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# Calculation method of carbon dioxide emission intensity from iron and steel production

## Part 1:
## Steel plant with blast furnace



*Méthode de calcul de l'intensité de l'émission de dioxyde de carbone de la production de la fonte et de l'acier —*

*Partie 1: Usine sidérurgique avec haut fourneau*

FDIS stage

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## Foreword

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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 documents 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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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 14404-1:2013), which has been technically revised.

The main changes are as follows:

— —revision of Introduction, Terms and definitions, and default emission factors;

— ——addingaddition and revisingrevision of some emissions sources;

— ——clarifyingclarification of the difference between "Boundary" and "Site boundary";

— ——revisedrevision of the calculation method of by-product gas;

— ——addingaddition of a new informative annex, Annex EAnnex E on “Decarbonization strategies and its impact in $CO_2$ Calculation Method” to give guidance on future relevant emission source categories as new materials and processes become widely applicable at industrial level.

A list of all parts in the ISO 14404 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

The steel industry recognizes the urgent need to take actions concerning climate change. Slowing and halting global warming requires reductions in GHG emissions on a global scale. To play a part in achieving these reductions, it is necessary for steel plants to identify the amount of $CO_2$ emitted during the production of steel products, in order to identify next opportunities for reduction of $CO_2$ on their pathway to decarbonization.

The production process of steel involves complex chemical reactions, various heating cycles, and the recycling of various by-products. This variety of imports, including raw materials, reactive agents, fuel and heat sources are transformed into wide range of steel products, by-products, waste materials and waste heat.

Steel plants manufacture a vast range of products with various shapes and specifications including: flat items, long items, pipes, tubes and many others. In addition, they produce unique specialty-grade steel products with high-performance. These are achieved using a number of sub-processes including micro-alloying and applying surface treatments like galvanizing and coating, which require additional heat treatments. The variety of products manufactured and processes used means there are not two identical steel plants in the world.

Climate regulations in each country require steel companies to devise methods to lower $CO_2$ emissions from steel plants while continuing to produce steel products by these diverse and complex steelmaking processes. To accomplish this, it is desirable to have universally common indicators for determining steel plant $CO_2$ emissions.

Additionally, there are other aspects related to the heterogeneity nature of steel industry around the globe other than assets characteristics, that should be taken into account – (inputs availability; market and business environment, innovation—,) when looking for commonalities in calculation methodologies to ensure consistency and comprehensiveness.



There are many methods for calculating $CO_2$ emission intensity from steel plants and specific processes. Each method was created to meet the objectives of a particular country or region. In some cases, a single country can have several calculation methods in order to fulfil different objectives. Each one of these methods reflects the unique local characteristics of a particular country or region. Therefore, these methods cannot be used for comparisons of $CO_2$ emission intensity from steel plants located in different countries and regions.

To overcome this methodological fragmentation, the World Steel Association (worldsteel) has developed a calculation method for $CO_2$ emission intensity of steel plants. This calculation method was developed to facilitate steel plant $CO_2$ emissions. The calculation methodIt helps members keep track of their $CO_2$ emissions intensity relative to the other member steel companies located in different places in the world. An agreement was reached among members, and worldsteel has issued the method as a guideline called "$CO_2$ Emissions Data Collection User Guide." Actual data collection among worldsteel members based upon the guide started in 2007. Furthermore, worldsteel is encouraging even non-member steel companies to begin using the guide to calculate $CO_2$ emission intensity of their steel plants.

The present ISO 14404-1 revision is based on worldsteel's $CO_2$ Data Collection Users Guide, version 11,[4], reviewed in 2022, and follows ISO14404-4[2].

This calculation method establishes clear boundaries for collection of $CO_2$ emissions data. The net $CO_2$ emissions and production from a steel plant are calculated using all parameters within the boundaries. The $CO_2$ emission intensity of the steel plant is calculated by the net $CO_2$ emission from the plant using the boundaries divided by the amount of crude steel production of the plant. With this methodology, the $CO_2$ emission intensity of steel plants is calculated irrespective of the variance in the type of process used, products manufactured and geographic characteristics.

This calculation method only uses basic imports and exports that are commonly measured and recorded by the plants; thus, the method requires neither the measurement of the specific efficiency of individual equipment or processes nor dedicated measurements of the complex flow and recycling of materials and waste heat. In this way, the calculation method ensures its simplicity and universal applicability without requiring steel plants to install additional dedicated measuring devices or to collect additional dedicated data other than those commonly used in the plant management. Even though, the use of measured carbon content and net calorific values are highly recommended to obtain more accurate emissions accounting for each material considered. Any home metrics needs to be referenced with link to a transparent and accessible source, including indirect emission factors. To ensure transparency in communicating results to interested parties, these distinctions should be clearly stated.

