lifetime is defined (notably including degradation phenomena) shall be documented and justified.

To the extent that such documents exist, the properties and characteristics shall be determined according to (descending order of priority):

– appropriate IEC standards or technical specifications;
– appropriate ISO standards or technical specifications;
– appropriate supranational standards or technical specifications (e.g. from CEN or CENELEC);
– appropriate national standards or technical specifications; or
– appropriate national guidance documents (e.g. from VDI, the Association of German Engineers).

NOTE In the case of fuel cell (combined heat and) power systems, examples of IEC standards include IEC 60050-485, IEC 62282-3-200, IEC 62282-3-201 and IEC 62282-3-400.

The documents according to which the properties and characteristics are determined shall be stated in the report/documentation (10.1).

6 Assessment

6.1 Goal of the assessment

The goal of the assessment described in Clauses 7 and 8 is the establishment of an EPD (Clause 9), characterizing the environmental performance of a heat-related device for residential applications, as specified in Clause 5, in a specific market. The market shall be defined in terms of country or region. The EPD shall be specific for a given market. If the manufacturer intends to sell its heat-related device in different countries or regions, specific EPD versions shall be provided.

The EPDs elaborated can be disclosed to the public and used for comparison purposes.

6.2 Boundary

6.2.1 Functional unit and reference flow

The functional unit is the annual satisfaction of the space heating and hot water demand of a given home. The space heating and hot water demands vary between homes of different sizes, of different levels of insulation, in different climates, and with different numbers and behaviours of inhabitants. It is the task of the installer of a heat-related device or CHP generator to determine the annual heat demand valid for a given home (9.2).

In order to allow for fair comparisons between systems, the reference lifetime shall be 10 years. If devices or components thereof last shorter than 10 years, respective replacements shall be taken into account. For replaced devices or components whose lifetime will not be fully used, the elementary flows and related environmental impacts related to the supply of the device shall be spread equally over the lifetime of the device or the component in question. In this case, only the years that fall into the reference lifetime of 10 years shall be taken into account. If devices or components thereof last longer than 10 years, the elementary flows and related environmental impacts related to the supply of the device shall be spread equally over the lifetime of the device or the component in question. In this case, only the first 10 years shall be taken into account.

NOTE The selection of a reference lifetime of 10 years was motivated by the expected lifetime of a fuel cell stack, noting that the expected lifetime of other heat-related devices can deviate.

In order to enable the installer to assess the specific environmental performance of an individual heat-related device or a CHP generator, or of a combination of these, the functional unit is split into the supply of a given heat-related device or CHP generator to the regional market on which it is used, and the system operation.

The reference flow for the supply of a given heat-related device or CHP generator to the regional market on which it is used is the device itself, referred to as "supply of device". Different combinations of space heating and hot water demands constitute the reference flows for the operation phase, referred to as "operation of device". Table 1 indicates the scenarios of space heating and hot water demands for which environmental performance-related information shall be determined by the manufacturer, as appropriate, averaged over the lifetime of the heat-related device or of the CHP generator. For each scenario, the following information shall additionally be documented and justified, preferably based on evidence:

– the overall lifetime of the heat-related device or the CHP generator expressed in expected years of operation, and
– the frequency of replacement of components (e.g. stack, desulfurizer, refrigerant) during that time.

Table 1 – Combinations of space heating and hot water demands to which the determined environmental impacts shall be related (reference flows)

Scenario ID	Heating demand [kWh/year]	Percentage of hot water demand
Si10	10 000	10 %
Si20	10 000	20 %
Si35	10 000	35 %
Si50	10 000	50 %
Sii10	20 000	10 %
Sii20	20 000	20 %
Sii35	20 000	35 %
Sii50	20 000	50 %
Sv10	50 000	10 %
Sv20	50 000	20 %
Sv35	50 000	35 %
Sv50	50 000	50 %
Sx10	100 000	10 %
Sx20	100 000	20 %
Sx35	100 000	35 %
Sx50	100 000	50 %

When a given space heating and hot water demand is provided by a CHP generator, a credit may be given to the electricity produced (7.3.2). When a heat-related device also serves cooling purposes (e.g. heat pumps), a credit may be given to the cold produced (7.3.3).

