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TECHNICAL SPECIFICATION

Fuel cell technologies –
Part 9-101: Evaluation methodology for the environmental performance of fuel cell power systems based on life cycle thinking – Streamlined life-cycle considered environmental performance characterization of stationary fuel cell combined heat and power systems for residential applications

IEC TS 62282-9-101:2020-10(en)

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Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62282-9-101, which is a Technical Specification, has been prepared by IEC technical committee 105: Fuel cell technologies.

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

Draft TS	Report on voting
105/787/DTS	105/799A/RVDTS

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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- withdrawn,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

This part of IEC 62282 introduces a simplified evaluation method for assessing the life-cycle considered environmental performance of stationary fuel cell power systems for residential applications that can be complemented with a supplementary heat generator or a thermal storage system.

As a response to the aggravation of global environmental issues in recent years, corporate environmental management is increasingly required in order to enhance the environmental performance of products and communicate this information to consumers. For that purpose, when developing new or improved products, manufacturers should pursue environmentally conscious designs and evaluate their efforts by taking a life cycle perspective.

Past life cycle assessment (LCA) studies of stationary fuel cell power systems for residential applications have shown that two environmental aspects are important in their life cycle (so-called hot spots). One is greenhouse gas (GHG) emissions during operation and the other is the consumption of metals, minerals and fossil fuels (so-called abiotic resources) contributing to their depletion during manufacturing and operation.

This document provides guidance on how to perform a targeted life cycle considered evaluation of these predominant environmental impacts, specific to the characteristics of stationary fuel cell power systems for residential applications that can be complemented with a supplementary heat generator or a thermal storage system.

FUEL CELL TECHNOLOGIES –

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1 Scope

This part of IEC 62282 provides a streamlined methodology to assess major environmental impacts of stationary fuel cell power systems for residential applications. The fuel cell power systems can be complemented with a supplementary heat generator and/or a thermal storage system such as a hot water tank. The analysis can include the import of electricity from the grid or the export to the grid. The analysed systems are intended to meet the electricity and heat demand of a given household.

NOTE This document intends to provide a streamlined life-cycle approach. A more comprehensive life cycle assessment (LCA) for environmental product declaration (EPD) is described in IEC TS 62282-9-102[1].

This document provides a set of specific rules, requirements and guidelines based on life cycle thinking for the description of relevant environmental impacts of fuel cell power systems that can be complemented with a supplementary heat generator or a thermal storage system. This document also provides guidance on how to communicate these environmental impacts to consumers.

This document covers the following two environmental aspects:

– greenhouse gas (GHG) emissions in the use stage; and
– utilization of abiotic resources.

This document focuses on residential applications, but can also be used to assess systems in commercial applications such as small retailers or service shops.

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.

IEC 62282-3-201:2017, *Fuel cell technologies – Part 3-201: Stationary fuel cell power systems – Performance test methods for small fuel cell power systems*

IEC 62282-3-400:2016, *Fuel cell technologies – Part 3-400: Stationary fuel cell power systems – Small stationary fuel cell power system with combined heat and power output*

[1] Under preparation. Stage at the time of publication IEC APUB 62282-9-102:2020.

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
life cycle
consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to the final disposal

[SOURCE: ISO 14040:2006, 3.1]

3.2
life cycle assessment
LCA
compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle

[SOURCE: ISO 14040:2006, 3.2]

3.3
life cycle thinking
LCT
consideration of all relevant environmental aspects of a product during its entire life cycle

[SOURCE: IEC 62430:2019, 3.2.3, modified – The second preferred term "life cycle perspective" and the notes to entry have been deleted.]

3.4
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

3.5
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]

3.6
primary data
information determined by direct measurement, estimation or calculation of the foreground system

3.7
secondary data
information obtained from sources other than primary data (3.6)

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 with "information", Note 1 to entry replaced with a new note 1 to entry.]

