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Environmental Engineering (EE) - Methodology for environmental Life Cycle Assessment (LCA) of Information and Communication Technology (ICT) goods, networks and services

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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Environmental Engineering (EE).

The present document was developed jointly by ETSI TC EE and ITU-T Study Group 5. It will be published respectively by ITU and ETSI as Recommendation ITU-T L.1410 [i.28] and ETSI Standard ETSI ES 203 199 (the present document), which are technically-equivalent.

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Introduction

The present document has been developed to complement ISO 14040 [1] and ISO 14044 [2] for the environmental assessment of the life cycle impact of ICT goods, networks and services.

The present document defines a set of requirements to reflect the quality that LCA practitioners should strive for. At this stage some of the requirements put forward here are considered as challenging due to Life Cycle Assessment (LCA) tool limitations, a lack of data, limitations in data granularity, etc. It is thus recognized that compliance to all requirements in the present document may not be possible at the time the present document is published. However, to foster results of LCAs becoming more transparent and, for the quality of data and LCA tools to improve over time, the present document is defining the requirements outlined in the following pages. The present document requires that deviation(s) from the requirements are clearly motivated and reported. For further details regarding compliance refer to clause 5.2.

The development of Information and Communication Technologies (ICTs) has led to concerns regarding its environmental impact. Taking into consideration the ongoing efforts within the United Nations Framework Convention on Climate Change [b-UNFCCC] to combat climate change, ITU-T and ETSI decided to enhance their previous work by jointly developing an internationally agreed methodology to help the ICT sector to assess the environmental impact of ICT goods, networks and services. The present document also gives guidance to the assessment of software.

Unlike many products and services sold in the world today, ICT distinguishes itself by its double-edged nature. On the one hand, ICTs have an environmental impact at each stage of its life cycle, e.g. from energy and natural resource consumption to e-waste. On the other hand, ICTs can enable vast efficiencies in lifestyle and in all sectors of the economy by the provision of digital solutions that can improve energy efficiency, inventory management and business efficiency by reducing travel and transportation, e.g. tele-working and video conferencing and by substituting physical products for digital information, e.g. e-commerce.

These different levels of impact are acknowledged in some academic literature as the three order effects of ICTs:

- First order effects (or the environmental load of ICTs): the impacts created by the physical existence of ICTs and the processes involved, e.g. energy consumption and GHG emissions, e-waste, use of hazardous substances and use of scarce, non-renewable resources.
- Second order effects (or the environmental load reduction achieved by ICTs): the impacts and opportunities created by the use and application of ICTs. This includes environmental load reduction effects which can be either actual or potential, such as travel substitution, transportation optimization, working environment changes, use of environmental control systems, use of e-business, e-government, etc.

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Higher order effects:

- particularly include, for some ICT services such as tele-working or video conferencing, the time gained by an end user using an ICT service which then may cause additional impact e.g. a leisurely drive and economic activities, which are difficult to track. Such additional impacts are often defined as "rebound effects".

Most of the benefits of ICTs lie in the second order effects via increased efficiency, transparency, speed of transactions, rapid market-clearing, long-tail effects and so on. There are environmental impacts associated with the first order: environmental impact of ICT goods, networks and services such as resource consumption and carbon emissions during manufacturing and the disposal of hardware. Thus, the present document focuses on the first and second order effects.

Recommendation ITU-T L.1480 [i.25] provides further guidance on the second order effects and higher order effects as well as the impacts and opportunities created by the aggregated effects on societal structural changes by using ICTs.

In constructing a sustainable society from an environmental viewpoint, the negative aspects of ICTs should be minimized and the positive ones should be maximized, as summarized in Figure 1.