6.2.2 General system boundary and life cycle stages

The life cycle of the heat-related device or of the CHP generator shall include and be split into the following life cycle stages:

– manufacturing (including material and component supply and all related relevant transports),
– operation (including the fuel and electricity supply to the device, and maintenance), and
– end-of-life.

The considered system is distinguished into the foreground system and the background system (Figure 1). The foreground system consists of heat-related devices as described in 5.1. The foreground system includes the manufacturing, the use and the end-of-life of the heat-related devices in question.

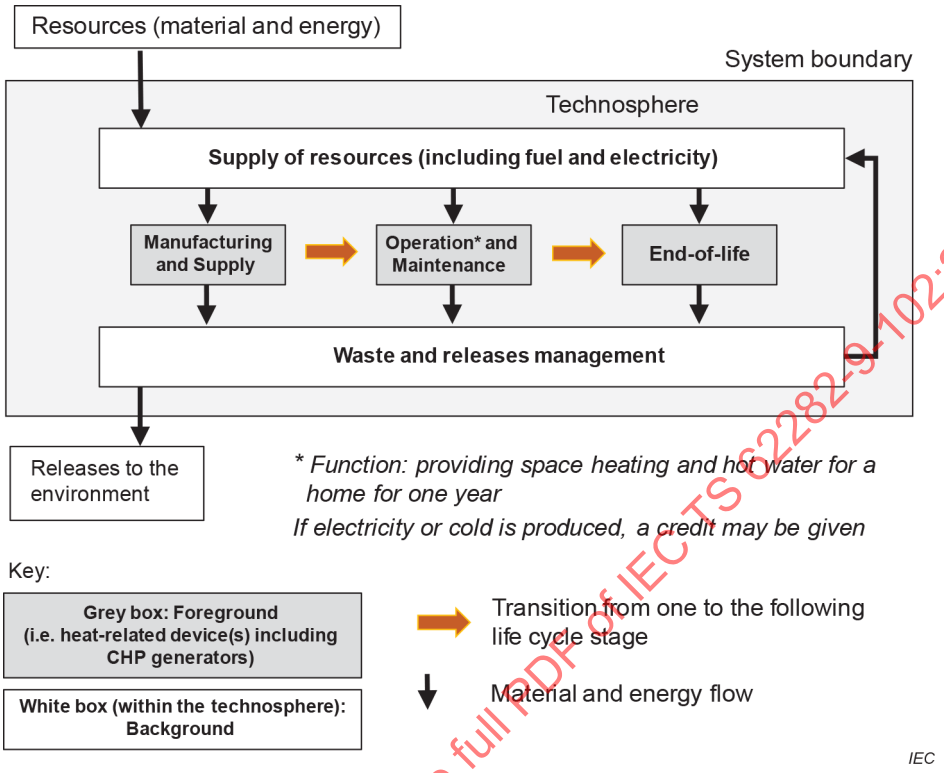

Figure 1 – System boundary, foreground and background

The remainder of the considered system (termed technosphere in Figure 1) constitutes the background system. Fuel and electricity supply is part of the background system. Secondary data may be used to describe fuel and electricity supply (6.2.3).

The way in which the end-of-life stage is treated is described in 6.2.3.4.

The boundaries of the heat-related device or of the CHP generator are defined according to the criteria as specified in 6.2.3.

6.2.3 Criteria for the inclusion of inputs and outputs

6.2.3.1 General

In the following Subclauses 6.2.3.2 to 6.2.3.5, requirements regarding the inclusion of inputs and outputs are given. If data cannot be obtained with reasonable effort, it shall be documented and reported for which processes, materials, energy uses, etc. data is missing.

6.2.3.2 Manufacturing

Primary data shall be used for:

– material composition of the different components of the heat-related device,
– material composition of auxiliary equipment (e.g. for fuel preparation such as a desulfurizer, inverter, provisions for mounting the device), if any,
– energy use for constructing and assembling the heat-related device and its components,
– distances by mode of transport, and related energy uses and releases for material supply,

– distances by mode of transport for delivering the heat-related device to the regional market on which it is used.

Secondary data may be used for energy uses and releases associated with transport in the manufacturing stage.

For the fuel, heat (including cold) or electricity supply at the manufacturing site(s), 6.2.3.5 applies.

