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Environmental ~~Management~~ management — Environmental ~~Techno~~techno-economic ~~Assessments –~~assessments — Principles, ~~Requirements,~~requirements and ~~Guidelines~~guidance

~~Draft CD~~

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Foreword

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This document was prepared by Technical Committee ISO/TC 207, *Environmental* ~~Management~~*management*, Subcommittee SC 5, *Life* ~~Cycle Assessment.~~*cycle assessment*

~~A list of all parts in the ISO 14000 series can be found on the ISO website~~.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

During the process of researching, designing, developing~~,~~ and commercializing process systems, many decisions ~~need to~~must be made concerning details such as the selection of unit operations, equipment types and sizes, operating conditions and procedures, mass and energy flows, financing contracts, sales prices~~,~~ and environmental releases. These decisions are made based on many indicators, especially technical indicators (~~such as~~e.g. product yield, process efficiency, ~~and~~ quality), economic indicators (~~such as~~e.g. cost, profitability, ~~and~~ returns on investment) and environmental indicators (~~such as~~e.g. greenhouse gas (GHG) emissions, resource depletion,~~ or~~ freshwater consumption). These ultimately affect the total value of the process system to companies, clients, consumers, government~~,~~ and society.

An environmental techno-economic assessment ~~is a method for characterizing~~(eTEA) characterizes process systems in terms of key environmental, technical (“techno~~”);~~”) and economic factors. These characteristics are represented by a collection of commonly understood metrics that can then be interpreted for decision-making purposes. Many assumptions ~~need to~~must be made as a part of an ~~environmental techno-economic assessment which~~eTEA can have a major impact on the results, with financial and environmental consequences throughout the life cycle of the process and its products. These assumptions can include the values of key parameters, analysis boundaries~~,~~ and the methods themselves. Because of its importance and the wide variability in methods for ~~environmental techno-economic assessments~~eTEAs, there is a need for practical guidance on their performance. Organizations can benefit significantly by providing clear and consistent guidance on how to conduct an ~~environmental techno-economic assessment~~eTEA.

Therefore, ~~the objectives of~~ this ~~technical specification are to~~document:

— ~~Establish~~establishes terminology and key definitions of common metrics used in ~~environmental techno-economic assessments~~eTEAs;

— ~~Provide guidance and~~ provides requirements and guidance on how to conduct ~~environmental techno-economic assessments~~eTEAs;

— ~~Provide~~provides a framework for clearly documenting the results and the underlying assumptions used in an ~~environmental techno-economic assessment~~eTEA so that others can effectively interpret the results.

This document is intended for eTEA practitioners~~. eTEA practitioners are~~(i.e. people who conduct eTEAs, such as data gathering, making calculations~~,~~ or assessing and interpreting the results~~.)~~. Practitioners can include industry, government~~,~~ or academia.

An illustrative example of an eTEA is given in Annex A.

Environmental ~~Management~~ management — Environmental ~~Techno~~techno-economic ~~Assessment~~assessments — Principles, ~~Requirements,~~requirements and ~~Guidelines~~ guidance

1 Scope

This document provides principles, requirements~~,~~ and ~~guidelines~~guidance for performing an environmental techno-economic assessment (eTEA). eTEAs provide economic analyses combined with an assessment of environmental impacts.

This document specifies ~~the~~ requirements for documenting the results, underlying assumptions, parameters~~,~~ and methodologies used in an ~~environmental techno-economic assessment.~~ eTEA.

This document ~~applies~~is applicable to process systems of any size or production scale.

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 14040:2006, *Environmental management — Life cycle assessment — Principles and framework*

ISO 14044:2006, *Environmental management — Life cycle assessment — Requirements and guidelines*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp~~3.1~~

— IEC Electropedia: available at https://www.electropedia.org/

3.1
environmental techno-economic assessment
eTEA
eco-technoeconomic analysis
compilation and evaluation of technological parameters, environmental impacts~~,~~ and economic performance of a *process system* (3.13) and an associated *product system* (3.12)

~~Note 1 to entry: Related term is eco-technoeconomic analysis~~

~~3.3~~3.2
basis of production
quantified performance of a *process system* (3.13~~,~~), reflecting its specific scale, size or rate

~~3.4~~3.3
process
set of interrelated or interacting activities that uses or transforms inputs to deliver a result

~~[SOURCE: ISO 14050:2020]~~

Note 1 to entry: The process can be physical or conceptual.

