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TECHNICAL REPORT

colour inside

Analysis of quantification methodologies for greenhouse gas emissions for electrical and electronic products and systems

IEC/TR 62725:2013(E)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ANALYSIS OF QUANTIFICATION METHODOLOGIES FOR GREENHOUSE GAS EMISSIONS FOR ELECTRICAL AND ELECTRONIC PRODUCTS AND SYSTEMS

FOREWORD

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IEC/TR 62725, which is a technical report, has been prepared by IEC technical committee 111: Environmental standardization for electrical and electronic products and systems.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
111/266/DTR	111/291/RVC

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

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

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

Electrical and electronic products and systems (hereinafter referred to as “EE products”) are widely used in our society, hence raising awareness of their environmental impacts. Consequently customers in the market and other stakeholders are requiring or requesting that the electronics sector take actions to address the quantification and reduction of environmental impacts through environmental conscious design during the product development phase.

Among those environmental impacts, climate change is an important issue. A number of initiatives at local, national, regional, and international levels are being developed and implemented, aiming to curb the concentration of greenhouse gas (GHG) emissions which is understood to be a major contributing factor.

A basic and generic methodology to quantify Carbon Footprint of Products (hereinafter referenced as “CFP”) is under development in ISO 14067. It specifies principles and requirements for studies to quantify CFP, based on the methodology of life cycle assessment (LCA) specified in ISO 14040 and ISO 14044. In addition, major standardisation activities, and private, government and industry driven initiatives have started work on establishing methodologies for CFP, quantifying GHG emissions and related issues.

This plurality of initiatives highlights the necessity of developing guidance, which facilitates the understanding of existing methodologies and suggests workable and implementable options that address the specific characteristics of EE products, for example;

- Supply chains can be dynamic, long, complicated and global. Some product categories are associated with significant impacts from raw material acquisition, production stage, or end-of-life. Reasonable and consistent methodologies are needed to be shared with all the relevant actors along the global supply chain.
- Many products have relatively long lives, extending over many years, with associated energy consumption, which underlines the significance of the use stage. For such product categories, specific attention is paid to energy efficiency. It should be noted that the assumptions behind use scenarios are critical to achieve consistency.
- In addition to associated CO_2 emissions, some products use substances that have the potential for additional GHG emissions (e.g. SF_6 used in switchgear).

These characteristics support the market relevance for providing generic guidance in the form of this Technical Report (hereinafter referred to as TR) for the quantification, documentation and communication of GHG along the life cycle of EE products.

The contents and features of this TR are as follows:

- A study and review of relevant standards, regional initiatives and practices are provided to clarify and compare the differences and similarities in multiple existing methodologies for CFP studies.
- This Technical Report, based on relevant International Standards, Draft International Standards, especially ISO/DIS 14067, and other standards, gives a comprehensive additional guidance which enable readers to carry out CFP study for EE products.

It should be also emphasized that CFP addresses the single impact category of climate change and does not assess other potential social, economic or environmental impacts. Therefore CFPs do not provide an indicator of the overall environmental impact of products.

The information in this TR is entirely informative in nature and does not establish nor is it intended to imply any normative requirements.

NOTE 1 This TR may be used as quantification guidance for GHG emissions as a part of the environmental impact categories in a multi-criteria environmental assessment.

NOTE 2 This TR is not directly intended for electrical and electronic equipment (EEE) as defined by EU regulation therefore this TR uses the term "electrical & electronic products (EE products)."

ANALYSIS OF QUANTIFICATION METHODOLOGIES FOR GREENHOUSE GAS EMISSIONS FOR ELECTRICAL AND ELECTRONIC PRODUCTS AND SYSTEMS

1 Scope

This Technical Report is intended to provide users with guidance to understand methodologies and to evaluate carbon footprint of products (hereinafter referred to as CFP), by quantifying the greenhouse gases (GHG) emissions (hereinafter referred to as CFP study) for Electrical and Electronic products (hereinafter referred to as EE products) based on life-cycle thinking.

This TR is applicable to any type of EE products, which are new or modified (e.g. reconditioned, upgraded, etc.).

This TR is based on the result of a comparative study on existing methodologies published or under discussion in representative international organizations.

This TR is intended to be used by those involved in design and development of EE products, and their supply chains regardless of industry sectors, regions, types, activities and sizes of organizations. This TR may also be used as guidance to prepare a PCR of each product category in EE sector.

