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Final report

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On behalf of the German Environment Agency

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Abstract: Shall the CBAM be expanded further downstream? Insights from assessing products along the automotive value chain

The Carbon Border Adjustment Mechanism (CBAM) is being introduced in the EU and gradually replaces free allocation in the covered sectors starting in 2026 with full phase-in set for 2034. The goal is to provide carbon leakage protection to EU industries covered by the European Union's Emission Trading System (EU ETS) while encouraging cleaner industrial production in non-EU countries. According to current rules, only basic materials, basic material products and some intermediate products in a number of sectors, such as iron and steel and aluminium, are covered by CBAM. Products further down the value chain, including the bulk of intermediate products, and finished products are not covered. This can put downstream EU products at a disadvantage compared to imported goods produced in a region in which there is no carbon price. Noting that this poses a risk of carbon leakage, the EU is considering including further downstream products under the CBAM. While the issue is less acute in the beginning when a lot of free allocation is still available, it is likely to become more pressing when a large share of free allocation has been replaced by CBAM (post-2030).

In this study, we move along the value chain of the automotive industry, starting with automotive parts such as wheels, brakes and crankshafts, and then moving backwards to address also forged and flat-rolled metal products. The latter represent manufacturing steps between the basic materials such as steel, and the automotive parts mentioned before. We examine the characteristics and production processes of these products, approximate carbon costs and analyse trade flows.

We estimate the carbon cost share in total production for nine PRODCOM codes, covering three flat-rolled and forged products that are already covered by the CBAM and six products that represent automotive parts (wheels, brakes, crankshafts, drive axles, steering wheels and silencers). We focus on cost from direct emissions, since the CBAM for steel and aluminium currently excludes indirect emissions from electricity consumption. We find that the products with the highest share of carbon costs compared to the production value are flat-rolled products at 14–28% (depending on the emissions intensity and regional focus) and forged products at 4-12%, both of which are included in the current CBAM scope. The cost share for the automotive parts analysed - not yet covered by CBAM - ranges from 1% to 6%. These figures comprise the cost shares at a carbon price of 100 EUR/tCO_2 and assuming a CBAM implementation of 100%, which applies from 2034 onwards after its gradual phase-in.

We also carried out interviews with 13 stakeholders and experts from the industry sector representing companies or associations. According to interview partners, the automotive industry, there is traditionally a 'local for local' strategy but shifts in production and trade flows occur due to a stagnating European market, relatively high domestic energy and labour costs and industry subsidies in third countries. According to the interviewees, the competitiveness of the European and German automotive industry is no longer protected by specialisation. Thus, cost increases as found by the present study are potentially critical to downstream producers if the CBAM scope is not adapted.

Interview partners state that the administrative costs of the CBAM are already felt by importers with reporting requirements today and they will likely be significantly larger if the CBAM is extended down the value chain. Monitoring, reporting and verification (MRV) is essential in the context of CBAM to ensure that each reported ton of greenhouse gas emissions (GHG) does indeed correspond to a ton. Interviewees suggest that reporting requirements should be

simplified and de-minimis rules adapted before the CBAM is extended further.[1] The risks that need to be analysed in case of an extension are, among others, related to avoiding CBAM costs by declaring products under other CN codes not covered.

A complementary expert workshop in September 2024 with representatives of industry associations, the relevant public authorities as well as researchers confirmed the approach, quantitative and qualitative findings as well as the criteria to be considered for the identifying products to be included.

Our recommendations for the next steps to be taken are as follows:

- Elaborate further on the emission and trade intensity as criteria for the inclusion of further products into CBAM.
  - The wide range of results on CBAM costs per production costs in our analysis shows that results are sensitive to assumptions on emission intensities and product prices. Further work is needed to arrive at robust cost shares per product.
  - Once robust cost shares are estimated, a suitable threshold value needs to be elaborated that could mark the inclusion or non-inclusion into the CBAM scope.
  - As the goal of the downstream extension of CBAM is to protect the EU's internal market from carbon leakage, the trade intensity criterion may be further developed into an import intensity criterion for the purposes of this extension.
- Analyse the risk of circumvention of the CBAM by declaring products under different CN codes: If this risk is large, then additional products may have to be included regardless of their current emissions or trade (import) intensity. Trade flows need to be closely monitored to detect possible circumvention activity.
  - For new products to be included on the basis of their emissions and trade or import intensity, one should in turn analyse, whether the circumvention risk by declaring under alternative CN codes is large. In case circumvention risk is deemed large and hard to come by, there it may be less recommendable to include these additional products.
- Check how administrative costs could be reduced by increasing the current de-minimis rule that is linked to general requirements for importers and introducing a de-minimis rule specific to the CBAM.[2]
- Take into account the expected administrative costs of including additional products vs. the additional benefits of including them. Possible criteria to assess this cost-benefit ratio include i) the cumulative emissions of the product (i.e. its relevance for climate protection), ii) the number of import transactions and the cost per transaction, iii) the number of upstream steps that precede the product in question and iv) the number of input factors already covered by CBAM.
- Evaluate the risk of a potential abuse of the CBAM extension as an argument for legitimizing a trade retaliation by third countries in response.

[1] A de-minimis rule, together with other simplifications in the context of CBAM, is addressed by the first "omnibus"-initiative of the EU COM (https://commission.europa.eu/publications/omnibus-i_en). At the time of writing, the initiative continues to be discussed and adoption is projected for the summer of 2025.

[2] Consider the previous footnote.

- In general, a possible extension should be introduced in a step-wise manner to keep the process administratively feasible.

Kurzbeschreibung: Soll der CO_2-Grenzausgleichsmechanismus auf nachgelagerte Produktionsschritte ausgeweitet werden? Einblicke am Beispiel von Produkten entlang der automobilen Wertschöpfungskette

Der CO_2-Grenzausgleichsmechanismus (Carbon Border Adjustment Mechanism, CBAM) wird in der EU eingeführt und ersetzt ab 2026 schrittweise die kostenlose Zuteilung in den erfassten Sektoren, wobei die vollständige Einführung bis 2035 vorgesehen ist. Ziel ist es, die unter das Emissionshandelssystem der Europäischen Union (EU ETS) fallenden Industriesektoren und -produkte vor Carbon Leakage zu schützen und gleichzeitig eine klimafreundliche Industrieproduktion in Drittländern zu fördern.

Nach den derzeitigen Vorgaben fallen nur Grundstoffe, Grundstoffprodukte und einige Zwischenprodukte in einer Reihe von Sektoren, wie Eisen und Stahl sowie Aluminium, in den Anwendungsbereich des CBAM. Produkte, die weiter hinten in der Wertschöpfungskette angesiedelt sind, einschließlich des Großteils der Zwischenprodukte und der Endprodukte, sind nicht erfasst. Dies kann dazu führen, dass nachgelagerte EU-Produkte im Vergleich zu importierten Waren, die in einer Region ohne CO_2-Preis hergestellt werden, Wettbewerbsnachteile haben. Da dies ein Risiko der Verlagerung von CO_2-Emissionen (Carbon Leakage) darstellt, erwägt die EU, weitere nachgelagerte Produkte in den Anwendungsbereich des CBAM aufzunehmen. Während das Problem zu Anfang der Einführungsphase des CBAM weniger akut sein dürfte, wird es wahrscheinlich drängender werden, wenn ein großer Teil der kostenlosen Zuteilungen durch CBAM ersetzt wurde (nach 2030).

In dieser Studie bewegen wir uns entlang der Wertschöpfungskette der Automobilindustrie, beginnend mit Autoteilen wie Rädern, Bremsen und Kurbelwellen, und gehen dann rückwärts, um auch geschmiedete und flachgewalzte Metallprodukte zu behandeln. Letztere befinden sich zwischen dem Grundstoff Stahl und den genannten Automobilteilen. Wir untersuchen die Merkmale und Produktionsprozesse dieser Produkte, schätzen die CBAM-Kosten ab und analysieren die Bedeutung der Handelsströme.

Wir schätzen den Anteil der CO_2-Kosten an der Gesamtproduktion für neun PRODCOM-Codes, darunter drei flachgewalzte und geschmiedete Produkte, die bereits in den Anwendungsbereich des CBAM fallen, und sechs Produkte, die Automobilteile darstellen (Räder, Bremsen, Kurbelwellen, Antriebsachsen, Lenkräder und Schalldämpfer). Wir konzentrieren uns auf die Kosten aus direkten Emissionen, da der CBAM für Stahl und Aluminium derzeit indirekte Emissionen aus dem Stromverbrauch ausschließt. In unserer Analyse haben flachgewalzte Produkte mit 14-28 % den höchsten Anteil an CO_2-Kosten im Vergleich zum Produktionswert (je nach Emissionsintensität und regionalem Schwerpunkt) und Schmiedeprodukte mit 4-12 % den zweithöchsten Anteil. Der Kostenanteil für die analysierten Automobilteile liegt zwischen 1 % und 6 %. Diese Zahlen repräsentieren Kostenanteile bei einem CO_2-Preis von 100 EUR/tCO_2 und unter der Annahme einer CBAM-Umsetzung von 100 %.

Neben den quantitativen Analysen wurden Interviews mit 13 Interessenvertreter*innen und Expert*innen aus dem Industriesektor geführt, die Unternehmen oder Verbände vertreten. Laut unserer Interviewpartner*innen, wird in der Automobilindustrie traditionell eine „local for local"-Strategie verfolgt. Allerdings sorgt der stagnierende europäische Markt, relativ hohe inländische Energie- und Arbeitskosten und Industriesubventionen in Drittländern laut der Interviewpartner*innen für Verlagerungen der Produktions- und Handelsströme. Nach Ansicht der Befragten ist die Wettbewerbsfähigkeit der europäischen und deutschen Automobilindustrie nicht mehr durch Spezialisierung geschützt.

Die Interviewpartner*innen geben weiterhin an, dass die administrativen Kosten des CBAM für Importeure mit Berichtspflichten bereits heute spürbar sind und wahrscheinlich deutlich höher

wären, sollte der CBAM auf die gesamte Wertschöpfungskette ausgedehnt werden. Monitoring, Reporting und Verification (MRV) sind im Zusammenhang mit dem CBAM unerlässlich, um sicherzustellen, dass jede gemeldete Tonne Treibhausgasemissionen (THG) tatsächlich einer Tonne entspricht. Interviewpartner*innen sprachen sich dafür aus, vor einer möglichen Ausweitung des Anwendungsbereichs die Berichtspflichten zu vereinfachten und die geltenden de-minimis Regeln zu überarbeiten.[3] Des Weiteren wurden in den Interviews eine Reihe von Möglichkeiten zur Umgehung eines ausgeweiteten CBAM-Anwendungsbereichs angesprochen. Dazu gehört die Vermeidung von CBAM-Kosten durch die Deklarierung von Produkten in anderen, nicht erfassten Warengruppen der Kombinierten Nomenklatur (KN).

Ein ergänzender Experten-Workshop im September 2024 mit Vertreterinnen und Vertretern von Industrieverbänden und den zuständigen Behörden sowie Wissenschaftlerinnen und Wissenschaftlern bestätigte den Ansatz, die quantitativen und qualitativen Ergebnisse sowie die Kriterien, die bei der Identifizierung der einzubeziehenden Produkte zu berücksichtigen sind.

Folgende Empfehlungen lassen sich aus unseren Analysen ableiten:

- Die Emissions- und Handelsintensität sollten als mögliche Kriterien für die Einbeziehung weiterer Produkte in den CBAM weiter ausgearbeitet werden.
  - Die große Bandbreite der Ergebnisse zu den CBAM-Kosten pro Produktionskosten in unserer Analyse zeigt, dass die Ergebnisse von den Annahmen zur Emissionsintensität und den Produktpreisen abhängen. Es sind weitere Arbeiten erforderlich, um zu robusten Kostenanteilen pro Produkt zu gelangen.
  - Sobald robuste Kostenanteile geschätzt sind, muss ein geeigneter Schwellenwert ausgearbeitet werden, der die Aufnahme oder Nichtaufnahme in den CBAM-Anwendungsbereich kennzeichnen könnte.
  - Da das Ziel der Ausweitung von CBAM auf nachgelagerte Produkte darin besteht, den EU-Binnenmarkt vor Carbon Leakage zu schützen, könnte das Kriterium der Handelsintensität für die Zwecke dieser Ausweitung zu einem Kriterium der Importintensität weiterentwickelt werden.
- Analyse des Risikos der Umgehung der CBAM durch die Anmeldung von Produkten unter nicht erfassten KN-Codes: Wenn dieses Risiko groß ist, müssen möglicherweise zusätzliche Produkte aufgenommen werden, unabhängig von ihren derzeitigen Emissionen oder ihrer Handels- bzw. Importintensität. Die Handelsströme müssen genau überwacht werden, um mögliche Umgehungsaktivitäten aufzudecken.
  - Wenn neue Produkte auf der Grundlage ihrer Emissions- und Handels- bzw. Importintensität aufgenommen werden sollen, ist wiederum zu prüfen, ob das Umgehungsrisiko durch die Anmeldung unter anderen KN-Codes groß ist. Wird das Umgehungsrisiko als groß und schwer eindämmbar eingeschätzt, ist die Tendenz zur Aufnahme dieser zusätzlichen Produkte geringer.

[3] Eine De-minimis-Regel ist zusammen mit anderen Vereinfachungen im Rahmen des CBAM Gegenstand der ersten „Omnibus"-Initiative der EU-Kommission (https://commission.europa.eu/publications/omnibus-i_en). Zum Zeitpunkt der Erstellung dieses Dokuments wird die Initiative noch diskutiert und die Annahme ist für den Sommer 2025 vorgesehen.