All hazardous and toxic materials used for manufacturing the heat-related device or the CHP generator that are under the control of the organization making the EPD shall be included in the inventory, regardless of their contribution to final environmental impacts. This also applies to materials that are critical in the sense of global scarcity or geopolitical constraints (e.g. precious metals or rare earth elements).

6.2.3.3 Operation

Primary data shall be used for:

– operation of the heat-related device or of the CHP generator,
– amounts of fuel and other auxiliary operational inputs (including electricity),
– fuel preparation processes (e.g. desulfurization) in situ, if any,
– maintenance in terms of replacement of components,
– handling/treatment/storage of fuel related waste, if any,
– amounts and type of treatment of other waste, if any.

Inspection trips related to maintenance are assumed to be the same for all heat-related devices used for heating homes, and are, therefore, disregarded.

For the fuel and electricity supply applicable to the regional market on which the corresponding EPD is used, 6.2.3.5 applies.

6.2.3.4 End-of-life

Practices related to the end-of-life stage vary considerably across countries. A quantitative assessment is, therefore, not required but encouraged. At least, information on the proven recyclability shall be documented by the manufacturer in terms of type of material, and its total and recyclable amount.

6.2.3.5 Fuel, heat and electricity supply

This subclause applies to the fuel, heat (including cold in non-residential applications) and electricity supply within or to the manufacturing site(s), and within or to the regional market on which the EPD of the heat-related device or CHP generator is used.

Unless primary data are available, secondary data should be used for:

– the fuel supply, including any of the applicable items of the following list and concerning any kind of relevant fuel (i.e. including biofuels): exploration, extraction, synthesizing, refining and all intermediate transports; construction, operation (including losses and storage provisions), maintenance and end-of-life of the corresponding provision(s); for biofuels, 7.2.2 shall be noted;
– the electricity supply, including construction, operation (including their respective fuel supplies), maintenance and end-of-life of the power generation technique(s) effective in the regional market concerned; construction, operation (including losses), maintenance and end-of-life of the power transmission and distribution network(s) including any storage provisions;

– process or space heat (or cold in non-residential applications) supply, including construction, operation (including their respective fuel supplies), maintenance and end-of-life of the heat (or cold) generator; construction, operation (including losses), maintenance and end-of-life of the heat (or cold) transmission and distribution network(s) including any storage provisions.

The fuel or electricity supply representative for the country or region that the manufacturing site is located in shall be used, unless a guarantee of origin can be proven.

In the case of CHP-derived heat at a manufacturing site, allocation shall be performed in accordance with 7.3.4.

6.2.4 Data quality rules

Data quality includes aspects regarding coverage, precision, completeness, representativeness, consistency, reproducibility, sources and uncertainty. In addition to the requirements and guidance stated in Clauses 7 and 8, data quality shall be ensured by following the principles as detailed in 4.1 to 4.5.

NOTE For example, the relevance principle (4.4) translates into the following:

- primary data is used by default;
- secondary data can be used if primary data cannot be identified with reasonable effort by the organization making the EPD and in cases where secondary data are sufficiently representative for the purpose of the EPD;
- secondary data used is not older than 10 years;
- the EPD corresponds to the regional market on which it is used.

An indication of the precision and uncertainty should be provided in terms of the variability of the data values for each data expressed (e.g. variance, confidence intervals; data with expert judgement in terms of confidence).

7 Life cycle inventory

7.1 Data collection

Data may be collected through measurement, calculation or estimation. Subclause 6.2.3 states in which cases primary data shall be used; it also mentions in which cases secondary data may be used without claims of completeness.

A check on data validity shall be conducted during the process of data collection to confirm and provide evidence that the data quality requirements (6.2.4) have been fulfilled. If data does not meet the data quality requirements (6.2.4), this shall be stated.

7.2 Inventory and calculation rules

7.2.1 General

Primary data shall be used for modelling the foreground system.

The input and output data corresponding to the supply of a given heat-related device or CHP generator to the regional market on which it is used shall be related to the reference flow "supply of one device".

The input and output data corresponding to the operation of a given heat-related device or CHP generator in a specific regional market shall be related to the reference flow "kWh of heat" for space heating and/or hot water demand satisfaction in accordance with the scenarios defined in Table 1, as appropriate.

The electricity produced and consumed by a CHP generator is assumed to be fully fed into and provided by the electricity grid, respectively.