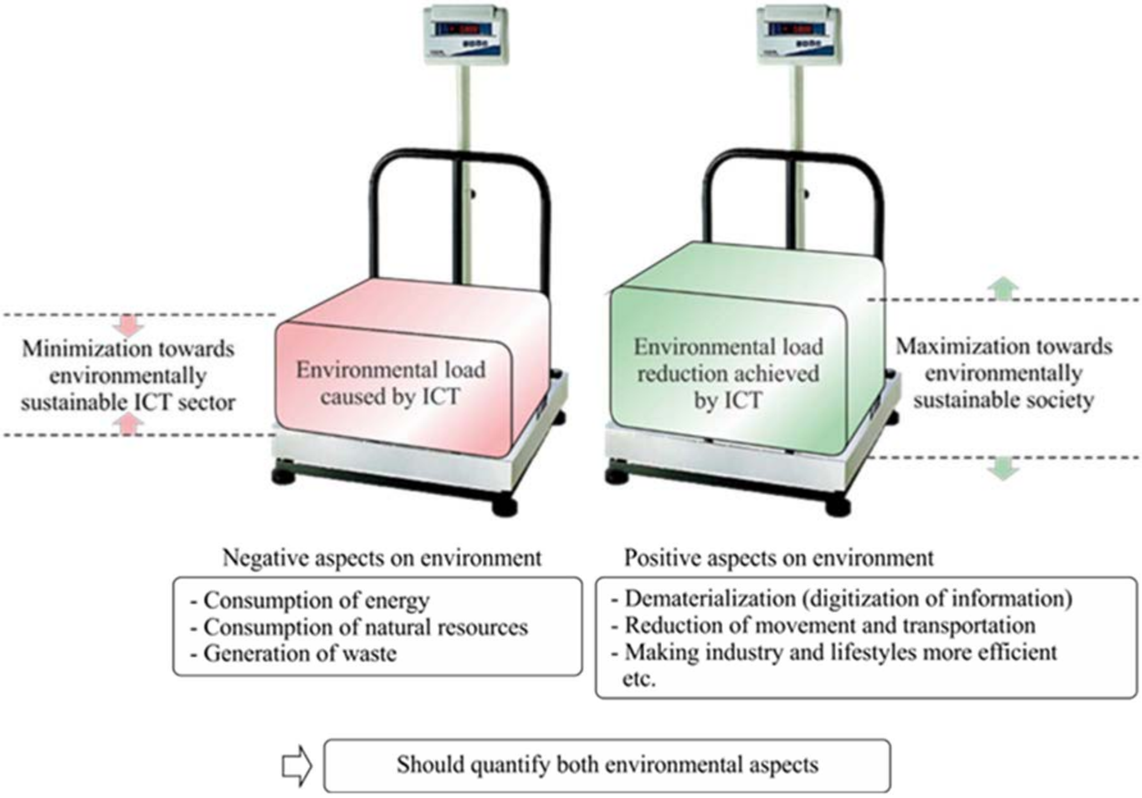
Minimization towards environmentally sustainable ICT sector
Environmental load caused by ICT
Environmental load reduction achieved by ICT
Maximization towards environmentally sustainable society
Negative aspects on environment
- Consumption of energy
- Consumption of natural resources
- Generation of waste
Positive aspects on environment
- Dematerialization (digitization of information)
- Reduction of movement and transportation
- Making industry and lifestyles more efficient
etc.
Should quantify both environmental aspects

Figure 1: Schematic model for the environmental assessment of ICT goods, networks and services

The first order effect (or environmental load caused by ICT) can be quantified by performing a Life Cycle Assessment (LCA). The second order effect (or environmental load reduction achieved by ICT) can be quantified by the comparison of LCA results between the ICT goods, networks and services product system and the reference product system performing the same function.

To reflect the first two order effects, the present document describes environmental assessments through Life Cycle Assessment (LCA) which is a systematic analytical method and model by which the potential environmental effects related to ICT goods, Networks and Services can be estimated. The present document also gives guidance to the assessment of software. LCAs have a cradle-to-grave scope where the life cycle stages, i.e. *raw material acquisition*, *production*, *use* and *end-of-life* are included. Transports and energy supply are moreover included in each life-cycle stage.