- Prüfen, wie die Verwaltungskosten gesenkt werden könnten, indem die derzeitige De-minimis-Regel, die an allgemeine Anforderungen für Importeure geknüpft ist, erhöht oder eine De-minimis-Regel speziell für den CBAM einführt wird.[4]
- Kosten-Nutzen Abwägung der zusätzlichen administrativen Kosten für die Aufnahme zusätzlicher Produkte im Vergleich zu den zusätzlichen Vorteilen, die sich aus der Aufnahme dieser Produkte ergeben. Mögliche Kriterien zur Bewertung dieses Kosten-Nutzen-Verhältnisses sind i) die kumulierten Emissionen des Produkts (d.h. seine Relevanz für den Klimaschutz), ii) die Anzahl der Importtransaktionen und die Kosten pro Transaktion, iii) die Anzahl der vorgelagerten Schritte, die dem fraglichen Produkt vorausgehen, und iv) die Anzahl der Inputfaktoren, die bereits von CBAM abgedeckt werden.
- Bewertung des Risikos, dass die CBAM-Erweiterung zur Legitimierung von Handelsvergeltungsmaßnahmen durch Drittländer genutzt werden könnte.
- Eine mögliche Erweiterung sollte Schritt-für-Schritt erfolgen, um die Verwaltung und Umsetzung zu erleichtern.

[4] Siehe vorherige Fußnote.

Table of content

List of figures

List of tables

List of abbreviations

Abbreviation	Explanation
CBAM	Carbon Border Adjustment Mechanism
CL	Carbon leakage
CN	Combined Nomenclature
CO_2	Carbon dioxide
EU ETS	EU Emissions Trading System 1
F-gases	Fluorinated greenhouse gases
GHG	Greenhouse gas
HSLA	High-strength low-alloy
MRV	Monitoring, Reporting, Verification
N_2O	Nitrous oxide (laughing gas)
NAO	Non-asbestos organic
n.e.c.	Not elsewhere classified
n.e.s.	Not elsewhere specified
OEM	Original Equipment Manufacturer
TWh	Terawatt hours
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

A carbon price applies to the production of emission intense goods in the EU. Producers have to report their emissions under the EU Emissions Trading System (EU ETS 1) and surrender a corresponding amount of EU allowances. The aim of the Carbon Border Adjustment Mechanism (CBAM) is to put a corresponding carbon price on goods stemming from countries without comparable carbon pricing upon the import into the EU. The CBAM has started covering basic materials and some intermediate products of selected sectors that are widely traded and have a high emission intensity such as steel, aluminum, and cement.[5] Basic material products covered in the iron and steel and aluminum sector include sheets, bars, tubes and wire. Some intermediate forged and sheet metal products are also included, as are screws. In the transitional phase, which spans 2023 to 2026, the CBAM is limited to reporting. The functioning of the CBAM will be evaluated during this phase and include a review of the scope, i.e. the products covered.

The introduction of the CBAM can lead to an increase in the costs of input products covered by the CBAM which downstream producers within the EU face and which their competitors in countries without comparable carbon pricing do not face. The additional costs depend, among others, on the embedded emissions in the input materials as well as on the extent to which the costs are passed on to prices for these input materials.[6] As a consequence of the CBAM, the cost pass-through of carbon costs to manufacturers within the EU should become easier as all input materials will have the same carbon costs, regardless of whether they were produced within the EU or in third countries.

According to current CBAM rules products further down the value chain that are not part of Annex I of the CBAM Regulation can still be imported into the EU without a carbon price being applied at the border. This may put importers of these products at a competitive advantage compared to producers located within the EU. One question is therefore whether and which products further down the value chain should be covered by the CBAM, as mentioned in Article 30(3) of the CBAM Regulation. In a discussion note presented to Member States, the EU Commission mentioned the following criteria for including products in CBAM:

- Share of CBAM goods used as inputs, as part of the total volume of the type of good to be included in the CBAM scope (i.e. downstream products candidates for inclusion);
- Proportion of carbon costs as a share of the total cost of producing them;
- Complexity of the value chain;
- Risk of Carbon Leakage (defined commonly as the product of trade intensity and emission intensity within the EU ETS).

In this study, we focus on the impacts of CBAM in the automotive sector. We look at the automotive parts of wheels, brakes and crankshafts, as well as at precursor products made of steel including forged and flat-rolled products. The assessment is based on the custom's classification for traded goods, combined nomenclature (CN), used in the CBAM Regulation. A screening of downstream products was undertaken and wheels, brakes and crankshafts were identified as parts in the automotive sector with high production value (economic importance), high embedded emissions and a relatively high share of expected CBAM cost, while being

[5] For a summary of the Carbon Border Adjustment Mechanism, please refer to Healy et al. (2023) and Wildgrube et al. (2024).

[6] More precisely, the phasing-out of free allocation in the EU ETS 1 – a consequence of opting for carbon leakage protection by means of CBAM – strengthens the CO_2-price signal for (emission intensive) goods produced in the EU and products made of these.

products that are not covered by CBAM. We also include forged and flat-rolled products in our analysis. Those are precursor products to the automotive parts but not strictly basic materials. Those products are largely covered by the current CBAM scope, but several CN codes that contain, for example, forged products are not part of the current scope. In our interviews, we also talk to producers of basic materials. In this way, we can contrast and compare the situation of products and producers at different steps in the automotive value chain.

The aims of this study are as follows:

1. Provide insights into the value chain of the automotive industry, production processes and current CBAM coverage;
2. Investigate carbon intensity and costs, as well as importance of trade and main trading partners for the selected products, as these two criteria could potentially be used to decide on the inclusion of further products into CBAM; and
3. Check and expand our findings in eight interviews with thirteen stakeholders from the automotive sector covering the different steps of the value chain.

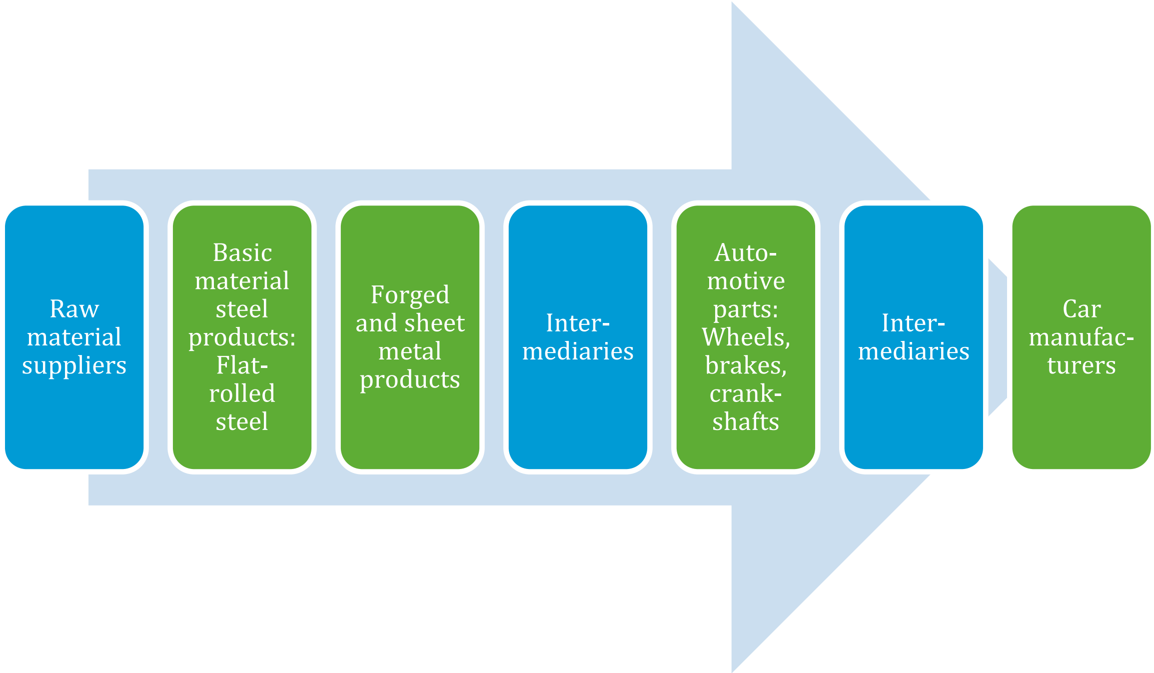
In order to achieve these aims, we carry out a quantitative analysis based on production and trade statistics. We determine CBAM costs related to overall production cost, the importance of the EU domestic market, as well as most important extra-EU trade partners for the products. Insights gathered in the interviews are used to check and expand the results of the quantitative analysis and to discuss further our estimated CBAM costs in the context of the risk of carbon leakage.

The structure of the study is as follows. In Section 2, we present the five focus products, show where they are situated in the automotive value chain, and provide background information and statistics related to production and trade. The quantitative assessment in Section 0 provides an estimate of the carbon costs relative to total production costs for each of the products under consideration. Section 4 summarises the insights gathered in the interviews. Section 5 provides the final conclusions from the study and recommendations for the next steps.

2 Examined products in the automotive industry

Figure 1 shows a simplified value chain of the automotive industry as relevant to this study. We focus mostly on steel products at different steps of the value chain related to the automotive parts of wheels, brakes and crankshafts.[7] Our analysis covers these three parts, as well as forged and flat-rolled products that serve as an input to production. Our quantitative analysis also incorporates the automotive parts of steering wheels, drive axles and silencers to provide further context and comparison. The interviews were conducted with representatives from companies producing basic material products, forged and sheet metal products, as well as wheels, brakes and crankshafts, and associations representing these companies.

Figure 1 Simplified value chain of the automotive industry relevant to the analysis in this study



Source: Own elaboration

Note: Products marked in green are investigated in the quantitative and qualitative analysis

In Figure 1, we also show the car manufacturers as an important step in the value chain. These manufacturers are usually multinational companies that have a lot of bargaining power. Based on discussions with managers working in the automotive industry, Lind et al. (2012) also position raw material suppliers (such as miners) as the first step in the value chain and car dealers as the final step. Not illustrated in our simplified value chain is the fact that in between the different steps there are further intermediate traders and additional production steps that can make the value chain relatively complex.

2.1 Wheels

Road wheels are traditionally made of rolled steel due to the material's low manufacturing costs and high strength. As noted in the interviews, the use of aluminium alloys in the production of road wheels has increased in prominence as they are considerably lighter than steel wheels. Furthermore, from an aesthetic standpoint, the more versatile designs are much preferred by

[7] The quantitative analysis also takes into account aluminium used in the production process of the three automotive parts.

the consumer. In the interviews, industry representatives stated that in fact aluminium wheels account for 80% of the overall market in the EU.

Table 1 provides a comparison of how road wheels are defined in the publicly available statistics from Eurostat. The CBAM refers to goods imported into the EU by their CN code, a statistical classification for trade. Road wheels are disaggregated in the statistic to include information on the material input and the type of vehicle the wheel is designed for.

Table 1 Definition of road wheels within the production and trade statistics

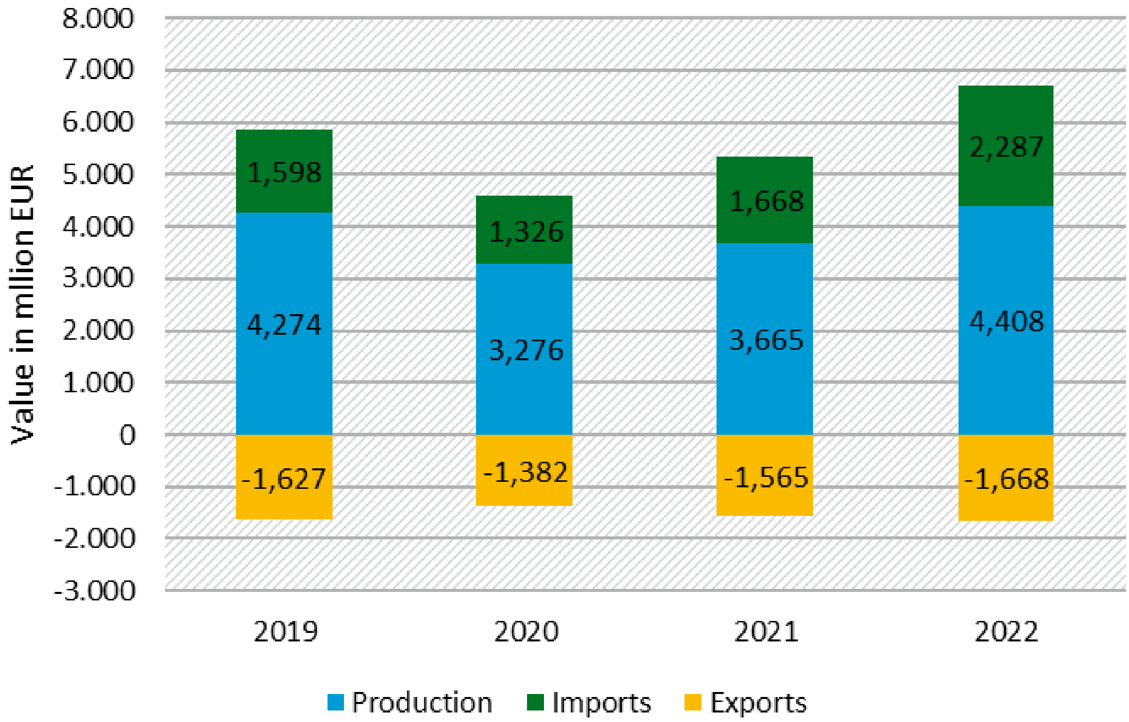
CN code	Product description	PRODCOM code	Product description
8708 70	Road wheels and parts and accessories thereof		
8708 70 10	For the industrial assembly of: Pedestrian-controlled tractors of subheading 8701 10; Vehicles of heading 8703; Vehicles of heading 8704 with either a compression-ignition internal combustion piston engine (diesel or semi-diesel) of a cylinder capacity not exceeding 2 500 cm3 or with a spark-ignition internal combustion piston engine of a cylinder capacity not exceeding 2 800 cm3; Vehicles of heading 8705	29323040	Road wheels and parts and accessories thereof
8708 70 50	Wheels of aluminium; parts and accessories of wheels, of aluminium	29323040	Road wheels and parts and accessories thereof
8708 70 91	Wheel centres in star form, cast in one piece, of iron or steel	29323040	Road wheels and parts and accessories thereof
8708 70 99	Other	29323040	Road wheels and parts and accessories thereof

Source: Own compilation based on European Commission (2023)

Information on production, imports and exports are provided in the PRODCOM classification (see also Table 1), summarising all type of road wheels as well as their parts and accessories. The domestic market is dominated by EU-27 production which accounts for 70% of the total market on average (Figure 2).[8] Based on COMEXT trade data, Figure 3 further dissects the import bar shown in Figure 2 for the year of 2022 by indicating the main countries of origin for extra-EU imports of road wheels. These were Türkiye, Marocco, China, Taiwan and the United Kingdom. We look at the origin of imports to gauge the risk of carbon leakage. Carbon leakage occurs if production relocates to jurisdictions that do not have a carbon price. Several interview partners stressed that the risk of relocation to certain regions is higher. China, Türkiye, Brazil and non-EU European countries were mentioned in this context in the interviews.

