CLIMATE CHANGE
73/2025

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Assessment and operationalisation of relevant criteria

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Abstract: Inclusion of downstream products in CBAM

The Carbon Border Adjustment Mechanism (CBAM) imposes a carbon price on imports of selected products to the EU market, with the aim of creating a level playing field between domestic production and imports. In the Annex I of the regulation 2023/956 establishing CBAM, 573 products are included under its scope, mainly from upstream sectors. However, the regulation recognises the need to evaluate and implement an expansion of the scope also to downstream products. This paper discusses the criteria that can be used to assess which downstream products could be prioritised for inclusion in CBAM. It discusses the significance and suitability of different criteria, as well as the availability and reliability of data to operationalise those criteria. Five main criteria are identified and discussed: whether a product contains a significant share of at least one CBAM good, whether a product is relevant in terms of emissions, whether a product is exposed to carbon leakage, whether a product inclusion does not create excessive administrative burden, and whether a product inclusion prevents circumvention.

The paper discusses options for various operationalisations of criteria. It offers examples of the applications of such criteria to a limited set of product groups and discusses different ways of combining those criteria. However, a final recommendation on the criteria for inclusion of downstream products into CBAM has not been developed as part of the paper. Instead, the paper aims to establish the operating space within which possible criteria can be chosen and combined, laying the general foundations for the discussion on downstream expansion. The broad spectrum of criteria and possible operationalisation and combination rules discussed in this paper requires a careful prioritisation of objectives. There are inherent trade-offs between broad coverage of products, a precautionary approach to leakage and circumvention, and the high administrative burden that such a broad scope would entail. Applying the criteria discussed in this paper can result in a prioritisation list, which can guide the decision on which product to include first within the CBAM scope. Ideally, such scope expansion is implemented over time, as this would allow the list to be updated and modified based on learning from and cooperation with industry associations, trade partners and regulated entities.

Kurzbeschreibung: Einbeziehung von Downstream-Produkten in den CBAM

Der Mechanismus für einen CO_2-Grenzausgleich (Carbon Border Adjustment Mechanism, CBAM) erhebt einen CO_2-Preis auf Importe ausgewählter Güter in den EU-Markt. Ziel ist die Schaffung gleicher Wettbewerbsbedingungen zwischen innereuropäischer Produktion und Importen. Per Anhang I der Verordnung 2023/956, die den CBAM etabliert, sind 573 Produkte aus hauptsächlich vorgelagerten Sektoren hiervon betroffen. Die Verordnung erkennt zugleich die Notwendigkeit an, eine Erweiterung um nachgelagerte Produkte zu prüfen und umzusetzen.

Die vorliegende Studie diskutiert Kriterien, die sinnvollerweise für die Priorisierung nachgelagerter Produkte für den CBAM-Einbezug angewendet werden könnten. Erörtert werden die Bedeutung und Eignung verschiedener Kriterien sowie die Verfügbarkeit und Zuverlässigkeit von Daten für die Anwendung der Kriterien. Wir identifizieren und diskutieren fünf Hauptkriterien: ein Produkt enthält einen signifikanten Anteil an mindestens einem CBAM-Gut; ein Produkt ist emissionsrelevant; ein Produkt ist Gefahr von Verlagerung ins EU-Ausland (Carbon Leakage) ausgesetzt; die Einbeziehung eines Produkts erzeugt keinen übermäßigen administrativen Aufwand; die Einbeziehung eines Produkts hilft bei der Vermeidung von Umgehungstatbeständen.

Ferner diskutiert die Studie verschiedene Optionen zur Operationalisierung von Kriterien. Zudem bietet sie Beispiele für die Anwendung solcher Kriterien auf eine begrenzte Anzahl von Produktgruppen und diskutiert Möglichkeiten zur Kombination der Kriterien. Eine endgültige Empfehlung zu den Kriterien für die Einbeziehung nachgelagerter Produkte in den CBAM liefert diese Studie jedoch nicht. Sie bezweckt vielmehr, den Handlungsspielraum aufzuzeigen, innerhalb dessen mögliche Kriterien ausgewählt und kombiniert werden können, um so eine allgemeine Grundlage für die Diskussion zum Einbezug nachgelagerter Produkte zu schaffen. Das breite Spektrum an Kriterien sowie möglichen Umsetzungs- und Kombinationsregeln, die hier diskutiert werden, erfordert eine sorgfältige Priorisierung der Ziele. Es bestehen inhärente Zielkonflikte zwischen einer breiten Abdeckung von Produkten sowie dem damit verbundenen erhöhten Umsetzungsaufwänden. Potentiell können die in dieser Studie erörterten Kriterien zu einer Prioritätenliste führen, anhand derer entschieden werden kann, welches Produkt zuerst in den CBAM-Anwendungsbereich aufgenommen werden soll. Idealerweise wird eine solche Erweiterung des Geltungsbereichs im Laufe der Zeit umgesetzt, so dass aus der Zusammenarbeit mit Industrieverbänden, Handelspartnern und regulierten Stellen notwendige Erkenntnisse hierfür möglich werden.

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List of abbreviations

Abbreviation	Full term
CBAM	Carbon Border Adjustment Mechanism
CN	Common Nomenclature
CO_2	Carbon Dioxide
CPA	Classification of Products by Activity
DRI	Direct Reduced Iron
EUA	EU Allowances
EU ETS 1	European Union Emissions Trading System
GHG	Greenhouse Gas
GVA	Gross value added
IA	Impact Assessment
IEA	International Energy Agency
JRC	Joint Research Centre
LCA	Life Cycle Assessment
MS	Member State
MRV	Monitoring, reporting, and verification
NACE	Nomenclature of Economic Activities
PRODCOM	Production Communautaire

1 Introduction

1.1 Background: EU CBAM and downstream expansion

The EU Carbon Border Adjustment Mechanism (CBAM) is the main instrument within the Fit-for-55 package to address the risk of carbon leakage. It has been established by Regulation 2023/956, adopted April 2023, which, between 2026 and 2034, will gradually replace the existing solution to address carbon leakage in the EU ETS 1, i.e., free allocation of emission certificates. With the 2050 net zero target enshrined in EU's legislation, price signals had to become effective also for industries, which thus far have mostly benefitted from free allocation. Furthermore, the gradual tightening of the EU ETS 1 cap reduces the available allowances, which are freely allocated or auctioned. CBAM was thus introduced to ensure a level playing field between domestic production and imports, while pursuing the EU's 2050 net-zero targets. Its functioning is conceptually straightforward: starting in 2026, importers of CBAM goods[1] will have to pay a carbon price that is comparable to what domestic firms pay to produce in Europe, yet the obligation to surrender CBAM certificates will be phased in gradually and will be fully effective only in 2034. Nevertheless, its concrete implementation requires many complex decisions.

One such decision concerns the scope of products to include under the CBAM regulation. The list of products subject to CBAM included in Annex I of Regulation 2023/956 currently includes 573 products, identified through their 8-digit CN codes[2], from six main sectors: iron and steel, aluminium, cement, electricity, fertilisers, and hydrogen. The initial selection of sectors and products was based on the respective risk of carbon leakage, depending on emission intensity as well as trade intensity. It has been kept short on purpose to keep complexity manageable at the initial stage of the transitional period (European Commission 2021). However, the choice of which products to include has since been debated among stakeholders.

While the initial coverage of CBAM is limited, the objective is to expand it to achieve a "broad product coverage" (2023/956, Recital 31). By 2030, the CBAM scope shall be extended to comprise products from all the sectors covered by the EU ETS 1 (2003/87/EC), see Recital 67 in the CBAM-Regulation (EU 2023/956). This can be conceived as a horizontal expansion of the scope and would imply, for example, the inclusion of chemicals and refinery products which have been currently left out of the scope because of the technical complexities associated with imputing emissions onto products (ibid., Recitals 34, 35).

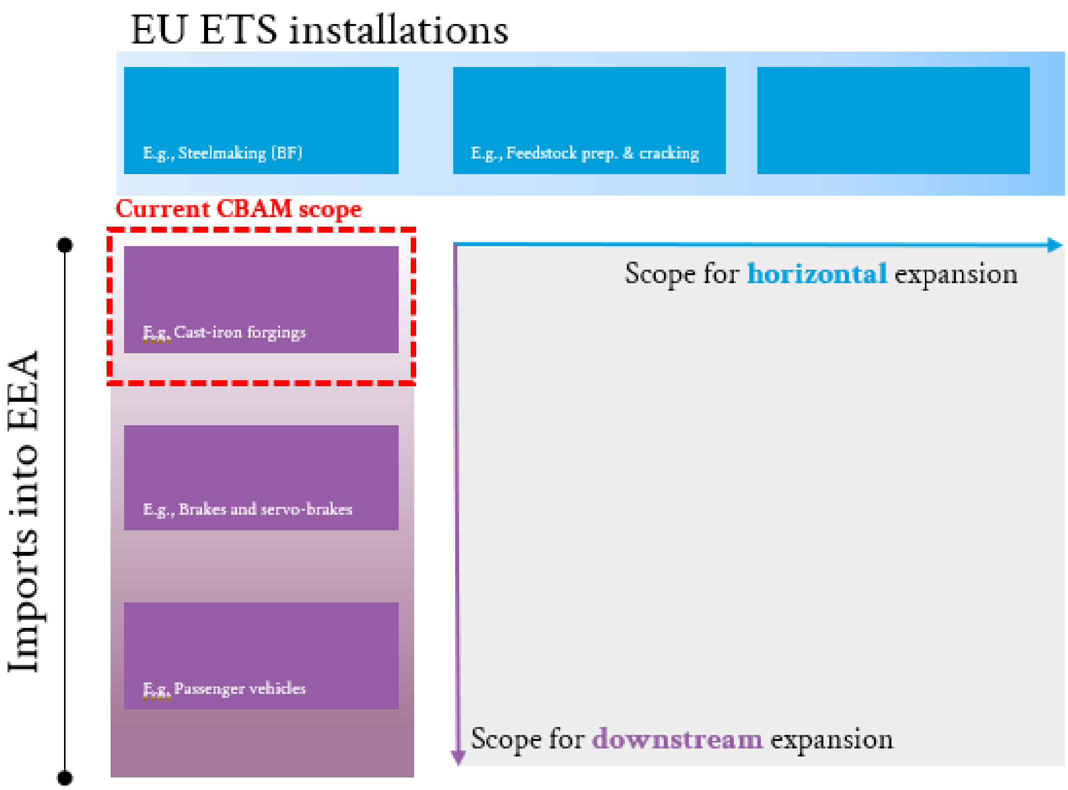
The second type of expansion envisaged by the CBAM regulation – and the focus of this paper – is a downstream expansion to cover activities and processes that use products from installations under the EU-ETS as intermediary inputs to their production processes (even though the activities and products themselves are not necessarily covered by the EU-ETS). These are generally referred to as products downstream along the value chain. The impact assessment report accompanying the CBAM regulation (European Commission 2021) offers definitions of value chains and downstream processes, which are useful to understand the possible scope of downstream expansion. Value chains are defined in Annex 5 as "the sum of subsequent production steps", and downstream processes as "all processes in which the discussed product

[1] "CBAM goods" thereafter refer to goods listed in Annex I to the CBAM Regulation (EU) 2023/956 and Annex II to the Implementing Regulation.

