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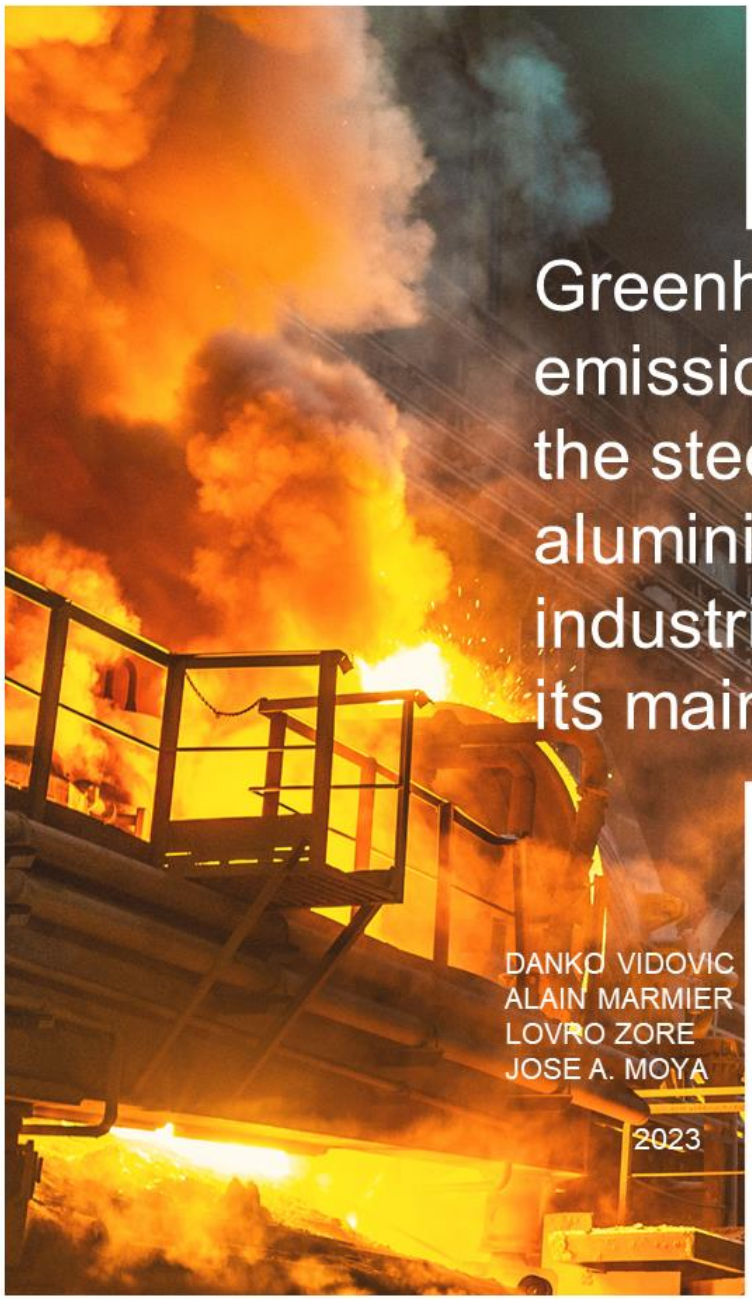

Greenhouse gas emission intensities of the steel, fertilisers, aluminium and cement industries in the EU and its main trading partners

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Contents

Abstract

This report provides an estimation of GHG emission intensities for products from four energy-intensive industries (iron and steel, fertilisers, aluminium and cement) in the EU and in its main trading partners. The aim of these estimations is to provide scientific support to the implementation of the Carbon Border Adjustment Mechanism (CBAM).

These estimations follow the methodology and definitions of the monitoring and reporting rules of the CBAM, adapting the approach to publicly available information. The results are validated, when feasible, by comparing results at EU level with weighted average emission intensities based on actual data (i.e. data gathered through the EU ETS benchmarking exercise), taking into consideration any methodological differences. The closely matching figures prove the robustness of our approach.

The potential use of the values provided in this report will facilitate the replacement of the carbon leakage mechanisms of the EU ETS with the CBAM, which, in turn, will facilitate the effective implementation of EU climate policy.

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Executive summary

Industry is of strategic importance to the EU economy, providing wealth and employment. However, it is also responsible for significant greenhouse gas (GHG) emissions: the energy-intensive industries alone contributed up to 22% of the EU total in 2019 (European Commission, 2021). To achieve its decarbonisation objectives, the EU is gearing up its policy response: the Carbon Border Adjustment Mechanism (CBAM) will complement the EU Emissions Trading System (EU ETS). The CBAM will ensure that the emissions embedded in goods imported into the EU will also be accounted for and subject to a carbon price. In support to the CBAM, this report provides the emission intensities of goods produced by key EU trading partners across four energy-intensive industries.

The EU has set clear, ambitious targets towards decarbonisation, with the goals of reducing emissions by 55% by 2030 and becoming the first climate-neutral continent by 2050. The imperative for the EU's energy-intensive industries to accelerate their transition was highlighted in the Commission's 2020 Industrial Strategy and its 2021 update.

This report is a contribution of the JRC in support to the CBAM, the EU's new mechanism to prevent carbon leakage. Carbon leakage occurs if, for reasons of costs related to climate policies, businesses in certain industry sectors or subsectors transfer production to other countries or imports from those countries replace equivalent products that are less intensive in terms of greenhouse gas emissions. The transitional CBAM period will start in October 2023. That period is limited to the reporting of emissions without any financial adjustments at the EU's borders. Once the CBAM is fully implemented from 2026 onwards, importers into the EU will have to pay for the emissions embedded in goods they import as if they were produced in the EU under the EU ETS. Simultaneously, EU producers will progressively receive less free allowances, which is the main carbon leakage measure of the EU ETS.

During the transitional CBAM period from October 2023 to December 2025, importers of CBAM goods are required to report the emissions embedded in those goods, based on actual emissions. However, Implementing Regulation (EU) 2023/5512 provides for some flexibilities including the use of default values until 31 July 2024 (European Commission, 2023b).

This report presents the JRC's estimations of the GHG emission intensities or specific embedded emissions in products from four energy-intensive industries (iron and steel, fertilisers, aluminium and cement) that may serve to establish the default values for the transitional CBAM period. The products under the scope of this study correspond to those in Annex I to the Carbon Border Adjustment Mechanism (CBAM) Regulation (EU) 2023/956. This report does not constitute or anticipate any decision by the Commission on default values to be used for the CBAM from 1 January 2026 onwards.

This report confirms the feasibility of accurately determining the emission intensity of products from four energy-intensive industries. It then provides the values, disaggregating between direct and indirect emissions, for products and countries in the scope of the CBAM.

Industry is increasingly reporting on its greenhouse gas emissions, and even providing data and/or methodological approaches of interest for this study. Complementing industry data with publicly available data allows capturing the complexity of the four industries considered in this report.

The production routes and product compositions strongly influence the emission intensities. Another important factor is if emissions from biomass combustion are zero-rated. Under the EU ETS, this is only possible if an operator provides evidence that the biomass consumed is sustainably sourced.

The JRC builds on a technical understanding of the sectors considered in this study to model the emissions embedded in products. This knowledge will serve further prospective studies, investigating the means and impact of emission reductions towards 2050. Also, as the CBAM enters its transitional phase, evidence provided by importers on actual emission intensities will enable a critical review of the results presented.

Chapter 1 sets the scene by describing the policy context and methodological aspects of relevance for all industries covered in this report. Chapters 2 to 5 focus on specific industries, namely iron and steel; fertilisers; aluminium; and cement. In all four cases, the geographical scope is detailed, focusing on the EU's main trading partners, and products of interests are specified, based on their CN codes and associated definitions. Emission intensities are then derived through a transparent methodology, on the basis of publicly available data. Results are validated, when feasible, by comparing them at EU level with weighted average emission intensities, taking into consideration any methodological differences. The latter data are gathered through the EU ETS benchmarking exercise, which relies on real plant data. The differences (between the carbon intensity values estimated in this report and the weighted average of the benchmarking curves) can largely be traced back to

the different scopes of the ETS (i.e. emissions per installation) and CBAM (i.e. emissions per goods including precursors). Applying the scope of the EU ETS to our calculations produces closely matching figures prove the robustness of our approach.

1 Introduction

As part of the European Green Deal (European Commission, 2019), the Commission proposed the 2030 Climate target plan in September 2020 to raise the EU's ambition on reducing greenhouse gas emissions to at least 55% below 1990 levels by 2030. To deliver these additional GHG emission reductions, the Commission announced a review of all relevant climate-related policy instruments by June 2021 under the name of the Fit-for-55 package (European Commission, 2021a). The package contains, among other initiatives, legislative proposals for a revision of the EU Emissions Trading System (EU ETS) and for a new Carbon Border Adjustment Mechanism (CBAM) (European Commission 2021b). The CBAM Regulation was agreed upon by Council and Parliament in December 2022 and the regulation published in May 2023 (European Union, 2023).

In its latest revision, the EU ETS tightened its provisions, including a reduced cap[1], to achieve a more ambitious emission reduction target. Installations covered by the EU ETS will thus have to further reduce GHG emissions compared to the levels that were formerly targeted (i.e. 43% reduction by 2030 compared to 2005 in the ETS revision of 2018). As a consequence of the increased emission reduction target, the free allocation budget will decrease. Moreover, carbon prices are expected to increase in phase 4 due to the decreased supply of allowances from a reduced cap.

These developments mean that the risk of carbon leakage may increase**.** Carbon leakage refers to the situation that may occur if, for reasons of costs related to climate policies, businesses were to transfer production to other countries with laxer emission constraints. This would involve either production being transferred from the EU to other countries with lower ambition for emission reduction, or EU products being replaced by more carbon-intensive imports.

To date, the free allocation of emission allowances is the main mechanism used under the EU ETS to mitigate the risk of carbon leakage. During phase 4 of the EU ETS (European Commission, 2023a), sectors that are deemed to be at risk of carbon leakage will receive a free allocation of allowances equivalent to 100% of the relevant benchmark value. For sectors not deemed to be at risk of carbon leakage, the free allocation will amount to 30% of the benchmark value from 2021 until 2026 and will be phased out from 2027 until 2030. No free allocation is given to electricity generation.

Indirect cost compensation is another mechanism under the EU ETS to mitigate the risk of carbon leakage. According to Article 10a(6) of the ETS Directive (European Union, 2018), Member States should adopt financial measures in favour of sectors or subsectors which are exposed to a genuine risk of carbon leakage due to significant indirect costs that are incurred due to GHG emission costs passed on in electricity prices. These financial measures need to be in accordance with State aid rules and should not cause undue distortions of competition in the internal market. Similarly to free allocation, indirect cost compensation is also based on the application of electricity consumption efficiency benchmarks.

The CBAM forms part of the Fit-for-55 package and is designed to address the risk of carbon leakage. The CBAM will equalise the price of carbon between domestic products and imports and will ensure that the EU's climate objectives are not undermined by the relocation of production by industry to countries with less ambitious policies. It also aims to encourage industry at global level and the EU's international partners to take steps in the same (carbon-neutral) direction.

Under the CBAM, EU importers will be required to buy carbon certificates corresponding to the carbon price that would have been paid, had the goods been produced under the EU's carbon pricing rules. Conversely, once a non-EU producer can show that they have already paid a price for the carbon used in the production of the imported goods in a third country, the corresponding cost can be fully deducted for the EU importer.

The CBAM will be introduced in stages. During the first, transitional phase, starting in 2023 and finishing at the end of 2025, importers will be obliged to report the emissions embedded in goods which fall under the scope of the regulation, on a quarterly basis and based on actual emissions. These reporting obligations will be applicable to both direct and indirect emissions. Implementing Regulation (EU) 2023/5512 provides for some flexibilities including the use of default values until 31 July 2024 (European Commission, 2023b). In 2026,

[1] The overall volume of greenhouse gases that can be emitted by power plants, industry factories and aviation sector covered by the EU Emissions Trading System (EU ETS) is limited by a 'cap' on the number of emission allowances. Within the cap, companies receive or buy emission allowances, which they can trade as needed. The cap decreases every year, ensuring that total emissions fall.

when the transitional period ends and the system becomes fully operational, EU importers will have to declare annually the quantity of goods and the amount of embedded emissions in the goods that they imported into the EU in the preceding year, and surrender the corresponding number of CBAM certificates.

This report is a contribution of the JRC in support to the CBAM. Its purpose is to estimate GHG emission intensities for products from four energy-intensive industries (iron and steel, fertilisers, aluminium and cement) in the EU and in its global trading partners. The main aim of these estimations is to provide scientific support to the implementation of the CBAM. Sections 2 to 5 describe the products for each industry, countries and production processes under the scope of this study; the used input data; the methodological approach; and the results. The methodological approach for each industry is customised according to the information publicly available. For the steel industry, we build upon previous analysis of the carbon intensity of steel products up to crude steel (JRC, 2022a), removing some of the simplifications used in the former (mainly, the artificial split in energy consumption up to crude steel and in the final manufacturing steps (e.g. hot rolling). Hereafter, this analysis is referred to as the pilot study. Section 2 is thus focused on describing the approach to the final manufacturing steps of the goods in Annex I to the CBAM regulation.

Emissions refer to the emissions of greenhouse gases relevant for each industry, expressed in tonnes of CO2e per tonne of good. For all industries and products, the indirect emissions use country-specific carbon emission factors of electricity, based on data from the International Energy Agency (IEA) and calculated as a five-year average for the period 2015-2019 (IEA, 2021a).

In order to keep the number of countries manageable for each industry, this analysis is limited to those countries which represent a cumulative share of more than 90% of total EU27 imports, with each country responsible for at least 1% of those imports. The list of countries for the steel industry includes Japan, at only 0.2%, alongside the 15 largest exporters to the EU27, for consistency with the pilot study. For the fertilisers industry, we add Saudi Arabia, Indonesia and Canada (due to their relevance in the global fertiliser trade) to the list of 19 countries which cover 98.4% of EU imports. For the aluminium industry, we also add the US, due to its relevance in the global aluminium trade, to the list of 15 countries which cover 91.2% of EU imports. The scale of aluminium imports from the first country excluded is comparable to a single small aluminium remelter or refinery. For the cement industry, we add eight countries (Saudi Arabia, Switzerland, United Kingdom, Malaysia, Egypt, Serbia, Pakistan and India) to the list of 11 countries which represent 90% of EU27 imports, reaching a coverage of over 96%. For countries that are not in the scope of this study in the respective industries, we also provide, as a proxy, a production-weighted average of the emission intensities of the countries under the scope. These values are referred to in this report as 'weighted average'.

For the discussion in section 1.1, necessary to frame the scope of emissions covered by the CBAM and therefore by our analysis, we assume that the reader is familiar with the implementing regulation (European Commission, 2023b) of Art 35 of the CBAM Regulation (EU) 2023/956 or with the guidance document (European Commission, 2023c). This report follows the definitions described in the implementing regulation.

1.1 Geographical scope of emissions: embedded emissions in complex goods

The following lines come from the guidance document of the CBAM (European Commission, 2023c), and detail how the embedded emissions are calculated for **complex goods**. The calculation needs to include the emissions of precursors.

This is represented in *Annex III (3)* of the CBAM regulation as follows:

$$SEE_g = \frac{AttrEm_g + EE_{InpMat}}{AL_g} \quad (1)$$

Where…

AttrEm$_g$ = attributed emissions of goods g

AL$_g$ = activity level of the goods, the latter being the quantity of goods produced in the reporting period in that installation

EE$_{InpMat}$ = embedded emissions of the precursors consumed in the production process.

Only input materials listed as relevant to the system boundaries of the production process as specified in the implementing regulation adopted pursuant to *Article 7(6)* are to be considered.

The relevant EE_{InpMat} are calculated as follows:

$$EE_{InpMat} = \sum_{i=1}^{n} M_i \cdot SEE_i \quad (2)$$

Where…

M$_i$ = mass of input material i used in the production process,

SEE$_i$ = specific embedded emissions for the input material.

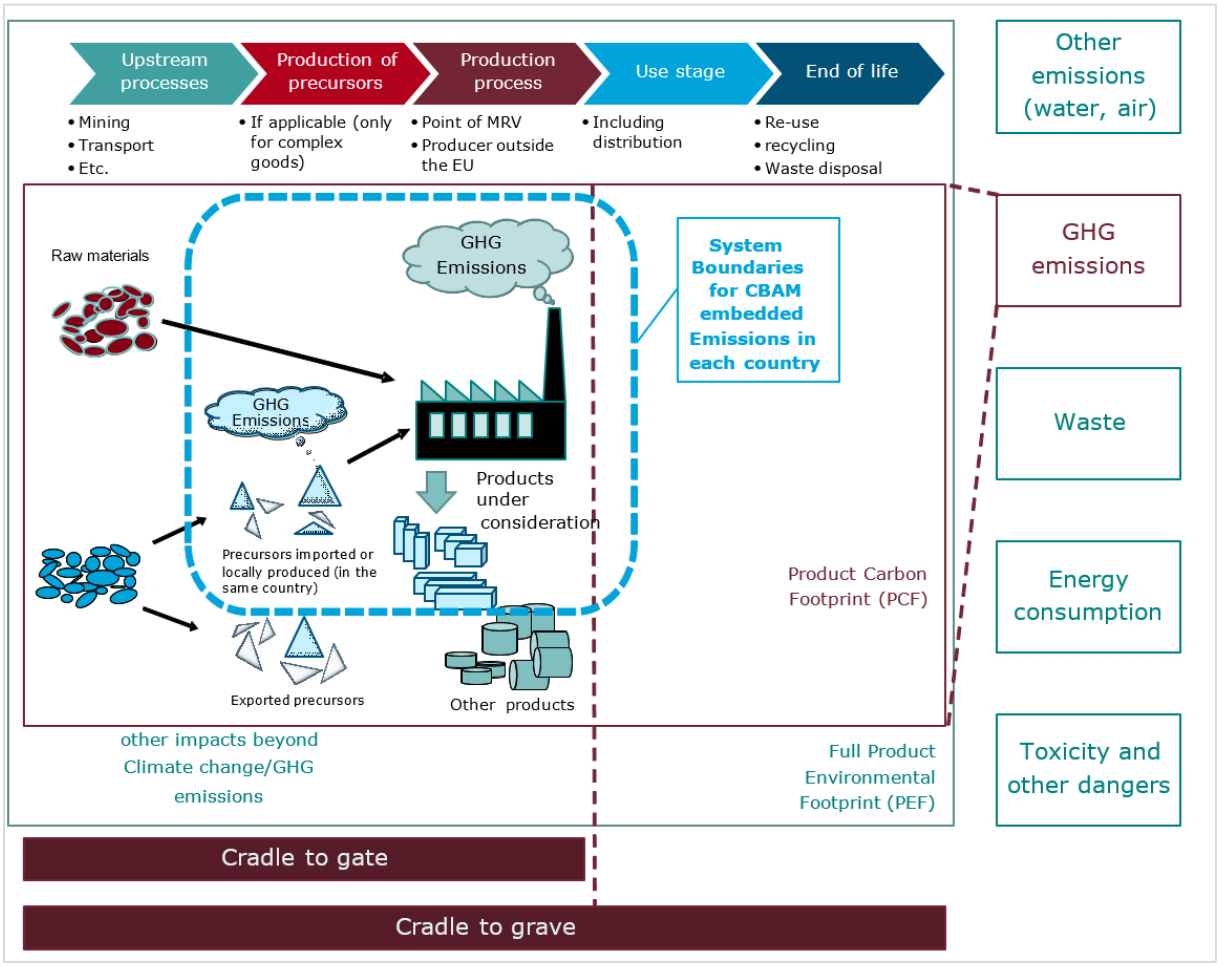
For SEE_i the operator of the installation shall use the value of emissions resulting from the installation where the input material was produced, provided that that installation's data can be adequately measured. The SEEi values can come from facilities in countries different to those of the installations reporting the emissions. If the same precursor comes from facilities in different countries, the mass of input material should have the specific embedded emissions corresponding to each facility.

That is, for simple goods (goods that do not incorporate any precursor), all GHG-related emissions take place in the same facility (and country) producing those simple goods. Whereas for complex goods, emissions from the manufacturing of precursors that are imported are included in the individual installation consuming the precursors. Figure 1, a slight modification of figure 6.1 of the guidance document (European Commission, 2023c), helps us to represent the GHG emissions from the precursors used for determining embedded emissions in the CBAM.

In view of the challenge to record SEEi values for all precursors in all global countries, this study uses as SEE_i for those third countries a value that corresponds to a global average. This is referred to hereafter as the 'trade effect'. Moreover, the weighted average values of SEEi of the third countries under scope is used as a proxy for the global averages.

However, for imported precursors that can have very different SEEi depending on the production route, due to the impossibility of identifying that production route, we use the GHG intensity of the country consuming it, using its most carbon-intensive route (this can be seen, for example, in the finalisation processes of aluminium and steel).

Figure 1. Comparison of product environmental and GHG footprint, and the specific partial GHG footprint that are to be used for determining embedded emissions in CBAM goods.



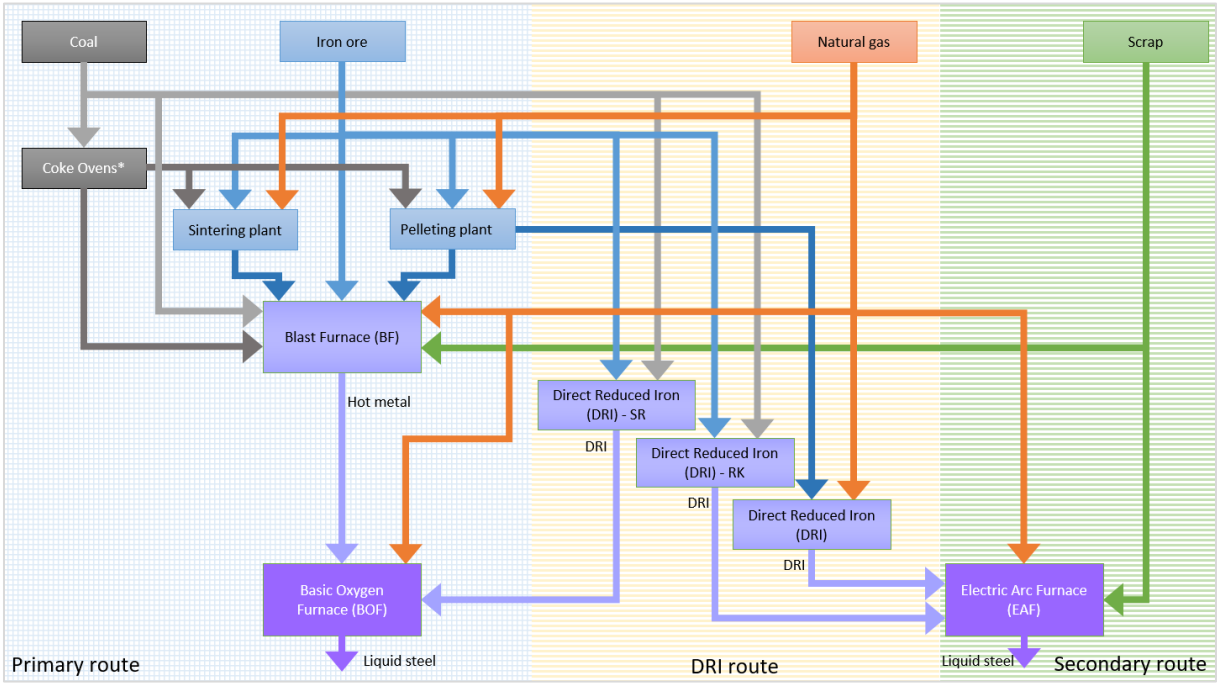
Source: JRC, 2023 based on Umweltbundesamt (European Commission, 2023c).

2 Analysis for the products of the iron and steel industry

Based on the production processes involved, steelmaking can be divided into primary, secondary, and DRI production routes, as shown in Figure 2.

Primary steelmaking mainly uses iron ores as feedstock for raw material preparation, iron making and steelmaking. This production route typically involves a coke oven plant, a sinter and/or pellet plant, a blast furnace (BF) and a basic oxygen furnace (BOF), and is also referred to as the BF-BOF route[2]. Preparatory steps include coke making in the coke oven (emissions corresponding to the coke production are not covered by the CBAM regulation) from coking coals and agglomerating iron ore in the sinter/pellet plant (a raw material preparation process). Coke, sinter, pellet, lump iron ore and limestone are then fed into the BF together with hot air, forming a molten metal called pig iron or hot metal (an iron making process). By blowing high-purity oxygen through this liquid metal, the pig iron, potentially in combination with steel scrap, it is converted into liquid steel in the BOF (a steelmaking process). The steelmaking process consists of melting, purifying and alloying subprocesses.

Figure 2. Main production routes for steelmaking.



* - emissions from Coke ovens are not covered by the CBAM regulation
SR – Smelting reduction
RK – Rotary Kiln

Source: JRC, 2023.

Another process to produce steel via the primary route is to make direct reduced iron (DRI), also called sponge iron, via a smelt reduction process (known commercially under the names Corex and Finex). This process uses coal as a reducing agent in the production of liquid DRI. Alternatively, natural gas (e.g. Midrex and Energiron HYL) or coal (e.g. rotary kiln furnaces) can be used as a reducing agent in the production of a solid state DRI that is usually fed into an electric arc furnace (EAF) to produce steel. In 2019, 76% of DRI production made use

[2] The open hearth furnace (OHF) also used to be a common process before the introduction of the BOF. The OHF has largely been replaced by the faster and more fuel-efficient BOF, but was still operational in 2018 in Ukraine and India. When referring to the primary process, we refer to both the BOF and OHF processes.

of natural gas as a reducing agent (Midrex, 2021). When low-carbon hydrogen (e.g. produced with renewable electricity) is used as the reducing gas instead of natural gas, the process offers great potential for reducing the carbon footprint of the entire steelmaking process.

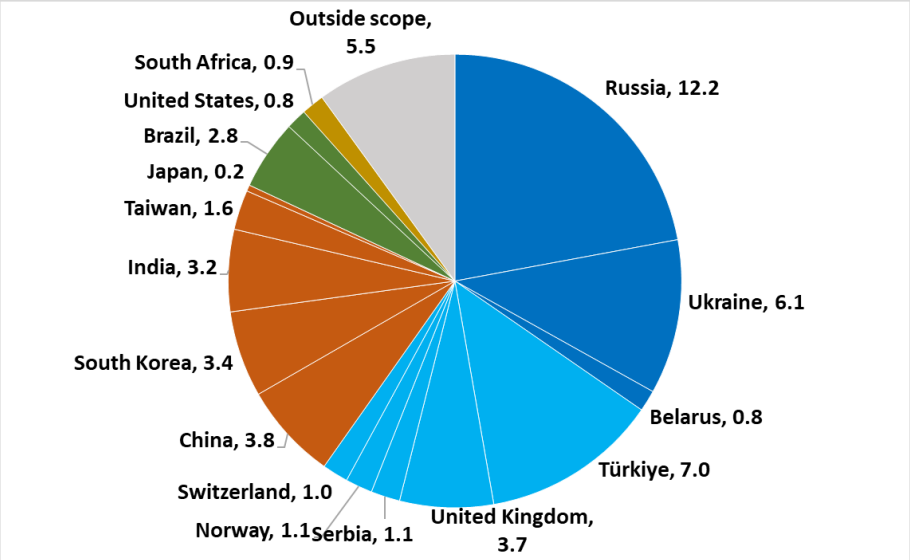
Steel via the secondary route uses scrap steel as the primary raw material, where the steelmaking is performed in an EAF[3]. The energy intensity is typically much lower than that of the primary route. High-current electric arcs melt the steel, allowing for thermal control and a range of alloy additions.

Liquid steel from any of the production routes (primary or EAF via DRI or scrap) is further converted to crude steel (the initial solid steel produced upon solidification of liquid steel) via a casting process, or cast into finished products in a foundry plant. Crude steel includes ingots (in conventional mills) and semis (in modern mills with a continuous casting facility). Semis represent the intermediate solid-steel products obtained by the hot rolling or forging of ingots or by continuous casting of liquid steel. There are various types of semis, such as blooms, billets, slabs, thin slabs, and near net shapes. These intermediate products are further rolled/forged to produce finished steel products.

2.1 Countries under scope

The countries under the scope in this section, presented in Figure 3, remain the same as in the pilot study (JRC, 2022a). Figure 3 visualises the 16 countries within the geographical scope of this work, jointly accounting for more than 90% of total imports of iron and steel products to the EU in 2018. The list includes the top 15 largest exporters to the EU in 2018[4], which happen to also be the major global crude steel producers, and Japan: While Japan is only the 22nd largest exporter of products to the EU, it plays a major role in the global iron and steel industry.

Figure 3. Geographical scope of the pilot study: import of iron and steel products to EU27 in 2018, in Mt.



Source: (JRC, 2022a).

[3] Most direct reduction plants also make use of this process, as they are part of a steelmaking process with an EAF located on site.

[4] The EU's sanctions adopted following Russia's military aggression against Ukraine modify the list of the largest exporting countries into the EU. However the estimations of carbon intensities for all industries rely on data from 2019: Russia is therefore maintained into the analysis.

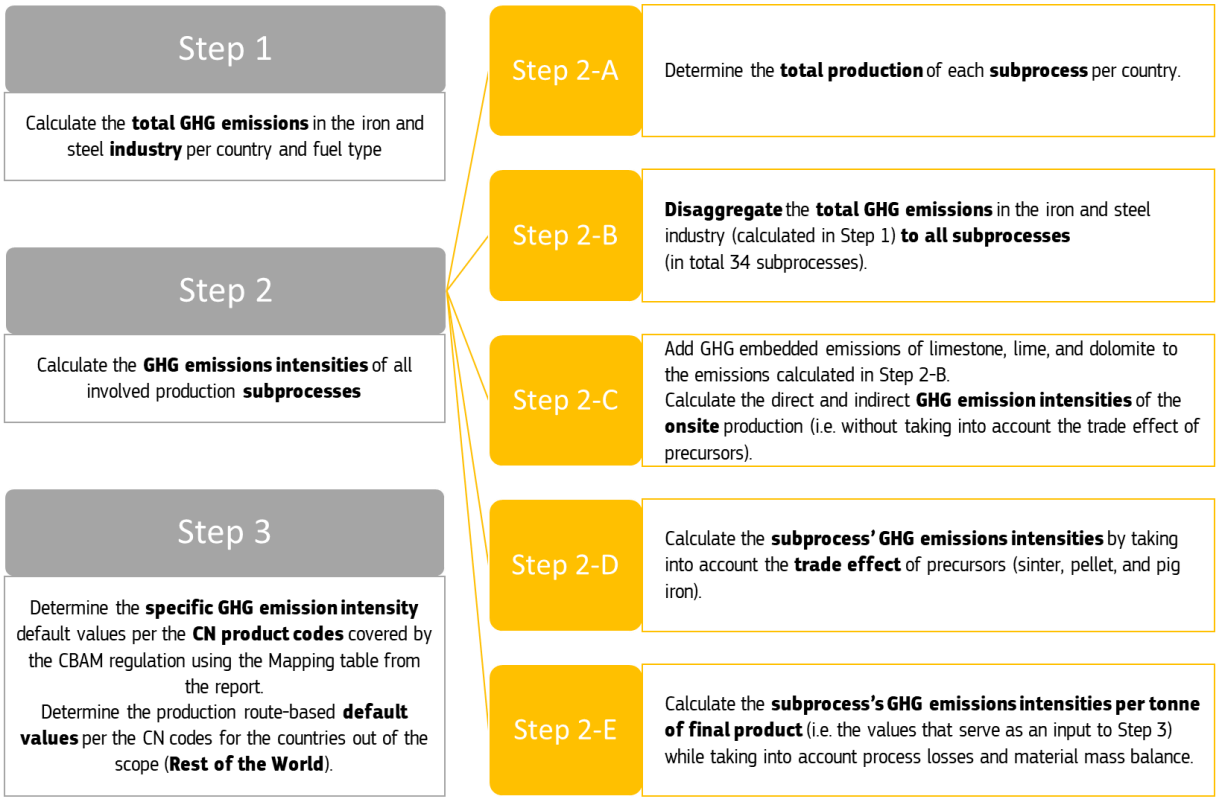
2.2 Determining greenhouse gas emission intensities

While the pilot study covered the semi-finished steel products (up to crude steel), this study goes one step further, i.e. the calculation of the specific embedded emissions of all iron and steel products (both semi-finished and final products) covered by the CBAM regulation.

Due to this difference in coverage, the methodology of this study differs from that of the pilot study regarding the disaggregation of the industry's total GHG emissions to the semi-finished steel products (i.e. up to crude steel) and finished steel products (i.e. products obtained after applying finalisation processes like forging, rolling and coating/plating to the semi-finished steel products). In the pilot study, an artificial split was made between semi-finished steel products and finalisation processes, based on the data for EU from the JRC-IDEES database (JRC, 2017c). In this study, a more accurate approach is applied, based on the production volume of the finished steel products per country, combined with the energy intensities of the processes involved (as described below), making the artificial split unnecessary.

The methodology applied in this study can be divided into three main steps summarised in Figure 4:

Figure 4. Methodology for calculation of iron and steel's GHG emission intensities.



Source: JRC, 2023.

In short:

Step 1: Calculate total GHG emissions in the iron and steel industry per country and fuel type;

Step 2: Calculate GHG emissions intensities of all involved production subprocesses, taking into account country's production volumes of the products covered by the CBAM regulation and the calculated total GHG emissions in step 1;

Step 3: Determine the specific GHG emission intensity per the CN product codes covered by the CBAM regulation for each country under the scope, as well as the production route-based embedded emissions per the CN codes for the countries out of the scope (referred to as weighted average).

In **Step 1**, to calculate total industry's GHG emissions per country and fuel type, the following equation is applied:

$$Total\ Emissions_{fuel}\left[\mathrm{t_{CO_2}}\right] = Fuel\ consumption\ [\mathrm{GJ}] \cdot EF_{fuel}\left[\frac{\mathrm{t_{CO_2}}}{\mathrm{GJ}}\right] \quad (3)$$

With EF_{fuel} standing for Emission Factor of fuel in tCO_2 per gigajoule.

Input data for the fuel consumption comes from the IEA Extended world energy balances (IEA, 2022), i.e. energy consumption in fuel transformation flow (blast furnaces) and energy consumption in final energy consumption flow (iron and steel industry). According to the CBAM regulation, GHG emissions from coke production in coke ovens are not covered (fuel consumption in coke ovens is reported separately from the iron and steel industry, i.e. under the fuel transformation flow for coke ovens in the IEA Extended world energy balances). CO_2 emission factors, listed in Annex 1, for stationary combustion in manufacturing industries, are retrieved principally from the CBAM Implementing Regulation (European Commission, 2023b). Country-specific carbon emission factors of electricity and heat are based on IEA data and calculated as a five-year average for the period 2015-2019 (IEA, 2021a).

In **Step 2**, GHG emission intensities of all subprocesses involved in the production of the products covered by the CBAM regulation (which serves as an input to Step 3) are calculated as follows. Figure 5 presents the processes involved in the production pathways of the iron and steel finished products, while Table 1 maps all the iron and steel products covered by the CBAM regulation, with the production routes (the list of numbers in the column, 'Mapping', of Table 1 corresponds to numbers in the upper left corner of the boxes in Figure 5). Some of the final products can be produced via several production routes (indicated in the column, 'Production route', of Table 1), and for each of these a GHG emission intensity value is produced, while the final product's GHG emission intensity is determined in Step 3. All boxes in Figure 5, except those which are green under the finished products group, represent the subprocesses for which the GHG emission intensity is determined. The GHG emission intensities of sinter and pellet plants are also determined since they represent precursors to pig iron production in a blast furnace. The green boxes in Figure 5 represent the final products whose GHG emission intensity is calculated as a sum of the GHG emission intensities of the previous boxes (numbers 1-20 + sinter and pellet GHG emission intensities, calculated per tonne of the final product) according to Table 1.

For some boxes in Figure 5, there are several variants on the GHG emission intensities: based on the material being processed (iron or steel for box number 8; and carbon steel or high alloy steel for box numbers 11, 12, 13, 14, 15, 17, 18, and 19), based on the technology used (Midrex, Corex, rotary kiln for box number 4), and on furnace type (basic EAF or induction furnace). Box number 5 (AOD/VOD) is treated differently, being considered a non-production box in which alloying elements are added to carbon steel in order to produce steel alloys. Energy consumption is not included and it is therefore considered a zero-GHG emission intensity subprocess for the purposes of this study. Consequently, GHG emission intensities are given for 34 subprocesses, including those of sinter and pellet plants.

In order to calculate the GHG emission intensity of the subprocesses involved per tonne of final product, it is necessary to:

- Step 2-A: Determine the total production of each subprocess per country.
- Step 2-B: Disaggregate the total GHG emissions calculated in the iron and steel industry in Step 1 to all subprocesses (34 in total, as described above).
- Step 2-C: Calculate the GHG emission intensities of onsite production (i.e., without taking into account the trade effect of the precursors (sinter, pellet and pig iron)).
- Step 2-D: Calculate the GHG emission intensities of the subprocesses, taking into account the trade effect of the precursors.
- Step 2-E: Calculate the GHG emission intensities of the subprocesses per tonne of the final product (i.e. the values that serve as an input to Step 3), taking into account process losses and material mass balance.

In **Step 2-A**, several references and assumptions were used in the determination of the subprocesses' production, as follows:

- Production data are directly available from (WorldSteel, 2021) for the following boxes in Figure 5: 1 (BF), 2 (BOF), 3 (EAF, where all production is attributed to the basic EAF, i.e., no production attributed to the induction furnace), 10 (Ingot casting) and 16 (Finishing of flat products). By applying to all countries the EU's share in total steel production of 78% of carbon non-alloy steel and 22% of high alloy steel (EUROFER, 2022), the corresponding production amounts from (WorldSteel, 2021) of boxes 11 (Continuous casting), 13 (Hot rolled mill), 17 (Beams, billets, rails and tubes mills), 18 (Bars, rods, and other long products mill), and 19 (Wire mill) are disaggregated into carbon steel and high alloy steel subvariants. Furthermore, by applying the EU's ratio of cold rolled flat products to total hot rolled flat products of 49% (EUROFER, 2022), the production amount can be calculated for box 14 (Cold rolled mill). It is assumed that all cold rolled flat products are also annealed, i.e., the production amounts of box 15 (Annealing) are the same as the production amounts of box 14 (Cold rolled mill), for both carbon steel and high alloy steel subvariants. The production amount of box 20 (Finishing of long products) is calculated by applying the EU's assumed share of 30% of galvanised/coated flat products in the total production of hot rolled flat products (EUROFER, 2022) to the total production of hot rolled bars, wire rods and tubular products (WorldSteel, 2021).
- The total production of DRI from (WorldSteel, 2021) is disaggregated into three types of DRI: natural gas-based Midrex, coal-based Corex, and coal-based Rotary Kiln, taking into account the production shares from (Midrex, 2021). DRI (natural gas-based Midrex) is the only production option in box 4 (DRI) for all countries except India, where 22.2% of total DRI production is natural gas-based Midrex, 8.3% coal-based Corex , and 69.5% coal-based Rotary Kiln.
- Production data are available from (CAEF, 2020) for the following boxes in Figure 5: 6 (Cast iron melting), 7 (Steel melting), 8 (Foundry casting, both of iron and steel) and 9 (Pig casting). Here, the assumption applied is that the total output from box 9 (Pig casting) is used in box 6 (Cast iron melting), and the total output from box 6 directly inputs into box 8 (Foundry casting – iron). Similarly, it is assumed that the total output from box 7 (Steel melting) becomes input to box 8 (Foundry casting – steel).
- The total production (EUROFORGE, 2022) of box 12 (Forging) in Figure 5 is disaggregated into carbon steel and high alloy steel subvariants by applying the EU's shares of 78% and 22%, respectively, in total steel production (EUROFER, 2022).
- Since sinter is not traded internationally, its production is assumed to be 4 380 kt in the United States (USGS, 2019). For other countries, sinter production is calculated as follows:

$$Sinter\ production\ [\mathrm{t}] = \frac{IO_{production} - IO_{export} + IO_{import} - IO_{pellet} - IO_{pig\ iron}}{iron\ ore\ consumption\ per\ t\ of\ sinter} \quad (4)$$

Where $IO_{production}$ denotes the total iron ore produced in a country, IO_{export} and IO_{import} denote total traded volumes of iron ore, and IO_{pellet} and $IO_{pig\ iron}$ represent the iron ore consumed in pellet and pig iron production, respectively.

Data source for iron ore production, export and import is (WorldSteel, 2021). Iron ore consumption per tonne of sinter and pellet is 0.81 t/t and 0.98 t/t, respectively. The iron ore consumption raises to 1.42t/t of pig iron when taking into account the amount of sinter, pellets and lump iron ore feeding the blast furnace, 1.09t/t, 0.36t/t and 0.18 t/t, respectively. (JRC, 2022b).

- In 2019, pellet production in Brazil was 32,000 kt (Löf & Löf, 2023). In the United States, pellet production is calculated as sum of 29,300 kt of pellet consumption (USGS, 2019) and 8,250 kt of pellet exports (UN Comtrade, 2022). For other countries, production of pellets it is assumed to be equal to the country's annual production capacity (Steel Institute VDEh, 2019).

In **Step 2-B**, the GHG emissions stemming from energy consumption reported under the final energy consumption flow of the iron and steel industry (calculated in Step 1) must be disaggregated to all 34 subprocesses described above, including the blast furnace. The GHG emissions stemming from energy

consumption reported under the fuel transformation flow of the blast furnace are attributed to the blast furnace subprocess only. To disaggregate the former per fuel type, it is multiplied by the share of fuel consumption of each subprocess in the total fuel consumption of each country. The following equation is applied:

$$Subprocess\ GHG\ emissions_{fuel}\left[\mathrm{t_{CO_2}}\right] = GHG\ emissions_{fuel}\left[\mathrm{t_{CO_2}}\right] \cdot Matrix\ A_{subprocess,fuel}[-] \quad (5)$$

Where *Subprocess GHG emissions*$_{fuel}$ represents the total GHG emissions per fuel type from Step 1, denoted with *GHG emissions*$_{fuel}$, disaggregated per the subprocesses, and *Matrix A*$_{subprocess,fuel}$ denote the subprocess' share of a corresponding fuel consumption in the total fuel consumption in iron and steel industry in a country.

Matrix A is calculated as follows:

$$Matrix\ A_{subprocess,fuel}[-] = \frac{Production_{subprocess}\ [\mathrm{t}] \cdot Matrix\ B_{subprocess,fuel}\left[\frac{\mathrm{GJ}}{\mathrm{t}}\right] \cdot Matrix\ C_{subprocess,fuel}[-]}{\sum_{subprocess}\left(Production_{subprocess}\ [\mathrm{t}] \cdot Matrix\ B_{subprocess,fuel}\left[\frac{\mathrm{GJ}}{\mathrm{t}}\right] \cdot Matrix\ C_{subprocess,fuel}[-]\right)} \quad (6)$$

Where *Production*$_{subprocess}$ represents the subprocess's production amount calculated in Step 2-A, *Matrix B* represents the subprocess's energy intensities given in Table 2, and *Matrix C,* given in Table 3, contains Boolean values to indicate whether a fuel is considered (1) or not (0) for a specific subprocess when disaggregating the energy balance sheets.

Thus, in the columns of *Matrix A* are listed all the same fuel types as in *Matrix B* (including the Total which corresponds to the consumption of all the fuels listed in the columns), while the rows contain the calculated country-specific shares (in %) of fuel consumption per subprocess. The sum of all rows per column (i.e., fuel types and Total) is 100%.

Since *Matrix A* has the same fuel types as *Matrix B,* but fewer than are reported in the IEA Extended world energy balances, the mapping approach of Table 4 is applied. For some fuels, there is a direct link between the IEA Extended world energy balances and *Matrix A* (e.g., blast furnace gas), while for some, where there is more granularity in the IEA Extended world energy balances, the broader definition from *Matrix A* is applied (e.g., coal instead of hard coal, brown coal, etc.). For the fuels that cannot be linked (e.g., peat and biogases), the Total column from *Matrix A* is applied (corresponding to the subprocess's share of all fuels consumed in the iron and steel industry).

In **Step 2-C**, although limestone and dolomite are not precursors within the CBAM, the direct CO_2 emissions from the consumption of carbonates (limestone or dolomite) occurring in the different iron and steel making processes are included in the scope. The corresponding emissions from the limestone and dolomite consumption are 0.44 tCO_2/and 0.476 tCO_2/t, respectively (WorldSteel, 2023a). These GHG emissions have to be added to the GHG emissions of sinter, pellet, BF, BOF, and EAF subprocesses (calculated in Step 2-B) according to the material mass balance given in Table 5..

GHG emission intensities of the onsite subprocess production (i.e., without taking into account the trade effect of the precursors) are calculated as follows:

$$Subprocess\ direct\ GHG\ emissions\ intensity_{onsite}\left[\frac{\mathrm{t_{CO_2}}}{t}\right] = \frac{\sum_{fuel} Subprocess\ GHG\ emissions_{fuel}\left[\mathrm{t_{CO_2}}\right]}{Production_{subprocess}\ [\mathrm{t}]} \quad (7)$$

$$Subprocess\ indirect\ GHG\ emissions\ intensity_{onsite}\left[\frac{\mathrm{t_{CO_2}}}{t}\right] = \frac{Subprocess\ GHG\ emissions_{electricity}\left[\mathrm{t_{CO_2}}\right]}{Production_{subprocess}\ [\mathrm{t}]} \quad (8)$$

Where *fuel* in the direct equation denotes all fuels from the IEA extended world energy balance sheet except electricity.

In **Step 2-D**, the GHG emission intensities of the subprocesses, taking into account the trade effect of the precursors (pellets and pig iron), are calculated using the equations given in section 1.1. Because of its physical

characteristics, sinter is not traded between countries. The source used for trade data on pellets is (UN Comtrade, 2022) and for pig iron the source is (WorldSteel, 2021).

The trade effect of crude steel (the precursor for rolling processes) is not taken into account because the emission intensity of crude steel is strongly dependent on the production route.

The values calculated in Step 2-D for sinter, pellets, pig iron and DRI cannot be used directly in the calculation of the product's carbon intensity because they are per tonne of the subprocess output. Thus, in **Step 2-E**, the emission intensities of sinter, pellets, pig iron and DRI are recalculated per tonne of the final product (iron or steel) as follows. The GHG emission intensity of sinter and pellet plants is calculated by dividing the calculated GHG emissions (both direct and indirect, with the trade effect) by the pig iron or DRI production figure. Here, it is assumed that sinter and pellets are used exclusively in the iron and steel industry. Where the final product is made of iron, the GHG emission intensities of pig iron and DRI (calculated in Step 2-D) are used.

For steel, a pig iron consumption of 0.94 t per tonne of semis is assumed from the calculations in (Moya & Pardo, 2013). Therefore, coke, sinter and pellets consumption per tonne of pig iron are affected by the same coefficient when accounted per tonne of semis. The DRI consumption per tonne of semis is similar to the consumption of pig iron per tonne of semis. There is also a consumption of:

- 1.06 tonnes of liquid steel per tonne of semis (output of continuous casting),
- 1.03 tonnes of semis per tonne of hot-rolled flat and long products, and
- 1.04 tonne of hot-rolled flat product per tonne of cold-rolled flat product.
- For other subprocesses, the data are not available and a factor of 1 is assumed, i.e. no material losses.

When combining these products' consumptions with the EU's production shares (39% long products, 61% flat products, of which 49% cold-rolled flat products (EUROFER, 2022), the effect is equivalent to an increase of the specific GHG emission intensities in steel furnaces (BOF, EAF), continuous casting, and hot rolling flat products by 11%, 4%, 2%, respectively.

In **Step 3**, the specific GHG emission intensities are calculated according to the CN product codes covered by the CBAM regulation. In addition to iron and non-alloy (carbon) steel, the CBAM regulation also covers stainless steel and other steel alloys. Therefore, embedded emissions from the added alloying elements are taken into account.

Ferro-manganese (FeMn), Ferro-chromium (FeCr) and Ferro-nickel (FeNi) represent ferroalloys covered by the CBAM regulation for which the GHG emission intensity values are calculated as described below. These ferroalloys, together with other alloying elements not covered by the CBAM regulation (like pure nickel (Ni), Ferro-molybdenum (FeMo), Ferro-silicon (FeSi), Silico-manganese (SiMn) etc.) and Nickel Pig Iron (NPI, covered by the CBAM regulation), represent precursors in the production of stainless steel and other steel alloys (both covered by the CBAM regulation). They are added to the carbon steel (produced via BOF or EAF) in box 5 of Figure 5 according to strictly prescribed amounts, to formulate the desired steel grade. Among the countries in scope, NPI as a nickel source is only relevant to China, where 60% of the nickel content in steel alloys comes from NPI (SMM, 2023). Ferroalloys are ranged in grades according to the content of the main alloying element. In the calculations, the following ferroalloy compositions were used:

- FeNi: 30% Ni, 70% Fe (Crundwell et al, 2011)
- FeCr: 52.5% Cr, 37% Fe (Holappa, 2013)
- FeMn: 72.5% Mn, 23% Fe (ZhenAn, 2023)
- Ni: 100% Ni
- FeMo: 62.5% Mo, 35.15% Fe (ZhenAn, 2023)
- FeSi: 70% Si, 27.74% Fe (ZhenAn, 2023)
- NPI: 12.5% Ni, 87.5% Fe (Rao et al., 2013)

Not all steel-producing countries also produce ferroalloys. Accordingly, the calculation of the GHG emission intensity of ferroalloys is divided into three steps. In the first two steps, the direct and indirect GHG emission intensities are calculated, while in the third step, the total GHG emission intensity of ferroalloys is calculated per country, based on our categorisation of the countries in terms of the production and imports of ferroalloys (as described below). In the first step, the direct GHG emission intensity is calculated by combining the energy

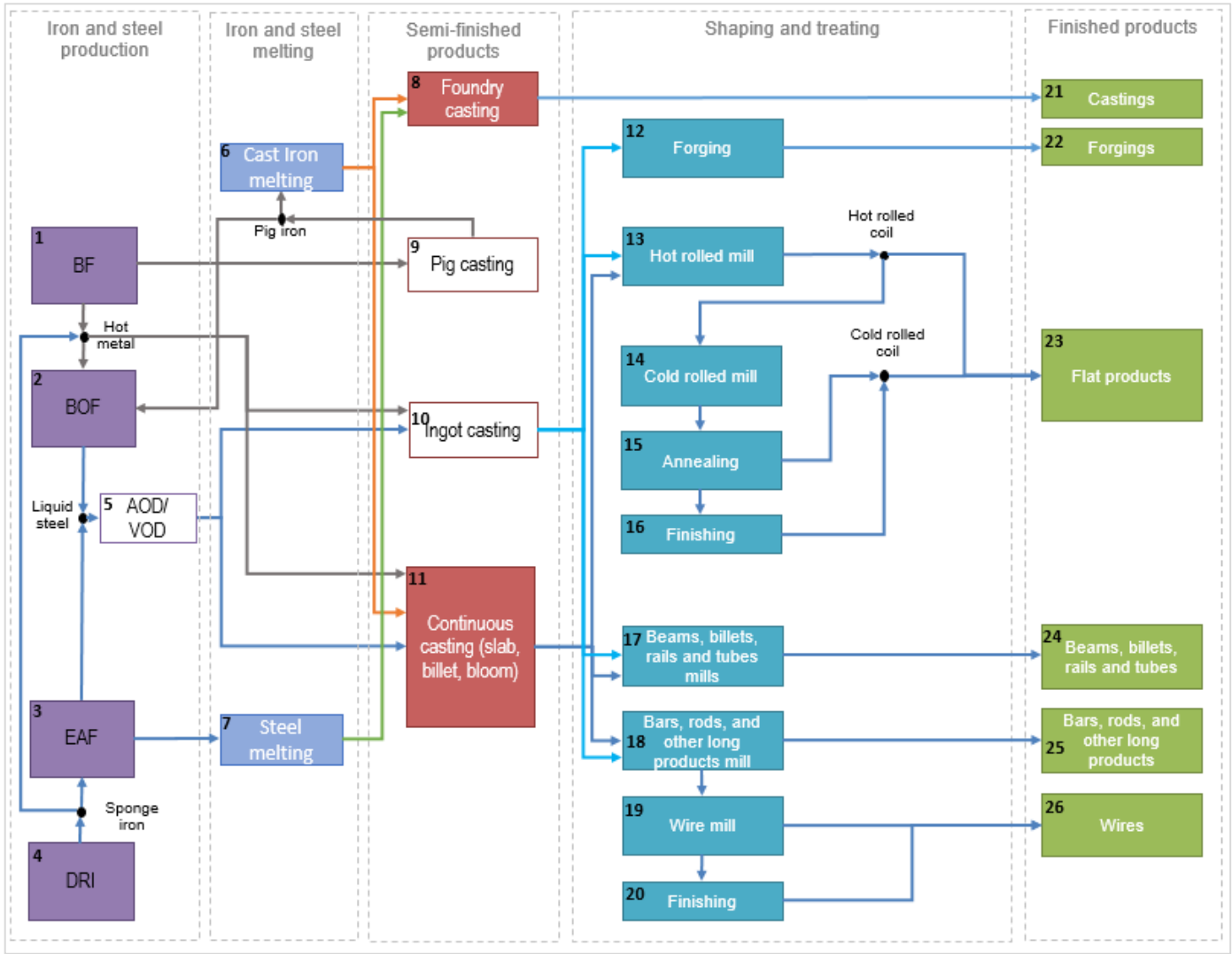
intensity of ferroalloys and the fuel emission factors (European Commission, 2023b), which results in the same value for all countries. In the second step, the indirect GHG emission intensity is calculated by multiplying the ferroalloy's electricity intensity with the carbon intensity of electricity in that country (IEA, 2021a). The data source for the energy intensity of FeCr and FeMn is (Holappa, 2013), and for FeNi and NPI the source is (Wei et al, 2020). Since the carbon intensity of electricity differs per country, the trade effect of ferroalloys (UN Comtrade, 2022) must be taken into account. In the absence of data on the production of ferroalloys, we use the presence of exports as an indication of local production in each country. Therefore, if a country exports ferroalloy, it is regarded as a ferroalloy producer and the total ferroalloy GHG emission intensity is calculated as the sum of the direct and indirect GHG emission intensities calculated in the first two steps described above. On the other hand, if a country does not export ferroalloys, it is assumed that it does not produce ferroalloys (i.e., it is regarded as a ferroalloy importer) and, in order to calculate the country's total GHG emission intensity for ferroalloys, the indirect GHG emission intensity, weighted by the imported volumes of ferroalloys, is added to the direct GHG emission intensity calculated in step 1.

To determine the GHG emission intensity of stainless steel and other steel alloys, the list of all steel grades per CN code (Steel Institute VDEh, 2023) is used. It is calculated by multiplying the mid values of the steel grade composition ranges by the alloying element emission intensities (FeNi, FeCr, FeMn and NPI), proportional to the alloying element grades (listed above). The GHG emission intensities of other alloying elements not covered by the CBAM regulation (like FeMo, FeSi, Ni, etc.) are not included, but their weight is taken into account for the determination of ferrous content in the steel grade. Similarly, no additional GHG emissions are attributed to the ferrous content in steel alloys stemming from the use of ferroalloys (which is already taken into account in the ferroalloy GHG emission intensity) but its weight is taken into account when determining the share of GHG emission intensity of the liquid (carbon) steel to be added in (i.e., the remaining ferrous content part). Two GHG emission intensities are attributed to the remaining ferrous content in steel grade: one for the liquid (carbon) steel from BOF and the other for liquid (carbon) steel from EAF. In situations where the use of FeNi (30%Ni) is not possible due to low nickel content, the highest possible FeNi grade FeNi (70%Ni) is applied. If FeNi (70%Ni) is also insufficient to provide all the nickel required, then the use of pure Ni is assumed (with a zero-GHG emission intensity, due to its exclusion from the list of precursors in the CBAM regulation). When all stainless steel and other steel alloy grades are considered, the selection of one steel grade, whose direct and indirect GHG emission intensities are included in the further calculations, is based on the median value of the total steel grade's GHG emission intensity. The same applies where several steel grades can be used under one CN code.