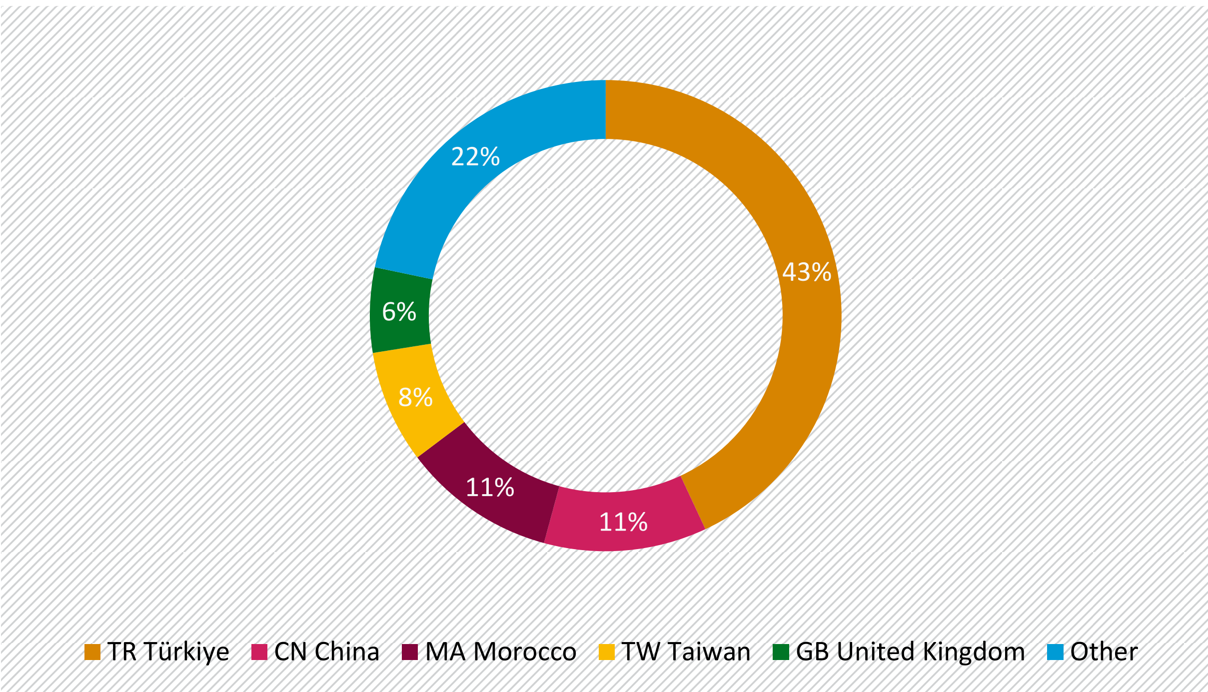
[8] Concerning the charts in this chapter, due to data availability, there is a slight discrepancy with respect to trade data (referring to the EU-27) and the regional scope of the EU ETS 1, which includes Norway, Liechtenstein and Iceland in addition to the EU-27. Where this is relevant, the text points it out.

Figure 2 EU-27 production, imports and exports of road wheels (value in million EUR)



Source: Eurostat (2024b)

Figure 3 Main countries of origin of Extra-EU imports for road wheels in 2022 (based on value)



Source: Eurostat (2024a)

2.2 Brakes

Brakes are made of several different components. The brake disc is often manufactured from cast iron and this is then linked to the axle and/or to the wheel. Brake pads are pieces of friction generating material that press against both sides of the brake disc in and are fixed on a mechanism known as a brake calliper (Kumar et al. 2021). Brake discs are primarily made from rolled steel. Brake pads are made of a composite of materials depending on application and the market. In Europe mostly low-Steel or low-Met friction pads are used, based on a mix of steel, non-ferrous materials, fibres, elastomers, graphites and other materials bound by resins. According to our interviewees, in other markets such as North America or Japan mainly non-asbestos organic (NAO) brake pads are used, which have no steel content. The difference is partly due to the safety regulations that apply in Europe. Low-steel brake pads score best on stopping under extreme conditions but have higher particulate matter emissions (Janssen 2023). The uptake of electrical vehicles and the inclusion of particulate matter emissions from brakes and wheels may also influence the choice of materials in the future.

Table 2 offers a comparison of how brakes are defined within the publicly available statistics from Eurostat. Under the CN code classification, the product is disaggregated to include information on the vehicles for which the brakes are designed.

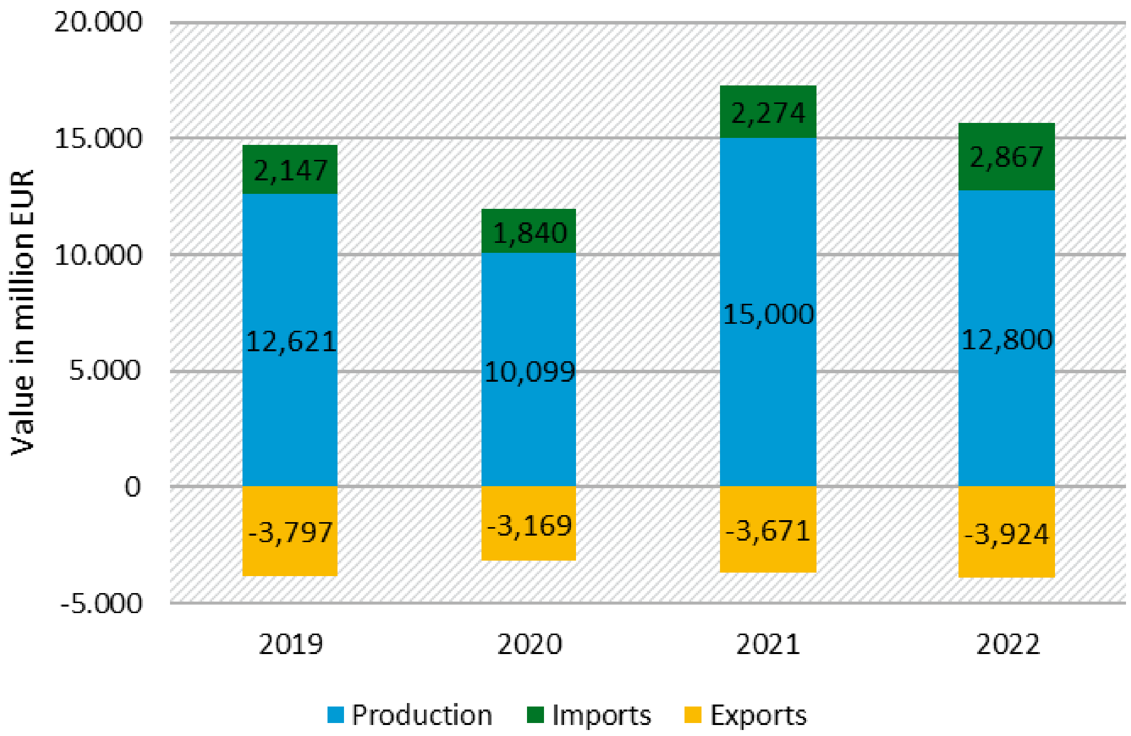
Table 2 Definition of brakes within the production and trade statistics

CN code	Product description	PRODCOM code	Product description
8708 30	Brakes and servo-brakes and parts thereof		
8708 30 10	for the industrial assembly of: pedestrian-controlled tractors, motor cars and vehicles principally designed for the transport of persons, vehicles for the transport of goods with compression-ignition internal combustion piston engine "diesel or semi-diesel engine" <= 2500 cm^3 or with spark-ignition internal piston engine <= 2800 cm^3, special purpose motor vehicles of heading 8705, n.e.s.	29323020	Brakes and servo-brakes and their parts (excluding unmounted linings or pads)
8708 30 91	For disc brakes	29323020	Brakes and servo-brakes and their parts (excluding unmounted linings or pads)
8708 30 99	Other	29323020	Brakes and servo-brakes and their parts (excluding unmounted linings or pads)

Source: Own compilation based on European Commission (2023)

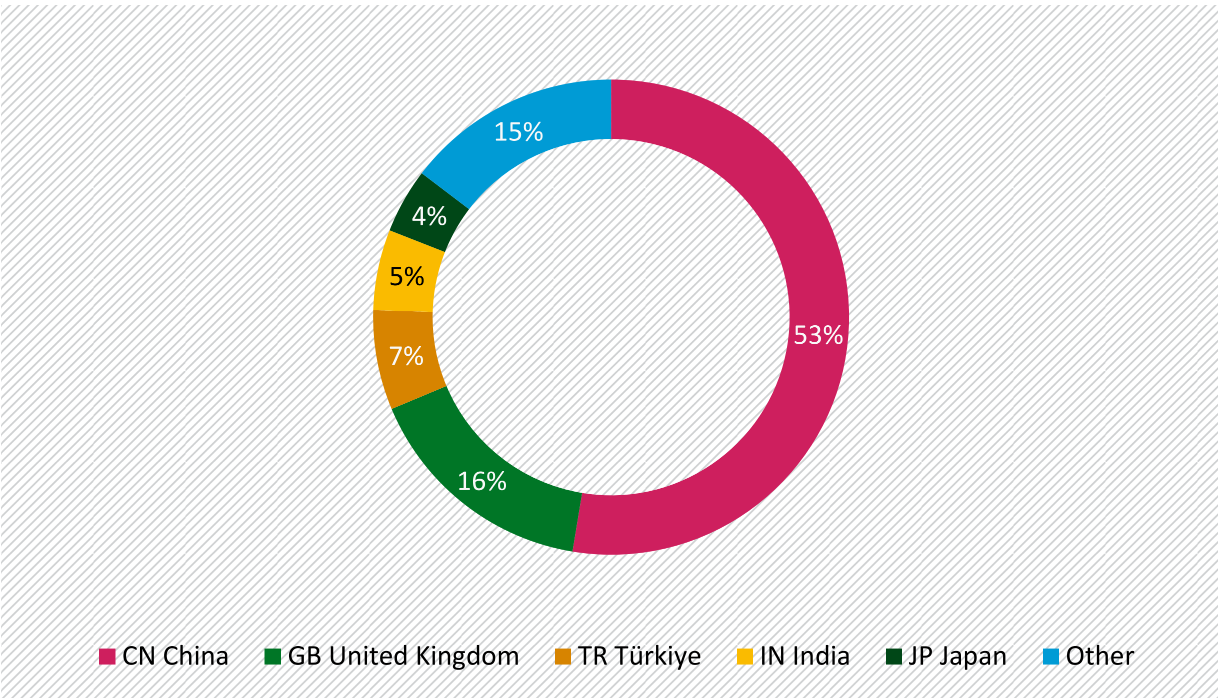
According to PRODCOM data, the domestic brake market is dominated by European production, responsible for 85% in the domestic market (see Figure 4). Based on COMEXT trade data, Figure 5 further dissects the import bar shown in Figure 4 for the year of 2022 by indicating the main countries of origin for extra-EU imports of brakes. These were China, Great Britain, Türkiye, India and Japan.

Figure 4 **European production, imports and exports of brakes**



Source: Eurostat (2024b)

Figure 5 **Main countries of origin of Extra-EU imports for brakes in 2022 (based on value)**



Source: Eurostat (2024a)

2.3 Crankshafts

Crankshafts convert the reciprocating motion into rotational motion in a piston engine. They are not needed in electrical vehicles. According to our interviewees, crankshafts are made 100% out of forged steel. Table 3 provides a comparison of how cranks and crankshafts are defined within the publicly available statistics from Eurostat. Under the CN code classification, the product is disaggregated to include information on the material input and process for the manufacture of the product (i.e. casting, forging or machining).

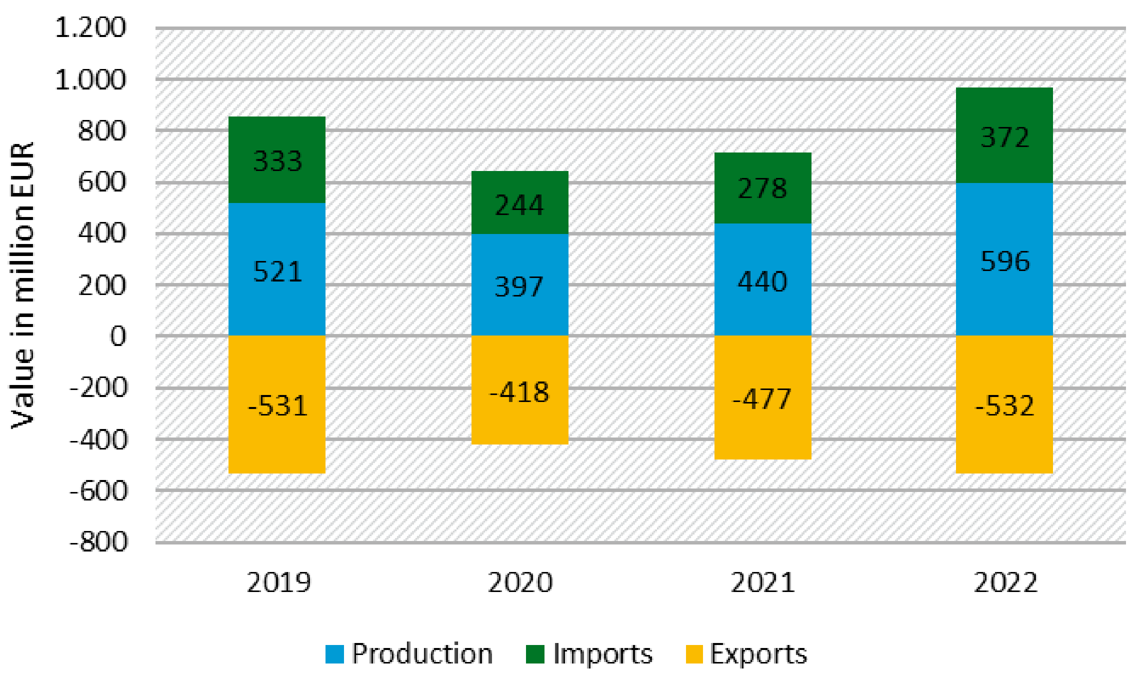
Table 3 Definition of cranks and crankshafts within the production and trade statistics

CN code	Product description	PRODCOM code	Product description
8483 10	- Transmission shafts (including cam shafts and crank shafts) and cranks: -- Cranks and crank shafts		
8483 10 21	Of cast iron or cast steel	28152230	Cranks and crankshafts
8483 10 25	Of open-die forged steel	28152230	Cranks and crankshafts
8483 10 29	Other	28152230	Cranks and crankshafts

Source: Own compilation based on European Commission (2023)

The majority of cranks and crankshafts for the domestic market are produced in the EU-27. Its production share in the domestic market is equal to 61% (Figure 6).