[2] While Annex I mentions some categories with their aggregated codes, the full list of individual 8-digit CN codes is listed, for example, in the Commission's „CBAM self-assessment tool".

or material can be used", adding that "Downstream processes can reach as far as to include manufactured products intended for the final consumer".

Figure 1: Horizontal and vertical scope expansion options for CBAM

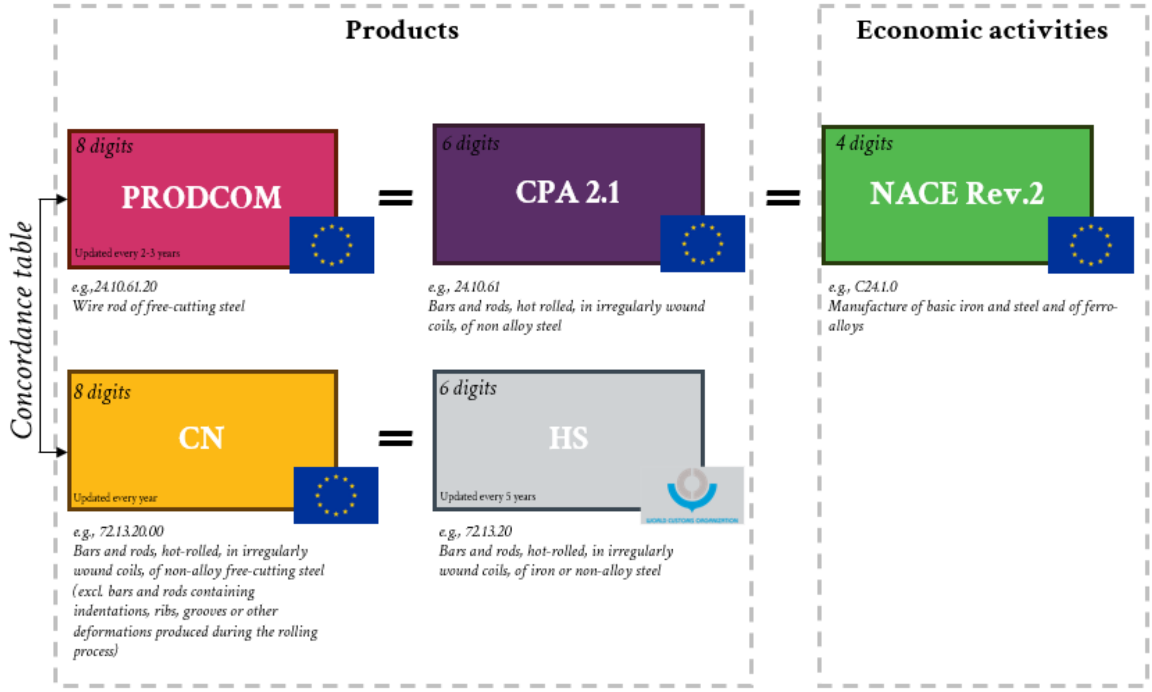


Notes: Boxes in light blue represent economic activities. Violet boxes represent products.. Illustration presents the example of one value chain, culminating in the final product: passenger vehicles. Source*: Own illustration, The Climate Desk*

To identify products that are within the scope of CBAM, the Common Nomenclature is used (Council Regulation (EEC) No 2658/87). The Common Nomenclature is a taxonomy of products through which imports are categorised (services are not included), and it is aligned with the Harmonized System taxonomy. The Harmonized System classifies international trade through a series of 6-digit codes, while the Common Nomenclature specifies the Harmonized System codes, further providing an 8-digit breakdown, which is referred to here as CN codes. Those codes are updated every year to reflect smaller changes in product or bigger changes in the underlying Harmonized System nomenclature.

One challenge when discussing CBAM in relation to the EU ETS is the fact that the instruments differ with respect to the point of regulation to which they apply. While CBAM refers to traded products, through the use of CN codes, the EU ETS applies to installations, which are instead classified under the NACE rev. 2 Classification of economic activities in the EU (Regulation (EC) No 1893/2006). NACE codes can be traced back to CN codes only through other classifications and through the use of correspondence table published by EUROSTAT: which products are produced within a 4-digit NACE sector can be seen from the CPA 2.1 classification, which has 6 digits (four equivalent to NACE and two additional ones). The Classification of Products by Activity (CPA) can be further specified into 8-digit PRODCOM codes, which have been developed as part of the PRODCOM statistics within the European Business Statistics. PRODCOM codes provide a more granular level of detail compared to CPA for products in manufacturing sectors and some areas of mining and quarrying (Section B and C of NACE Rev. 2). Figure 2 offers a schematic illustration of such an ecosystem of classifications. The rest of this paper will utilise the NACE classification when discussing installations or economic sectors, while the CN or the PRODCOM code will be used to identify products.

Figure 2: Schematic representation of the different taxonomies



Source: Own illustration, The Climate Desk

1.2 Legislative framework of the EU CBAM regulation

To understand the rationale behind the need for a vertical expansion of CBAM, it is important to recognise the fundamental differences between CBAM and the most important policy tool used until now to protect industries from carbon leakage, namely, free allocations of allowances (EUA) for emission-intensive sectors in the EU.

Free allocation of allowances plays a crucial role as the instrument of choice to protect the competitiveness of the industries bearing the EUA price (or simply CO_2 price): while formally an exemption from auctioning as the basic allocation principle, most allowances in the industrial sector remain allocated for free based on a benchmarking system. For example, in Germany in 2022, 86% of industrial emissions were covered by free allocations (DEHSt 2024). However, the increased mitigation ambition of the EU, as adopted in the Fit-for-55 Reform package of 2023, tightens the cap through a higher linear reduction factor and envisages the gradual phase-out of free allocation.

CBAM is a tool designed to ensure a level playing field by equalising the carbon cost burden between imports and domestically produced products, while free allowances are gradually phased out over the coming years. CBAM aims to avoid the increased ambition within the EU being offset by higher emissions abroad through the substitution of domestic production with imports. However, there are substantial differences between CBAM and free allocation due to the level at which the two instruments apply.

Free allocation is given to operators of ETS installations in sectors that are deemed to be at risk of carbon leakage. The free allocation of allowances will be slowly phased out for operators of EU installations. As a result, operators of installations producing basic materials, for example, steel, will start to pass those carbon costs through. The competitiveness of domestically produced steel will be maintained through CBAM, which will ensure that imports also face carbon costs. CBAM will therefore substitute free allocations as the main instrument against leakage for the goods included in its scope. Once primary producers start to pass through carbon costs to downstream sectors that use CBAM goods, downstream producers will compete with imports of downstream goods that might not be facing similar carbon costs: unless the products produced by those downstream producers are also included in CBAM, they might not be able to pass those costs through or they might be outcompeted by imports and reduce their output, , leading to carbon leakage (Ambec et al. 2024; Bushnell & Huber, 2017; Stede et al., 2021). This might have repercussions on producers of basic materials as well, since if downstream firms face difficulties or even closure, domestic demand for basic materials likely decreases.

The CBAM regulation recognises the need to address this potential leakage channel and explicitly states that the Commission should prioritise the expansion of the scope of CBAM to: "downstream products that contain a significant share of at least one of the goods within the scope of this Regulation" (recital 67). Furthermore, the rationale for inclusion in CBAM is generally to be based on "their relevance in terms of cumulated greenhouse gas (GHG) emissions and risk of carbon leakage in the corresponding EU ETS 1 sectors, while limiting complexity and administrative burden on the operators concerned" (recital 30). Yet, the regulation specifies that in the context of downstream products, "certain products should be included in the scope of the CBAM despite their low level of embedded emissions occurring during the production process as their exclusion would increase the likelihood of circumventing the inclusion of steel products in the CBAM by modifying the pattern of trade towards downstream products" (recital 38). Finally, the regulation stresses that "To reduce the risk of carbon leakage, the Commission should take action to address practices of circumvention" (recital 53). Relevant for downstream products is the form of circumvention that materialises from avoidance based on minor modification or misclassification of imported products (European Commission 2021*)*.

In summary, five overarching criteria for the inclusion of downstream products can therefore be derived from the regulation:

1. A product contains a significant share of at least one CBAM good
2. A product is relevant in terms of cumulated GHG emissions
3. A product is exposed to carbon leakage risk
4. Product inclusion does not create a disproportionate administrative burden
5. Product inclusion prevents circumvention

1.3 Aim and structure of this paper

This paper discusses five overarching criteria that can be deduced from the CBAM Regulation and provides examples of how they can be operationalised in practice. Furthermore, it discusses options on how those criteria could be aggregated to produce a roadmap for prioritised inclusion. In section 2, each criterion is analysed in isolation in terms of its relevance, possible operationalisation options, and data limitations. When possible, an approximation of such operationalisations is presented based on available data. Section 3 discusses different approaches on how the criteria could be brought together to provide a roadmap for defining which products should be prioritised for inclusion in CBAM. Overall, the paper provides a preliminary examination of the different approaches, which is not meant to substitute a comprehensive assessment.

The scope of this paper is on products currently listed in Annex I and their downstream sectors, limiting the scope to vertical expansion rather than horizontal expansion. Specifically, many examples concentrate on steel and aluminium, as these materials are widely used as intermediate products in production, and therefore, there is a large number of downstream products that might be affected. Yet at the same time, those products are concentrated in a manageable number of sub-sectors. On the other hand, e.g., cement was not chosen as the main case study due to the limited number of downstream products that are related to it, while the CBAM goods included in the fertiliser industry sector are used in a vast amount of sub-sectors and products, which leads to difficulties tracking the flow of such material through the economy. Even if the focus of the examples of this paper is on metal products, it provides a blueprint that (given the necessary data availability) can be applied to all sectors and materials. Additionally, electricity is excluded from the scope of this paper, as its inclusion in CBAM would require a broad and complex discussion regarding the role of indirect emissions (Görlach et al., forthcoming). Finally, this analysis focuses on the significance of import substitution and does not deal with carbon leakage risks for goods produced in the EU and then exported.

2 Criteria for the inclusion of downstream products

2.1 Criterion I: a product contains a significant share of at least one CBAM good

Whether a product contains a significant share of at least one CBAM good is an important criterion that emerges from the CBAM regulation. This criterion offers a simple proxy for many other often-used metrics of exposure to carbon leakage. Since embedded emissions in downstream products are often driven by the emissions of their precursors, more than process emissions. As a result, the share of a CBAM good also drives the additional cost resulting from a potential pass-through of the EU ETS 1 price. This, in turn, comes into play when assessing the risk of carbon leakage for this product and whether there is a sufficient level playing field between imports and domestic production.

However, such a criterion is difficult to operationalise due to the lack of an official standardised dataset describing the material composition of different products. Existing life cycle assessment databases could be used to identify products with a high share of at least one CBAM good. There are a variety of established methodologies to determine the material composition and related emissions over the life cycle of different products (e.g., ISO standards such as ISO 14067 or the European standard EN 19694 for energy intensive industries). However, there is no official European database that consolidates information on material content in a standardised way[3].