If a material is used in the manufacturing for which the life cycle inventory data sources used do not contain information, an alternative material should be identified and used in the assessment instead, in order to approximate the elementary flows and related environmental impacts of the missing material in terms of extraction and subsequent processing and supply. If the missing material contributes to one weight-per cent or more to the device, or is hazardous, toxic, scarce or geopolitically constrained, an alternative material shall be identified. Its data shall be used in the assessment instead.

NOTE 1 For the identification of scarce or geopolitically constrained materials, governmental documents can be consulted. For the EU, see for example Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the 2017 list of Critical Raw Materials for the EU as of 13 September 2017 (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017DC0490).

The selection of the alternative material shall be justified. Corresponding stoichiometric conversions shall be taken into account.

NOTE 2 For example, when manufacturing a solid oxide fuel cell, materials such as yttrium oxide, lanthanum nitrite, manganese nitrite and strontium nitrite might be used. Corresponding LCA data is not necessarily available from the literature or databases. These can therefore be approximated by lanthanum oxide (for yttrium oxide), lanthanum oxide (for lanthanum nitrite), manganese oxide (for manganese nitrite) and strontium carbonate (for strontium nitrite), respectively. The justification is that these substances can be used in chemical reactions to form the chemical substances needed in the manufacturing or that the elements have similar geological occurrences (e.g. yttrium and the lanthanides are always found in nature together in rare-earth minerals). Another argument for using an alternative material could consist in the fact that the materials are functional substitutes.

7.2.2 Carbon neutrality and market-mediated impacts of biofuels

Greenhouse gas emissions related to the combustion of biomass-based fuels ("biofuels" that can be solid, liquid or gaseous) shall be treated as if they were of fossil origin. Full or partial greenhouse gas neutrality primarily results in situations in which the amount of greenhouse gases emitted due to combustion or growing of the biomass in agriculture or silviculture, including its further processing, is compensated in full or in part by the CO_2 captured by the grown biomass over a given (equal) period of time. However, the manufacturers of heat-related devices will not necessarily be able to know to which extent the devices run on biofuels (including on which kind of biofuel). Even if the heat-related device only runs on biofuels (e.g. wood-pellet boiler, wood log stove), its manufacturer cannot necessarily assert that the way in which the biomass is grown, harvested, processed and transported is carbon neutral.

With biofuels, market-mediated impacts can also occur such as from indirect land use changes (ILUC; e.g. impacts from land use changes in other parts of the world) or fuel use changes (e.g. wood and paper industry selling the by-products and burning fossil fuels instead). The manufacturer cannot necessarily take such market-mediated impacts into account when establishing the EPD.

Therefore, the case of carbon neutrality and market-mediated impacts of biofuels cannot quantitatively be dealt with in the EPD. It shall, however, be discussed in the EPD so that the consumer or installer of a heat-related device can take potentially existing carbon neutrality and market-mediated impacts into account (9.2.4).

NOTE At the time of publication of this document, a new ISO standard on "carbon neutrality" (ISO 14068) is under development.

7.3 Allocation rules and multifunctionality

7.3.1 General

CHP generators are multifunctional in that they produce heat and electricity at the same time. In this document, system expansion is used to deal with multifunctionality during the operation phase (i.e. credits may be given for the electricity or cold produced, see 7.3.2 and 7.3.3). If CHP production occurs during manufacturing, allocation shall be performed (i.e., assigning elementary flows and associated environmental impacts according to the heat and electricity produced, see 7.3.4).

7.3.2 Credits to electricity generated by a CHP generator for residential application

When a given space heating and hot water demand is satisfied by a CHP generator for residential application, a credit may be given to the electricity produced by the CHP generator in terms of environmental impacts avoided. This credit depends on the electricity production avoided and varies by region or country. If credits are considered, these shall be computed based on the environmental impacts per kWh of electricity produced in the applicable region or country as shown in Table 2.

NOTE In this document, the credit is not assessed according to the primary energy demand for the electricity generation avoided (such as assessed by means of the conversion coefficient for electric energy used in energy-related products in B.6.2.1.101.2 of IEC 62282-3-400:2016). Even though this would be rather straightforward, the environmental impacts avoided would be limited to those associated with the fuel used by the CHP generator (e.g. natural gas or hydrogen of different origin).