[SOURCE: ISO 14050:2020, 3.1.9, modified — Note 1 to entry added.]

~~3.5~~3.4
functional unit
quantified performance of a *product system* (3.12) for use as a reference unit

~~[SOURCE: ISO 14040:2006]~~

Note 1 to entry: ~~the~~ The functional unit reflects the size of the *process system* (3.13).

[SOURCE: ISO 14040:2006, 3.20, modified — Note 1 to entry added.]

~~3.6~~3.5
reference flow
measure of the outputs from *processes* (3.3) in a given *product system* (3.12) required to fulfil the function expressed by the *functional unit* (3.4)

[SOURCE: ISO 14040:2006, 3.29]

~~3.7~~3.6
life cycle assessment
LCA
compilation and evaluation of the inputs, outputs and the potential environmental impacts of a *product system* (3.12) throughout its life cycle
~~[SOURCE: ISO 14040:2006]~~

[SOURCE: ISO 14040:2006, 3.2]

~~3.8~~3.7
life cycle impact assessment
LCIA
phase of *life cycle assessment* (3.6) aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a *product system* (3.12) throughout the life cycle of the *product* (3.9 ~~[SOURCE: ISO 14040:2006]~~)

[SOURCE: ISO 14040:2006, 3.4]

~~3.9~~3.8
techno-economic analysis
TEA
compilation and evaluation of technological parameters and economic performance of a *process system* (3.13)

~~3.10~~3.9
product
any goods or service

[SOURCE: ISO 14050:2020, 3.5.12]

~~3.11~~3.10
environment
surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans and their interrelationships
~~[SOURCE: ISO 14050:2020, 3.2.2]~~

[SOURCE: ISO 14050:2020, 3.2.2]

3.123.11
business unit
discrete and accountable function or sub-function within an organization.

[SOURCE: ISO/TS 21089:2018, 3.28, modified — Note 1 to entry deleted.]

3.133.12
product system
collection of unit *processes* (3.3) with elementary and product flows, performing one or more defined functions, and which models the life cycle of a *product* (3.9) [SOURCE: ISO 14040:2006]

[SOURCE: ISO 14040:2006, 3.28]

3.143.13
process system
system of one or more interlinked unit *processes* (3.3) on which a *techno-economic analysis* (3.8TEA) is conducted over which the *business unit* (3.11) has control

Note 1 to entry: In the *life cycle assessment* (3.6LCA) part of the *environmental techno-economic assessment* (3.1eTEA), up and downstream processes are normally added.

Note 2 to entry: The process system is part of the *product system* (3.12.).

4 Principles of eTEAs

4.1 General

eTEAs are the combination of a techno-economic analysis (TEA) and a life cycle assessment (LCA). eTEAs include economic, technical and environmental considerations that can inform decision-making.

These principles are fundamental and should be used as guidance for decisions relating to both the planning and conducting of an eTEA.

4.2 Two focuses, two perspectives

eTEA considers the combination of the following two focuses with two different perspectives.:

— The techno-economic focus considers the mass flows, energy flows, and economic value of a process system from the perspective of a business unit that has control over the process system. The economic boundary is usually defined by the boundary of the business unit of relevance and includes all expenses, costs, or revenues directly associated with the process system of interest, typically incurred by the business unit only, such as those associated with manufacturing, operation, commissioning, startup, and decommissioning.

— The environmental focus of the analysis considers the life cycle of a product system associated with a process system from the perspective of the environment. The LCA follows the principles described in ISO 14040, generally beginning at raw material extraction and acquisition, including the manufacture of products, and final use and end of life or disposal.

4.3 Basis of production, functional unit and reference flows

~~The basis of production is the quantified performance of a process system, reflecting its specific scale, size or rate.~~

Since eTEAs typically support specific decisions with ~~non-linear~~nonlinear consequences, the basis of production for the process system and the functional unit for the corresponding product system should have the same size as the expected outcome of the decision regarding the process system. ~~The reference flow is a measure of the outputs from unit processes in a given product system required to fulfil the function expressed by the basis of production and functional unit.~~

Information on selecting the basis of production is given in Annex B.

4.4 Iterative approach

eTEA is an iterative approach. The individual phases within the LCA use the results of other phases, and have iterative approaches within them as well. Similarly, the TEA directly influences the LCA, and vice versa, as technical and economic decisions can be made considering their environmental impacts.