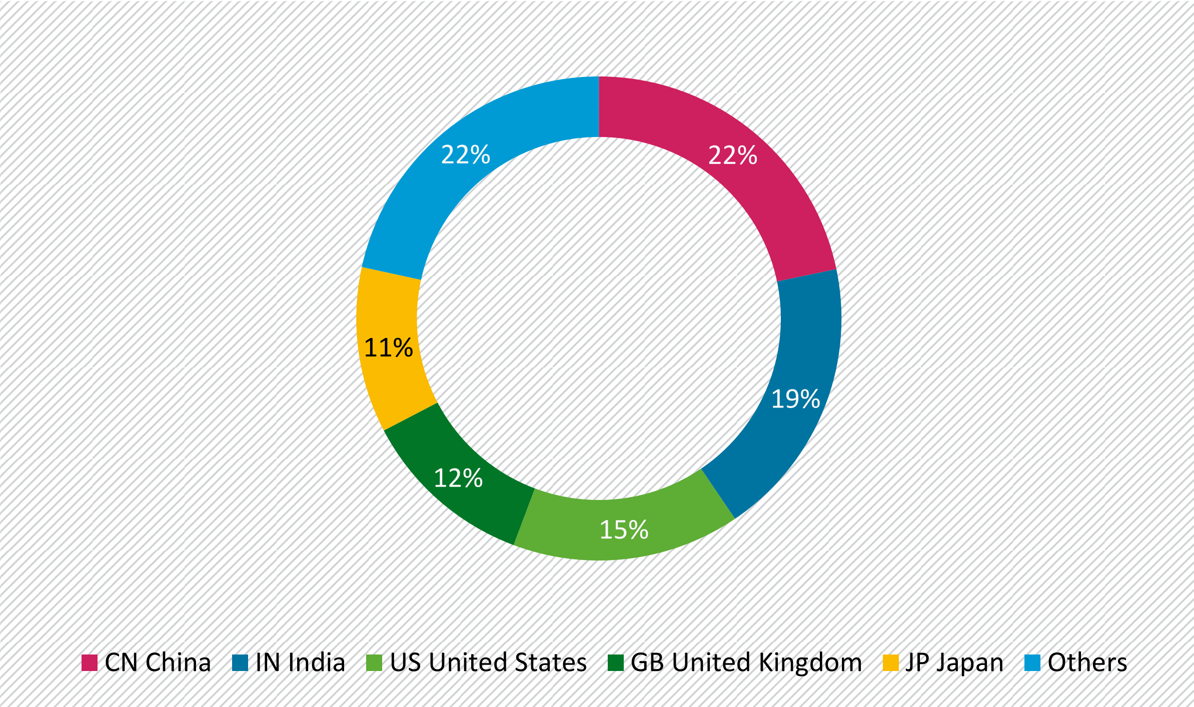
Figure 6 European production, imports and exports of crankshafts



Source: Eurostat (2024b)

Based on COMEXT trade data, Figure 7 further dissects the import bar shown in Figure 6 for the year of 2022 by indicating the main countries of origin for extra-EU imports of crankshafts. These were China, India, the United States, the United Kingdom and Japan.

Figure 7 Main countries of origin of Extra-EU imports for crankshafts in 2022 (based on value)



Source: Eurostat (2024a)

2.4 Forged metal products

According to our interview with EUROFORGE, approx. 80% of the production volume of forged metal products is supplied to the automotive sector both for internal combustion and electric engines. In terms of the value chain, forged products sit between the basic material producer (rolled steel as an input to forging) and the producers of automotive parts.

Forged metal products are produced by applying compressive force to semi-finished steel products such as steel ingots (Vidovic et al. 2023). Products listed in Annex B.2 are covered by the CBAM and involve a forging process.

Table 4 provides a comparison of how forged or stamped articles of iron and steel are defined within the publicly available statistics from Eurostat. Under the CN code classification, the products are more disaggregated than in the PRODCOM statistic.

Table 4 Definition of forged or stamped articles of iron or steel

CN code	Product description	PRODCOM code	Product description	Included into CBAM
7326	Other articles of iron or steel: – Forged or stamped, but not further worked:			

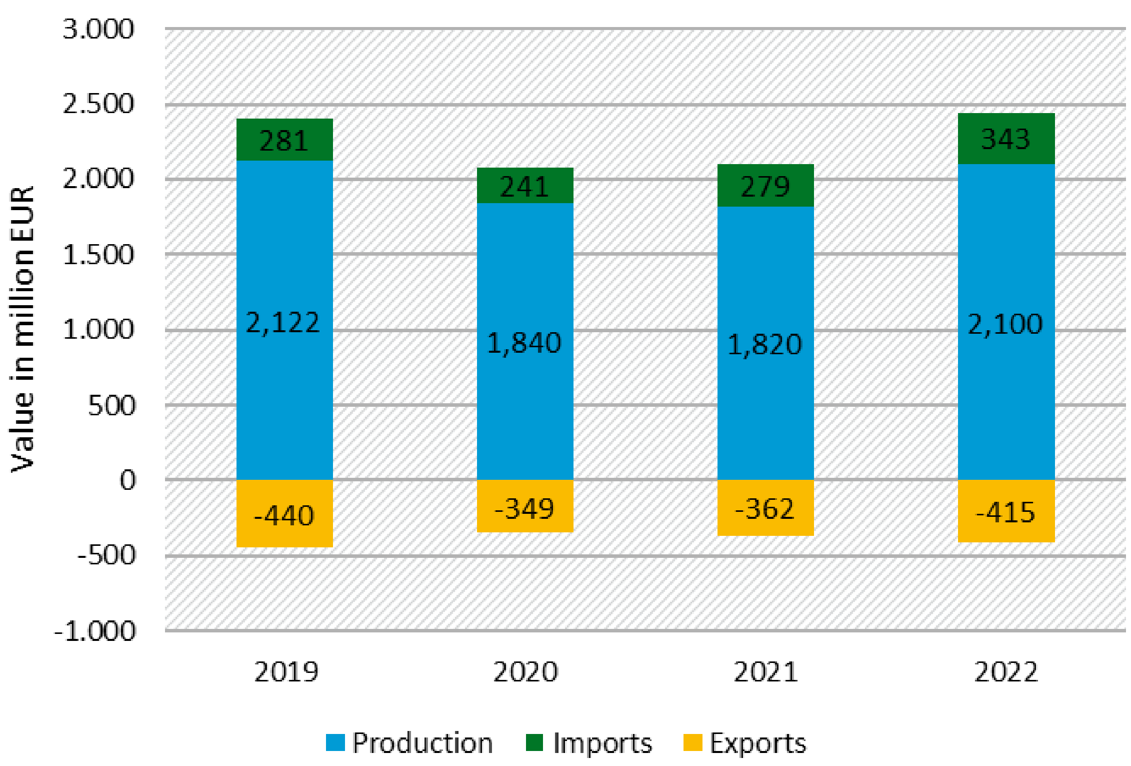
CN code	Product description	PRODCOM code	Product description	Included into CBAM
7326 11 00	– – Grinding balls and similar articles for mills	25992922	Forged or stamped articles of iron or steel, n.e.c.	Yes
7326 19	– – Other:			Yes
7326 19 10	– – – Open-die forged	25992922	Forged or stamped articles of iron or steel, n.e.c.	Yes
7326 19 90	– – – Other	25992922	Forged or stamped articles of iron or steel, n.e.c.	Yes

Source: Own compilation based on European Commission (2023)

The majority of forged or stamped articles of iron and steel are produced in the EU-27. Its production share in the domestic market amounts to 88% (compare Figure 8).

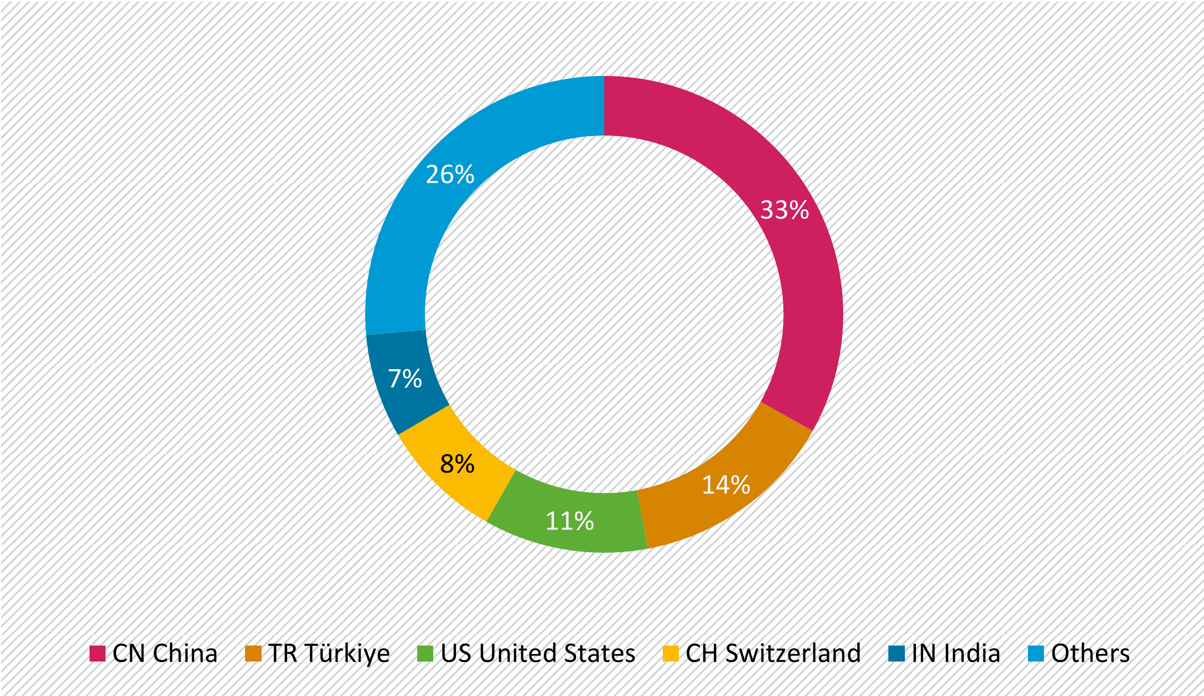
Based on COMEXT trade data, Figure 9 further dissects the import bar shown in Figure 8 for the year of 2022 by indicating the main countries of origin for extra-EU imports of crankshafts. These were China, Türkiye, the United States, Switzerland, and India. The case of Switzerland is a special one. Since the Swiss ETS is linked to the EU ETS, no CBAM obligation will apply to imports from Switzerland. This also holds for the non-EU countries of Norway, Iceland and Liechtenstein that participate in the EU ETS.

Figure 8 **European production, imports and exports of forged or stamped articles of iron and steel**



Source: Eurostat (2024b)

Figure 9 **Main countries of origin of Extra-EU imports for forged metal products in 2022 (based on value)**



Source: Eurostat (2024a)

2.5 Flat-rolled products

In this section, we look at flat-rolled products that are used as an input in the automotive value chain. Under the CN codes mentioned below, also sheet metal products can be included. Sheet metal forming is a non-cutting manufacturing technology applied to semi-finished steel products such as steel ingots. In the EU and Germany, a large part of the sheet metal formed products supply the automotive industry.

According to our interviewees in sheet metal forming, the sector has a complicated value chain. Often small companies buy from traders or cold rollers and not directly from the steel mill. They then deliver to suppliers who in turn deliver to car manufacturers. Therefore, in trade statistics, sheet metal forming is not well-represented meaning that they may appear in many different CN codes as products go through intermediaries. This is why we focus here on flat-rolled products which represent both inputs to sheet metal forming and – under the relevant CN codes – also contain sheet metal products.

Table 5 provides a comparison of how flat-rolled products are defined within the publicly available statistics from Eurostat. We focus on CN code 7211, which includes sheet metal products, but also some basic material products that serve as an input to sheet metal forming. In this sense, our analysis incorporates both semi-finished and finished steel products.

According to interviewees, sheet metal products are also included in CN codes that are not included under the CBAM, such as 73269098, as well as CN codes 85 and 87 as parts for cars and machinery.

