

TECHNICAL REPORT



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



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2013 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,...).

It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available on-line and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

TECHNICAL REPORT



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

XB

ICS 13.020.30; 19.040

ISBN 978-2-83220-690-4

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative reference	7
3 Terms and definitions	7
4 Principles	11
4.1 General.....	11
4.2 Life Cycle Thinking (LCT)	11
4.3 Relevance	11
4.4 Completeness	12
4.5 Consistency	12
4.6 Accuracy	12
4.7 Transparency	12
5 Comparative study on the existing relevant documents.....	12
6 Quantification framework	13
6.1 General.....	13
6.1.1 Provisions in CFP and LCA standards	13
6.1.2 Electrotechnical industry guidance for basic steps of CFP study	14
6.2 Goal and scope definition	15
6.2.1 Provisions in CFP and LCA standards	15
6.2.2 Electrotechnical industry guidance.....	15
6.3 Unit of analysis.....	16
6.3.1 Provisions in CFP and LCA standards	16
6.3.2 Electrotechnical industry guidance.....	17
6.4 System boundary	18
6.4.1 General	18
6.4.2 Life cycle stage and process map.....	20
6.4.3 Attributional and consequential approaches.....	25
6.4.4 Time boundary	26
6.4.5 Specific GHG sources and sinks.....	27
6.4.6 Cut-off criteria	28
6.5 Trial estimation and decision on boundary to be cut-off	30
6.5.1 Electrotechnical industry guidance.....	30
6.6 Data collection and quality assessment	31
6.6.1 General	31
6.6.2 Primary data.....	34
6.6.3 Secondary data	34
6.6.4 Data quality	35
6.7 Calculating GHG emissions	36
6.7.1 General	36
6.7.2 Allocation	38
6.8 Uncertainty.....	39
6.8.1 Provisions in CFP and LCA standards	39
6.8.2 Electrotechnical industry guidance.....	40
6.9 Use and maintenance scenario.....	41
6.9.1 Provisions in CFP and LCA standards	41

6.9.2	Electrotechnical industry guidance.....	42
6.10	End-of-life stage scenario.....	42
6.10.1	Provisions in CFP and LCA standards	42
6.10.2	Electrotechnical industry guidance.....	43
7	CFP-PCR	45
7.1	Provisions in CFP standards	45
7.2	Electrotechnical industry guidance	46
8	Documentation	46
8.1	Provisions in CFP and LCA standards	46
8.2	Electrotechnical industry guidance	47
9	Communication and verification	48
9.1	General.....	48
9.1.1	Provisions in CFP and LCA standards	48
9.1.2	Electrotechnical industry guidance.....	49
9.2	Options of communication	50
9.2.1	Provisions in CFP and LCA standards	50
9.2.2	Electrotechnical industry guidance.....	50
9.3	Verification and assurance	51
9.3.1	Provisions in CFP and LCA standards	51
9.3.2	Electrotechnical industry guidance.....	52
Annex A (informative)	Example of existing databases which can be used for quantification as secondary data.....	54
Annex B (informative)	Study results of comparison analysis on selected existing relevant documents including International Standards and regional and national initiatives	57
Annex C (informative)	Examples of PCRs/Sector specific rules.....	65
Annex D (informative)	Additional information on trial estimation approach and uncertainty.....	73
Bibliography	75
Figure 1	– Basic steps of CFP study related to LCA framework.....	15
Figure 2	– Analysis of relationship of three types of data according to ISO/DIS 14067	33
Table 1	– An example of BOM	25
Table 2	– Example of applicable data types	37
Table 3	– Example of applicable emission factors for each life cycle stage/unit processes	37

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

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
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 CO₂ emissions, some products use substances that have the potential for additional GHG emissions (e.g. SF₆ 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]