NOTE 1 In this TR, ISO/DIS 14067, ITU-T L.1400 and L.1410, GHG Protocol Product Life Cycle Accounting and Reporting Standard (hereinafter referred to as GHG Protocol Product Standard), BSI PAS 2050, and other international, regional and national initiatives are studied and compared since these documents and initiatives are regarded as the most influential ones worldwide at the moment.

NOTE 2 This TR refers to requirements relevant to EE products in the existing documents and quotes them with boxes. The boxes are followed by guidance applicable to EE products. The documents which this TR refers to (e.g. ISO/DIS 14067) may be revised in the future. These boxes do not capture the full text of the standards referred to and readers are encouraged to read these standards for thorough understanding of their requirements.

NOTE 3 This TR is programme-neutral. If a programme (e.g. a specific Carbon Footprint of Products (CFP) Initiative) is applicable, some requirements of that programme may be additional to the guidance provided in this TR.

2 Normative reference

There are no normative references. Informative references are noted in the bibliography.

NOTE This clause is included so as to respect IEC clause numbering.

3 Terms and definitions

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

3.1
allocation
partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems

[SOURCE: ISO 14040:2006, 3.17]

3.2
attributional approach
an approach to LCA where GHG emissions and removals are attributed to the unit of analysis of the studied product by linking together attributable processes along its life cycle

[SOURCE: GHG Protocol Product Life Cycle Accounting & Reporting Standard: 2011]

3.3
biogenic carbon
carbon derived from biomass

[SOURCE: ISO/DIS 14067:–, 3.8.2]

3.4
carbon dioxide equivalent
CO2 equivalent, CO2e
unit for comparing the radiative forcing of a greenhouse gas to that of carbon dioxide

Note 1 to entry: The carbon dioxide equivalent is calculated by multiplying the mass of a given greenhouse gas by its global warming potential.

[SOURCE: ISO 14064-1:2006, 2.19]

3.5
carbon footprint of a product-product category rules
CFP-PCR
set of specific rules, requirements and guidelines for quantification and communication on the CFP for one or more product categories

[SOURCE: ISO/DIS 14067:–, 3.4.12]

3.6
consequential approach
an approach to LCA where processes are included in the life cycle boundary to the extent that they are expected to change as a consequence of a change in demand for the unit of analysis.

[SOURCE: GHG Protocol Product Life Cycle Accounting & Reporting Standard: 2011]

3.7
functional unit
quantified performance of a product system for use as a reference unit

Note 1 to entry: As the CFP treats information on a product, the functional unit can be a product unit, sales unit or service unit.

[SOURCE: ISO/DIS 14067:–, 3.4.7]

3.8
global warming potential
GWP
characterization factor (ISO 14050:2009, 7.2.2.2) describing the mass of carbon dioxide that has the same accumulated radiative forcing over a given period of time as one mass unit of a given greenhouse gas

[SOURCE: ISO/DIS 14067:–, 3.3.4]

3.9
greenhouse gas
GHG
gaseous constituent of the atmosphere, both natural and anthropogenic, that absorbs and emits radiation at specific wavelengths within the spectrum of infrared radiation emitted by the earth's surface, the atmosphere, and clouds

Note 1 to entry: Greenhouse gases include, among others, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

[SOURCE: ISO 14064-1:2006, 2.1]

3.10
greenhouse gas emission
GHG emission
total mass of a greenhouse gas released to the atmosphere over a specified period of time

[SOURCE: ISO 14064-1:2006, 2.5]

3.11
greenhouse gas removal
GHG removal
total mass of a greenhouse gas removed from the atmosphere over a specified period of time

[SOURCE: ISO 14064-1:2006, 2.6]

3.12
intermediate product
output from a unit process that is input to other unit processes that require further transformation within the system

[SOURCE: ISO 14044:2006, 3.23]

3.13
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]

3.14
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]

3.15
life cycle stage
element of a life cycle

Note 1 to entry: The phrase 'life cycle phase' is sometimes used interchangeably with 'life cycle stage'.

Note 2 to entry: Examples of life cycle stages are: Raw material acquisition and production; manufacturing; packaging and distribution; installation and use, maintenance and upgrading; and end of life.