Table 5 Definition of flat-rolled products

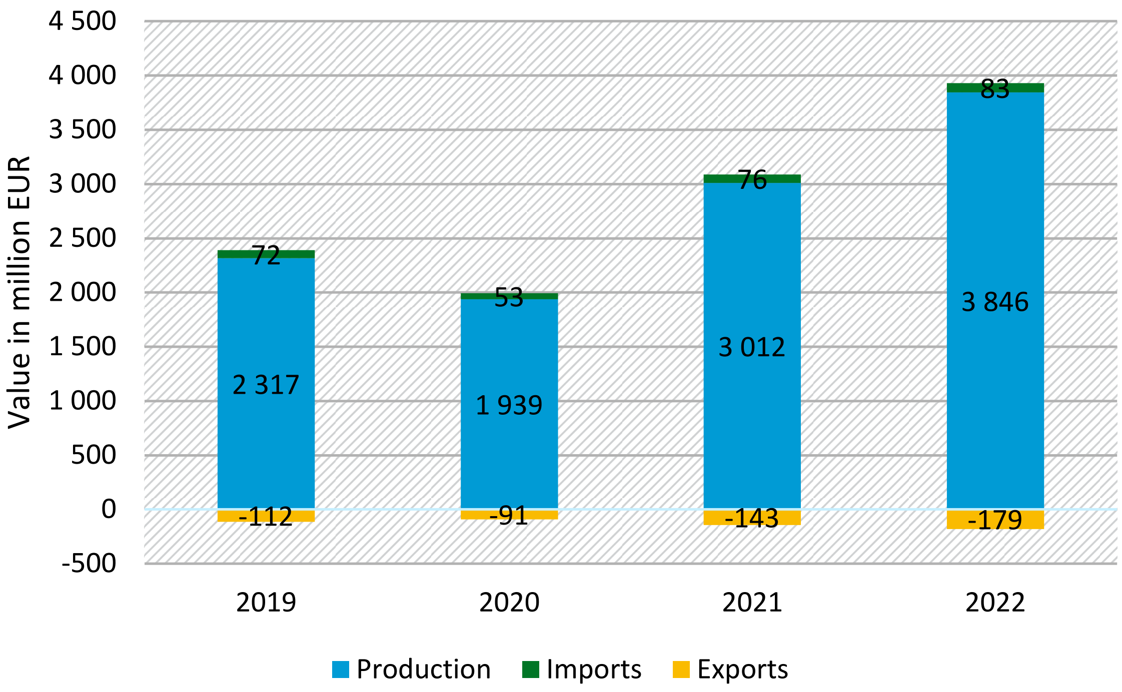
CN code	Product description	PRODCOM code	Product description	Included into CBAM
7211	Flat-rolled products of iron or non-alloy steel, of a width of less than 600 mm, not clad, plated or coated: – Not further worked than hot-rolled			
7211 13 00	– – Rolled on four faces or in a closed box pass, of a width exceeding 150 mm and a thickness of not less than 4 mm, not in coils and without patterns in relief.	24103210	Flat-rolled products of iron or non-alloy steel, simply hot-rolled, commonly known as 'wide flats'	Yes
7211 14 00	– – Other, of a thickness of 4.75 mm or more	24103230	Flat-rolled products of iron or non-alloy steel, simply hot-rolled (excluding 'wide flats')	Yes
7211 19 00	– – Other	24103230	Flat-rolled products of iron or non-alloy steel, simply hot-rolled (excluding 'wide flats')	Yes

Source: Own compilation based on European Commission (2023)

According to Vidovic et al. (2023) the iron and steel goods in Annex B.3 are covered by the CBAM and involve a rolling process. The majority of flat-rolled products for the domestic market are produced in the EU-27. Its production share in the domestic market amounts to more than 90% (Figure 10).

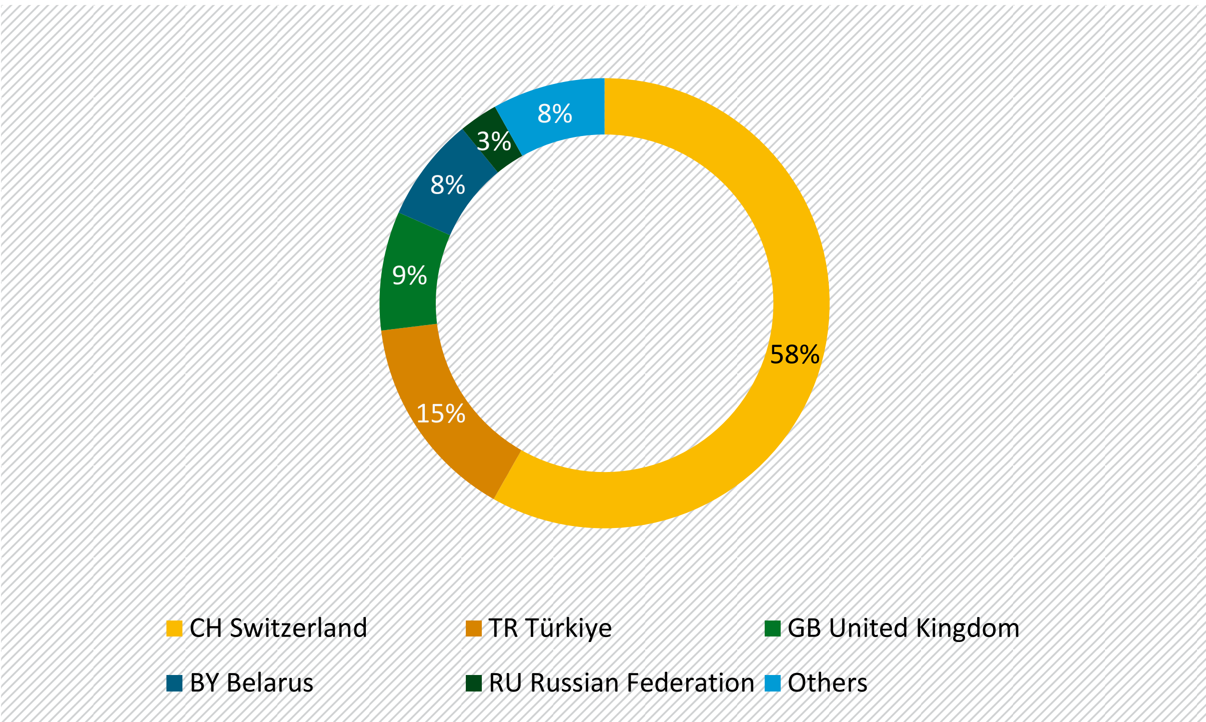
Based on COMEXT trade statistics, Figure 11 further dissects the import bar shown in Figure 10 for the year of 2022 by indicating the main countries of origin for extra-EU imports of crankshafts. These were Switzerland, Türkiye, the United Kingdom, Belarus and Russia. As noted above, since the Swiss ETS is linked to the EU ETS, no CBAM obligation will apply to imports from Switzerland.

Figure 10 European production, imports and exports of flat-rolled products



Source: Eurostat (2024b)

Figure 11 Main countries of origin of Extra-EU imports for flat-rolled products in 2022 (based on value)



Source: Eurostat (2024a)

3 Quantitative assessment of CBAM material share and costs

In the discussion note by the EU Commission for including further products in CBAM, the material content covered by CBAM and the proportion of carbon costs as a share of the total costs of producing them are mentioned as criteria that should be considered in relation to downstream extension. In this section, we shed further light on those aspects and quantify them where possible.

3.1 Material content covered by CBAM

The material content of the goods assessed in this study is based on the study by Stede et al. (2021). The study includes a list of 4476 sectors at 8-digit level in PRODCOM classification the share of materials that might be covered by CBAM including steel, aluminium, copper, plastics, paper and cement. Material shares do normally not add up to 100%, as further materials are not specified. For the products assessed in this study the values given for those materials included in the CBAM to date are shown in the table below.

We used both the literature review and the expert interviews in an attempt to verify the material content shares for the focus sectors of wheels, brakes and crankshafts. If the sector representatives confirmed the values, no additional information is provided. When they felt the shares were not representative, alternative values are shown (last two columns of Table 6).

Table 6 Material content of assessed products according to Stede et. al (2021) and sector representatives

		Stede et. al		Sector representatives	
Prodcom code	**Description**	**Material content steel**	**Material content aluminium**	**Material content steel**	**Material content aluminium**
24103210	Flat-rolled products of iron or non-alloy steel, simply hot-rolled, commonly known as 'wide flats'	98%	0%		
24103230	Flat-rolled products of iron or non-alloy steel, simply hot-rolled (excluding 'wide flats')	98%	0%		
25992922	Forged or stamped articles of iron or steel, n.e.c.	95%	0%		
28152230	**Cranks and crankshafts**	**80%**	**2%**	**100%**	
29323020	**Brakes and servo-brakes and their parts**	**70%**	**10%**		
29323036	Drive-axles with differential, non-driving axles and their parts	70%	10%		
29323040	**Road wheels and parts and accessories thereof**	**70%**	**10%**	**100% (steel wheel)**	**90% (aluminium wheel)**

		Stede et. al		Sector representatives	
29323063	Silencers and exhaust pipes; parts thereof	70%	10%		
29323067	Steering wheels, steering columns and steering boxes; parts thereof	70%	10%		

Source: Stede et al. (2021), interviews with sector representatives

For wheels we found that they are typically either steel wheels or aluminium wheels rather than a mix of both materials. According to our interview partner from the sector, wheels are either made entirely of aluminium alloy or of steel. This would make for an even higher share of CBAM material in wheels. Aluminium alloy also includes other materials like silicon; we estimate the share of aluminium in the aluminium alloy to be 90% (Tyresave n.d.).

For brakes including all parts, our interview partner confirmed that steel is the main material used. Aluminium plays a smaller role and tends to be used in, for example, the casing to reduce weight. Brake pads are typically a composite of different materials including materials not covered by the CBAM such as fibres, elastomers, graphites and resins. While the expert could not provide exact material shares, the order of magnitude given by Stede et al. (2021) was confirmed.

For cranks and crankshafts, sector representatives put the material content at 100% steel.

We can conclude that for all product groups assessed, the share of CBAM materials is high and might be even higher than estimated by Stede et al. (2021) for wheels and cranks and crankshafts.

3.2 Proportion of carbon costs as a share of the total cost of producing them

As an input to the estimation of the share of carbon costs in total production costs, we use the following information:

- Material content covered by CBAM;
- Emission intensity of these materials;
- The share of emissions to be covered by CBAM certificates;
- The carbon price; and
- Total production costs.

The previous section outlined the information obtained on **CBAM material content**. For those sectors for which interview partners highlighted a higher share of CBAM materials content, we include a sensitivity analysis into the quantification.

The **emission intensity of steel and aluminium production** depends on the production site of these materials. We have based the emission intensity of the production on the benchmarks set in the EU ETS 1 (first column in Table 7). The approach is complemented by information from a study Vidovic et al. (2023) the CBAM default values (second column in the table).

For the calculation based on benchmark values, we assume for steel that 20% scrap is used in a blast furnace route. Steel from an electric arc furnace would mean lower specific emissions. The emissions for aluminium are also based on the benchmarks and include PFC emissions as these are covered by the EU ETS 1 and the CBAM alike. Indirect emissions from electricity are not included. For more information on the way emissions are derived, see Graichen et al. (2022).

The benchmark is based on the 10% best performing installations within the EU. Alternatively, an average can be used to estimate emissions. The emissions of the average installation in the benchmarking curve are similar to the values for materials in primary form given by Vidovic et al. (2023) in their study informing the CBAM default values (furthermore also referred to as "JRC study"). According to Vidovic et al. (2023) the specific emissions estimated for the material in the study reflect that more material might be used in the production process than is included in the final product (e.g. due to cutting residues). Furthermore, Vidovic et al. (2023) take into account the energy needed to roll or forge the material as these emissions are also included into CBAM for covered products. Forging requires high temperatures and natural gas is used to generate the necessary heat. Rolling is less energy intensive, therefore the emission factor for flat products is much closer to the material in primary form. Again, only direct emissions are included in the table below.

Table 7 Emission intensity of steel and aluminium based on the benchmarks used for free allocation and the Vidovic et al. (2023) values

	Specific emission (t CO_2 / t product)					
	Based on benchmark curve		Based on JRC study informing CBAM default values			
Material	Material in primary form, benchmark	Material in primary form, average installation	Material in primary form	Rolled product	Forged product	Cast product
Steel	1.335	1.619	1.770	1.889	2.675	
Aluminium	1.598	1.816	1.870			1.888

Source: Graichen et al. (2022), Vidovic et al. (2023)

Note: Values are given for CN 7206 Iron and non-alloy steel in ingots or other primary forms and 7601 Unwrought aluminium

Below, we apply both the benchmark approach and the Vidovic et al. (2023) values to assess emission intensity. For road wheels, we assume the emission factor of rolled steel as steel wheels are made of sheet metal and metal plates. The same emission factor is applied to brakes, as the brake disc is produced out of a steel plate. The group is completed by the flat-rolled products.

Cranks are forged and therefore attributed the higher emission factor for forged steel. The same is true for forged or stamped articles not covered elsewhere, drive axles, silencers and exhaust pipes and steering wheels.

The combination of the share of CBAM materials (Table 6) and the specific emissions results in 1.1 to 1.4 t CO_2 per tonne of product (see Table 8).

Table 8 Emission per ton of product for different material shares and emission factors (t CO_2/t product)

	Based on benchmark EF	Based on JRC rolled steel EF	Based on JRC forged steel EF
98% steel	1,308	1,681	

	Based on benchmark EF	Based on JRC rolled steel EF	Based on JRC forged steel EF
95% steel	1,268		2,541
80% steel, 2% aluminium	1,100		2,178
70% steel, 10% aluminium	1,094	1,511	2,061
100% steel	1,335	1,889	
90% aluminium	1,438	1,699	

Source: Own calculation

The cost of the CBAM for importers depends both on the **share of emissions to be covered by CBAM certificates** and the **carbon price**. The CBAM is introduced with an increasing share of emissions to be covered.[9] In 2026, free allocation is reduced by 2.5%; in 2030 allocation will be roughly half of the benchmark value and from 2034 free allocation is phased out. The share of emissions covered by free allocation in the EU is deducted from the CBAM obligation of importers. For the estimate of carbon costs, we assume that all emissions are covered and the carbon price will stand at 100 € per t of CO_2e. We assume a cost pass-through of 100%.

It is difficult to locate **information on production costs**. As a proxy, we use the average production value based on statistical information by dividing the production value in Euro by their quantity provided in kg. It can be assumed that this value is higher than the production cost as it includes some profit or investment element. The assessment for the years 2019-2022 shows that values are quite constant over time; however, average production value per tonne differ substantially between Germany and the EU-27, especially in the case of brakes (see Table 9 and Annex B.1).

Table 9 Average production value in Euro per t of product for Germany and EU-27 (2019-2022)

PRODCOM code	Description	EU-27			Germany		
		Specific value (Euro/t product)					
		Production	Import	Export	Production	Import	Export
24103210	Flat-rolled products of iron or non-alloy steel, simply hot-rolled, commonly known as ‘wide flats’	658	769	890	n/a	782	930
24103230	Flat-rolled products of iron or non-alloy steel, simply hot-rolled (excluding ‘wide flats’)	770	799	895	851	784	911
25992922	Forged or stamped articles of iron or steel, n.e.c.	2 254	3 158	3 176	n/a	3 202	3 619
28152230	Cranks and crankshafts	8 565	5 462	6 631	9 479	4 035	4 817

[9] Article 10a (3) of Directive (EU) 2023/959, Official Journal of the EU 16th May 2023.