Table 2 – Credits by impact category attributed to a kWh of electricity produced by CHP generators in a given country or region

Impact category (see 8.2)	Unit	Country or group of countries (region)			
	… per kWh of electricity production avoided	European Union	Japan	USA	Rest of the world
Climate change	kg CO_2-eq	0,426	0,646	0,597	0,803
Abiotic resource depletion – minerals and metals	kg Sb-eq	1,16E-07	8,76E-08	1,30E-07	4,33E-08
Respiratory inorganics	disease incidents	1,07E-08	9,63E-09	1,46E-08	1,23E-07
Acidification	mol H+-eq	0,001 3	0,001 25	0,001 95	0,005 54
Photochemical ozone formation	kg NMVOC-eq	0,000 691	0,000 97	0,000 693	0,002 35
NOTE 1 Sourced from Environmental footprint database 'Energy' v.2.0, extract. © Sphera 2020. Reproduced from Datasets: "Electricity grid mix (consumption mix), < 1 kV" for the respective country/region, with the permission of Sphera 2020. Users of the indicators in this table are required to consult the binding conditions on use of the indicators and disclaimer. [1]					
NOTE 2 "Rest of the world" mix calculated for the 11 biggest electricity consuming countries/regions excluding EU, USA and Japan (i.e. Australia, Brazil, Canada, China, Indonesia, India, South Korea, Mexico, Russia, Saudi Arabia, Turkey), weighted by the country-specific electricity consumption.					

[1] *Sphera grants to the User of this document the non-exclusive, non-transferable, non-sublicensable right to use the Sphera Data published in this document free of charge, solely and exclusively for the calculation of Results under this document, ("permitted purpose"). Any further use shall be agreed with the data owner (Sphera, https://sphera.com/).*

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7.3.3 Credits to cold generated by heat pumps for residential application

When the alternative system consists of a heat-related device producing also cold (i.e. heat pumps), only the elementary flows and related environmental impacts associated with the heat production by means of this heat-related device shall be taken into consideration for the purpose of the EPD.

The elementary flows occurring during the manufacturing of the system shall be allocated to the heat production based on the expected respective operational time according to: $time_{heat\ production}$ / ($time_{heat\ production}$ + $time_{cold\ production}$).

7.3.4 Dealing with multifunctionality of CHP in manufacturing

If CHP generation occurs at the manufacturing site(s) of a heat-related device, allocation shall be performed using exergy. In the exergy calculations, the reference conditions shall be 298,15 K and 100 000 Pa.

For temperatures of the heat produced lower than 423,15 K (150 °C), an allocation corresponding to the temperature of 423,15 K may be performed to avoid an underestimation of the value of the heat produced.

8 Life cycle impact assessment

8.1 General

If the life cycle impact assessment method used to assess a specific impact category (8.3) provides region-specific characterization factors, these shall be used.

Neither normalization, nor grouping, nor weighting shall be performed.

8.2 Impact categories

The following environmental impact categories shall be assessed:

– climate change;
– abiotic resource depletion – minerals and metals;
– respiratory inorganics;
– acidification;
– photochemical ozone formation.

8.3 Impact assessment methods

The following methods and data shall be used to assess the environmental impact categories as specified in 8.2:

a) Climate change: Characterization factors for radiative forcing in terms of global warming potentials (GWP) for a time horizon of 100 years without climate feedback for the non-CO_2 greenhouse gases, noting 7.2.2. The characterization factors are expressed in kg of carbon dioxide-equivalents (kg CO_2-eq).

NOTE 1 The characterization factors for radiative forcing are displayed in Table 8.A.1 in IPCC (2013).

b) Abiotic resource depletion – minerals and metals: Characterization factors for the depletion of chemical elements from the earth's crust (ultimate reserves), as defined in the methodology "CML-IA Characterization Factors". The characterization factors are expressed in kg of antimony equivalents (kg Sb-eq).

c) Respiratory inorganics: Characterization factors for the development of respiratory diseases in humans due to primary and secondary inorganic particulate matter (PM) in the atmosphere with an aerodynamic diameter of less than 2,5 µm, obtained according to the PM model recommended by UNEP in 2016. The characterization factors are expressed in disease incidences.

d) Acidification: Characterization factors for the creation of inorganic acids in the atmosphere, as used in the Environmental Footprint pilot studies (Version 2.0). The characterization factors are expressed in mol of proton-equivalents (mol H^+-eq).

e) Photochemical ozone formation: Characterization factors for the increase of ozone in the lower atmosphere (i.e. troposphere) as proposed in the ReCiPe 2008 methodology. The characterization factors are expressed in units kg of non-methane volatile organic compound-equivalents (kg NMVOC-eq).