Finally, the GHG emission intensities per the CN product codes covered by the CBAM regulation are calculated by summing the specific GHG emission intensities per tonne of the final product (calculated in Step 2-E) while following the mapping roadmap information given in Table 1. In the case of stainless steel and other steel alloys, the GHG emission intensities calculated, per tonne, represent the starting point to which the intensities (calculated in Step 2-E) of boxes 6-20 of Figure 5 are added, according to Table 1. When there are several production pathways possible for a CN code, the final GHG emission intensity corresponds to the production pathway with the highest GHG emission intensity.

For countries not under the scope of this study, embedded emissions for the primary route are calculated weighting (by production volume) the calculated GHG emission intensities of the third countries under the scope of this study (in this case, for China, NPI is not considered a nickel source). The resulting embedded emission per CN code for all countries under the scope and weighted average are given in Annex 2.

Figure 5. Production routes of the iron and steel finished products.



BF – Blast Furnace; BOF - Basic Oxygen Furnace; EAF – Electric Arc Furnace; DRI – Direct Reduced Iron; AOD - Argon Oxygen Decarburization; VOD - Vacuum Oxygen Decarburization

Source: JRC, 2023.

Table 1. Mapping of the iron and steel products covered by the CBAM with the production routes and product CN codes.

Product CN Code	Mapping*	Production route	Description
2601 12 00	Sinter ore	Iron ore	Agglomerated iron ores and concentrates, other than roasted iron pyrites
2601 12 00	Pellets ore	Iron ore	Agglomerated iron ores and concentrates, other than roasted iron pyrites
7201	1, 9	Primary route	Pig iron and spiegeleisen in pigs, blocks or other primary forms
7202 11 7202 19	Ferro-manganese	Ferro-alloys	Ferro-manganese
7202 41 7202 49	Ferro-chromium	Ferro-alloys	Ferro-chromium
7202 60 00	Ferro-nickel	Ferro-alloys	Ferro-nickel
7203	4	DRI (Midrex)	Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products, in lumps, pellets or the like; iron having a minimum purity of 99.94%, in lumps, pellets or similar forms
7203	4	DRI (Corex)	Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products, in lumps, pellets or the like; iron having a minimum purity of 99.94%, in lumps, pellets or similar forms
7205	1, 9	Primary route	Granules and powders, of pig iron, spiegeleisen, iron or steel
7205	1, 2	Primary route	Granules and powders, of pig iron, spiegeleisen, iron or steel
7206			Iron and non-alloy steel in ingots or other primary forms (excluding iron of heading no. 7203)
7206 10 00	1, 2, 10	Primary route	Ingots
7206 10 00	3, 10	Secondary route - EAF	Ingots
7206 10 00	3, 10	Secondary route - Induction furnace	Ingots
7206 90 00	1, 2, 11	Primary route	Continuous casting (slab, billet, bloom)
7206 90 00	3, 11	Secondary route - EAF	Continuous casting (slab, billet, bloom)
7206 90 00	3, 11	Secondary route - Induction furnace	Continuous casting (slab, billet, bloom)
7207			Iron or non-alloy steel; semi-finished products thereof
7207 11 11 7207 11 14 7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32	1, 2, 11, 18, 25	Primary route	Bars, rods, and other long products

Product CN Code	Mapping*	Production route	Description
7207 20 52 7207 20 80			
7207 11 11 7207 11 14 7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32 7207 20 52 7207 20 80	3, 11, 18, 25	Secondary route - EAF	Bars, rods, and other long products
7207 11 11 7207 11 14 7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32 7207 20 52 7207 20 80	3, 11, 18, 25	Secondary route - Induction furnace	Bars, rods, and other long products
7207 11 11 7207 11 14 7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32 7207 20 52 7207 20 80	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Bars, rods, and other long products
7207 11 11 7207 11 14	2, 4, 11, 18, 25	DRI (Corex)-BOF	Bars, rods, and other long products

Product CN Code	Mapping*	Production route	Description
7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32 7207 20 52 7207 20 80			
7207 11 11 7207 11 14 7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32 7207 20 52 7207 20 80	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Bars, rods, and other long products
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	1, 2, 10, 12, 22	Primary route	Forgings
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	3, 10, 12, 22	Secondary route - EAF	Forgings
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	3, 10, 12, 22	Secondary route - Induction furnace	Forgings

Product CN Code	Mapping*	Production route	Description
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	3, 4, 10, 12, 22	DRI (Midrex)-EAF	Forgings
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	2, 4, 10, 12, 22	DRI (Corex)-BOF	Forgings
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	3, 4, 10, 12, 22	DRI (Rotary Kiln)-EAF	Forgings
7208	1, 2, 11, 13, 23	Primary route	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated
7208	3, 11, 13, 23	Secondary route - EAF	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated
7208	3, 11, 13, 23	Secondary route - Induction furnace	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated
7208	3, 4, 11, 13, 23	DRI (Midrex)-EAF	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated
7208	2, 4, 11, 13, 23	DRI (Corex)-BOF	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated
7208	3, 4, 11, 13, 23	DRI (Rotary Kiln)-EAF	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated
7209	1, 2, 11, 13, 14, 15, 23	Primary route	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated
7209	3, 11, 13, 14, 15, 23	Secondary route - EAF	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated
7209	3, 11, 13, 14, 15, 23	Secondary route - Induction furnace	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated
7209	3, 4, 11, 13, 14, 15, 23	DRI (Midrex)-EAF	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated

Product CN Code	Mapping*	Production route	Description
7209	2, 4, 11, 13, 14, 15, 23	DRI (Corex)-BOF	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated
7209	3, 4, 11, 13, 14, 15, 23	DRI (Rotary Kiln)-EAF	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated
7210	1, 2, 11, 13, 14, 15, 16, 23	Primary route	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated
7210	3, 11, 13, 14, 15, 16, 23	Secondary route - EAF	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated
7210	3, 11, 13, 14, 15, 16, 23	Secondary route - Induction furnace	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated
7210	3, 4, 11, 13, 14, 15, 16, 23	DRI (Midrex)-EAF	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated
7210	2, 4, 11, 13, 14, 15, 16, 23	DRI (Corex)-BOF	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated
7210	3, 4, 11, 13, 14, 15, 16, 23	DRI (Rotary Kiln)-EAF	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated
7211			Iron or non-alloy steel; flat-rolled products, width less than 600mm, not clad, plated or coated
7211 13 00 7211 14 00 7211 19 00	1, 2, 11, 13, 23	Primary route	Hot-rolled flat products
7211 13 00 7211 14 00 7211 19 00	3, 11, 13, 23	Secondary route - EAF	Hot-rolled flat products
7211 13 00 7211 14 00 7211 19 00	3, 11, 13, 23	Secondary route - Induction furnace	Hot-rolled flat products
7211 13 00 7211 14 00 7211 19 00	3, 4, 11, 13, 23	DRI (Midrex)-EAF	Hot-rolled flat products
7211 13 00 7211 14 00 7211 19 00	2, 4, 11, 13, 23	DRI (Corex)-BOF	Hot-rolled flat products
7211 13 00 7211 14 00 7211 19 00	3, 4, 11, 13, 23	DRI (Rotary Kiln)-EAF	Hot-rolled flat products
7211 23 7211 29 00 7211 90	1, 2, 11, 13, 14, 15, 23	Primary route	Cold-rolled and annealed flat products
7211 23 7211 29 00 7211 90	3, 11, 13, 14, 15, 23	Secondary route - EAF	Cold-rolled and annealed flat products
7211 23 7211 29 00 7211 90	3, 11, 13, 14, 15, 23	Secondary route - Induction furnace	Cold-rolled and annealed flat products

Product CN Code	Mapping*	Production route	Description
7211 23 7211 29 00 7211 90	3, 4, 11, 13, 14, 15, 23	DRI (Midrex)-EAF	Cold-rolled and annealed flat products
7211 23 7211 29 00 7211 90	2, 4, 11, 13, 14, 15, 23	DRI (Corex)-BOF	Cold-rolled and annealed flat products
7211 23 7211 29 00 7211 90	3, 4, 11, 13, 14, 15, 23	DRI (Rotary Kiln)-EAF	Cold-rolled and annealed flat products
7212	1, 2, 11, 13, 14, 15, 16, 23	Primary route	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated
7212	3, 11, 13, 14, 15, 16, 23	Secondary route - EAF	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated
7212	3, 11, 13, 14, 15, 16, 23	Secondary route - Induction furnace	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated
7212	3, 4, 11, 13, 14, 15, 16, 23	DRI (Midrex)-EAF	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated
7212	2, 4, 11, 13, 14, 15, 16, 23	DRI (Corex)-BOF	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated
7212	3, 4, 11, 13, 14, 15, 16, 23	DRI (Rotary Kiln)-EAF	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated
7213	1, 2, 11, 18, 25	Primary route	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils
7213	3, 11, 18, 25	Secondary route - EAF	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils
7213	3, 11, 18, 25	Secondary route - Induction furnace	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils
7213	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils
7213	2, 4, 11, 18, 25	DRI (Corex)-BOF	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils
7213	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils
7214			Iron or non-alloy steel; bars and rods, not further worked than forged, hot-rolled, hot drawn or hot-extruded, but including those twisted after rolling
7214 10 00	1, 2, 10, 12, 22	Primary route	Forgings
7214 10 00	3, 10, 12, 22	Secondary route - EAF	Forgings
7214 10 00	3, 10, 12, 22	Secondary route - Induction furnace	Forgings
7214 10 00	3, 4, 10, 12, 22	DRI (Midrex)-EAF	Forgings
7214 10 00	2, 4, 10, 12, 22	DRI (Corex)-BOF	Forgings
7214 10 00	3, 4, 10, 12, 22	DRI (Rotary Kiln)-EAF	Forgings
7214 20 00 7214 30 00 7214 91 7214 99	1, 2, 11, 18, 25	Primary route	Bars, rods, and other long products
7214 20 00 7214 30 00	3, 11, 18, 25	Secondary route - EAF	Bars, rods, and other long products

Product CN Code	Mapping*	Production route	Description
7214 91 7214 99			
7214 20 00 7214 30 00 7214 91 7214 99	3, 11, 18, 25	Secondary route - Induction furnace	Bars, rods, and other long products
7214 20 00 7214 30 00 7214 91 7214 99	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Bars, rods, and other long products
7214 20 00 7214 30 00 7214 91 7214 99	2, 4, 11, 18, 25	DRI (Corex)-BOF	Bars, rods, and other long products
7214 20 00 7214 30 00 7214 91 7214 99	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Bars, rods, and other long products
7215	1, 2, 11, 18, 25	Primary route	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72
7215	3, 11, 18, 25	Secondary route - EAF	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72
7215	3, 11, 18, 25	Secondary route - Induction furnace	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72
7215	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72
7215	2, 4, 11, 18, 25	DRI (Corex)-BOF	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72
7215	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72
7216	1, 2, 11, 18, 25	Primary route	Iron or non-alloy steel, angles, shapes and sections
7216	3, 11, 18, 25	Secondary route - EAF	Iron or non-alloy steel, angles, shapes and sections
7216	3, 11, 18, 25	Secondary route - Induction furnace	Iron or non-alloy steel, angles, shapes and sections
7216	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Iron or non-alloy steel, angles, shapes and sections
7216	2, 4, 11, 18, 25	DRI (Corex)-BOF	Iron or non-alloy steel, angles, shapes and sections
7216	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Iron or non-alloy steel, angles, shapes and sections
7217			Wire of iron or non-alloy steel.
7217 10	1, 2, 11, 18, 19, 26	Primary route	Wires
7217 10	3, 11, 18, 19, 26	Secondary route - EAF	Wires
7217 10	3, 11, 18, 19, 26	Secondary route - Induction furnace	Wires
7217 10	3, 4, 11, 18, 19, 26	DRI (Midrex)-EAF	Wires
7217 10	2, 4, 11, 18, 19, 26	DRI (Corex)-BOF	Wires

Product CN Code	Mapping*	Production route	Description
7217 10	3, 4, 11, 18, 19, 26	DRI (Rotary Kiln)-EAF	Wires
7217 20 7217 30 7217 90	1, 2, 11, 18, 19, 20, 26	Primary route	Plated or coated wires
7217 20 7217 30 7217 90	3, 11, 18, 19, 20, 26	Secondary route - EAF	Plated or coated wires
7217 20 7217 30 7217 90	3, 11, 18, 19, 20, 26	Secondary route - Induction furnace	Plated or coated wires
7217 20 7217 30 7217 90	3, 4, 11, 18, 19, 20, 26	DRI (Midrex)-EAF	Plated or coated wires
7217 20 7217 30 7217 90	2, 4, 11, 18, 19, 20, 26	DRI (Corex)-BOF	Plated or coated wires
7217 20 7217 30 7217 90	3, 4, 11, 18, 19, 20, 26	DRI (Rotary Kiln)-EAF	Plated or coated wires
7218			Stainless steel in ingots or other primary forms; semi-finished products of stainless steel.
7218 10 00 7218 99 19 7218 99 80	1, 2, 5, 10, 12, 22	Primary route steel alloy	Ingots and forgings
7218 10 00 7218 99 19 7218 99 80	3, 5, 10, 12, 22	Secondary route steel alloy - EAF	Ingots and forgings
7218 10 00 7218 99 19 7218 99 80	3, 5, 10, 12, 22	Secondary route steel alloy - Induction furnace	Ingots and forgings
7218 91 7218 99 11 7218 99 20	1, 2, 5, 11, 13, 23	Primary route steel alloy	Hot-rolled flat products
7218 91 7218 99 11 7218 99 20	3, 5, 11, 13, 23	Secondary route steel alloy - EAF	Hot-rolled flat products
7218 91 7218 99 11 7218 99 20	3, 5, 11, 13, 23	Secondary route steel alloy - Induction furnace	Hot-rolled flat products
7219			Stainless steel; flat-rolled products of width of 600mm or more

Product CN Code	Mapping*	Production route	Description
7219 11 00 7219 12 7219 13 7219 14 7219 21 7219 22 7219 23 00 7219 24 00	1, 2, 5, 11, 13, 23	Primary route steel alloy	Hot-rolled flat products
7219 11 00 7219 12 7219 13 7219 14 7219 21 7219 22 7219 23 00 7219 24 00	3, 5, 11, 13, 23	Secondary route steel alloy - EAF	Hot-rolled flat products
7219 11 00 7219 12 7219 13 7219 14 7219 21 7219 22 7219 23 00 7219 24 00	3, 5, 11, 13, 23	Secondary route steel alloy - Induction furnace	Hot-rolled flat products
7219 31 00 7219 32 7219 33 7219 34 7219 35 7219 90	1, 2, 5, 11, 13, 14, 15, 23	Primary route steel alloy	Cold-rolled and annealed flat products
7219 31 00 7219 32 7219 33 7219 34 7219 35 7219 90	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - EAF	Cold-rolled and annealed flat products
7219 31 00 7219 32 7219 33	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - Induction furnace	Cold-rolled and annealed flat products

Product CN Code	Mapping*	Production route	Description
7219 34 7219 35 7219 90			
7220			Stainless steel; flat-rolled products of width less than 600mm
7220 11 00 7220 12 00	1, 2, 5, 11, 13, 23	Primary route steel alloy	Hot-rolled flat products
7220 11 00 7220 12 00	3, 5, 11, 13, 23	Secondary route steel alloy - EAF	Hot-rolled flat products
7220 11 00 7220 12 00	3, 5, 11, 13, 23	Secondary route steel alloy - Induction furnace	Hot-rolled flat products
7220 20 7220 90	1, 2, 5, 11, 13, 14, 15, 23	Primary route steel alloy	Cold-rolled and annealed flat products
7220 20 7220 90	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - EAF	Cold-rolled and annealed flat products
7220 20 7220 90	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - Induction furnace	Cold-rolled and annealed flat products
7221	1, 2, 5, 11, 18, 25	Primary route steel alloy	Stainless steel bars and rods, hot-rolled, in irregularly wound coils
7221	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Stainless steel bars and rods, hot-rolled, in irregularly wound coils
7221	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Stainless steel bars and rods, hot-rolled, in irregularly wound coils
7222			Stainless steel bars and rods, angles, shapes and sections
7222 11 7222 19 7222 20 7222 40	1, 2, 5, 11, 18, 25	Primary route steel alloy	Bars, rods, and other long products
7222 11 7222 19 7222 20 7222 40	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Bars, rods, and other long products
7222 11 7222 19 7222 20 7222 40	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Bars, rods, and other long products

Product CN Code	Mapping*	Production route	Description
7222 30	1, 2, 5, 10, 12, 22	Primary route steel alloy	Forgings
7222 30	3, 5, 10, 12, 22	Secondary route steel alloy - EAF	Forgings
7222 30	3, 5, 10, 12, 22	Secondary route steel alloy - Induction furnace	Forgings
7223			Stainless steel wire
7223 00	1, 2, 5, 11, 18, 19, 26	Primary route steel alloy	Wires
7223 00	3, 5, 11, 18, 19, 26	Secondary route steel alloy - EAF	Wires
7223 00	3, 5, 11, 18, 19, 26	Secondary route steel alloy - Induction furnace	Wires
7224			Alloy steel in ingots or other primary forms, semi-finished products of other alloy steel
7224 10 7224 90 18 7224 90 90	1, 2, 5, 10, 12, 22	Primary route steel alloy	Ingots and forgings
7224 10 7224 90 18 7224 90 90	3, 5, 10, 12, 22	Secondary route steel alloy - EAF	Ingots and forgings
7224 10 7224 90 18 7224 90 90	3, 5, 10, 12, 22	Secondary route steel alloy - Induction furnace	Ingots and forgings
7224 90 02 7224 90 03 7224 90 05 7224 90 07 7224 90 14 7224 90 31 7224 90 38	1, 2, 5, 11, 13, 23	Primary route steel alloy	Hot-rolled flat products
7224 90 02 7224 90 03 7224 90 05 7224 90 07 7224 90 14 7224 90 31 7224 90 38	3, 5, 11, 13, 23	Secondary route steel alloy - EAF	Hot-rolled flat products

Product CN Code	Mapping*	Production route	Description
7224 90 02 7224 90 03 7224 90 05 7224 90 07 7224 90 14 7224 90 31 7224 90 38	3, 5, 11, 13, 23	Secondary route steel alloy - Induction furnace	Hot-rolled flat products
7225			Alloy steel flat-rolled products, of a width 600mm or more
7225 11 00 7225 19 10 7225 30 7225 40	1, 2, 5, 11, 13, 23	Primary route steel alloy	Hot-rolled flat products
7225 11 00 7225 19 10 7225 30 7225 40	3, 5, 11, 13, 23	Secondary route steel alloy - EAF	Hot-rolled flat products
7225 11 00 7225 19 10 7225 30 7225 40	3, 5, 11, 13, 23	Secondary route steel alloy - Induction furnace	Hot-rolled flat products
7225 19 90 7225 50	1, 2, 5, 11, 13, 14, 15, 23	Primary route steel alloy	Cold-rolled and annealed flat products
7225 19 90 7225 50	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - EAF	Cold-rolled and annealed flat products
7225 19 90 7225 50	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - Induction furnace	Cold-rolled and annealed flat products
7225 91 00 7225 92 00 7225 99 00	1, 2, 5, 11, 13, 14, 15, 16, 23	Primary route steel alloy	Plated or coated flat products
7225 91 00 7225 92 00 7225 99 00	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - EAF	Plated or coated flat products
7225 91 00 7225 92 00 7225 99 00	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - Induction furnace	Plated or coated flat products
7226			Alloy steel flat-rolled products, of a width of less than 600mm
7226 11 00 7226 19 10	1, 2, 5, 11, 13, 23	Primary route steel alloy	Hot-rolled flat products

Product CN Code	Mapping*	Production route	Description
7226 20 00 7226 91			
7226 11 00 7226 19 10 7226 20 00 7226 91	3, 5, 11, 13, 23	Secondary route steel alloy - EAF	Hot-rolled flat products
7226 11 00 7226 19 10 7226 20 00 7226 91	3, 5, 11, 13, 23	Secondary route steel alloy - Induction furnace	Hot-rolled flat products
7226 19 80 7226 92 00	1, 2, 5, 11, 13, 14, 15, 23	Primary route steel alloy	Cold-rolled and annealed flat products
7226 19 80 7226 92 00	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - EAF	Cold-rolled and annealed flat products
7226 19 80 7226 92 00	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - Induction furnace	Cold-rolled and annealed flat products
7226 99	1, 2, 5, 11, 13, 14, 15, 16, 23	Primary route steel alloy	Plated or coated flat products
7226 99	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - EAF	Plated or coated flat products
7226 99	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - Induction furnace	Plated or coated flat products
7227	1, 2, 5, 11, 18, 25	Primary route steel alloy	Steel, alloy; bars and rods, hot-rolled, in irregularly wound coils
7227	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Steel, alloy; bars and rods, hot-rolled, in irregularly wound coils
7227	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Steel, alloy; bars and rods, hot-rolled, in irregularly wound coils
7228			Alloy steel bars, rods, shapes and sections; hollow drill bars and rods, of alloy or non-alloy steel
7228 10 20 7228 10 90 7228 20 7228 30 7228 50 7228 60	1, 2, 5, 11, 18, 25	Primary route steel alloy	Bars, rods, and other long products

Product CN Code	Mapping*	Production route	Description
7228 70 7228 80 00			
7228 10 20 7228 10 90 7228 20 7228 30 7228 50 7228 60 7228 70 7228 80 00	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Bars, rods, and other long products
7228 10 20 7228 10 90 7228 20 7228 30 7228 50 7228 60 7228 70 7228 80 00	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Bars, rods, and other long products
7228 10 50 7228 40	1, 2, 5, 10, 12, 22	Primary route steel alloy	Forgings
7228 10 50 7228 40	3, 5, 10, 12, 22	Secondary route steel alloy - EAF	Forgings
7228 10 50 7228 40	3, 5, 10, 12, 22	Secondary route steel alloy - Induction furnace	Forgings
7229	1, 2, 5, 11, 18, 19, 26	Primary route steel alloy	Wire of other alloy steel.
7229	3, 5, 11, 18, 19, 26	Secondary route steel alloy - EAF	Wire of other alloy steel.
7229	3, 5, 11, 18, 19, 26	Secondary route steel alloy - Induction furnace	Wire of other alloy steel.
7301	1, 2, 11, 13, 14, 15, 23	Primary route	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.
7301	1, 2, 5, 11, 13, 14, 15, 23	Primary route steel alloy	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.
7301	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - EAF	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.

Product CN Code	Mapping*	Production route	Description
7301	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - Induction furnace	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.
7301	3, 4, 11, 13, 14, 15, 23	DRI (Midrex)-EAF	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.
7301	2, 4, 11, 13, 14, 15, 23	DRI (Corex)-BOF	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.
7301	3, 4, 11, 13, 14, 15, 23	DRI (Rotary Kiln)-EAF	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.
7302	1, 2, 11, 17, 24	Primary route	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates
7302	1, 2, 5, 11, 17, 24	Primary route steel alloy	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates
7302	3, 5, 11, 17, 24	Secondary route steel alloy - EAF	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates
7302	3, 5, 11, 17, 24	Secondary route steel alloy - Induction furnace	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates
7302	3, 4, 11, 17, 24	DRI (Midrex)-EAF	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates
7302	2, 4, 11, 17, 24	DRI (Corex)-BOF	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates
7302	3, 4, 11, 17, 24	DRI (Rotary Kiln)-EAF	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates
7303			Tubes, pipes & hollow profiles of cast iron
730300	1, 9, 6, 11, 17, 24	Primary route	Tubes, pipes & hollow profiles of cast iron
7304			Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel
7304 11 00 7304 22 00 7304 24 00 7304 41 00 7304 49	1, 2, 5, 11, 17, 24	Primary route steel alloy	Beams, billets, rails and tubes -- alloying elements group 1

Product CN Code	Mapping*	Production route	Description
7304 51 7304 59			
7304 11 00 7304 22 00 7304 24 00 7304 41 00 7304 49 7304 51 7304 59	3, 5, 11, 17, 24	Secondary route steel alloy - EAF	Beams, billets, rails and tubes -- alloying elements group 1
7304 11 00 7304 22 00 7304 24 00 7304 41 00 7304 49 7304 51 7304 59	3, 5, 11, 17, 24	Secondary route steel alloy - Induction furnace	Beams, billets, rails and tubes -- alloying elements group 1
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	1, 2, 11, 17, 24	Primary route	Beams, billets, rails and tubes -- alloying elements group 2
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	1, 2, 5, 11, 17, 24	Primary route steel alloy	Beams, billets, rails and tubes -- alloying elements group 2
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	3, 5, 11, 17, 24	Secondary route steel alloy - EAF	Beams, billets, rails and tubes -- alloying elements group 2
7304 19 7304 23 00 7304 29 7304 31	3, 5, 11, 17, 24	Secondary route steel alloy - Induction furnace	Beams, billets, rails and tubes -- alloying elements group 2

Product CN Code	Mapping*	Production route	Description
7304 39 7304 90 00			
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	3, 4, 11, 17, 24	DRI (Midrex)-EAF	Beams, billets, rails and tubes -- alloying elements group 2
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	2, 4, 11, 17, 24	DRI (Corex)-BOF	Beams, billets, rails and tubes -- alloying elements group 2
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	3, 4, 11, 17, 24	DRI (Rotary Kiln)-EAF	Beams, billets, rails and tubes -- alloying elements group 2
7305	1, 2, 11, 13, 14, 15, 23	Primary route	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.
7305	1, 2, 5, 11, 13, 14, 15, 23	Primary route steel alloy	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.
7305	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - EAF	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.
7305	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - Induction furnace	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.
7305	3, 4, 11, 13, 14, 15, 23	DRI (Midrex)-EAF	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.
7305	2, 4, 11, 13, 14, 15, 23	DRI (Corex)-BOF	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.
7305	3, 4, 11, 13, 14, 15, 23	DRI (Rotary Kiln)-EAF	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.
7306			Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel.
7306 30 18	1, 2, 11, 13, 23	Primary route	Hot-rolled flat products

Product CN Code	Mapping*	Production route	Description
7306 30 18	1, 2, 5, 11, 13, 23	Primary route steel alloy	Hot-rolled flat products
7306 30 18	3, 5, 11, 13, 23	Secondary route steel alloy - EAF	Hot-rolled flat products
7306 30 18	3, 5, 11, 13, 23	Secondary route steel alloy - Induction furnace	Hot-rolled flat products
7306 30 18	3, 4, 11, 13, 23	DRI (Midrex)-EAF	Hot-rolled flat products
7306 30 18	2, 4, 11, 13, 23	DRI (Corex)-BOF	Hot-rolled flat products
7306 30 18	3, 4, 11, 13, 23	DRI (Rotary Kiln)-EAF	Hot-rolled flat products
7306 19 00 7306 29 00 7306 30 12	1, 2, 11, 13, 14, 15, 23	Primary route	Cold-rolled and annealed flat products
7306 19 00 7306 29 00 7306 30 12	1, 2, 5, 11, 13, 14, 15, 23	Primary route steel alloy	Cold-rolled and annealed flat products
7306 19 00 7306 29 00 7306 30 12	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - EAF	Cold-rolled and annealed flat products
7306 19 00 7306 29 00 7306 30 12	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - Induction furnace	Cold-rolled and annealed flat products
7306 19 00 7306 29 00 7306 30 12	3, 4, 11, 13, 14, 15, 23	DRI (Midrex)-EAF	Cold-rolled and annealed flat products
7306 19 00 7306 29 00 7306 30 12	2, 4, 11, 13, 14, 15, 23	DRI (Corex)-BOF	Cold-rolled and annealed flat products
7306 19 00 7306 29 00 7306 30 12	3, 4, 11, 13, 14, 15, 23	DRI (Rotary Kiln)-EAF	Cold-rolled and annealed flat products
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99	1, 2, 11, 13, 14, 15, 16, 23	Primary route	Plated or coated flat products

Product CN Code	Mapping*	Production route	Description
7306 69 90 7306 90 00			
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	1, 2, 5, 11, 13, 14, 15, 16, 23	Primary route steel alloy	Plated or coated flat products
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - EAF	Plated or coated flat products
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - Induction furnace	Plated or coated flat products
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	3, 4, 11, 13, 14, 15, 16, 23	DRI (Midrex)-EAF	Plated or coated flat products

Product CN Code	Mapping*	Production route	Description
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	2, 4, 11, 13, 14, 15, 16, 23	DRI (Corex)-BOF	Plated or coated flat products
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	3, 4, 11, 13, 14, 15, 16, 23	DRI (Rotary Kiln)-EAF	Plated or coated flat products
7306 40 80 7306 50 29	1, 2, 5, 11, 13, 23	Primary route steel alloy	Hot-rolled flat products -- alloyed
7306 40 80 7306 50 29	3, 5, 11, 13, 23	Secondary route steel alloy - EAF	Hot-rolled flat products -- alloyed
7306 40 80 7306 50 29	3, 5, 11, 13, 23	Secondary route steel alloy - Induction furnace	Hot-rolled flat products -- alloyed
7306 11 00 7306 21 00 7306 40 20 7306 61 10 7306 69 10	1, 2, 5, 11, 13, 14, 15, 23	Primary route steel alloy	Cold-rolled and annealed flat products -- alloying elements group 1
7306 11 00 7306 21 00 7306 40 20 7306 61 10 7306 69 10	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - EAF	Cold-rolled and annealed flat products -- alloying elements group 1
7306 11 00 7306 21 00 7306 40 20	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - Induction furnace	Cold-rolled and annealed flat products -- alloying elements group 1

Product CN Code	Mapping*	Production route	Description
7306 61 10 7306 69 10			
7306 50 21 7306 50 80	1, 2, 5, 11, 13, 14, 15, 23	Primary route steel alloy	Cold-rolled and annealed flat products -- alloying elements group 2
7306 50 21 7306 50 80	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - EAF	Cold-rolled and annealed flat products -- alloying elements group 2
7306 50 21 7306 50 80	3, 5, 11, 13, 14, 15, 23	Secondary route steel alloy - Induction furnace	Cold-rolled and annealed flat products -- alloying elements group 2
7307			Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel.
7307 11 7307 19 10	1, 10, 12, 22	Primary route	Forgings of cast iron
7307 19 90	3, 10, 12, 22	Secondary route - EAF	Forgings of cast steel
7307 19 90	3, 10, 12, 22	Secondary route - Induction furnace	Forgings of cast steel
7307 21 00 7307 22 7307 23 7307 29	1, 2, 5, 11, 17, 24	Primary route steel alloy	Beams, billets, rails and tubes -- of stainless steel
7307 21 00 7307 22 7307 23 7307 29	3, 5, 11, 17, 24	Secondary route steel alloy - EAF	Beams, billets, rails and tubes -- of stainless steel
7307 21 00 7307 22 7307 23 7307 29	3, 5, 11, 17, 24	Secondary route steel alloy - Induction furnace	Beams, billets, rails and tubes -- of stainless steel
7307 91 00 7307 92 7307 93 7307 99	1, 2, 11, 17, 24	Primary route	Beams, billets, rails and tubes
7307 91 00 7307 92 7307 93 7307 99	3, 11, 17, 24	Secondary route - EAF	Beams, billets, rails and tubes
7307 91 00 7307 92 7307 93 7307 99	3, 11, 17, 24	Secondary route - Induction furnace	Beams, billets, rails and tubes

Product CN Code	Mapping*	Production route	Description
7307 91 00 7307 92 7307 93 7307 99	3, 4, 11, 17, 24	DRI (Midrex)-EAF	Beams, billets, rails and tubes
7307 91 00 7307 92 7307 93 7307 99	2, 4, 11, 17, 24	DRI (Corex)-BOF	Beams, billets, rails and tubes
7307 91 00 7307 92 7307 93 7307 99	3, 4, 11, 17, 24	DRI (Rotary Kiln)-EAF	Beams, billets, rails and tubes
7308	1, 2, 11, 13, 14, 15, 16, 23	Primary route	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel
7308	1, 2, 5, 11, 13, 14, 15, 16, 23	Primary route steel alloy	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel
7308	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - EAF	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel
7308	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - Induction furnace	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel
7308	3, 4, 11, 13, 14, 15, 16, 23	DRI (Midrex)-EAF	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel
7308	2, 4, 11, 13, 14, 15, 16, 23	DRI (Corex)-BOF	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and

Product CN Code	Mapping*	Production route	Description
			windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel
7308	3, 4, 11, 13, 14, 15, 16, 23	DRI (Rotary Kiln)-EAF	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel
7309	1, 2, 11, 13, 14, 15, 16, 23	Primary route	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7309	1, 2, 5, 11, 13, 14, 15, 16, 23	Primary route steel alloy	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7309	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - EAF	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7309	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - Induction furnace	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7309	3, 4, 11, 13, 14, 15, 16, 23	DRI (Midrex)-EAF	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7309	2, 4, 11, 13, 14, 15, 16, 23	DRI (Corex)-BOF	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7309	3, 4, 11, 13, 14, 15, 16, 23	DRI (Rotary Kiln)-EAF	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7310	1, 2, 11, 13, 14, 15, 16, 23	Primary route	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7310	1, 2, 5, 11, 13, 14, 15, 16, 23	Primary route steel alloy	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7310	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - EAF	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment

Product CN Code	Mapping*	Production route	Description
7310	3, 5, 11, 13, 14, 15, 16, 23	Secondary route steel alloy - Induction furnace	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7310	3, 4, 11, 13, 14, 15, 16, 23	DRI (Midrex)-EAF	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7310	2, 4, 11, 13, 14, 15, 16, 23	DRI (Corex)-BOF	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7310	3, 4, 11, 13, 14, 15, 16, 23	DRI (Rotary Kiln)-EAF	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7311			Containers for compressed or liquefied gas, of iron or steel
7311 00	1, 2, 11, 18, 25	Primary route	Containers for compressed or liquefied gas, of iron or steel
7311 00	1, 2, 5, 11, 18, 25	Primary route steel alloy	Containers for compressed or liquefied gas, of iron or steel
7311 00	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Containers for compressed or liquefied gas, of iron or steel
7311 00	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Containers for compressed or liquefied gas, of iron or steel
7311 00	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Containers for compressed or liquefied gas, of iron or steel
7311 00	2, 4, 11, 18, 25	DRI (Corex)-BOF	Containers for compressed or liquefied gas, of iron or steel
7311 00	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Containers for compressed or liquefied gas, of iron or steel
7318			Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel
7318 11 00 7318 12 90 7318 13 00 7318 14 91 7318 14 99 7318 19 00 7318 21 00 7318 24 00 7318 29 00	1, 2, 11, 18, 25	Primary route	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel
7318 11 00 7318 12 90 7318 13 00 7318 14 91	3, 11, 18, 25	Secondary route - EAF	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel

Product CN Code	Mapping*	Production route	Description
7318 14 99 7318 19 00 7318 21 00 7318 24 00 7318 29 00			
7318 11 00 7318 12 90 7318 13 00 7318 14 91 7318 14 99 7318 19 00 7318 21 00 7318 24 00 7318 29 00	3, 11, 18, 25	Secondary route - Induction furnace	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel
7318 11 00 7318 12 90 7318 13 00 7318 14 91 7318 14 99 7318 19 00 7318 21 00 7318 24 00 7318 29 00	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel
7318 11 00 7318 12 90 7318 13 00 7318 14 91 7318 14 99 7318 19 00 7318 21 00 7318 24 00 7318 29 00	2, 4, 11, 18, 25	DRI (Corex)-BOF	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel
7318 11 00 7318 12 90 7318 13 00 7318 14 91 7318 14 99 7318 19 00 7318 21 00	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel

Product CN Code	Mapping*	Production route	Description
7318 24 00 7318 29 00			
7318 12 10 7318 14 10	1, 2, 5, 11, 18, 25	Primary route steel alloy	Other wood screws; self-tapping screws - of stainless steel
7318 12 10 7318 14 10	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Other wood screws; self-tapping screws - of stainless steel
7318 12 10 7318 14 10	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Other wood screws; self-tapping screws - of stainless steel
7318 15	1, 2, 11, 18, 25	Primary route	Other screws and bolts, whether or not with their nuts or washers
7318 15	1, 2, 5, 11, 18, 25	Primary route steel alloy	Other screws and bolts, whether or not with their nuts or washers
7318 15	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Other screws and bolts, whether or not with their nuts or washers
7318 15	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Other screws and bolts, whether or not with their nuts or washers
7318 15	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Other screws and bolts, whether or not with their nuts or washers
7318 15	2, 4, 11, 18, 25	DRI (Corex)-BOF	Other screws and bolts, whether or not with their nuts or washers
7318 15	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Other screws and bolts, whether or not with their nuts or washers
7318 16	1, 2, 11, 18, 25	Primary route	Nuts
7318 16	1, 2, 5, 11, 18, 25	Primary route steel alloy	Nuts
7318 16	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Nuts
7318 16	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Nuts
7318 16	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Nuts
7318 16	2, 4, 11, 18, 25	DRI (Corex)-BOF	Nuts
7318 16	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Nuts
7318 22 00	1, 2, 11, 18, 25	Primary route	Other washers
7318 22 00	1, 2, 5, 11, 18, 25	Primary route steel alloy	Other washers
7318 22 00	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Other washers
7318 22 00	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Other washers

Product CN Code	Mapping*	Production route	Description
7318 22 00	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Other washers
7318 22 00	2, 4, 11, 18, 25	DRI (Corex)-BOF	Other washers
7318 22 00	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Other washers
7318 23 00	1, 2, 11, 18, 25	Primary route	Rivets
7318 23 00	1, 2, 5, 11, 18, 25	Primary route steel alloy	Rivets
7318 23 00	3, 5, 11, 18, 25	Secondary route steel alloy - EAF	Rivets
7318 23 00	3, 5, 11, 18, 25	Secondary route steel alloy - Induction furnace	Rivets
7318 23 00	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Rivets
7318 23 00	2, 4, 11, 18, 25	DRI (Corex)-BOF	Rivets
7318 23 00	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Rivets
7326			Other articles of iron or steel
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	1, 2, 10, 12, 22	Primary route	Forged, stamped, or sintered
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	3, 10, 12, 22	Secondary route - EAF	Forged, stamped, or sintered
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	3, 10, 12, 22	Secondary route - Induction furnace	Forged, stamped, or sintered
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	3, 4, 10, 12, 22	DRI (Midrex)-EAF	Forged, stamped, or sintered
7326 11 00 7326 19 7326 90 92	2, 4, 10, 12, 22	DRI (Corex)-BOF	Forged, stamped, or sintered

Product CN Code	Mapping*	Production route	Description
7326 90 94 7326 90 96			
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	3, 4, 10, 12, 22	DRI (Rotary Kiln)-EAF	Forged, stamped, or sintered
7326 20 00	1, 2, 11, 18, 19, 20, 26	Primary route	Articles of iron or steel wire
7326 20 00	3, 11, 18, 19, 20, 26	Secondary route - EAF	Articles of iron or steel wire
7326 20 00	3, 11, 18, 19, 20, 26	Secondary route - Induction furnace	Articles of iron or steel wire
7326 20 00	3, 4, 11, 18, 19, 20, 26	DRI (Midrex)-EAF	Articles of iron or steel wire
7326 20 00	2, 4, 11, 18, 19, 20, 26	DRI (Corex)-BOF	Articles of iron or steel wire
7326 20 00	3, 4, 11, 18, 19, 20, 26	DRI (Rotary Kiln)-EAF	Articles of iron or steel wire
7326 90 30 7326 90 40 7326 90 50 7326 90 60	1, 2, 11, 18, 25	Primary route	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry
7326 90 30 7326 90 40 7326 90 50 7326 90 60	3, 11, 18, 25	Secondary route - EAF	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry
7326 90 30 7326 90 40 7326 90 50 7326 90 60	3, 11, 18, 25	Secondary route - Induction furnace	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry
7326 90 30 7326 90 40 7326 90 50 7326 90 60	3, 4, 11, 18, 25	DRI (Midrex)-EAF	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry
7326 90 30 7326 90 40 7326 90 50 7326 90 60	2, 4, 11, 18, 25	DRI (Corex)-BOF	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry
7326 90 30 7326 90 40 7326 90 50 7326 90 60	3, 4, 11, 18, 25	DRI (Rotary Kiln)-EAF	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry
7326 90 98	1, 2, 11, 13, 14, 15, 16, 23	Primary route	Other articles of iron or steel

Product CN Code	Mapping*	Production route	Description
7326 90 98	3, 11, 13, 14, 15, 16, 23	Secondary route - EAF	Other articles of iron or steel
7326 90 98	3, 11, 13, 14, 15, 16, 23	Secondary route - Induction furnace	Other articles of iron or steel
7326 90 98	3, 4, 11, 13, 14, 15, 16, 23	DRI (Midrex)-EAF	Other articles of iron or steel
7326 90 98	2, 4, 11, 13, 14, 15, 16, 23	DRI (Corex)-BOF	Other articles of iron or steel
7326 90 98	3, 4, 11, 13, 14, 15, 16, 23	DRI (Rotary Kiln)-EAF	Other articles of iron or steel

*Numbers in the column Mapping represents the blocks from the Figure 5 (number shown in the upper left corner of the block).

Source: JRC, 2023.

Table 2. Net energy process balance per subprocess in the iron and steel industry.

Block number	Subprocess (subvariant) name	Unit	Total	Coke	Coal	Tar	Oil	Electricity	Steam	Natural gas	Coke oven gas	Blast furnace gas	BOS gas
-	Sinter plant[a]	GJ/t sinter	1.51	1.28	0.00	0.00	0.00	0.16	0.00	0.02	0.02	0.02	0.00
-	Pellet plant[a]	GJ/t pellet	1.02	0.33	0.00	0.00	0.11	0.14	0.00	0.43	0.00	0.00	0.00
1	Blast furnace[a,b]	GJ/t hot metal	11.18	10.81	1.00	0.00	1.27	0.27	0.16	0.17	0.28	1.54	0.21
2	BOF plant[a]	GJ/t semis	0.36	0.01	0.00	0.00	0.00	0.12	0.00	0.23	0.00	0.00	0.00
3	EAF[a]	GJ/t semis	4.02	0.00	0.49	0.00	0.00	2.07	0.67	0.78	0.00	0.00	0.00
3	Induction furnace	GJ/t semis											
4	DRI-EAF (natural gas based)[a]	GJ/t semis	13.76	0.00	0.49	0.00	0.00	2.42	0.67	10.18	0.00	0.00	0.00
4	DRI-EAF (coal based)[a]	GJ/t semis	28.19	0.00	24.42	0.00	0.00	2.33	0.67	0.78	0.00	0.00	0.00
5	AOD/VOD	GJ/t semis											
6	Cast Iron melting[a]	GJ/t semis	3.92	3.42				0.36		0.14			
7	Steel melting[a]	GJ/t semis	2.34					2.34		0.00			
8	Foundry casting (Iron)[a]	GJ/t semis	5.70					0.00		5.70			
8	Foundry casting (Steel)[a]	GJ/t semis	10.49					0.00		10.49			
9	Pig casting	GJ/t semis											
10	Ingot casting	GJ/t semis											
11	Continuous casting (Carbon steel)[c]	GJ/t semis	0.06					0.03		0.03			
11	Continuous casting (High alloy steel)[c]	GJ/t semis	0.06					0.03		0.03			
12	Forging (Carbon steel)[d]	GJ/t product	29.09					2.06		27.03			

Block number	Subprocess (subvariant) name	Unit	Total	Coke	Coal	Tar	Oil	Electricity	Steam	Natural gas	Coke oven gas	Blast furnace gas	BOS gas
12	Forging (High alloy steel)[d]	GJ/t product	29.09					2.06		27.03			
13	Hot rolled mill (Carbon steel)[e]	GJ/t product	1.59					0.18		1.40			
13	Hot rolled mill (High alloy steel)[e]	GJ/t product	2.68					0.35		2.33			
14	Cold rolled mill (Carbon steel)[c]	GJ/t product	0.40					0.30		0.10			
14	Cold rolled mill (High alloy steel)[c]	GJ/t product	0.40					0.30		0.10			
15	Annealing (Carbon steel) [e]	GJ/t product	0.96					0.00		0.96			
15	Annealing (High alloy steel)[e]	GJ/t product	0.96					0.00		0.96			
16	Finishing flat products [e]	GJ/t product	1.17					0.10		1.07			
17	Beams, billets, rails and tubes mills (Carbon steel) [e]	GJ/t product	2.00					0.18		1.81			
17	Beams, billets, rails and tubes mills (High alloy steel) [e]	GJ/t product	2.00					0.18		1.81			
18	Bars and rods mills (Carbon steel) [e]	GJ/t product	1.52					0.31		1.21			
18	Bars and rods mills (High alloy steel) [e]	GJ/t product	4.35					0.86		3.49			
19	Wire mill (Carbon steel) [e]	GJ/t product	0.53					0.53		0.00			
19	Wire mill (High alloy steel) [e]	GJ/t product	0.53					0.53		0.00			
20	Finishing long products [e]	GJ/t product	1.17					0.10		1.07			

Source: a(JRC, 2022b), b(IEA, 2019), c(Worrell et al, 2007), d(Dindorf & Wos 2020), e(JRC, 2022c).

Table 3. Boolean values that indicate whether a fuel is considered (1) or not (0) for a specific subprocess when disaggregating the iron and steel industry's energy balance sheets.

Block number	Subprocess (subvariant) name	Coke	Coal	Tar	Oil	Electricity	Steam	Natural gas	Coke oven gas	Blast furnace gas	BOS gas
-	Sinter plant	1	1	0	1	1	0	1	1	1	1
-	Pellet plant	1	1	0	1	1	0	1	1	1	1
1	Blast furnace	0	1	0	1	1	1	1	1	0	1
2	BOF plant	1	1	0	1	1	0	1	1	1	1
3	EAF	1	1	1	1	1	1	1	1	1	1
3	Induction furnace	1	1	0	0	1	1	1	1	1	1
4	DRI-EAF (natural gas based)	1	1	1	0	1	1	1	1	1	1
4	DRI-EAF (coal based)	1	1	1	0	1	1	1	1	1	1
5	AOD/VOD	1	1	0	0	1	0	1	1	1	1

Block number	Subprocess (subvariant) name	Coke	Coal	Tar	Oil	Electricity	Steam	Natural gas	Coke oven gas	Blast furnace gas	BOS gas
6	Cast Iron melting	1	1	0	0	1	0	1	1	1	1
7	Steel melting	1	1	0	0	1	0	1	1	1	1
8	Foundry casting (Iron)	1	1	0	0	1	0	1	1	1	1
8	Foundry casting (Steel)	1	1	0	0	1	0	1	1	1	1
9	Pig casting	1	1	0	0	1	0	1	1	1	1
10	Ingot casting	1	1	0	0	1	0	1	1	1	1
11	Continuous casting (Carbon steel)	1	1	0	0	1	0	1	1	1	1
11	Continuous casting (High alloy steel)	1	1	0	0	1	0	1	1	1	1
12	Forging (Carbon steel)	1	1	0	0	1	0	1	1	1	1
12	Forging (High alloy steel)	1	1	0	0	1	0	1	1	1	1
13	Hot rolled mill (Carbon steel)	1	1	0	0	1	0	1	1	1	1
13	Hot rolled mill (High alloy steel)	1	1	0	0	1	0	1	1	1	1
14	Cold rolled mill (Carbon steel)	1	1	0	0	1	0	1	1	1	1
14	Cold rolled mill (High alloy steel)	1	1	0	0	1	0	1	1	1	1
15	Annealing (Carbon steel)	1	1	0	0	1	0	1	1	1	1
15	Annealing (High alloy steel)	1	1	0	0	1	0	1	1	1	1
16	Finishing flat products	1	1	0	0	1	0	1	1	1	1
17	Beams, billets, rails and tubes mills (Carbon steel)	1	1	0	0	1	0	1	1	1	1
17	Beams, billets, rails and tubes mills (High alloy steel)	1	1	0	0	1	0	1	1	1	1
18	Bars and rods mills (Carbon steel)	1	1	0	0	1	0	1	1	1	1
18	Bars and rods mills (High alloy steel)	1	1	0	0	1	0	1	1	1	1
19	Wire mill (Carbon steel)	1	1	0	0	1	0	1	1	1	1
19	Wire mill (High alloy steel)	1	1	0	0	1	0	1	1	1	1
20	Finishing long products	1	1	0	0	1	0	1	1	1	1

Source: JRC, 2023.

Table 4. Fuel type mapping between the IEA extended world energy balance and *Matrix A* from eq. (6).

Fuel from the IEA extended world energy balance	**Column names in *Matrix A***	**Fuel from the IEA extended world energy balance**	**Column names in *Matrix A***
Hard coal (if no detail)	Coal	Gas/diesel oil excl. biofuels	Oil
Brown coal (if no detail)	Coal	Fuel oil	Oil
Anthracite	Coal	Naphtha	Oil
Coking coal	Coal	White spirit & SBP	Total
Other bituminous coal	Coal	Lubricants	Total
Sub-bituminous coal	Coal	Bitumen	Total
Lignite	Coal	Paraffin waxes	Total
Patent fuel	Coal	Petroleum coke	Total
Coke oven coke	Coke	Other oil products	Total
Gas coke	Coke	Industrial waste	Total
Coal tar	Tar	Municipal waste (renewable)	Total
BKB	Total	Municipal waste (non-renewable)	Total
Gas works gas	Total	Primary solid biofuels	Total
Coke oven gas	Coke oven gas	Biogases	Total
Blast furnace gas	Blast furnace gas	Biogasoline	Total
Other recovered gases	BOS gas	Biodiesels	Total
Peat	Total	Bio jet kerosene	Total
Peat products	Total	Other liquid biofuels	Total
Oil shale and oil sands	Total	Non-specified primary biofuels and waste	Total
Natural gas	Natural gas	Charcoal	Total
Crude/NGL/feedstocks (if no detail)	Total	Elec/heat output from non-specified manufactured gases	Total
Crude oil	Total	Heat output from non-specified combustible fuels	Total
Natural gas liquids	Total	Nuclear	Total
Refinery feedstocks	Total	Hydro	Total
Additives/blending components	Total	Geothermal	Total
Other hydrocarbons	Total	Solar photovoltaics	Total
Refinery gas	Total	Solar thermal	Total
Ethane	Total	"Tide, wave and ocean"	Total
Liquefied petroleum gases (LPG)	Total	Wind	Total
Motor gasoline excl. biofuels	Total	Other sources	Total
Aviation gasoline	Total	Memo: Renewables	Total
Gasoline type jet fuel	Total	Total	Total
Kerosene type jet fuel excl. biofuels	Total	Heat	Steam
Other kerosene	Total	Electricity	Electricity

Source: JRC, 2023.

Table 5. Material mass balance.

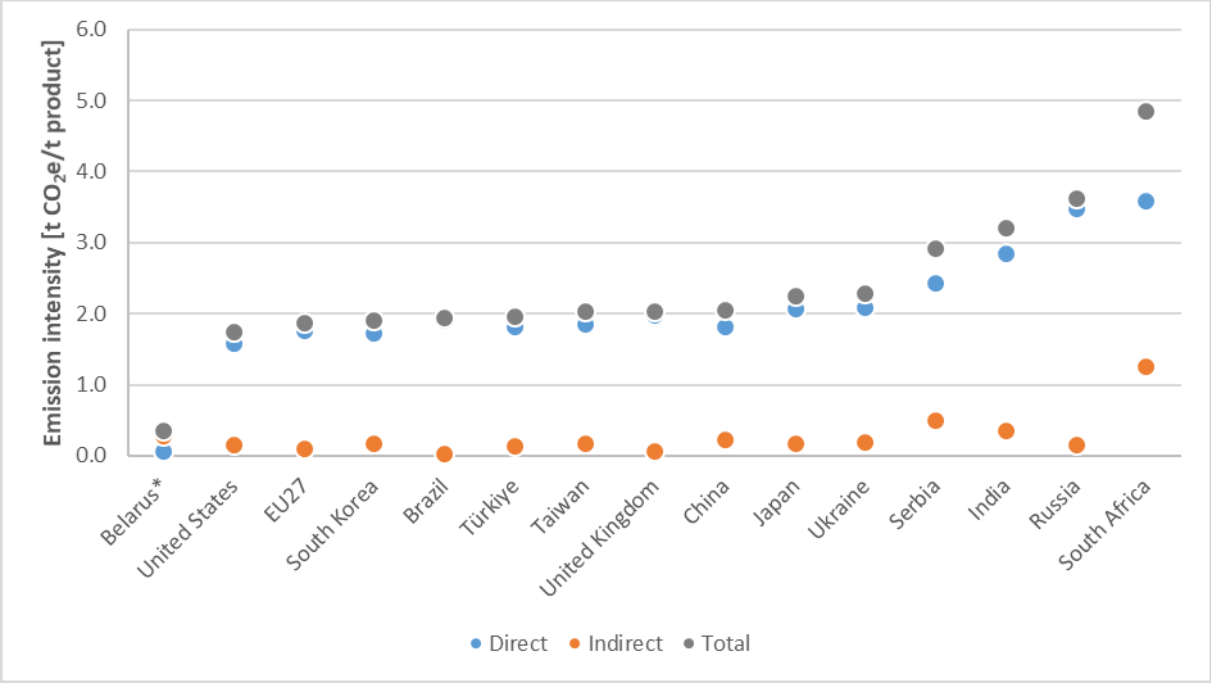
	Unit	Limestone	Lime	Dolomite
Sinter plant	kg/t sinter	131.1	10.2	0.0
Pellet plant	kg/t pellet	2.5	0.0	6.8
Blast furnace	kg/t hot metal	0.0	25.7	0.0
Basic oxygen furnace	kg/t liquid steel	0.0	48.5	14.2
Electric arc furnace	kg/t liquid steel	0.0	82.5	0.0

Source: (JRC, 2023).

2.3 Results

Figures 6-12 present the specific GHG emission intensities of semis, hot-rolled flat products and wires produced from non-alloy steel, stainless steel, and other alloy steel. Norway and Switzerland are not shown in the figures below since the CBAM regulation will not be applied to goods imported from those countries. The low values shown for Belarus are because together with Norway and Switzerland, Belarus has the secondary steelmaking route only. All the other countries under the scope of this study make use, to some extent, of the primary steelmaking route, which has a much higher GHG emission intensity than the secondary steelmaking route.