4.5 Transparency

Due to the complexity of eTEA studies, it is important that assumptions and limitations are reported transparently, and that information is provided in an open and comprehensive manner to enable accurate interpretation of results and understanding of trade-offs. Aim for transparency by ensuring that documentation and reports are available, comprehensive and understandable to allow the intended audience to use the eTEA results and/or facilitate replicability of the eTEA.

4.6 Comprehensiveness

eTEA considers a wide range of technical, economic~~,~~ and environmental indicators~~. The~~:

— the technical indicators include mass flows, energy flows~~,~~ and performance metrics~~. Economic~~;

— the economic indicators include costs, revenues, investments, shareholders, debts, equity, liability, taxation, regulation, time valuation~~,~~ and others~~. Environmental~~;

— the environmental indicators include the impacts on the natural environment, human health~~,~~ and resources.

By considering all of these indicators in a comprehensive analysis, trade-offs can be identified, processes can be improved~~,~~ and responsible decisions can be made that directly affect the business unit and indirectly affect the rest of the world.

4.7 Priority of scientific and economic approach

The technological and environmental portions of the eTEA are preferably based on natural sciences. The economic portion of the eTEA is preferably based on economics, vendor quotes~~,~~ or knowledgeable estimates.

5 General description of an ~~environmental techno-economic assessment (~~eTEA~~)~~

5.1 Framework for TEA

5.1.1 General

eTEA consists of the integration of TEA with LCA. The relationship between TEA and LCA is described in Figure 1. The phases of the eTEA framework are:

— the goal and scope definition~~,~~;

— TEA~~,~~;

— LCA~~, and~~;

— interpretation.