PRODCOM code	Description	EU-27			Germany		
29323020	Brakes and servo-brakes and their parts (excluding unmounted linings or pads)	5 993	3 160	6 614	10 555	4 002	5 695
29323036	Drive-axles with differential, non-driving axles and their parts	6 298	4 883	7 586	8 313	5 887	6 843
29323040	Road wheels and parts and accessories thereof	3 467	4 149	6 004	3 217	4 635	5 257
29323063	Silencers and exhaust pipes; parts thereof	8 270	11 421	16 292	8 227	9 721	19 345
29323067	Steering wheels, steering columns and steering boxes; parts thereof	12 066	11 217	18 017	10 608	13 741	18 349

Source: Own calculation Eurostat (2024b)

Table 8 provides estimations of the CBAM costs relative to production value for the EU-27 and Germany. The quantitative analysis covers three product groups covered by the CBAM and six groups that are not covered. The products with the highest share of carbon costs compared to production value (flat-rolled products and forged or stamped articles) are the ones covered by the CBAM. The cost impact on downstream products assessed appears to be limited in the short term with the additional cost equivalent to between 1 and 6 percent of the estimated product value with the highest values found for road wheels. The additional costs are significantly lower than those estimated for steel products further up the value chain in Graichen et. al 2022.

Table 10 Results for selected downstream products in Germany and EU-27 based on average 2019-2022 data

PRCCODE (Codes)	Description	Specific carbon costs (€ / t product)		Production value (€/ t product)	CBAM cost relative to production value EU-27		Production value DE (€/ t product)	CBAM cost relative to production value DE	
		Bench-mark	JRC	EU-27	Bench-mark	JRC	DE	Bench-mark	JRC
24103210	Flat-rolled products of iron or non-alloy steel, simply hot-rolled, commonly known as 'wide flats'	119	182*	658	18%	28%	856**	14%	21%
24103230	Flat-rolled products of iron or non-alloy steel, simply hot-rolled (excluding 'wide flats')	119	182*	770	15%	24%	851	14%	21%
25992922	Forged or stamped articles of iron or steel, n.e.c.	127	263*	2 254	6%	12%	3 410**	4%	8%
28152230	Cranks and crankshafts			8 565			9 479		
	80% steel, 2% aluminium	110	218		1%	3%		1%	2%
	100% steel	134	268		2%	3%		1%	3%
29323020	Brakes and servo-brakes and their parts	109	151	5 993	2%	3%	10 555	1%	1%
29323036	Drive-axles with differential, non-driving axles and their parts	109	206	6 298	2%	3%	8 313	1%	2%
29323040	Road wheels and parts and accessories thereof			3 467			3 217		
	70% steel, 10% aluminium	109	151		3%	4%		3%	5%
	100% steel	134	189		4%	5%		4%	6%
	90% aluminium	144	170		4%	5%		4%	5%

PRCCODE (Codes)	Description	Specific carbon costs (€ / t product)		Production value (€/ t product)	CBAM cost relative to production value EU-27		Production value DE (€/ t product)	CBAM cost relative to production value DE	
29323063	Silencers and exhaust pipes; parts thereof	109	206	8 270	1%	2%	8 227	1%	3%
29323067	Steering wheels, steering columns and steering boxes; parts thereof	109	206	12 066	1%	2%	10 608	1%	2%

Notes: * The specific carbon cost for goods already included in the CBAM list based on the JRC values are based on their publication (not calculated)

** No production value for Germany was reported, it is replaced by the average import and export value

Source: Own estimate based on Eurostat (2024b), Graichen et al. (2022), Stede et al. (2021), Vidovic et al. (2023).

4 Stakeholder interviews

Please note that in the following, we present a summary of the key takeaways from the interviews conducted. Therefore, the following sections comprise the view of the industry representatives, companies and experts that were interviewed. The guiding interview questions underlying our semi-structured interviews can be found in Annex A.[10]

Current impact of CBAM in interviewed sectors

Interviewees state that industry sectors work on small margins and that even small cost increases are seen as a risk to competitiveness. This is why the interviewed stakeholders in the wheels, brakes and crankshaft business expressed concerns about the costs which CBAM will add to basic material imports. It was also noted in the interviews that while EU importers of basic materials are aware that the CBAM will likely increase the cost of imports in the near term and that domestic and foreign producers may pass through initially higher costs of clean technology, not all are aware that domestic basic materials will likely also increase in price as free allocation is being phased out. As investment in clean technologies picks up and production becomes less carbon intensive, CO_2 costs in the EU will fall in the medium and long term.

More so than the carbon costs, interviewees highlighted the additional administrative costs associated with CBAM compliance. These administrative costs relate to the monitoring, reporting and verification (MRV) of the carbon emissions of imports. Good MRV is important to ensure that each reported tonne of CO_2 is indeed a tonne. As importers of the covered basic materials, interviewees point to considerable efforts undertaken to provide the information required in the CBAM reports. Interviewees state that they are dependent on their suppliers to provide the necessary information while being liable themselves. It should be noted that the use of standard emission values is generally possible under CBAM. In the transitional period, the use of actual emission values is encouraged. Obtaining those is seen as a further challenge.

In order to reduce the administrative burden, one interviewee suggested increasing the de-minimis rules (e.g. for import quantities below 1 t of product). The fact that standard emission factors can be used again after the transitional phase is also seen as important. It was also suggested that it would reduce the burden on importing companies if they themselves were not responsible for collecting data on emissions factors in third countries, but if there were an EU-wide register for which data is collected from importers.

Interviewees also note that CBAM costs already need to be included in the quotes for products that will be supplied in the future, although there is limited information on the actual emission intensity of suppliers and future carbon prices.

While producers of basic materials and finished steel products generally see the CBAM as an important tool for safeguarding the competitiveness of European industry, interviewees expressed their concerns that downstream production may be moved to third countries or that production facilities in those countries will be more heavily utilised.

Including downstream sectors into CBAM: Competitiveness considerations

One interviewee reflected on the fact that in the first drafts of the CBAM Regulation the original criteria for inclusion in the CBAM were that the product is i) covered by the EU ETS 1 ii) trade

[10] At the time of conducting the interviews (February – June 2024), the transitional phase of CBAM had just started and CBAM declarants faced the challenge to report actual values for emission intensities. In summer 2024, the EU Commission introduced provisions to address these difficulties during the transitional phase. For the definitive phase starting as of January 2026, default values are principally permitted. Moreover, the first "Omnibus"-Initiative by the EU Commission aims at introducing far reaching simplifications in the context CBAM, including an ample de-minimis rule (https://commission.europa.eu/publications/omnibus-i_en). At the time of writing, the proposals are still being discussed and their adoption is foreseen for the summer of 2025.

intensive and has iii) a carbon leakage risk. In its current form, the CBAM includes a number of products that are not in the EU ETS 1 (such as forged and sheet metal products). It was noted that when CBAM is extended further down the value chain, there need to be clear criteria for the products covered and those excluded. Emissions and trade intensity were often mentioned as the relevant criteria that should be used to determine downstream inclusion.

At present, the separation in coverage of the CBAM along the value chain is seen by a number of interviewees as problematic since it could expose downstream suppliers to international competition without a level playing field. Thus, there are concerns amongst a number of interview partners that certain producers along the value chain will relocate to non-EU countries or imports of the relevant products will increase. Especially basic material producers stressed that the downstream extension needs to be implemented before the CBAM starts in 2026.

Careful consideration of whether and how the CBAM scope should be extended to downstream sectors is necessary to prevent unintended consequences. The challenge is to define the point in the value chain to which the CBAM should be extended. Interviewees note that the further down the value chain, the lower the embedded carbon costs and the greater the importance of non-material costs in a product (R&D). Those in favour of an extension further down the value chain noted that the whole vehicle should not be included but intermediate products and assembled parts should be included.

In the forging sector, a number of products are already covered by the CBAM, e.g. CN codes 7326 and 7616. Interviewees explained, however, that their products can reasonably be declared under other CN codes (e.g. 8707). In this context, interviewees note that if the CBAM is extended, it needs to be ensured that the system cannot be circumvented simply by declaring products under another CN code. Interviewees suggest that to mitigate these risks, the Commission should monitor the traded volumes under the different CN codes to detect circumventions.

Several interviewees also voiced the concern that if the CBAM were extended further down the value chain, EU automotive suppliers could lose access to third country markets in case of retaliation to an expansion of the CBAM to downstream products.

Including downstream sectors in the CBAM: additional administrative costs

Not all interviewees were in full favour of an extension down the value chain, especially those producing automotive parts. Reluctance about such an extension is related to the additional administrative burden that would arise as the CBAM is extended. This is because data of different installations that deliver the basic materials for the downstream products would have to be aggregated and reported. In this context, it was also suggested that if further downstream products are to be included, the emissions reporting would have to be simplified. It could be based on the basic input material share and default emission values (like the analysis carried out in this study). The further downstream a product is situated, the more difficult it is to estimate and verify the embedded carbon emissions. Furthermore, it was suggested that the increase of the existing de-minimis rule to a higher value would aid the extension of CBAM downstream.

Established trade flows and competitiveness aspects

The interviewed European producers of automotive parts state that they are generally not protected from risks of carbon leakage through specialisation: A lot of techniques are well-established and new techniques tend to diffuse rapidly. In this context, Chinese manufacturers were mentioned both in relation to wheels and brakes, as well as to basic and finished steel products. Similarly, the grade of steel required for the production of crankshafts would not protect producers in the EU from international competition according to our interviewees.

The interviewed European producers of automotive parts further state that the lack of protection by means of (technology-based) competitive advantage means that the price of the components is key, which is why European producers are concerned about price increases related to carbon costs. If prices change significantly, the interviewed producers expressed concerns that a shift in trade flows may occur, away from the traditionally 'local for local' strategy in the automotive sector. One interviewee noted that 100% of CBAM costs may not be passed on along the value chain, but that bargaining power at the different steps of the chain may determine where the CBAM costs end up.

In all interviews it became clear that these considerations related to the EU ETS and CBAM arise against the backdrop of general market developments in the automotive industry with a stagnating European market. High energy and labour costs in Europe and subsidies in third countries were mentioned as general challenges in the basic materials and automotive sector. It was also noted by interviewees that the move to more electric vehicles will impact the demand for certain parts as, for example, crankshafts are not needed in them. Other automotive parts may face different requirements, e.g. due to the increased weight of battery electric vehicles.

5 Conclusions

The automotive value chain in Germany and Europe is already impacted by CBAM. On the one hand, during the current transitional phase, importers of basic material products need to report embedded emissions and collect the relevant information. They are also starting to reflect expected carbon and CBAM costs in quotes. On the other hand, especially producers of basic materials and finished steel products note that clients take into account future CBAM costs and express their concerns that a relocation of production and trade flows may be one consequence of the CBAM. Since the CBAM covers only products located at a relatively early stage in the automotive value chain, there are concerns that certain producers along the value chain will relocate to non-EU countries or that imports of products not covered by CBAM to the EU will increase. This brings about a risk of carbon leakage as production is moved to third countries which do not have a carbon price.

For all products examined, there is a strong European market and this 'local for local' strategy in the automotive sector was also confirmed in the interviews. For most products, there is also relevant imports from countries that are not part of the EU ETS or are not linked to it. Important Extra-EU trade partners related to the import of automotive parts into the EU are Türkiye (wheels and forged products), China (brakes) and India (crankshafts). Interviewees noted that while the 'local for local' strategy still holds today, there are concerns that shifts in production and trade flows will be observed as there is some flexibility in moving production to third countries as the competitiveness of most products in the EU and Germany is not protected by specialisation. High energy and labour costs, as well as industry subsidies in third countries were named as factors that present challenges to the European and German automotive industry. In all interviews it was clear that the discussions about the ETS and CBAM occur against the backdrop of the overall economic situation.

In our quantitative analysis, we examine the emissions and the importance of trade compared to domestic production as two relevant dimensions for the decision on the inclusion of downstream sectors into CBAM. We estimate the emissions intensity and the carbon cost share in total production cost as a measure for exposure. This cost share decreases the further down the value chain one moves as the cost share of material and energy inputs diminishes, and the cost share of non-material inputs (e.g. R&D) increases. We estimate the carbon cost share in total production for nine PRODCOM codes, covering three products in the sheet metal and forging sectors that are already covered by CBAM and six products, not yet in the CBAM scope, that represent automotive parts (wheels, brakes, crankshafts, drive axles, steering wheels and silencers). We find that the products with the highest share of carbon cost compared to production value are flat-rolled products at 14–28% (depending on the emissions intensity and regional focus) and forged products at 4–12%. The cost share in the automotive parts sectors examined ranges from 1–6%, with road wheels at the higher end. These figures comprise cost shares at a carbon price of 100 EUR/tCO_2 and with a 100% implementation of the CBAM and therefore overestimate the CBAM impact at the beginning of the system.

The wide range of results per product shows that quantitative analysis of the cost content depends strongly on assumptions about emission intensities and product prices. Even if the cost share can be identified in a robust manner, there will be a challenge in identifying the threshold value deemed relevant for inclusion in the CBAM, i.e. which cost mark-up would be too high for EU industry to stay competitive and thus enable carbon leakage? Interview partners noted that the sector operates on small margins and that even small cost increases have the potential to hurt competitiveness. In addition to desk research and expert interviews, a workshop was held on 23 September 2024 where representatives of industry associations, the Federal Ministry for

Economic Affairs and Climate Change (BMWK), the German Federal Environment Agency / German Emissions Trading Authority, Öko-Institut, Ecologic Institute and The Climate Desk participated. The discussions widely confirmed the approach of the present analysis, quantitative and qualitative findings as well as the criteria to be considered for identifying products to be included (see below).

As next steps related to defining relevant criteria to identify products the CBAM could be extended to, we suggest to:

- Elaborate further on the emission and trade intensity as criteria for the inclusion of further products.
  - The wide range of results on CBAM costs per production costs in our analysis shows that results are sensitive to assumptions on emission intensities and product prices. Further work is needed to arrive at robust cost shares per product.
  - Once robust cost shares are estimated, a suitable threshold value needs to be elaborated that could mark the inclusion or non-inclusion into the CBAM scope.
  - As the goal of the downstream extension of CBAM is to protect the EU's internal market from carbon leakage, the trade intensity criterion may be further developed into an import intensity criterion for the purposes of this extension.