ISO has standardized the LCA methodology. In the present document, ICT specific additions to the ISO 14040 [1] and ISO 14044 [2] standards will be described. As addition to the ISO 14040 [1] and ISO 14044 [2] standards, the European Commission has published a handbook that gives detailed guidance on all the steps required to conduct an LCA [i.16]. This handbook will also be referred to with special ICT considerations in mind.

The present document is divided into two parts:

- Part I (clauses 5 to 10) - ICT life cycle assessment: framework and guidance. This part deals with the LCA methodology applied to ICT goods, networks and services.
- Part II (clauses 11 to 14) - Comparative analysis between an ICT product system and a reference product system (baseline scenario): framework and guidance. This part deals with comparative analysis based on LCA results of the ICT goods, networks and services product system and the reference product system.

The structure of this LCA methodology specification for ICT goods, Networks and Services is shown in Figure 2. Figure 2 indicates where specific requirements and considerations apply for ICT goods, networks and services respectively and where the same requirements and considerations apply for all of those product systems.

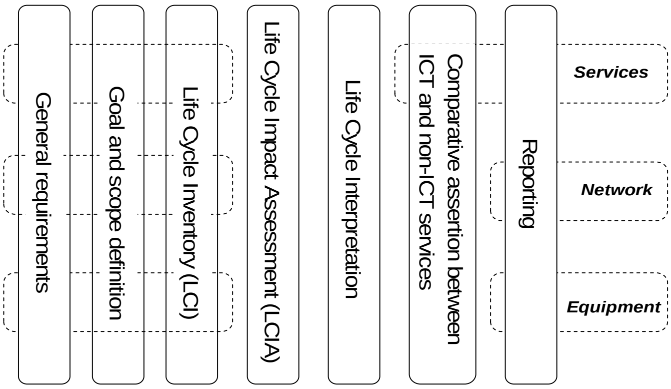
General requirements
Goal and scope definition
Life Cycle Inventory (LCI)
Life Cycle Impact Assessment (LCIA)
Life Cycle Interpretation
Comparative assertion between ICT and non-ICT services
Reporting
Services
Network
Equipment

Figure 2: Structure of LCA methodology specification for ICT goods, Networks and Services

The structure of part I and part II is based on ISO 14040 [1] and ISO 14044 [2] in order to support the LCA practitioner and thus each part is structured in accordance with:

- General requirements: high level requirements of assessment.
- Goal and scope definition: requirements of the functional unit, system boundaries and data quality.
- Life Cycle Inventory (LCI): requirements for data collection, calculation and allocation.
- Life Cycle Impact Assessment (LCIA): requirements for impact assessment.
- Life cycle interpretation: requirements for the interpretation of results and calculation of second order effects.
- Reporting: requirements for reporting.

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Both parts are then divided into applicable clauses and Part I is additionally structured into the three product system types, i.e. ICT goods, networks and services as appropriate.

The present document is intended for LCA practitioners wanting to assess ICT goods, networks and services impacts and it will help them to perform and report their LCAs of *ICT goods*, *Networks* and *Services* in a uniform and transparent manner. It is possible to use the present document to get guidance on what to consider in an LCA on three levels: ICT goods, Networks and Services.

The following uses of ICT LCA applications are the most frequently used ones, but others may be identified and used as well:

- Evaluation of product system environmental impact, such as climate change.
- Assessment of primary energy consumption.
- Identification of life cycle stages and activities with high significance.
- Comparisons of specific ICT goods, Networks, or Services under the conditions described in clause 5.3 (Comparisons of results).
- Comparative analysis between an ICT product system and reference product system.

NOTE: The LCA practitioner is advised to check ITU-T Recommendations giving guidance on simplified LCA methods, when relevant.