While official data is not available, Stede et al. (2021) compiled a database based on both quantitative and qualitative estimates, corroborated by expert opinions, about the quantity of different materials embedded in EU products. This dataset has the advantage of having been developed explicitly to investigate the effect of the EU ETS and CBAM on the value chains and consumers. As a result, the data is directly linked to the European NACE, CN, and PRODCOM classifications, and it was already used in other studies assessing the potential for downstream expansion of the CBAM scope (Cludius et al., forthcoming).

Based on the estimates from Stede et al. (2021), it is possible to provide an illustrative example of how this criterial could be operationalised. The dataset can be used to calculate the percentage of steel, aluminium, or cement embedded in each CN code and rank them from highest to lowest (the dataset also contains information about plastic, copper, and paper content). The table below provides an example of such operationalisation for the case of steel, reporting how many products contain more than 70%, 80%, 90%, or 95% steel that are currently not included in CBAM.

[3] There are a variety of proprietary databases, such as Ecoinvent, that collect life cycle assessment on different products and product groups. Those databases cover a broad variety of products which could potentially be aggregated at the level of specific CN codes. They could provide a detailed representation of the material content of goods. However, these datasets are proprietary, thus cannot be made public, which might limit their use as a basis for a legislative decision. The European Union has its own footprinting database, but it only contains embedded emissions, not material footprinting. Also, it is at the sector level (2-digit NACE codes), and it does not delve into the specifics of each product within those sectors. The EU also has material flow accounts that provide data on the total quantities of raw materials used by different countries, but it does not assign these flows to specific products. Furthermore, many data points are not reported due to confidentiality; this is, for example, the case for iron in the EU and Germany.

Table 1: Number of products containing different shares of steel

% of embedded steel in one tonne of product	Unique CN codes (all)	Unique CN not included in CBAM	Corresponding unique PRODCOM codes of CN-Codes not included in CBAM
Greater than 95%	496	45	26
Greater than 90%	589	107	78
Greater than 80%	719	237	174
Greater than 70%	1,278	796	546
Less than 70%	7,369	7,207	2,844

Notes: The number of unique PRODCOM codes differs from the number of unique CN codes since sometimes one PRODCOM code refers to multiple CN codes. There can also be cases in which one PRODCOM code refers to multiple CN codes. Such a one-to-many match is often due to the different levels of detail required in the two datasets to distinguish a product. However, in most cases, matching codes refer to the same product but with minor alterations. Source: Own calculation based on Stede et al (2021), The Climate Desk

This table shows that many of the most relevant products based on this criterion are already included in CBAM. Looking at products with at least 90% steel content, 107 out of 589 CN codes are not included in CBAM. The corresponding number of PRODCOM code is lower (here 78). This is due to the fact that there are many products that belong to the same PRODCOM code. The CN classification often provides a higher level of detail, for example, distinguishing between different thicknesses for a given slab of metal, yet they likely refer to the same product.

One relevant limitation of this analysis is that it does not capture all the possible variation in the material content of each product. Some products could be made with either steel or aluminium, or some products might contain a larger or smaller share of steel depending on their precise characteristics. For example, some tools might contain larger or smaller shares of plastic and other materials depending on their use and shape. In the rest of this paper, only the central estimate reported in Stede et al. (2021) is used. This is likely to reflect the average material content of products.

2.2 Criterion II: a product is relevant in terms of GHG emissions

One of the criteria mentioned in the CBAM regulation is whether a product is relevant in terms of greenhouse gas emissions. Each product can be seen as representative of a bundle of emissions occurring in the EU that could potentially leak abroad[4] as a result of stringent climate policies if that product is not included under CBAM. The more products are included, the more emissions are covered. However, this increment is not linear; instead, the additional emissions included will be proportional to the amount of material embedded within each additional product and its emission intensity. Furthermore, carbon leakage can also be defined with respect to the relative emission intensity of EU production compared to its major trading partners (Reinaud 2008). Those two metrics are described as Approach A in section 2.2.1 and Approach B in section 2.2.2, respectively. Section 2.2.3 offers an alternative Approach (C) using

[4] This section focuses on the maximum *potential* extent of leakage. The *realised* extent of this potential leakage depends on factors such as the relative cost burden and exposure to trade, which will be discussed in section 2.3

EUROSTAT input output data to approximate the relevance in terms of emissions based on monetary flows of intermediate consumption between EU sectors.

2.2.1 Approach A: Magnitude of potential leakage in absolute terms

The total potential emissions that could leak when a product is subject to an effective carbon price but not included in CBAM depend largely on the current level of production in the EU[5]. Stringent climate mitigation policies without counterbalancing carbon border adjustment, and in the presence of strong international competition, could potentially result in the complete substitution of EU production with imports.

As an example, consider a product like disc brakes, of which 2.3 million tons were produced in the EU in 2022. Regardless of whether the steel used to produce them is sourced from a domestic or international steel plant, as steel is already included under CBAM, it will bear carbon costs in either case. Assuming that disc brakes are composed of 70% steel, then 1.6 million tons of steel could potentially be substituted with steel embedded in disc brakes, which are produced in third countries and are not covered by CBAM. The resulting leaking emissions from this substitution can be calculated by multiplying this quantity by the emission intensity of steel.

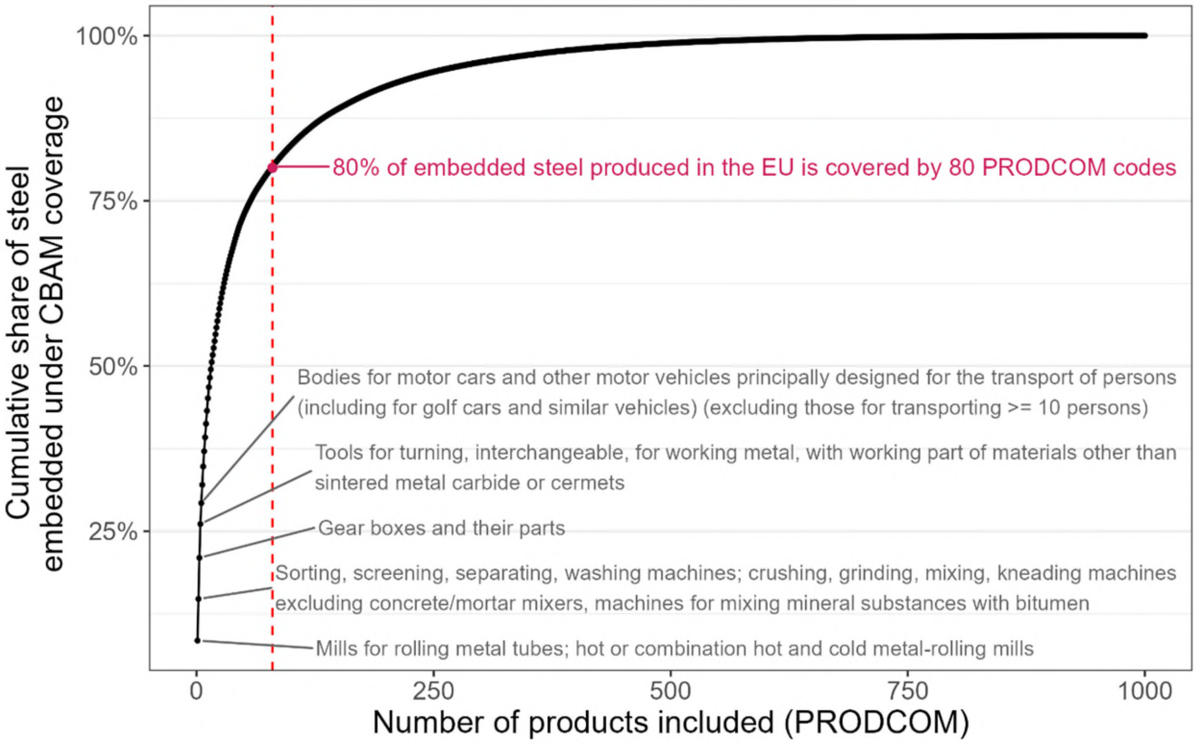
Data on EU production can be obtained from the PRODCOM statistics. The PRODCOM statistics cover approximately 3900 different manufactured products produced in the EU. These datasets provide information on both the quantity of products produced (in kg) and the total value of the products. The PRODCOM data is disaggregated at the level of individual Member States and the EU as a whole. However, the data for individual Member States contains a significant amount of confidential information. For this reason, aggregated EU-level data are preferred. Although these also contain some missing values for confidentiality reasons, they provide adequate coverage for most products in the PRODCOM classification.

By combining PRODCOM data with data from Stede et al. (2021) on the quantity of different materials (steel, aluminium, plastic, paper, copper, and cement) included in each product, it would be possible to calculate the total amount of each material embedded in EU production.

Figure 3 provides an example of this calculation for the case of steel and the products thus far not included within CBAM. By combining the quantity of steel embedded in different products thus far not included in CBAM with the total production in the EU of those products, the amount of steel "embedded" in EU production is derived. Figure 3 shows how the total quantity of embedded steel is distributed in relation to the number of products under consideration. It illustrates the gradually flattening increase in the amount of steel covered by including an increasing number of products in the CBAM. On the x-axis, the products are ordered from the highest to the lowest embedded steel content, calculated as described above. This graph highlights how a few products account for most of the embedded steel in EU production, thereby offering potential operationalised criteria to prioritise which products to include in CBAM.

[5] Alternatively, domestic consumption, including imports, could be regarded as a relevant metric. An alternative operationalisation of this criterion focused on consumption is described in section 2.2.3.

Figure 3: Number of products and cumulative coverage of steel embedded in EU production



Notes: Products on the x-axis have been ordered from largest to smallest in terms of total embedded steel in EU production based on data from PRODCOM. Only products currently not included in the CBAM scope are shown. The y-axis reports the share of cumulative steel embedded in products under a potential and incremental inclusion of each additional product. The first 5 products are labelled. Source: own illustration, The Climate Desk.

Figure 3 shows that 80% of the total embedded steel in EU products, which are not yet covered by CBAM, would be covered by extending the CBAM scope to the 80 products with the highest amount of embedded steel in total production. Table 2 details the number of products included under different thresholds: for example, increasing the threshold from 80% to 90% would include 164 products. Conversely, reducing the threshold to 50% would imply covering only 16 products (see Table 2).