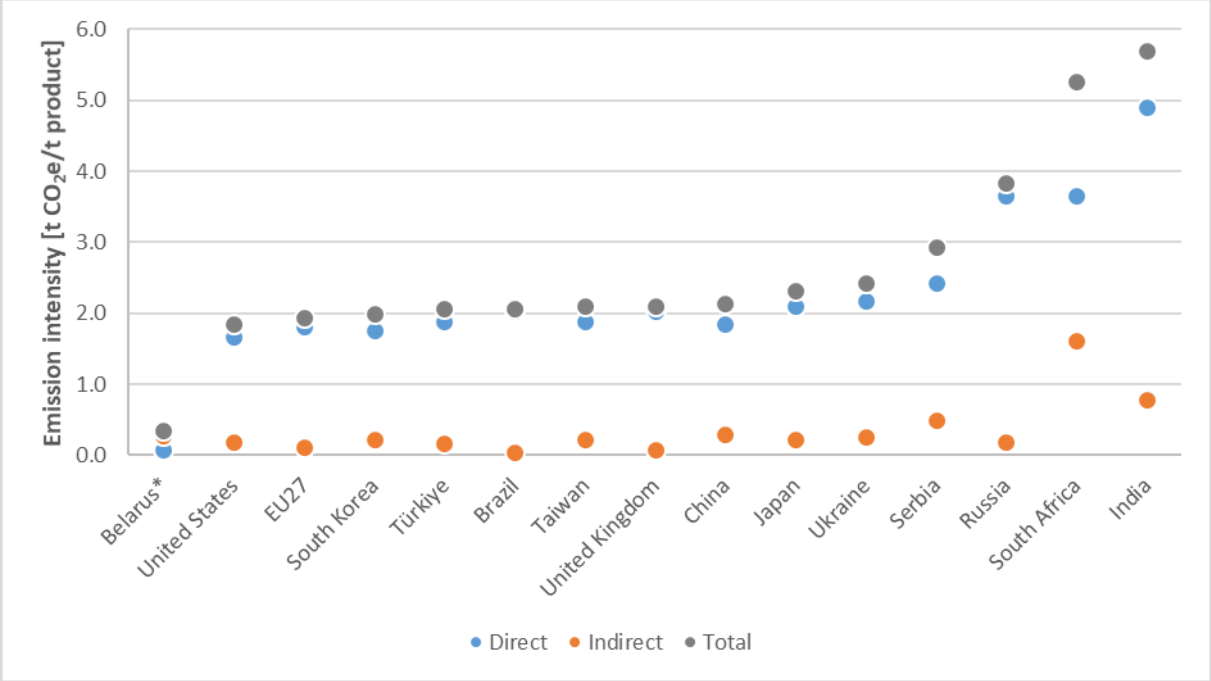
Figure 6. GHG emission intensity for CN code 7206 90 00 - Semis (slab, billet, bloom) of non-alloy steel.



* Value for Belarus is based on the secondary production route.

Source: JRC, 2023.

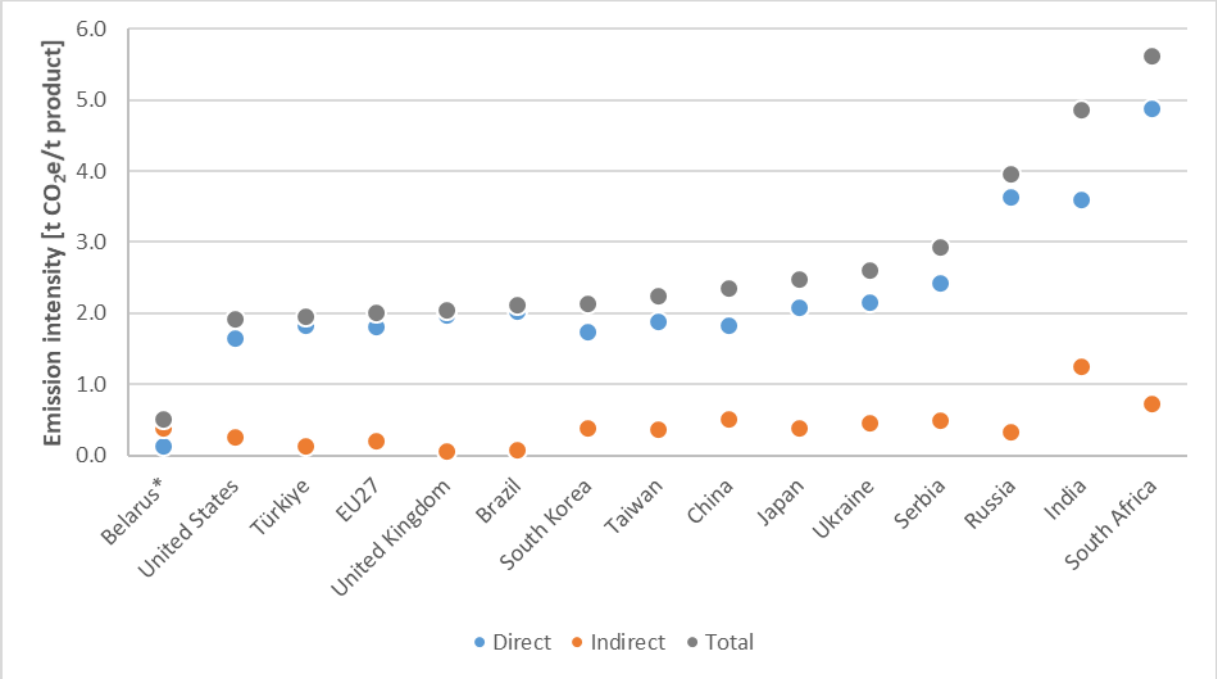
Figure 7. GHG emission intensity for CN codes 7211 13 00, 7211 14 00, 7211 19 00 - Hot-rolled flat products of non-alloy steel.



* Value for Belarus is based on the secondary production route.

Source: JRC, 2023.

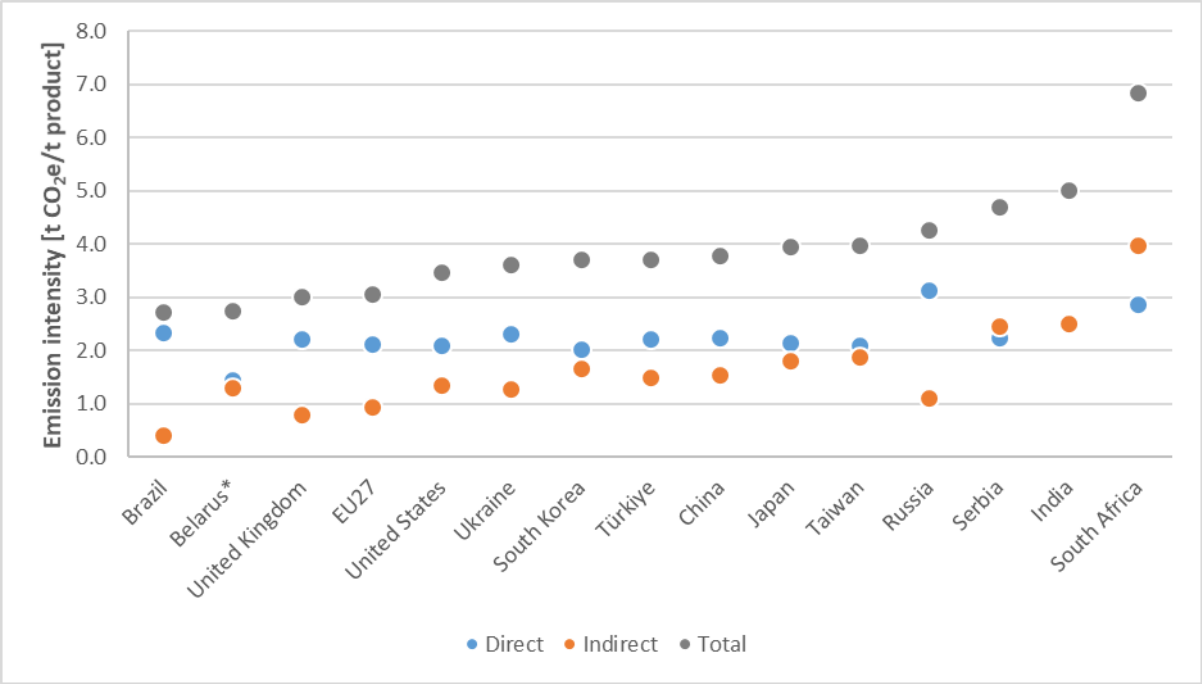
Figure 8. GHG emission intensity for CN code 7217 10 – Wires of non-alloy steel.



* Value for Belarus is based on the secondary production route.

Source: JRC, 2023.

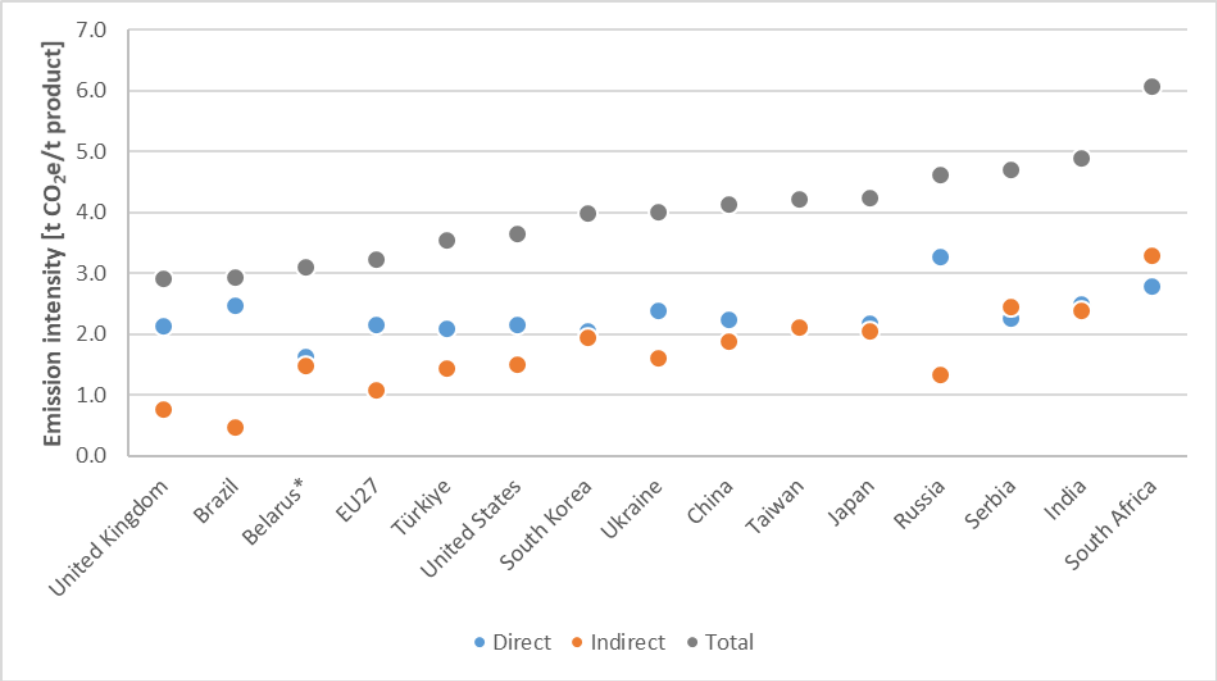
Figure 9. GHG emission intensity for CN codes 7220 11 00, 7220 12 00 - Hot-rolled flat products of stainless steel.



* Value for Belarus is based on the secondary production route.

Source: JRC, 2023.

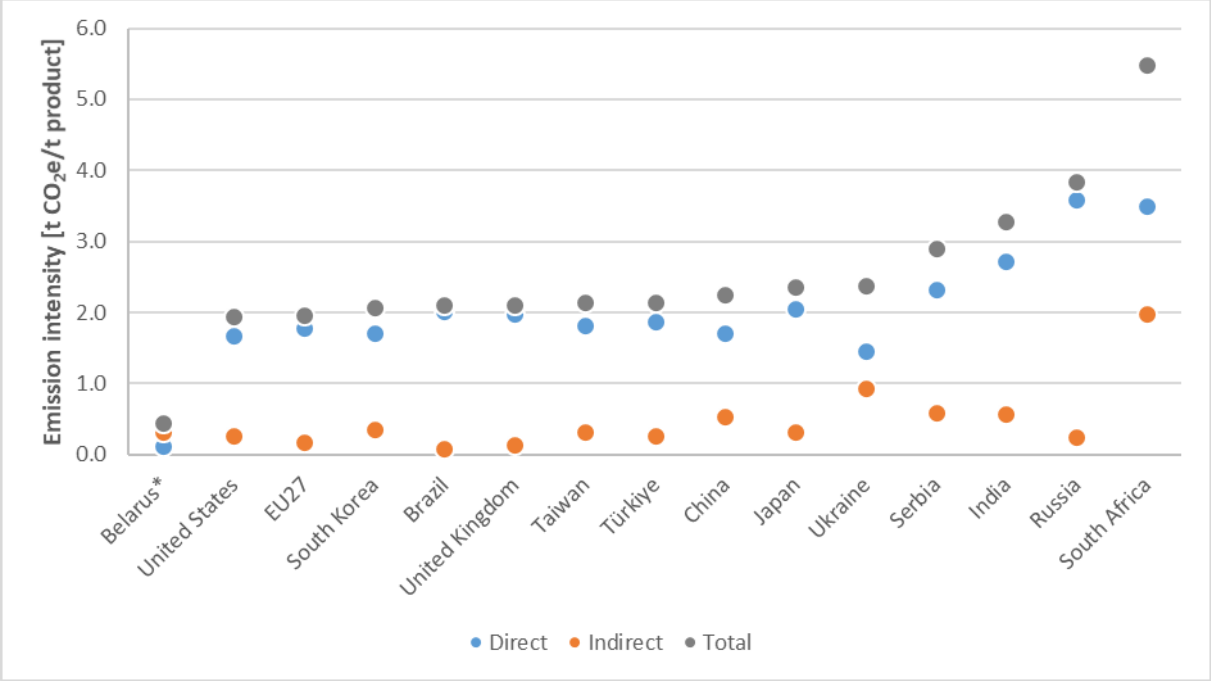
Figure 10. GHG emission intensity for CN code 7223 00 – Wires of stainless steel.



* Value for Belarus is based on the secondary production route.

Source: JRC, 2023.

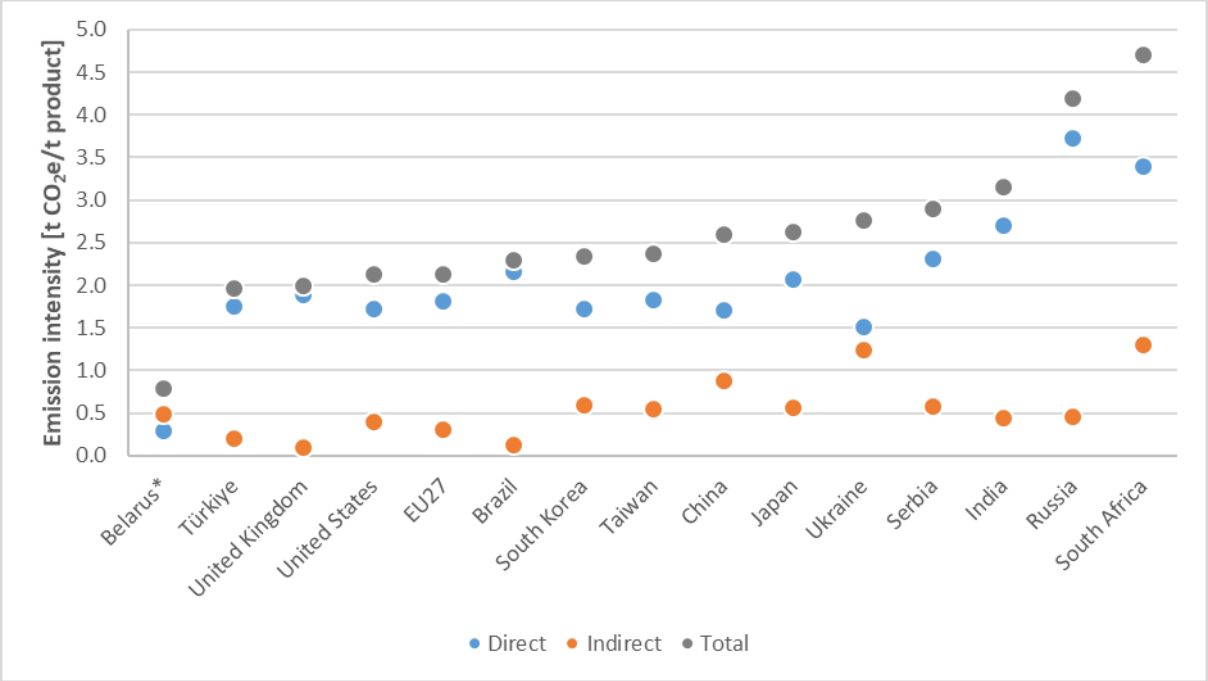
Figure 11. GHG emission intensity for CN codes 7226 11 00, 7226 19 10, 7226 20 00, 7226 91 - Hot-rolled flat products of other alloy steel.



* Value for Belarus is based on the secondary production route.

Source: JRC, 2023.

Figure 12. GHG emission intensity for CN code 7229 – Wires of other alloy steel.



* Value for Belarus is based on the secondary production route

Source: JRC, 2023.

When, instead of using an intermediate value for the composition of stainless steel and other steel alloy grades, we use the most carbon-intensive composition, the most highly affected CN code almost triples its carbon

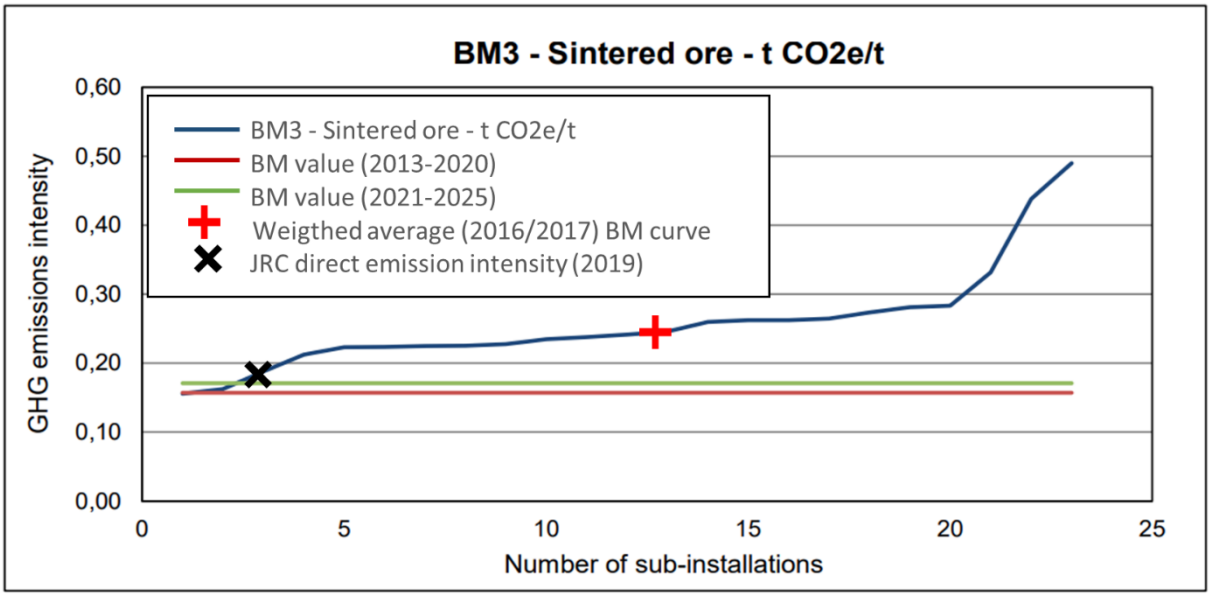
intensity. The difference between using the most carbon-intensive steel grades within each CN code, instead of the median value, only changes the carbon intensity by a maximum of around 5%.

Using the same boundaries as (Worldsteel, 2023b) results in a weighted average carbon intensity of 2.28 tCO2/t for the primary production route, which fits reasonably well with Worldsteel's own value, produced using information from 65 sites, of 2.32 tCO2/t. The primary production route of the countries in this study amounted in 2019 to 96.7% of primary steel production overall (1300 Mt vs. 1345 Mt).

Figure 13 to Figure 17 compare the carbon intensities estimated in this study, within the boundaries defined for the CBAM, with the six products which have a benchmarking curve in the EU ETS (sintered ore, hot metal, iron casting, EAF carbon steel and EAF high alloy steel). The JRC values presented for iron casting, EAF carbon steel and EAF high alloy steel include indirect emissions since these are also included in the benchmarking curves, whereas sintered ore and hot metal include direct emissions only.

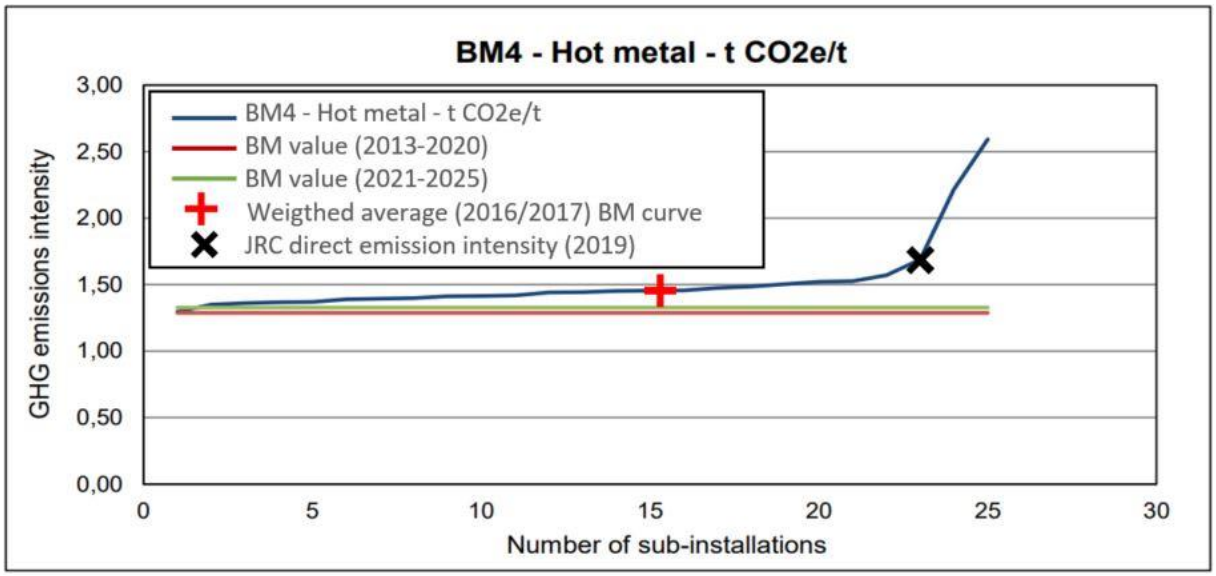
Figure 15 shows that the estimated JRC carbon intensity for iron casting is reasonably close to the weighted average of the benchmarking curve. The major discrepancy is for sintered ore, but not when the variability range of the value is taken into account. The difference between the estimated direct emissions for hot metal and the weighted average value of the benchmarking curve can be justified by the differing boundaries of the EU ETS and the CBAM. In the CBAM, the embedded emissions in the precursors (in this case sinter) are included in the value for hot metal, but not included in the benchmarking values. In fact, when removing the embedded emissions of sinter from the JRC-estimated value in Figure 14 (1.70 tCO2/t), the resulting value (1.51 tCO2/t) is much closer to the weighted average of the benchmarking curve (1.495 tCO2/t).

Figure 13. Benchmarking curve of the EU ETS for sintered ore and JRC-estimated direct emission intensity.



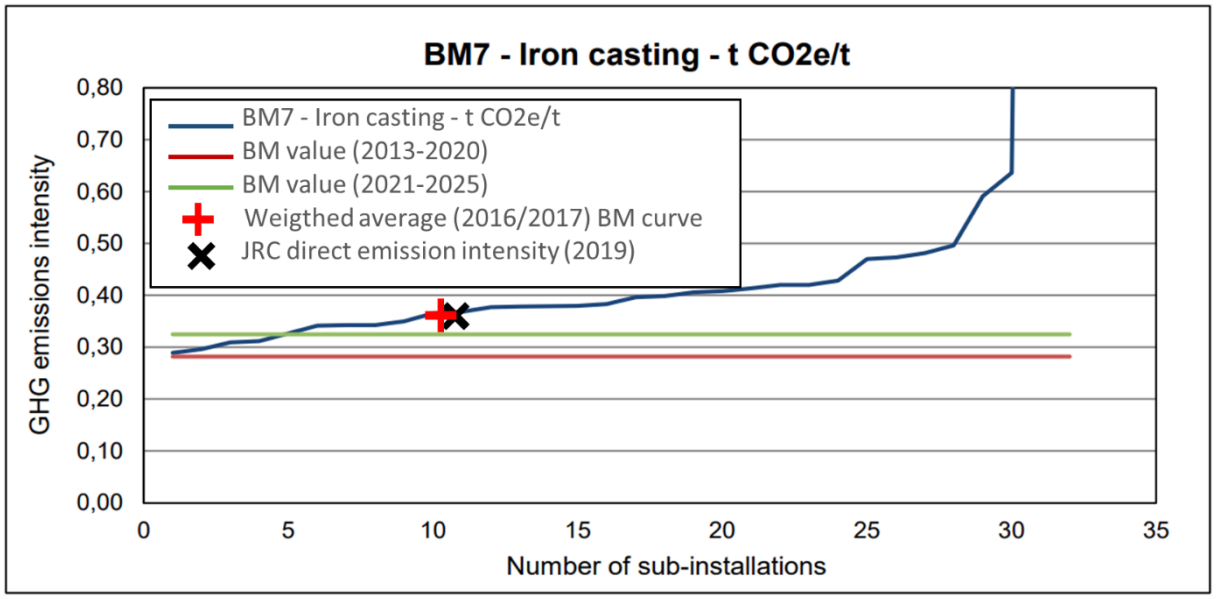
Source: JRC, 2023 and (European Commission, 2021c).

Figure 14. Benchmarking curve of the EU ETS for hot metal and JRC direct emission intensity.



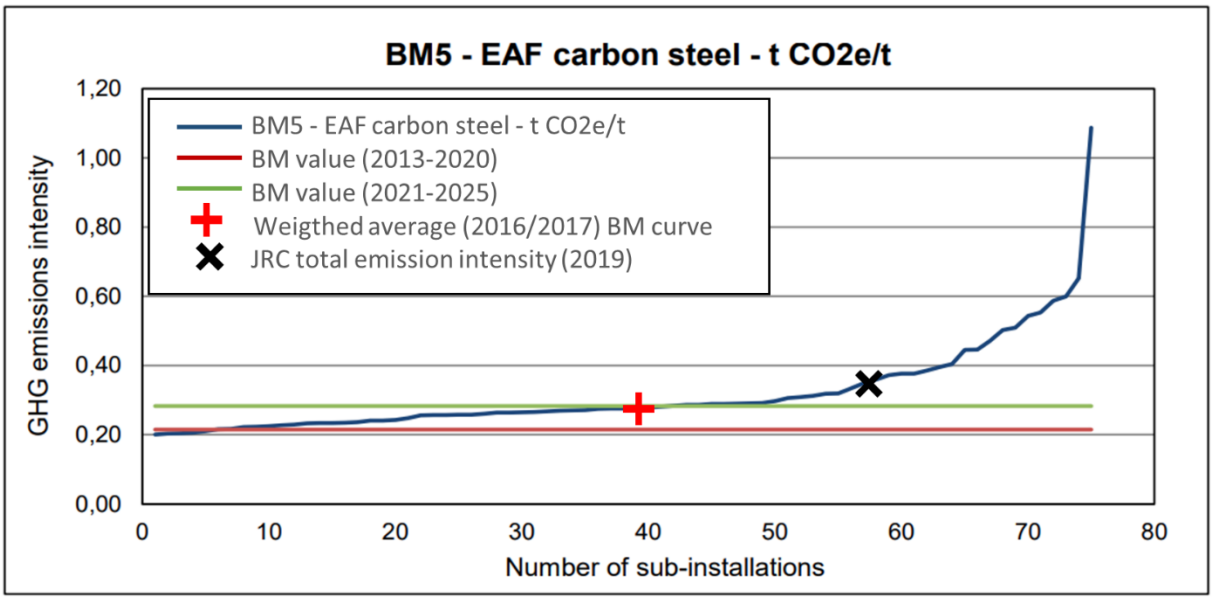
Source: JRC, 2023 and (European Commission, 2021c).

Figure 15. Benchmarking curve of the EU ETS for iron casting and JRC-estimated total emission intensity.



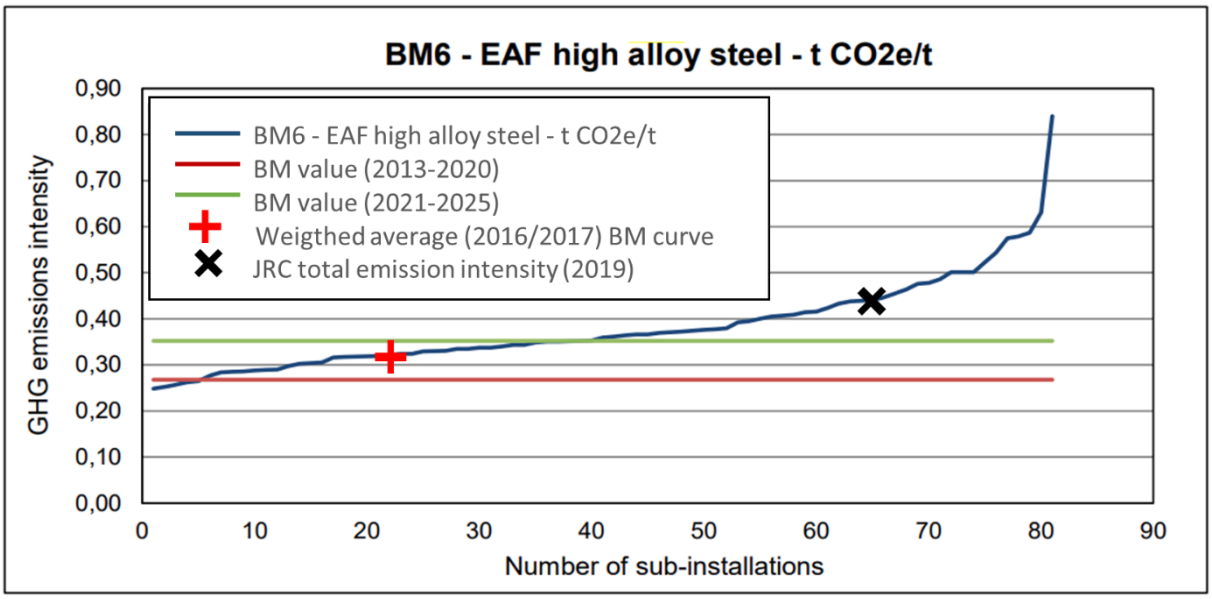
Source: JRC, 2023 and (European Commission, 2021c).

Figure 16. Benchmarking curve of the EU ETS for EAF carbon steel and JRC-estimated total emission intensity.



Source: JRC, 2023 and (European Commission, 2021c).

Figure 17. Benchmarking curve of the EU ETS for EAF high alloy steel and JRC-estimated total emission intensity.



Source: JRC, 2023 and (European Commission, 2021c).

Detailed results for the countries under the scope are given in Table 18 of Annex 2, along with weighted averages.

2.4 Update of the results of the pilot study

Annex 3 provides updated GHG emission intensities of crude steel following the methodology applied in the pilot study. The boundaries of the processes in the pilot study and in Annex 3 are different from the ones in this analysis. Also, a simplification in the pilot study affected results in a different manner for all countries. The interest of the reproducing the results presented in Annex 3 is to check how, after removing now the simplification of the pilot study, the ranking of countries in the results is more similar to this study.

3 Analysis for the products of the fertilisers industry

Mineral fertilisers are divided into three main groups based on essential plant nutrients: nitrogen (N), phosphorus (P) and potassium (K).

The production of nitrogen-based fertilisers starts by reacting nitrogen from the air with hydrogen, at high temperatures and pressure, to create ammonia (Haber-Bosch process). Natural gas is the main feedstock used to produce the hydrogen, except in China where coal is predominant (IFA, 2014). Nitrogen-based fertilisers account for around 80% of today's ammonia demand (IRENA and AEA, 2022). Nitric acid is produced by reacting ammonia and oxygen (Ostwald process). Around 75-80% of nitric acid produced annually is used in the production of fertilisers (NACAG, 2022). Urea is produced by reacting ammonia with carbon dioxide (Bosch-Meiser process). Urea is a fertiliser on its own, but also an intermediate product. Although ammonia and nitric acid are predominantly used as intermediate products in the production of nitrate fertilisers such as ammonium nitrate (AN), in this study they are analysed together with the remaining fertiliser products. Further mixing urea, AN, and water, produces urea ammonium nitrate (UAN) solution. Two-thirds of the total AN production is used for fertilisers, while the rest is used for other purposes such as the production of explosives.

Phosphorus-based and potassium-based fertilisers are produced from mined ores.

Combining two or three main nutrients forms the family of NPK fertilisers ([5]).

Table 6 lists the fertiliser products covered by Annex 1 of the CBAM regulation. In 2019, the listed fertiliser products accounted for 86% of the EU27's total mineral fertiliser production, as shown in Figure 18. Nitrogen-only-based fertiliser production, including intermediate products ammonia and nitric acid, accounted for 58% of the EU27's total mineral fertiliser production. Even though group 3105 in Table 6 includes many fertiliser products, Figure 18 reveals that 70% of that group consists of fertilisers with all three fertilising elements (N, P, and K), followed by 15% of fertilisers with two fertilising elements (N and P). At the other end of the scale, fertilisers in tablet form or similar, or in packages weighing less than 10 kg gross, represent only 0.15% of the EU27's total mineral fertiliser production. The production of nitrates of potassium is even lower in the EU27, at only 0.07%.

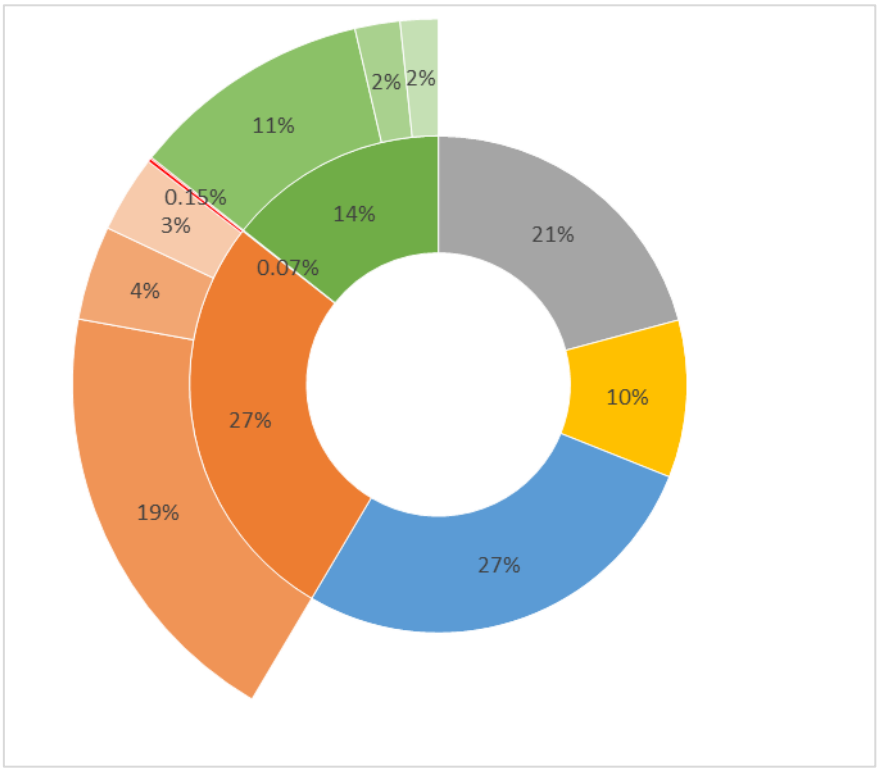
Table 6. Fertiliser products covered by Annex 1 of the CBAM.

CN code	Greenhouse gas
2808 00 00 – Nitric acid; sulphonitric acids	Carbon dioxide and nitrous oxide
2814 – Ammonia, anhydrous or in aqueous solution	Carbon dioxide
2834 21 00 - Nitrates of potassium	Carbon dioxide and nitrous oxide
3102 – Mineral or chemical fertilisers, nitrogenous	Carbon dioxide and nitrous oxide
3105 – Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium; other fertilisers; goods of this chapter in tablets or similar forms or in packages of a gross weight not exceeding 10 kg - Except: 3105 60 00 – Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium	Carbon dioxide and nitrous oxide

Source: (European Union, 2023).

[5] In this study, in the interests of simplicity, under the family of NPK fertilisers we consider all combinations of mineral fertilisers consisting of two or three main nutrients, i.e. NP, NK, PK, and NPK fertilisers.

Figure 18. Share of mineral fertiliser production in the EU27 in 2019.



- Ammonia, anhydrous or in aqueous solution
- Nitric acid; sulphonitric acids
- Mineral or chemical fertilisers, nitrogenous
- Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium; other fertilisers; goods of this chapter in tablets or similar forms or in packages of a gross weight not exceeding 10 kg
  - Except: 3105 60 00 – Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium
  - Mineral or chemical fertilisers containing the three fertilising elements nitrogen, phosphorus and potassium (excluding those in tablets or similar forms, or in packages with a gross weight of <= 10 kg)
  - Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus
  - Other fertilisers, n.e.c.
  - Fertilisers in tablets or similar forms or in packages of a gross weight of <= 10 kg
- Nitrates of potassium
- Not covered by CBAM
  - Potassium-based fertilizers
  - Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium
  - Phosphorus-based fertilizers

Source: JRC 2023, based on Eurostat Prodcom.

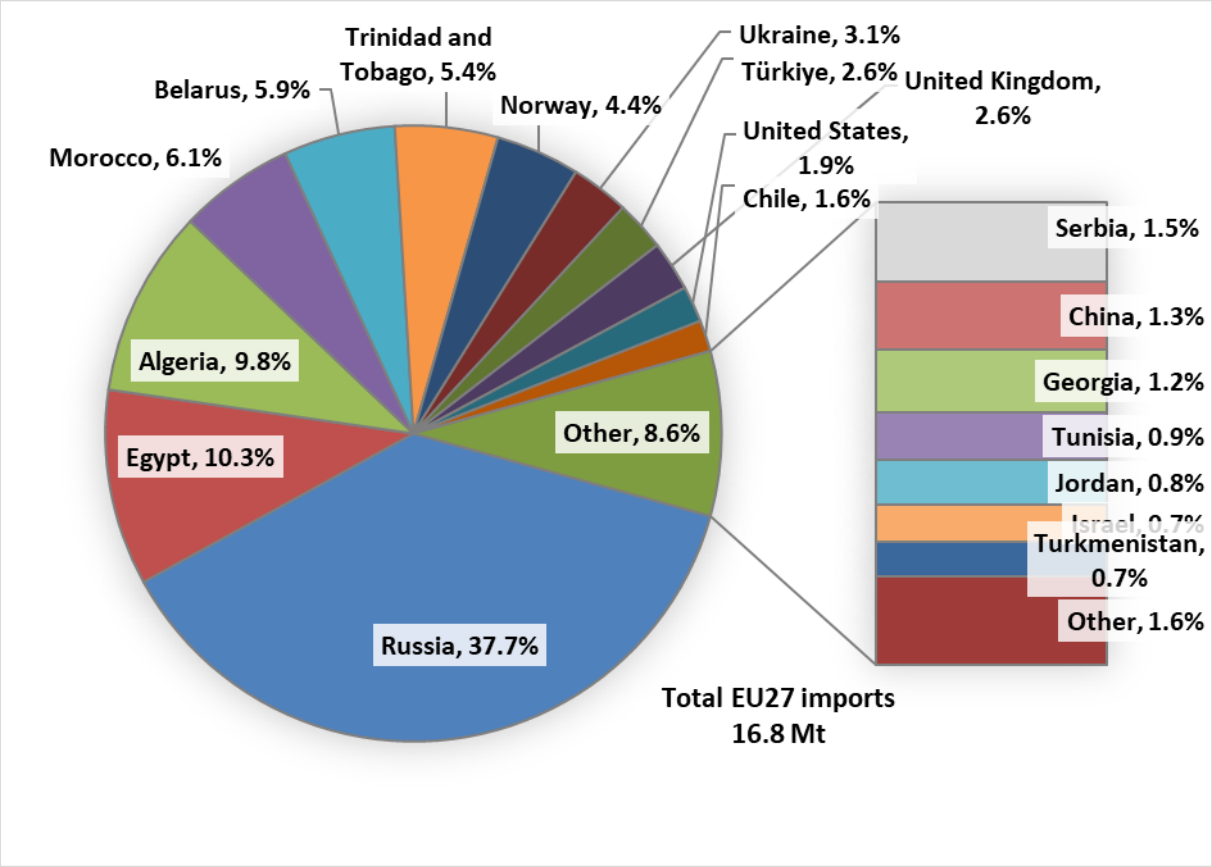
3.1 Countries under scope

Figure 19 shows that 12 countries represent more than 90% of imports of the fertilisers under the scope. In order to reach 98.4% of the total imports, an additional seven countries are selected. The remaining 1.6% represents 65 countries, the highest being Other Europe (countries not elsewhere specified in the UN Comtrade database) at 0.47%, followed by Switzerland at 0.22%, and Azerbaijan at 0.21%.

Figure 19 shows the largest worldwide exporters of fertilisers under the scope, independently of whether they export to the EU or not.

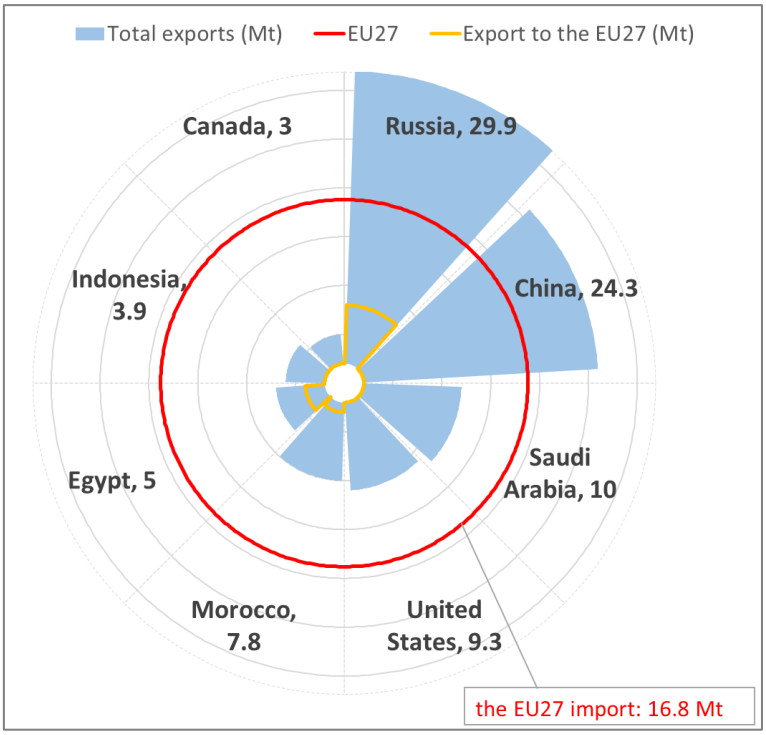
Although imports from Saudi Arabia, Indonesia, and Canada are currently very small, we include them in the list of countries under the scope (together with 19 countries listed in Figure 19) since they belong to the list of eight of the largest worldwide exporters of the fertilisers under the scope.

Figure 19. The main exporters of fertilisers covered by the CBAM to the EU27 in 2019.



Source: JRC, 2023 based on (UN Comtrade, 2022).

Figure 20. Exports to any country of fertilisers covered by the CBAM versus the total EU27 imports in 2019.



Source: JRC, 2023 based on (UN Comtrade, 2022).

3.2 Determining greenhouse gas emission intensities

The production of ammonia is the most energy-intensive stage of fertiliser production. It accounts for approximately 90% of the total energy consumption of the fertilisers industry globally (IFA, 2014). The production of fertilisers consumes approximately 1.2% of the world's total energy, while the rest of the chemical industry consumes 19.3% (IFA, 2014), which means that only about 6% of the chemical industry's total energy consumption can be apportioned to fertilisers. We therefore consider it challenging to follow the top-down approach for the fertilisers industry, based on the disaggregation of the values reported in the energy balance sheets (in this case, fertilisers are a family of products among the thousands included in the chemical industry). Instead, we follow a product-oriented methodology based on the publicly available average plant energy efficiency (described below) to calculate the GHG emission intensities of the products in Table 6.

Each fertiliser product requires different energy input and different production processes or a combination of processes, so the list of products in Table 6 is extended in Table 7 with the associated EU27 import data for 2019. For the products marked in grey in Table 7, it is not possible to calculate GHG emission intensities since the composition of those fertilisers is unknown, but they accounted for only 1.8% of all the EU27's fertiliser imports in 2019. To be able to calculate their GHG emission intensities, it is necessary to know their type/composition.

Table 7. Detailed list of the fertiliser products covered by Annex 1 of the CBAM regulation.

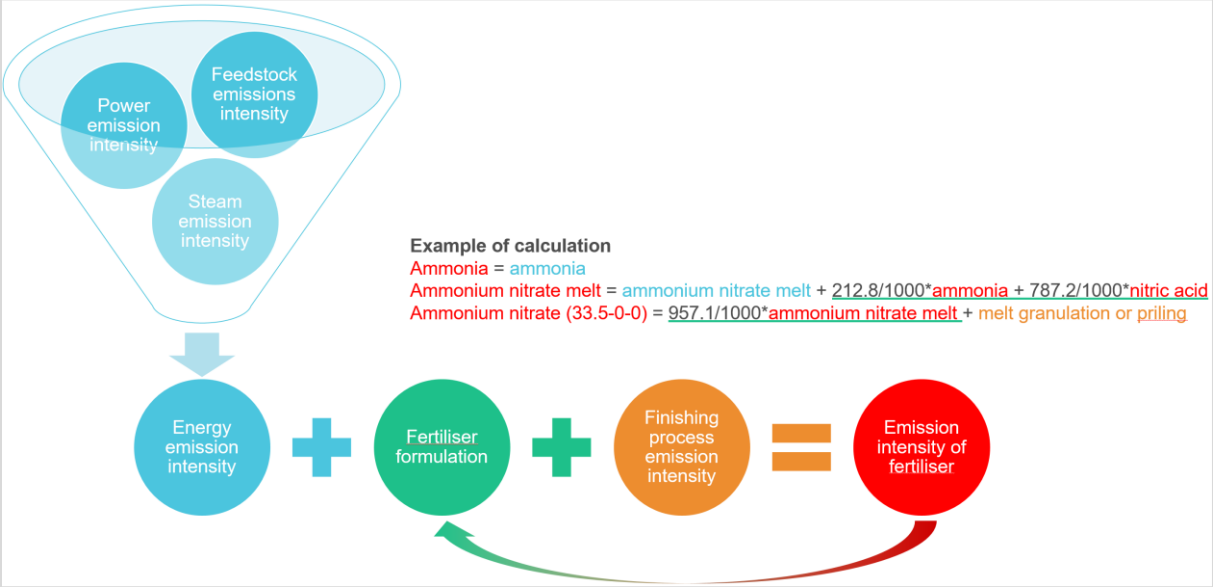
Commodity Code	Commodity	2019 Import 1000 t	Share of the total import in 2019
2814	Ammonia; anhydrous or in aqueous solution	3234	23.5%
3102	Fertilizers; mineral or chemical, nitrogenous	7569	54.9%
310210	*Fertilizers, mineral or chemical; nitrogenous, urea, whether or not in aqueous solution*	*4175*	*30.3%*
310280	*Fertilizers, mineral or chemical; nitrogenous, mixtures of urea and ammonium nitrate in aqueous or ammoniacal solution*	*1633*	*11.9%*
310240	*Fertilizers, mineral or chemical; ammonium nitrate with calcium carbonate or other inorganic non-fertilizing substances, mixtures thereof*	*752*	*5.5%*
310221	*Fertilizers, mineral or chemical; nitrogenous, ammonium sulphate*	*430*	*3.1%*
310230	*Fertilizers, mineral or chemical; nitrogenous, ammonium nitrate, whether or not in aqueous solution*	*345*	*2.5%*
310229	*Fertilizers, mineral or chemical; nitrogenous, other than ammonium sulphate*	*126*	*0.9%*
310290	*Fertilizers, mineral or chemical; nitrogenous, other kinds including mixtures not specified in the foregoing subheadings*	*52*	*0.4%*
310260	*Fertilizers, mineral or chemical; nitrogenous, double salts and mixtures of calcium nitrate and ammonium nitrate*	*32*	*0.2%*
310250	*Fertilizers, mineral or chemical; nitrogenous, sodium nitrate*	*25*	*0.2%*
280800	Nitric acid; sulphonitric acids	11	0.1%
283421	Nitrates; of potassium	419	3.0%
310510	Fertilizers, mineral or chemical; in tablets or similar forms or in packages of a gross weight not exceeding 10kg	11	0.1%
310520	Fertilizers, mineral or chemical; containing the three fertilizing elements nitrogen, phosphorus and potassium	2210	16.0%
310551	Fertilizers, mineral or chemical; containing nitrates and phosphates	94	0.7%
310559	Fertilizers, mineral or chemical; containing the two fertilizing elements nitrogen and phosphorus, other than nitrates and phosphates	173	1.3%
310590	Fertilizers, mineral or chemical; n.e.c. in heading no. 3105	53	0.4%

Source: JRC based on (UN Comtrade, 2022).

The nutrient content, or grade, of fertilisers is used to classify their composition based on the three major nutrients (nitrogen expressed in elemental form N, phosphorus expressed in elemental form P or oxide form P_2O_5, and potassium expressed in elemental form K or oxide form K_2O). For example, a fertiliser grade of 7-28-14 means 7% N, 28% P_2O_5, and 14% K_2O (Harold and Reetz, 2016).

The methodology used in this study (shown in Figure 21), for the calculation of GHG emission intensities of fertilisers products, is based on the extended and updated methodology of the Fertilizers Europe Carbon Footprint Calculator (Fertilizers Europe, 2022), which is further based on the scheme proposed in 1998 at the IFA Technical Conference (Kongshaug, 1998). Accordingly, the GHG emission intensity of fertilisers is composed of three distinct parts: the GHG emissions originating from the energy consumed in the production process (further disaggregated to feedstock, electricity, and steam), the fertiliser formulation (as described below, where applicable), and the finishing process (prilling or granulation, where applicable). Feedstock is hereafter used to refer both to the fuels used in the process of ammonia production, but also, in the interests of simplicity, the fuels used for energy purposes (e.g. heating).

Figure 21. Methodology for calculation of fertiliser's GHG emission intensities.



Source: JRC, 2023.

The first step is to calculate the GHG emission intensities (tCO_2e per t product) of the energy-related part (blue circle on Figure 21) for each fertiliser under the scope using the following equation:

$$Energy\ emission\ intensity\ \left[\frac{t_{CO_2}}{t}\right] = \sum_{f}^{all\ fuels} \left(Energy\ intensity_{\ fuel}\ \left[\frac{GJ}{t}\right] * EF_f\ \left[\frac{t_{CO_2}}{GJ}\right]\right) \quad (9)$$

Where EF_{fuel} standing for emission factor of fuel in tCO_2 per gigajoule, and fuel designate feedstock, power and steam.

Table 8 provides publicly available data on regional energy intensities in ammonia production (Wendołowski, 2019). Negative values for steam mean that the process generates steam, which the exothermic reaction of hydrogen with nitrogen can explain. Total steam demand is decreased for the steam exported from exothermic reactions. This approach is based on the assumption that all excess heat can be used onsite. Ammonia production is an exothermic process, but the heat generated can either be exported or used in the process to decrease the use of other fuels (e.g. run compressors) (ENERGY STAR, 2017). In the absence of more detailed data, it is assumed that steam is not exported from ammonia facilities in other regions. The energy consumption intensities in the production processes of other fertiliser products are presented in Table 9 (Fertilizers Europe, 2022), and the same data are used for all countries under the scope. For fertilisers not listed in Table 9 energy consumption intensities are not publicly available, and these are not included when calculating the GHG emission intensities of fertilisers.

For feedstock, the emission factors listed in Annex 1 are applied. These figures are for stationary combustion in manufacturing industries, retrieved principally from the CBAM Implementing Regulation (European Commission, 2023b). In all countries under the scope, natural gas is used as feedstock, except in China, where 78% of ammonia production is coal-based and 22% is natural gas-based (IEA, 2009).

It is assumed that all steam demand is produced onsite, either in an autoproducer CHP plant (in which case steam demand is considered to be 100% covered by CHP according to the IEA energy balances) or an onsite steam boiler. The presence of information about autoproducer plants in the IEA energy balances (IEA, 2022) is used to assume the presence of CHP in the industry of each country. The assumed fuel type input to CHPs and steam boilers is the same as for ammonia feedstock.

The country-specific CO_2 emission factor for electricity is calculated by weighting a five-year average of the grid-electricity carbon emission factor for 2015-2019 (IEA, 2021) and the carbon emission intensity of electricity produced onsite in the CHP plant is calculated according to its fuel mix. Dividing the estimated onsite electricity generation (obtained using a total steam demand calculated using the CHP parameters detailed in the next paragraph) by the fertiliser industry electricity demand, a weighting factor for onsite generated electricity is obtained.

For the onsite autoproducer CHP plant, the following parameters are used: 0.55 power-to-heat ratio (JRC, 2017), 90% heat output to fuel-for-heat input ratio (IEA, 2021), and 76% overall CHP efficiency (JRC, 2017). For the onsite steam boiler, an efficiency of 90% is applied (IEA, 2021b).

The production of fertilisers per country is not publicly available (on IFASTAT, it is reserved only for members). Hence it was modelled using publicly available data. Ammonia production is calculated by dividing the total N-based fertiliser production per country (IFASTAT, 2023) with N content in ammonia (82%). The production of other fertilisers per country is calculated as follows:

$$Production\ [\mathrm{t}] = consumption\ [\mathrm{t}] + export[\mathrm{t}] - import[\mathrm{t}] \quad (10)$$

Where input data for consumption of fertilisers per country is from (IFASTAT, 2023), and export/import data are from (UN Comtrade, 2022).

Since data on fertiliser consumption per country (IFASTAT, 2023) is given per tonne of nutrient, they are recalculated per tonne of product using the stoichiometry principles and fertiliser formulations given in Table 11. For ammonium phosphate fertilisers, the consumption per country is calculated considering the regional ratio of mono-ammonium and diammonium phosphates (IFASTAT, 2023). Furthermore, in order to calculate the total electricity and heat demand, a 15% N grade is assumed for NPK fertilisers and 20% N grade for other NP fertilisers. As described below, the GHG emission intensities are calculated using the given equation for those complex fertilisers.

The total heat and electricity demand is determined considering the calculated production volume of each type of fertiliser under the scope, the corresponding energy intensities in Table 8 and Table 9, and the fertiliser formulations in Table 11.

Finally, the total onsite electricity generation is calculated as follows:

$$Onsite\ electricity\ generation\ [\mathrm{GJ}] = Heat\ production\ in\ CHP\ [\mathrm{GJ}] \cdot CHP_{ratio} \quad (11)$$

Table 8. Energy consumption intensities in production process of ammonia (GJ/t product).

	Feedstock	Electricity	Steam
EU average 2013/14	34.03	0.84	-1.49
North America	34.891		
Latin America	41.379		
Africa	36.705		
Middle East	35.745		
Commonwealth of Independent States (CIS)	39.491		
South East Asia	37.454		
South Asia	42.814		
Oceania	32.105		
China, Coal based	44.255		
China, Gas based	39.491		

Source: (Wendołowski, 2019).

Table 9. Energy consumption intensities in production processes of final fertilisers and intermediate products (GJ/t product).

Fertilizer	Feedstock	Electricity	Steam
Nitric acid	0	0.03	-1.75
Ammonium nitrate melt (35-0-0)	0	0.1	0.6
Melt granulation	0.4	0.2	0.2
Prilling	0	0.1	0.3
Ammonium sulphate (21-0-0, 24S)	0	0.1	0.7
Calcium nitrate melt (N basis)[a]	0	0.2	5
Nitrophosphate	0	1.6	2.9
Urea (46-0-0)	0	0.2	3.9
Urea ammonium nitrate (30-0-0)	0	0.1	0

[a] per t of N

Source: JRC, 2023 based on (Fertilizers Europe, 2022).

Some fertiliser products are produced by combining two or more other intermediate or final products (precursors), as shown in Figure 22. This process is known as fertiliser formulation (the green circle in Figure 21), and it is based on stoichiometry principles. Table 11 lists precursors and their consumption (i.e. the fertilisers' formulation) in the production of the intermediate and final fertiliser products under the scope, accompanied by the relevant finishing process types (listed below the table). The difference between the intermediate and final fertilisers is that for the former, the finishing process is not applied, and they only serve as precursors in producing other, final fertilisers. Examples of intermediate fertilisers (marked in light green in Figure 22) are ammonium nitrate melt and ammonium sulphate intermediate products. The CBAM regulation does not cover the precursors in white boxes in Figure 22, and hence their GHG emission intensity is taken in calculations as 0 tCO_2e per t product.

