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Life cycle inventory calculation methodology for steel products

Méthodologie de calcul de l'inventaire du cycle de vie des produits en acier

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 21, *Environment related to climate change in the iron and steel industry*.

This second edition cancels and replaces the first edition (ISO 20915:2018), which has been technically revised.

The main changes are as follows:

— stainless steel has been included;

— definitions have been clarified [product, scraps, recycling rate, coal and fuel (fossil and biogenic)];

— declared unit has been used instead of functional unit;

— alternative recycling methodologies have been allowed;

— explanations of primary data share (PDS) and data quality rating (DQR) have been added;

— examples of main outputs include CO_2 (for CCU);

— contractual instruments (energy attribute certificates, RECs, guarantees of origin, green energy certificates) and residual mix information have been included in electricity;

— co-product allocation has been modified to avoid double counting the benefits of co-product;

— for clarification, process gas in allocation specifies inclusion of combustion.

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.

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Introduction

The life cycle inventory (LCI) of steel products is an important component in the support of life cycle assessments for a wide range of products and applications that contain steel or where steel is used to support the manufacture, production or delivery of products. ISO 14044 [1] explains as follows.

LCA addresses the environmental aspects and potential environmental impacts (e.g. use of resources and environmental consequences of releases) throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, recycling and final disposal (i.e. cradle-to-grave). There are four phases in an LCA study:

a) the goal and scope definition phase,

b) the inventory analysis phase,

c) the impact assessment phase, and

d) the interpretation phase.

The life cycle inventory analysis phase (LCI phase) is the second phase of LCA. It is an inventory of input/output data with regard to the system being studied. It involves collection of the data necessary to meet the goals of the defined study.

This document describes the methodology for the analysis of the steel life cycle inventories that should be applied to a wide range of steel products, and represents the main process routes for global steel production. This includes the extraction of raw materials from the earth through to the production of steel products at the factory gate, as well as provision for scrap recycling of steel products and the treatment of steel scrap. The methodology conforms to the principles and framework set out in ISO 14040 [2] and ISO 14044 [1] and demonstrates how these principles should be applied to steel product manufacture and steel recycling.

The life cycle of steel products consists of the following stages (see Figure 1):

— sourcing of natural resources (which includes mining, transportation and intermediate processing of raw materials) and scrap (recovered from both the manufacturing processes and the end of life of final products);

— production of steel products at the steelworks, including scrap recovery;

— manufacturing of final products by downstream users, for example, by customers of the steel industry, such as automotive, construction and engineering industries;

— use of final products, where the environmental performance of the final product depends on the steel products being used; for example, the fuel (or energy) consumption of an automobile depends partly upon the weight of its steel components;

— end of life of final products, including scrap recovery.

— recycling of scrap from both the manufacturing process and the end of life of final products to substitute the use of raw materials from the earth.

This document covers life cycle stages including sourcing of raw materials from the earth and scrap, production of steel products at the steelworks, and recycling of scrap. It does not cover the manufacturing of final products and the use of final products.

All global steel production is sourced from different ratios of scrap and primary ores. Therefore, an understanding of the value of steel recycling becomes a necessary part of the steel product LCI.

It is generally understood that the recycling of metallic materials makes a positive contribution towards reducing resource consumption and energy requirements, and helps to avoid the potential impacts of raw materials extraction and processing. However, all recycling routes (including the processing and transport of recycled materials) carry environmental burdens and these should be quantified as part of a life cycle assessment.

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A critical factor in the understanding of the benefits of materials recycling is the quality of the materials and products produced from the recycled material. Where the recycled products which are made to the same inherent properties as those sourced from primary materials, this is described as closed-loop recycling.

With the existing process and scrap quality controls, steel sourced from (scrap-based) steel recycling can be made to the same specification as steels sourced from the (iron ore based) primary routes. The properties of the different steel grades are achieved through different alloying concepts as well as process steps, such as heat treatment and secondary steel metallurgy allows the control of alloying and tramp element levels. This proves the judgement that steel recycling is to be regarded as closed-loop recycling.

Life cycle assessment may be used to quantify the potential benefits of recycling to conform to the guidance set out in ISO 14044:2006 [3], 4.3.4.3.

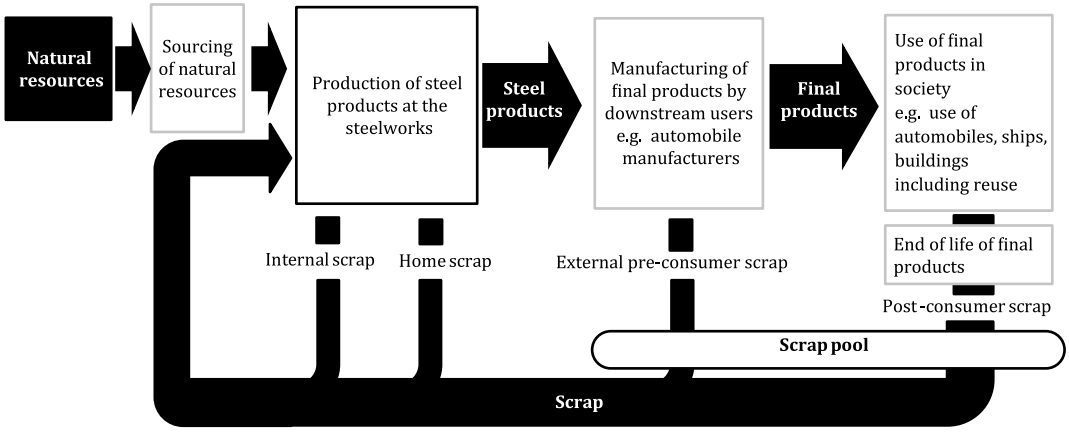

Figure 1 — Schematic diagram of the life cycle of steel

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Life cycle inventory calculation methodology for steel products

1 Scope

This document specifies guidelines and requirements for conducting life cycle inventory (LCI) studies of steel products reflecting steel's capacity for closed-loop recycling, including:

a) specification of the declared unit used for LCI calculation of steel products;

b) definition of the system boundaries used for LCI calculation of steel products;

c) evaluation of scrap in LCI calculation of steel products;

d) evaluation of co-products in LCI calculation of steel products;

e) reporting of LCI calculation results of steel products.

The application of LCI results, including life cycle impact assessment (LCIA), is outside the scope of this document.

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 6929, *Steel products — Vocabulary*

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definition given in ISO 6929, ISO 14040, ISO 14044 and the following apply.

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

— ISO Online browsing platform: available at http://www.iso.org/obp

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

3.1
life cycle inventory
LCI, noun
phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle

[SOURCE: ISO 14040:2006 [4], 3.3]

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