Table 2: Number of products under different threshold levels

Cumulative % total steel produced in the EU*	Unique PRODCOM not included in CBAM
Greater than 90%	164
Greater than 80%	80
Greater than 70%	43
Greater than 60%	26
Greater than 50%	16

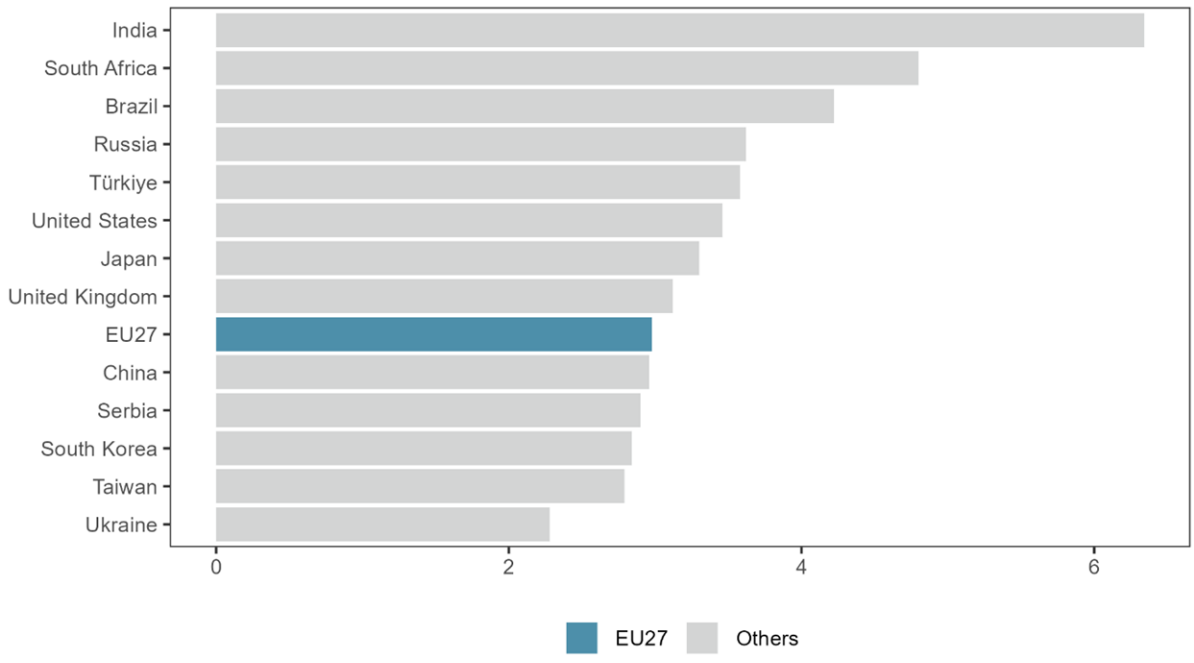
*Note: Excluding products already included in CBAM. Source: Own illustration, The Climate Desk

To arrive at the magnitude of GHG emissions associated with a specific product, the cumulative total embedded tons of CBAM goods in products that are not yet covered by CBAM need to be multiplied by their emission intensity, and other emissions occurring during the production process of the downstream product also need to be accounted for. Emission intensity values are published by the JRC for all the products currently included in CBAM (Vidovic et al., 2023). Standard values for emission intensities of downstream products are not yet available, nor is a matching between existing standard values and various downstream products that could serve as an approximation to identify which currently included CBAM products are embedded in other downstream products. However, since the standard values for steel and steel products currently included in CBAM are relatively homogeneous, one possible approach would be to apply the average emission intensity to all products. Such a value, multiplied by the cumulative % of the CBAM product used as precursor, calculated as in Figure 3, would yield the relevance in terms of GHG emissions. The relative order of the products will, however, remain the same.

2.2.2 Approach B: EU emissions intensity relative to major trading partners

As mentioned above, the total emissions subject to the risk of leakage depend on the emission intensity of each product. Following a definition designed by the IEA, carbon leakage is when "the ratio of emissions increases from a specific sector outside the country (as a result of a policy affecting that sector in the country) over the emission reductions in the sector (again, as a result of the environmental policy)" (Reinaud, 2008). Thus, the extent of carbon leakage depends inter alia on the difference between EU emission intensity and the emission intensity of imports. Figure 4 shows the various emission intensities of one CBAM good: forgings of semi-finished products of iron or non-alloy steel (CN code: 72071190), by different countries of origin.

Figure 4: Emission intensity of forgings of semi-finished products of iron or non-alloy steel



Notes: Emission intensities in tons of CO_2 per ton of product are reported on the x-axis based on data from Vidovic et al. (2023). *Source: Own illustration, The Climate Desk.*

Emission intensities per ton of forgings of iron in the EU are 2.9 tons of CO_2 per ton of product; they range from 2.1 in Ukraine to 4.3 in South Africa, and globally are on average 3.2 tons of CO_2

per ton of product. These variations depend on the production processes and the energy mix prevalently used in the country of origin. In the brake example of the previous section, the 1.6 million tons of material embedded in brakes would translate into 4.6 million tons of CO_2 that are embedded in such a product, assuming an emission intensity of 2.9 tons of CO_2 per ton of product. Those emissions could be exposed to the risk of carbon leakage[6]. The actual realisation of this leakage can vary greatly. In part, it depends on the extent to which production is substituted with imports (see section 2.3), but also on which country of origin those imports would come from. The country from which imports are most frequent of a given product and its emission intensity could therefore potentially be included as an additional criterion when determining the relevance in terms of emissions of a given product. This can be retrieved from EUROSTAT trade data (COMEXT). For example, for the case of forgings of semi-finished products of iron or non-alloy steel (CN code: 72071190), the countries with the largest exports to the EU in 2024 were India, the USA, China, and Turkey.

2.2.3 Approach C: Coverage of material consumption

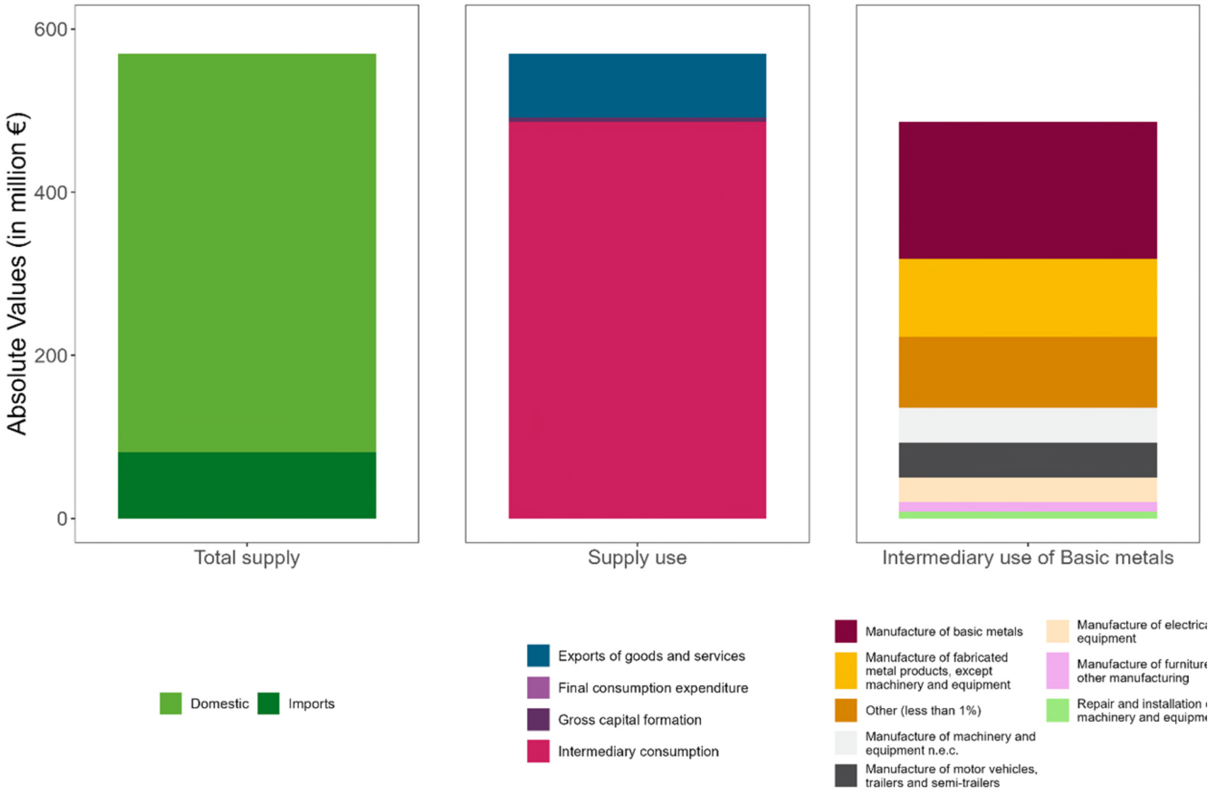
An alternative approach to assessing the relevance in terms of emissions of a product is to look at where such a product is consumed in the economy as an intermediary input for production. This section discusses an alternative approach to identifying sectors that use “Basic Metals” within their production process as an intermediary material for their production by using input-output tables. The sector “Basic Metals” (C24 according to NACE rev.2) is chosen as an example for this analysis because it contains both steel and aluminium, which are relevant in the context of the downstream expansion of CBAM. Further level of disaggregation into specific materials is not possible due to limited data availability.

The input-output framework provides a structured representation of monetary flows within the economy in a standardised format for 60 industries and products. It uses NACE rev. 2 classifications for the sectors and the CPA 2.1 classification for the products. Within the input-output framework, the supply tables inform about the quantities and origins of goods and services, including domestic production and imports, while the use tables delineate their utilisation across intermediate and final consumption categories, using the sector “Basic Metals” as an example for the application of this method. By tracing the use of “Basic Metals” in production processes, this approach allows us to identify the sectors that purchase a large share of the total production and imports (and therefore emissions) of steel and other metals[7].

[6] The risk of carbon leakage is assessed at product level here. To estimate the overall change in emissions within the scope of the EU ETS, the cap would need to be considered. As the cap represents a fixed supply of allowances, relocating production to other regions of the world could result in higher global GHG emissions without reducing total emissions within the EU ETS. The extent of this effect will depend on the tightness of the allowance market.

[7] Such an approach relies on monetary flow instead of physical flows. Therefore, its conclusions are dependent on the assumption that products within the sector are relatively homogeneous in terms of prices.

Figure 5: Identification of downstream sectors using input-output tables



Notes: Monetary value (in Million €) of basic metals supply (left-hand chart) and use (centre chart). Use of basic metals for intermediary production is further broken down by sector (right-hand chart). Sectors individually purchasing less than 1% of the total intermediary production of basic metals are clustered in a residual category “other”. Data used for the calculation: EUROSTAT National supply, use, and input-output tables from 2022 (naio_10_n). *Source: Own illustration, The Climate Desk*

Figure 5 illustrates the monetary flow of basic metals within the economy. The first column displays the total supply of basic metals, which encompasses both domestic production and imports. The magnitude of this supply is estimated at approximately 570 billion EUR in 2022; the majority being domestically produced. A large share of domestic production already signals higher exposure to leakage.

The second column categorises the utilisation of the basic metal supply into four distinct groups: gross capital formation, final consumption expenditures, intermediate consumption, and exports. In the case of basic metals, classified as upstream products, their contribution to gross capital formation and final consumption is relatively limited, while exports make up a small but significant part, but are not the focus of this study.