Nitric acid plant efficiency is set to 93% (JRC, 2007). N_2O emissions from nitric acid production (that are added to the direct GHG emissions) are given in Table 10 (Fertilizers Europe, 2022; Argus, 2020). For countries not listed in Table 10, regional values are applied. A Global warming potential of 265 $tCO_2e/t\ N_2O$ is used (European Commission, 2023b).

Similarly, it is assumed that potassium and sodium nitrate plants have an efficiency of 95%.

Calcium nitrate (CN) is composed of 1.2% ammonical-N and 14.3% nitrate-N (Fertilizers Europe, 2022).

Half of the total N in urea ammonium nitrate (UAN) comes from the urea solution and half from the ammonium nitrate solution (IPNI, 2022).

Phosphate ore grades range between 2% and 35% phosphorus pentoxide P_2O_5, which can be further increased to 27-40% by additional processing (IFA, 2015). In this study, we apply a value of 32% for P_2O_5 content in phosphate rock (Fertilizers Europe, 2022).

The difference between ammonium sulphate (21-0-0, 24S) and ammonium sulphate intermediate products is that the latter does not include a finishing process (melt granulation).

Figure 21 also contains examples of GHG emission intensity calculations. Notably, the GHG emission intensities of fertilisers used in the formulation step represent the relevant fertilisers' total GHG emission intensity (red

circle in Figure 21). Accordingly, Table 11 can also be read, for example, as follows: the formulation step in the production of AN melt (35-0-0) consists of 21.28% of the ammonia's total GHG emission intensity (red circle in Figure 21) and 78.72% of the nitric acid's total GHG emission intensity (also red circle in Figure 21). On top of the formulation step, to calculate the total GHG emission intensity of AN melt (35-0-0), the GHG emission intensity related to energy consumption (blue circle in Figure 21) has to be added. Furthermore, the calculation of the total GHG emission intensity for AN (33.5-0-0) does not include the energy-related GHG emission intensity, i.e. it consists only of the formulation step (95.71% of the total GHG emission intensity of AN melt (35-0-0), due to other additives) and the finishing process step (GHG emission intensity of the applied melt granulation or prilling).

Table 10. N_2O emissions in production process of nitric acid (kg N_2O/t product).

Country	Region	kg N_2O/t product
	EU	0.7
	Africa	4.3
	China	7.4
	CIS	8.1
	Latin America	4.7
	Middle East	7.5
	North America	4.0
	Oceania	3.2
	South Asia	4.5
	South East Asia	5.9
Algeria	Middle East	4.8
Belarus	CIS	4.6
Egypt	Middle East	5.0
Russia	CIS	8.1
Trinidad and Tobago	Latin America	9.0
USA	North America	4.0

Source: (Fertilizers Europe, 2022), (Argus, 2020).

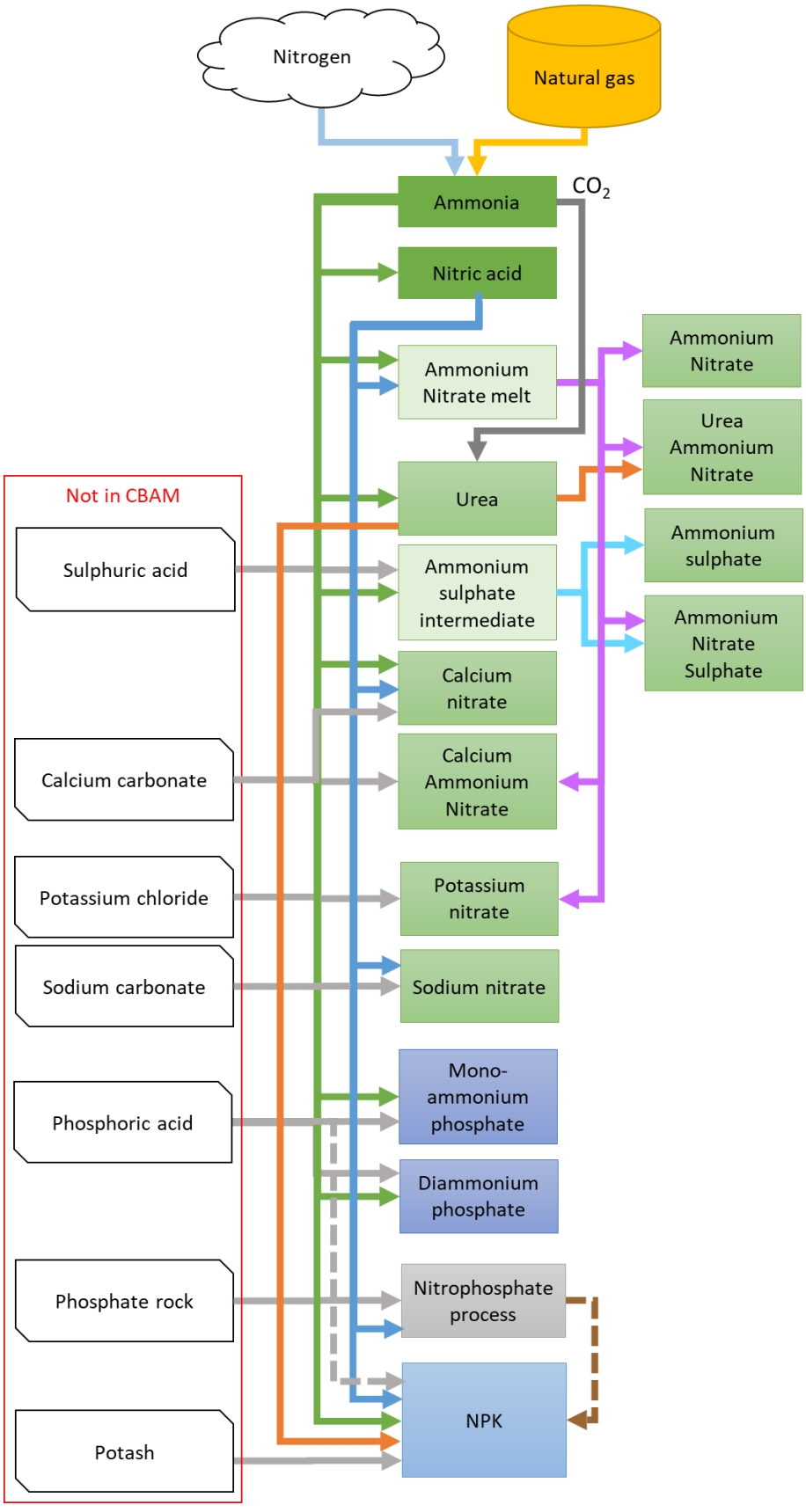
Table 11. Formulation of intermediate and final products of fertilisers (kg/t product).

To produce one tonne of the product in each row, various products given in kg in corresponding columns are needed as input	Ammonia	Nitric acid	Ammonium nitrate melt	Sulphur	Sulphuric acid (100%)	Phosphate rock (32% P_2O_5)	CO_2	Urea	Calcium carbonate	Ammonium sulphate intermediate	Phosphoric acid (P_2O_5 basis)	Potassium chloride	Sodium carbonate
Nitric acid	290.6												
Ammonium nitrate melt (35-0-0)	212.8	787.2											
Ammonium nitrate (33.5-0-0)[a, b]			957.1										
Sulphuric acid				326.9									
Ammonium sulphate (21-0-0, 24S)[a]	257.8				742.2								
Calcium nitrate (15.5-0-0)[a]	14.6	643.5							341.9				
Phosphoric acid					2750.0	3350.0							
Nitrophosphate[a*]						3125.0							
Urea (46-0-0)	567.2						732.8						
Urea ammonium nitrate solution (30-0-0)			428.6					326.1					
Calcium ammonium nitrate (27-0-0)[a]			771.4						228.6				
Ammonium nitrate sulphate (26-0-0, 14S)[a]			387.0							593			
Mono-ammonium phosphate (11-52-0)[a]	133.6										520.0		
Diammonium phosphate (18-46-0)[a]	218.6										460.0		
Ammonical nitrogen	1215.9												
Nitrate nitrogen			5714.7										
Potassium nitrate												776.2	
Sodium nitrate													1312.6

[a] melt granulation
[b] prilling
* For simplicity, all nitric acid is assumed to be processed through the ammonium nitrate unit in the production of NPK fertilisers. Hence, nitric acid consumption in nitrophoshate process is not shown in this table.

Source: JRC, 2023 partially based on (Fertilizers Europe, 2022).

Figure 22. Production of mineral fertilisers under the scope.



Source: JRC, 2023.

NPK fertilisers are described by their grade: total nitrogen content, nitrate nitrogen content, urea nitrogen content, phosphorus content, and potash content. They can be produced using nitrophosphate or the mixed acid process. Since the nitrophosphate process is more GHG emission-intensive in terms of the CBAM regulation, it is selected when calculating the GHG emission intensities. The following equation is applied when calculating the GHG emission intensity of the NPK fertiliser family:

$$\begin{aligned} &NPK\ fertiliser\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &= energy\ related\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &+ ammonical\ nitrogen\ related\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &+ nitrate\ nitrogen\ related\ GHG\ \ emissionintensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &+ urea\ nitrogen\ related\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &+ phosphorus\ related\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &+ potash\ related\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &+ melt\ granulation\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \end{aligned} \quad (12)$$

Where:

$$\begin{aligned} &Energy\ related\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &= nitrate\ nitrogen\ content[\%] \\ &\cdot nitrate\ nitrogen\ formulation[\text{dimensionless}] \\ &\cdot ammonium\ nitrate\ melt\ energy\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \end{aligned} \quad (13)$$

$$\begin{aligned} &Ammonical\ nitrogen\ related\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &= (total\ nitrogen\ content[\%] - nitrate\ nitrogen\ content\ [\%] \\ &- urea\ nitrogen\ content\ [\%]) \cdot \frac{ammonium\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right]}{nitrogen\ content\ in\ ammonia[\%]} \end{aligned} \quad (14)$$

$$\begin{aligned} &Nitrate\ nitrogen\ related\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &= nitrate\ nitrogen\ content[\%] \cdot \frac{nitric\ acid\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right]}{nitrogen\ content\ in\ nitric\ acid[\%]} \end{aligned} \quad (15)$$

$$\begin{aligned} &Urea\ nitrogen\ related\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right] \\ &= urea\ nitrogen\ content[\%] \cdot \frac{urea\ GHG\ emission\ intensity\ \left[\frac{t_{CO2}}{t_{product}}\right]}{nitrogen\ content\ in\ urea[\%]} \end{aligned} \quad (16)$$

$$Phosphorus\ related\ GHG\ emission\ intensity \left[\frac{t_{CO2}}{t_{product}}\right] = 0 \quad (17)$$

$$Potash\ related\ GHG\ emission\ intensity \left[\frac{t_{CO2}}{t_{product}}\right] = 0 \quad (18)$$

Equation (12) is also used for NP and NK fertilisers; only the missing nutrient (K or P, equations (17) and (18) respectively) part is equal to 0.

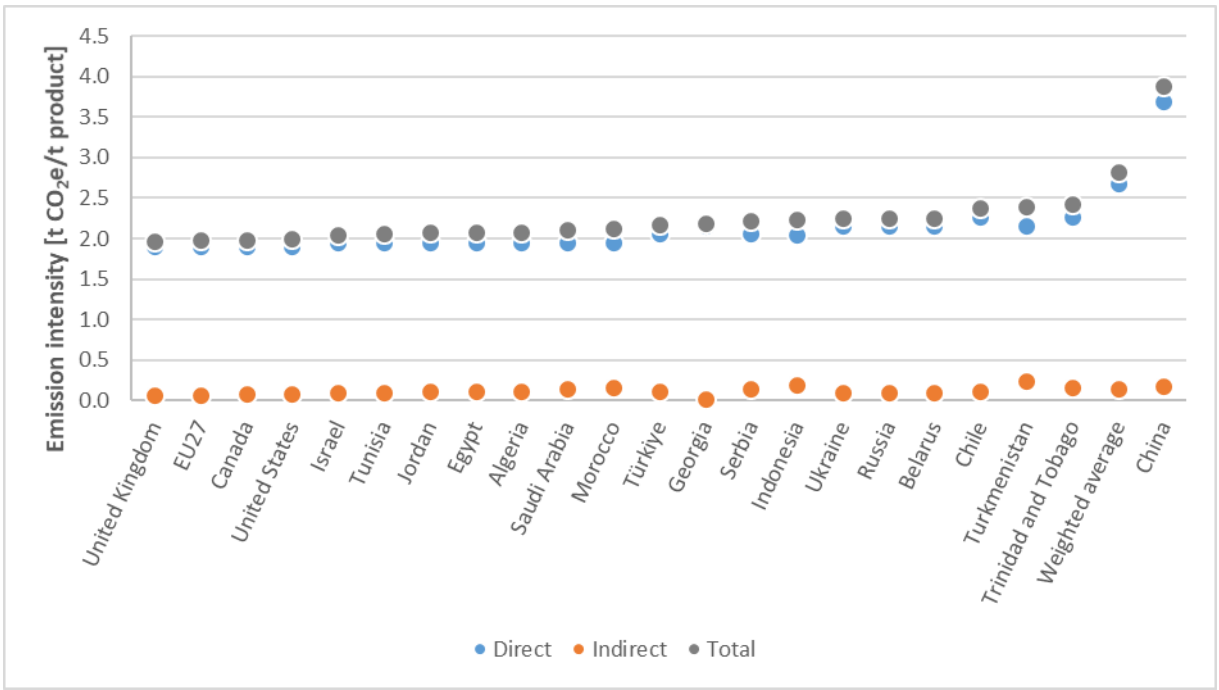
Ammonia and nitric acid represent the precursors covered by the CBAM regulation that should be taken into account when determining the GHG emission intensity of the fertilisers under the scope. The trade effect of ammonia and nitric acid on the fertiliser's GHG emission intensity is calculated using the equations given in section 1.1.

3.3 Results

The GHG emission intensities of the ammonia, nitric acid, nitrates of potassium, urea, AN, UAN, and NPK (15-15-15) are shown below. Detailed results for fertilisers and countries under the scope are given in Table 20 of Annex 2, as well as the embedded emission intensity applicable to countries out of the scope.

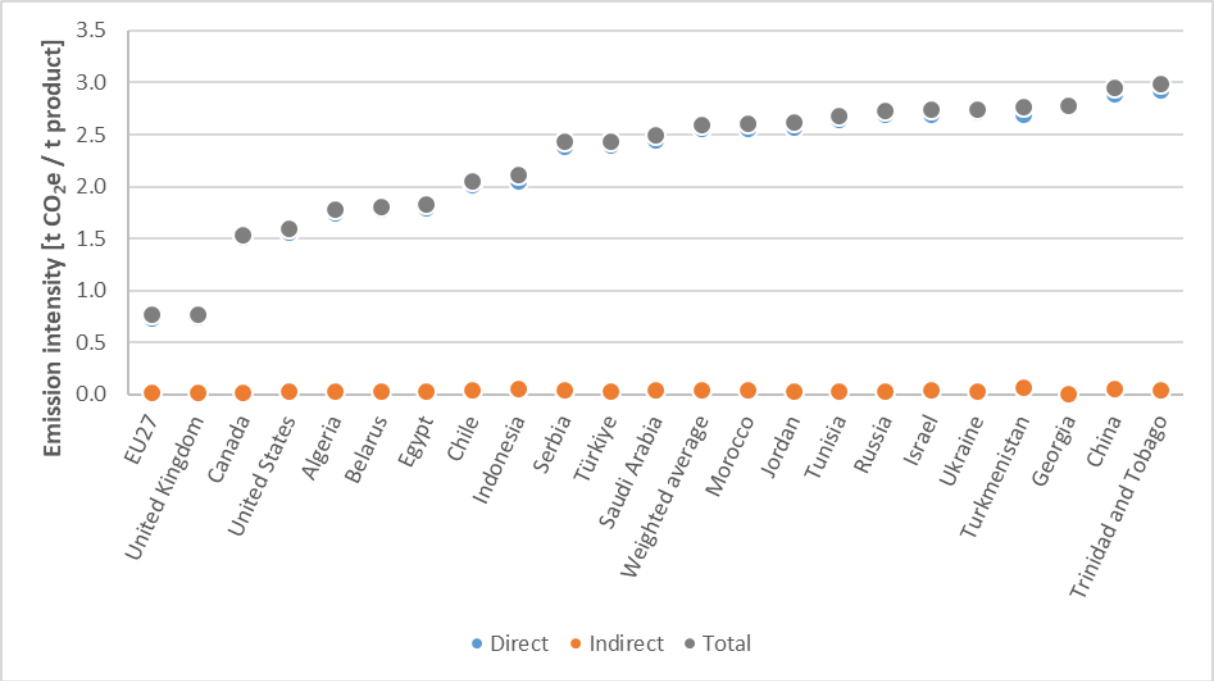
The high GHG emission intensity of ammonia production in China is because of the feedstock fuel used (78% of production is coal-based). The low GHG emission intensity of nitric acid production in the EU and the UK is because of very low N_2O emissions compared to the other countries (6 to 13 times lower), as a consequence of the retrofits implemented by European industry after of the entry into force of the EU ETS (JRC, 2017a). The GHG emissions of ammonia and nitric acid are embedded in the other fertilisers according to the formulation principles. The GHG emission intensity of urea is largely influenced by the emission factor of the steam consumed, as urea production requires the highest steam consumption among all fertilisers.

Figure 23. GHG emission intensity for CN code 2814 – Ammonia.



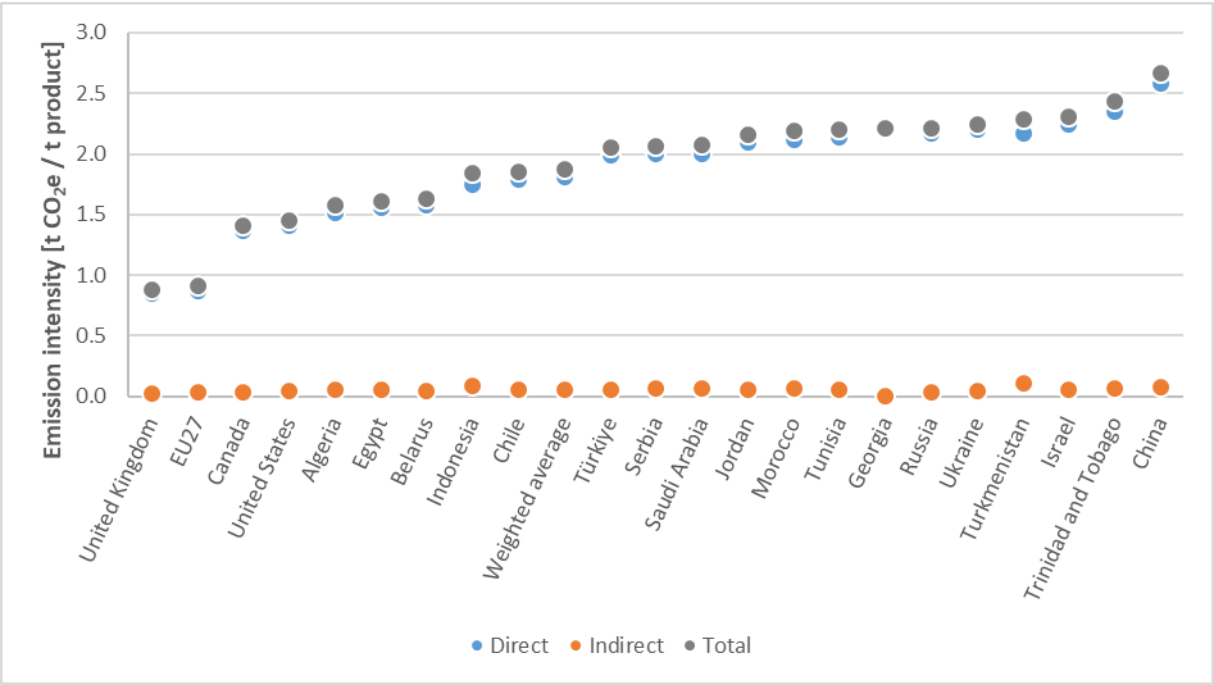
Source: JRC, 2023.

Figure 24. GHG emission intensity for CN code 2808 00 00 – Nitric acid.



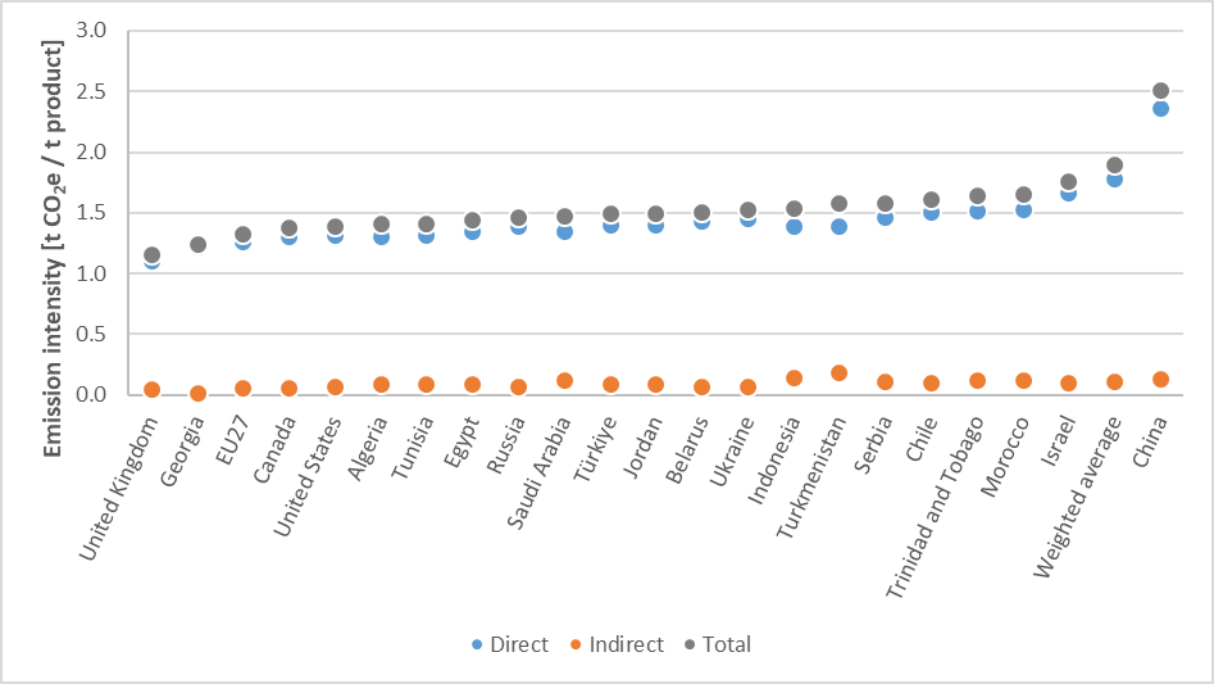
Source: JRC, 2023.

Figure 25. GHG emission intensity for CN code 2834 21 00 – Nitrates of potassium.



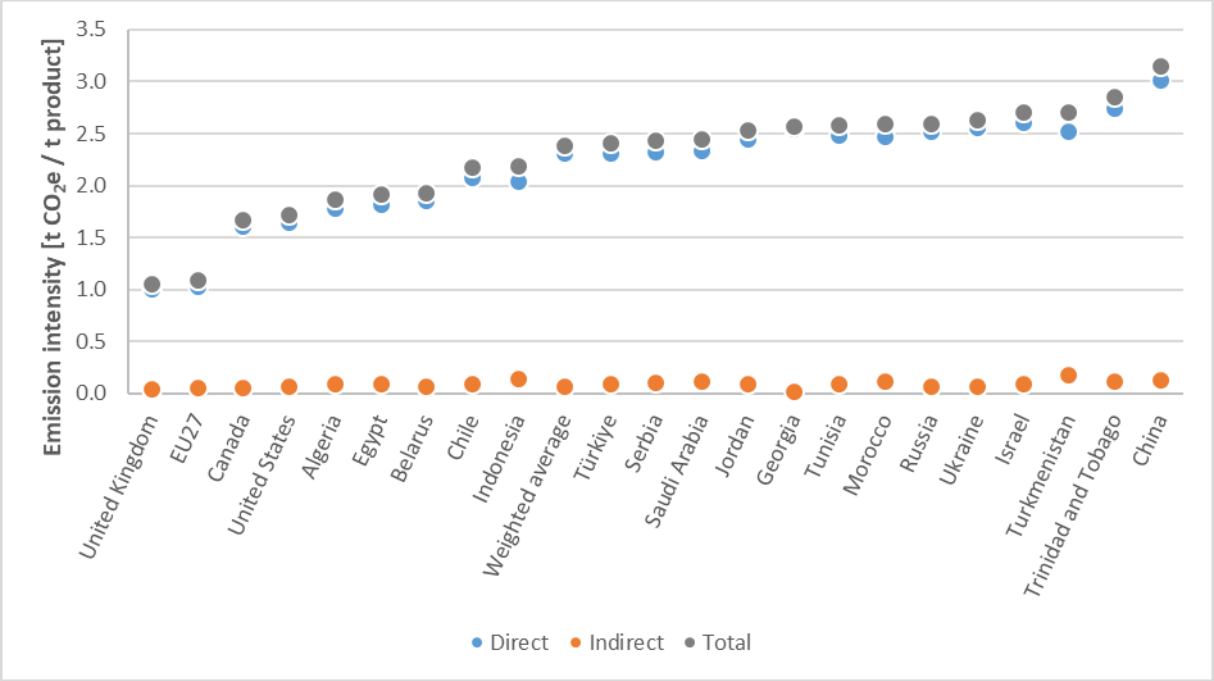
Source: JRC, 2023.

Figure 26. GHG emission intensity for CN code 3102 10 – Urea.



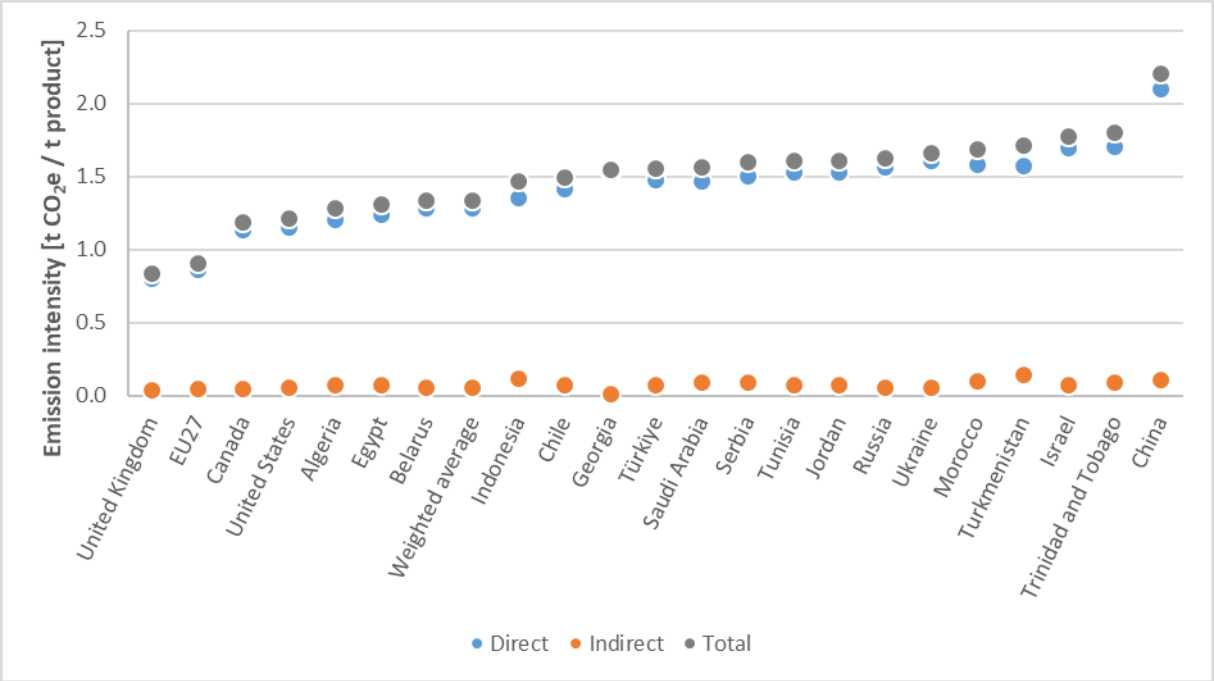
Source: JRC, 2023.

Figure 27. GHG emission intensity for CN code 3102 30 – Ammonium nitrate.



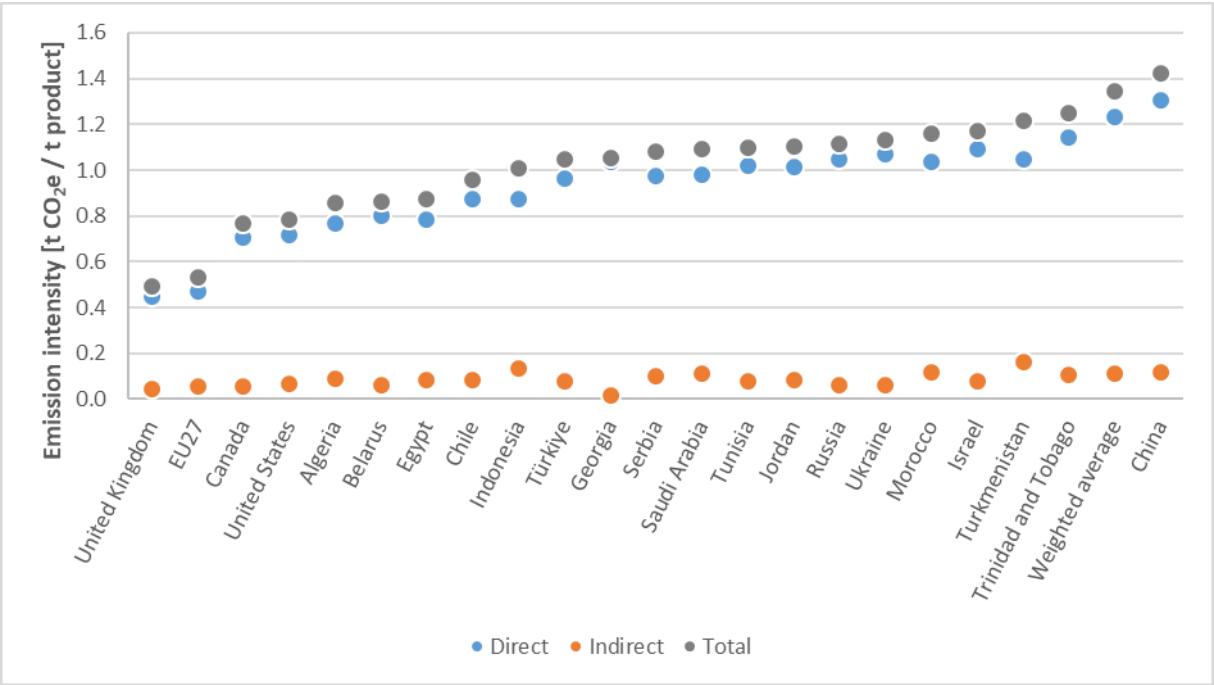
Source: JRC, 2023.

Figure 28. GHG emission intensity for CN code 3102 80 00– Urea ammonium nitrate.



Source: JRC, 2023.

Figure 29. GHG emission intensity for CN code 3105 20 – NPK (15-15-15).

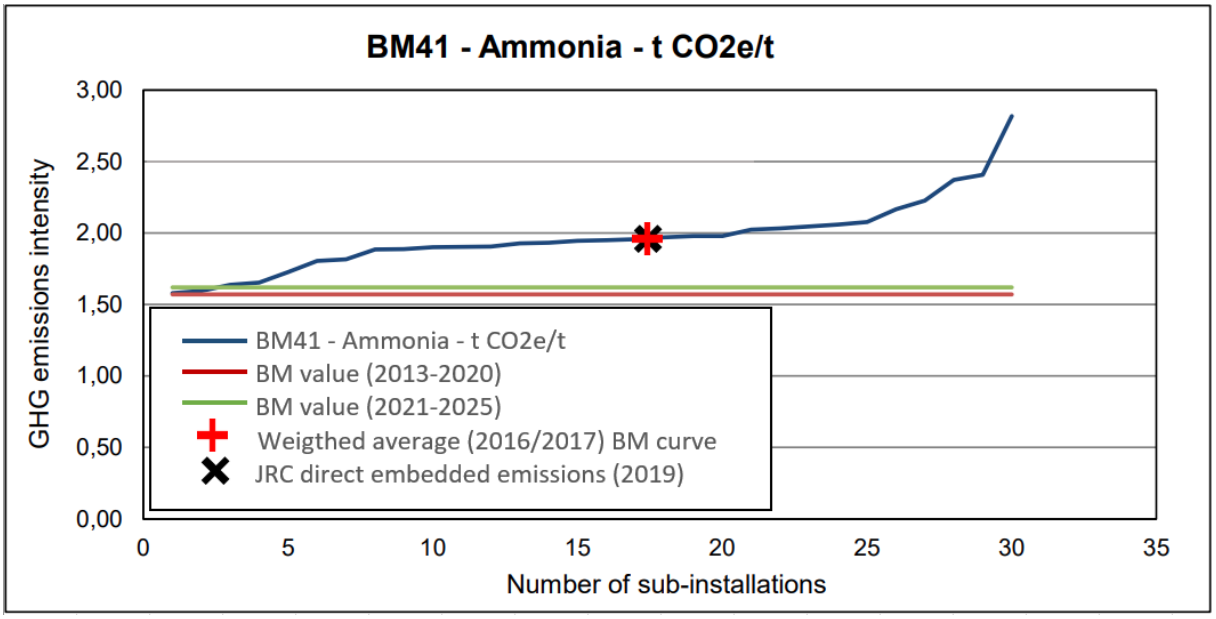


Source: JRC, 2023.

Only two of the products from the fertilisers industry feature in the benchmarking curves of the EU ETS: ammonia and nitric acid. Figures 29 and 30 below present the JRC estimations of direct GHG emission intensities and their corresponding benchmarking curves (European Commission, 2021c). The estimated direct emissions for ammonia in the EU27 are reasonably accurate (Figure 30). The value for nitric acid (Figure 31) is much higher (0.77 tCO2e/t) than the weighted EU average in the benchmarking curve (0.205 tCO2e/t); this is because unlike the EU ETS, the embedded emissions in the CBAM include the emissions of ammonia as a precursor. If

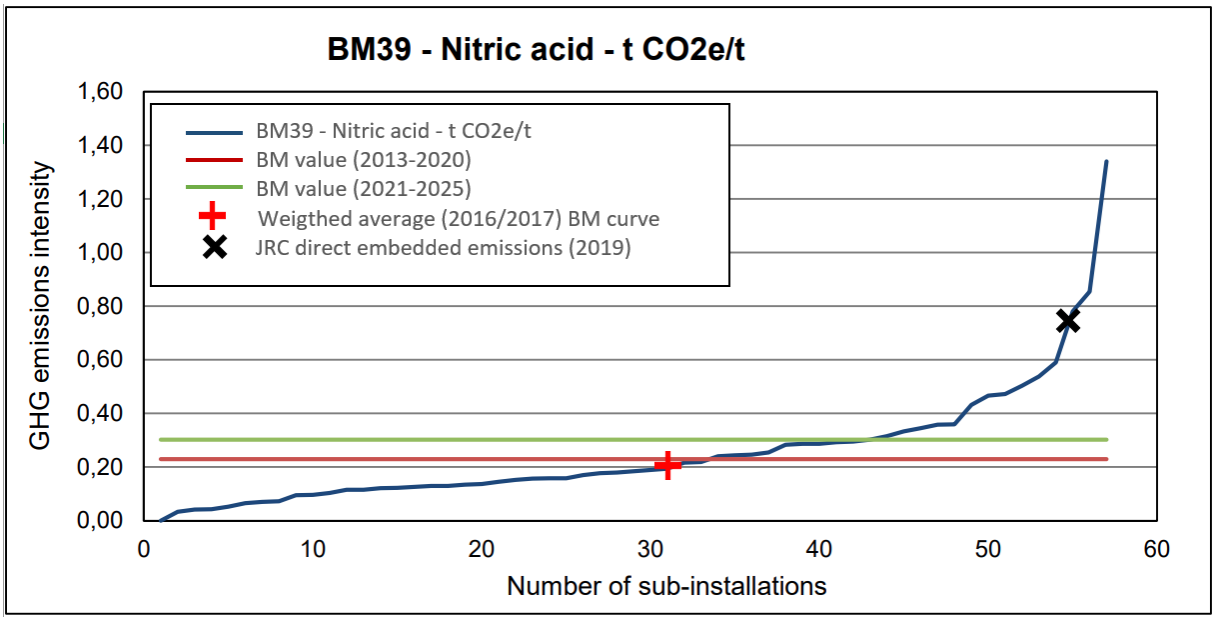
this effect is discounted, the resulting emissions of 0.22 tCO2e/t are more aligned with the weighted average of the EU ETS.

Figure 30. Benchmarking curve of the EU ETS for ammonia and JRC-estimated direct embedded emissions.



Source: JRC, 2023 and (European Commission, 2021c).

Figure 31. Benchmarking curve of the EU ETS for nitric acid and JRC-estimated direct emissions.



Source: JRC, 2023 and (European Commission, 2021c).

4 Analysis for the products of the aluminium industry

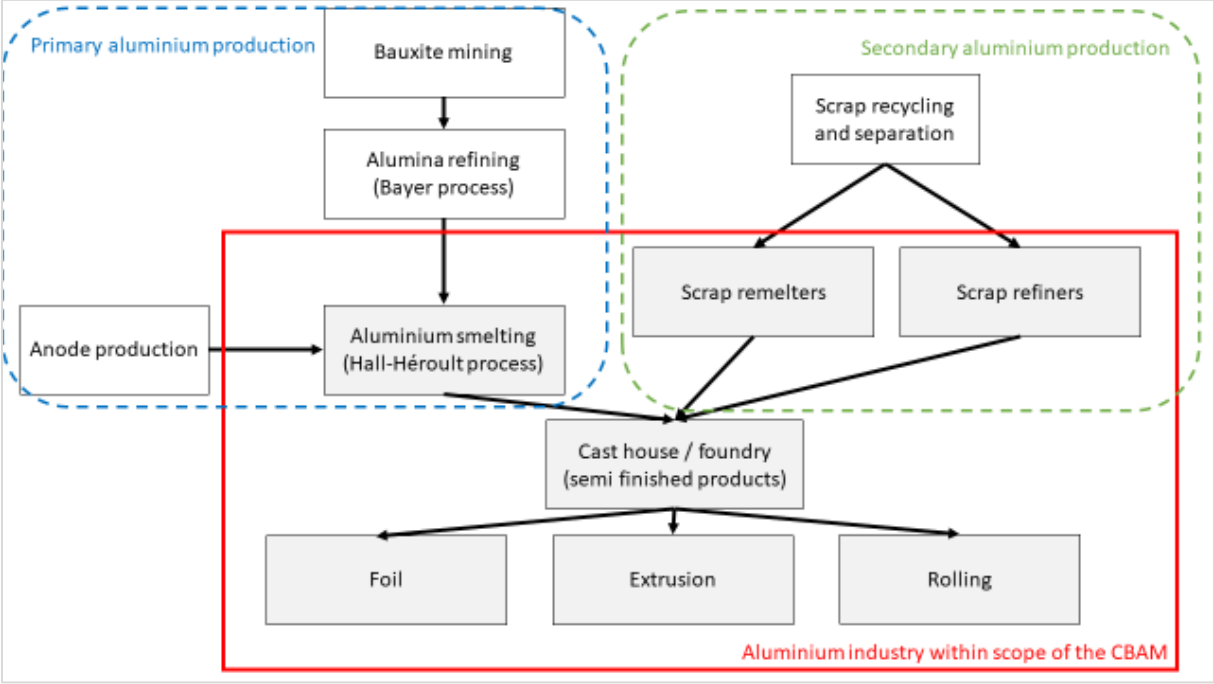
The primary aluminium production route starts with the production of aluminium oxide (alumina) from the aluminium mineral (bauxite) in alumina refineries using the Bayer process([6]). Primary aluminium is produced in electrolysis plants or smelters by the Hall-Héroult process([7]). The carbon anodes([8]) are consumed in the electrolytic process. The carbon anodes can be produced in a separate anode plant ('pre-baked') or in the smelter, using the Söderberg technology. In Europe, almost all carbon anodes are 'pre-baked'. Both alumina and carbon anodes are outside the scope of the CBAM.

The secondary aluminium production route uses scrap, either in remelters or in refineries to produce recycled aluminium. Remelters use new scrap (also called process scrap or pre-consumer scrap), whereas refiners use old scrap (also called post-consumer scrap). Refiners produce casting alloy, and remelters generate wrought alloys for sheet (foil), rolling and extrusion.

The scope of the CBAM includes goods produced from primary and secondary aluminium and therefore encompasses the following processes: aluminium smelting (primary production route), aluminium recycling (secondary production route), fabrication (cast house) and manufacturing (rolling/sheet, cold rolling/foil and extrusion).

Figure 32 summarises the aluminium manufacturing processes and indicates the scope of the CBAM in red.

Figure 32. Main processes from the aluminium primary and secondary production routes within the context of the CBAM.



Source: JRC, 2023.

[6] The Bayer process is the name for the hydrometallurgical extraction and refinement of alumina from Bauxite.

[7] The Hall-Heroult process is the major industrial process for smelting aluminium. It involves dissolving aluminium oxide (alumina) in molten cryolite and electrolysing the molten salt bath, typically in a purpose-built cell (https://en.wikipedia.org/wiki/Hall%E2%80%93H%C3%A9roult_process).

[8] Carbon anodes are a specific type of anode designed for aluminium smelting. During the smelting process, these anodes are suspended within the electrolysis cell containing the aluminium oxide or aluminium fluoride. The process consumes around 450 kg of anode per tonne of aluminium produced, and is the main source of CO_2 emissions in primary aluminium production.

Table 12 lists the aluminium products covered by Annex 1 of the CBAM Regulation. All of these aluminium products can be produced through both the primary and secondary production route. Therefore, the GHG emission intensities of the final products are considered for each route (primary and secondary), in each country.

Table 12. Aluminium products covered by Annex 1 of the CBAM Regulation.

CN Code	PRODCOM Codes	Production processes
7601 – Unwrought aluminium	24421130 24421153 24421155 24421155	Primary
7603 – Aluminium powders and flakes	24422100	Casting
7604 – Aluminium bars, rods and profiles	24422230 24422250	Rolling, Extrusion
7605 – Aluminium wire	24422330 24422350	Rolling
7606 – Aluminium plates, sheets and strip, of a thickness exceeding 0,2 mm	24422430 24422450	Rolling
7607 – Aluminium foil (whether or not printed or backed with paper, paper-board, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0,2 mm	24422500	Foil
7608 – Aluminium tubes and pipes	24422630 24422650	Extrusion
7609 00 00 – Aluminium tube or pipe fittings (for example, couplings, elbows, sleeves)	24422670	Extrusion
7610 – Aluminium structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, balustrades, pillars and columns); aluminium plates, rods, profiles, tubes and the like, prepared for use in structures	25112370 25121050	Extrusion
7611 00 00 – Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity not fitted with mechanical or thermal equipment exceeding 300 litres, whether or not lined or heat-insulated, but	25291170	Sheet
7612 – Aluminium casks, drums, cans, boxes and similar containers (including rigid or collapsible tubular containers), for any material (other than compressed or liquefied gas), of a capacity not exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	25921210 25921240 25921260	Sheet
7613 00 00 – Aluminium containers for compressed or liquefied gas. Collapsible tubular containers	25291200	Sheet
7614 – Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated	25931270	Rolling
7616 – Other articles of aluminium	25931400 25992955 25621013	Casting, Rolling

Source: JRC, 2023 based on (European Union, 2023) and (IAI, 2018).

Although for the definitive period of the CBAM, indirect emissions are not included in the CBAM values, these indirect emissions are provided in Annex 2. Indirect emissions incorporate the emissions from power production, for which the average value from the power emission factor from the IEA (IEA, 2021a) from 2015 to 2019 is used.

4.1 Countries under scope

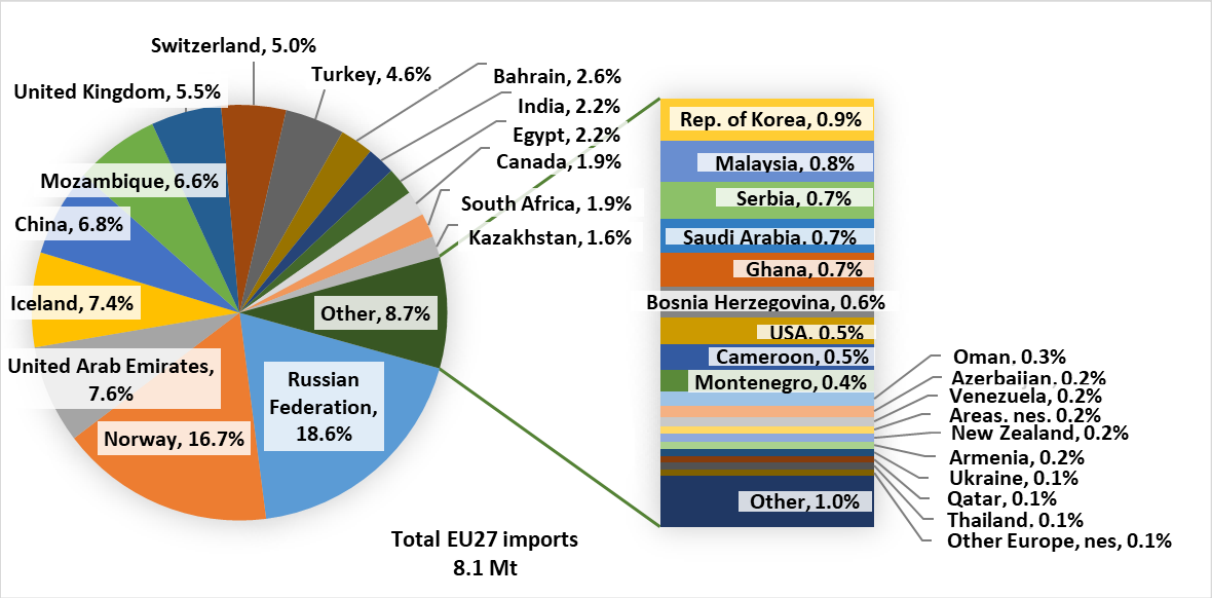
Figure 33 shows that there are 15 countries with a share of at least 1% of total imports to the EU. The accumulated share of these 15 countries amounts to 91.2% of the total.

Figure 34 shows the nine largest aluminium exporters worldwide, independently of whether they export to the EU. Although the US is a significant worldwide exporter of aluminium (among the nine largest), it only represents 0.5% of the EU's total imports (Figure 33). Norway and Iceland form part of the EU ETS and are therefore not

affected by the CBAM. However, they are included in this study due to the relevance of their primary aluminium production.

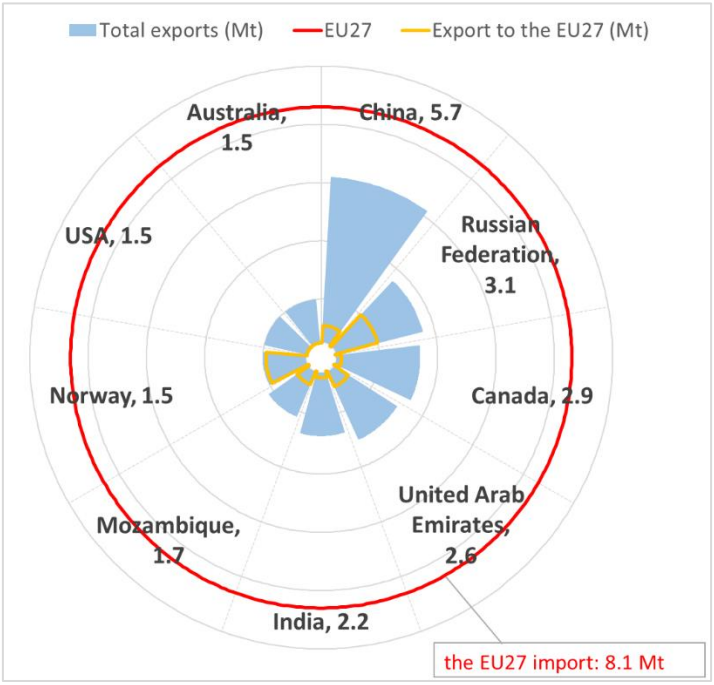
The exports from the remaining countries are so small (ranging between the size of a single small remelter or refinery of ~75 000 t/y (JRC, 2015), and one-tenth of that size) that there can be high variability in the countries exporting to the EU from year to year.

Figure 33. Total aluminium EU imports in 2019.



Source: JRC, 2023 based on (UN Comtrade, 2022).

Figure 34. Total EU aluminium imports vs total production from key producing countries.



Source: JRC, 2023 based on (UN Comtrade, 2022).

4.2 Input data

4.2.1 Metal data

Primary aluminium

A key source of information on primary aluminium production is the British Geological Survey - World Mineral Production Report (BGS, 2022). This survey contains production data for more than 70 metals and minerals for all producing countries, such as alumina, primary aluminium, copper, lead and zinc. The primary aluminium information closely resembles the United States Geological Survey - Mineral Commodity Summary (MCS, 2022) and UNFCC data (NIR, 2022) (for selected countries).

Secondary aluminium

The data on secondary aluminium is obtained from the Alucycle model (Alucycle, 2022). This model constitutes the most comprehensive publicly available dataset on aluminium flows. It encompasses all aluminium lifecycle components – mining, refining, production, fabrication, manufacturing, use, recycling, end-of-life management, mining fill, residue management and disposal and incineration. The data from Alucycle model (Alucycle, 2022) presents data agglomerated into ten regions; China, Europe, Japan, Middle East, Non Producers, North America, Oceania, Other Asia, Other Producers and South America. The full scope and methodology are presented in the paper, 'A regionally-linked, dynamic material flow modelling tool for rolled, extruded and cast aluminium products' (Bertram et al., 2017). Since the model is regionally agglomerated, the quantities for secondary aluminium production are arranged according to the total regional production volume and secondary aluminium production capacity per country of the respected region. The data on secondary aluminium production capacities were obtained from the magazine, Light Metal Age (Pawlek, 2022), which is exclusively devoted to the production and semi-fabrication of aluminium and other light metals. Country productions are estimated according to the share of their production capacity in each region.

Semi-finished products

The data from Alucycle model (Alucycle, 2022) for the regional production of semi-finished products (fabricated aluminium products which are precursors to manufactured/finished products) is disaggregated per country, with respect to the total raw aluminium output per country (sum of primary and secondary production) and the regional total semi-finished product output.

4.2.2 Emission data

Emission factors for stationary combustion in manufacturing industries are retrieved from the CBAM Implementing Regulation (European Commission, 2023b). The emission factors are applied to the energy intensities and corresponding fuel mix from the Environmental Profile report from European Aluminium (European Aluminium, 2018) for each aluminium-making process.

4.2.3 Other data

An important emission source in primary aluminium production is due to the "anode effect". The anode effect occurs when the alumina content in the bath is so low that normal fused salt electrolysis cannot be maintained. This is followed by a rapid increase of pot voltage from about 4.3 V to values in the range of 10 to 80 V. As a result of a local depletion of oxide ions, the cryolite decomposes and forms perfluorocarbon (PFC) gases with the carbon from the anodes (Kremser, 2020). PFCs have a global warming potential several thousand times greater than that of CO_2. Data from the International Aluminium Institute (IAI, 2020) is used to estimate the emissions per country due to the anode effect. The values provided by the IAI depend on the smelter technology. The perfluorocarbon gas emissions of the industry per country can be estimated using the results from the report on the Aluminium Industry's Global Perfluorocarbon Gases Emissions, published in 2020 by the International Aluminium Institute (IAI, 2020). This report contains the results of the 2019 Anode Effect Survey per technology. We estimate the carbon anode effect by weighting the average of carbon anode effect values according to the installed capacities per technology in each country produced. The share of technologies in the global smelters can be extracted from the work of R. Pawlek (Pawlek, 2019). The lowest PFC emission intensity is achieved with the use of the PFPB (point feed prebake) anode. The countries which have a 100% PFPB smelter technology have an emission intensity of 0.16 tCO_2eq/t of produced aluminium.

Table 13. CO_2 equivalent PFC emission intensity per country.

Country	PFC emission intensity [tCO_2e/t aluminium]
Bahrain	0.160
Canada	0.343
China	0.799
Egypt	0.160
India	0.160
Kazakhstan	0.160
Mozambique	0.160
Russian Federation	0.317
South Africa	0.175
Türkiye	0.160
United Arab Emirates	0.160
United Kingdom	0.160
United States	0.540
EU	0.270[9]
Rest of the World (Weighted average)	0.225

Source: JRC, 2023 with data from (Pawlek, 2019) and (IAI, 2020).

This section describes the origin of CO_2 emissions and the relevant products. Direct CO_2 emissions are calculated per tonne of all intermediary products, taking into consideration the technologies employed, the process emissions and the fuel mix for thermal operations. Direct and indirect emissions are provided for the relevant CN codes.

The specific emissions of each process of interest can be calculated by multiplying the energy intensity of the process by the fuel mix of the process and the respective emission factor of fuel. The equation for the calculation is given below:

$$GHG_{process\ j} = EI_{process\ j}\ PRO_{process\ j} \sum_{i=fuel\ 1}^{all\ fuels} PERCENT_{fuel\ i}\ EF_{fuel\ i}\ (+SPEC_{process\ j}) \quad (19)$$

$EI_{process\ j}$ *is the energy intensity for the process j (GJ/t product),* from Environmental report (European Aluminium, 2018)

EF_i is the emission factor of the fuel i, from (European Commission, 2023b) (tCO_2/GJ), for the electricity the average value from the power emission factor from the IEA (IEA, 2021) from 2015 to 2019 is used

$PERCENT_{fuel\ i}$ is the share of fuel i in the energy balance sheet (%), from Environmental report (European Aluminium, 2018)

$PRO_{process\ j}$ is quantity of product from process j (t product), from Environmental report (European Aluminium, 2018)

$SPEC_{process\ j}$ are anode reaction and PFC emissions related to the process (if applicable)

The energy intensities of the processes within the scope of the aluminium industry correspond to the values included in (European Aluminium, 2018) for Europe and the rest of the world. This formula (1) is valid for any process of aluminium production within the red boundary in Figure 32, though for primary production, the only GHG emissions within scope of the CBAM come from the anode consumption (Springer and Hasanbeigi, 2016) and anode effect. The CO2 from the anode consumption comes from the reaction between alumina (aluminium oxide) and the carbon in the anode (2Al2O3 + 3C -> 4Al + 3CO2). The amount of carbon consumption and CO2

[9] Spain has a large share of SWPB (side-worked prebake) smelters, which have a high PFC intensity from the anode effect, thereby worsening the EU weighted average

released is higher than the stoichiometric balance due to the imperfections in the raw materials and the process and is equal to 1.6 tCO2/t of primary aluminium for EU+EFTA countries and 1.79 tCO2/t for the rest of the world.

4.2.4 Data for primary aluminium

Primary aluminium is produced directly from alumina via the Hall–Héroult process. Although they are not in the scope of the CBAM, the main inputs into the process are alumina, carbon (in the form of carbon anodes) and electricity. Given that carbon anodes are consumed in the chemical reaction (413 kg anode / t of primary aluminium for EU+EFTA countries and 463 kg anode / t of primary aluminium for other countries (European Aluminium, 2018)), their consumption constitutes a proportion of the direct emissions from the primary production route. The additional GHG emissions come from the anode effect.