NOTE 2 At the time of publication of this document, the related characterization factors of b), c), d), and e) are available from the "EF Life Cycle Impact Assessment method" as of March 2019 (http://eplca.jrc.ec.europa.eu/permalink/EF-LCIAMethod_CF(EF-v2.0).xlsx).

Characterization factors that are specific to the location where an individual environmental flow occurs shall be used to the extent that they are available. If country or region specific characterization factors are not available, substitute characterization factors shall be used and justified.

9 Environmental product declaration (EPD)

9.1 Content

9.1.1 General

The following general information shall be included in the EPD:

a) identification and description of the organization making the declaration;

b) description of heat-related device (including a CHP generator) including components, efficiencies and lifetimes of the device or components thereof if deviating;

c) identification of the heat-related device (including a CHP generator) (e.g. model number, brand name);

d) under which conditions the indicated results have been determined, i.e. in terms of region (e.g. country or group of countries, 6.1) and overall heat and hot water demand (Table 1); if the heat-related device or CHP generator is not appropriate for a scenario as defined in Table 1, this shall be indicated by stating "not applicable" for the scenario in question;

e) name of the programme and the programme operator's address and, if relevant, logo and website. See NOTE 1 in 10.2.;

f) PCR identification according to IEC TS 62282-9-102;

g) date of publication and period of validity;

h) data from LCA, LCI or information modules (9.1.2);

i) additional environmental information (9.1.3);

j) content declaration covering materials and substances to be declared (e.g. information about product content, including specification of materials and substances that can adversely affect human health and the environment, in all stages of the life cycle);

k) a statement that the end-of-life stage has not been assessed quantitatively unless this has been done;

l) a statement that environmental declarations from different programmes cannot be comparable;

m) information on where explanatory material can be obtained.

The contents of an EPD shall be verifiable (Clause 10) and shall not include ratings, judgements or direct comparisons with other heat-related devices.

The EPD shall be written in a language that corresponds to the language(s) spoken in the country(ies) in which the heat-related device is sold (6.1).

9.1.2 Data from the LCA

In accordance with this document, only aggregated and characterized LCA results (i.e. life cycle impact assessment results, Clause 8) shall be presented in the EPD. The EPD shall provide quantitative information on all impact categories stated in 8.2, distinguished into the life cycle stages as stated in 6.2.2. The quantitative information as provided by the manufacturer per market (i.e. country or region) shall be organized in tables for the supply of one device and operation of device separately. These tables shall have the structure as shown in Table 4 and Table 5, respectively.

If a heat-related device can be operated in different modes of operation, then the data shall be stated in the EPD for each mode of operation in accordance with Table 5 separately.

In the EPD, it shall be stated that greenhouse gas emissions related to the combustion of biomass-based fuels are treated by default as if they were of fossil origin. Note the provisions for the installer in 9.2.4.

The impact category names as used by the LCA community do not lend themselves to be easily understood by laypersons. As a result, these shall be replaced by more readily understandable terms in the information provided to the general public (Table 3).

Table 3 – Replacing impact category names used by the LCA community by names more readily understandable by the general public

Name used in the LCA community	Climate change	Abiotic resource depletion – minerals and metals	Respiratory inorganics	Acidification	Photochemical ozone formation
Name to be used in public communications	Climate change	Mineral and metal depletion	Health impacts due to fine dust	Acid rain formation	Summer smog/ozone formation

Table 4 – Environmental impact results due to the "supply of one device" to a given market – Information for the installer

Environmental impact [per device]				
Climate change	**Mineral and metal depletion**	**Health impacts due to fine dust**	**Acid rain formation**	**Summer smog/ozone formation**
[kg CO_2-eq]	[kg Sb-eq]	[disease incidences]	[mol H^+-eq]	[kg NMVOC-eq]
…	…	…	…	…
"…" denotes cells that the manufacturer shall fill with numbers.				