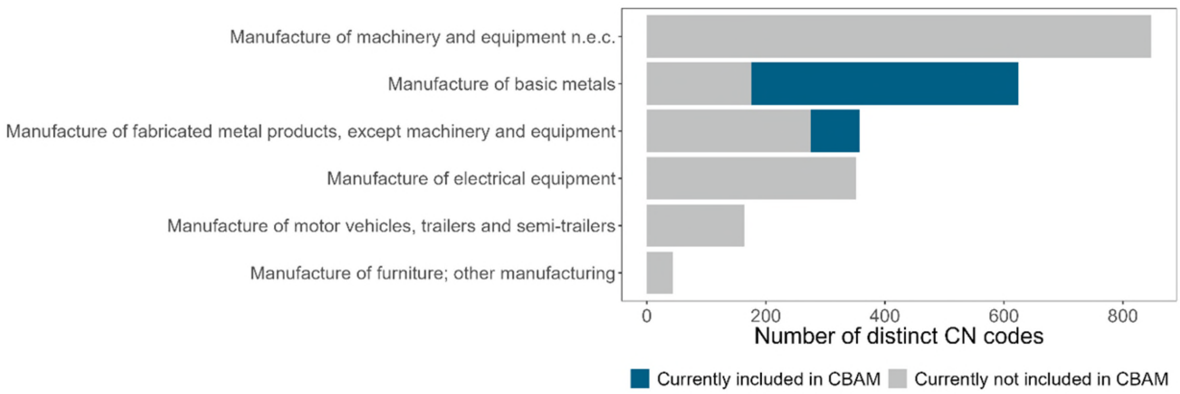
The third column further disaggregates intermediate consumption by identifying the sectors that use basic metals as inputs in their production processes. The basic metals sector is the largest consumer of its own products. This is because the sector encompasses multiple stages of metal production, including crude steel production, forging, and alloying. Beyond the basic metals sector, the six largest users of basic metals are “Manufacture of metal products (excluding machinery and equipment)”, followed by “Manufacture of machinery and equipment” and “Manufacture of motor vehicles, trailers and semi-trailers”, “Manufacturer of electrical equipment”, “Manufacturer of furniture”, and “Repair and installation of machinery and equipment”. A residual category, identified as "other", accounts for all sectors that individually purchase less than 1% of intermediate consumption. This category spans multiple sectors and illustrates the broad but diffuse use of basic metals across the economy. Although each sector represents less than 1% of intermediate consumption, the total category accounts for 18% of basic metals consumed. The choice of this threshold is of great political relevance as it can determine how many sectors are considered, with the implicit trade-off that the more sectors are considered relevant downstream sectors, the more products will have to be included as relevant downstream products.

One remark is necessary with respect to the sector "Repair and installation of machinery and equipment" - that figures as the 6th largest purchaser of basic metals. While this sector, like the others listed here, generates added value and creates part of the demand for basic metals, it is concerned with services rather than the production of goods. As such, it is not included in the list of CN codes. Consequently, despite the sector using/consuming a significant amount of steel, it cannot be included in any CBAM-related lists since it is categorised as a service rather than a product. However, services such as repair are generally less exposed to carbon leakage compared to products.

Excluding "Repair and installation of machinery and equipment", the majority—approximately 80%—of the value of basic metals consumed in the economy is concentrated within six key sectors. By including all products manufactured by these sectors in the CBAM, it would be possible to achieve broad coverage of downstream products and therefore emissions derived from basic metals. However, such broad inclusion criteria would result in an extensive list.

Figure 6 illustrates the number of unique CN codes associated with the six sectors that account for 80% of the consumption value of basic metals in the EU. Many products under the "Manufacture of basic metals" sector are already covered by the CBAM. Similarly, the "Manufacture of fabricated metal products" sector includes a substantial number of CN codes covered by the CBAM. However, within those sectors, not all the products are included in the CBAM goods list, with significant gaps, particularly within fabricated metal products. Other sectors depicted in the graph, such as the manufacture of electrical equipment, furniture, machinery, and motor vehicles, are currently not included in the CBAM.

Figure 6: Number of CN codes per downstream sector and respective CBAM coverage



Note: The number of distinct CN codes included or not included in CBAM was obtained by matching the CBAM list contained in Annex I of CBAM regulation with the list of CN codes from 2022 as defined by the Commission Implementing Regulation (EU) 2021/1832. Source: Own illustration, The Climate Desk.

While some products are not included on purpose, for example, because they do not contain a share of emission intensive material, others are currently not included in the CBAM list to limit complexity. The rationale for this initial CBAM scope can be traced back to the impact assessment accompanying the CBAM regulation, which suggested limiting the initial scope to products that had the highest direct and indirect emissions and for which it was possible to determine standard values for embedded emissions by product. The long list of products resulting from Figures 5 and 6 would therefore need to be refined to account for other criteria and practical limitations. Nonetheless, it offers an alternative approach to the one presented in section 2.2.1 which has the advantage of being reliant on official EUROSTAT statistics only.

2.3 Criterion III: a product is exposed to carbon leakage risk

The incidence of carbon costs and trade exposure are two critical components that together contribute to determining whether a product is exposed to carbon leakage. This section will discuss them and present ways to operationalise such criteria in the context of downstream scope expansion of CBAM.

2.3.1 ETS-induced cost share and trade exposure

The risk of carbon leakage increases with the relative impact that carbon pricing entails for the production of a given product. With the gradual phase-out of free allocation together with the inclusion of upstream products in CBAM, downstream sectors will likely see carbon costs being passed through to them. The total carbon cost for downstream sectors will depend on the embedded emissions (of precursors) of their products and the EUA price[8]. This section provides an exemplary calculation of the carbon cost incidence (defined as the share of ETS-induced costs) related to the steel content of a product, assuming an average emission intensity of steel of 2.5 tonnes of CO_2 per tonne of product (which is in line with the average standard value calculated by JRC for steel products) and a carbon price of 100€ per ton of CO_2.

Multiplying the EUA price by the average emission intensity of steel and the share of steel embedded in a product (calculated as in section 2.2.1) gives the ETS-induced cost increase or absolute incidence of carbon pricing on that product once free allocations are fully phased out. However, relative incidence, i.e., the carbon cost in relation to the product price or its value added, could be considered a more useful metric since it better reflects the impact of carbon pricing on the product price (or its cost structure) and therefore potentially also on its competitive position.

Calculating relative incidence requires one additional data source on prices or total costs. Information on prices could be retrieved from the PRODCOM statistics by dividing the total value of production sold by the total quantity sold. Alternatively, relative price incidences have been operationalised when compiling the Carbon Leakage List (Commission Decision 2014/746/EU of 27 October 2014) by dividing the emission intensity of an entire sector (at the 4-digit NACE level) by the gross value added of that sector.

Even if a product has a very high relative incidence, it may not be exposed to carbon leakage if it is difficult or impossible to trade. Therefore, the second question to investigate is: How likely is substitution through imports of this product? Such a question is translated in economic terms as trade elasticities of substitution, which indicate the amount of imports that increase as a result of a 1% increase in the price of a product. Knowing such elasticities, in combination with the

[8] In practice, the cost burden also depends on the share of cost passthrough in each sector, which, to simplify the discussion, is assumed to be 100%.

relative incidence calculated above, would yield a combined measure of the actual exposure to carbon leakage attributed to an increase in the price of any given product[9].

However, price elasticities are difficult to calculate, and a variety of different estimations are presented in the literature, many of which maintain a high level of aggregation[10]. Only some go to a level of detail that corresponds to PRODCOM level granularity. Another way of approximating elasticities could be to look at the transport costs related to specific products. This information could be combined for each product at the 6-digit PRODCOM level to obtain a prioritisation or a proxy for trade elasticities.

A more established, albeit more simplistic alternative is to use trade intensities. This metric has been used in the design of the aforementioned Carbon Leakage List in combination with the incidence criteria discussed above to identify the sectors worthy of protection and inclusion in the free allocation scheme. Such a metric is calculated by dividing the total imports by the sum of domestic output and imports, yielding the share of imports in the overall consumption of the products.

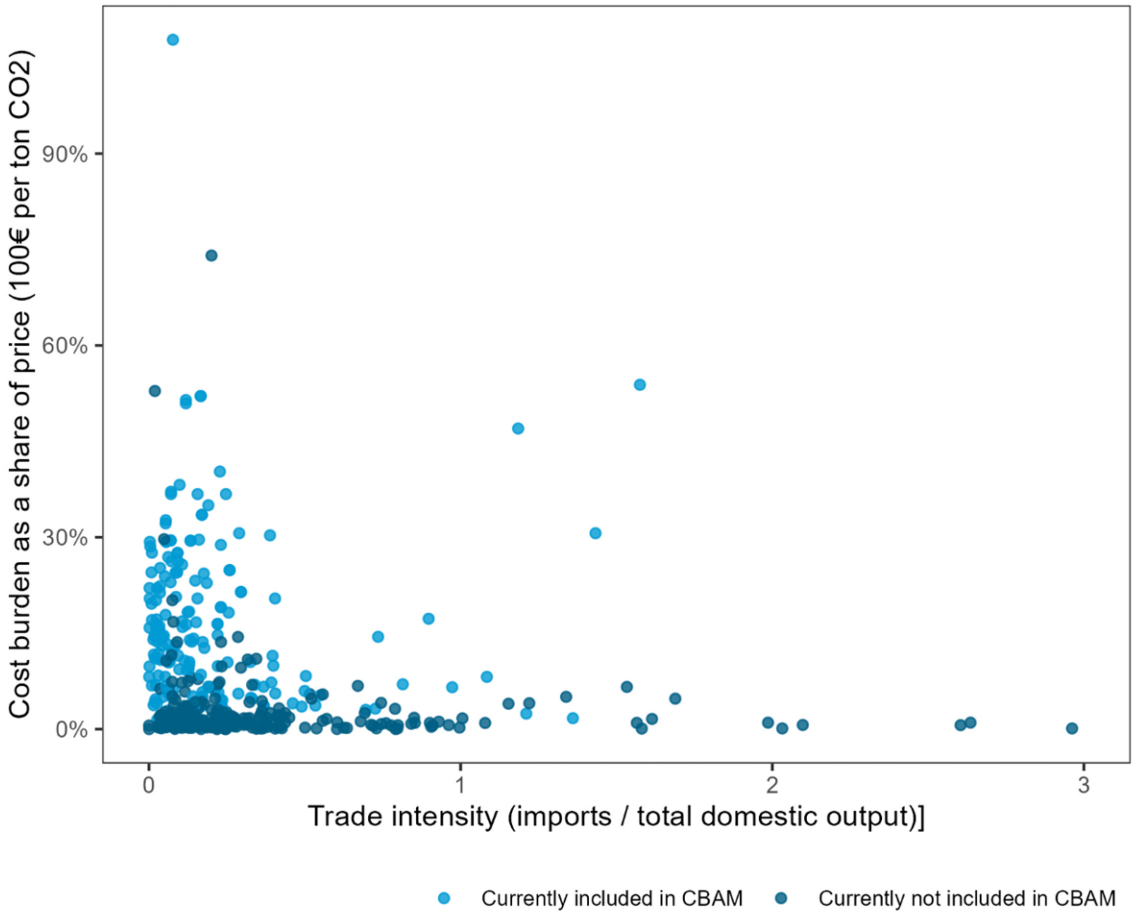
As a showcase for products that contain steel, Figure 7 presents a plot of carbon cost against trade intensity for products currently under CBAM (red) and not currently covered (blue). From this calculation, it emerges that, at least with respect to steel, the products with the highest incidence and trade intensity are currently already included in the CBAM regulation. However, there are still some products that have a very high incidence. The corresponding PRODCOM code and description for those products with a burden that is greater than 15% are reported in Table 3. There are also many products that score high in terms of trade exposure but that do not have a significant cost burden.