In order to model primary aluminium production, the following inputs are used:

— EU+EFTA (European Free Trade Association) intensity (European Aluminium, 2018)

- 14.79 MWh of electricity per tonne of primary aluminium
- 0.413 tonnes of carbon anode per tonne of primary aluminium

— Rest of world intensity (European Aluminium, 2018)

- 14.21 MWh of electricity per tonne of primary aluminium
- 0.463 tonnes of carbon anode per tonne of primary aluminium

Secondary aluminium is produced via remelting (new scrap) or refining (old scrap). New scrap is process scrap, which is untainted by other materials and needs neither separation nor refining. Old scrap is recycled consumer scrap, which is usually painted and contains other materials and impurities. It must therefore be refined prior to remelting. This increases its energy intensity, and therefore its GHG emission intensity. A common ratio between refined and remelted scrap (62% remelted, 38% refined) (JRC, 2017b) and energy consumption is applied to the fuel mix provided in the Environmental report (European Aluminium, 2018).

The following inputs are used for all countries:

3.96 GJ thermal energy and 0.102 MWh of electricity per tonne of recycled aluminium

The following fuel mix is used (European Aluminium, 2018):

— EU+EFTA fuel mix:

- Heavy oil – 5%
- Natural gas – 77%
- Electricity – 18%

— Rest of world fuel mix:

- Heavy oil – 5%
- Diesel and light fuel oil – 2%
- Natural gas – 76%
- Electricity – 17%

4.2.5 Data for finalisation processes and manufacturing

The resulting quantities and intensities that stem from aluminium production are then carried over to the fabrication and manufacturing steps. The methodology recognises casting as the fabrication step and hot rolling, cold rolling and extrusion as manufacturing steps. Some final products end at the fabrication steps (such as flakes and powder), while all other manufactured products necessarily include both the fabrication and relevant manufacturing steps.

In order to model aluminium fabrication and manufacture, the following inputs are used:

— EU+EFTA countries (European Aluminium, 2018):

- 1.604 GJ thermal energy and 0.095 MWh of electricity per tonne of casted product

- 1.983 GJ thermal energy and 0.479 MWh of electricity per tonne of hot rolled product
- 5.831 GJ thermal energy and 1.173 MWh of electricity per tonne of cold rolled product
- 2.105 GJ thermal energy and 0.766 MWh of electricity per tonne of extruded product

— Rest of world countries (European Aluminium, 2018):

- 0.905 GJ thermal energy and 0.053 MWh of electricity per tonne of casted product
- 1.965 GJ thermal energy and 0.479 MWh of electricity per tonne of hot rolled product
- 5.831 GJ thermal energy and 1.173 MWh of electricity per tonne of cold rolled product
- 2.105 GJ thermal energy and 0.766 MWh of electricity per tonne of extruded product

The following fuel mix is used (European Aluminium, 2018):

— EU+EFTA casting:

- Heavy oil – 5%
- Natural gas – 77%
- Electricity – 18%

— Rest of world countries:

- Heavy oil – 5%
- Diesel and light fuel oil – 2%
- Natural gas – 76%
- Electricity – 17%

— Hot rolling (all countries):

- Heavy, diesel and light fuel oil - <1%
- Natural gas – 53%
- Electricity – 47%

— Cold rolling (all countries):

- Heavy oil - <1%
- Diesel and light fuel oil – 6%
- Natural gas – 52%
- Electricity – 42%

— Extrusion (all countries):

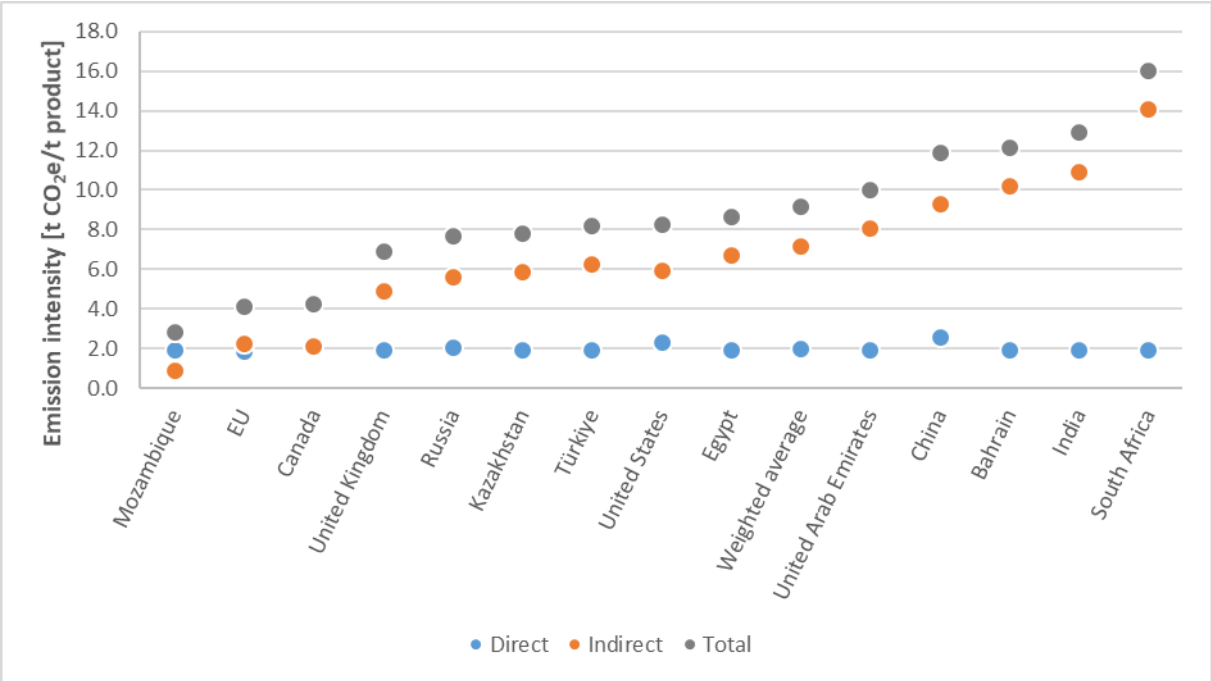
- Heavy oil - <1%
- Diesel and light fuel oil – 2%
- Natural gas – 41%
- Electricity – 57%

4.3 Results

This section presents the main results from the application of the methodology outlined above, whereas the CO_2e emission intensities can be found in Annex 2, ordered by country and product. The results are presented in figure 35 to 39. The scope begins with the manufacture of unwrought aluminium. Although China counts with the most energy-efficient technology (PFPB), the IAI reports higher PFC emission values for China (0.8 tCO_2e/t) than in the rest of the world (0.16 tCO_2e/t of aluminium). The higher Chinese PFC emissions compared to other

countries results in a higher overall GHG emission intensity. The Russian Federation, where the Söderberg technology is applied, presents a similar case.

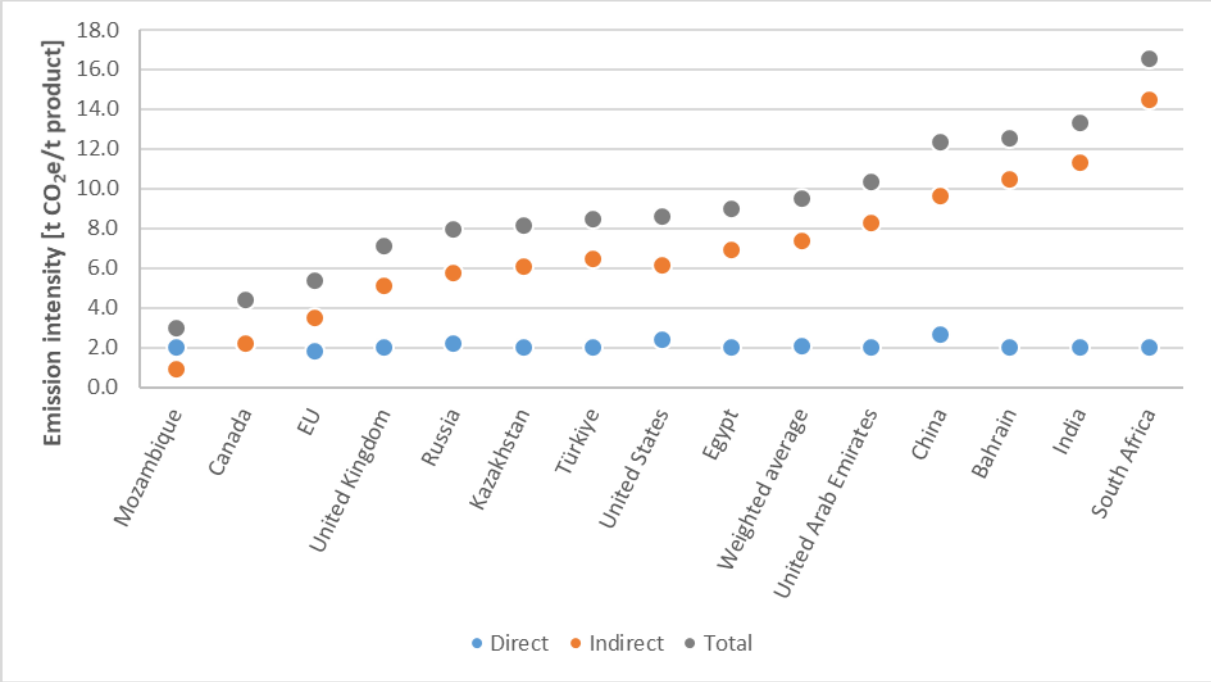
Figure 35. GHG emission intensity for unwrought aluminium (2019).



Source: JRC, 2023.

The fabrication and manufacture of aluminium is the continuation of the process where semi products and final products are produced. The processes themselves rely on thermal and mechanical energy expenditure.

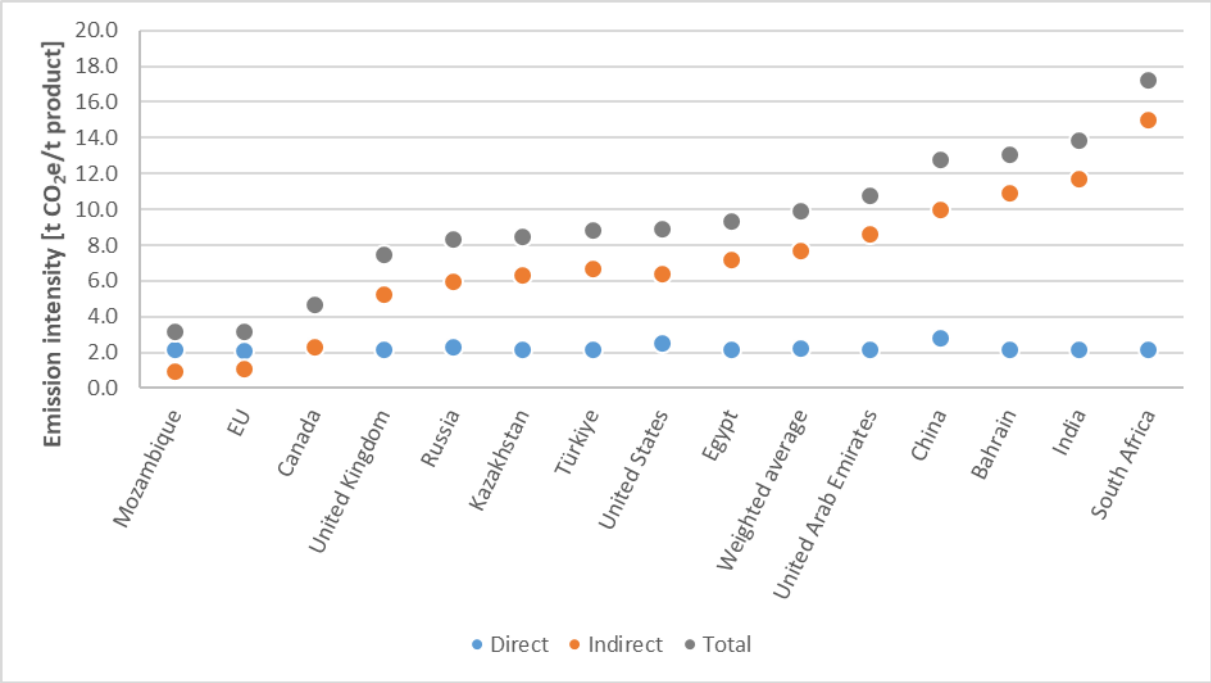
Figure 36. GHG emission intensity for casted aluminium (2019).



Source: JRC, 2023.

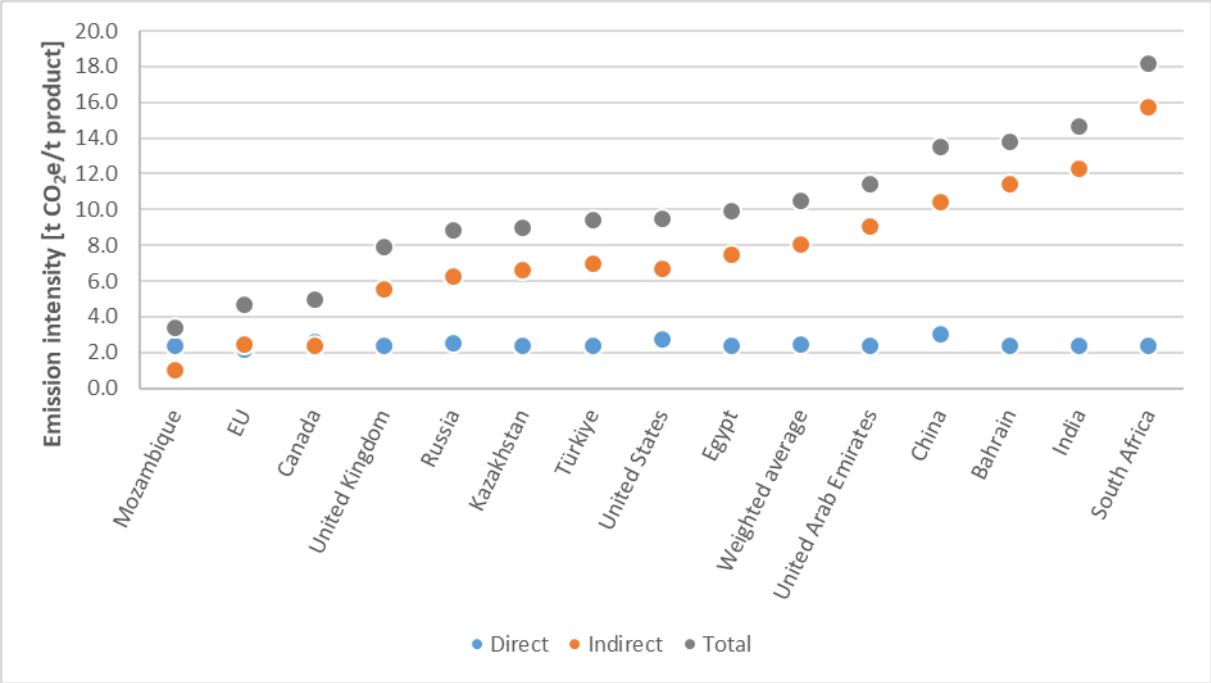
The cast products are then either consumed onsite or traded, where they are fed into manufacture and finalisation processes. Given that most of the energy is spent producing unwrought aluminium, the order of intensity remains constant.

Figure 37. GHG emission intensity for hot rolled aluminium (2019).



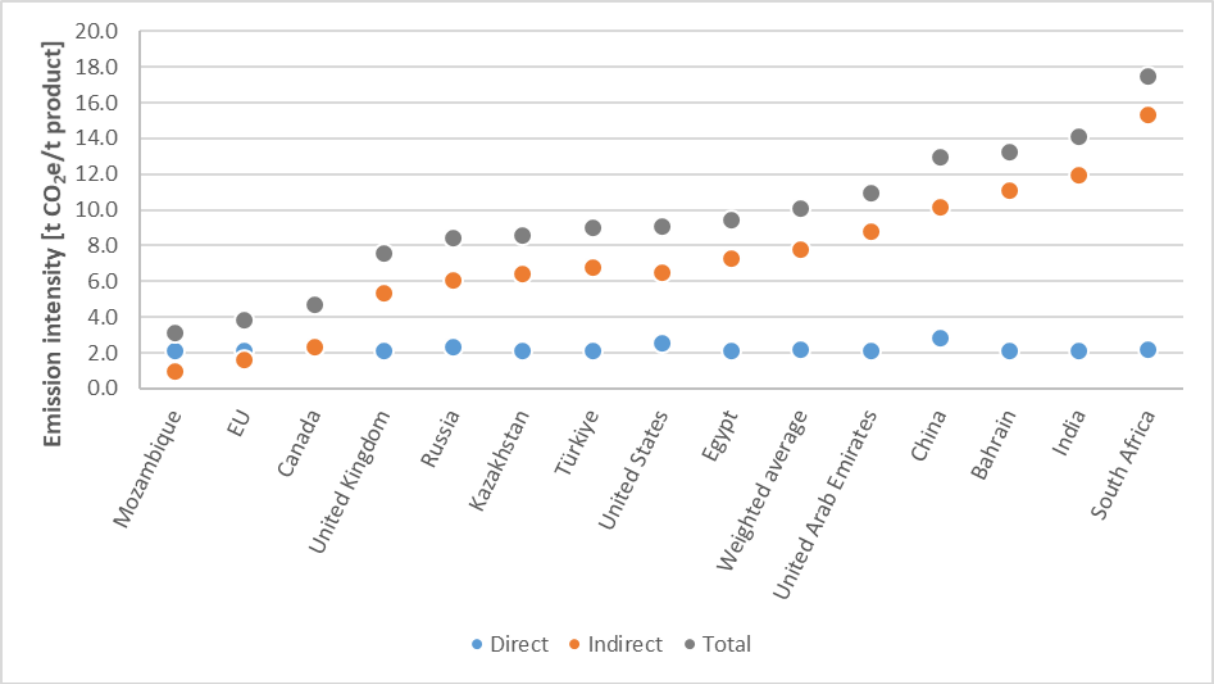
Source: JRC, 2023.

Figure 38. GHG emission intensity for cold rolled aluminium (2019).



Source: JRC, 2023.

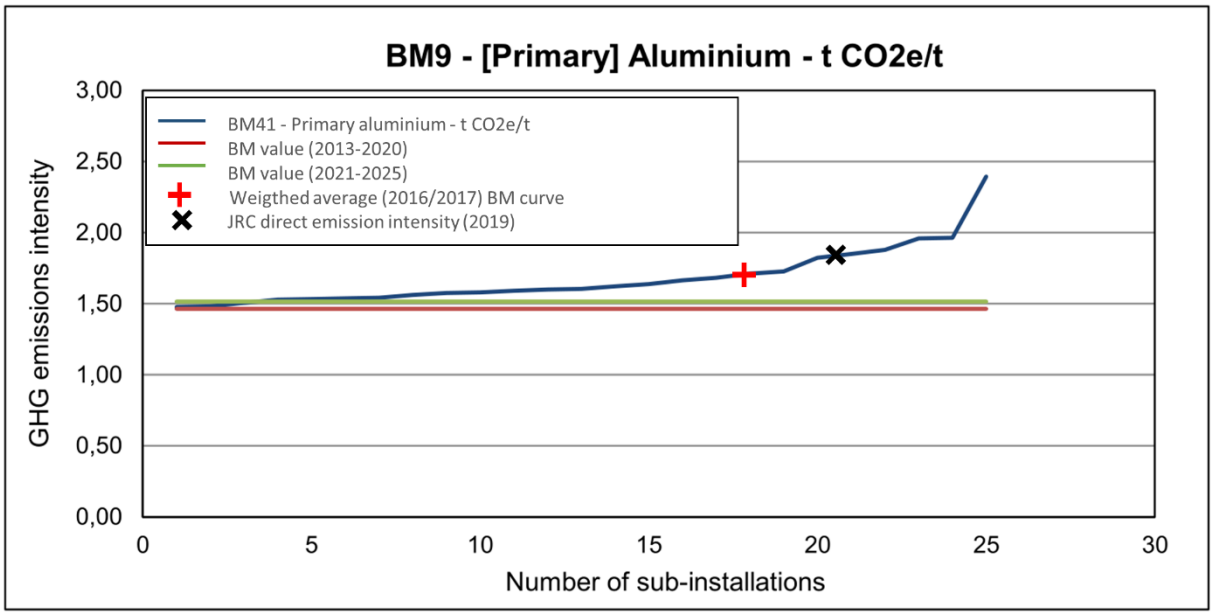
Figure 39. GHG emission intensity for extruded aluminium (2019).



Source: JRC, 2023.

As figure 40 shows, the direct emission intensity estimated in this study for the EU (1.87 tCO_2e/t) is slightly higher, at around 14%, than the weighted average of the benchmarking curve (1.641 tCO_2e/t). Whereas the benchmarking curves are based on actual data from EU facilities, the JRC's estimation is based on publicly available data from (European Aluminium, 2018) for the carbon anode consumption, and on the results of the carbon anode effect per technology (IAI, 2020) combined with information about the technology of each smelter in all countries (Pawlek, 2019).

Figure 40. Benchmarking curve of the EU ETS for primary aluminium and JRC-estimated total emission intensity.



Source: JRC, 2023 and (European Commission, 2021c).

5 Analysis for the products of the cement industry

Cement is a finely ground, non-metallic, inorganic powder. When mixed with water, it forms a paste that sets and hardens. This hydraulic hardening is primarily due to the formation of calcium silicate and calcium aluminate hydrates as a result of the reaction between water and the constituents of the cement.

The main steps in cement production are (i) preparing and grinding the raw materials, (ii) producing the intermediate clinker and (iii) grinding and blending the clinker with additives to make cement.

The main constituent of Portland and blended cements, 'Portland clinker', is obtained by the calcination of limestone: about two thirds of clinker-bound emissions stem from the decomposition of limestone, while the remaining third are due to the combustion of carbon-based fuels that provide the high temperatures required for the thermal processes (calcination of limestone and sintering of clinker).

To limit cement GHG emissions, alternative cement compositions can be used. While 'Portland cement' (PC, clinker mixed with max. 5% of gypsum) remains the reference, standards have evolved to include larger shares of additives or supplementary cementitious materials (SCMs) ([10]), such as fly ash, blast furnace slag or pozzolanic materials. Most of these SCMs have no emissions associated with their production. Clays, however, require a thermal treatment for enhancing reactivity, so that calcined clays are SCMs of interest for cement-related GHG emissions. These alternative cements, hereafter referred to as 'other hydraulic cement', are defined by their clinker-to-cement ratio. A lower clinker-to-cement ratio requires less (GHG-intensive) clinker and is thus associated with cement with a lower GHG intensity. In practical terms, the GHG intensity of cement is thus the GHG intensity of clinker multiplied by the clinker-to-cement ratio, potentially adding emissions associated with the thermal processing of clays. For example, the emission intensity of Portland cement grade CEM I is at least. 95% the emission intensity of clinker, while blended cement grade CEM II/A-Q is made of 94% Portland clinker and 6% calcined clay. Its emission intensity is thus 94% – the emission intensity of clinker plus 6% of the emission intensity of calcined clay.

This approach also applies to white Portland cement, though the constituents of white and grey clinker differ, and so do their emissions.

In addition, aluminous cements or calcium aluminate cements are produced by the fusion or sintering of calcareous (limestone or lime) and aluminous (bauxite or alumina) materials.

Figure 41 summarises the cement manufacturing processes analysed in this study and marks the scope of the CBAM in red. Table 14 lists the cement products covered by Annex 1 of the CBAM Regulation.

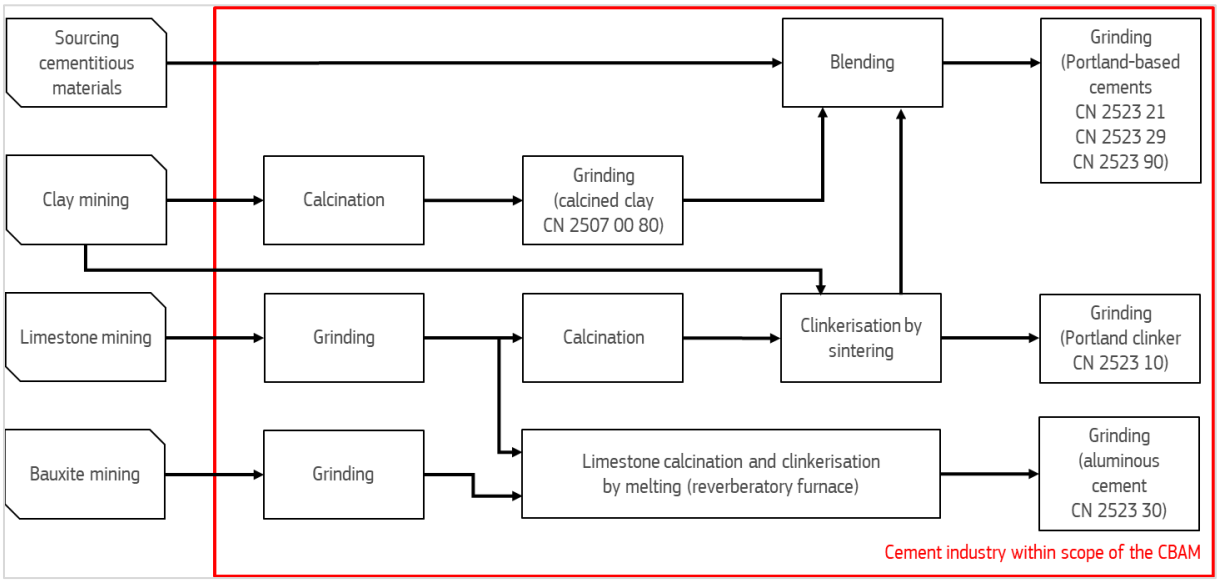
Table 14. Commodity codes for cement products in the scope of the CBAM.

Commodity Code	Commodity
2507 00 80	Kaolin and other kaolinic clays, calcined
2523 10	Cement clinkers (whether or not coloured)
2523 21	Cement; Portland, white, whether or not artificially coloured
2523 29	Cement; Portland, other than white, whether or not artificially coloured
2523 90	Cement; hydraulic kinds not elsewhere considered (n.e.c.) in heading no. 2523
2523 30	Aluminous cement

Source: (European Union, 2023).

[10] These are materials with cementitious properties, and include fly ash from coal-fired power plants, granulated blast furnace slag (GBFS) from blast furnaces for iron and steel production, and silica fume. SCMs react with clinker, playing a role in the strength development of concrete (Chatham House, 2018).

Figure 41. Selected processes from the cement production routes within the frame of the CBAM.



Source: JRC, 2023.

5.1 Countries under scope

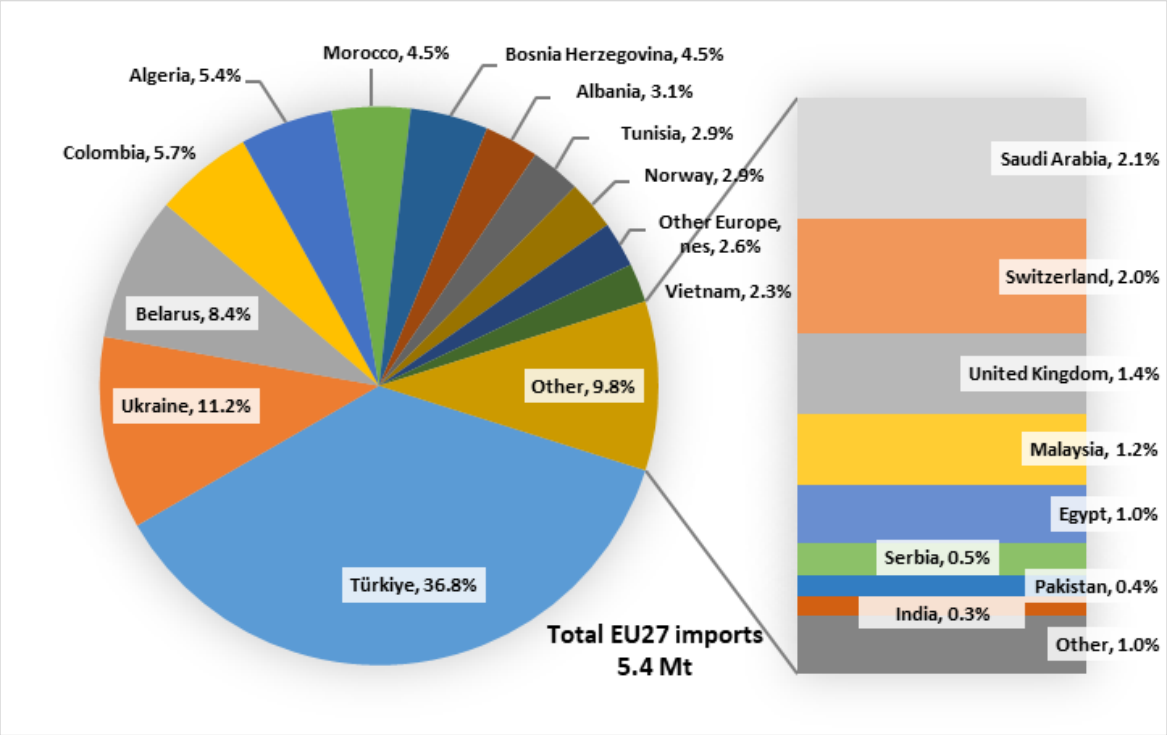
Key exporting countries are identified based on UN trade statistics (UN Comtrade, 2022). The imports of individual EU27 countries are retrieved for the year 2019 for the commodity codes noted in Table 14 and Figure 40. Figure 42 shows that 11 countries and one region ("Other Europe, nes", where nes stands for not elsewhere specified ([11])) represent 90% of EU27 cement imports. Each of these countries contributes to more than 1% of the total EU imports.

We include seven additional countries (Saudi Arabia, Switzerland, United Kingdom, Malaysia, Egypt, Serbia, Pakistan and India) in order to reach 99% of the total imports, but it should be noted that the latter three each contribute less than 1% of EU imports, and Norway and Switzerland are excluded from the scope of the CBAM.

Of the ten largest global cement exporters (Figure 43), only Türkiye, Vietnam, Saudi Arabia and Pakistan are listed among the countries contributing to 99% of EU imports (Figure 42).

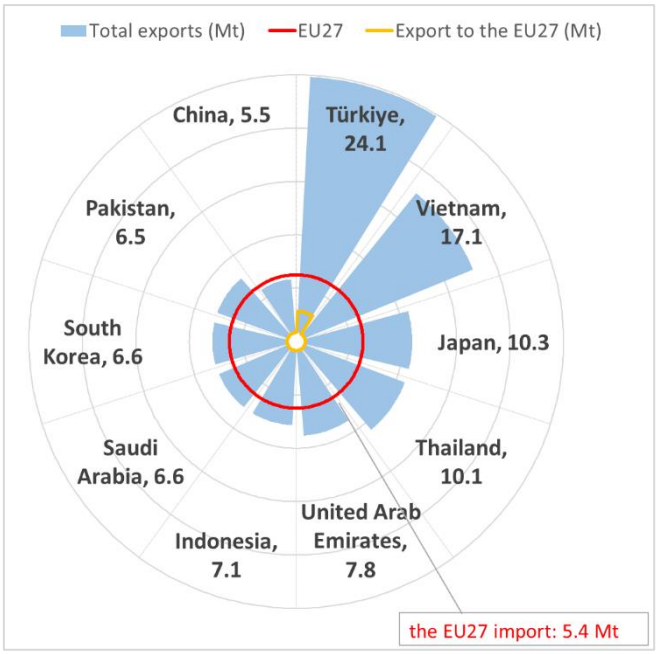
[11] https://unstats.un.org/wiki/display/comtrade/Areas+not+elsewhere+specified

Figure 42. Total EU cement imports in 2019.



Source: JRC, 2023 based on (UN Comtrade, 2022).

Figure 43. Total EU cement imports vs total production from key producing countries.



Source: JRC, 2023 based on (UN Comtrade, 2022).

5.2 Determining greenhouse gas intensities

The main input data for this study are publicly available:

- specific statistics on cement production (GCCA, 2019);
- the extended world energy balances from the International Energy Agency (IEA, 2022);

— the emission factors for stationary combustion from the CBAM Implementing Regulation (European Commission, 2023b) and from the WBCSD Cement Sustainability Initiative (CSI) and European Cement Research Academy (ECRA) (GCCA, 2020);

— the emission factor of electricity (IEA, 2021a).

We begin by discussing the three main data sources in detail and go on to describe further input data sources in light of the general methodology, developed along established approaches for determining GHG emissions in the cement industry (GCCA, 2020; EN 19694-3, 2016),

5.2.1 Input data

5.2.1.1 "Getting the numbers right" (GNR) initiative

The "Getting the numbers right" (GNR) initiative, managed by the Global Cement and Concrete Association (GCCA) (GCCA, 2019), provides key information on the cement sector (e.g. clinker-to-cement ratio; thermal energy and power consumption; fuel mix) at different geographical scales: worldwide coverage; in world regions such as Africa and Central America; and at country level.

For consistency of approach across countries, we disaggregate the data available at regional level (Africa, Asia (n.e.c.) + Oceania, Brazil, CIS, Europe, India, Middle East, North America, South America ex. Brazil) to country level.

5.2.1.2 Extended world energy balances

The extended world energy balances by the IEA are the most complete global accounting framework of energy products and their flows (IEA, 2022). They provide statistical data of all energy sources produced, traded, transformed and consumed at country scale for indicated sectors and an indicated reference year. By presenting all data in a common energy unit, the energy balances further allow for comparison of sectoral energy demand as well as the carbon intensities of energy flows and products.

In the IEA extended world energy balances, the cement industry is covered by the broader heading of 'Non-Metallic Minerals' (NMM). This data set is used as a proxy to determine the share of energy consumption, by relevant fuel category, of a specific country within its corresponding region (e.g. Spain consumes 11.6% of the biomass consumed in Europe in the Non-Metallic Mineral industry). Of the 66 specific energy products presented in the energy balances, only those relevant to the cement industry are kept. They are aggregated under the broader headings of 'fossil fuels', 'alternative fuels and waste' and 'bioenergy', at country and regional level. This aggregation (see Annex 1) allows us to disaggregate GNR data on fuel consumption from regions to countries of interest.

5.2.1.3 Emission factors for fuels

Emission factors for stationary combustion in manufacturing industries are retrieved principally from the CBAM Implementing Regulation (European Commission, 2023b). This includes emission factors for biomass fuels (assuming that biomass fuels are carbon-neutral as sustainably sourced), yet excludes specific waste streams of relevance for the cement industry. Emission factors of waste fuels used in the cement industry are retrieved from (GCCA, 2020).

Regarding biomass sustainability, the guidance document for the transitional CBAM period reads: 'For biomass fuels or mixed fuels containing biomass, the emission factor for biomass may be set to zero, provided that certain sustainability criteria are met' (European Commission, 2023c). In the absence of information regarding biomass sustainability, emissions from biomass fuels are considered in this study.

The energy products and respective emission factors under consideration in this study are listed in Annex 1.

5.2.1.4 Further data sources

Besides the main data sources listed above, the following input data is used in the scope of this study:

— Emissions per kWh of electricity (IEA, 2021a): Indirect emissions incorporate the emissions from power production. We use the average value of the power emission factors from 2015 to 2019.

— Production volumes of cement (USGS, 2020): Data on the national production volume of cement help determine the production volumes of clinker and then the share of clinker production of a specific country within its corresponding region (e.g. Germany produces 17.5% of the clinker produced in Europe).

— Imports and exports of clinker (UN Comtrade, 2022): Trade data are used for the calculation of emission intensities of cement when accounting for the trade of clinker.

— Thermal energy and power consumption for the production of calcined clay (ECRA, 2022);

— Standards (EN197-1, 2011; EN197-5, 2022) for clinker and cement composition;

— Emission factor for the calcination of calcium carbonate in Portland clinker (European Commission, 2023b).

5.2.2 Methodological approach for products based on Portland clinker

This section describes emissions for the cement industry, in accordance with established approaches (GCCA, 2020; EN 19694-3, 2016), depending on the origin of emissions and for relevant products. Direct GHG emissions are calculated per tonne of product (grey and white Portland clinker and cement), taking into consideration clinker and cement composition, process emissions and the fuel mix for thermal operations. The trade of Portland clinker is considered by factoring the origin (and thus the relevant emission intensity) of the clinker consumed. Direct, indirect and total emission intensities are then provided for the relevant CN codes.

5.2.2.1 Direct emissions

For clinker:

Process emissions:

For process emissions, within direct emissions, we use the value of 525 CO_2/t clinker for all countries under scope, in accordance with the value reported in the CBAM Implementing Regulation (European Commission, 2023b).

Emissions from fuels:

For the calcination (and other thermal operations) to take place, different fuels are burned. Emissions from fuel combustion are thus the sum of GHG emissions from each fuel of the fuel mix. This value takes into account the emission factors of the fuels consumed (i.e. how much CO_2 is produced per quantity of energy released for each fuel of the mix), the composition of the fuel mix (i.e. shares of fuel consumed or how much each fuel is consumed as a percentage of the total energy consumed) and the overall thermal energy consumed.

$$\begin{aligned} &Direct\ Thermal\ Emissions_{clinker}\ \left[\frac{t_{CO_2}}{t_{clinker}}\right] \\ &= \left(Thermal\ energy\ consumption\ \left[\frac{GJ}{t_{clinker}}\right] - \frac{Waste\ heat\ transfered\ [GJ]}{Clinker\ production\ [t_{clinker}]}\right) \\ &* \sum_{fuel}^{all\ fuels} \left(Percentage\ of\ fuel_{fuel} * EF_{fuel}\left[\frac{t_{CO_2}}{GJ}\right]\right) \end{aligned} \quad (20)$$

With EF_f standing for Emission Factor of fuel in tCO_2 per gigajoule (see annex 1).

The information needed for each country/region to feed the previous formula comes from the following relevant indicators from the GNR initiative:

— 93AG: Thermal energy consumption - Weighted average including drying of fuels - Grey clinker [GJ / t clinker]

— 34TGW: Total waste heat supplied to external customers | Grey and white cement [GJ / year]

— 25aAGFC: Thermal energy consumption - Weighted average excluding drying of fuels - Grey clinker - by fuel category [% total energy]

— 25aAGF: Thermal energy consumption - Weighted average excluding drying of fuels - Grey clinker - by fuel [%]

The above calculation provides an estimate of clinker GHG emissions from thermal processes produced in a given country. By adding process emissions for the production of clinker due to limestone carbon content, the direct emissions of clinker can be retrieved.

For cement:

The direct emissions of clinker can be tailored to other CBAM products of interest by considering:

- the clinker-to-cement ratio of the cements of interest (retrieved from the GNR dataset via the volume of additives ([12]) and supplementary cementitious materials consumed in the region). This enables the calculation of direct emissions for cement;
- the volumes of clinker traded (retrieved through COMTRADE data). This enables the calculation of net direct emissions taking into account the trade of clinker.

Products in the scope of the CBAM include clinker but also different types of cement. These cements are produced by mixing clinker with additives. Emissions of cement are the sum of the emissions of its constituents, i.e. clinker and calcined clay, the GHG-intensive precursors in the scope of this study:

$$Direct\ CO_2\ Emissions_{cement}\left[\frac{t_{CO_2}}{t_{cement}}\right] = \frac{Direct\ CO_2\ Emissions_{clinker}\ * M_{clinker} + Direct\ CO_2\ Emissions_{calcined\ clay}\ * M_{calcined\ clay}}{M_{clinker} + M_{additives}} \quad (21)$$

When no calcined clay is added, other constituents such as gypsum dilute clinker emissions by unit of weight. In other words, the emissions of these cements are the emissions of clinker multiplied by the clinker-to-cement ratio.

$$Direct\ CO_2\ Emissions_{cement} = Clinker\ to\ cement\ ratio_{cement} * Direct\ CO_2\ Emissions_{clinker}$$

This approach involves a minor simplification due to the lack of publicly available data, as it does not account for GHG emissions due to the drying of other cement constituents that could take place at the cement plant.

For each country/region, GNR provides the following relevant indicators for the definition of clinker-to-cement ratios:

- 21TGWcm - Total production volumes of cement | Grey and white cement [t]
- 21TGWct - Total production volumes of cementitious products | Grey and white cementitious products [t]
- 12TGW - Total mineral components used to produce Portland cement | Grey and white cement [t]
- 19TGW - Total mineral components used as cement substitute | Grey and white cement [t]

The clinker-to-cement ratio of Portland cement, grade CEM I, is between 95% and 100%. As the GHG intensity of gypsum is deemed to be zero, the most GHG-intensive Portland cement is made of only Portland clinker.

5.2.2.2 Indirect emissions

Emissions connected to the consumption of electricity enable the calculation of indirect emissions. For each country/region, GNR provides the following relevant indicators for the definition of emissions linked to electricity production:

- 12TGW - Total mineral components used to produce Portland cement | Grey and white cement [t]
- 21TGWcm - Total production volumes of cement | Grey and white cement [t]
- 33eTGW - Total power consumption up to and including clinker production | Grey and white cement [MWh / year]

[12] Additives for the purpose of EN 197-1 are constituents (not otherwise covered in the standard) which are added to improve the manufacture or the properties of the cement (EN 197-1:2011).

— 33AGW - Cement plant power consumption - Weighted average| Grey and white cement [kWh / t_{cement}]

For clinker:

Subtracting the total mineral components (12TGW) from the total production volume of cement (21TGWcm) and combining it with the CO_2 intensity of electricity in the considered country (IEA, 2021a), 33eTGW allows for the calculation of indirect emission intensity for clinker.

$$Indirect\ CO_2\ Emissions_{clinker_{Electricity}}\left[\frac{t_{CO_2}}{t_{clinker}}\right] = \frac{Total\ power\ consumption_{clinker}[GJ]}{M_{clinker}[t_{clinker}]} * EF_{Electricity}\left[\frac{t_{CO_2}}{GJ}\right] \quad (22)$$

For cement:

GHG emissions from the grinding operations are retrieved by:

— computing the total cement plant power consumption (33AGW * 21TGWcm);

— subtracting the total power consumption up to and including clinker production (33eTGW);

— dividing by the mass of cement produced in the country (21TGWcm);

— and multiplying by the CO_2 intensity of electricity in the considered country (IEA, 2021).

$$Indirect\ CO_2\ Emissions_{grinding_{Electricity}}\left[\frac{t_{CO_2}}{t_{cement}}\right] = \frac{(Total\ power\ consumption_{cement} - Total\ power\ consumption_{clinker})[GJ]}{M_{cement}[t_{cement}]} * EF_{Electricity}\left[\frac{t_{CO_2}}{GJ}\right] \quad (23)$$

These values can then be allocated to the different cements based on the clinker-to-cement ratio and complemented by the emissions from the grinding operations.

$$Indirect\ CO_2\ Emissions_{cement_{Electricity}} = Clinker\ to\ cement\ ratio_{cement} * Indirect\ CO_2\ Emissions_{clinker_{Electricity}} + Indirect\ CO_2\ Emissions_{grinding_{Electricity}} \quad (24)$$

5.2.3 Methodological approach for calcined clays

Energy intensity and power consumptions for the production of calcined clay are retrieved in (ECRA, 2022). Though the calcination can take place in flash calciners, in the absence of information about the processes and fuel mix in the countries under scope, it is assumed here that: 1) this process takes place in kilns; and 2) that the kiln relies on the same fuel mix as that used for the production of grey clinker. Direct emissions are then solely equivalent to emissions from the combustion of fuels (as calculated for clinker in section 5.2.2.2 above). The carbon content of clay is not considered since clays can have various compositions (i.e. with unknown carbonate content) and carbonate may not decompose through the calcination process.

Regarding indirect emissions, it is worth noting that the values already include the grinding of calcined clay.

Lastly, there are no emissions calculated for the trade of precursors since precursors are not considered for the production of calcined clay, and there is a lack of production data for this commodity.

5.2.4 Methodological approach for aluminous cements

Aluminous cements can be produced through two processes / technologies:

— **Sintering / kiln, with a temperature of 1 425°C** (Pereira et al., 2017). Efficiency and fuel mix are derived from GCCA data for grey clinker;

— **Fusion / reverberatory furnace, with a temperature of 1 550°C** (Pereira et al., 2017). The efficiency of the reverberatory furnace (for aluminium production, in the absence of data for aluminous cement

production) ranges between 15% and 39%, with an average estimated at 30% (US DoE, 2001; Adeniji and Waheed, 2021). The reverberatory furnace can be fuelled by natural gas, LPG, extra-light fuel oil (JRC, 2017b), pulverised coal or oil with a hot-air blast (Hewlet and Liska, 2019). Among these options, pulverised anthracite is the most GHG-intensive of all. However, the emission factor of anthracite is only slightly higher than that of the fuel mix for grey clinker (as reported by GCCA). The emission factor of the kiln fuel mix for grey clinker (as reported by GCCA, see 5.2.2.1) is then chosen to provide a conservative estimation of emissions while reflecting the country fuel mix available to the (Portland) cement industry.

Aluminous cements are mostly composed of lime and alumina. They can be produced from:

— Limestone or lime;

— Bauxite or alumina.

EN14647 (EN 14647:2005) restricts alumina content to 35%wt and 58%wt of the final product. However, high alumina cement (with up to 80%wt alumina) is also produced and commercialised in the EU, and CN 2523 30 does not restrict alumina content. EN14647 does not specify lime content either, though it indicates that an excess of free lime disturbs the cement setting and hardening processes and the quality of the final product. In order to determine a conservative estimate of the possible emission intensity of aluminous cements, aluminous cements are assumed to be composed only of lime and alumina produced from limestone and bauxite, respectively.

In view of the lack of detailed information on the imported cement, we provide an analysis of the emission intensity of aluminous cement depending on its composition, production route and input materials. Emission intensities are determined, relying on EU data, by varying the alumina content (and deriving the lime content) and calculating:

1. the direct emissions, considering (as relevant):
    - the carbon content in the necessary limestone;
    - the theoretical enthalpies needed for materials to reach the process temperatures;
    - the theoretical enthalpy of reaction for the decomposition of limestone in lime.

For the latter two points, process efficiencies and fuel emission factors (see technology description above) are applied to derive (effective) emission intensities from thermal processes. Enthalpies of reaction for the fusion or sintering process are not considered.

2. the indirect emissions, considering (as relevant):
    - the power intensity needed for the production of Portland clinker. This is assumed to be applicable to the grinding of limestone and bauxite and the operation of the aluminous cement production process (irrespective of its type, i.e. kiln or reverberatory furnace);
    - the power intensity needed for the grinding of grey and white cement. This is assumed to be applicable to the grinding of products from the sintering process;
    - the power intensity needed for the grinding of slag, derived from (ECRA, 2022). This is assumed to be applicable to the grinding of products from the fusion process, considering that aluminous cements are hard to grind (Alelweet & Pavia, 2022).

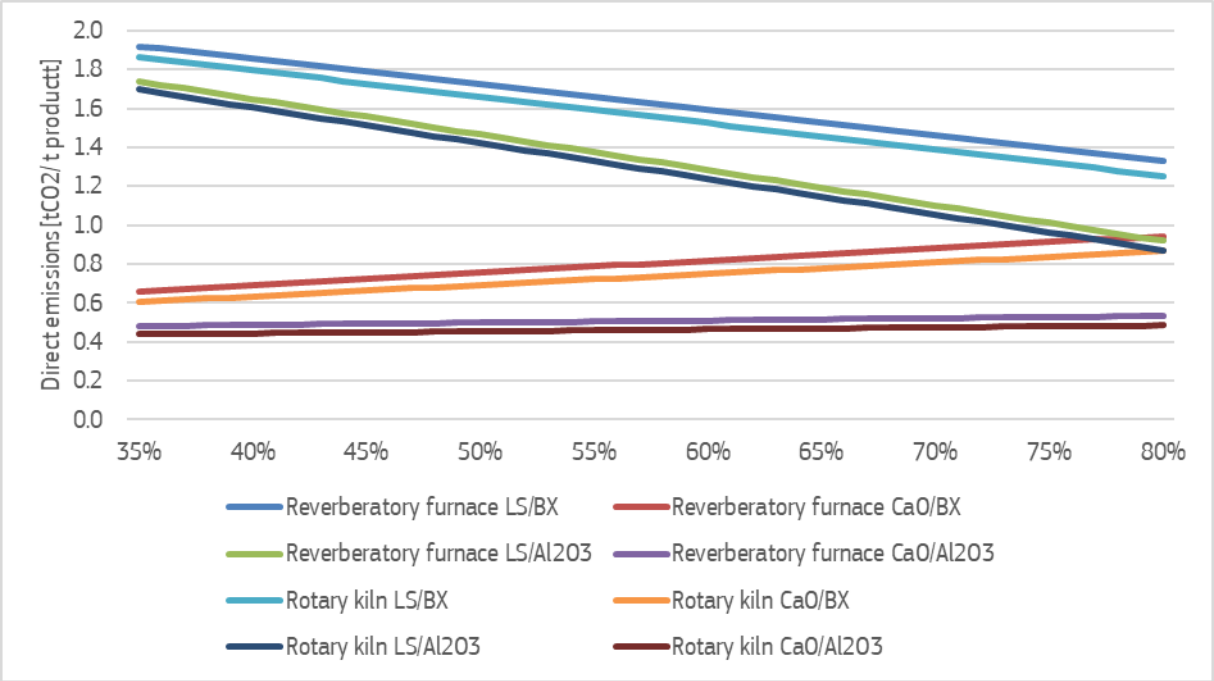
Indirect emissions are derived by applying IEA electricity emission intensity at country level (see 5.2.1.4) to the power intensities noted above.

Figure 44 shows the evolution of the (direct) emission intensity of aluminous cement in the EU for the two processes and four mixes of raw materials. The most GHG-intense production route corresponds to:

— the reverberatory process (running at higher temperatures than the sintering process);

— fed with limestone and bauxite as raw materials since lime and alumina are not considered to be precursors under the CBAM regulation.

Figure 44. Aluminous cement emission intensity in function of the alumina content.

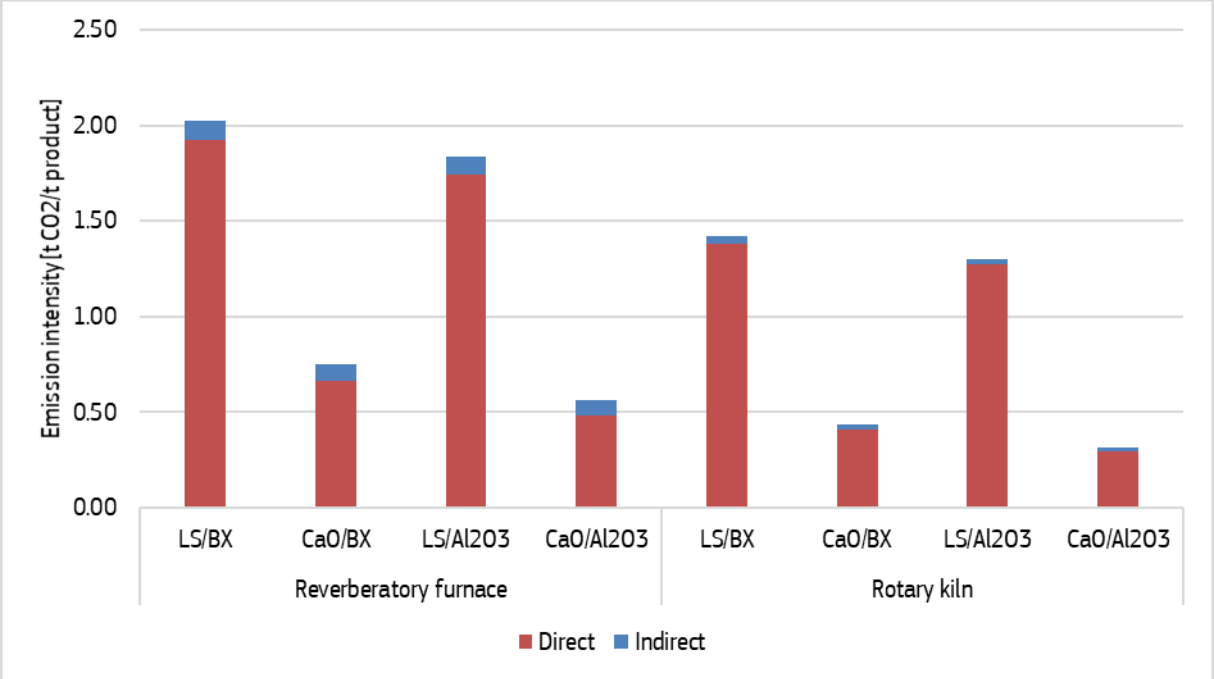


Note: LS stands for limestone, BX stands for bauxite.

Source: JRC, 2023.

Figure 45 displays both direct and indirect emissions in the EU for the two processes and four mixes of raw materials with an averaged alumina concentration of 46.5% according to EN14647 standards and the corresponding lime concentration. The high power intensity of grinding the products of the fusion process reinforces the previous observation regarding the most GHG-intensive case combination.

Figure 45. EU direct and indirect emissions of aluminous cement per process and raw materials.



Note: LS stands for limestone, BX stands for bauxite. Aluminous cement production levels are unknown;

Source: JRC, 2023.

5.3 Results

We report all GHG emission intensities within the geographical scope of relevance for the cement industry (see 5.1). Emissions are calculated for the cement sector in a specific country. Indirect emissions relate exclusively to the consumption of electricity, assumed to be purchased from the grid. In addition, we take into account the transfer of emissions due to the trade of precursors. While the main results can be found below, GHG emission intensities are reported in Annex 2, ordered by industry, country, product and scope.

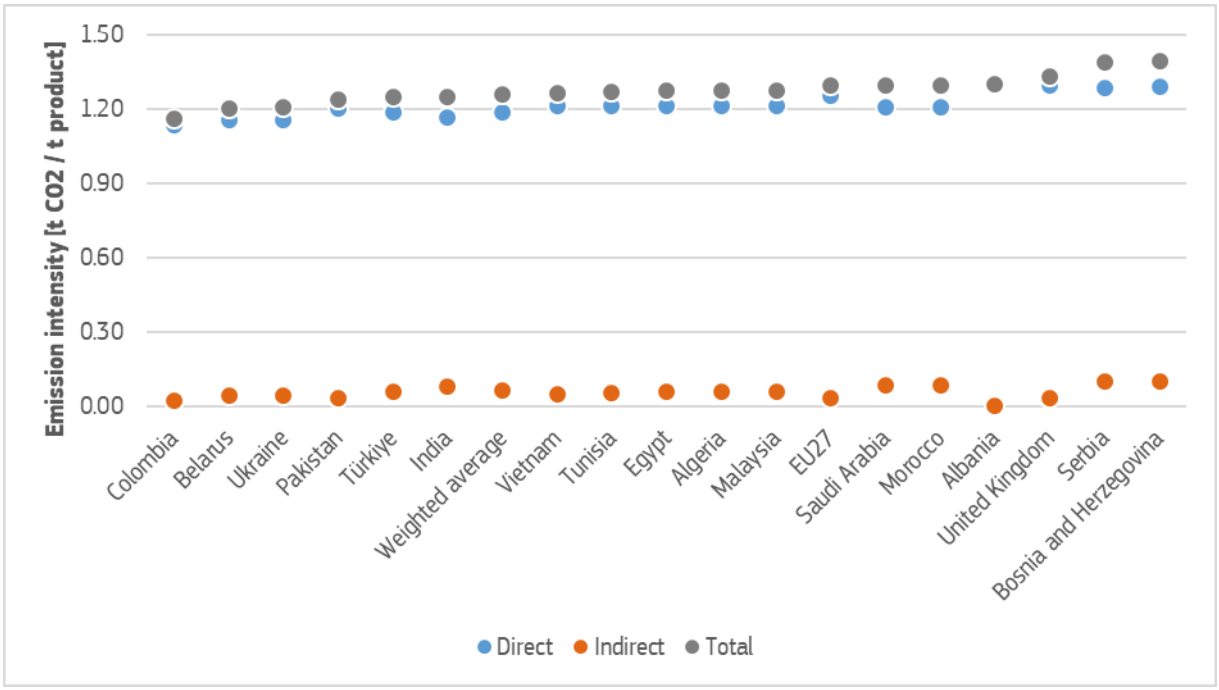
5.3.1 Emissions from the production of Portland cement precursor clinker

In this section, we report the overall GHG emission intensities of white and grey Portland clinker (Figure 46 and Figure 47).