[SOURCE: IEC 62430:2009, 3.10]

3.16
life cycle thinking
LCT
consideration of all relevant environmental aspects during the entire life cycle of products

[SOURCE: IEC 62430:2009, 3.11]

3.17
organization
group of people and facilities with an arrangement of responsibilities, authorities and relationships

[SOURCE: ISO 9000:2006, 3.3.1]

3.18
primary data
data collected from specific processes in the studied product's life cycle

[SOURCE: GHG Protocol Product Life Cycle Accounting & Reporting Standard: 2011]

3.19
process
set of interrelated or interacting activities which transform inputs into outputs

Note 1 to entry: Inputs to a process are generally outputs of other processes.

Note 2 to entry: Processes in an organization are generally planned and carried out under controlled conditions to add value.

[SOURCE: ISO 9000:2006, 3.4.1]

3.20
product
any goods or service

Note 1 to entry: This includes interconnected and / or interrelated goods or services.

[SOURCE: IEC 62430:2009, 3.14]

3.21
product category
group of technologically or functionally similar products where the environmental aspects can reasonably be expected to be similar

[SOURCE: IEC 62430:2009, 3.15]

3.22
product category rules
PCR
set of specific rules, requirements and guidelines for developing Type III environmental declarations (ISO 14050:2009, 8.5) for one or more product categories

Note 1 to entry: PCR include quantification rules compliant with ISO 14044.

[SOURCE: ISO/DIS 14067:–, 3.4.11]

3.23
product system
collection of unit processes with elementary and product flows, performing one or more defined functions and which models the life cycle of a product

[SOURCE: ISO 14044:2006, 3.28]

3.24
reference flow
measure of the outputs from processes in a given product system required to fulfil the function expressed by the functional unit

Note 1 to entry: GHG Protocol Product Standard uses the term in a slightly different way: “The reference flow is the amount of studied product needed to fulfil the function defined in the unit of analysis.” However, GHG Protocol regards that these are meant to be the same.

[SOURCE: ISO 14040:2006, 3.29]

3.25
secondary data
process data that are not from specific processes in the studied product’s life cycle.

[SOURCE: GHG Protocol Product Life Cycle Accounting & Reporting Standard: 2011]

3.26
uncertainty
parameter associated with the result of quantification which characterizes the dispersion of the values that could be reasonably attributed to the quantified amount

Note 1 to entry: Uncertainty information typically specifies quantitative estimates of the likely dispersion of values and a qualitative description of the likely causes of the dispersion.

[SOURCE: ISO 14064-1:2006, 2.37]

3.27
verification
systematic, independent and documented process for the assessment of a greenhouse gas assertion against agreed validation criteria.

[SOURCE: ISO 14064-1:2006, 2.35]

4 Principles

4.1 General

The following principles should be applied in the quantification, documentation and reporting of product GHG emissions of EE product’s under assessment.

4.2 Life Cycle Thinking (LCT)

In the development of methodology to quantify the GHG emissions throughout EE product’s life cycle, take all stages of the life cycle of a product into consideration.

4.3 Relevance

Select and use data, methods, criteria and assumptions that are appropriate to the assessment of GHG emissions and removals from the goal and scope definition being studied.

4.4 Completeness

Include all GHG emissions and removals that provide a significant contribution to the assessment of GHG emissions and removals arising from the goal and scope definition being studied.

4.5 Consistency

Apply assumptions, methods and data in the same way throughout the GHG emissions for EE product's life cycle to arrive at conclusions in accordance with the goal and scope definition.

4.6 Accuracy

Reduce bias and uncertainties as far as is practical.

4.7 Transparency

Address and document all relevant issues in an open, comprehensive and understandable presentation of information. Fully disclose any relevant assumptions and limitations and make appropriate references to the methodologies and data sources used. Clearly explain any estimates and avoid bias so that the GHG emissions throughout EE product's life cycle study report faithfully represent what it purports to represent.

NOTE The above principles (4.3 to 4.7) are adapted from ISO 14064-1:2006, Clause 3 with modification.

5 Comparative study on the existing relevant documents

Annex B summarizes the results of a comparative study on existing relevant documents including International Standards and regional and national initiatives which specify the methodology of CFP study and LCA, and which are referred to widely around the world.