An interesting case here is that of scraps, which might appear very high in this prioritisation list depending on the way emissions are attributed to it. In particular, it would be meaningful to distinguish between pre-consumer and post-consumer scrap, as the former would justify the attribution of at least a part of the emissions related to its production in case it was generated in the process of producing a CBAM good. However, the latter should be considered to have zero emissions as it is recycled. In the case in which it is difficult or impossible to distinguish those two types of scraps, an ad hoc assessment would be necessary to judge the appropriateness of their inclusion. This topic will also be touched upon in Section 2.5 on circumvention, as the question of whether or not to include scraps is closely tied to strategies that could be used to mask or redefine specific products being imported into the EU to avoid payment of the CBAM. Nevertheless, due to the presumed complexity of an adequate treatment of metal scraps in the EU CBAM, the present paper does not delve into further analysis and assessment.

[9] Ambec et al. (2024) provide an in-depth analysis and explanation of the main economic mechanism at play when investigating carbon leakage. The paper also calibrates the theoretical model to the cement sector, estimating trade elasticities empirically.

[10] For example, see Fontagné et al. (2022) or Ghodsi et al. (2016)

Figure 7: Cost burden relative to the product price and trade exposure related to steel content



Notes: The cost burden reported on the y-axis is calculated by multiplying the share of steel embedded in each tonne of product (from Stede et al. 2021) with an average emission intensity of 2.5 tonnes of CO2 per ton of steel and an assumed CO2 price of 100€ per ton of CO2. Trade intensity on the x-axis is calculated as the ratio between imports and the sum of domestic production and exports (data from PRODCOM statistics). Colours indicate whether a product is currently included in CBAM or not. Source: Own illustration, The Climate Desk.

Table 3: Products with the highest cost burden currently not included in CBAM

PRODCOM CODE	PRODCOM Labels	Cost burden relative to the product price
25.99.12.37	Other table, kitchen and household articles of iron or steel (excluding cast iron), enamelled	74%
25.93.13.20	Welded grill, netting and fencing manufactured from wire	30%
25.93.13.43	Woven, not welded, wire mesh, grill, netting and fencing	20%

PRODCOM CODE	PRODCOM Labels	Cost burden relative to the product price
25.93.13.30	Welded grill, netting and fencing, not classified in HS 7314 20	17%
24.10.12.45	Ferro-silico-manganese	16%
25.93.12.30	Barbed wire and barbed wire entanglements made from steel or steel wire	15%

Source: Own illustration, The Climate Desk.

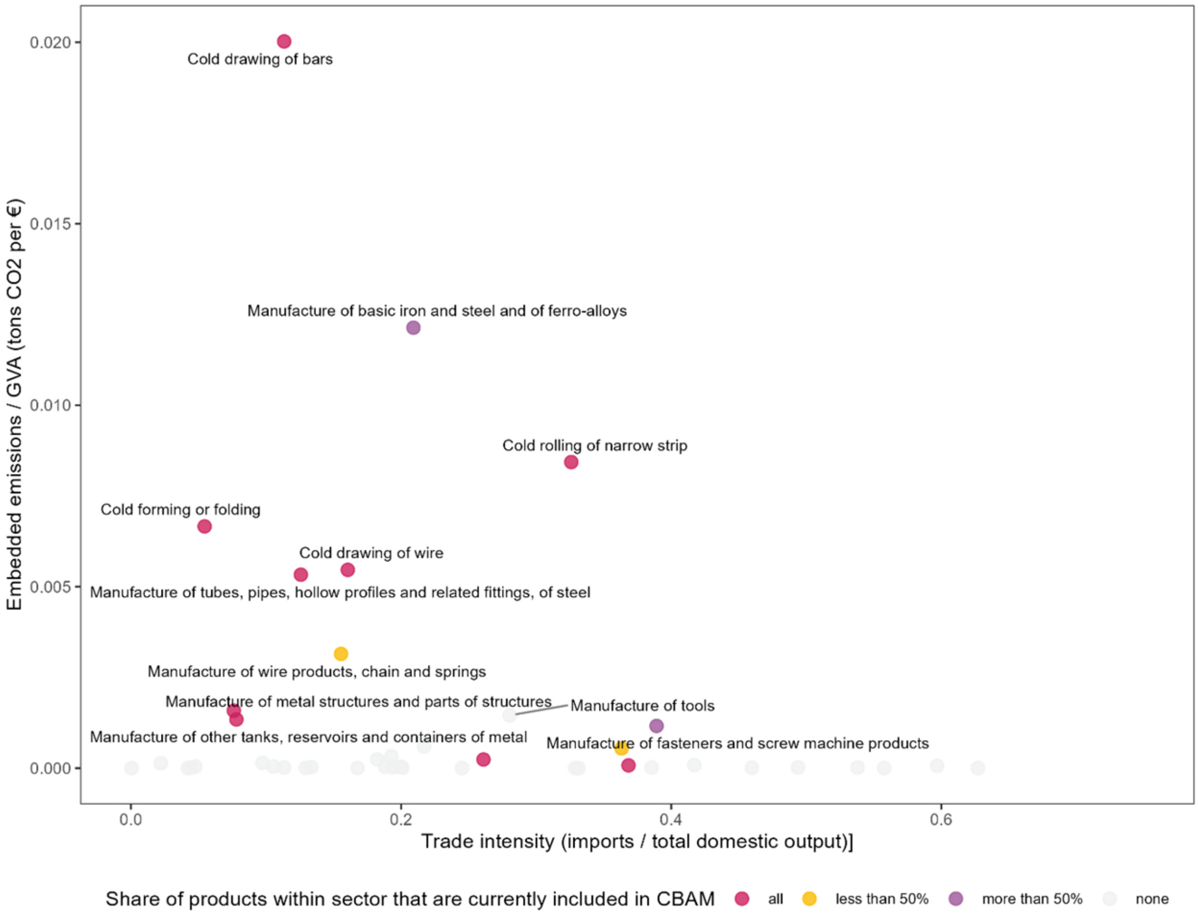
Gross Value Added (GVA) could be used as an alternative to prices calculated through the PRODCOM data. Value added is available from EUROSTAT Structural business statistics[11] (sbs_ovw_act), however, it is only available at the level of economic activities (4-digit NACE Rev. 2 level). Therefore, the level of aggregation when using such data would be less fine-grained compared to PRODCOM product-level data. Yet, the advantage of using GVA instead of prices is that it provides more nuanced information when combined with the potential cost incidence of carbon pricing. Putting GVA in relationship with incidence would approximate, to a certain extent, the capacity of the sector to cope with the carbon price. Higher GVA relative to total output in a sector means that there are higher expenses for labour and capital per unit of output, implying more physical and technological investments as well as human capital and capabilities necessary to produce those products: this could allow for better absorption of carbon pricing incidence without losing excessive market shares.

The Carbon Leakage List for phase 4[12], as well as the previous lists, have been compiled in part using GVA and average emission intensities by sectors. However, the emission intensities of the sectors calculated for the purpose of compiling the Carbon Leakage List only include direct and indirect emissions, not taking into account the embedded emissions in precursors, which are of highest importance for downstream sectors. To account for embedded emissions, one approach would be to use the embedded quantity of material and its emission intensity (as is being done for Figure 7). Figure 8 provides an example of such a calculation.

[11] Dataset can be accessed here https://ec.europa.eu/eurostat/web/structural-business-statistics/database , Enterprises by detailed NACE Rev. 2 activity and special aggregates (Code: sbs_ovw_act)).

[12] The Carbon Leakage List for phase 4 is defined in the Annex of "COMMISSION DELEGATED DECISION (EU) 2019/708 of 15 February 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council concerning the determination of sectors and subsectors deemed at risk of carbon leakage for the period 2021 to 2030" http://data.europa.eu/eli/dec_del/2019/708/oj.

Figure 8: Emission intensities of GVA and trade intensity by 4-digits NACE sectors



Notes: The emission intensity per GVA reported on the y-axis is calculated by multiplying the amount of steel embedded in the production of a given sector (aggregated from Stede et al. 2021) with an average emission intensity of 2.5 tonnes of CO2 per ton of steel. Gross Value Added (GVA), available from EUROSTAT at the 4-digit NACE Rev. 2 sector level. Trade intensity on the x-axis is calculated as the ratio between imports and the sum of domestic production and exports (data from PRODCOM statistics). Colours indicate whether a product is currently included in CBAM or not. Source: own illustration, The Climate Desk.

The products that are identified as having the highest incidence are similar regardless of whether one uses product-price or GVA incidence. The sub-sectors (NACE 4-digit) where the products with the highest incidence (80th percentile) in Figure 7 are mostly the same as the sub-sectors with the highest incidence (also 80th percentile) in Figure 8. Those sub-sectors are: “Manufacture of basic iron and steel and of ferro-alloys”, “Manufacture of tubes, pipes, hollow profiles and related fittings, of steel”, “Cold drawing of bars”, “Cold rolling of narrow strip”, “Cold forming or folding”, “Cold drawing of wire”, “Manufacture of metal structures and parts of structures”, “Manufacture of wire products, chain and springs”[13]. In addition, all of those sub-sectors are already covered by CBAM, with the only exception of “Manufacture of wire products, chain and springs”.

[13] The only difference between the sectors using the 80th percentile threshold is that “Manufacture of other fabricated metal products n.e.c.” appears only for price incidence, while “Manufacture of tools” only for GVA-based incidence.

2.4 Criterion IV: Product inclusion does not create a disproportionate administrative burden

The CBAM regulation explicitly states that administrative costs must be taken into account when considering the inclusion of additional products in the CBAM. This paper does not aim to provide a detailed discussion of the criteria for determining administrative costs, but rather offers a brief overview of the key issues to be considered.

First and generally applying to CBAM, overall and individual administrative costs are driven by the complexity of the instrument (e.g., MRV-requirements, treatment of third-country carbon pricing, complexity of supply chains covered by the scope – i.e., system boundaries), the number of regulated firms, and the size of consignments, among other aspects. Some of these challenges have been addressed by the so-called Omnibus I regulation[14] , such as the introduction of an annual mass-based threshold to significantly reduce the number of obligated importers.

Regarding the expansion of CBAM to downstream products, a number of issues should be considered. Regulated entities will incur costs for providing and submitting relevant information for each product included in the CBAM list in the required format. The further downstream one progresses in the value chain, the more complex and expensive it becomes to analyse and document the chain of upstream products, and the embedded emissions accumulated along this value chain. This is especially true when the production process involves multiple, separately sourced CBAM precursors. For competent authorities, the extension of the scope to downstream products means rising costs. These are driven by registering additional importers, reviewing a greater number of annual reports, where some will entail more complexity due to the nature of downstream products, enforcing the regulation (e.g., in cases of dispute), and other factors.[15]

Next to that, the question of unambiguous identification of a specific product, whether it is distinguishable from others, as well as the complexity of determining benchmarks and standard values, should be considered. Finally, resulting ways of circumvention must be identified, and costs for containment from the side of competent authorities should be factored in.