The EU's position on the graph reflects its high reliance on biomass with its relatively high emission factor. Contrary to the EU ETS, which assumes biomass to be carbon-neutral when reported as sustainable, biomass emissions are not zero-rated in this study (for coherence between countries, as information on biomass sustainability is not available outside the EU).

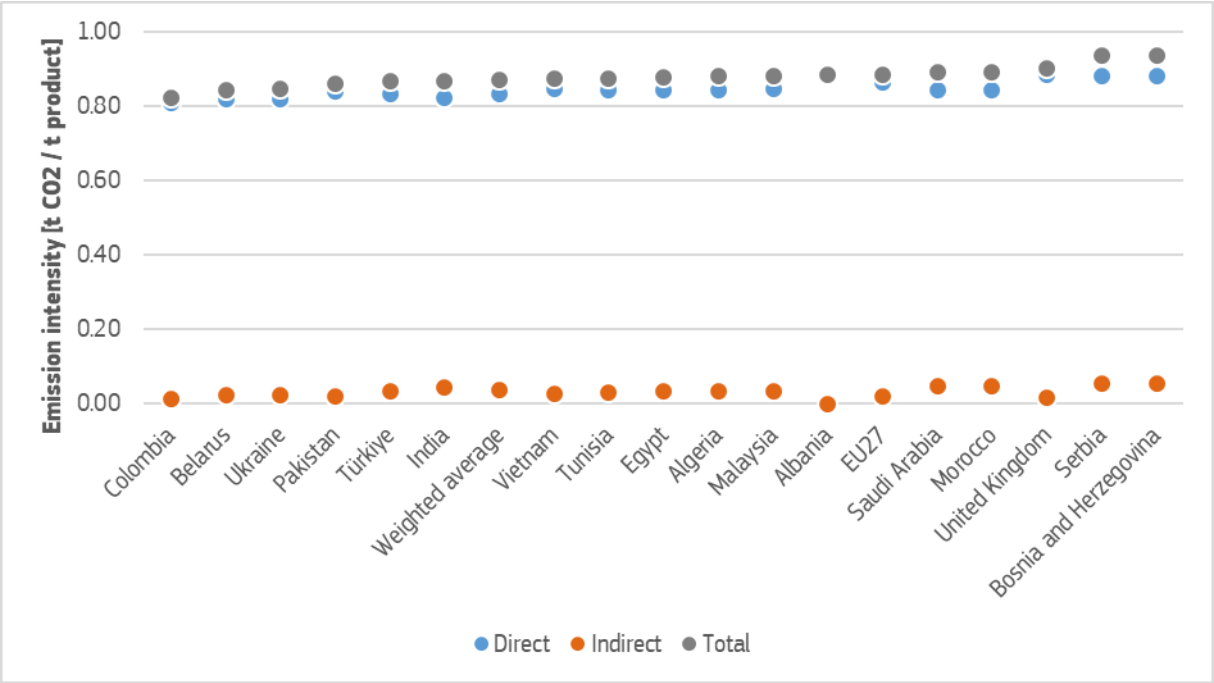
Albania's low indirect emission intensity is linked to a low emission factor of electricity in the country.

Figure 46. GHG emission intensity for CN code 2523 10 for white clinker.



Source: JRC, 2023.

Figure 47. GHG emission intensity for CN code 2523 10 for grey clinker.



Source: *JRC, 2023.*

Table 15 below provides a comparison of the effect of zero-rating emissions from biomass combustion on the emission intensity for grey and white clinker in the EU. Under the EU ETS, such zero-rating is applied when operators can prove that the combusted biomass complies with the sustainability and greenhouse gas savings criteria of Directive (EU) 2018/2001.Taking biomass sustainability into account affects values by approximately 12%. Assuming the EU consumed only sustainable (i.e. carbon-neutral) biomass, its emission intensities for white and grey Portland clinker would be lower than those of Columbia (as displayed on Figure 46 and Figure 47 above) and therefore the least GHG-intensive of all.

Table 15. Effect of biomass sustainability on GHG emission intensity for CN code 2523 10 in the EU.

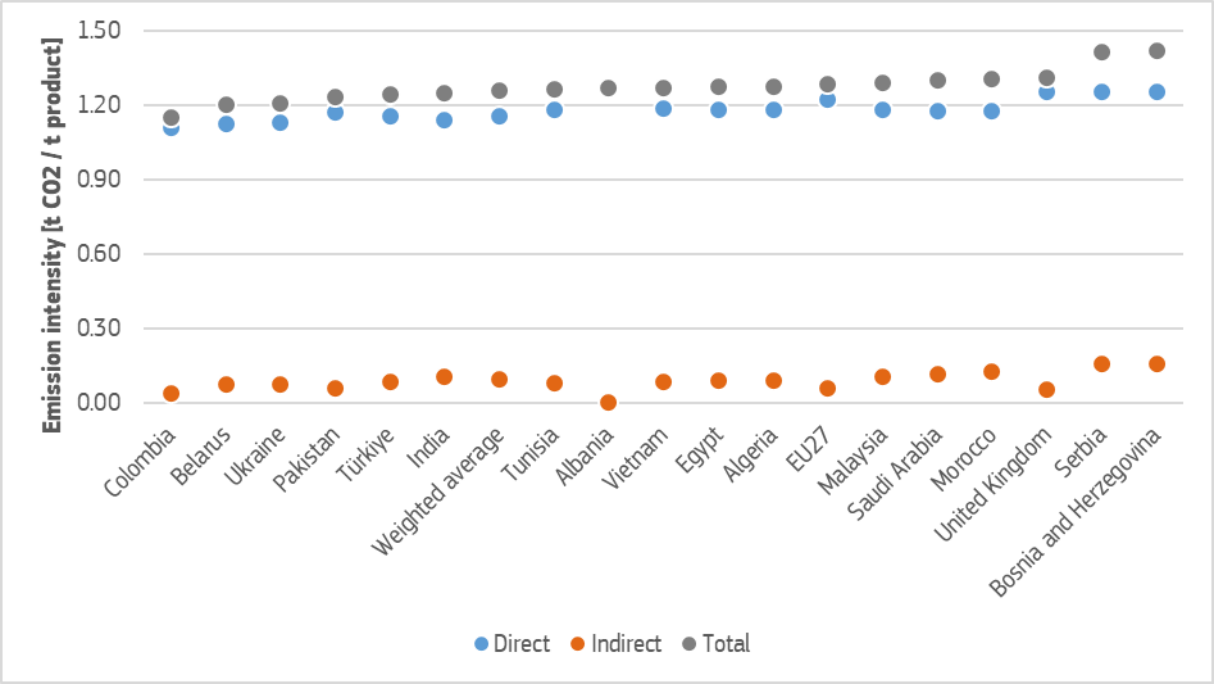
Product	Direct intensity (tCO_2 / $t_{clinker}$)		Indirect intensity	Total intensity (tCO_2 / $t_{clinker}$)	
	Biomass sustainability		(tCO_2 / $t_{clinker}$)	Biomass sustainability	
	No	Yes		No	Yes
White Portland clinker	1.26	1.10	0.04	1.30	1.14
Grey Portland clinker	0.86	0.79	0.02	0.89	0.81

Source: JRC, 2023.

5.3.2 Emissions from the production of Portland cements

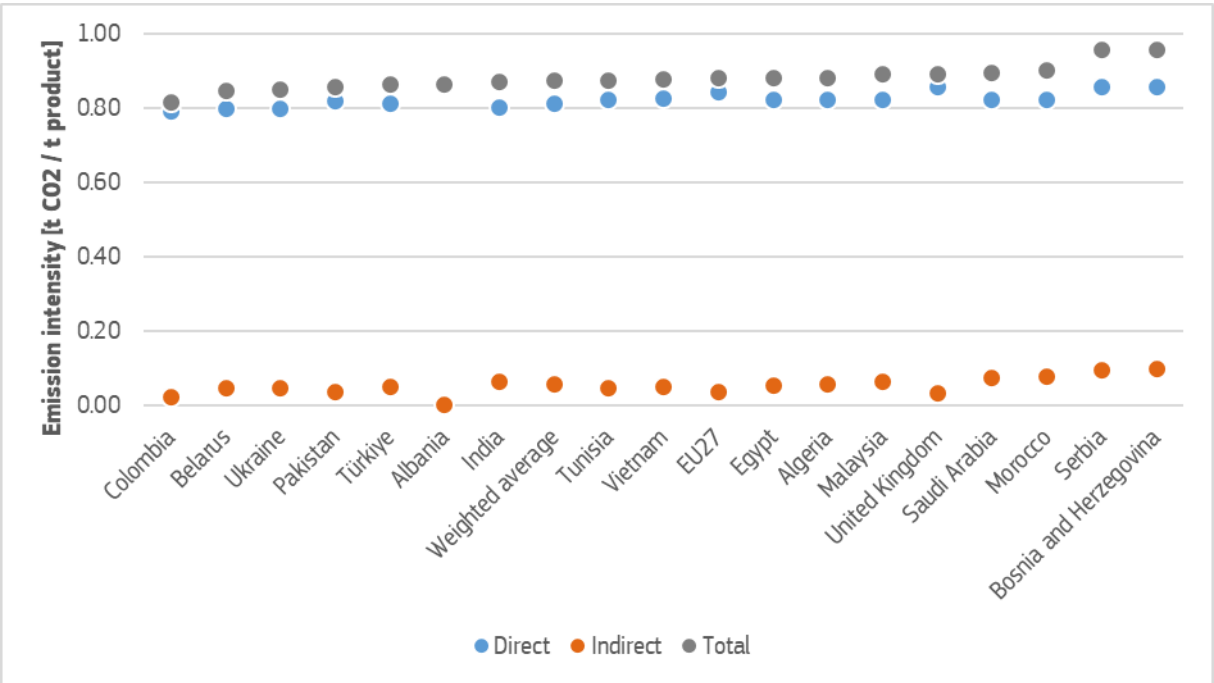
In this section, we report GHG emission intensities of both white and grey Portland cement. Overall emissions at country level are calculated assuming that the Portland clinker consumed in a given country is used solely for the production of Portland cement. Emission intensities are calculated assuming the intermediate value of the precursors' composition range, or 'averaged composition', i.e. that Portland cement is composed of 97.5% Portland clinker complemented by gypsum. Observations made in the previous section regarding Portland clinker are equally valid here.

Figure 48. GHG emission intensity for CN code 2523 21 (white Portland cement).



Source: JRC, 2023.

Figure 49. GHG emission intensity for CN code 2523 29 (grey Portland cement).

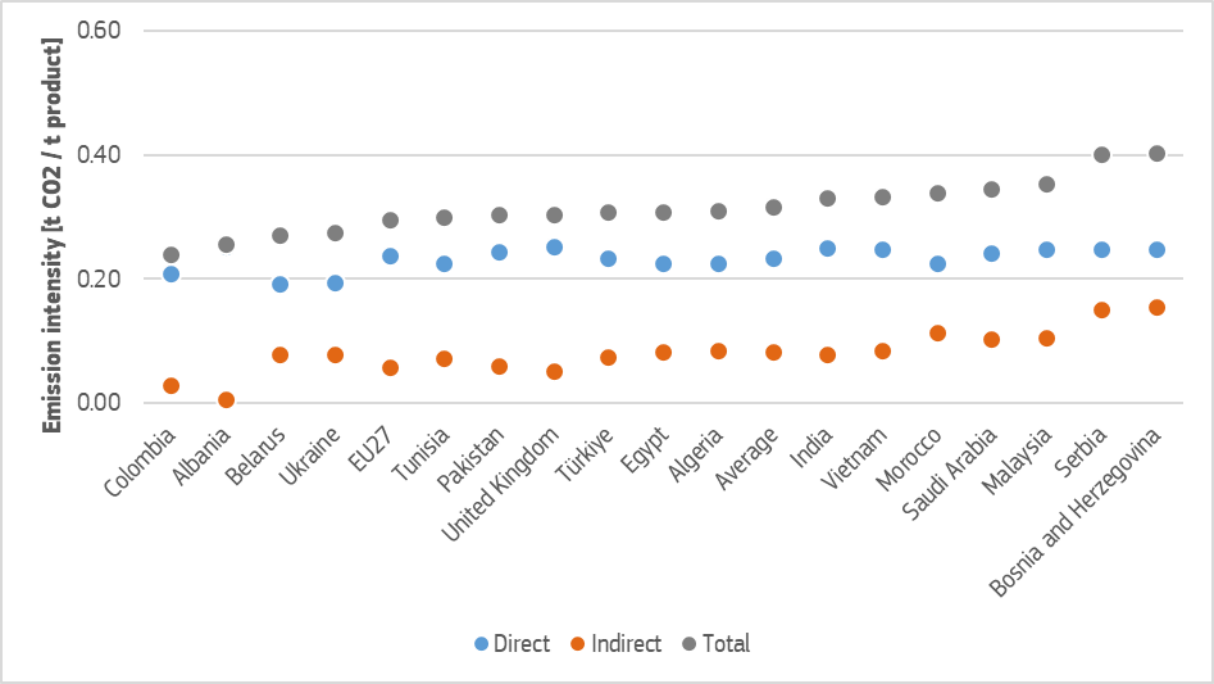


Source: JRC, 2023.

5.3.3 Emissions from the production of other hydraulic cement precursor calcined clay

In this section, we report the GHG emission intensities of calcined clay, a GHG-intensive supplementary cementitious material (SCM). In the absence of production statistics for calcined clay, the average emission intensity is non-weighted. Further, direct emission covers only for the emissions from thermal processes and therefore reflects the emission intensity of the fuel mix in the countries of interest. This also explains the relatively high share of indirect emissions in the total emissions.

Figure 50. GHG emission intensity for CN code 2507 00 80 (calcined clay).



Source: JRC, 2023.

5.3.4 Emissions from the production of other hydraulic cements

In this section, we report the overall GHG emission intensities of hydraulic cement not considered elsewhere. Under standard EN197, these are referred to as blended cements. The production volumes of the different types of blended cement are missing: the emission intensities displayed on Figure 51 and reported in Table 22 below are thus the median emission intensities of the different blended cements described under EN197 (assuming the intermediate value of the precursors' composition range, or 'averaged composition'). Table 16 below provides the GHG intensity of four products among the 31 cement types covered by CN code 2523 90 for the EU.

- CEM II/A-Q, with 94% of clinker and 6% of calcined clay, represents the most GHG-intensive product when selecting the most GHG-intensive cement composition;
- CEM II/A-D, with 90% of clinker, represents the most GHG-intensive product when selecting the averaged cement composition;
- CEM II/B-V, with 70% of clinker, represents the product with the median GHG intensity when selecting the averaged cement composition;
- CEM II/B-V, with 79% of clinker, represents the product with the median GHG intensity when selecting the most GHG-intensive cement composition.

Comparing the first two products or the last two products indicates an increase of maximum 12% in GHG intensity when selecting the most GHG-intensive cement composition over the averaged cement composition.

Comparing the first and last products or the second and third products indicates an increase of maximum 28% in GHG intensity when selecting the most GHG intensive product over the product with the median emission intensity.

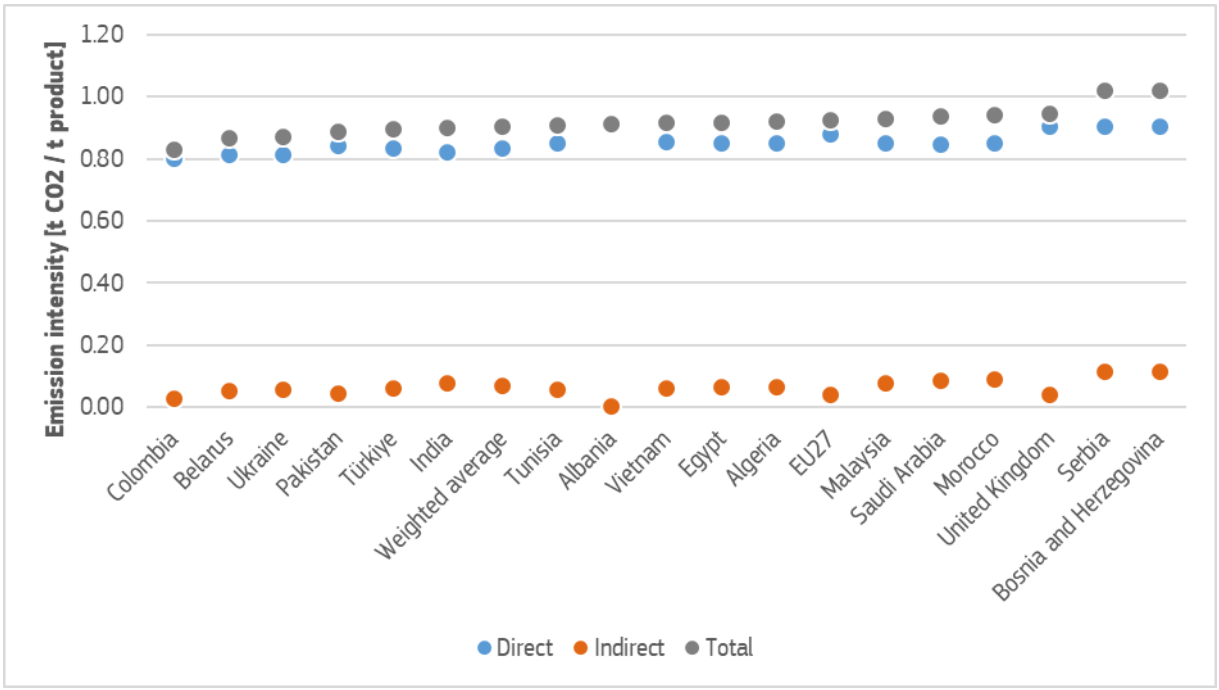
Combining both aspects, the GHG intensity increases from 0.635 tCO_2 / $t_{product}$ (for a product with median GHG intensity and average composition) to 0.867 tCO_2 / $t_{product}$ (for the most GHG-intensive product and composition). This represents an overall increase of 37%.

Table 16. Effect of product (type and composition) on GHG emission intensity for CN code 2523 90 in the EU.

Choice of product (type and composition)	Example of cement	Share clinker (%)	Share calcined clay (%)	Direct intensity	Indirect intensity	Total intensity	Variation vs reference
Most GHG-intensive product; Most GHG-intensive composition	CEM II/A-Q	94%	6%	0.83	0.04	0.87	37%
Most GHG-intensive product; Average composition	CEM II/A-D	90%	0%	0.78	0.03	0.81	28%
Product with median GHG intensity; Average composition	CEM II/B-S	70%	0%	0.61	0.03	0.63	Reference
Product with median GHG intensity; Most GHG-intensive composition	CEM II/B-S	79%	0%	0.68	0.03	0.71	12%

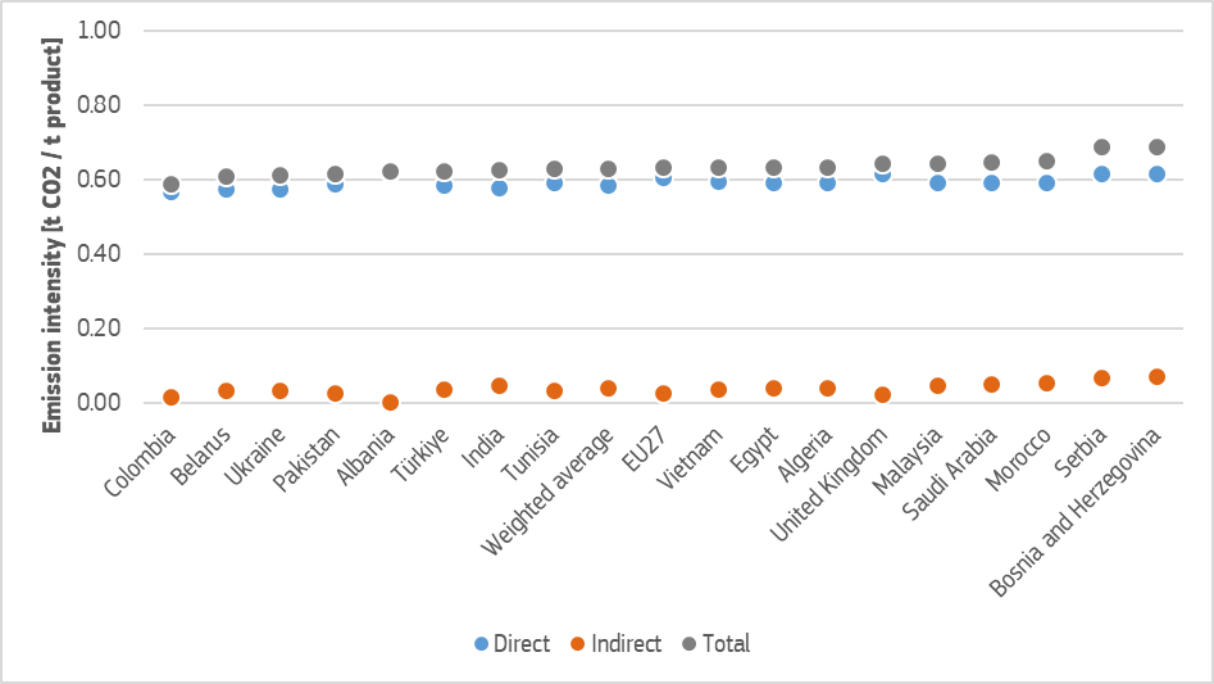
Source: JRC, 2023.

Figure 51. GHG emission intensity for CN code 2523 90 (white hydraulic cement not elsewhere considered).



Source: JRC, 2023.

Figure 52. GHG emission intensity for CN code 2523 90 (grey hydraulic cement not elsewhere considered).

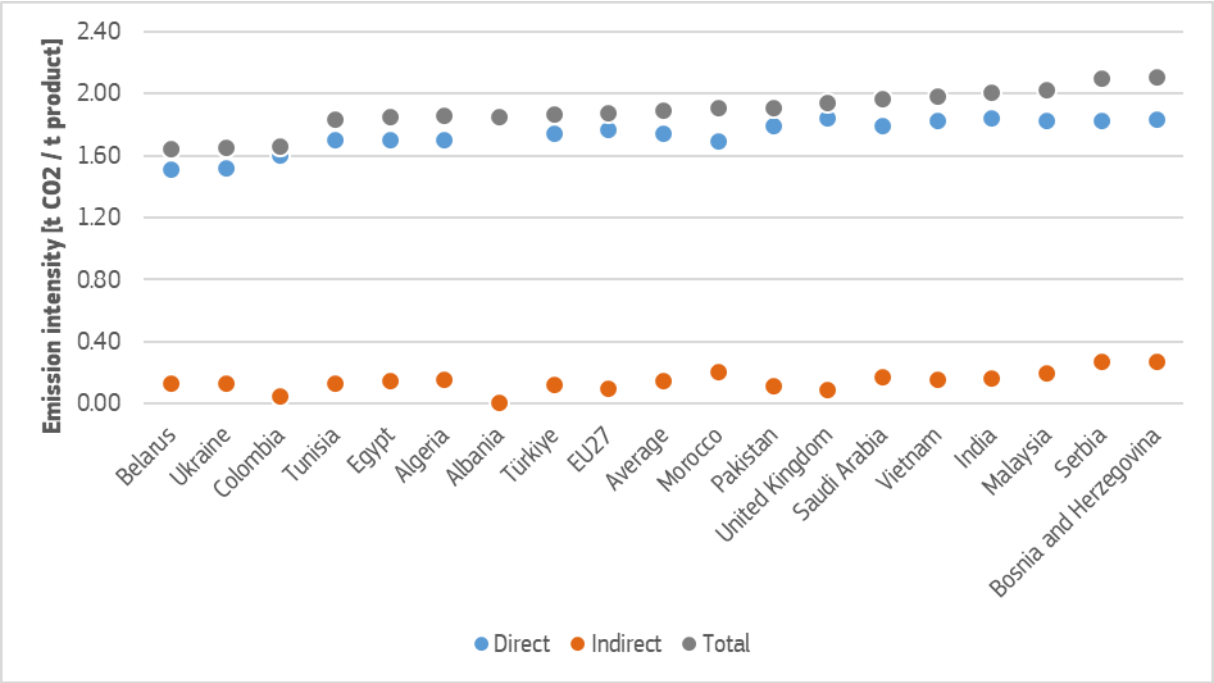


Source: JRC, 2023.

5.3.5 Emissions from the production of aluminous cements

In this section, we report GHG emission intensities of aluminous cement. The emission intensities reported below are derived from an average composition of aluminous cement (i.e. 46.5% alumina and 53.5% lime) produced along the most GHG-intensive route (i.e. in a reverberatory furnace fed with limestone and bauxite). In the absence of production statistics for aluminous cement, the average emission intensity is non-weighted.

Figure 53. GHG emission intensity for CN code 2523 30 (aluminous cements).



Source: JRC, 2023.

5.3.6 Comparison with the ETS benchmark curves

Two products of the cement industry are covered by a benchmarking curve under the EU ETS (European Commission, 2021c): white and grey cement clinker.

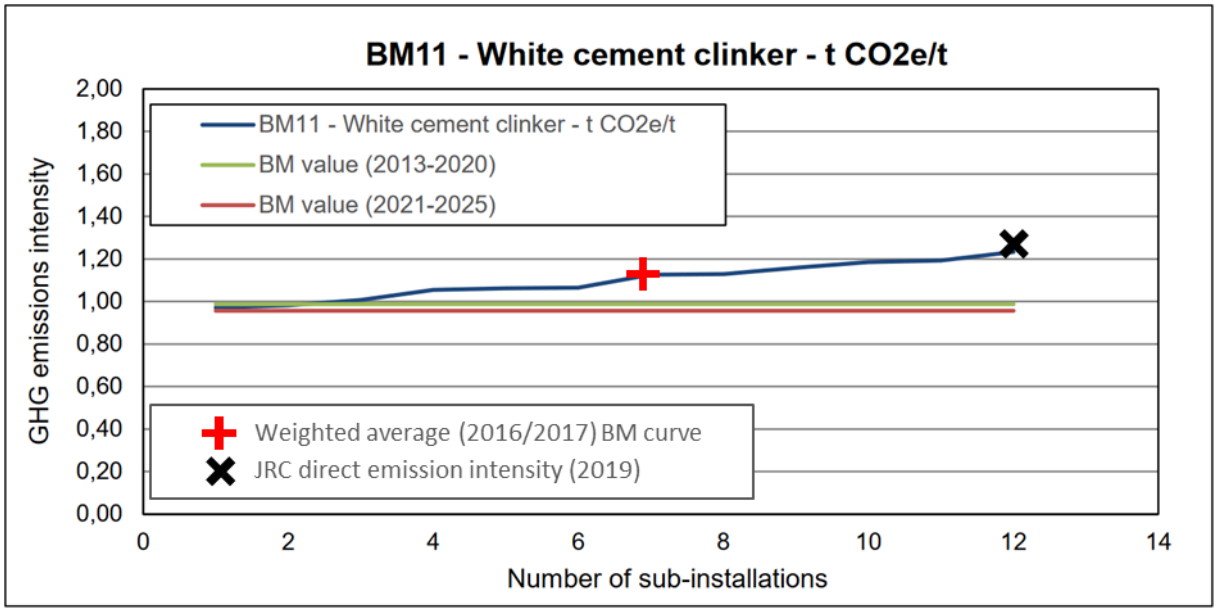
Figure 54 and Figure 55 display the JRC estimation for the direct GHG emission intensity of both products on their corresponding benchmarking curve. For both white and grey cement clinker, the JRC estimation for direct GHG emission intensity corresponds to the worst performing EU installations. This is largely explained by the different treatment of biomass sustainability across the two exercises, as detailed in section 5.2.2 and quantified in Table 15. Should the emission intensities calculated in this report assume a sustainable (and carbon-neutral) biomass, instead of accounting for the emissions due to the combustion of biomass, the estimated direct emissions for both white and grey cement clinker in the EU would accurately match (within 2.3% variation) the weighted average emission intensity of EU installations, retrieved from the benchmarking exercise (see Table 17).

Table 17. Comparison of direct GHG emission intensity for CN code 2523 10 in the EU in CBAM and EU ETS exercises.

Source	CBAM with emissions from biomass combustion	CBAM with sustainable biomass	EU ETS benchmarking (sustainable biomass)	Variation with sustainable biomass
Product	Direct emission intensity (tCO_2 / tclinker)			%
White clinker	1.26	1.10	1.11	1.1%
Grey clinker	0.86	0.79	0.81	2.3%

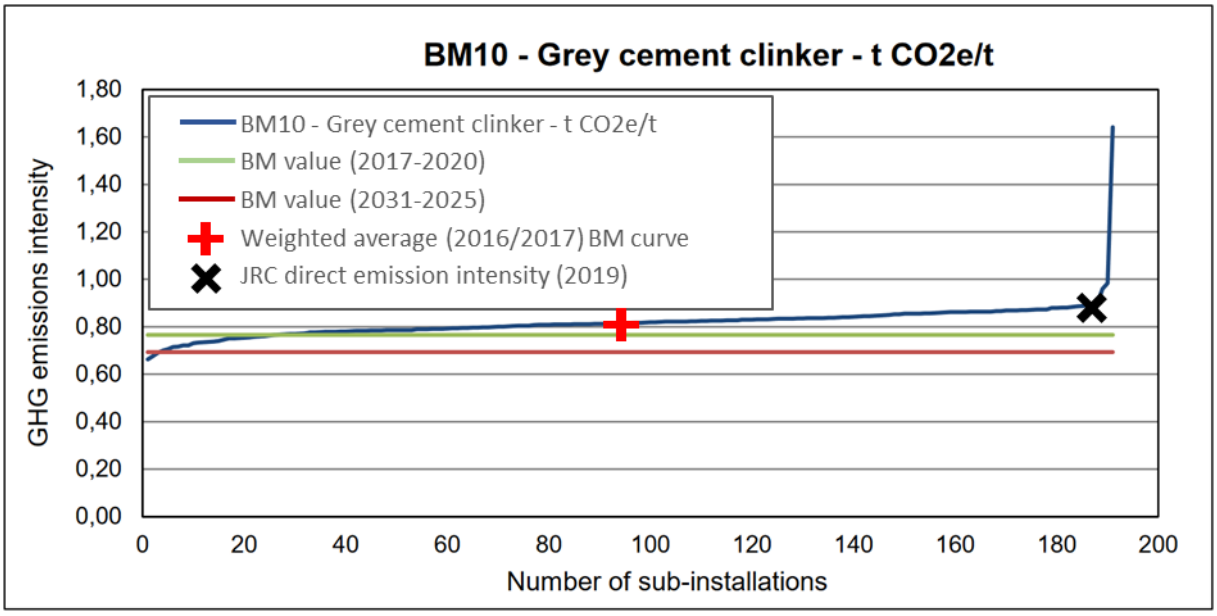
Source: JRC and (European Commission, 2021c).

Figure 54. EU ETS benchmarking curve for white cement clinker with JRC-estimated direct emission intensity.



Source: JRC, 2023 and (European Commission, 2021c).

Figure 55. EU ETS benchmarking curve for grey cement clinker with JRC-estimated direct emission intensity.



Source: JRC, 2023 and (European Commission, 2021c).

In addition to the validation based on EU ETS benchmarking curves (as displayed above), a comparison with industry numbers (GCCA, 2019) is also feasible: Indicator 59cAG reports the weighted average CO_2 emissions of grey clinker. The EU27 value of indicator 59cAG reaches 0.81 $tCO_2/t_{clinker}$ when excluding the contribution of the UK from the EU28 reported value. This value is in agreement with the one derived from the EU ETS benchmarking exercise and is somewhat higher than the value calculated in this report (see Table 17).

Indicator 59cAG is the most accurate representation of the emission intensity calculated in this section: it reports gross emissions, thus assuming biomass sustainability, and it does not consider CO_2 from on-site power generation, consistently with our reported number. However it relies on slightly different fuel emission factors (as hinted in Annex 1); and it does also include other sources of emissions outside the scope of our calculation: i.e. CO_2 from equipment and on-site vehicles; CO_2 from room heating and cooling and CO_2 from drying of mineral components. It also does not discount emissions from waste heat transferred to third parties, as considered in the EU ETS exercise. Excluding these parameters from indicator 59cAG would lower its value and bring it closer to our estimation.

6 Conclusions

This report is a contribution of the JRC in support to the Carbon Border Adjustment Mechanism (CBAM). Its purpose is to provide GHG emission intensities for products from four energy-intensive industries (iron and steel, fertilisers, aluminium and cement) in the EU and in its global trading partners. The main aim of these estimations is to provide scientific support to the implementation of the CBAM.

The CBAM is the new EU mechanism to prevent carbon leakage. Carbon leakage occurs if, for reasons of costs related to climate policies, businesses in certain industry sectors or subsectors transfer production to other countries or imports from those countries replace equivalent products that are less intensive in terms of greenhouse gas emissions. The transitional CBAM period will start in October 2023. That period is limited to the reporting of emissions without any financial adjustments at the EU's borders. Once the CBAM is fully implemented from 2026 onwards, importers into the EU will be required to pay for the emissions embedded in their products as if they were produced in the EU under the EU Emissions Trading System (EU ETS). Simultaneously, EU producers will progressively receive less free allowances, which is the main carbon leakage measure of the EU ETS.

During the transitional CBAM period from October 2023 to December 2025, importers of CBAM goods are required to report the emissions embedded in those goods, based on actual emissions. However, Implementing Regulation (EU) 2023/5512 provides for some flexibilities including the use of default values until 31 July 2024 (European Commission, 2023b).

The estimations carried out in this report are aligned with the definitions and boundaries set in the implementing regulation of Article 35 of the CBAM; that is, with the monitoring and reporting rules. However, for each industry, the approach is customised to use publicly available information wherever possible.

As a validation of this analysis, for the products with a benchmarking curve in the EU ETS, we include our estimated value, following the CBAM rules, alongside the corresponding benchmarking curves. Most discrepancies are solved when we factor in the differences in system boundaries between the CBAM and the EU ETS. This is the case, for example, with hot metal and nitric acid, for which the CBAM includes sinter and ammonia as precursors, respectively, whereas the EU ETS does not. The same happens when we rate emissions from biomass combustion used in the EU cement industry to zero, assuming that it fulfils the sustainability criteria. In this case, the EU value estimated for grey clinker, of 0.79 tCO_2/t, is relatively close to the weighted average of emission intensity in the benchmarking curve of 0.81 tCO2/t. In some cases, where there are no precursors involved, such as for ammonia, our estimated carbon intensity (1.91 tCO_2/t) is also reasonably similar to the weighted average of the benchmarking curve of the EU ETS (1.95 tCO_2/t). For the products for which the discrepancy is higher, such as sintered ore and EAF high-alloy steel, the difference between the estimated value and the weighted average of the benchmarking curve is a limited fraction of the total variation range in the benchmarking curve (23% and 22% respectively).

Regarding the carbon intensity of the primary steelmaking production route, using the same boundaries as (Worldsteel, 2023b) results in a weighted average carbon intensity of 2.28 tCO2/t, which fits reasonably well with Worldsteel's own value, produced using information from 65 sites, of 2.32 tCO2/t. The primary production route of the countries in this study amounted in 2019 to 96.7% of primary steel production overall (1300 Mt vs. 1345 Mt).

It is not possible to validate the carbon intensities of products produced in third countries as we have done for the EU, where we used the benchmarking curves of the EU ETS. The information in these curves is based on actual data from European facilities reported to Member States, who in turn report to the European Commission. In order to validate our estimation for third countries, we would need access to actual data from their facilities. However, the fact that our estimations compare reasonably well with the weighted averages in the benchmarking curves give us confidence in the robustness of our approach.

References

Adeniji, T. A., Waheed, M. A. (2021). *Evaluation of the energy efficiency of an aluminum melting furnace for a Nigerian cast-coiled plant*, Fuel Communications, Volume 9, 2021, 100027, ISSN 2666-0520, https://doi.org/10.1016/j.jfueco.2021.100027.

Alelweet, O., Pavia S. (2022). *Pozzolanic and hydraulic activity of bauxite for binder production*, Journal of Building Engineering, Volume 51, 2022, 104186, ISSN 2352-7102, https://doi.org/10.1016/j.jobe.2022.104186.

Alucycle (2022). *The Global Aluminium Cycle*, International Aluminium Institute, https://alucycle.international-aluminium.org/.

Apunda, M. O., Nyangoye, B. O. (2017). *Selection of a Combined Heat and Power (CHP), and CHP Generation Compared to Buying of Electrical Power from the National Grid and Separate Thermal Heat Production,* Open Science Journal (Vol. 2, Issue 3), https://doi.org/10.23954/osj.v2i3.1170.

Argus (2020). *N_2O emissions review,* https://www.fertilizerseurope.com/wp-content/uploads/2023/05/N2O-Slides-For-Ferts-Europe.pdf.

Bertram, M., Ramkumar, S., Rechberger, H., Rombach, G., Bayliss, C., Martchek, K.J., Müller, D.B., Liu, G. (2017). *A regionally linked, dynamic material flow modelling tool for rolled, extruded and cast aluminium products*, Resources, Conservation and Recycling, Volume 125, 2017, Pages 48-69, ISSN 0921-3449, https://doi.org/10.1016/j.resconrec.2017.05.014.

BGS (2022). *World minerals statistics data*, British Geological Survey, https://www2.bgs.ac.uk/mineralsuk/statistics/wms.cfc?method=searchWMS.

CAEF (2020). *The European Foundry Industry in 2020*, CAEF - The European Foundry Association, https://www.caef.eu/wp-content/uploads/2019/01/CAEF-Commission-for-Economics-and-Statistics_2020.pdf.

Chatham House (2018). *Making Concrete Change Innovation in Low-carbon Cement and Concrete*, 13 June 2018, ISBN: 978 1 78413 272 9, https://www.chathamhouse.org/2018/06/making-concrete-change-innovation-low-carbon-cement-and-concrete.

Crundwell, F. K., Moats, M. S., Ramachandran, V., Robinson, T. G., Davenport, W. G. (2011). *Extractive Metallurgy of Nickel, Cobalt and Platinum Group Metals*. Elsevier, Oxford, United Kingdom, 2011. ISBN: 978-0-08-096809-4

Dindorf, R., Wos, P. (2020). *Energy-Saving Hot Open Die Forging Process of Heavy Steel Forgings on an Industrial Hydraulic Forging Press*, Energies, 13(7), 1620, https://doi.org/10.3390/en13071620.

ECRA (2022). *The ECRA Technology Papers 2022 - State of the Art Cement Manufacturing - Current Technologies and their Future Development*, European Cement Research Academy, Ed., Düsseldorf, 2022, https://ecra-online.org/research/technology-papers/.

EN 14647 (2005). *EN 14647:2005, Calcium aluminate cement - Composition, specifications and conformity criteria*.

EN 19694-3 (2016). *EN 19694-3:2016, Stationary source emissions - Determination of greenhouse gas (GHG) emissions in energy-intensive industries - Part 3: Cement industry*.

EN 197-1 (2011). *EN 197-1:2011, Cement — Part 1: Composition, specifications and conformity criteria for common cements*.

EN 197-5 (2021). *EN 197-5:2021, Cement - Part 5: Portland-composite cement CEM II/C-M and Composite cement CEM VI*.

ENERGY STAR (2017). *Energy Efficiency and Cost Saving Opportunities for Ammonia and Nitrogenous Fertilizer Production*, https://www.energystar.gov/sites/default/files/tools/Fertilizer_guide_170418_508.pdf.

EUROFER (2022). *European Steel in Figures 2022*, https://www.eurofer.eu/assets/publications/brochures-booklets-and-factsheets/european-steel-in-figures-2022/European-Steel-in-Figures-2022-v2.pdf.

EUROFORGE (2022). *International Statistics*, https://www.euroforge.org/wp-content/uploads/2022/05/International-Statistics.pdf.

European Aluminium (2018). *Environmental Profile Report – Life-Cycle inventory data for aluminium production and transformation processes in Europe*, European Aluminium, February 2018.

European Commission (2018). *Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012,* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R2066-20210101.

European Commission (2019). *Communication COM(2019)640 of 11 December 2019 on the European Green Deal,* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN.

European Commission (2021a). *Communication COM(2021)550 of 14 July 2021 on 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality*, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0550.

European Commission (2021b). *Proposal for a Regulation of the European Parliament and of the European Council COM(2021)564 establishing a Carbon Border Adjustment Mechanism*, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0564.

European Commission (2021c). *Update of benchmark values for the years 2021 – 2025 of phase 4 of the EU ETS*, Benchmark curves and key parameters, https://climate.ec.europa.eu/system/files/2021-10/policy_ets_allowances_bm_curve_factsheets_en.pdf.

European Commission (2022). *Investment Support for Ecosystems Energy-Intensive Industries*, July 2022, https://ec.europa.eu/docsroom/documents/51115/attachments/1/translations/en/renditions/native.

European Commission (2023a). *Carbon leakage*, https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/free-allocation/carbon-leakage_en#documentation.

European Commission (2023b). Implementing Regulation (EU) 2023/5512 of 17.8.2023 laying down the rules for the application of Regulation (EU) 2023/956 of the European Parliament and of the Council as regards reporting obligations for the purposes of the carbon border adjustment mechanism during the transitional period, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=PI_COM:C(2023)5512.

European Commission (2023c). *Guidance document on CBAM implementation for installation operators outside the EU*, https://taxation-customs.ec.europa.eu/system/files/2023-08/CBAM%20Guidance_non-EU%20installations.pdf.

European Union (2018). *Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814*, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018L0410.

European Union (2023). *Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 establishing a carbon border adjustment mechanism*, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R0956.

Fertilizers Europe (2022). *Fertilizers Europe Carbon Footprint Calculator*, http://www.calcfert.com/account/login/?next=/.

GCCA (2019). *Emissions Report 2019*, Global Cement and Concrete Association, Getting the Numbers Right Project, https://gccassociation.org/gnr/Excel/GNR%20-%20Totals_&_Averages%20-%20Light%20Report%202019.xls.

GCCA (2020). *Internet manual*, the Cement CO_2 and Energy Protocol, Version 3 CO_2 and Energy Accounting and Reporting Standard for the Cement Industry, Global Cement and Concrete Association, https://www.cement-co2-protocol.org/en/Content/Resources/Downloads/GCCA_Internet_Manual.pdf.

Harold F., Reetz, Jr. (2016). *Fertilizers and their Efficient Use, First edition*, IFA, Paris, France, https://www.fertilizer.org/wp-content/uploads/2023/01/2016_ifa_reetz.pdf.

Hewlet, P. C., Liska M. (2019). *Lea's Chemistry of Cement and Concrete*, 5th ed. Oxford: Butterworth-Heinemann, 2019, ISBN 978-0-08-100773-0.

Holappa (2013). *Handbook of Ferroalloys: Theory and Technology*. Edited by Michael Gasik, Elsevier, Oxford, United Kingdom, 2013. ISBN: 978-0-08-097753-9.

IAI (2020). *2019 Anode Effect Survey Report*, International Aluminium Institute, https://international-aluminium.org/wp-content/uploads/2021/03/2019_anode_effect_survey_result_2020.pdf.

IEA (2009). *Chemical and petrochemical sector: Potential of best practice technology and other measures for improving energy efficiency*, International Energy Agency information paper, https://iea.blob.core.windows.net/assets/c2d071e4-4142-44f1-8a41-88ece29be439/ChemicalandPetrochemicalSector.pdf.

IEA (2019). Coal Information. Statistics, Coal Information 2019 | OECD iLibrary (oecd-ilibrary.org), https://www.oecd-ilibrary.org/energy/coal-information-2019_4a69d8c8-en.

IEA (2021a). *IEA Emission factors 2021: Annual GHG emission factors for World countries from electricity and heat generation*, International Energy Agency, https://www.iea.org/data-and-statistics/data-product/emissions-factors-2021#emissions-factors.

IEA (2021b). *IEA Emission factors 2021: Database documentation*, International Energy Agency, https://iea.blob.core.windows.net/assets/8f05b8a2-e2e4-46a4-a4f9-c03163484501/CO2KWH_Methodology.pdf.

IEA (2022). *Extended world energy balances*, IEA World Energy Statistics and Balances (database), International Energy Agency, https://doi.org/10.1787/data-00513-en.

IFA (2014). *Ammonia Production: Moving Towards Maximum Efficiency and Lower GHG Emissions*, Fertilizer Facts, International Fertilizer Association.

IFA (2015). *Phosphate supply*, Fertilizer Facts, International Fertilizer Association.

IFASTAT (2023). *Consumption of fertilisers database*, International Fertilizer Association, https://www.ifastat.org/databases/plant-nutrition.

IPNI (2022). *Urea-Ammonium Nitrate*, Nutrient Source Specifics no. 7, International Plant Nutrition Institute, http://www.ipni.net/publication/nss.nsf/0/5BB8639163BB14E3852579AF0075540B/$FILE/NSS-07%20Urea%20Ammonium%20Nitrate.pdf.

IRENA and AEA (2022). *Innovation Outlook: Renewable Ammonia*, International Renewable Energy Agency, Abu Dhabi, Ammonia Energy Association, Brooklyn, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/May/IRENA_Innovation_Outlook_Ammonia_2022.pdf.

JRC (2007). *Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals - Ammonia, Acids and Fertilisers*, European IPPC Bureau, https://eippcb.jrc.ec.europa.eu/sites/default/files/2022-03/LVIC-AAF.pdf.

JRC (2013). *Best Available Techniques (BAT) Reference Document for Iron and Steel Production*, European IPPC Bureau, 2013, EUR 25521, Luxembourg (Luxembourg): Publications Office of the European Union, doi:10.2791/97469.

JRC (2015). *Energy Efficiency and GHG Emissions: Prospective Scenarios for the Aluminium Industry*, EUR 27335, Luxembourg (Luxembourg): Publications Office of the European Union, 2015.

JRC (2017a). *Energy efficiency and GHG emissions: Prospective scenarios for the Chemical and Petrochemical Industry*, EUR 28471 EN, Luxembourg (Luxembourg): Publications Office of the European Union.

JRC (2017b). *Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries*, European IPPC Bureau, 2017, EUR 28648, doi:10.2760/8224.

JRC (2017c). *JRC-IDEES: Integrated Database of the European Energy Sector: Methodological note*, EUR 28773 EN, Luxembourg (Luxembourg): Publications Office of the European Union, JRC108244.

JRC (2022a). *Greenhouse gas intensities of the EU steel industry and its trading partners*, EUR 31112 EN, Luxembourg (Luxembourg): Publications Office of the European Union.

JRC (2022b). *Reference Document on Best Available Techniques for the Smitheries and Foundries Industry*, European IPPC Bureau, https://eippcb.jrc.ec.europa.eu/sites/default/files/2022-02/SF_BREF_D1_web.pdf.

JRC (2022c). *Best Available Techniques (BAT) Reference Document for the Ferrous Metals Processing Industry*, European IPPC Bureau, 2022, EUR 31321, Luxembourg (Luxembourg): Publications Office of the European Union, doi:10.2760/196475.

Kongshaug, G. (1998). *Energy Consumption and Greenhouse Gas Emissions in Fertilizer Production*, IFA Technical Conference, Marrakech, Morocco, https://www.fertilizer.org/wp-content/uploads/2023/01/1998_ifa_marrakech_kongshaug.pdf.

Kremser R, Grabowski N, Düssel R, Mulder A, Tutsch D. (2020). *Anode Effect Prediction in Hall-Héroult Cells Using Time Series Characteristics*, Applied Sciences, 2020, 10(24):9050, https://doi.org/10.3390/app10249050.

Löf, A., Löf, O. (2023). *This Year's Iron Ore Report Looks Much Better Than Many Expected*, https://www.e-mj.com/features/this-years-iron-ore-report-looks-much-better-than-many-expected/.

Midrex (2021). *World Direct Reduction Statistics*, https://www.midrex.com/wp-content/uploads/MidrexSTATSBook2021.pdf.

Moya, J. A., Pardo, N. (2013). *The potential for improvements in energy efficiency and CO2 emissions in the EU27 iron and steel industry under different payback periods*, Journal of Cleaner Production, vol. 52, 2013, pp. 71-83, https://doi.org/10.1016/j.jclepro.2013.02.028.

NACAG (2022). *Nitrous oxide emissions from nitric acid production*, Nitric Acid Climate Action Group, https://www.nitricacidaction.org/about/nitrous-oxide-emissions-from-nitric-acid-production/.

Pawlek, R.P. (2019). *Primary Aluminium Smelters and Producers of the World*, 2022, https://www.lightmetalage.com/resources-section/primary-producers/.

Pawlek, R. P. (2022). *Secondary Aluminium Producers*, Light Metal Age, 2022, https://www.lightmetalage.com/resources-section/secondary-producers/.

Pereira, A. L., Reis, M. A., Ferreira, L. L. H. C., Passos, E. R., Ribeiro, L. C., Novo, M. M. M., Nakachima, P. M. (2017). *Characterization of a New Sintered Calcium Aluminate Cement*, Technology trends, Refractories WORLDFORUM 9 (2017), https://www.refractories-worldforum.com/php/paper_download.php?article_id=100577&hash=bb5210fd6a.

Rao, Mingjun & Li, Guanghui & Luo, Jun & Zhang, Yuanbo & Fan, Xiaohui. (2013). Carbothermic Reduction of Nickeliferous Laterite Ores for Nickel Pig Iron Production in China: A Review. JOM. 65. 10.1007/s11837-013-0760-7.

SMM (2023). *China stainless steel production growth to slow in 2020*, Shanghai Metals Market, https://www.hellenicshippingnews.com/china-stainless-steel-production-growth-to-slow-in-2020/.

Springer, C., Hasanbeigi, A. (2016). *Emerging Energy Efficiency and Carbon Dioxide Emissions Reduction Technologies for Industrial Production of Aluminum*, China Energy Group Energy Analysis and Environmental Impacts Division Energy Technologies Area Lawrence Berkeley National Laboratory, June 2016.

Steel Institute VDEh (2019). *Plantfacts Capacity Database.*

Steel Institute VDEh (2023). *StahlDat SX database - The Register of European Steels*, https://www.stahldaten.de/stahldat-sx/stahl-eisen-liste/.

UN Comtrade (2022). *UN Comtrade database*, http://comtrade.un.org/.

US DoE (2001). *Aluminium project factsheet*, https://cat.engr.uky.edu/sites/cat/files/EnergyEfficiency.pdf.

USGS (2019). *Minerals Yearbook – Iron ore*, United States Geological Survey, 2019, https://www.usgs.gov/centers/national-minerals-information-center/iron-ore-statistics-and-information.

USGS. (2020). *Data for annual publication, Minerals Yearbook, Cement*. XLS Format, United States Geological Survey, 2020, https://www.usgs.gov/centers/national-minerals-information-center/cement-statistics-and-information.

Wei, W., Samuelsson, P. B., Tilliander, A., Gyllenram, R., Jönsson, P. G. (2020). *Energy Consumption and Greenhouse Gas Emissions of Nickel Products*. Energies 2020, 13, 5664, Basel, Switzerland.

Wendołowski, M. (2019). *Fertilizer carbon footprint calculator*, Fertilizer focus, 2019, pp. 8-12, https://www.fertilizerseurope.com/wp-content/uploads/2019/11/Fertilizer-Carbon-Footprint-Calculator-Fertilizer-Focus-Magazine.pdf.

WorldSteel (2021). *Steel Statistical Yearbook 2021*, WorldSteel, 2021, https://worldsteel.org/steel-topics/statistics/steel-statistical-yearbook/.

WorldSteel (2023a). *CO2 Data Collection. User Guide, version 11*, WorldSteel, 2023, https://worldsteel.org/wp-content/uploads/CO2_User_Guide_V11.pdf.

Worldsteel (2023b). Åsa Ekdehl. *Worldsteel's CO2 Data collection*, WorldSteel, 2023.

Worrell, E., Price, L., Neelis, M., Galitsky, C., Zhou, N. (2007). *World Best Practice Energy Intensity Values for Selected Industrial Sectors, Lawrence Berkeley National Laboratory*, https://escholarship.org/uc/item/77n9d4sp.

ZhenAn (2023). https://www.ferro-silicon-alloy.com/.

List of abbreviations and definitions

AA	Administrative Arrangement
AN	Ammonium Nitrate
AOD	Argon Oxygen Decarburization
BAT	Best Available Techniques
BREF	Best Available Techniques Reference Document
BF	Blast Furnace
BOF	Basic Oxygen Furnace
CAEF	The European Foundry Association
CBAM	Carbon Border Adjustment Mechanism
CSI	Cement Sustainability Initiative
DRI	Direct Reduced Iron
EAF	Electric Arc Furnace
ECRA	European Cement Research Academy
EFfuel	Emission factor of fuel in kg CO_2 per gigajoule
EFTA	European Free Trade Association
EU	European Union
EUROFER	European Steel Association
GCCA	Global Cement and Concrete Association
GHG	Greenhouse Gas
GNR	"Getting the numbers right"
JRC	Joint Research Centre
IAI	International Aluminium Institute
IMEDAL	Instituto Mexicano Del Aluminio
IPCC	Intergovernmental Panel on Climate Change
n.e.c.	not elsewhere considered
nes	Not Elsewhere Specified
NFM	Non-Ferrous Metal
NMM	Non-Metallic Mineral
NIMs	National Implementation Measures
PC	Portland cement
PFC	Perfluorocarbon
Weighted average	Rest of the World
SCM	Supplementary Cementitious Materials
UAN	Urea Ammonium Nitrate
VOD	Vacuum Oxygen Decarburization

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Annex 1. Mapping of energy products across databases (GNR, IEA and CBAM)

Table 18. Mapping of energy products and emission factors.

Fuel categories	Fuels in GNR data	Fuels in IEA energy balance	Fuels in CBAM Implementing Regulation	Emission factor [kg CO_2/GJ]
Fossil fuels				
	coal + anthracite + waste coal	Hard coal (if no detail) Brown coal (if no detail) Anthracite Coking coal Other bituminous coal Sub-bituminous coal	Sub-Bituminous Coal	96.1
	petrol coke	Petroleum coke	Petroleum Coke	97.5
	(ultra) heavy fuel	Other hydrocarbons	Residual Fuel Oil	77.4
	diesel oil	Gas/diesel oil excl. biofuels	Gas/Diesel Oil	74.1
	natural gas (dry)	Natural gas	Natural Gas	56.1
	oil shale	Oil shale and oil sands	Oil Shale and Tar Sands	107.0
	lignite	Lignite	Lignite	101.0
	gasoline	Petroleum coke	Motor gasoline	69.3
Alternative fossil fuels				
	waste oil	Fuel oil	Waste Oils	73.3
	tyres	Industrial waste	Waste tyres	85.0
	plastics		n.a. GNR data used	75.0*
	solvents		n.a. GNR data used	74.0*
	impregnated saw dust		n.a. GNR data used	75.0*
	mixed industrial waste		n.a. GNR data used	83.0*
	other fossil-based wastes	Municipal waste (non-renewable)	Coal Tar	80.7
Biomass fuels				
	dried sewage sludge	Primary solid biofuels	Other Primary Solid Biomass	100.0**
	wood, non-impregnated saw dust		Wood / Wood Waste	112.0**
	paper, carton		Other Primary Solid Biomass	100.0**
	animal meal		Other Primary Solid Biomass	100.0**
	animal bone meal		Other Primary Solid Biomass	100.0**
	animal fat		Other Primary Solid Biomass	100.0**
	agricultural, organic, diaper waste, charcoal	Municipal waste (renewable) Charcoal	Charcoal	112.0**
	other biomass	Biogases Biogasoline Biodiesels Bio jet kerosene Other liquid biofuels	Other liquid biofuels	79.6**

Note: Emission factors are sourced in MRR except * Emission factors from GNR

Source: JRC based on (GCCA, 2019; IEA, 2022, European Commission 2023b).