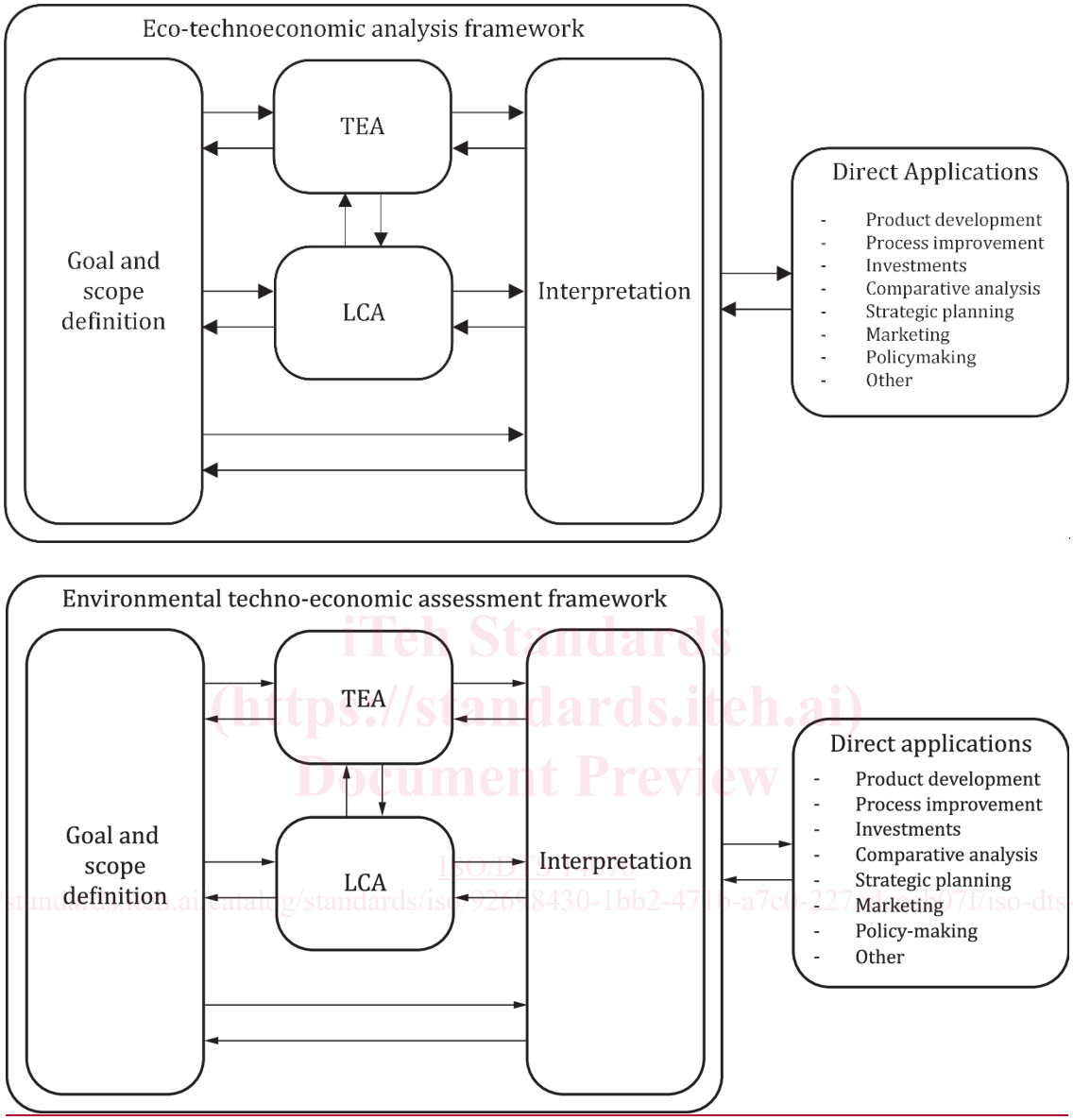

Figure 1 — Framework for an eTEA

~~5.1.1~~5.1.2 Phases of TEA

In addition to the goal and scope and interpretation of the general eTEA framework, TEA comprises:

— technical determination of mass and energy flows~~, and~~;

— economic analysis.

~~5.1.2~~5.1.3 Phases of LCA

The LCA is conducted ~~according to~~in accordance with the ~~ISO 14040/14044~~ framework, guidelines, principles~~,~~ and requirements given in ISO 14040 and ISO 14044. In addition to the goal and scope and interpretation of the general eTEA framework, LCA comprises:

— inventory analysis~~, and~~;

— impact assessment.

5.2 Key features of an eTEA

The ~~following lists the~~ key features of the eTEA methodology are as follows:

a) An eTEA incorporates both a TEA and an LCA~~;~~.

b) An eTEA assesses, in a systematic way, the technical, economic~~,~~ and environmental impacts of a product and its product system, in accordance with the stated goal and scope~~;~~.

c) eTEAs are influenced by the size, capacity~~,~~ or production rate of the processes of interest as defined by the basis of production, because of the effects of economies ~~-~~of ~~-~~scale~~;~~.

d) ~~the~~The depth of detail and time frame of an eTEA is defined by the goal and scope definition~~;~~.

e) ~~specific~~Specific requirements are applied to eTEA that are intended to be used for comparative analyses~~;~~.

f) ~~there~~There is no single method for conducting an eTEA. Organizations have the flexibility to implement eTEA as established in this document, in accordance with the intended application and the requirements of the organization~~;~~.

g) ~~outcomes~~Outcomes of the eTEA are naturally uncertain; there is an inherent uncertainty in the measurement or prediction of technical aspects, economic aspects~~,~~ and environmental impacts~~; the~~. The uncertainty is generally the lowest for the portions of product system that are directly related to the business unit, and larger for the portions outside of it~~;~~.

h) ~~there~~There is no scientific basis for reducing all metrics obtained in an eTEA to a single number for decision-making purposes. Attempts to combine subsets of metrics typically involve weights which are value choices. However, such combinations can be useful in some circumstances, when considered in the context of value choices, assumptions~~,~~ and uncertainty.

5.3 General concepts of techno-economic and environmental boundaries

The LCA portion of an eTEA uses the concept of the product system as defined in ISO 14040~~/~~ and ISO 14044, which describes the life cycle of a product. The TEA portion uses economic boundaries which are the portion of the product system in which a business unit has direct control, such as in the purchase or sale of resources, goods~~,~~ or services, and the actual manufacture of the product. The economic boundary, which is called the "process system boundary~~,~~", can include elementary, product~~,~~ and intermediate/waste flows across it.

An example is shown in Figure 2~~Figure 2.~~. In this example, the business unit (a printer ink manufacturer) is directly responsible for material pre-treatment, the commissioning and decommissioning of the manufacturing facilities, the production of the product, and also a recycling ~~program~~programme where consumers return spent ink cartridges for recycle or reuse. The upstream and downstream aspects of the product system occur outside of the direct control of the business unit.