2.5 Criterion V: Product inclusion prevents circumvention

Circumvention refers to a situation in which (regulated) entities adjust their production processes or trading patterns so that the traded products no longer fall under the CBAM. This can take different forms:[16]

- Further processing in the country of origin through minor modification of products before the import, so that the exports to the EU are no longer primary inputs (which would fall under the scope of CBAM) but rather semi-finished products or even final products (which are not covered by the CBAM);[17]

[14] During the writing of this text, the legislative process had not been completed. The proposal of February 2025 can be found here: https://commission.europa.eu/publications/omnibus-i_en (Accessed July 15th 2025)

[15] A higher number of imports / CBAM reports also likely translates into higher demand for reviewing of the rule for quarterly purchase of CBAM certificates, follow-up of missing reports, as well as monitoring and follow-up if the annual mass-based threshold is exceeded. Also, overhead services as running a service desk and risk management, likely have to be scaled up.

[16] Other circumvention options include resource shuffling, where a company with multiple production units designates the output from the cleanest units for exports to the EU, and transhipments of products, where CBAM goods are imported via third countries that are exempted from the EU CBAM, but do not have a corresponding mechanism in place themselves. These other circumvention options, however, are not specific to the extension of CBAM to downstream products, nor could they be mitigated by extending CBAM, and are therefore not discussed here.

[17] There are several categories of steel products that are not part of the CBAM, but which do not represent a significant added depth of manufacturing, and which consist mostly or entirely of CBAM products. In the case of steel, these include, for instance,

- Deliberately using flexibilities in the Combined Nomenclature, where the same product can be classified into different categories, to classify products so that they fall outside the scope of CBAM, e.g., since the classification hinges on their intended use rather than physical characteristics of the traded good, to classify products so that they fall outside the scope of CBAM;
- Intentionally misclassifying products that are difficult or impossible to distinguish.

Except for the last option, such circumvention is not necessarily fraudulent or illegal; instead, entities might simply exploit existing regulatory gaps or imprecisions. Still, they undermine the effectiveness of CBAM and present a disadvantage for domestic producers.

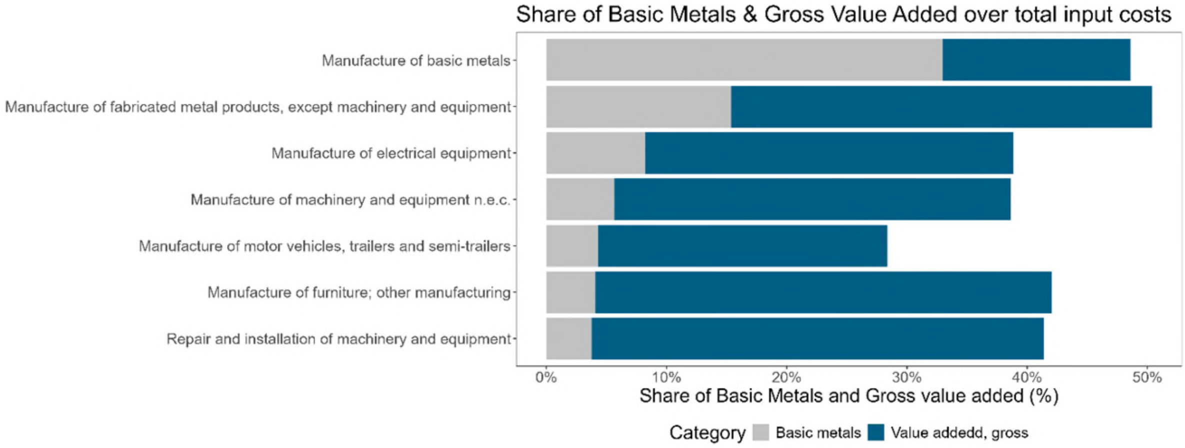
In the first instance, extending the scope of CBAM to downstream products may effectively mitigate the risk of circumvention. Such risk is higher the easier it is to make modifications to a product whose CN code changes. Relocating large sections of processing and value creation is logistically difficult and expensive, but if the modifications are minor, those production changes presumably could quickly and easily be implemented by installations outside the EU, making those particular cases of high importance.

Therefore, a core consideration in this respect is what constitutes a "minor" modification. Economically, this can be approximated via the increase in value of a product from a processing step: the circumvention risk is most acute where the value added by one processing step to another is small in relation to the cost of materials. Figure 9 provides an approximation of this risk for the case of steel and aluminium (basic metals). The analysis presented in Figure 9 compares the share of total production value that comes from purchasing basic metal inputs with the share of total production value that comes from Gross Value Added (e.g., wages and capital returns).

The figure shows that, at this level of aggregation, there is little reason to expect circumvention strategies by moving from the import of basic metals to finished products, as basic metals only account for a negligible share of the total value for these, and the value added created in downstream manufacturing steps constitutes more than 30% of the total production value. Yet the closer to raw basic metals, the higher is the risk of this kind of circumvention: there could be some scope for circumvention by processing basic metals to other interim products, since basic metals account for more than 15% of the total value of "manufacture of fabricated metal products, except machinery and equipment", which comprises subcategories such as steel bars, steel tubes, wire etc. - most of which, however, are included in the CBAM already.

barbed wire of iron or steel (CN 7313); cloth, grill, netting and fencing, of iron or steel wire (CN 7314); chains (CN 7315) or anchors (CN 7316).

Figure 9: Cost of intermediary consumption of basic metals and gross value added as a % of total production value



Notes: Share of total production value for gross value added and consumption of basic metals obtained from input-output tables (Stacked bars). The sector Manufacture of basic metals uses basic metals itself as intermediate consumption. This is because the NACE code "Manufacture of Basic metals" also includes some downstream products of steel and not just raw steel (for example, tubes, pipes and other kinds of first processing). Data used for the calculation: EUROSTAT National supply, use and input-output tables from 2022 (naio_10_n). Source: own illustration, The Climate Desk.

Such an approach is limited by the high level of aggregation of available data. There could be high variation in the additional value added that is created when moving from one specific product to another. One example is the case of furniture made of metal, which in some instances might resemble simple fabricated metal products but has additional holes and bends. In this case, there is a thin line between intentionally misclassification and minor modification, circumvention strategies that could be combined to increase the likelihood of not being detected. In this regard, ad hoc assessment and active monitoring would be required.

An interesting case with respect to circumvention is that of scraps, which is not the typical case of a processed product, since the value of the recycled steel recovered from scrap is bound to be higher than the value of scrap, but lower than the commercial value of the product from which the scrap originated. Nonetheless, the case can be made that scrap metal in the EU, if produced from scrap that was produced since the introduction of the EU ETS 1 in 2005, will include some carbon price element, which is not true of steel outside the EU. When scraps enter the EU, it might be easier to distinguish between pre-consumer and post-consumer scraps before the re-melting takes place, as they usually take the form of shavings or cuts. However, once remelted, it is harder to distinguish between pre- or post-consumer scraps of aluminium or steel. Given the high level of complexity of the matter, the topic of inclusion of scraps would require a separate study and is not further analysed in the present paper.

In general, some degree of circumvention of this type will be hard to avoid, as the nomenclature of traded products will never quite capture the complexity of value chains, and since the nomenclature was developed for other purposes than carbon leakage protection. To address the circumvention risk, there are, in general, two strategies:

- **Proactive**: identify circumvention risks where CN classifications are ambiguous or overly flexible, thereby opening loopholes for circumvention and evasion. Ideally, this would be based on the value added of products, where a processing step that adds little to the value of the (intermediate) product is most susceptible to circumvention. Alternatively, and as a cruder proxy, this could also be approximated by the physical properties of the (intermediate) product, where products that entirely consist of CBAM goods (e.g. steel) are most susceptible to circumvention;
- **Reactive:** monitor the trading patterns with extra-EU suppliers to ascertain any notable shifts. If loopholes in the CN classifications were used for circumvention, this would be observable in a drastic increase in the traded quantities of certain downstream products, which could then retroactively be added to the CBAM list.

2.6 Summary of operationalisation methods and data sources

Table 4: Summary of operationalisation methods and data sources

Criterion	Possible operationalisation methods	Data availability	Limitations and challenges
I. A product contains a significant share of at least one CBAM product	Estimates of material content	Material content available for steel, aluminium, cement, and plastic from Stede et al. (2021)	Lack of official statistics on material content
II. A product is relevant in terms of GHG emissions	1. Estimates of material content, domestic output of that product, and emission intensity of precursors (absolute emissions) 2. Difference between EU and the rest of the world intensities (relative emissions) 3. Monetary flows for the purchase of intermediate goods	1. Material content from Stede et al. (2021), domestic production from PRODCOM dataset[18], emission intensities of precursors from the JRC study (Vidovic et al. (2023)) 2. Emission intensities by major trading partners and products from JRC study (Vidovic et al., 2023) 3. Monetary flows from supply, use, and input-output tables[19]	*1. & 2. Linkage between the emission intensities of a given CBAM product (precursor) and the downstream products needs to be inferred* *3. High level of aggregation*

[18] https://ec.europa.eu/eurostat/web/prodcom.

[19] https://ec.europa.eu/eurostat/databrowser/explore/all/all_themes?lang=en&subtheme=na10.naio_10&display=list&sort=category.

Criterion	Possible operationalisation methods	Data availability	Limitations and challenges
III. A product is exposed to carbon leakage	1. ETS-induced cost share in % of price or gross value added 2. Exposure to international trade	1. Emission intensities from the JRC study (Vidovic et al., 2023) and prices from the PRODCOM dataset. Alternatively, GVA from EUROSTAT[20] 2. Either by use of trade intensities (PRODCOM dataset) or by use of trade elasticities from academic literature	*1. Prices obtained from PRODCOM only offer an average and hide the variation between products. GVA only for sectors.* *2. Trade elasticities in the literature are subject to high uncertainty*
IV. The inclusion of a product does not create a disproportionate administrative burden	MRV-requirements System boundaries unambiguous identification	*Further assessment necessary*	*Further assessment necessary*
V. The inclusion of a product prevents circumvention	1. Value added for each downstream step	1. Input-output tables (EUROSTAT naio_10_n)	*1. High level of aggregation. More detailed metrics needed.*

[20] Enterprises by detailed NACE Rev. 2 activity and special aggregates (Code: sbs_ovw_act) https://ec.europa.eu/eurostat/web/structural-business-statistics/database.

3 Combining the different criteria to produce a prioritisation roadmap

There are different ways in which the criteria discussed in the previous section can be combined to create at least a prioritisation list of products to be included in CBAM. It is possible to calculate a score for each product, then take a simple or weighted average of the scores to rank products from highest to lowest. Alternatively, thresholds could be set for each criterion, with products within all of those thresholds being considered. Another approach could involve a hierarchical distinction between criteria, where some criteria are treated as subordinate to others until the final list is completed.