Annex 2. Emission intensities at country level

Emission intensities of products in the iron and steel industry

Table 19. Emission intensities of products in the iron and steel industry.

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2601 12 00	Agglomerated iron ores and concentrates, other than roasted iron pyrites	0.19	0.02	0.21	0.38	0.01	0.39	0.28	0.05	0.33	0.34	0.05	0.39	0.20	0.04	0.24
7201	Pig iron and spiegeleisen in pigs, blocks or other primary forms	1.38	0.08	1.47	1.79	0.03	1.82	1.75	0.17	1.93	2.74	0.30	3.04	1.98	0.14	2.11
7202 11 7202 19	Ferro-manganese	1.44	1.21	2.65	1.44	0.39	1.83	1.44	2.04	3.48	1.44	2.37	3.81	1.44	1.64	3.08
7202 41 7202 49	Ferro-chromium	2.07	1.51	3.58	2.07	0.49	2.55	2.07	2.54	4.61	2.07	2.96	5.03	0.00	0.00	0.00
7202 60 00	Ferro-nickel	3.48	3.14	6.62	3.48	1.01	4.49	0.00	0.00	0.00	0.00	0.00	0.00	3.48	4.27	7.75
7203	Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products, in lumps, pellets or the like; iron having a minimum purity of 99.94%, in lumps, pellets or similar forms	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.81	0.00	4.81	0.00	0.00	0.00
7205	Granules and powders, of pig iron, spiegeleisen, iron or steel	1.38	0.08	1.47	1.83	0.04	1.87	1.76	0.22	1.98	2.75	0.34	3.09	1.99	0.17	2.16
7206	Iron and non-alloy steel in ingots or other primary forms (excluding iron of heading no. 7203)	see below			see below			see below			see below			see below		
7206 10 00	Ingots	0.07	0.28	0.35	1.90	0.04	1.94	1.83	0.23	2.06	2.86	0.35	3.21	2.07	0.17	2.24
7206 90 00	Continuous casting (slab, billet, bloom)	0.07	0.28	0.36	1.90	0.04	1.94	1.83	0.24	2.07	2.86	0.36	3.22	2.07	0.18	2.25
7207	Iron or non-alloy steel; semi-finished products thereof	see below			see below			see below			see below			see below		

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7207 11 11 7207 11 14 7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32 7207 20 52 7207 20 80	Bars, rods, and other long products	0.13	0.32	0.45	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	Forgings	0.07	0.28	0.35	4.06	0.16	4.22	2.05	0.91	2.96	4.97	1.37	6.34	2.63	0.67	3.30
7208	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated	0.07	0.28	0.36	2.02	0.05	2.07	1.84	0.30	2.14	4.90	0.79	5.69	2.10	0.23	2.32
7209	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated	0.07	0.28	0.36	2.12	0.07	2.19	1.85	0.40	2.25	4.90	0.88	5.79	2.12	0.30	2.42
7210	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated	0.07	0.28	0.36	2.21	0.07	2.28	1.86	0.43	2.29	4.91	0.92	5.82	2.14	0.32	2.47
7211	Iron or non-alloy steel; flat-rolled products, width less than 600mm, not clad, plated or coated	see below			see below			see below			see below			see below		
7211 13 00 7211 14 00 7211 19 00	Hot-rolled flat products	0.07	0.28	0.36	2.02	0.05	2.07	1.84	0.30	2.14	4.90	0.79	5.69	2.10	0.23	2.32
7211 23 7211 29 00 7211 90	Cold-rolled and annealed flat products	0.07	0.28	0.36	2.12	0.07	2.19	1.85	0.40	2.25	4.90	0.88	5.79	2.12	0.30	2.42

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7212	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated	0.07	0.28	0.36	2.21	0.07	2.28	1.86	0.43	2.29	4.91	0.92	5.82	2.14	0.32	2.47
7213	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils	0.13	0.32	0.45	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7214	Iron or non-alloy steel; bars and rods, not further worked than forged, hot-rolled, hot drawn or hot-extruded, but including those twisted after rolling	see below			see below			see below			see below			see below		
7214 10 00	Forgings	0.07	0.28	0.35	4.06	0.16	4.22	2.05	0.91	2.96	4.97	1.37	6.34	2.63	0.67	3.30
7214 20 00 7214 30 00 7214 91 7214 99	Bars, rods, and other long products	0.13	0.32	0.45	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7215	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72	0.13	0.32	0.45	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7216	Iron or non-alloy steel, angles, shapes and sections	0.13	0.32	0.45	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7217	Wire of iron or non-alloy steel.	see below			see below			see below			see below			see below		
7217 10	Wires	0.13	0.38	0.52	2.04	0.09	2.13	1.84	0.51	2.35	4.90	0.73	5.63	2.10	0.38	2.48
7217 20 7217 30 7217 90	Plated or coated wires	0.19	0.40	0.59	2.13	0.09	2.22	1.85	0.54	2.39	4.90	0.73	5.63	2.12	0.40	2.52
7218	Stainless steel in ingots or other primary forms; semi-finished products of stainless steel.	see below			see below			see below			see below			see below		
7218 10 00 7218 99 19 7218 99 80	Ingots and forgings	1.46	1.30	2.76	4.29	0.51	4.80	2.44	2.10	4.54	2.58	3.03	5.61	2.66	2.22	4.88
7218 91 7218 99 11 7218 99 20	Hot-rolled flat products	1.46	1.31	2.77	2.33	0.41	2.74	2.24	1.54	3.78	2.51	2.50	5.02	2.15	1.82	3.97
7219	Stainless steel; flat-rolled products of width of 600mm or more	see below			see below			see below			see below			see below		

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7219 11 00 7219 12 7219 13 7219 14 7219 21 7219 22 7219 23 00 7219 24 00	Hot-rolled flat products	1.46	1.31	2.77	2.33	0.41	2.74	2.24	1.54	3.78	2.51	2.50	5.02	2.15	1.82	3.97
7219 31 00 7219 32 7219 33 7219 34 7219 35 7219 90	Cold-rolled and annealed flat products	1.46	1.31	2.77	2.43	0.43	2.86	2.25	1.64	3.89	2.52	2.60	5.12	2.17	1.89	4.06
7220	Stainless steel; flat-rolled products of width less than 600mm	see below			see below			see below			see below			see below		
7220 11 00 7220 12 00	Hot-rolled flat products	1.46	1.31	2.77	2.33	0.41	2.74	2.24	1.54	3.78	2.51	2.50	5.02	2.15	1.82	3.97
7220 20 7220 90	Cold-rolled and annealed flat products	1.46	1.31	2.77	2.43	0.43	2.86	2.25	1.64	3.89	2.52	2.60	5.12	2.17	1.89	4.06
7221	Stainless steel bars and rods, hot-rolled, in irregularly wound coils	1.64	1.41	3.05	2.44	0.44	2.88	2.25	1.71	3.96	2.51	2.39	4.90	2.17	1.94	4.11
7222	Stainless steel bars and rods, angles, shapes and sections	see below			see below			see below			see below			see below		
7222 11 7222 19 7222 20 7222 40	Bars, rods, and other long products	1.64	1.41	3.05	2.44	0.44	2.88	2.25	1.71	3.96	2.51	2.39	4.90	2.17	1.94	4.11
7222 30	Forgings	1.46	1.30	2.76	4.29	0.51	4.80	2.44	2.10	4.54	2.58	3.03	5.61	2.66	2.22	4.88
7223	Stainless steel wire	see below			see below			see below			see below			see below		
7223 00	Wires	1.64	1.48	3.11	2.47	0.47	2.94	2.25	1.89	4.14	2.51	2.39	4.90	2.18	2.06	4.24
7224	Alloy steel in ingots or other primary forms, semi-finished products of other alloy steel	see below			see below			see below			see below			see below		
7224 10 7224 90 18 7224 90 90	Ingots and forgings	0.12	0.32	0.44	3.98	0.18	4.16	1.91	1.10	3.01	2.78	1.09	3.87	2.56	0.72	3.28

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7224 90 02 7224 90 03 7224 90 05 7224 90 07 7224 90 14 7224 90 31 7224 90 38	Hot-rolled flat products	0.13	0.32	0.45	2.03	0.08	2.10	1.71	0.54	2.25	2.72	0.57	3.28	2.05	0.32	2.36
7225	Alloy steel flat-rolled products, of a width 600mm or more	see below			see below			see below			see below			see below		
7225 11 00 7225 19 10 7225 30 7225 40	Hot-rolled flat products	0.13	0.32	0.45	2.03	0.08	2.10	1.71	0.54	2.25	2.72	0.57	3.28	2.05	0.32	2.36
7225 19 90 7225 50	Cold-rolled and annealed flat products	0.13	0.32	0.45	2.12	0.10	2.22	1.72	0.64	2.36	2.72	0.66	3.38	2.07	0.39	2.46
7225 91 00 7225 92 00 7225 99 00	Plated or coated flat products	0.13	0.32	0.45	2.21	0.10	2.31	1.73	0.68	2.40	2.72	0.69	3.41	2.09	0.41	2.50
7226	Alloy steel flat-rolled products, of a width of less than 600mm	see below			see below			see below			see below			see below		
7226 11 00 7226 19 10 7226 20 00 7226 91	Hot-rolled flat products	0.13	0.32	0.45	2.03	0.08	2.10	1.71	0.54	2.25	2.72	0.57	3.28	2.05	0.32	2.36
7226 19 80 7226 92 00	Cold-rolled and annealed flat products	0.13	0.32	0.45	2.12	0.10	2.22	1.72	0.64	2.36	2.72	0.66	3.38	2.07	0.39	2.46
7226 99	Plated or coated flat products	0.13	0.32	0.45	2.21	0.10	2.31	1.73	0.68	2.40	2.72	0.69	3.41	2.09	0.41	2.50
7227	Steel, alloy; bars and rods, hot-rolled, in irregularly wound coils	0.31	0.43	0.73	2.14	0.11	2.25	1.72	0.71	2.43	2.71	0.45	3.16	2.07	0.44	2.51
7228	Alloy steel bars, rods, shapes and sections; hollow drill bars and rods, of alloy or non-alloy steel	see below			see below			see below			see below			see below		

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7228 10 20 7228 10 90 7228 20 7228 30 7228 50 7228 60 7228 70 7228 80 00	Bars, rods, and other long products	0.31	0.43	0.73	2.14	0.11	2.25	1.72	0.71	2.43	2.71	0.45	3.16	2.07	0.44	2.51
7228 10 50 7228 40	Forgings	0.12	0.32	0.44	3.98	0.18	4.16	1.91	1.10	3.01	2.78	1.09	3.87	2.56	0.72	3.28
7229	Wire of other alloy steel.	0.31	0.49	0.80	2.16	0.14	2.30	1.72	0.89	2.60	2.71	0.45	3.16	2.07	0.57	2.64
7301	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.	0.09	0.29	0.38	2.12	0.07	2.19	1.85	0.40	2.25	4.90	0.88	5.79	2.12	0.30	2.42
7302	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates	0.20	0.33	0.52	2.05	0.05	2.10	1.84	0.30	2.14	4.90	0.79	5.69	2.11	0.23	2.33
7303	Tubes, pipes & hollow profiles of cast iron	see below			see below			see below			see below			see below		
730300	Tubes, pipes & hollow profiles of cast iron	1.48	0.11	1.59	2.68	0.06	2.75	2.01	0.36	2.37	3.06	0.48	3.54	2.17	0.27	2.45
7304	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	see below			see below			see below			see below			see below		
7304 11 00 7304 22 00 7304 24 00 7304 41 00 7304 49 7304 51 7304 59	Beams, billets, rails and tubes -- alloying elements group 1	0.22	0.34	0.56	1.98	0.06	2.04	1.83	0.34	2.17	2.72	0.49	3.21	2.02	0.28	2.30

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	Beams, billets, rails and tubes -- alloying elements group 2	0.18	0.31	0.49	2.05	0.05	2.10	1.84	0.30	2.14	4.90	0.79	5.69	2.11	0.23	2.33
7305	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.	0.12	0.32	0.45	2.12	0.07	2.19	1.85	0.40	2.25	4.90	0.88	5.79	2.12	0.30	2.42
7306	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel.	see below			see below			see below			see below			see below		
7306 30 18	Hot-rolled flat products	0.08	0.29	0.38	2.02	0.05	2.07	1.84	0.30	2.14	4.90	0.79	5.69	2.10	0.23	2.32
7306 19 00 7306 29 00 7306 30 12	Cold-rolled and annealed flat products	0.08	0.29	0.38	2.12	0.07	2.19	1.85	0.40	2.25	4.90	0.88	5.79	2.12	0.30	2.42
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	Plated or coated flat products	0.08	0.29	0.38	2.21	0.07	2.28	1.86	0.43	2.29	4.91	0.92	5.82	2.14	0.32	2.47
7306 40 80 7306 50 29	Hot-rolled flat products -- alloyed	0.08	0.29	0.38	2.03	0.06	2.09	1.77	0.36	2.14	2.74	0.48	3.21	2.03	0.28	2.30
7306 11 00 7306 21 00 7306 40 20 7306 61 10 7306 69 10	Cold-rolled and annealed flat products -- alloying elements group 1	0.12	0.32	0.45	2.13	0.09	2.22	1.85	0.49	2.34	2.73	0.63	3.36	2.06	0.39	2.45
7306 50 21 7306 50 80	Cold-rolled and annealed flat products -- alloying elements group 2	0.08	0.29	0.38	2.12	0.08	2.20	1.78	0.46	2.24	2.74	0.57	3.31	2.05	0.35	2.40

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7307	Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel.	see below			see below			see below			see below			see below		
7307 11 7307 19 10	Forgings of cast iron	1.38	0.08	1.47	3.96	0.15	4.11	1.97	0.85	2.83	2.81	0.94	3.75	2.54	0.63	3.17
7307 19 90	Forgings of cast steel	0.07	0.28	0.35	2.58	0.26	2.83	0.53	1.44	1.97	0.15	1.37	1.52	0.64	1.04	1.68
7307 21 00 7307 22 7307 23 7307 29	Beams, billets, rails and tubes -- of stainless steel	0.26	0.37	0.63	2.00	0.08	2.08	1.85	0.38	2.22	2.73	0.58	3.31	2.04	0.34	2.39
7307 91 00 7307 92 7307 93 7307 99	Beams, billets, rails and tubes	0.16	0.31	0.47	2.05	0.05	2.10	1.84	0.30	2.14	4.90	0.79	5.69	2.11	0.23	2.33
7308	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock-gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel	1.82	1.59	3.40	2.70	0.53	3.22	2.26	1.44	3.69	4.91	0.92	5.82	2.52	2.23	4.75
7309	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	0.21	0.38	0.59	2.21	0.07	2.28	1.95	0.50	2.45	4.91	0.92	5.82	2.14	0.32	2.47
7310	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	0.12	0.32	0.44	2.21	0.07	2.28	1.86	0.43	2.29	4.91	0.92	5.82	2.14	0.32	2.47

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7311	Containers for compressed or liquefied gas, of iron or steel	see below			see below			see below			see below			see below		
7311 00	Containers for compressed or liquefied gas, of iron or steel	0.25	0.41	0.67	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7318	Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel	see below			see below			see below			see below			see below		
7318 11 00 7318 12 90 7318 13 00 7318 14 91 7318 14 99 7318 19 00 7318 21 00 7318 24 00 7318 29 00	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel	0.13	0.32	0.45	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7318 12 10 7318 14 10	Other wood screws; self-tapping screws - of stainless steel	1.52	1.34	2.86	2.24	0.41	2.65	2.23	1.53	3.76	2.51	2.39	4.90	2.12	1.81	3.93
7318 15	Other screws and bolts, whether or not with their nuts or washers	0.33	0.48	0.81	2.02	0.11	2.13	2.17	0.47	2.64	4.90	0.73	5.63	2.09	0.25	2.35
7318 16	Nuts	0.23	0.38	0.61	2.01	0.06	2.07	1.85	0.41	2.26	4.90	0.73	5.63	2.09	0.25	2.35
7318 22 00	Other washers	0.22	0.38	0.60	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7318 23 00	Rivets	0.14	0.33	0.47	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7326	Other articles of iron or steel	see below			see below			see below			see below			see below		
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	Forged, stamped, or sintered	0.07	0.28	0.35	4.06	0.16	4.22	2.05	0.91	2.96	4.97	1.37	6.34	2.63	0.67	3.30
7326 20 00	Articles of iron or steel wire	0.19	0.40	0.59	2.13	0.09	2.22	1.85	0.54	2.39	4.90	0.73	5.63	2.12	0.40	2.52

Country		Belarus			Brazil			China			India			Japan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7326 90 30 7326 90 40 7326 90 50 7326 90 60	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry	0.13	0.32	0.45	2.01	0.06	2.07	1.84	0.34	2.18	4.90	0.73	5.63	2.09	0.25	2.35
7326 90 98	Other articles of iron or steel	0.07	0.28	0.36	2.21	0.07	2.28	1.86	0.43	2.29	4.91	0.92	5.82	2.14	0.32	2.47

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2601 12 00	Agglomerated iron ores and concentrates, other than roasted iron pyrites	0.13	0.04	0.17	0.11	0.04	0.14	1.42	0.03	1.45	0.11	0.04	0.14	0.43	0.31	0.74
7201	Pig iron and spiegeleisen in pigs, blocks or other primary forms	1.66	0.14	1.79	12.73	0.01	12.74	3.30	0.12	3.42	2.26	0.37	2.63	3.44	0.91	4.36
7202 11 7202 19	Ferro-manganese	1.44	1.69	3.13	1.44	0.03	1.47	1.44	1.18	2.62	0.00	0.00	0.00	1.44	2.94	4.38
7202 41 7202 49	Ferro-chromium	0.00	0.00	0.00	0.00	0.00	0.00	2.07	1.47	3.54	0.00	0.00	0.00	2.07	3.68	5.74
7202 60 00	Ferro-nickel	3.48	4.38	7.86	0.00	0.00	0.00	0.00	0.00	0.00	3.48	6.28	9.76	0.00	0.00	0.00
7203	Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products, in lumps, pellets or the like; iron having a minimum purity of 99.94%, in lumps, pellets or similar forms	0.00	0.00	0.00	0.00	0.00	0.00	1.62	0.12	1.74	0.00	0.00	0.00	0.53	0.70	1.23
7205	Granules and powders, of pig iron, spiegeleisen, iron or steel	1.67	0.17	1.84	12.73	0.01	12.74	3.35	0.14	3.49	2.34	0.46	2.80	3.46	1.17	4.63
7206	Iron and non-alloy steel in ingots or other primary forms (excluding iron of heading no. 7203)	see below			see below			see below			see below			see below		
7206 10 00	Ingots	1.73	0.18	1.91	0.90	0.09	0.99	3.48	0.15	3.62	2.43	0.48	2.90	3.60	1.20	4.80
7206 90 00	Continuous casting (slab, billet, bloom)	1.73	0.19	1.92	0.90	0.09	1.00	3.48	0.16	3.64	2.43	0.50	2.93	3.60	1.26	4.86

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7207	Iron or non-alloy steel; semi-finished products thereof	see below			see below			see below			see below			see below		
7207 11 11 7207 11 14 7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32 7207 20 52 7207 20 80	Bars, rods, and other long products	1.75	0.26	2.01	0.90	0.09	1.00	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	Forgings	2.14	0.69	2.84	0.90	0.09	0.99	3.48	0.15	3.62	2.43	0.48	2.90	3.60	1.20	4.80
7208	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated	1.76	0.23	1.99	0.90	0.09	1.00	3.65	0.19	3.84	2.43	0.50	2.93	3.65	1.62	5.27
7209	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated	1.77	0.31	2.08	0.90	0.09	1.00	3.78	0.26	4.04	2.43	0.50	2.93	3.70	2.19	5.88
7210	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated	1.79	0.33	2.12	0.90	0.09	1.00	3.90	0.28	4.18	2.43	0.50	2.93	3.70	2.19	5.88
7211	Iron or non-alloy steel; flat-rolled products, width less than 600mm, not clad, plated or coated	see below			see below			see below			see below			see below		

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7211 13 00 7211 14 00 7211 19 00	Hot-rolled flat products	1.76	0.23	1.99	0.90	0.09	1.00	3.65	0.19	3.84	2.43	0.50	2.93	3.65	1.62	5.27
7211 23 7211 29 00 7211 90	Cold-rolled and annealed flat products	1.77	0.31	2.08	0.90	0.09	1.00	3.78	0.26	4.04	2.43	0.50	2.93	3.70	2.19	5.88
7212	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated	1.79	0.33	2.12	0.90	0.09	1.00	3.90	0.28	4.18	2.43	0.50	2.93	3.70	2.19	5.88
7213	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils	1.75	0.26	2.01	0.90	0.09	1.00	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7214	Iron or non-alloy steel; bars and rods, not further worked than forged, hot-rolled, hot drawn or hot-extruded, but including those twisted after rolling	see below			see below			see below			see below			see below		
7214 10 00	Forgings	2.14	0.69	2.84	0.90	0.09	0.99	3.48	0.15	3.62	2.43	0.48	2.90	3.60	1.20	4.80
7214 20 00 7214 30 00 7214 91 7214 99	Bars, rods, and other long products	1.75	0.26	2.01	0.90	0.09	1.00	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7215	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72	1.75	0.26	2.01	0.90	0.09	1.00	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7216	Iron or non-alloy steel, angles, shapes and sections	1.75	0.26	2.01	0.90	0.09	1.00	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7217	Wire of iron or non-alloy steel.	see below			see below			see below			see below			see below		
7217 10	Wires	1.75	0.39	2.15	0.90	0.09	1.00	3.63	0.33	3.96	2.43	0.50	2.93	3.60	1.26	4.86
7217 20 7217 30 7217 90	Plated or coated wires	1.77	0.42	2.19	0.90	0.09	1.00	3.76	0.35	4.11	2.43	0.50	2.93	3.60	1.26	4.86
7218	Stainless steel in ingots or other primary forms; semi-finished products of stainless steel.	see below			see below			see below			see below			see below		

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7218 10 00 7218 99 19 7218 99 80	Ingots and forgings	2.41	2.10	4.51	1.81	0.07	1.88	2.85	1.04	3.89	2.25	2.43	4.68	2.78	3.25	6.03
7218 91 7218 99 11 7218 99 20	Hot-rolled flat products	2.03	1.68	3.71	1.81	0.07	1.88	3.14	1.12	4.26	2.26	2.45	4.71	2.88	3.98	6.86
7219	Stainless steel; flat-rolled products of width of 600mm or more	see below			see below			see below			see below			see below		
7219 11 00 7219 12 7219 13 7219 14 7219 21 7219 22 7219 23 00 7219 24 00	Hot-rolled flat products	2.03	1.68	3.71	1.81	0.07	1.88	3.14	1.12	4.26	2.26	2.45	4.71	2.88	3.98	6.86
7219 31 00 7219 32 7219 33 7219 34 7219 35 7219 90	Cold-rolled and annealed flat products	2.05	1.76	3.81	1.81	0.07	1.88	3.27	1.18	4.45	2.26	2.45	4.71	2.92	4.55	7.47
7220	Stainless steel; flat-rolled products of width less than 600mm	see below			see below			see below			see below			see below		
7220 11 00 7220 12 00	Hot-rolled flat products	2.03	1.68	3.71	1.81	0.07	1.88	3.14	1.12	4.26	2.26	2.45	4.71	2.88	3.98	6.86
7220 20 7220 90	Cold-rolled and annealed flat products	2.05	1.76	3.81	1.81	0.07	1.88	3.27	1.18	4.45	2.26	2.45	4.71	2.92	4.55	7.47
7221	Stainless steel bars and rods, hot-rolled, in irregularly wound coils	2.05	1.81	3.86	1.81	0.07	1.88	3.28	1.23	4.50	2.26	2.45	4.71	2.78	3.31	6.09
7222	Stainless steel bars and rods, angles, shapes and sections	see below			see below			see below			see below			see below		
7222 11 7222 19 7222 20 7222 40	Bars, rods, and other long products	2.05	1.81	3.86	1.81	0.07	1.88	3.28	1.23	4.50	2.26	2.45	4.71	2.78	3.31	6.09

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7222 30	Forgings	2.41	2.10	4.51	1.81	0.07	1.88	2.85	1.04	3.89	2.25	2.43	4.68	2.78	3.25	6.03
7223	Stainless steel wire	see below			see below			see below			see below			see below		
7223 00	Wires	2.05	1.94	3.99	1.81	0.07	1.88	3.28	1.34	4.62	2.26	2.45	4.71	2.78	3.31	6.09
7224	Alloy steel in ingots or other primary forms, semi-finished products of other alloy steel	see below			see below			see below			see below			see below		
7224 10 7224 90 18 7224 90 90	Ingots and forgings	2.09	0.77	2.86	0.92	0.08	1.00	3.30	0.17	3.47	2.31	0.56	2.88	3.41	1.25	4.65
7224 90 02 7224 90 03 7224 90 05 7224 90 07 7224 90 14 7224 90 31 7224 90 38	Hot-rolled flat products	1.72	0.35	2.07	0.92	0.08	1.00	3.59	0.25	3.84	2.32	0.59	2.91	3.50	1.98	5.48
7225	Alloy steel flat-rolled products, of a width 600mm or more	see below			see below			see below			see below			see below		
7225 11 00 7225 19 10 7225 30 7225 40	Hot-rolled flat products	1.72	0.35	2.07	0.92	0.08	1.00	3.59	0.25	3.84	2.32	0.59	2.91	3.50	1.98	5.48
7225 19 90 7225 50	Cold-rolled and annealed flat products	1.74	0.42	2.16	0.92	0.08	1.00	3.72	0.32	4.03	2.32	0.59	2.91	3.55	2.55	6.09
7225 91 00 7225 92 00 7225 99 00	Plated or coated flat products	1.75	0.45	2.20	0.92	0.08	1.00	3.84	0.34	4.18	2.32	0.59	2.91	3.55	2.55	6.09
7226	Alloy steel flat-rolled products, of a width of less than 600mm	see below			see below			see below			see below			see below		
7226 11 00 7226 19 10 7226 20 00 7226 91	Hot-rolled flat products	1.72	0.35	2.07	0.92	0.08	1.00	3.59	0.25	3.84	2.32	0.59	2.91	3.50	1.98	5.48
7226 19 80 7226 92 00	Cold-rolled and annealed flat products	1.74	0.42	2.16	0.92	0.08	1.00	3.72	0.32	4.03	2.32	0.59	2.91	3.55	2.55	6.09
7226 99	Plated or coated flat products	1.75	0.45	2.20	0.92	0.08	1.00	3.84	0.34	4.18	2.32	0.59	2.91	3.55	2.55	6.09

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7227	Steel, alloy; bars and rods, hot-rolled, in irregularly wound coils	1.74	0.47	2.21	0.92	0.08	1.00	3.73	0.36	4.09	2.32	0.59	2.91	3.41	1.31	4.71
7228	Alloy steel bars, rods, shapes and sections; hollow drill bars and rods, of alloy or non-alloy steel	see below			see below			see below			see below			see below		
7228 10 20 7228 10 90 7228 20 7228 30 7228 50 7228 60 7228 70 7228 80 00	Bars, rods, and other long products	1.74	0.47	2.21	0.92	0.08	1.00	3.73	0.36	4.09	2.32	0.59	2.91	3.41	1.31	4.71
7228 10 50 7228 40	Forgings	2.09	0.77	2.86	0.92	0.08	1.00	3.30	0.17	3.47	2.31	0.56	2.88	3.41	1.25	4.65
7229	Wire of other alloy steel.	1.74	0.61	2.34	0.92	0.08	1.00	3.73	0.47	4.20	2.32	0.59	2.91	3.41	1.31	4.71
7301	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.	1.77	0.31	2.08	0.91	0.09	1.00	3.78	0.26	4.04	2.43	0.50	2.93	3.70	2.19	5.88
7302	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates	1.76	0.23	1.99	0.91	0.09	1.00	3.70	0.19	3.89	2.43	0.50	2.93	3.60	1.26	4.86
7303	Tubes, pipes & hollow profiles of cast iron	see below			see below			see below			see below			see below		
730300	Tubes, pipes & hollow profiles of cast iron	1.86	0.28	2.14	20.50	0.03	20.53	6.74	0.24	6.98	2.33	0.63	2.96	3.44	0.97	4.42
7304	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	see below			see below			see below			see below			see below		

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7304 11 00 7304 22 00 7304 24 00 7304 41 00 7304 49 7304 51 7304 59	Beams, billets, rails and tubes -- alloying elements group 1	1.70	0.29	1.98	0.93	0.09	1.02	3.51	0.23	3.75	2.33	0.56	2.89	3.41	1.31	4.71
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	Beams, billets, rails and tubes -- alloying elements group 2	1.76	0.23	1.99	0.91	0.09	1.00	3.70	0.19	3.89	2.43	0.50	2.93	3.60	1.26	4.86
7305	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.	1.77	0.31	2.08	0.93	0.09	1.02	3.78	0.26	4.04	2.43	0.50	2.93	3.70	2.19	5.88
7306	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel.	see below			see below			see below			see below			see below		
7306 30 18	Hot-rolled flat products	1.76	0.23	1.99	0.91	0.09	1.00	3.65	0.19	3.84	2.43	0.50	2.93	3.65	1.62	5.27
7306 19 00 7306 29 00 7306 30 12	Cold-rolled and annealed flat products	1.77	0.31	2.08	0.91	0.09	1.00	3.78	0.26	4.04	2.43	0.50	2.93	3.70	2.19	5.88
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	Plated or coated flat products	1.79	0.33	2.12	0.91	0.09	1.00	3.90	0.28	4.18	2.43	0.50	2.93	3.70	2.19	5.88
7306 40 80 7306 50 29	Hot-rolled flat products -- alloyed	1.70	0.28	1.98	0.91	0.09	1.00	3.60	0.24	3.84	2.33	0.50	2.83	3.54	1.90	5.44

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7306 11 00 7306 21 00 7306 40 20 7306 61 10 7306 69 10	Cold-rolled and annealed flat products -- alloying elements group 1	1.72	0.40	2.13	0.93	0.09	1.02	3.71	0.33	4.04	2.33	0.56	2.89	3.54	2.55	6.09
7306 50 21 7306 50 80	Cold-rolled and annealed flat products -- alloying elements group 2	1.71	0.36	2.07	0.91	0.09	1.00	3.73	0.30	4.03	2.33	0.50	2.83	3.58	2.48	6.06
7307	Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel.	see below			see below			see below			see below			see below		
7307 11 7307 19 10	Forgings of cast iron	2.07	0.65	2.72	12.73	0.01	12.74	3.30	0.12	3.42	2.26	0.37	2.63	3.44	0.91	4.36
7307 19 90	Forgings of cast steel	0.46	1.09	1.56	0.90	0.09	0.99	0.88	0.49	1.36	1.28	1.52	2.80	0.64	4.37	5.01
7307 21 00 7307 22 7307 23 7307 29	Beams, billets, rails and tubes -- of stainless steel	1.73	0.35	2.08	0.95	0.09	1.04	3.27	0.45	3.71	2.34	0.65	3.00	3.37	1.35	4.73
7307 91 00 7307 92 7307 93 7307 99	Beams, billets, rails and tubes	1.76	0.23	1.99	0.90	0.09	1.00	3.70	0.19	3.89	2.43	0.50	2.93	3.60	1.26	4.86
7308	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock-gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel	2.39	2.29	4.68	2.09	0.07	2.16	3.90	0.28	4.18	2.56	3.15	5.72	3.70	2.19	5.88
7309	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	1.79	0.33	2.12	0.96	0.09	1.05	3.90	0.28	4.18	2.43	0.50	2.93	3.70	2.19	5.88

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7310	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	1.79	0.33	2.12	0.92	0.09	1.01	3.90	0.28	4.18	2.43	0.50	2.93	3.70	2.19	5.88
7311	Containers for compressed or liquefied gas, of iron or steel	see below			see below			see below			see below			see below		
7311 00	Containers for compressed or liquefied gas, of iron or steel	1.75	0.26	2.01	0.97	0.09	1.06	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7318	Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel	see below			see below			see below			see below			see below		
7318 11 00 7318 12 90 7318 13 00 7318 14 91 7318 14 99 7318 19 00 7318 21 00 7318 24 00 7318 29 00	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel	1.75	0.26	2.01	0.90	0.09	1.00	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7318 12 10 7318 14 10	Other wood screws; self-tapping screws - of stainless steel	2.01	1.67	3.68	1.81	0.07	1.88	3.00	1.11	4.11	2.26	2.45	4.71	2.78	3.31	6.09
7318 15	Other screws and bolts, whether or not with their nuts or washers	1.77	0.49	2.26	1.04	0.09	1.13	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7318 16	Nuts	1.75	0.26	2.01	0.95	0.09	1.04	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7318 22 00	Other washers	1.75	0.26	2.01	0.92	0.08	1.00	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7318 23 00	Rivets	1.75	0.26	2.01	0.91	0.09	1.00	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7326	Other articles of iron or steel	see below			see below			see below			see below			see below		

Country		South Korea			Norway			Russia			Serbia			South Africa		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	Forged, stamped, or sintered	2.14	0.69	2.84	0.90	0.09	0.99	3.48	0.15	3.62	2.43	0.48	2.90	3.60	1.20	4.80
7326 20 00	Articles of iron or steel wire	1.77	0.42	2.19	0.90	0.09	1.00	3.76	0.35	4.11	2.43	0.50	2.93	3.60	1.26	4.86
7326 90 30 7326 90 40 7326 90 50 7326 90 60	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry	1.75	0.26	2.01	0.90	0.09	1.00	3.63	0.22	3.85	2.43	0.50	2.93	3.60	1.26	4.86
7326 90 98	Other articles of iron or steel	1.79	0.33	2.12	0.90	0.09	1.00	3.90	0.28	4.18	2.43	0.50	2.93	3.70	2.19	5.88

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2601 12 00	Agglomerated iron ores and concentrates, other than roasted iron pyrites	0.17	0.00	0.17	0.16	0.04	0.20	0.22	0.03	0.25	0.70	0.05	0.75	0.25	0.01	0.26
7201	Pig iron and spiegeleisen in pigs, blocks or other primary forms	1.38	0.08	1.47	1.79	0.13	1.92	1.74	0.11	1.85	1.98	0.14	2.13	1.88	0.06	1.94
7202 11 7202 19	Ferro-manganese	0.00	0.00	0.00	1.44	1.85	3.29	0.00	0.00	0.00	1.44	1.23	2.67	1.44	0.84	2.28
7202 41 7202 49	Ferro-chromium	0.00	0.00	0.00	2.07	2.31	4.38	2.07	1.81	3.88	0.00	0.00	0.00	0.00	0.00	0.00
7202 60 00	Ferro-nickel	0.00	0.00	0.00	3.48	4.80	8.28	0.00	0.00	0.00	3.48	3.21	6.69	3.48	2.18	5.66
7203	Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products, in lumps, pellets or the like; iron having a minimum purity of 99.94%, in lumps, pellets or similar forms	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7205	Granules and powders, of pig iron, spiegeleisen, iron or steel	1.38	0.08	1.47	1.80	0.16	1.96	1.76	0.13	1.89	2.01	0.19	2.19	1.90	0.06	1.97
7206	Iron and non-alloy steel in ingots or other primary forms (excluding iron of heading no. 7203)	see below			see below			see below			see below			see below		
7206 10 00	Ingots	0.18	0.03	0.21	1.87	0.17	2.03	1.83	0.14	1.96	2.09	0.19	2.28	1.98	0.07	2.04
7206 90 00	Continuous casting (slab, billet, bloom)	0.18	0.03	0.21	1.87	0.17	2.04	1.83	0.14	1.97	2.09	0.20	2.29	1.98	0.07	2.05
7207	Iron or non-alloy steel; semi-finished products thereof	see below			see below			see below			see below			see below		
7207 11 11 7207 11 14 7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32 7207 20 52 7207 20 80	Bars, rods, and other long products	0.18	0.03	0.21	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	Forgings	0.18	0.03	0.21	2.15	0.63	2.79	3.07	0.51	3.58	2.09	0.19	2.28	2.91	0.21	3.12
7208	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated	0.18	0.03	0.21	1.88	0.22	2.10	1.89	0.18	2.07	2.18	0.26	2.43	2.03	0.08	2.11

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7209	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated	0.18	0.03	0.21	1.89	0.28	2.18	1.94	0.23	2.17	2.24	0.35	2.59	2.06	0.10	2.17
7210	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated	0.18	0.03	0.21	1.90	0.31	2.21	1.94	0.23	2.17	2.31	0.38	2.69	2.06	0.10	2.17
7211	Iron or non-alloy steel; flat-rolled products, width less than 600mm, not clad, plated or coated	see below			see below			see below			see below			see below		
7211 13 00 7211 14 00 7211 19 00	Hot-rolled flat products	0.18	0.03	0.21	1.88	0.22	2.10	1.89	0.18	2.07	2.18	0.26	2.43	2.03	0.08	2.11
7211 23 7211 29 00 7211 90	Cold-rolled and annealed flat products	0.18	0.03	0.21	1.89	0.28	2.18	1.94	0.23	2.17	2.24	0.35	2.59	2.06	0.10	2.17
7212	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated	0.18	0.03	0.21	1.90	0.31	2.21	1.94	0.23	2.17	2.31	0.38	2.69	2.06	0.10	2.17
7213	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils	0.18	0.03	0.21	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7214	Iron or non-alloy steel; bars and rods, not further worked than forged, hot-rolled, hot drawn or hot-extruded, but including those twisted after rolling	see below			see below			see below			see below			see below		
7214 10 00	Forgings	0.18	0.03	0.21	2.15	0.63	2.79	3.07	0.51	3.58	2.09	0.19	2.28	2.91	0.21	3.12
7214 20 00 7214 30 00 7214 91 7214 99	Bars, rods, and other long products	0.18	0.03	0.21	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7215	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72	0.18	0.03	0.21	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7216	Iron or non-alloy steel, angles, shapes and sections	0.18	0.03	0.21	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7217	Wire of iron or non-alloy steel.	see below			see below			see below			see below			see below		
7217 10	Wires	0.18	0.03	0.21	1.88	0.36	2.24	1.83	0.14	1.97	2.16	0.46	2.62	1.98	0.07	2.05

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7217 20 7217 30 7217 90	Plated or coated wires	0.18	0.03	0.21	1.89	0.39	2.28	1.83	0.14	1.97	2.23	0.49	2.72	2.01	0.08	2.09
7218	Stainless steel in ingots or other primary forms; semi-finished products of stainless steel.	see below			see below			see below			see below			see below		
7218 10 00 7218 99 19 7218 99 80	Ingots and forgings	1.50	0.09	1.60	2.37	2.26	4.63	3.35	1.80	5.15	2.18	1.17	3.35	3.07	0.92	3.98
7218 91 7218 99 11 7218 99 20	Hot-rolled flat products	1.51	0.09	1.60	2.11	1.88	3.99	2.21	1.50	3.72	2.33	1.29	3.62	2.22	0.80	3.02
7219	Stainless steel; flat-rolled products of width of 600mm or more	see below			see below			see below			see below			see below		
7219 11 00 7219 12 7219 13 7219 14 7219 21 7219 22 7219 23 00 7219 24 00	Hot-rolled flat products	1.51	0.09	1.60	2.11	1.88	3.99	2.21	1.50	3.72	2.33	1.29	3.62	2.22	0.80	3.02
7219 31 00 7219 32 7219 33 7219 34 7219 35 7219 90	Cold-rolled and annealed flat products	1.51	0.09	1.60	2.12	1.95	4.07	2.26	1.56	3.82	2.40	1.38	3.78	2.26	0.82	3.07
7220	Stainless steel; flat-rolled products of width less than 600mm	see below			see below			see below			see below			see below		
7220 11 00 7220 12 00	Hot-rolled flat products	1.51	0.09	1.60	2.11	1.88	3.99	2.21	1.50	3.72	2.33	1.29	3.62	2.22	0.80	3.02
7220 20 7220 90	Cold-rolled and annealed flat products	1.51	0.09	1.60	2.12	1.95	4.07	2.26	1.56	3.82	2.40	1.38	3.78	2.26	0.82	3.07

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7221	Stainless steel bars and rods, hot-rolled, in irregularly wound coils	1.51	0.09	1.60	2.12	2.00	4.12	2.10	1.44	3.54	2.40	1.44	3.85	2.14	0.77	2.91
7222	Stainless steel bars and rods, angles, shapes and sections	see below			see below			see below			see below			see below		
7222 11 7222 19 7222 20 7222 40	Bars, rods, and other long products	1.51	0.09	1.60	2.12	2.00	4.12	2.10	1.44	3.54	2.40	1.44	3.85	2.14	0.77	2.91
7222 30	Forgings	1.50	0.09	1.60	2.37	2.26	4.63	3.35	1.80	5.15	2.18	1.17	3.35	3.07	0.92	3.98
7223	Stainless steel wire	see below			see below			see below			see below			see below		
7223 00	Wires	1.51	0.09	1.60	2.12	2.11	4.24	2.10	1.44	3.54	2.40	1.61	4.01	2.14	0.77	2.91
7224	Alloy steel in ingots or other primary forms, semi-finished products of other alloy steel	see below			see below			see below			see below			see below		
7224 10 7224 90 18 7224 90 90	Ingots and forgings	0.25	0.03	0.28	2.08	0.70	2.78	3.01	0.57	3.58	1.30	0.82	2.12	2.83	0.25	3.08
7224 90 02 7224 90 03 7224 90 05 7224 90 07 7224 90 14 7224 90 31 7224 90 38	Hot-rolled flat products	0.26	0.03	0.29	1.82	0.32	2.14	1.87	0.27	2.14	1.45	0.94	2.39	1.98	0.13	2.11
7225	Alloy steel flat-rolled products, of a width 600mm or more	see below			see below			see below			see below			see below		
7225 11 00 7225 19 10 7225 30 7225 40	Hot-rolled flat products	0.26	0.03	0.29	1.82	0.32	2.14	1.87	0.27	2.14	1.45	0.94	2.39	1.98	0.13	2.11
7225 19 90 7225 50	Cold-rolled and annealed flat products	0.26	0.03	0.29	1.83	0.39	2.22	1.92	0.32	2.24	1.52	1.03	2.54	2.02	0.15	2.17
7225 91 00 7225 92 00 7225 99 00	Plated or coated flat products	0.26	0.03	0.29	1.84	0.41	2.25	1.92	0.32	2.24	1.58	1.06	2.64	2.02	0.15	2.17
7226	Alloy steel flat-rolled products, of a width of less than 600mm	see below			see below			see below			see below			see below		

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7226 11 00 7226 19 10 7226 20 00 7226 91	Hot-rolled flat products	0.26	0.03	0.29	1.82	0.32	2.14	1.87	0.27	2.14	1.45	0.94	2.39	1.98	0.13	2.11
7226 19 80 7226 92 00	Cold-rolled and annealed flat products	0.26	0.03	0.29	1.83	0.39	2.22	1.92	0.32	2.24	1.52	1.03	2.54	2.02	0.15	2.17
7226 99	Plated or coated flat products	0.26	0.03	0.29	1.84	0.41	2.25	1.92	0.32	2.24	1.58	1.06	2.64	2.02	0.15	2.17
7227	Steel, alloy; bars and rods, hot-rolled, in irregularly wound coils	0.26	0.03	0.29	1.83	0.43	2.26	1.76	0.21	1.97	1.52	1.09	2.61	1.90	0.11	2.01
7228	Alloy steel bars, rods, shapes and sections; hollow drill bars and rods, of alloy or non-alloy steel	see below			see below			see below			see below			see below		
7228 10 20 7228 10 90 7228 20 7228 30 7228 50 7228 60 7228 70 7228 80 00	Bars, rods, and other long products	0.26	0.03	0.29	1.83	0.43	2.26	1.76	0.21	1.97	1.52	1.09	2.61	1.90	0.11	2.01
7228 10 50 7228 40	Forgings	0.25	0.03	0.28	2.08	0.70	2.78	3.01	0.57	3.58	1.30	0.82	2.12	2.83	0.25	3.08
7229	Wire of other alloy steel.	0.26	0.03	0.29	1.83	0.55	2.38	1.76	0.21	1.97	1.52	1.25	2.77	1.90	0.11	2.01
7301	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.	0.20	0.03	0.22	1.89	0.28	2.18	1.94	0.23	2.17	2.24	0.35	2.59	2.06	0.10	2.17
7302	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates	0.21	0.03	0.24	1.89	0.22	2.10	1.83	0.14	1.97	2.20	0.26	2.46	1.98	0.07	2.05
7303	Tubes, pipes & hollow profiles of cast iron	see below			see below			see below			see below			see below		
730300	Tubes, pipes & hollow profiles of cast iron	1.67	0.09	1.76	1.99	0.26	2.26	2.15	0.18	2.33	3.06	0.32	3.38	2.37	0.08	2.45

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7304	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	see below			see below			see below			see below			see below		
7304 11 00 7304 22 00 7304 24 00 7304 41 00 7304 49 7304 51 7304 59	Beams, billets, rails and tubes -- alloying elements group 1	0.23	0.03	0.26	1.81	0.28	2.09	1.76	0.19	1.95	2.11	0.29	2.41	1.90	0.10	2.00
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	Beams, billets, rails and tubes -- alloying elements group 2	0.20	0.03	0.22	1.89	0.22	2.10	1.83	0.14	1.97	2.20	0.26	2.46	1.98	0.07	2.05
7305	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.	0.23	0.03	0.26	1.89	0.28	2.18	1.94	0.23	2.17	2.24	0.35	2.59	2.06	0.10	2.17
7306	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel.	see below			see below			see below			see below			see below		
7306 30 18	Hot-rolled flat products	0.20	0.03	0.22	1.88	0.22	2.10	1.89	0.18	2.07	2.18	0.26	2.43	2.03	0.08	2.11
7306 19 00 7306 29 00 7306 30 12	Cold-rolled and annealed flat products	0.20	0.03	0.22	1.89	0.28	2.18	1.94	0.23	2.17	2.24	0.35	2.59	2.06	0.10	2.17
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	Plated or coated flat products	0.20	0.03	0.22	1.90	0.31	2.21	1.94	0.23	2.17	2.31	0.38	2.69	2.06	0.10	2.17

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7306 40 80 7306 50 29	Hot-rolled flat products -- alloyed	0.20	0.03	0.22	1.81	0.27	2.08	1.87	0.21	2.07	2.15	0.31	2.46	1.98	0.10	2.07
7306 11 00 7306 21 00 7306 40 20 7306 61 10 7306 69 10	Cold-rolled and annealed flat products -- alloying elements group 1	0.23	0.03	0.26	1.83	0.38	2.22	1.92	0.31	2.22	2.21	0.44	2.65	2.02	0.14	2.16
7306 50 21 7306 50 80	Cold-rolled and annealed flat products -- alloying elements group 2	0.20	0.03	0.22	1.82	0.34	2.16	1.91	0.26	2.18	2.21	0.40	2.62	2.01	0.12	2.13
7307	Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel.	see below			see below			see below			see below			see below		
7307 11 7307 19 10	Forgings of cast iron	1.38	0.08	1.47	2.07	0.60	2.67	2.99	0.48	3.46	1.98	0.14	2.13	2.82	0.20	3.02
7307 19 90	Forgings of cast steel	0.18	0.03	0.21	0.31	0.99	1.30	1.33	0.78	2.11	0.97	0.70	1.67	0.99	0.31	1.30
7307 21 00 7307 22 7307 23 7307 29	Beams, billets, rails and tubes -- of stainless steel	0.28	0.03	0.32	1.84	0.35	2.19	1.78	0.25	2.03	2.14	0.34	2.48	1.92	0.13	2.05
7307 91 00 7307 92 7307 93 7307 99	Beams, billets, rails and tubes	0.18	0.03	0.21	1.89	0.22	2.10	1.83	0.14	1.97	2.20	0.26	2.46	1.98	0.07	2.05
7308	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock-gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel	1.86	0.11	1.97	2.42	2.47	4.89	2.48	1.93	4.41	2.67	1.77	4.44	2.50	1.09	3.59

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7309	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	0.33	0.04	0.37	1.90	0.31	2.21	1.94	0.23	2.17	2.31	0.38	2.69	2.06	0.10	2.17
7310	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	0.23	0.03	0.26	1.90	0.31	2.21	1.94	0.23	2.17	2.31	0.38	2.69	2.06	0.10	2.17
7311	Containers for compressed or liquefied gas, of iron or steel	see below			see below			see below			see below			see below		
7311 00	Containers for compressed or liquefied gas, of iron or steel	0.30	0.03	0.33	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7318	Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel	see below			see below			see below			see below			see below		
7318 11 00 7318 12 90 7318 13 00 7318 14 91 7318 14 99 7318 19 00 7318 21 00 7318 24 00 7318 29 00	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel	0.18	0.03	0.21	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7318 12 10 7318 14 10	Other wood screws; self-tapping screws - of stainless steel	1.51	0.09	1.60	2.10	1.87	3.97	2.10	1.44	3.54	2.26	1.27	3.53	2.14	0.77	2.91
7318 15	Other screws and bolts, whether or not with their nuts or washers	0.37	0.04	0.41	1.88	0.50	2.38	1.84	0.34	2.18	2.16	0.29	2.46	1.98	0.07	2.05
7318 16	Nuts	0.27	0.03	0.30	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7318 22 00	Other washers	0.27	0.03	0.30	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05

Country		Switzerland			Taiwan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7318 23 00	Rivets	0.19	0.03	0.22	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7326	Other articles of iron or steel	see below			see below			see below			see below			see below		
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	Forged, stamped, or sintered	0.18	0.03	0.21	2.15	0.63	2.79	3.07	0.51	3.58	2.09	0.19	2.28	2.91	0.21	3.12
7326 20 00	Articles of iron or steel wire	0.18	0.03	0.21	1.89	0.39	2.28	1.83	0.14	1.97	2.23	0.49	2.72	2.01	0.08	2.09
7326 90 30 7326 90 40 7326 90 50 7326 90 60	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry	0.18	0.03	0.21	1.88	0.24	2.12	1.83	0.14	1.97	2.16	0.29	2.46	1.98	0.07	2.05
7326 90 98	Other articles of iron or steel	0.18	0.03	0.21	1.90	0.31	2.21	1.94	0.23	2.17	2.31	0.38	2.69	2.06	0.10	2.17

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2601 12 00	Agglomerated iron ores and concentrates, other than roasted iron pyrites	1.09	0.02	1.11	0.17	0.02	0.19	0.31	0.05	0.36
7201	Pig iron and spiegeleisen in pigs, blocks or other primary forms	1.50	0.14	1.64	1.69	0.07	1.76	1.90	0.17	2.07
7202 11 7202 19	Ferro-manganese	1.44	1.35	2.79	1.44	0.92	2.36	1.44	2.08	3.51
7202 41 7202 49	Ferro-chromium	0.00	0.00	0.00	2.07	1.15	3.22	2.06	3.38	5.45
7202 60 00	Ferro-nickel	0.00	0.00	0.00	3.48	2.40	5.88	3.45	2.81	6.26
7203	Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products, in lumps, pellets or the like; iron having a minimum purity of 99.94%, in lumps, pellets or similar forms	0.63	0.07	0.70	0.39	0.08	0.47	4.81	0.00	4.81

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7205	Granules and powders, of pig iron, spiegeleisen, iron or steel	1.52	0.15	1.68	1.70	0.09	1.80	1.90	0.17	2.07
7206	Iron and non-alloy steel in ingots or other primary forms (excluding iron of heading no. 7203)	see below			see below			see below		
7206 10 00	Ingots	1.58	0.16	1.74	1.77	0.09	1.86	2.52	0.23	2.75
7206 90 00	Continuous casting (slab, billet, bloom)	1.58	0.16	1.75	1.77	0.10	1.87	1.97	0.23	2.20
7207	Iron or non-alloy steel; semi-finished products thereof	see below			see below			see below		
7207 11 11 7207 11 14 7207 11 16 7207 12 10 7207 19 12 7207 19 80 7207 20 11 7207 20 15 7207 20 17 7207 20 32 7207 20 52 7207 20 80	Bars, rods, and other long products	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	Forgings	3.04	0.42	3.46	2.63	0.35	2.98	2.65	0.62	3.27
7208	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated	1.66	0.19	1.85	1.82	0.12	1.94	2.01	0.27	2.28

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7209	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated	1.72	0.23	1.94	1.85	0.16	2.01	2.03	0.36	2.39
7210	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated	1.78	0.24	2.01	1.88	0.17	2.06	1.97	0.39	2.35
7211	Iron or non-alloy steel; flat-rolled products, width less than 600mm, not clad, plated or coated	see below			see below			see below		
7211 13 00 7211 14 00 7211 19 00	Hot-rolled flat products	1.66	0.19	1.85	1.82	0.12	1.94	2.01	0.27	2.28
7211 23 7211 29 00 7211 90	Cold-rolled and annealed flat products	1.72	0.23	1.94	1.85	0.16	2.01	2.03	0.36	2.39
7212	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated	1.78	0.24	2.01	1.88	0.17	2.06	1.97	0.39	2.35
7213	Iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7214	Iron or non-alloy steel; bars and rods, not further worked than forged, hot-rolled, hot drawn or hot-extruded, but including those twisted after rolling	see below			see below			see below		
7214 10 00	Forgings	3.04	0.42	3.46	2.63	0.35	2.98	2.65	0.62	3.27
7214 20 00 7214 30 00 7214 91 7214 99	Bars, rods, and other long products	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7215	Iron or non-alloy steel; bars and rods, n.e.c. in chapter 72	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7216	Iron or non-alloy steel, angles, shapes and sections	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7217	Wire of iron or non-alloy steel.	see below			see below			see below		
7217 10	Wires	1.65	0.27	1.92	1.81	0.20	2.01	1.88	0.49	2.37

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7217 20 7217 30 7217 90	Plated or coated wires	1.71	0.28	1.99	1.84	0.22	2.06	1.95	0.51	2.46
7218	Stainless steel in ingots or other primary forms; semi-finished products of stainless steel.	see below			see below			see below		
7218 10 00 7218 99 19 7218 99 80	Ingots and forgings	3.43	1.58	5.01	2.91	1.16	4.07	2.51	2.10	4.61
7218 91 7218 99 11 7218 99 20	Hot-rolled flat products	2.10	1.37	3.47	2.13	0.95	3.07	2.18	1.90	4.08
7219	Stainless steel; flat-rolled products of width of 600mm or more	see below			see below			see below		
7219 11 00 7219 12 7219 13 7219 14 7219 21 7219 22 7219 23 00 7219 24 00	Hot-rolled flat products	2.10	1.37	3.47	2.13	0.95	3.07	2.18	1.90	4.08
7219 31 00 7219 32 7219 33 7219 34 7219 35 7219 90	Cold-rolled and annealed flat products	2.16	1.41	3.56	2.16	0.98	3.15	2.21	1.99	4.19
7220	Stainless steel; flat-rolled products of width less than 600mm	see below			see below			see below		
7220 11 00 7220 12 00	Hot-rolled flat products	2.10	1.37	3.47	2.13	0.95	3.07	2.18	1.90	4.08
7220 20 7220 90	Cold-rolled and annealed flat products	2.16	1.41	3.56	2.16	0.98	3.15	2.21	1.99	4.19

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7221	Stainless steel bars and rods, hot-rolled, in irregularly wound coils	2.16	1.43	3.59	2.16	1.01	3.17	2.14	2.17	4.30
7222	Stainless steel bars and rods, angles, shapes and sections	see below			see below			see below		
7222 11 7222 19 7222 20 7222 40	Bars, rods, and other long products	2.16	1.43	3.59	2.16	1.01	3.17	2.14	2.17	4.30
7222 30	Forgings	3.43	1.58	5.01	2.91	1.16	4.07	2.51	2.10	4.61
7223	Stainless steel wire	see below			see below			see below		
7223 00	Wires	2.16	1.50	3.66	2.16	1.08	3.24	2.13	2.36	4.49
7224	Alloy steel in ingots or other primary forms, semi-finished products of other alloy steel	see below			see below			see below		
7224 10 7224 90 18 7224 90 90	Ingots and forgings	3.00	0.48	3.48	2.57	0.39	2.96	2.41	0.79	3.20
7224 90 02 7224 90 03 7224 90 05 7224 90 07 7224 90 14 7224 90 31 7224 90 38	Hot-rolled flat products	1.67	0.27	1.94	1.78	0.18	1.97	1.95	0.40	2.35
7225	Alloy steel flat-rolled products, of a width 600mm or more	see below			see below			see below		
7225 11 00 7225 19 10 7225 30 7225 40	Hot-rolled flat products	1.67	0.27	1.94	1.78	0.18	1.97	1.95	0.40	2.35
7225 19 90 7225 50	Cold-rolled and annealed flat products	1.73	0.30	2.03	1.82	0.22	2.04	1.98	0.49	2.46
7225 91 00 7225 92 00 7225 99 00	Plated or coated flat products	1.79	0.32	2.10	1.85	0.23	2.08	1.92	0.51	2.43

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7226	Alloy steel flat-rolled products, of a width of less than 600mm	see below			see below			see below		
7226 11 00 7226 19 10 7226 20 00 7226 91	Hot-rolled flat products	1.67	0.27	1.94	1.78	0.18	1.97	1.95	0.40	2.35
7226 19 80 7226 92 00	Cold-rolled and annealed flat products	1.73	0.30	2.03	1.82	0.22	2.04	1.98	0.49	2.46
7226 99	Plated or coated flat products	1.79	0.32	2.10	1.85	0.23	2.08	1.92	0.51	2.43
7227	Steel, alloy; bars and rods, hot-rolled, in irregularly wound coils	1.73	0.33	2.06	1.82	0.25	2.06	1.86	0.57	2.43
7228	Alloy steel bars, rods, shapes and sections; hollow drill bars and rods, of alloy or non-alloy steel	see below			see below			see below		
7228 10 20 7228 10 90 7228 20 7228 30 7228 50 7228 60 7228 70 7228 80 00	Bars, rods, and other long products	1.73	0.33	2.06	1.82	0.25	2.06	1.86	0.57	2.43
7228 10 50 7228 40	Forgings	3.00	0.48	3.48	2.57	0.39	2.96	2.41	0.79	3.20
7229	Wire of other alloy steel.	1.73	0.40	2.13	1.82	0.31	2.13	1.84	0.75	2.59
7301	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel.	1.72	0.23	1.94	1.85	0.16	2.01	2.03	0.36	2.39
7302	Railway or tramway track construction material of iron or steel, the following : rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates	1.68	0.19	1.87	1.83	0.12	1.95	1.93	0.29	2.21

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7303	Tubes, pipes & hollow profiles of cast iron	see below			see below			see below		
730300	Tubes, pipes & hollow profiles of cast iron	2.20	0.21	2.41	1.90	0.15	2.05	2.21	0.35	2.56
7304	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	see below			see below			see below		
7304 11 00 7304 22 00 7304 24 00 7304 41 00 7304 49 7304 51 7304 59	Beams, billets, rails and tubes -- alloying elements group 1	1.63	0.23	1.86	1.76	0.15	1.92	1.86	0.35	2.20
7304 19 7304 23 00 7304 29 7304 31 7304 39 7304 90 00	Beams, billets, rails and tubes -- alloying elements group 2	1.68	0.19	1.87	1.83	0.12	1.95	1.93	0.29	2.21
7305	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel.	1.72	0.23	1.94	1.85	0.16	2.01	2.03	0.36	2.39
7306	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel.	see below			see below			see below		
7306 30 18	Hot-rolled flat products	1.66	0.19	1.85	1.82	0.12	1.94	2.01	0.27	2.28
7306 19 00 7306 29 00 7306 30 12	Cold-rolled and annealed flat products	1.72	0.23	1.94	1.85	0.16	2.01	2.03	0.36	2.39

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7306 30 41 7306 30 49 7306 30 72 7306 30 77 7306 30 80 7306 61 92 7306 61 99 7306 69 90 7306 90 00	Plated or coated flat products	1.78	0.24	2.01	1.88	0.17	2.06	1.97	0.39	2.35
7306 40 80 7306 50 29	Hot-rolled flat products -- alloyed	1.65	0.22	1.86	1.78	0.14	1.92	1.95	0.33	2.28
7306 11 00 7306 21 00 7306 40 20 7306 61 10 7306 69 10	Cold-rolled and annealed flat products -- alloying elements group 1	1.72	0.29	2.01	1.82	0.21	2.03	1.98	0.46	2.44
7306 50 21 7306 50 80	Cold-rolled and annealed flat products -- alloying elements group 2	1.70	0.26	1.96	1.81	0.18	1.99	1.97	0.41	2.38
7307	Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel.	see below			see below			see below		
7307 11 7307 19 10	Forgings of cast iron	2.96	0.40	3.36	2.55	0.33	2.88	2.54	0.57	3.11
7307 19 90	Forgings of cast steel	1.52	0.56	2.09	0.94	0.55	1.49	0.61	1.05	1.66
7307 21 00 7307 22 7307 23 7307 29	Beams, billets, rails and tubes -- of stainless steel	1.66	0.28	1.94	1.79	0.19	1.98	1.87	0.43	2.30
7307 91 00 7307 92 7307 93 7307 99	Beams, billets, rails and tubes	1.68	0.19	1.87	1.83	0.12	1.95	1.93	0.29	2.21

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7308	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock-gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balusTrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel	2.48	1.79	4.27	2.46	1.25	3.71	2.46	2.55	5.01
7309	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	1.78	0.24	2.01	1.88	0.17	2.06	1.97	0.39	2.35
7310	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	1.78	0.24	2.01	1.88	0.17	2.06	1.97	0.39	2.35
7311	Containers for compressed or liquefied gas, of iron or steel	see below			see below			see below		
7311 00	Containers for compressed or liquefied gas, of iron or steel	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7318	Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel	see below			see below			see below		

Country		United States			EU27			Weighted average primary		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7318 11 00 7318 12 90 7318 13 00 7318 14 91 7318 14 99 7318 19 00 7318 21 00 7318 24 00 7318 29 00	Coach screws; other wood screws; screw hooks and screw rings; self-tapping screws; other threaded articles; spring washers and other lock washers; cotters and cotter pins; other non-threaded articles - of iron or steel	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7318 12 10 7318 14 10	Other wood screws; self-tapping screws - of stainless steel	2.04	1.36	3.40	2.09	0.94	3.03	2.10	1.99	4.10
7318 15	Other screws and bolts, whether or not with their nuts or washers	1.69	0.38	2.07	1.83	0.26	2.09	1.89	0.32	2.21
7318 16	Nuts	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7318 22 00	Other washers	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7318 23 00	Rivets	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7326	Other articles of iron or steel	see below			see below			see below		
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	Forged, stamped, or sintered	3.04	0.42	3.46	2.63	0.35	2.98	2.65	0.62	3.27
7326 20 00	Articles of iron or steel wire	1.71	0.28	1.99	1.84	0.22	2.06	1.95	0.51	2.46
7326 90 30 7326 90 40 7326 90 50 7326 90 60	Ladders and steps; Pallets and similar platforms for handling goods; Reels for cables, piping and the like; Non-mechanical ventilators, guttering, hooks and like articles used in the building industry	1.65	0.20	1.85	1.81	0.14	1.95	1.89	0.32	2.21
7326 90 98	Other articles of iron or steel	1.78	0.24	2.01	1.88	0.17	2.06	1.97	0.39	2.35

Note: According to the CBAM regulation (European Council, 2022), coke is not a CBAM good and consequently emissions from coke production are not included in the calculation of embedded emissions of iron and steel goods.