The expansion of the CBAM to include additional products and therefore other CN codes may also be driven by the fact that products that are already covered by the CBAM (e.g. forged products under CN codes 7326 and 7616) can reasonably be declared under other CN codes (e.g. 8707). If this is indeed the case, it may be a strong argument for including the additional CN codes regardless of a specific threshold value for emission intensity or carbon cost to avoid circumvention of the mechanism.

As next steps related to avoiding circumvention of CBAM, we suggest to:

- Analyse the risk of circumvention of the CBAM by declaring products under different CN codes: If this risk is large, then additional products may have to be included regardless of their current emissions or trade (import) intensity. Trade flows need to be closely monitored to detect possible circumvention activity.
  - For new products to be included on the basis of their emissions and trade or import intensity, one should in turn analyse, whether the circumvention risk by declaring under alternative CN codes is large. In case circumvention risk is deemed large and hard to abate, there may be a lower tendency to include these additional products.

The extension of the CBAM to include further downstream products would increase the administrative costs of European importers of these products. Interviewees report that already today, importers of covered products face considerable administrative costs in gathering all relevant information from their suppliers, setting up reporting systems and integrating CBAM processes and expected costs into their overall production processes.

If the CBAM is extended to further products, importers of these products would have to make sure that data of different installations that deliver the basic materials for the downstream products is aggregated and reported. It was also suggested that if further downstream products are to be included, the emissions reporting would have to be simplified. The return to default emission factors after the transitional phase helps in this context. The further downstream a product is situated, the more difficult it is to estimate and verify the embedded carbon emissions. It was also suggested that the current de-minimis rules should be adjusted in order to exclude small import quantities from reporting requirements and compliance.

On the one hand, the correct monitoring, reporting and verification (MRV) is an integral part of the mechanism, on the other hand reporting requirements need to be kept at a reasonable level.

As next steps related to making the CBAM more administratively feasible, we suggest to:

- Check how administrative costs could be reduced by increasing the current de-minimis rule that is linked to general requirements for importers and introducing a de-minimis rule specific to the CBAM.
- Take into account the expected administrative costs of including additional products vs. the additional benefits of including them. Possible criteria to assess this cost-benefit ration include i) the cumulative emissions of the product (i.e. its relevance for climate protection), ii) the number of import transactions and the cost per transaction, iii) the number of upstream steps that precede the product in question and iv) the number of input factors already covered by CBAM.

Several interviewees also voiced the concern that if CBAM was extended further down the value chain, EU automotive suppliers could lose access to third country markets in case of retaliation to an expansion of the CBAM to downstream products.

As a next step related to possible retaliation by third countries in case of CBAM extension, we suggest to:

- Evaluate the risk of retaliation in response to the CBAM extension.

These questions should ideally be answered before the CBAM starts in 2026. In general, a possible extension should be introduced in a step-wise manner to keep the process administratively feasible.

It should be kept in mind that all of these considerations take place against the backdrop of general market developments in the automotive industry with a stagnating European market, high energy and labour costs in Europe and industry subsidies in third countries.

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A Guiding interview questions

A.1 Basic material producers

- Do you produce downstream products next to basic materials? If not, concerning downstream products, do you speak on behalf of your clients?
- How have you been affected by CBAM and what is your experience so far?
- Can you clarify the different impacts CBAM, its introduction and possible expansion has along your value chain?
- Where do you see the advantages and disadvantages of CBAM for your company? As a producer of raw materials? As a producer of downstream products?
- As a producer? As an exporter? As an importer?
- Is the assessment different for different products?
- Does this depend on (i) emissions intensity (ii) export / trade intensity (iii) the administrative ease with which CBAM could be introduced at the downstream level?
- Is your view specific to the iron/steel sector?
- Do you expect that third country competition in downstream products will increase as a consequence of CBAM? What is the implication for EU producers?
- Where do you see the greatest risk of CL, i.e. in which products or product groups, and why?
- What criteria speak in favour of/against the inclusion of those goods at risk? As a producer of basic materials, do you see the risk that your clients may relocate outside the EU where these materials can be bought without a carbon mark-up?
- In terms of overall product value or production cost, what is a critical cost increase that would cause producers to lose competitiveness? Are there different levels of sensitivity across products/product groups?
- How quickly do you expect markets outside the EU to catch up in terms of carbon pricing?
- What about the downstream products? Are all product and product groups affected or do you see certain products or product groups most at risk?
- Would you see the downstream automotive industry at risk? All products/products groups or only certain ones? Which products among the vehicle parts are particularly affected?
- Who would be most affected by the administrative cost of including downstream products into CBAM? The importers of these goods? Would the balance between inclusion / exclusion be different for those that only import and those that both produce and import?
- Assuming that the administrative burden of including downstream products into CBAM would be the biggest barrier: Are there downstream products where the production process is so complex that it would be hard to include them? Others where this is not the case?

- Our experience from interviews shows that there seem to be some downstream products that state very clearly that they would like to be included into CBAM while others are more cautious. Why do you think this difference exists? What does it depend on?
- Are there alternatives to including downstream products into CBAM?
- How much of a competitive advantage does the EU have with regards to the specialisation of its industry? Its downstream products?
- Given the aspiration to phase out the use of the internal combustion engine in Europe, how is the industry in Europe responding? Changing products or resending them to outside the EU?

A.2 Forging and sheet metal forming

- Can you tell us where in the value chain the companies you represent stand?
- Can you tell us a little bit about the companies you buy from and about your clients? Where are they located? What industry do they belong to? Has the structure been stable or changed during the last years and decades?
- How much of a competitive advantage does the EU have with regards to the specialisation of its industry? Its downstream products?

Impacts of CBAM

- How have you been affected by CBAM and what is your experience so far?
- Are the products your association represents included into CBAM? Which ones are and which ones are not?
- What is your experience with CBAM related to buying products / materials? What is your experience to selling products?
- Where do you see the advantages and disadvantages of CBAM for the companies your association represents?
- Do you expect that third country competition in downstream products will increase as a consequence of CBAM? What is the implication for EU producers?
- Do you already see reactions, i.e. relocation as a reaction to CBAM? Do the companies that you represent react themselves? Are there plans to relocate? What about client industries?
- Is your view specific to the iron/steel sector?

Extending CBAM down the value chain

- Where do you see the advantages and disadvantages of extending CBAM to further products for the companies your association represents?
- Is the assessment different for different products?
- Does this depend on (i) emissions intensity (ii) export / trade intensity (iii) the administrative ease with which CBAM could be introduced at the downstream level?

- Our experience from interviews shows that there seem to be some downstream products that state very clearly that they would like to be included into CBAM while others are more cautious. Why do you think this difference exists? What does it depend on?
- In terms of overall product value or production cost, what is a critical cost increase that would cause producers to lose competitiveness? Are there different levels of sensitivity across products / product groups?
- Is your view specific to the iron/steel sector?

Administrative cost

- What is your experience with the administrative cost of CBAM so far?
- Who would be most affected by the administrative cost of including downstream products into CBAM? Would the companies you represent be affected? What about their clients?
- Assuming that the administrative burden of including downstream products into CBAM would be the biggest barrier: Are there downstream products where the production process is so complex that it would be hard to include them? Others where this is not the case?
- Which other barriers exist? E.g. related to standardisation, monitoring, CN Codes?
- Are there alternatives to including downstream products into CBAM?

A.3 Wheels, brakes and crankshafts

Wheels

- Are you (or your members) affected by CBAM so far and in what regard?
- Within the literature we found evidence that aluminium penetration in wheels was in the year 2000 for European vehicles about 30%. What is a more up to date ratio?
- What are the main differences in the customer market for steel and aluminium wheels. Is it likely that they will co-exist as options or could one material dominate the market in the future?
- The literature review suggests that car wheels are produced by external suppliers and then assembled at the car manufacture site. Is this generally, correct? If so, who are the main players supplying wheels in the European automotive industry?
- If these suppliers are based in Europe, is it likely that third country competition will increase as a consequence of the CBAM? What is the implication for EU producers if basic materials such as steel/aluminium become more expensive in EU because of the carbon price?
- How much of a competitive advantage does the EU have with regards to the specialisation of their wheel products? Within the literature we see advanced techniques such as flow forming for steel and the use of reduced rim technology in alloys, would such processes be difficult to replicate for competitors outside of the EU?
- Are there concerns that certain high grades of materials (i.e. such as HSLA steel) may not be available in the future, impacting competitiveness? What is the share of BOF/BF steel used for the production of road steel wheels compared to the EF route?

- Germany is a net-importer of road wheels, the majority of which originates from intra-EU trade reflecting the regional interconnected nature of the EU's automotive value chain. However, around 20% of average 2019-22 imports originated from Turkey. Can you help us explain this trend?
- Is it mainly a consequence of Maxion wheels operating a plant in Turkey (refer to https://www.maxionwheels.com/locations/manisa-turkey)? What made this an attractive place to invest?

Brakes

- Are you (or your members) affected by CBAM so far and in what regard?
- Within the literature we learned that the production of brake discs is primarily made from steel whilst the composition of brake pads is much more complex and varies by application. Is this correct? Innovations regarding the use of particle-reinforced aluminium matrix composite materials, which - due to their special property characteristics – could be more promising for applications in brake discs and drums. Could you envisage aluminium substituting for steel in the future?
- The literature review suggests that brakes are produced by external suppliers and then assembled at the car manufacture site. Is this generally, correct? If so, who are the main players supplying brakes in the European automotive industry?
- If these suppliers are based in Europe, is it likely that third country competition will increase as a consequence of the CBAM? What is the implication for EU producers?
- How much of a competitive advantage does the EU have with regards to the specialisation of brake disc products? Within the literature we see advanced techniques, especially for the composition of brake pad materials, would such processes be difficult to replicate for competitors outside of the EU?
- Are there concerns that certain high grades of materials (i.e. such as HSLA steel) may not be available in the future, impacting competitiveness? What is the share of BOF/BF steel used for the production of brake discs compared to the EF route?
- Concerns have recently been raised with regards to a dependence on China for certain imports (refer to https://www.ft.com/content/4b7ad09a-b05c-4651-b6ff-43a448a9bd76). Could you discuss this further?

Crankshafts

- Are you (or your members) affected by CBAM so far and in what regard?
- Within the literature we learned that the production of crankshafts is primarily made from iron or steel. Is this correct?
- The literature review suggests that crankshafts are produced by external suppliers and then assembled at the car manufacture site. Is this generally, correct? If so, who are the main players supplying crankshafts in the European automotive industry?
- If these suppliers are based in Europe, is it likely that third country competition will increase as a consequence of the CBAM? What is the implication for EU producers?

- How much of a competitive advantage does the EU have with regards to the specialisation of crankshaft products? Within the literature we see advanced techniques, especially with regards to design optimization and the forming simulation and forging process optimization. Any other processes?
- Are there concerns that certain high grades of materials (i.e. such as HSLA steel) may not be available in the future, impacting competitiveness? What is the share of BOF/BF steel used for the production of crankshafts compared to the EF route?
- Given the aspiration to phase out the use of the internal combustion engine in Europe, how is the industry in Europe responding? Changing products or resending them to outside the EU?
- Concerns have recently been raised with regards to a dependence on China for certain imports (refer to https://www.ft.com/content/4b7ad09a-b05c-4651-b6ff-43a448a9bd76). Could you discuss this further as well as the high volume of imports from India in 2022?

To be added as a final question for all product (categories):

- We are also interested in learning about the complexity of the production process and the value chain to understand the challenges with expanding the CBAM to cover more sectors downstream. Would you prefer your product/product category to be included in the CBAM or rather not? What advantages/disadvantages do you see from an economic point and/or from an administrative perspective?
- How high is the share of sales to extra-EU customers? Against the background of a possible inclusion of your product/product category, what would the implications be if there are no carbon export rebates?

B Quantitative assessment

B.1 Specific product value

Table 11 Specific product value (€/t product), EU-27, 2019-2022

PRODCOM code	Description	Year	Pro-duction	Import	Export
			Specific value (€ / t product)		
24101100	Pig iron and spiegeleisen in pigs, blocks or other primary forms	2019	199	336	455
		2020	375	301	331
		2021	500	475	451
		2022	400	582	746
24103210	Flat-rolled products of iron or non-alloy steel, simply hot-rolled on four faces or in a closed box pass, not clad, plated or coated, of a width of > 150 mm but < 600 mm and a thickness of >= 4 mm, not in coils, without patterns in relief, commonly known as 'wide flats'	2019	512	590	731
		2020	512	537	641
		2021	500	810	921
		2022	1 108	1 140	1 267
24103230	Flat-rolled products of iron or non-alloy steel, of a width < 600 mm, simply hot-rolled, not clad, plated or coated (excluding 'wide flats')	2019	674	605	725
		2020	611	568	708
		2021	771	931	877
		2022	1 024	1 092	1 268
25992922	Forged or stamped articles of iron or steel, n.e.c.	2019	2 356	3 064	3 201
		2020	2 165	2 697	2 879
		2021	2 275	2 955	2 886
		2022	2 222	3 915	3 740
28152230	Cranks and crankshafts	2019	7 695	4 978	6 415
		2020	8 659	5 722	6 613
		2021	8 462	4 956	6 402
		2022	9 444	6 192	7 094
29323020	Brakes and servo-brakes and their parts (excluding unmounted linings or pads)	2019	5 725	3 004	6 612
		2020	5 296	2 975	6 468
		2021	7 500	3 193	6 396
		2022	5 452	3 469	6 980
29323036		2019	6 675	4 856	7 266

PRODCOM code	Description	Year	Pro-duction	Import	Export
	Drive-axles with differential, non-driving axles and their parts	2020	6 500	4 731	7 449
		2021	6 084	4 722	7 572
		2022	5 934	5 222	8 056
29323040	Road wheels and parts and accessories thereof	2019	3 489	3 913	5 662
		2020	3 391	3 744	5 435
		2021	3 489	3 941	5 808
		2022	3 498	4 997	7 111
29323063	Silencers and exhaust pipes; parts thereof	2019	7 640	11 245	14 409
		2020	7 232	11 701	15 830
		2021	8 696	10 514	16 467
		2022	9 512	12 222	18 461
29323067	Steering wheels, steering columns and steering boxes; parts thereof	2019	11 487	11 194	17 607
		2020	11 953	11 154	17 978
		2021	12 298	10 665	18 031
		2022	12 527	11 855	18 453
243210Z1	Cold-rolled narrow strip and cold-rolled slit strip, of non-alloy steel and of alloy steel (other than stainless steel), of a width < 600 mm	2019	1 116	1 219	1 967
		2020	992	1 496	1 991
		2021	1 215	1 639	2 148
		2022	1 697	1 799	2 727