3.8
global warming potential
measure of the globally-averaged radiative forcing arising from the emissions of a particular greenhouse gas relative to that of CO_2

3.9
abiotic resource depletion
extraction of ores, minerals, stones, rocks or fossil fuels (including peat) from the place of their natural occurrence and subsequent use with the effect that they become scarcer

3.10
fuel cell power system
generator system that uses one or more fuel cell stack(s) to generate electric power and heat

[SOURCE: IEC 60050-485:2020, 485-09-01, modified – "module" replaced with "stack".]

3.11
supplementary heat generator
non-preferential heat source providing peak load

[SOURCE: IEC 62282-3-400:2016, 3.1.22]

3.12
electric efficiency
ratio of the average net electric power output produced by a fuel cell power system to the average fuel power input supplied to the fuel cell power system

Note 1 to entry: The lower heating value (LHV) is assumed unless otherwise stated.

[SOURCE: IEC 60050-485:2020, 485-10-02, modified – "average" added before "net electric power output" and "total enthalpy flow" replaced with "average fuel power input".]

3.13
heat recovery efficiency
ratio of the average recovered thermal power output of a fuel cell power system to the average total power input supplied to the fuel cell power system

[SOURCE: IEC 60050-485:2020, 485-10-04, modified – "recovered heat flow" replaced with "the average recovered thermal power output"; "total enthalpy flow" replaced with "average total power input" and Note 1 to entry deleted.]

3.14
overall energy efficiency
ratio of total usable power output (net electric power and recovered thermal power) to the average total power input supplied to the fuel cell power system

[SOURCE: IEC 60050-485:2020, 485-10-05, modified – second preferred term "total thermal efficiency" deleted; "energy flow" replaced with "power output"; in brackets, "heat flow" replaced with "thermal power"; "total enthalpy flow" replaced with "average total power input" and Note 1 to entry deleted.]

4 Framework for evaluation process

4.1 General

This document evaluates two environmental impacts of fuel cell power systems with or without a supplementary heat generator: global warming and abiotic resource depletion. Global warming due to GHG emissions is assessed for the use stage. The utilization of abiotic resources is assessed for the stages "manufacturing" and "use".

NOTE The reason behind selecting environmental impact categories and life cycle stages is as follows: global warming can be taken as a proxy for environmental performance during the use stage, while abiotic resource depletion is used to characterize the environmental performance regarding raw material acquisition.

4.2 Life cycle stages

The life cycle stages considered in this document are manufacturing (acquisition and utilization of abiotic resources, including for replaced components during the use stage) and use (GHG emissions, and utilization and acquisition of abiotic resources) as shown in solid rectangles in Figure 1.

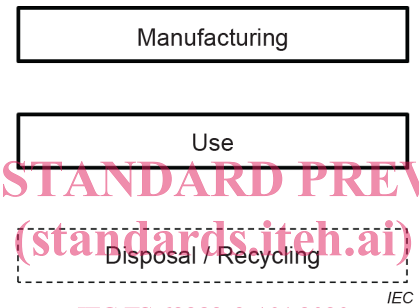

Figure 1 – Life cycle stages (prioritized stages in solid-lined boxes)

NOTE Transportation is not depicted in Figure 1, but can be included in the assessment.

4.3 Functional unit

The functional unit is defined as the satisfaction of the demand of electricity and heat in a typical household for a representative year including seasonal variations.

It shall be documented whether or not the analysed fuel cell power system is complemented with a supplementary heat generator or a thermal storage system.

Ten years of operation shall be evaluated (target duration). The fuel cell power system that can be complemented with a supplementary heat generator or a thermal storage system shall be characterized in such a way that the technical characteristics of the first ten years of its operation (notably efficiency degradation) are taken into account.

The demand shall be specific to the geographic region where the fuel cell power systems are operated. The systems that can be complemented with a supplementary heat generator or a thermal storage system are operated. Typical demands are shown in Annex A.

Any replacement of components, which are expected during the 10-year operation period, such as fuel cell stacks or fuel processing systems, shall be taken into account. Such replacements are considered as part of manufacturing as the primary concern of components resides in their production.

If the component(s) (e.g. parts of the fuel cell power system, supplementary heat generator or thermal storage system, if applicable) operates for longer than ten years, the elementary flows and related environmental impacts that these component(s) represent shall be spread equally over their lifetime. Only the first ten years shall be taken into account.