Source: JRC, 2023.

Emission intensities of products in the fertilisers industry

Table 20. Emission intensities of products in the fertilisers industry.

Country		Algeria			Belarus			Canada			Chile			People's Republic of China		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2808 00 00	Nitric acid; sulphonitric acids	1.75	0.04	1.79	1.78	0.03	1.81	1.51	0.03	1.54	2.02	0.04	2.06	2.90	0.06	2.96
2814	Ammonia, anhydrous or in aqueous solution	1.96	0.12	2.08	2.16	0.09	2.25	1.91	0.08	1.99	2.27	0.12	2.39	3.70	0.18	3.88
2834 21 00	Nitrates of potassium	1.52	0.06	1.58	1.59	0.05	1.63	1.38	0.04	1.42	1.80	0.06	1.86	2.59	0.09	2.67
3102	Mineral or chemical fertilizers, nitrogenous	See below			See below			See below			See below			See below		
3102 10	Urea, whether or not in aqueous solution	1.31	0.10	1.41	1.43	0.07	1.51	1.31	0.06	1.38	1.51	0.10	1.61	2.37	0.14	2.51
3102 21 00	Ammonium sulphate	0.57	0.07	0.65	0.63	0.05	0.69	0.57	0.05	0.62	0.71	0.07	0.78	1.05	0.10	1.15
3102 29 00	Double salts and mixtures of ammonium sulphate and ammonium nitrate	1.06	0.08	1.14	1.13	0.06	1.19	0.99	0.06	1.05	1.26	0.08	1.35	1.84	0.11	1.96
3102 30	Ammonium nitrate, whether or not in aqueous solution	1.78	0.10	1.88	1.86	0.07	1.93	1.61	0.06	1.68	2.09	0.10	2.18	3.02	0.13	3.16
3102 40	Mixtures of ammonium nitrate with calcium carbonate or other inorganic non-fertilising substances	1.23	0.06	1.29	1.25	0.04	1.29	1.10	0.04	1.14	1.36	0.06	1.42	2.02	0.08	2.10
3102 50 00	Sodium nitrate	2.73	0.06	2.79	2.79	0.05	2.84	2.40	0.04	2.44	3.15	0.07	3.22	4.52	0.09	4.61
3102 60 00	Double salts and mixtures of calcium nitrate and ammonium nitrate	1.44	0.08	1.52	1.50	0.06	1.56	1.31	0.06	1.36	1.69	0.08	1.77	2.44	0.11	2.56
3102 80 00	Mixtures of urea and ammonium nitrate in aqueous or ammoniacal solution	1.21	0.08	1.29	1.28	0.06	1.34	1.14	0.05	1.19	1.42	0.08	1.49	2.10	0.11	2.21
3105	Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium	See below			See below			See below			See below			See below		
3105 20	Mineral or chemical fertilisers containing the three fertilising elements nitrogen, phosphorus and potassium	0.77	0.09	0.86	0.80	0.07	0.87	0.71	0.06	0.77	0.88	0.08	0.96	1.31	0.12	1.43
3105 30 00	Diammonium hydrogenorthophosphate (diammonium phosphate)	0.46	0.05	0.52	0.52	0.04	0.56	0.45	0.04	0.49	0.60	0.05	0.66	0.85	0.08	0.93

Country		Algeria			Belarus			Canada			Chile			People's Republic of China		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
3105 40 00	Ammonium dihydrogenorthophosphate (monoammonium phosphate) and mixtures thereof with diammonium hydrogenorthophosphate (diammonium phosphate)	0.29	0.04	0.34	0.33	0.03	0.36	0.29	0.03	0.32	0.38	0.04	0.42	0.54	0.06	0.60
3105 51 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (nitrates and phosphates)	1.05	0.11	1.16	1.09	0.08	1.17	0.96	0.08	1.04	1.20	0.10	1.30	1.78	0.15	1.93
3105 59 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (excl. nitrates and phosphates)	1.05	0.11	1.16	1.09	0.08	1.17	0.96	0.08	1.04	1.20	0.10	1.30	1.78	0.15	1.93

Country		Egypt			Georgia			Indonesia			Israel			Jordan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2808 00 00	Nitric acid; sulphonitric acids	1.80	0.04	1.83	2.77	0.01	2.78	2.06	0.06	2.12	2.70	0.04	2.75	2.58	0.04	2.62
2814	Ammonia, anhydrous or in aqueous solution	1.96	0.12	2.08	2.16	0.03	2.19	2.05	0.19	2.24	1.96	0.10	2.05	1.96	0.12	2.07
2834 21 00	Nitrates of potassium	1.56	0.06	1.61	2.20	0.01	2.22	1.75	0.09	1.84	2.25	0.06	2.31	2.10	0.06	2.16
3102	Mineral or chemical fertilizers, nitrogenous	See below			See below			See below			See below			See below		
3102 10	Urea, whether or not in aqueous solution	1.35	0.10	1.44	1.23	0.02	1.25	1.40	0.15	1.55	1.66	0.10	1.77	1.40	0.10	1.50
3102 21 00	Ammonium sulphate	0.58	0.07	0.66	0.58	0.02	0.59	0.60	0.11	0.72	0.75	0.07	0.82	0.63	0.07	0.70
3102 29 00	Double salts and mixtures of ammonium sulphate and ammonium nitrate	1.08	0.08	1.16	1.38	0.02	1.39	1.19	0.13	1.31	1.50	0.08	1.58	1.36	0.08	1.44
3102 30	Ammonium nitrate, whether or not in aqueous solution	1.82	0.09	1.92	2.55	0.02	2.57	2.05	0.15	2.19	2.61	0.09	2.70	2.44	0.10	2.54
3102 40	Mixtures of ammonium nitrate with calcium carbonate or other inorganic non-fertilising substances	1.26	0.06	1.32	1.84	0.01	1.85	1.44	0.09	1.53	1.82	0.06	1.87	1.75	0.06	1.80
3102 50 00	Sodium nitrate	2.80	0.06	2.86	4.33	0.01	4.34	3.23	0.09	3.33	4.17	0.07	4.24	4.02	0.06	4.08
3102 60 00	Double salts and mixtures of calcium nitrate and ammonium nitrate	1.48	0.08	1.56	2.06	0.02	2.08	1.66	0.13	1.78	2.11	0.08	2.19	1.98	0.08	2.06

Country		Egypt			Georgia			Indonesia			Israel			Jordan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
3102 80 00	Mixtures of urea and ammonium nitrate in aqueous or ammoniacal solution	1.24	0.07	1.31	1.53	0.02	1.55	1.36	0.12	1.47	1.70	0.08	1.77	1.54	0.08	1.61
3105	Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium	See below			See below			See below			See below			See below		
3105 20	Mineral or chemical fertilisers containing the three fertilising elements nitrogen, phosphorus and potassium	0.79	0.09	0.88	1.04	0.02	1.06	0.88	0.14	1.01	1.09	0.08	1.17	1.02	0.09	1.11
3105 30 00	Diammonium hydrogenorthophosphate (diammonium phosphate)	0.47	0.05	0.52	0.49	0.01	0.51	0.48	0.08	0.57	0.62	0.05	0.67	0.52	0.05	0.57
3105 40 00	Ammonium dihydrogenorthophosphate (monoammonium phosphate) and mixtures thereof with diammonium hydrogenorthophosphate (diammonium phosphate)	0.30	0.04	0.34	0.31	0.01	0.32	0.31	0.07	0.38	0.39	0.04	0.43	0.33	0.04	0.37
3105 51 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (nitrates and phosphates)	1.08	0.11	1.19	1.44	0.02	1.46	1.20	0.17	1.37	1.50	0.10	1.60	1.40	0.11	1.51
3105 59 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (excl. nitrates and phosphates)	1.08	0.11	1.19	1.44	0.02	1.46	1.20	0.17	1.37	1.50	0.10	1.60	1.40	0.11	1.51

Country		Morocco			Russian Federation			Saudi Arabia			Serbia			Trinidad and Tobago		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2808 00 00	Nitric acid; sulphonitric acids	2.57	0.05	2.62	2.70	0.03	2.73	2.45	0.05	2.50	2.39	0.05	2.43	2.94	0.05	2.99
2814	Ammonia, anhydrous or in aqueous solution	1.96	0.16	2.12	2.16	0.09	2.25	1.96	0.15	2.11	2.07	0.15	2.22	2.27	0.16	2.43
2834 21 00	Nitrates of potassium	2.12	0.08	2.20	2.18	0.04	2.22	2.00	0.07	2.08	2.00	0.07	2.07	2.36	0.08	2.43
3102	Mineral or chemical fertilizers, nitrogenous	See below			See below			See below			See below			See below		
3102 10	Urea, whether or not in aqueous solution	1.53	0.12	1.65	1.39	0.07	1.46	1.35	0.12	1.48	1.47	0.11	1.58	1.52	0.12	1.64

Country		Morocco			Russian Federation			Saudi Arabia			Serbia			Trinidad and Tobago		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
3102 21 00	Ammonium sulphate	0.67	0.10	0.77	0.62	0.05	0.67	0.58	0.09	0.68	0.66	0.09	0.75	0.66	0.09	0.75
3102 29 00	Double salts and mixtures of ammonium sulphate and ammonium nitrate	1.40	0.11	1.50	1.39	0.06	1.45	1.29	0.10	1.39	1.33	0.10	1.43	1.50	0.10	1.60
3102 30	Ammonium nitrate, whether or not in aqueous solution	2.47	0.12	2.59	2.53	0.07	2.60	2.33	0.12	2.45	2.33	0.11	2.44	2.74	0.12	2.86
3102 40	Mixtures of ammonium nitrate with calcium carbonate or other inorganic non-fertilising substances	1.76	0.08	1.84	1.83	0.04	1.88	1.70	0.07	1.78	1.63	0.07	1.70	2.00	0.07	2.08
3102 50 00	Sodium nitrate	4.00	0.08	4.08	4.22	0.05	4.26	3.86	0.08	3.94	3.73	0.07	3.81	4.58	0.08	4.66
3102 60 00	Double salts and mixtures of calcium nitrate and ammonium nitrate	2.00	0.11	2.10	2.05	0.06	2.11	1.89	0.10	1.99	1.88	0.10	1.98	2.22	0.10	2.32
3102 80 00	Mixtures of urea and ammonium nitrate in aqueous or ammoniacal solution	1.59	0.10	1.69	1.57	0.06	1.63	1.47	0.10	1.57	1.51	0.09	1.60	1.71	0.09	1.80
3105	Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium	See below			See below			See below			See below			See below		
3105 20	Mineral or chemical fertilisers containing the three fertilising elements nitrogen, phosphorus and potassium	1.04	0.12	1.16	1.05	0.06	1.12	0.98	0.11	1.10	0.98	0.11	1.08	1.15	0.11	1.25
3105 30 00	Diammonium hydrogenorthophosphate (diammonium phosphate)	0.54	0.07	0.61	0.50	0.04	0.54	0.46	0.07	0.53	0.54	0.06	0.61	0.53	0.07	0.60
3105 40 00	Ammonium dihydrogenorthophosphate (monoammonium phosphate) and mixtures thereof with diammonium hydrogenorthophosphate (diammonium phosphate)	0.34	0.06	0.40	0.32	0.03	0.35	0.30	0.06	0.35	0.34	0.05	0.40	0.34	0.05	0.39
3105 51 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (nitrates and phosphates)	1.43	0.15	1.58	1.45	0.08	1.53	1.35	0.14	1.50	1.34	0.13	1.47	1.58	0.13	1.71
3105 59 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (excl. nitrates and phosphates)	1.43	0.15	1.58	1.45	0.08	1.53	1.35	0.14	1.50	1.34	0.13	1.47	1.58	0.13	1.71

Country		Tunisia			Turkmenistan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2808 00 00	Nitric acid; sulphonitric acids	2.65	0.04	2.69	2.70	0.08	2.77	2.40	0.04	2.44	2.72	0.03	2.75	0.75	0.02	0.78
2814	Ammonia, anhydrous or in aqueous solution	1.96	0.11	2.06	2.16	0.24	2.40	2.07	0.11	2.18	2.16	0.09	2.25	1.91	0.06	1.97
2834 21 00	Nitrates of potassium	2.15	0.06	2.21	2.18	0.11	2.29	2.00	0.06	2.05	2.21	0.05	2.25	0.86	0.03	0.89
3102	Mineral or chemical fertilizers, nitrogenous	See below			See below			See below			See below			See below		
3102 10	Urea, whether or not in aqueous solution	1.32	0.09	1.42	1.40	0.18	1.58	1.40	0.09	1.49	1.46	0.08	1.53	1.11	0.05	1.16
3102 21 00	Ammonium sulphate	0.62	0.07	0.69	0.62	0.14	0.75	0.64	0.07	0.71	0.64	0.05	0.70	0.53	0.04	0.57
3102 29 00	Double salts and mixtures of ammonium sulphate and ammonium nitrate	1.37	0.08	1.45	1.39	0.15	1.54	1.32	0.08	1.40	1.42	0.06	1.48	0.72	0.04	0.76
3102 30	Ammonium nitrate, whether or not in aqueous solution	2.49	0.09	2.58	2.53	0.18	2.71	2.32	0.09	2.41	2.57	0.07	2.64	1.01	0.05	1.06
3102 40	Mixtures of ammonium nitrate with calcium carbonate or other inorganic non-fertilising substances	1.76	0.05	1.82	1.83	0.11	1.94	1.62	0.06	1.68	1.85	0.04	1.89	0.55	0.03	0.58
3102 50 00	Sodium nitrate	4.13	0.06	4.19	4.21	0.12	4.33	3.75	0.06	3.81	4.25	0.05	4.30	1.21	0.03	1.25
3102 60 00	Double salts and mixtures of calcium nitrate and ammonium nitrate	2.01	0.08	2.09	2.04	0.15	2.20	1.88	0.08	1.95	2.07	0.06	2.14	0.82	0.04	0.86
3102 80 00	Mixtures of urea and ammonium nitrate in aqueous or ammoniacal solution	1.54	0.07	1.61	1.57	0.14	1.72	1.48	0.07	1.56	1.61	0.06	1.67	0.80	0.04	0.84
3105	Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium	See below			See below			See below			See below			See below		
3105 20	Mineral or chemical fertilisers containing the three fertilising elements nitrogen, phosphorus and potassium	1.02	0.08	1.10	1.05	0.16	1.22	0.97	0.08	1.05	1.07	0.06	1.14	0.45	0.05	0.50
3105 30 00	Diammonium hydrogenorthophosphate (diammonium phosphate)	0.53	0.05	0.58	0.50	0.10	0.60	0.54	0.05	0.59	0.52	0.04	0.56	0.45	0.03	0.48
3105 40 00	Ammonium dihydrogenorthophosphate (monoammonium phosphate) and mixtures thereof with diammonium hydrogenorthophosphate (diammonium phosphate)	0.33	0.04	0.37	0.32	0.08	0.40	0.34	0.04	0.38	0.33	0.03	0.36	0.28	0.02	0.31

Country		Tunisia			Turkmenistan			Türkiye			Ukraine			United Kingdom		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
3105 51 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (nitrates and phosphates)	1.41	0.10	1.51	1.45	0.20	1.66	1.33	0.10	1.43	1.47	0.08	1.56	0.60	0.06	0.66
3105 59 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (excl. nitrates and phosphates)	1.41	0.10	1.51	1.45	0.20	1.66	1.33	0.10	1.43	1.47	0.08	1.56	0.60	0.06	0.66

Country		United States			EU27_2020			Norway			Weighted average		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2808 00 00	Nitric acid; sulphonitric acids	1.57	0.03	1.60	0.74	0.03	0.77	0.97	0.04	1.01	2.56	0.05	2.60
2814	Ammonia, anhydrous or in aqueous solution	1.91	0.09	2.00	1.91	0.07	1.98	1.91	0.00	1.91	2.68	0.14	2.82
2834 21 00	Nitrates of potassium	1.41	0.05	1.46	0.87	0.04	0.92	1.11	0.05	1.16	1.82	0.06	1.88
3102	Mineral or chemical fertilizers, nitrogenous	See below			See below			See below			See below		
3102 10	Urea, whether or not in aqueous solution	1.31	0.08	1.39	1.27	0.07	1.33	1.52	0.08	1.60	1.78	0.12	1.90
3102 21 00	Ammonium sulphate	0.58	0.06	0.64	0.58	0.05	0.62	0.71	0.04	0.75	0.86	0.09	0.94
3102 29 00	Double salts and mixtures of ammonium sulphate and ammonium nitrate	1.01	0.06	1.08	0.76	0.05	0.81	0.95	0.05	1.00	1.54	0.10	1.63
3102 30	Ammonium nitrate, whether or not in aqueous solution	1.65	0.07	1.72	1.03	0.06	1.10	1.30	0.06	1.36	2.32	0.07	2.39
3102 40	Mixtures of ammonium nitrate with calcium carbonate or other inorganic non-fertilising substances	1.11	0.05	1.15	0.56	0.04	0.60	0.69	0.03	0.72	1.77	0.06	1.84
3102 50 00	Sodium nitrate	2.45	0.05	2.50	1.18	0.04	1.22	1.52	0.06	1.58	3.99	0.07	4.06
3102 60 00	Double salts and mixtures of calcium nitrate and ammonium nitrate	1.34	0.06	1.40	0.84	0.05	0.89	1.05	0.05	1.10	1.87	0.08	1.95
3102 80 00	Mixtures of urea and ammonium nitrate in aqueous or ammoniacal solution	1.15	0.06	1.21	0.86	0.05	0.91	1.07	0.05	1.12	1.28	0.06	1.34

Country		United States			EU27_2020			Norway			Weighted average		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
3105	Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium	See below			See below			See below			See below		
3105 20	Mineral or chemical fertilisers containing the three fertilising elements nitrogen, phosphorus and potassium	0.72	0.07	0.79	0.48	0.06	0.53	0.58	0.03	0.61	1.23	0.11	1.35
3105 30 00	Diammonium hydrogenorthophosphate (diammonium phosphate)	0.47	0.04	0.51	0.48	0.04	0.51	0.61	0.03	0.64	0.69	0.06	0.75
3105 40 00	Ammonium dihydrogenorthophosphate (monoammonium phosphate) and mixtures thereof with diammonium hydrogenorthophosphate (diammonium phosphate)	0.30	0.03	0.33	0.30	0.03	0.33	0.38	0.02	0.40	0.44	0.05	0.49
3105 51 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (nitrates and phosphates)	0.98	0.09	1.06	0.63	0.07	0.70	0.77	0.04	0.81	1.29	0.11	1.40
3105 59 00	Other mineral or chemical fertilisers containing the two fertilising elements nitrogen and phosphorus (excl. nitrates and phosphates)	0.98	0.09	1.06	0.63	0.07	0.70	0.77	0.04	0.81	1.29	0.11	1.40

Source: JRC, 2023.

Emission intensities of products in the aluminium industry

Table 21. Emission intensities of products in the aluminium industry.

Country		Bahrain			Canada			China			Egypt			India		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7601	Unwrought aluminium	1.95	10.20	12.15	2.14	2.15	4.29	2.59	9.34	11.93	1.95	6.71	8.67	1.95	10.96	12.91
7603	Aluminium powders and flakes	2.06	10.53	12.59	2.24	2.22	4.46	2.71	9.64	12.36	2.06	6.93	8.99	2.06	11.32	13.37
7604 10 10	Bars and rods	2.18	10.92	13.09	2.36	2.30	4.66	2.83	10.00	12.83	2.18	7.19	9.36	2.18	11.73	13.91
7604 10 90	Profiles	2.18	11.11	13.29	2.37	2.34	4.71	2.84	10.18	13.01	2.18	7.32	9.49	2.18	11.94	14.12
7604 21 00	Hollow profiles	2.18	11.11	13.29	2.37	2.34	4.71	2.84	10.18	13.01	2.18	7.32	9.49	2.18	11.94	14.12
7604 29 10	Bars and rods	2.18	10.92	13.09	2.36	2.30	4.66	2.83	10.00	12.83	2.18	7.19	9.36	2.18	11.73	13.91
7604 29 90	Profiles	2.18	11.11	13.29	2.37	2.34	4.71	2.84	10.18	13.01	2.18	7.32	9.49	2.18	11.94	14.12
7605	Aluminium wire	2.18	10.92	13.09	2.36	2.30	4.66	2.83	10.00	12.83	2.18	7.19	9.36	2.18	11.73	13.91
7606	Aluminium plates, sheets and strip, of a thickness exceeding 0,2 mm	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71
7607	Aluminium foil (whether or not printed or backed with paper, paperboard, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0,2 mm	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71
7608	Aluminium tubes and pipes	2.18	11.11	13.29	2.37	2.34	4.71	2.84	10.18	13.01	2.18	7.32	9.49	2.18	11.94	14.12
7609 00 00	Aluminium tube or pipe fittings (for example, couplings, elbows, sleeves)	2.18	11.11	13.29	2.37	2.34	4.71	2.84	10.18	13.01	2.18	7.32	9.49	2.18	11.94	14.12
7610 10 00	Doors, windows and their frames and thresholds for doors	2.18	11.11	13.29	2.37	2.34	4.71	2.84	10.18	13.01	2.18	7.32	9.49	2.18	11.94	14.12
7610 90	Other	2.18	11.11	13.29	2.37	2.34	4.71	2.84	10.18	13.01	2.18	7.32	9.49	2.18	11.94	14.12
7610 90 10	Bridges and bridge-sections, towers and lattice masts	2.18	11.11	13.29	2.37	2.34	4.71	2.84	10.18	13.01	2.18	7.32	9.49	2.18	11.94	14.12
7610 90 90	Other	2.18	11.11	13.29	2.37	2.34	4.71	2.84	10.18	13.01	2.18	7.32	9.49	2.18	11.94	14.12
7611 00 00	Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71

Country		Bahrain			Canada			China			Egypt			India		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7612	Aluminium casks, drums, cans, boxes and similar containers (including rigid or collapsible tubular containers), for any material (other than compressed or liquefied gas), of a capacity not exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71
7613 00 00	Aluminium containers for compressed or liquefied gas	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71
7614	Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated	2.18	10.92	13.09	2.36	2.30	4.66	2.83	10.00	12.83	2.18	7.19	9.36	2.18	11.73	13.91
7615 10 10	Cast	2.06	10.53	12.59	2.24	2.22	4.46	2.71	9.64	12.36	2.06	6.93	8.99	2.06	11.32	13.37
7615 10 30	Manufactured from foil of a thickness not exceeding 0,2 mm	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71
7615 10 80	Other	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71
7615 20 00	Sanitary ware and parts thereof	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71
7616 10 00	Nails, tacks, staples (other than those of heading 8305), screws, bolts, nuts, screw hooks, rivets, cotters, cotter pins, washers and similar articles	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71
7616 91 00	Cloth, grill, netting and fencing, of aluminium wire	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71
7616 99 10	Cast	2.06	10.53	12.59	2.24	2.22	4.46	2.71	9.64	12.36	2.06	6.93	8.99	2.06	11.32	13.37
7616 99 90	Other	2.41	11.45	13.85	2.60	2.41	5.01	3.07	10.48	13.55	2.41	7.54	9.94	2.41	12.30	14.71

Country		Kazakhstan			Mozambique			Russian Federation			South Africa			Türkiye		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7601	Unwrought aluminium	1.95	5.91	7.86	1.95	0.92	2.87	2.11	5.61	7.72	1.97	14.07	16.04	1.95	6.27	8.22
7603	Aluminium powders and flakes	2.06	6.10	8.16	2.06	0.95	3.01	2.22	5.80	8.01	2.07	14.53	16.60	2.06	6.47	8.53
7604 10 10	Bars and rods	2.18	6.32	8.50	2.18	0.98	3.16	2.34	6.01	8.35	2.19	15.07	17.26	2.18	6.71	8.89
7604 10 90	Profiles	2.18	6.44	8.62	2.18	1.00	3.18	2.34	6.12	8.46	2.20	15.33	17.53	2.18	6.83	9.01
7604 21 00	Hollow profiles	2.18	6.44	8.62	2.18	1.00	3.18	2.34	6.12	8.46	2.20	15.33	17.53	2.18	6.83	9.01
7604 29 10	Bars and rods	2.18	6.32	8.50	2.18	0.98	3.16	2.34	6.01	8.35	2.19	15.07	17.26	2.18	6.71	8.89
7604 29 90	Profiles	2.18	6.44	8.62	2.18	1.00	3.18	2.34	6.12	8.46	2.20	15.33	17.53	2.18	6.83	9.01

Country		Kazakhstan			Mozambique			Russian Federation			South Africa			Türkiye		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7605	Aluminium wire	2.18	6.32	8.50	2.18	0.98	3.16	2.34	6.01	8.35	2.19	15.07	17.26	2.18	6.71	8.89
7606	Aluminium plates, sheets and strip, of a thickness exceeding 0,2 mm	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44
7607	Aluminium foil (whether or not printed or backed with paper, paperboard, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0,2 mm	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44
7608	Aluminium tubes and pipes	2.18	6.44	8.62	2.18	1.00	3.18	2.34	6.12	8.46	2.20	15.33	17.53	2.18	6.83	9.01
7609 00 00	Aluminium tube or pipe fittings (for example, couplings, elbows, sleeves)	2.18	6.44	8.62	2.18	1.00	3.18	2.34	6.12	8.46	2.20	15.33	17.53	2.18	6.83	9.01
7610 10 00	Doors, windows and their frames and thresholds for doors	2.18	6.44	8.62	2.18	1.00	3.18	2.34	6.12	8.46	2.20	15.33	17.53	2.18	6.83	9.01
7610 90	Other	2.18	6.44	8.62	2.18	1.00	3.18	2.34	6.12	8.46	2.20	15.33	17.53	2.18	6.83	9.01
7610 90 10	Bridges and bridge-sections, towers and lattice masts	2.18	6.44	8.62	2.18	1.00	3.18	2.34	6.12	8.46	2.20	15.33	17.53	2.18	6.83	9.01
7610 90 90	Other	2.18	6.44	8.62	2.18	1.00	3.18	2.34	6.12	8.46	2.20	15.33	17.53	2.18	6.83	9.01
7611 00 00	Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44
7612	Aluminium casks, drums, cans, boxes and similar containers (including rigid or collapsible tubular containers), for any material (other than compressed or liquefied gas), of a capacity not exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44
7613 00 00	Aluminium containers for compressed or liquefied gas	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44
7614	Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated	2.18	6.32	8.50	2.18	0.98	3.16	2.34	6.01	8.35	2.19	15.07	17.26	2.18	6.71	8.89
7615 10 10	Cast	2.06	6.10	8.16	2.06	0.95	3.01	2.22	5.80	8.01	2.07	14.53	16.60	2.06	6.47	8.53
7615 10 30	Manufactured from foil of a thickness not exceeding 0,2 mm	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44
7615 10 80	Other	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44
7615 20 00	Sanitary ware and parts thereof	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44
7616 10 00	Nails, tacks, staples (other than those of heading 8305), screws, bolts, nuts, screw hooks, rivets, cotters, cotter pins, washers and similar articles	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44

Country		Kazakhstan			Mozambique			Russian Federation			South Africa			Türkiye		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7616 91 00	Cloth, grill, netting and fencing, of aluminium wire	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44
7616 99 10	Cast	2.06	6.10	8.16	2.06	0.95	3.01	2.22	5.80	8.01	2.07	14.53	16.60	2.06	6.47	8.53
7616 99 90	Other	2.41	6.63	9.04	2.41	1.03	3.44	2.57	6.30	8.87	2.42	15.80	18.22	2.41	7.04	9.44

Country		United Arab Emirates			United Kingdom			United States			Iceland			Norway		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7601	Unwrought aluminium	1.95	8.07	10.02	1.95	4.96	6.91	2.34	5.97	8.31	1.76	0.00	1.76	1.84	0.13	1.97
7603	Aluminium powders and flakes	2.06	8.33	10.39	2.06	5.12	7.17	2.45	6.17	8.62	1.90	0.00	1.90	1.98	0.13	2.11
7604 10 10	Bars and rods	2.18	8.64	10.82	2.18	5.30	7.48	2.57	6.40	8.97	2.02	0.00	2.02	2.10	0.14	2.24
7604 10 90	Profiles	2.18	8.79	10.97	2.18	5.40	7.58	2.57	6.51	9.08	2.02	0.00	2.02	2.10	0.14	2.24
7604 21 00	Hollow profiles	2.18	8.79	10.97	2.18	5.40	7.58	2.57	6.51	9.08	2.02	0.00	2.02	2.10	0.14	2.24
7604 29 10	Bars and rods	2.18	8.64	10.82	2.18	5.30	7.48	2.57	6.40	8.97	2.02	0.00	2.02	2.10	0.14	2.24
7604 29 90	Profiles	2.18	8.79	10.97	2.18	5.40	7.58	2.57	6.51	9.08	2.02	0.00	2.02	2.10	0.14	2.24
7605	Aluminium wire	2.18	8.64	10.82	2.18	5.30	7.48	2.57	6.40	8.97	2.02	0.00	2.02	2.10	0.14	2.24
7606	Aluminium plates, sheets and strip, of a thickness exceeding 0,2 mm	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7607	Aluminium foil (whether or not printed or backed with paper, paperboard, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0,2 mm	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7608	Aluminium tubes and pipes	2.18	8.79	10.97	2.18	5.40	7.58	2.57	6.51	9.08	2.02	0.00	2.02	2.10	0.14	2.24
7609 00 00	Aluminium tube or pipe fittings (for example, couplings, elbows, sleeves)	2.18	8.79	10.97	2.18	5.40	7.58	2.57	6.51	9.08	2.02	0.00	2.02	2.10	0.14	2.24
7610 10 00	Doors, windows and their frames and thresholds for doors	2.18	8.79	10.97	2.18	5.40	7.58	2.57	6.51	9.08	2.02	0.00	2.02	2.10	0.14	2.24
7610 90	Other	2.18	8.79	10.97	2.18	5.40	7.58	2.57	6.51	9.08	2.02	0.00	2.02	2.10	0.14	2.24
7610 90 10	Bridges and bridge-sections, towers and lattice masts	2.18	8.79	10.97	2.18	5.40	7.58	2.57	6.51	9.08	2.02	0.00	2.02	2.10	0.14	2.24
7610 90 90	Other	2.18	8.79	10.97	2.18	5.40	7.58	2.57	6.51	9.08	2.02	0.00	2.02	2.10	0.14	2.24

Country		United Arab Emirates			United Kingdom			United States			Iceland			Norway		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7611 00 00	Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7612	Aluminium casks, drums, cans, boxes and similar containers (including rigid or collapsible tubular containers), for any material (other than compressed or liquefied gas), of a capacity not exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7613 00 00	Aluminium containers for compressed or liquefied gas	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7614	Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated	2.18	8.64	10.82	2.18	5.30	7.48	2.57	6.40	8.97	2.02	0.00	2.02	2.10	0.14	2.24
7615 10 10	Cast	2.06	8.33	10.39	2.06	5.12	7.17	2.45	6.17	8.62	1.90	0.00	1.90	1.98	0.13	2.11
7615 10 30	Manufactured from foil of a thickness not exceeding 0,2 mm	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7615 10 80	Other	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7615 20 00	Sanitary ware and parts thereof	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7616 10 00	Nails, tacks, staples (other than those of heading 8305), screws, bolts, nuts, screw hooks, rivets, cotters, cotter pins, washers and similar articles	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7616 91 00	Cloth, grill, netting and fencing, of aluminium wire	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48
7616 99 10	Cast	2.06	8.33	10.39	2.06	5.12	7.17	2.45	6.17	8.62	1.90	0.00	1.90	1.98	0.13	2.11
7616 99 90	Other	2.41	9.06	11.47	2.41	5.56	7.97	2.80	6.71	9.51	2.25	0.00	2.25	2.33	0.14	2.48

Country		Switzerland			EU			Weighted average		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7601	Unwrought aluminium	0.09	0.01	0.10	1.87	2.26	4.13	2.36	8.14	10.49
7603	Aluminium powders and flakes	0.19	0.01	0.20	1.88	3.52	5.40	2.48	8.40	10.88
7604 10 10	Bars and rods	0.30	0.04	0.34	2.10	1.10	3.20	2.31	7.49	9.80
7604 10 90	Profiles	0.30	0.06	0.37	2.18	1.67	3.85	2.73	9.30	12.04

Country		Switzerland			EU			Weighted average		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7604 21 00	Hollow profiles	0.30	0.06	0.37	2.18	1.67	3.85	2.73	9.30	12.04
7604 29 10	Bars and rods	0.30	0.04	0.34	2.10	1.10	3.20	2.31	7.49	9.80
7604 29 90	Profiles	0.30	0.06	0.37	2.18	1.67	3.85	2.73	9.30	12.04
7605	Aluminium wire	0.30	0.04	0.34	2.10	1.10	3.20	2.31	7.49	9.80
7606	Aluminium plates, sheets and strip, of a thickness exceeding 0,2 mm	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11
7607	Aluminium foil (whether or not printed or backed with paper, paperboard, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0,2 mm	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11
7608	Aluminium tubes and pipes	0.30	0.06	0.37	2.18	1.67	3.85	2.73	9.30	12.04
7609 00 00	Aluminium tube or pipe fittings (for example, couplings, elbows, sleeves)	0.30	0.06	0.37	2.18	1.67	3.85	2.73	9.30	12.04
7610 10 00	Doors, windows and their frames and thresholds for doors	0.30	0.06	0.37	2.18	1.67	3.85	2.73	9.30	12.04
7610 90	Other	0.30	0.06	0.37	2.18	1.67	3.85	2.73	9.30	12.04
7610 90 10	Bridges and bridge-sections, towers and lattice masts	0.30	0.06	0.37	2.18	1.67	3.85	2.73	9.30	12.04
7610 90 90	Other	0.30	0.06	0.37	2.18	1.67	3.85	2.73	9.30	12.04
7611 00 00	Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11
7612	Aluminium casks, drums, cans, boxes and similar containers (including rigid or collapsible tubular containers), for any material (other than compressed or liquefied gas), of a capacity not exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11
7613 00 00	Aluminium containers for compressed or liquefied gas	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11
7614	Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated	0.30	0.04	0.34	2.10	1.10	3.20	2.31	7.49	9.80
7615 10 10	Cast	0.19	0.01	0.20	1.88	3.52	5.40	2.48	8.40	10.88
7615 10 30	Manufactured from foil of a thickness not exceeding 0,2 mm	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11
7615 10 80	Other	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11

Country		Switzerland			EU			Weighted average		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
7615 20 00	Sanitary ware and parts thereof	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11
7616 10 00	Nails, tacks, staples (other than those of heading 8305), screws, bolts, nuts, screw hooks, rivets, cotters, cotter pins, washers and similar articles	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11
7616 91 00	Cloth, grill, netting and fencing, of aluminium wire	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11
7616 99 10	Cast	0.19	0.01	0.20	1.88	3.52	5.40	2.48	8.40	10.88
7616 99 90	Other	0.52	0.09	0.62	2.18	2.49	4.68	2.86	9.25	12.11

Source: JRC, 2023.

Emission intensities of products in the cement industry

Table 22. Emission intensities of products in the cement industry.

Country		Albania			Algeria			Belarus			Bosnia and Herzegovina			Colombia		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2507 00 80	Calcined clay	0.25	0.01	0.26	0.23	0.08	0.31	0.19	0.08	0.27	0.25	0.15	0.40	0.21	0.03	0.24
2523 10	White clinker	1.30	0.00	1.30	1.21	0.06	1.28	1.16	0.05	1.20	1.29	0.10	1.40	1.14	0.03	1.16
2523 10	Grey clinker	0.88	0.00	0.89	0.85	0.04	0.88	0.82	0.03	0.85	0.88	0.06	0.94	0.81	0.01	0.82
2523 21	CEM I white	1.27	0.01	1.27	1.18	0.09	1.28	1.13	0.08	1.21	1.26	0.16	1.42	1.11	0.04	1.15
2523 29	CEM I grey	0.86	0.00	0.87	0.82	0.06	0.88	0.80	0.05	0.85	0.86	0.10	0.96	0.79	0.02	0.82
2523 90	Other white cements	0.91	0.00	0.92	0.85	0.07	0.92	0.81	0.06	0.87	0.91	0.12	1.02	0.80	0.03	0.83
2523 90	Other grey cements	0.62	0.00	0.62	0.59	0.04	0.64	0.58	0.03	0.61	0.62	0.07	0.69	0.57	0.02	0.59
2523 30	Aluminous cement	1.85	0.01	1.86	1.70	0.16	1.86	1.52	0.13	1.65	1.83	0.28	2.11	1.61	0.06	1.66

Country		Egypt			India			Malaysia			Morocco			Pakistan		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2507 00 80	Calcined clay	0.23	0.08	0.31	0.25	0.08	0.33	0.25	0.11	0.35	0.23	0.11	0.34	0.24	0.06	0.30
2523 10	White clinker	1.21	0.06	1.28	1.17	0.08	1.25	1.22	0.06	1.28	1.21	0.09	1.30	1.20	0.04	1.24
2523 10	Grey clinker	0.85	0.03	0.88	0.83	0.05	0.87	0.85	0.03	0.88	0.84	0.05	0.89	0.84	0.02	0.86
2523 21	CEM I white	1.18	0.09	1.28	1.14	0.11	1.25	1.19	0.11	1.29	1.18	0.13	1.31	1.17	0.06	1.24
2523 29	CEM I grey	0.82	0.06	0.88	0.80	0.07	0.87	0.83	0.07	0.89	0.82	0.08	0.90	0.82	0.04	0.86
2523 90	Other white cements	0.85	0.07	0.92	0.82	0.08	0.90	0.85	0.08	0.93	0.85	0.09	0.94	0.85	0.05	0.89
2523 90	Other grey cements	0.59	0.04	0.64	0.58	0.05	0.63	0.59	0.05	0.64	0.59	0.06	0.65	0.59	0.03	0.62
2523 30	Aluminous cement	1.70	0.15	1.86	1.84	0.17	2.01	1.83	0.20	2.02	1.70	0.21	1.91	1.80	0.11	1.92

Country		Saudi Arabia			Serbia			Tunisia			Türkiye			Ukraine		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2507 00 80	Calcined clay	0.24	0.10	0.35	0.25	0.15	0.40	0.23	0.07	0.30	0.23	0.07	0.31	0.19	0.08	0.27
2523 10	White clinker	1.21	0.09	1.30	1.29	0.10	1.39	1.21	0.06	1.27	1.19	0.06	1.25	1.16	0.05	1.21
2523 10	Grey clinker	0.84	0.05	0.89	0.88	0.06	0.94	0.85	0.03	0.88	0.83	0.03	0.87	0.82	0.03	0.85
2523 21	CEM I white	1.18	0.12	1.30	1.26	0.16	1.42	1.18	0.08	1.27	1.16	0.09	1.24	1.13	0.08	1.21
2523 29	CEM I grey	0.82	0.08	0.90	0.86	0.10	0.96	0.82	0.05	0.88	0.81	0.05	0.87	0.80	0.05	0.85
2523 90	Other white cements	0.85	0.09	0.94	0.91	0.11	1.02	0.85	0.06	0.91	0.83	0.06	0.90	0.82	0.06	0.87
2523 90	Other grey cements	0.59	0.05	0.65	0.62	0.07	0.69	0.59	0.04	0.63	0.59	0.04	0.62	0.58	0.04	0.61
2523 30	Aluminous cement	1.79	0.17	1.97	1.83	0.27	2.10	1.70	0.14	1.84	1.75	0.12	1.87	1.52	0.14	1.66

Country		United Kingdom			Vietnam			EU27			Weighted average			Norway			Switzerland		
Product CN Code	Description	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2507 00 80	Calcined clay	0.25	0.05	0.30	0.25	0.08	0.33	0.24	0.06	0.30	0.23	0.08	0.32	0.23	0.00	0.23	0.23	0.01	0.23
2523 10	White clinker	1.30	0.04	1.33	1.22	0.05	1.27	1.26	0.04	1.30	1.19	0.07	1.26	1.23	0.00	1.23	1.23	0.00	1.23
2523 10	Grey clinker	0.88	0.02	0.90	0.85	0.03	0.88	0.87	0.02	0.89	0.83	0.04	0.87	0.85	0.00	0.85	0.85	0.00	0.85
2523 21	CEM I white	1.26	0.06	1.32	1.19	0.09	1.27	1.22	0.06	1.29	1.16	0.10	1.26	1.20	0.00	1.20	1.20	0.01	1.20
2523 29	CEM I grey	0.86	0.04	0.89	0.83	0.05	0.88	0.84	0.04	0.88	0.81	0.06	0.87	0.83	0.00	0.83	0.83	0.00	0.83
2523 90	Other white cements	0.91	0.04	0.95	0.86	0.06	0.92	0.88	0.04	0.93	0.84	0.07	0.91	0.86	0.00	0.87	0.86	0.00	0.87
2523 90	Other grey cements	0.62	0.03	0.64	0.60	0.04	0.63	0.61	0.03	0.63	0.59	0.04	0.63	0.60	0.00	0.60	0.60	0.00	0.60
2523 30	Aluminous cement	1.85	0.09	1.94	1.83	0.16	1.99	1.77	0.10	1.88	1.75	0.15	1.90	1.72	0.00	1.73	1.72	0.01	1.73

Note: *For countries not covered by the CBAM (i.e. outside of the EU and EFTA countries) and outside the scope of this study, "weighted average" values apply. These values are calculated by averaging the values of the countries under the scope of this study. For Portland clinker and cement, as well as other hydraulic cements, these averages are weighted with the cement production volume in each country under scope (USGS, 2020). For calcined clay and aluminous cement, for which no production volumes are available, non-weighted averages are provided.

Source: JRC, 2023.

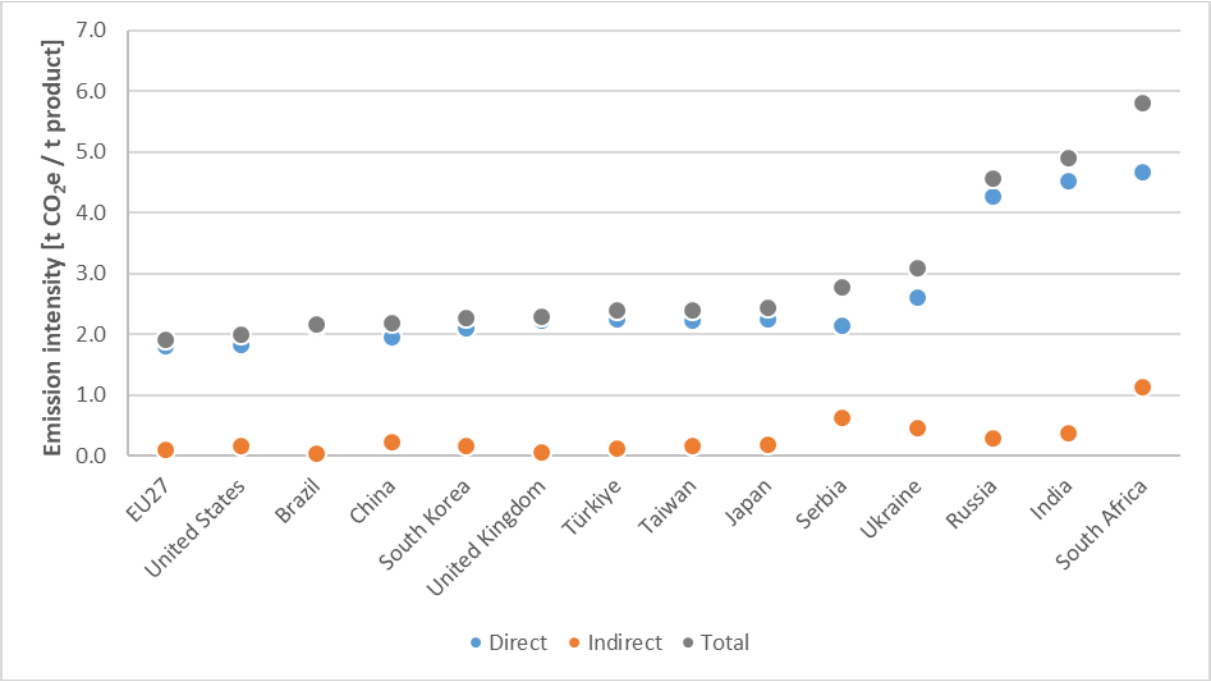
Annex 3. Crude steel emission intensities – updated values following the methodology in the pilot study

The purpose of this annex is to show how once removed the artificial split in the energy consumption implemented in the pilot study (JRC, 2022a), the ranking of countries in this update is similar to the one produced in this document. In order to obtain this update of the results of the pilot study, the remaining differences in the boundaries between the pilot study and this document are kept constant. The main differences are that in the pilot study:

- GHG emissions originating from coke production in coke ovens are taken into account.
- The Monitoring and Reporting Regulation (European Commission, 2018) regarding the waste gases calculation treatment is used instead of the Free Allocation Rules.
- GHG emissions corresponding to the waste gases combustion in the autoproducers and main activity producers power plants are completely attributed to the iron and steel industry.

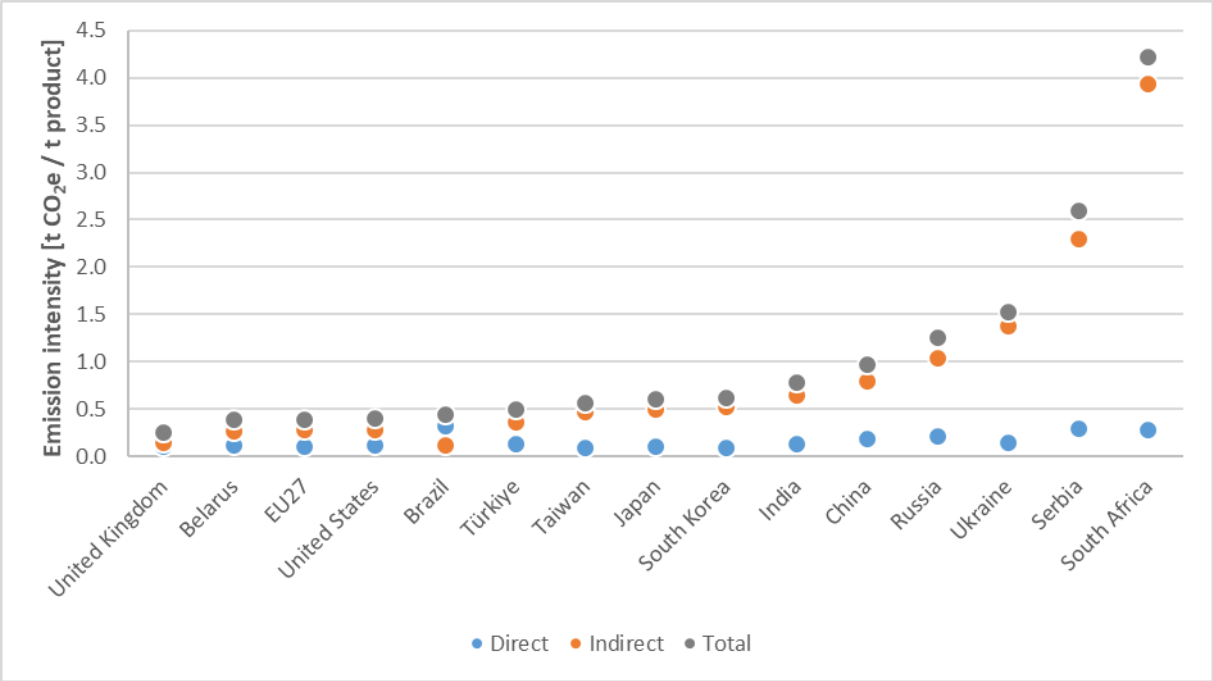
The pilot study only estimated the carbon intensity of semi-finished steel, disregarding finalisation processes, for that we had to introduce an artificial split between the energy consumed in the statistics in these two parts. That split was based on the data for EU from JRC-IDEES database (JRC, 2017c).

Figure 56. GHG emission intensity for crude steel of non-alloy steel from primary steelmaking route.



Source: JRC, 2023.

Figure 57. GHG emission intensity for crude steel of non-alloy steel from secondary steelmaking route.



Source: JRC, 2023.

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