Source: Eurostat (2024b)

Table 12 Specific product value (€/t product), Germany, 2019-2022

PRODCOM code	Description	Year	Pro-duction	Import	Export
			Specific value (€ / t product)		
24101100	Pig iron and spiegeleisen in pigs, blocks or other primary forms	2019		373	379
		2020		319	314
		2021		493	457
		2022		621	711
24103210	Flat-rolled products of iron or non-alloy steel, simply hot-rolled on four faces or in a closed box pass, not clad, plated or coated, of a width of > 150 mm but < 600 mm and a thickness of >= 4 mm, not in	2019		618	736

PRODCOM code	Description	Year	Pro-duction	Import	Export
	coils, without patterns in relief, commonly known as 'wide flats'				
		2020		561	706
		2021		812	952
		2022		1 139	1 328
24103230	Flat-rolled products of iron or non-alloy steel, of a width < 600 mm, simply hot-rolled, not clad, plated or coated (excluding 'wide flats')	2019	739	655	767
		2020	649	575	712
		2021	822	781	906
		2022	1 193	1 123	1 258
25992922	Forged or stamped articles of iron or steel, n.e.c.	2019		3 132	3 926
		2020		2 921	3 159
		2021		3 059	3 489
		2022		3 695	3 903
28152230	Cranks and crankshafts	2019	9 333	3 936	4 655
		2020	10 090	4 086	4 650
		2021	8 683	3 659	4 583
		2022	9 812	4 457	5 379
29323020	Brakes and servo-brakes and their parts (excluding unmounted linings or pads)	2019	11 490	4 160	5 494
		2020	10 373	3 889	5 566
		2021	9 881	3 919	5 672
		2022	10 477	4 039	6 048
29323036	Drive-axles with differential, non-driving axles and their parts	2019		6 095	6 683
		2020		5 786	6 939
		2021	8 767	5 623	6 784
		2022	7 859	6 045	6 965
29323040	Road wheels and parts and accessories thereof	2019	3 014	4 510	5 113
		2020	3 022	4 298	4 967
		2021	3 156	4 394	5 131
		2022	3 676	5 339	5 817
29323063	Silencers and exhaust pipes; parts thereof	2019		9 055	16 110
		2020		8 993	18 452
		2021	7 095	9 635	21 193

PRODCOM code	Description	Year	Pro-duction	Import	Export
		2022	9 360	11 201	21 627
29323067	Steering wheels, steering columns and steering boxes; parts thereof	2019	9 870	13 493	17 826
		2020	10 566	13 206	18 775
		2021	10 583	13 179	18 484
		2022	11 412	15 087	18 311
243210Z1	Cold-rolled narrow strip and cold-rolled slit strip, of non-alloy steel and of alloy steel (other than stainless steel), of a width < 600 mm	2019	1 139	1 275	1 188
		2020	1 102	1 117	1 117
		2021	1 287	1 414	1 404
		2022	1 728	1 950	1 863

Source: Eurostat (2024b)

B.2 Forged iron and steel products and their emission intensities

According to According to Vidovic et al. (2023), the direct emission intensity of the forging processes range from 2.55 to 2.91 t CO_2 per t of product with the exemption of 'other tube or pipe fittings' (CN code 7307 19 90) The average direct emission intensity without the outlier amounts to 2.675 t CO_2 per t product.

Table 13 Emission intensity of forged iron and steel products covered by CBAM, EU-27 values

Product CN Code	CN description (4-digit level)	JRC description	Emission intensity (t CO_2 per t product)		
			Direct	Indirect	Total
7207 11 90 7207 12 90 7207 19 19 7207 20 19 7207 20 39 7207 20 59	Semi-finished products of iron or non-alloy steel	Forgings	2.63	0.35	2.98
7214 10 00	Bars and rods, of iron or non-alloy steel, not further worked than forged, hot-rolled, hot-drawn or hot-extruded, but incl. those twisted after rolling (excl. in irregularly wound coils)	Forgings	2.63	0.35	2.98
7218 10 00 7218 99 19 7218 99 80	Stainless steel in ingots or other primary forms (excl. remelting scrap ingots and products obtained by continuous casting); semi-finished products of stainless steel	Ingots and forgings	2.91	1.16	4.07

Product CN Code	CN description (4-digit level)	JRC description	Emission intensity (t CO_2 per t product)		
7222 30	Other bars and rods of stainless steel; angles, shapes and sections of stainless steel, n.e.s.	Forgings	2.91	1.16	4.07
7224 10 7224 90 18 7224 90 90	Steel, alloy, other than stainless, in ingots or other primary forms, semi-finished products of alloy steel other than stainless (excl. waste and scrap in ingot form, and products obtained by continuous casting)	Ingots and forgings	2.57	0.39	2.96
7228 10 50 7228 40	Other bars and rods of alloy steel other than stainless, angles, shapes and sections of alloy steel other than stainless, n.e.s.; hollow drill bars and rods, of alloy or non-alloy steel	Forgings	2.57	0.39	2.96
7307 11 7307 19 10	Tube or pipe fittings "e.g. couplings, elbows, sleeves", of iron or steel	Forgings of cast iron	2.55	0.33	2.88
7307 19 90	Tube or pipe fittings "e.g. couplings, elbows, sleeves", of iron or steel	Forgings of cast steel	0.94	0.55	1.49
7326 11 00 7326 19 7326 90 92 7326 90 94 7326 90 96	Articles of iron or steel, n.e.s. (excl. cast articles)	Forged, stamped, or sintered	2.63	0.35	2.98

Source: Vidovic et al. (2023)

B.3 Rolled products and their emission intensity

According to According to Vidovic et al. (2023), the direct emission intensity of the rolling processes (including prime material emissions) range from 1.780 to 1.880 t CO_2 per t of product for iron and non-alloy steel. Stainless steel requires higher temperature levels and thus causes higher emissions: their emission intensity is of 2.130-2.160 t CO_2 per t of product. The average direct emission intensity without the outlier amounts to 1.889 t CO_2 per t product.[11]

Table 14 Emission intensity of flat iron and steel products covered by CBAM, EU-27 values

Product CN Code	CN description	JRC description	Emission intensity (t CO_2 per t product)		
			Direct	Indirect	Total
7208	Flat-rolled products of iron or non-alloy steel, of a width >= 600 mm, hot-rolled, not clad, plated or coated	Iron or non-alloy steel; flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated	1.82	0.12	1.94
7209	Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, cold-rolled "cold-reduced", not clad, plated or coated	Iron or non-alloy steel; flat-rolled products, width 600mm or more, cold-rolled (cold-reduced), not clad, plated or coated	1.85	0.16	2.01
7210	Flat-rolled products of iron or non-alloy steel, of a width >= 600 mm, hot-rolled or cold-rolled "cold-reduced", clad, plated or coated	Iron or non-alloy steel; flat-rolled products, width 600mm or more, clad, plated or coated	1.88	0.17	2.06
7211 13 00 7211 14 00 7211 19 00	Flat-rolled products of iron or non-alloy steel, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced", not clad, plated or coated	Hot-rolled flat products	1.82	0.12	1.94
7211 23 7211 29 00 7211 90	Flat-rolled products of iron or non-alloy steel, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced", not clad, plated or coated	Cold-rolled and annealed flat products	1.85	0.16	2.01

[11] There is one outlier (7308 Structures and parts of structures "e.g., 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) with a direct emission intensity of 2.46 t CO_2 per t of product.

Product CN Code	CN description	JRC description	Emission intensity (t CO_2 per t product)		
7212	Flat-rolled products of iron or non-alloy steel, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced", clad, plated or coated	Iron or non-alloy steel; flat-rolled products, width less than 600mm, clad, plated or coated	1.88	0.17	2.06
7218 91 7218 99 11 7218 99 20	Stainless steel in ingots or other primary forms (excl. remelting scrap ingots and products obtained by continuous casting); semi-finished products of stainless steel	Hot-rolled flat products	2.13	0.95	3.07
7219 11 00 7219 12 7219 13 7219 14 7219 21 7219 22 7219 23 00 7219 24 00	Flat-rolled products of stainless steel, of a width of >= 600 mm, hot-rolled or cold-rolled "cold-reduced"	Hot-rolled flat products	2.13	0.95	3.07
7219 31 00 7219 32 7219 33 7219 34 7219 35 7219 90	Flat-rolled products of stainless steel, of a width of >= 600 mm, hot-rolled or cold-rolled "cold-reduced"	Cold-rolled and annealed flat products	2.16	0.98	3.15
7220 11 00 7220 12 00	Flat-rolled products of stainless steel, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced"	Hot-rolled flat products	2.13	0.95	3.07
7220 20 7220 90	Flat-rolled products of stainless steel, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced"	Cold-rolled and annealed flat products	2.16	0.98	3.15
7224 90 02 7224 90 03 7224 90 05 7224 90 07 7224 90 14 7224 90 31 7224 90 38	Steel, alloy, other than stainless, in ingots or other primary forms, semi-finished products of alloy steel other than stainless (excl. waste and scrap in ingot form, and products obtained by continuous casting)	Hot-rolled flat products	1.78	0.18	1.97

Product CN Code	CN description	JRC description	Emission intensity (t CO_2 per t product)		
7225 11 00 7225 19 10 7225 30 7225 40	Flat-rolled products of alloy steel other than stainless, of a width of >= 600 mm, hot-rolled or cold-rolled "cold-reduced"	Hot-rolled flat products	1.78	0.18	1.97
7225 19 90 7225 50	Flat-rolled products of alloy steel other than stainless, of a width of >= 600 mm, hot-rolled or cold-rolled "cold-reduced"	Cold-rolled and annealed flat products	1.82	0.22	2.04
7225 91 00 7225 92 00 7225 99 00	Flat-rolled products of alloy steel other than stainless, of a width of >= 600 mm, hot-rolled or cold-rolled "cold-reduced"	Plated or coated flat products	1.85	0.23	2.08
7226 11 00 7226 19 10 7226 20 00 7226 91	Flat-rolled products of alloy steel other than stainless, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced"	Hot-rolled flat products	1.78	0.18	1.97
7226 19 80 7226 92 00	Flat-rolled products of alloy steel other than stainless, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced"	Cold-rolled and annealed flat products	1.82	0.22	2.04
7226 99	Flat-rolled products of alloy steel other than stainless, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced"	Plated or coated flat products	1.85	0.23	2.08
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	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.	1.85	0.16	2.01
7305	Tubes and pipes, having circular cross-sections and an external diameter of > 406,4 mm, of flat-rolled products of iron or steel "e.g., welded, riveted or similarly closed"	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.	1.85	0.16	2.01

Product CN Code	CN description	JRC description	Emission intensity (t CO_2 per t product)		
7306 30 18	Tubes, pipes and hollow profiles "e.g., open seam or welded, riveted or similarly closed", of iron or steel (excl. of cast iron, seamless tubes and pipes and tubes having internal and external circular cross-sections and an external diameter of > 406,4 mm)	Hot-rolled flat products	1.82	0.12	1.94
7306 19 00 7306 29 00 7306 30 12	Tubes, pipes and hollow profiles "e.g., open seam or welded, riveted or similarly closed", of iron or steel (excl. of cast iron, seamless tubes and pipes and tubes having internal and external circular cross-sections and an external diameter of > 406,4 mm)	Cold-rolled and annealed flat products	1.85	0.16	2.01
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	Tubes, pipes and hollow profiles "e.g., open seam or welded, riveted or similarly closed", of iron or steel (excl. of cast iron, seamless tubes and pipes and tubes having internal and external circular cross-sections and an external diameter of > 406,4 mm)	Plated or coated flat products	1.88	0.17	2.06
7306 40 80 7306 50 29	Tubes, pipes and hollow profiles "e.g., open seam or welded, riveted or similarly closed", of iron or steel (excl. of cast iron, seamless tubes and pipes and tubes having internal and external circular cross-sections and an external diameter of > 406,4 mm)	Hot-rolled flat products -- alloyed	1.78	0.14	1.92
7306 11 00 7306 21 00 7306 40 20 7306 61 10 7306 69 10	Tubes, pipes and hollow profiles "e.g., open seam or welded, riveted or similarly closed", of iron or steel (excl. of cast iron, seamless tubes and pipes and tubes having internal and external circular cross-sections and	Cold-rolled and annealed flat products -- alloying elements group 1	1.82	0.21	2.03

Product CN Code	CN description	JRC description	Emission intensity ($t CO_2$ per t product)		
	an external diameter of > 406,4 mm)				
7306 50 21 7306 50 80	Tubes, pipes and hollow profiles "e.g., open seam or welded, riveted or similarly closed", of iron or steel (excl. of cast iron, seamless tubes and pipes and tubes having internal and external circular cross-sections and an external diameter of > 406,4 mm)	Cold-rolled and annealed flat products -- alloying elements group 2	1.81	0.18	1.99
7308	Structures and parts of structures "e.g., 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 (excl. prefabricated buildings of heading 9406)	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	2.46	1.25	3.71
7309	Reservoirs, tanks, vats and similar containers, of iron or steel, for any material "other than compressed or liquefied gas", of a capacity of > 300 l, not fitted with mechanical or thermal equipment, whether or not lined or heat-insulated (excl. containers specifically constructed or equipped for one or more types of transport)	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	1.88	0.17	2.06

Product CN Code	CN description	JRC description	Emission intensity (t CO_2 per t product)		
7310	Tanks, casks, drums, cans, boxes and similar containers, of iron or steel, for any material "other than compressed or liquefied gas", of a capacity of <= 300 l, not fitted with mechanical or thermal equipment, whether or not lined or heat-insulated, n.e.s.	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	1.88	0.17	2.06
7326 90 98	Articles of iron or steel, n.e.s. (excl. cast articles)	Other articles of iron or steel	1.88	0.17	2.06

Source: Vidovic et al. (2023)