A basic and generic methodology relevant to a CFP study is under development in ISO/DIS 14067. It specifies principles and requirements for studies to quantify Carbon Footprint of Products and GHG emissions assessments respectively, based on the methodology of life cycle assessment (LCA) as specified in ISO 14040 and ISO 14044. ISO/DIS 14067 also sets rules related to use of CFP study for different purposes and related communication.

GHG Protocol Product Life Cycle Accounting & Reporting Standard (hereinafter GHG Protocol Product Standard), which is a forum/industry standard, was developed in parallel with the GHG Protocol Corporate Value Chain (Scope 3) Accounting & Reporting Standard (hereinafter GHG Protocol Scope 3 Standard). The GHG Protocol Scope 3 Standard is written as a supplement to GHG Protocol Corporate Accounting & Reporting Standard. It accounts for value chain emissions at the corporate level, whereas the GHG Protocol Product Standard accounts for life cycle GHG emissions at the individual product level. The CFP study specified in the GHG Protocol Product Standard is for the most part based on the life cycle assessment methods specified in ISO 14044 and the communication requirements specified in the ISO 14020 series of standards.

Methodologies for environmental impact assessment specific to ICT sector are developed by ITU-T. Among them is ITU-T L.1410 which specifies methodologies for ICT goods, networks and services (GNS) and provides practical guidance for a CFP study in the sector. ITU-T L.1410 is composed of a framework and guidance for life cycle assessment based on the methodology specified in ISO 14040 and ISO 14044. It is organized in two parts, part 1 deals with the LCA methodology applied to ICT GNS and part 2 deals with comparative analysis based on LCA results of an ICT GNS product system and a referenced product system.

Annex B of this TR also presents compiled summaries of regional standards/initiatives such as EC Product Environmental Footprint and ETSI EE TS 103 199, national ones such as

PAS 2050 (UK), TS-Q 0010 (Japan) and Korean CFP guidance, etc., in addition to the standards and draft standards discussed above.

All the existing relevant documents and initiatives adopt a life cycle approach for calculating GHG emissions. Most of them base their calculation methodologies on ISO 14040 and ISO 14044, including ISO/DIS 14067 which was described above. ISO 14040 and ISO 14044 allow for LCA studies of GHG emissions and practitioners are encouraged to carefully consider the representativeness of results in the interpretation phase.

In a CFP study of a product, treatment of the comparative analysis between products needs attention. ISO 14040 and ISO 14044 are stringent regarding product comparisons. In contrast, CFP related assessments of GHG emissions according to ISO/DIS 14067 are often expected to deliver single values to be used as a basis for product comparisons. However, such values are only representative of the preconditions of the study and will provide limited information about the actual GHG emissions due to the complexities of many EE products, their value chains and uses. ISO/DIS 14067 acknowledges the need for CFP-PCRs to achieve comparability. This Technical Report can therefore not be used as a sole basis for product comparisons as comparable conditions could not be defined at a sector level with sufficient level of details.

6 Quantification framework

6.1 General

6.1.1 Provisions in CFP and LCA standards

CFP and LCA standards provide the following requirements regarding a CFP study:

A CFP study according to this International Standard shall include the four phases of LCA, i.e. goal and scope definition, LCI, LCIA and life cycle interpretation.

[Source: ISO/DIS 14067, 6.1]

The necessity of a sector specific approach applicable to EE products is recognized by considering the specific characteristics of EE products which could include a large quantity of components/materials in a product, dynamic, long and complicated supply chains, rapidly evolving technology, the complexity of production processes and use/end-of-life scenarios, etc., which can lead to considerable challenges in performing CFP.

The CFP consists of the GHG emissions and removals in the life cycle of a product (i.e. product system). The unit processes comprising the product system are grouped into life cycle stages; e.g., raw material acquisition, production, distribution, use and end-of-life. Accordingly the data of GHG emission and removals collected over the product's life cycle are assigned to the life cycle stages. Partial CFP studies that account for only specific life cycle stages can be combined to form the full CFP covering the entire life cycle provided that they are performed according to the same methodology, and the time frame for relevant activities is viewed as equivalent.

To set specific GHGs to be calculated, this TR recommends considering relevance and international framework/studies. For example, 6 gases are recognized in the international framework (Kyoto Protocol): CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. For gases other than CO_2, the CO_2 equivalent (CO_2e) is obtained by multiplying each GHG emissions by the GWP of those gases.

In a CFP study, Life Cycle Inventory (LCI) is calculated through the specific processes outlined in this document.