1 Scope

The present document aims to provide a methodology for evaluating the environmental impact of ICTs objectively and transparently and is based upon the Life Cycle Assessment (LCA) methodology standardized in ISO 14040 [1] and ISO 14044 [2].

The present document can be read by anyone aiming for a better understanding of the specific conditions and requirements applicable to the LCA of ICT goods, networks and services. However, the present document is especially intended for LCA practitioners with a prior knowledge of LCA standards, i.e. ISO 14040 [1] and ISO 14044 [2].

The purpose of the present document is to:

- provide ICT-specific requirements, in addition to those of ISO 14040 [1] and ISO 14044 [2], to ensure a sufficient quality of LCA studies of ICT goods, networks and services; increase the quality of the LCA by adding ICT specific requirements to those of ISO 14040 [1] and ISO 14044 [2];
- harmonize the LCAs of ICT goods, Networks and Services;
- increase the credibility of LCAs of ICT goods, networks and services;
- increase the transparency and facilitate the interpretation of LCA studies of ICT goods, networks and services;
- facilitate the communication of LCA studies of ICT goods, networks and services; and
- provide a methodology for telecommunication operators and service providers to assess the environmental load of one or more Services carried by their ICT Networks.

While recognizing ISO 14040 [1] and ISO 14044 [2], including Annex A of ISO 14040 [1] "Application of LCA", as normative references, the present document will give generic and specific requirements for the LCA of ICT goods, networks and services. The present document is valid for all types of ICT goods including end-user goods and also for ICT networks and services. The present document also gives guidance to the assessment of software. LCA practitioners are encouraged to also consider other environmental aspects in accordance with ISO 14040 [1] and ISO 14044 [2].

The present document defines a set of requirements which reflect the quality that LCA practitioners should strive for. At this stage some of the requirements put forward here are considered as challenging due to LCA tool limitations, a lack of data, limitations in data granularity, etc. It is thus recognized that compliance to all requirements in the present document may not be possible at the time the present document is published. However, to foster results of LCAs becoming more transparent and, for the quality of data and LCA tools to improve over time, the present document defines the requirements outlined in the following pages. The present document requires that deviation(s) from the requirements are clearly motivated and reported. For further details regarding compliance refer to clause 5.2.

Comparisons of results from environmental assessments of ICT goods, networks and services, assessments which have been performed by different organizations are beyond the scope of the present document, as such comparisons would require that the assumptions and context of each study are exactly equivalent.

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[1] ISO 14040:2006: "Environmental management -- Life cycle assessment -- Principles and framework".

[2] ISO 14044:2006: "Environmental management -- Life cycle assessment -- Requirements and guidelines".

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

iTeh Standards (https://standards.iteh.ai) Document Preview SIST ES 203 199 V1.4.1:2025

[i.1] ETSI TS 102 706 (V1.3.1): "Environmental Engineering (EE); Measurement method for energy efficiency of wireless access network equipment".

[i.2] Void.

[i.3] European Commission - Joint Research Centre - Institute for Environment and Sustainability JRC48211: "International Reference Life Cycle Data System (ILCD) Handbook - Framework and Requirements for Life Cycle Impact Assessment Models and Indicators". First edition March 2010. EUR 24586 EN. Luxembourg. Publications Office of the European Union; 2010.

[i.4] ETSI ES 202 336-1: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks) Part 1: Generic Interface".

[i.5] Recommendation ITU-T L.1310 (09/2020): "Energy efficiency metrics and measurement methods for telecommunication equipment".

[i.6] EUR 24708 EN (2010): "International Reference Life Cycle Data (ILCD) System Handbook: General guide for Life Cycle Assessment - Detailed guidance, 1st edition., European Commission Joint Research Centre".

[i.7] European Commission - Joint Research Centre EUR 25167 [b-EUR 25167 EN]: "Characterisation factors of the ILCD Recommended Life Cycle Impact Assessment methods" EN - 2012 (20/02/2013 updated).

[i.8] Green House Gas Protocol Corporate Standard, 2006.