Table 5 – Environmental impact results due to the "operation of device" in a given market – Information for the installer

Heating demand	Of which hot water demand	Environmental impact without giving credits to the electricity produced [per kWh of overall heat]					Electricity produced [per kWh of heat]
		Climate change	Mineral and metal depletion	Health impacts due to fine dust	Acid rain formation	Summer smog/ozone formation	
[kWh / year]		[kg CO_2-eq]	[kg Sb-eq]	[disease incidences]	[mol H^+-eq]	[kg NMVOC-eq]	[kWhel]
10 000	10 %	…	…	…	…	…	…
10 000	20 %	…	…	…	…	…	…
10 000	35 %	…	…	…	…	…	…
10 000	50 %	…	…	…	…	…	…
20 000	10 %	…	…	…	…	…	…
20 000	20 %	…	…	…	…	…	…
20 000	35 %	…	…	…	…	…	…
20 000	50 %	…	…	…	…	…	…
50 000	10 %	…	…	…	…	…	…
50 000	20 %	…	…	…	…	…	…
50 000	35 %	…	…	…	…	…	…
50 000	50 %	…	…	…	…	…	…
100 000	10 %	…	…	…	…	…	…
100 000	20 %	…	…	…	…	…	…
100 000	35 %	…	…	…	…	…	…
100 000	50 %	…	…	…	…	…	…
"…" denotes cells that the manufacturer shall fill with numbers. This information should separately be stating the electricity produced by the CHP generator, if applicable.							

9.1.3 Additional environmental information to be reported

In the EPD, additional environmental information may be provided. It shall be clearly separated from the information obtained from the LCA that is described in Clauses 6, 7 and 8.

NOTE For example, during operation, stationary fuel cell CHP systems produce less noise than heat-related devices based on combustion of fuels. As a result, a manufacturer might want to indicate the noise level during operation of its heat-related device(s) in the EPD.

In the EPD, the manufacturer shall document information on its participation or not in recycling or recovery programmes concerning the heat-related device, provided that details of these programmes are readily available to the purchaser or user and contact information is provided. Information on the proven recyclability of the heat-related device shall be reported in terms of type of material, its total and recyclable amount. The extent to which recycled material is used in the manufacturing of the heat-related device shall be reported in terms of type of material and its total amount.

The EPD shall make a statement that the environmental information provided is limited to the reported impact categories. It cannot be precluded that the system for which the EPD is made has other environmental impacts, including on the living environment (biodiversity).

If provided, the additional environmental information shall:

- be based on information that is substantiated and verified, in accordance with the requirements of ISO 14020 and Clause 5 of ISO 14021:2016,
- be relevant to the particular heat-related device,
- be specific, accurate and not misleading,
- be unlikely to result in misinterpretation, particularly through the omission of certain facts,
- only relate to an environmental aspect that either exists, is likely to be realized during the life cycle of the heat-related device or is related to the life cycle of the heat-related device,
- not make a comparative assertion, but shall be comparable within the product category,
- only state the absence of a substance as "… free" when the level of the specified substance is no more than that which would be found as an acknowledged trace contaminator background level,
- not refer to the absence of substances or features that are not or have never been associated with the product category, and, when using symbols,
- follow the requirements outlined in ISO 14021:2016, 5.8, 5.9 and 5.10.

In order to determine significant environmental aspects to be included as additional environmental information in the EPD, the following items may be taken into consideration:

- the organization's adherence to any environmental management system, with a statement on where an interested party may find details of the system;
- any environmental certification programme applied to the heat-related device and a statement on where an interested party may find details of the certification programme;
- other environmental activities of the organization, such as participation in recycling or recovery programmes, provided details of these programmes are readily available to the purchaser or user and contact information is provided;
- instructions and limits for efficient use of the heat-related device;
- hazard and risk assessment on human health and the environment resulting from the manufacturing, operation or decommissioning of the heat-related device;
- information on absence or level of presence of a material in the product that is considered of environmental significance in certain areas;
- preferred waste management option for used products;
- potential for incidents that can have impact(s) on the environment.

9.1.4 Demonstration of verification

The following information related to verification (Clause 10) shall be clearly provided in the EPD:

a) EPD review, was conducted by:

<name and organization of the chair, and information on how to contact the chair through the programme operator>

b) Date when the verification was conducted:

<date>

c) Independent verification of the declaration and data, according to ISO 14025:2006

– internal:

– external:

d) If applicable, third party verifier:

<name of the third party verifier>