With this method, a steel company can calculate a single figure for the $CO_2$ emissions intensity of a steel plant as a whole. By observing changes in $CO_2$ emissions intensity over time using this methodology, steel companies can evaluate whether their efforts to reduce $CO_2$ emissions are being properly implemented. As was explained earlier, most steel plants manufacture vast range of products with various shapes and specifications. This calculation method is simple and universally applicable because it is not affected by the differences in the production processes of such diverse products, and treats a whole steel plant as one unit with one $CO_2$ emission intensity. Therefore, this calculation method is not applicable for calculating and determining the carbon footprint of any specific steel product.

When comparing $CO_2$ emission intensity between different steel plants, it should be kept in mind that each steel plant has a different composition of manufacturing products and that the energy sources and raw materials available varies among countries and regions. In addition, since the ISO 14404 series strictly defines the boundary of the target process route for each part, only steel plants using the same part of the ISO 14404 series (i.e. ISO 14404-1, ISO 14404-2, ISO 14404-3) can be compared with each other. Note that the default emission factors provided in the ISO 14404 series are global averages and is not adjusted to reflect regional differences in energy sources and raw materials. When calculating total $CO_2$ emissions or $CO_2$ emission intensity for inventory or benchmarking purposes, the emission factors applicable to the conditions of the target country or region should be selected.

In order to give guidance to users on which areas of interest will be dealt with as future sources for direct and indirect $CO_2$ emission factors in programmed revisions of this document, tentative list is provided in Annex E.Annex E.

# Calculation method of carbon dioxide emission intensity from iron and steel production

# Part 1: Steel plant with blast furnace

## 1 Scope

This document specifies calculation methods for the total annual carbon dioxide ($CO_2$) intensity of the plant where steel is produced through a blast furnace.

NOTE The steel plant is generally called “the integrated steel plant”.

It includes boundary definition, material and energy flow definition and emission factor of $CO_2$. Besides direct source import to the boundary, upstream and credit concept is applied to exhibit the plant $CO_2$ intensity.

This document supports steel producers to establish $CO_2$ emissions attributable to a site.

Conversion to energy consumption and to consumption efficiency can be obtained using Annex A.Annex A.



## 2 Normative references

There are no normative references in this document.

## 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/obphttps://www.iso.org/obp

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

### 3.1 Emissions

**3.1.1**
**emission source**
process emitting $CO_2$ during production of steel products

Note 1 to entry: There are three categories of $CO_2$ emission sources: direct, upstream and credit. Examples of emission sources that are subject to this document are given in 3.1.2, 3.1.3 and 3.1.4.3.1.2, 3.1.3 and 3.1.4.

**3.1.2**
**direct $CO_2$ emission**
$CO_2$ emissions from steel production activity inside the boundary

Note 1 to entry: Direct $CO_2$ emission is categorized as "direct GHG emissions" in ISO 14064-1.

**3.1.3**
**upstream $CO_2$ emission**
$CO_2$ emissions from imported material related to outsourced steel production activities outside the site boundary and from imported electricity and steam into the site boundary

Note 1 to entry: Possible outsourced activities are, for example, production of coke, burnt lime, burnt dolomite, pellet, sintered ore, hot metal, cold iron, direct reduced iron, oxygen, nitrogen and argon.

Note 2 to entry: $CO_2$ emissions from imported material in this term is categorized as "other indirect GHG emissions" in ISO 14064-1.

Note 3 to entry: $CO_2$ emissions from imported electricity and steam in this term are categorized as "energy indirect GHG emissions" in ISO 14064-1.

**3.1.4**
**credit $CO_2$ emission**
$CO_2$ emission that corresponds to exported material and electricity or steam

Note 1 to entry: Credit $CO_2$ emission is categorized as "direct GHG emissions" in ISO 14064-1.

## 3.2 Gas fuel

**3.2.1**
**natural gas**
mixture of gaseous hydrocarbons, primarily methane, occurring naturally on earth, and used in metallurgic plants either as a fuel or as raw material

**3.2.2**
**coke oven gas**
**COG**
gas recovered from coke oven

**3.2.3**
**blast furnace gas**
**BFG**
gas recovered from blast furnace

**3.2.4**
**basic oxygen furnace gas**
**BOF gas**
gas recovered from basic oxygen furnace

Note 1 to entry: Also known as Linz Donawitz converter gas (LDG)).

## 3.3 Liquid fuel

**3.3.1**
**heavy oil**
No. 4 and No. 6 fuel oil defined by the American Society for Testing and Materials (ASTM)

Note 1 to entry: For No. 4 and No.6 fuel oil, see ASTM Fuel Oils Standard Specification.