These three broad approaches represent the main avenues that can be taken. However, they can be modified, integrated, and mixed to achieve different results. In some cases, thresholds and weights could even be adjusted to produce similar results across the different approaches. The choice of which approach to adopt depends on the objectives of the decision-maker. A general limitation that affects all those combination approaches concerns data availability. In some instances, some criteria might be quantifiable for a given product, while others might have missing data. This would require an ad-hoc solution, for example, inferring missing values from similar products, to assess that product with all relevant criteria.

The remainder of this section will briefly discuss these criteria in general, using the example of just two criteria. The next section, based on the assessment carried out in Section 2, will explore the pros and cons of applying the different approaches to the criteria described above.

3.1 Possible approaches

3.1.1 Weighted averages approach

The weighted average approach assigns to each criterion a standardised score and a corresponding weight. The score can be standardised across all criteria, which can be achieved by scaling values between 0 and 1 or 0 to 100%. This process can involve statistical centiles of the distribution, or account for potential outliers, and upper and lower thresholds that correspond to the maximum and minimum scores could be defined.

Once the scores are standardised, they are weighted according to the weight assigned to that criterion. This results in an ordered list of products based on their weighted score. A threshold can then be applied to determine inclusion, such as selecting the top 100 products, the top 10% of products, or any other cut-off point. Alternatively, the ordered list can simply be used for prioritisation without a strict threshold.

Table 5 offers an example of a selection of products in the sector "Manufacture of motor vehicles". Values for percentage of steel content (criterion I) and for the ETS-induced cost share (component of criterion III) are reported; weights have been set to 40% and 60% respectively. Since both are already in percentages, there is no need to normalise them. The resulting index is calculated, and its weighted average is provided.

Table 5: Example of the application of the weighted average approach

PRODCOM code	PRODCOM label	Steel content [in %] (Weight 40 %)	Price incidence [in %] (Weight 60 %)	Evaluation using the weighted average approach
29.32.30.50	Suspension systems and parts thereo f (including shock absorbers)	70%	15%	37%
29.32.30.33	Gearboxes and their parts	70%	13%	36%
29.10.41.40	Motor vehicles for the transport of g oods with only ICE (>20 tons)	80%	7%	36%
29.10.41.10	Motor vehicles for the transport of g oods with ICE (> 5 tons)	80%	4%	34%
29.20.10.30	Bodies for motor cars and other mot or vehicles	70%	6%	32%
29.10.13.10	Vehicle compression-ignition internal combustion piston e ngines (diesel and semi-diesel)	65%	8%	31%
29.20.23.00	Other trailers and semi-trailers n.e.c.	70%	4%	30%
29.32.30.20	Brakes and servo-brakes , and their parts (excluding unmounte d linings or pads)	70%	3%	30%
29.10.22.30	Motor vehicles with only petrol engin e > 1 500 cm³	65%	1%	27%
29.10.21.00	Vehicles with only spark-ignition engine of a cylinder capacity <= 1 500 cm³	65%	1%	27%
29.10.24.50	Motor vehicles, with only electric mo tor for propulsion	65%	1%	27%

Notes: Price incidence assumes a carbon price of 100€ per ton and an emission intensity of steel of 2.5 tons of CO2 per ton of steel. The resulting percentage is a weighted average of two percentage values, and as such should be interpreted only with respect to its relative distribution. Source: Own illustration, The Climate Desk.

This method has several advantages. It provides a clear prioritisation of products and can accommodate an unlimited number of criteria in a structured and transparent way. However, it does have some drawbacks. While it can incorporate qualitative assessments (such as high, medium, or low classifications), it can only do so by assigning a value (such as 1, 0.5, or 0). Furthermore, one single criterion cannot define by itself the inclusion or the exclusion of a product. Products with an extreme outlier value in one category might consistently appear in the final selection, unless the weight for that criterion is set low enough, weakening the overall relevance of such a criterion.

This approach is similar to the approach used for the definition of the Carbon Leakage List, where the emission intensity and import intensities of the sectors were multiplied (instead of averaged) to arrive at a combined value, which was then judged against a given threshold.

3.1.2 Overlap approach

The overlap approach does not require assigning standardised scores. Instead, specific thresholds are established for each criterion. These thresholds can be defined in terms of centiles or absolute cut-off values. Only products that meet the thresholds for all selected criteria are included.

For instance, using the same example as above, two different thresholds could be set for steel content and price incidence, respectively. For example, above 70% for the former and above 5% for the latter (absolute cut-off values). Products would then be considered for inclusion only if they pass both thresholds. Table 6 shows the exemplary results of applying this approach to a limited set of products.

Table 6: Example of the application of the overlap approach

PRODCOM code	PRODCOM label	Steel content [in %]	ETS-induced cost share [in %]	Both thresholds passed?
29.32.30.50	Suspension systems and parts thereof (inclu ding shock absorbers)	70%	15%	Yes
29.32.30.33	Gear boxes and their parts	70%	13%	Yes
29.10.41.40	Motor vehicles for the transport of goods w ith only ICE (>20 tons)	80%	7%	Yes
29.10.41.10	Motor vehicles for the transport of goods w ith ICE (> 5 tons)	80%	4%	No
29.20.10.30	Bodies for motor cars and other motor vehi cle	70%	6%	No
29.10.13.10	Vehicle compression-ignition internal combustion piston engines (diesel and semi-disel)	65%	8%	No
29.20.23.00	Other trailers and semi-trailers n.e.c.	70%	4%	No
29.32.30.20	Brakes and servo-brakes and their parts (excluding unmounte d linings or pads)	70%	3%	No
29.10.22.30	Motor vehicles with only petrol engine > 1 5 00 cm³	65%	1%	No
29.10.21.00	Vehicles with only spark-ignition engine of a cylinder capacity <= 1 5 00 cm³	65%	1%	No
29.10.24.50	Motor vehicles, with only electric motor for propulsion	65%	1%	No

Notes: thresholds are set at >70% steel content and >5% ETS-induced cost share. Price incidence assumes a carbon price of 100€ per ton and an emission intensity of steel of 2.5 tons of CO_2 per ton of steel. Source: own illustration, The Climate Desk.

One limitation of this method is that it generates separate lists for each criterion, and each criterion can only be assessed in isolation from the other. For example, if one product is below one threshold, but substantially above another threshold, it might be excluded following this approach, while priority would be given to a product even if it is slightly above both thresholds. Moreover, the necessity to establish multiple individual thresholds can add complexity. However, this approach offers flexibility in threshold setting and prevents the inclusion of products that score extremely high in one criterion while being very low in others. On the other hand, the advantage of this method is that it can produce a very limited list depending on how the thresholds are defined.

3.1.3 Staggered prioritisation

The staggered priority approach is a variation of the overlap approach, incorporating a hierarchy of criteria to refine the selection process. This method involves an initial broader selection using one criterion, followed by a secondary refinement based on a stricter criterion. For example, one could first select all products that contain more than a specific percentage of steel and then differentiate these based on qualitative assessments of administrative burden, categorizing them as low, medium, or high administrative burden. Those with a low administrative burden could be considered for inclusion first, while those classified as having a medium administrative burden might be allowed more time to develop necessary monitoring, reporting, and verification (MRV) in the country of origin and/or product benchmarks. Similarly, one could select all products with more than 90% steel content and then prioritise based on trade intensities. No specific example in this case is provided, as it would be similar to Table 5 but with a higher threshold for one of the two criteria.

This approach is particularly beneficial as it allows to define a hierarchy of criteria based on their stringency. The more stringent criterion could, for example, be criterion IV to account for practical limitations such as feasibility and administrative burden. The more stringent criterion could be applied either before or after an initial selection. Applying it after allows for the assessment of this more stringent criterion on a limited set of products.

3.1.4 Combining different approaches

A hybrid approach incorporating elements from all three methods may provide an effective selection framework. This could involve initially generating a long list of products using the overlap approach. Such long list could be further refined by a qualitative assessment of technical feasibility based on criterion IV. From the refined list, prioritisation could be achieved using the weighted average approach, ensuring that products are ranked based on a balanced combination of criteria. By integrating these different methodologies, the Commission can ensure a comprehensive and balanced selection process, effectively prioritising products for inclusion while maintaining transparency and limiting administrative burden.

4 Discussion and conclusions

Evaluating the expansion of the CBAM scope to downstream products raises many technical questions. Ultimately, the CBAM scope should ensure appropriate protection against carbon leakage for sectors covered by the EU ETS 1, as well as avoiding the substitution through imports of downstream and final products. This goal must be balanced by ensuring a manageable regulatory effort that does not create a disproportionate burden on importers and other regulated entities. The administrative burden is particularly relevant for downstream products, as the information requirements of tracing emissions that occur along the whole supply chain increase significantly the closer one moves towards final products.

The paper explores the challenges and potential approaches to operationalising various criteria. It provides illustrative examples of applying these criteria to specific product groups and demonstrates how different aggregation methods can be combined to create a prioritisation roadmap. However, it does not propose a definitive recommendation for the criteria to include downstream products in CBAM. Rather, the focus is on defining the framework within which criteria can be selected and combined, setting the stage for discussions on downstream expansion that are expected to begin in 2025. Five main criteria are identified and discussed: whether a product contains a significant share of at least one CBAM good (criterion I), whether a product is relevant in terms of emissions (criterion II), whether a product is exposed to carbon leakage (criterion III), whether a product inclusion does not create excessive administrative burden (criterion IV), and whether a product inclusion prevents circumvention (criterion V).[21]

Whether a product contains a significant share of at least one CBAM good is a relevant criterion that can serve as an insightful proxy for other criteria as well. By identifying the products that contain a very large share of one CBAM material relative to their total composition, a relatively short list of highly relevant products can be identified. For example, only 78 products contain more than 90% of steel and are not currently included in CBAM. However, to be operationalised, such a criterion necessitates detailed data on the material content of products, and no such dataset is produced by EUROSTAT.

Whether a product is relevant in terms of emissions is correlated with its material composition, but is also dependent on the total emissions stemming from the production and consumption of that product within the EU and the difference between the emission intensity of its production in the EU and abroad. Such a criterion reflects more accurately the possible extent of leakage that could be linked with such a product. Data on production levels and emission intensities are available from PRODCOM and JRC, respectively; however, they nonetheless need to be combined with data on material content for this criterion to be operationalised successfully. An alternative approach for operationalising this criterion by using input-output tables has been discussed in this paper. By looking at the monetary flows of different sectors of the economy, such as "basic metals", other sectors that use the products of this sector for intermediate consumption could be identified. However, this approach is limited to a very high level of aggregation, given that input-output tables are publicly available only at a 2-digit sector level, resulting in a very large list of single products.

Whether a product is exposed to carbon leakage depends on the relative cost burden that can be expected for that product, as well as the exposure to trade of that product. Such a criterion is very relevant as trade elasticities ultimately play a critical role in determining the ultimate extent of potential carbon leakage. However, no systematic estimation of trade elasticities is

[21] As mentioned above, in the EU ETS 1, the initial Carbon Leakage List was based on a quantitative assessment on a relatively high aggregation level. However, there was the possibility for sectors to request case-by-case assessments. A similar option could be considered in the context of a downstream extension of CBAM.

available, and operationalising this criterion requires assumptions on specific emission intensities and the price development of the EU ETS 1. Here, an approach similar to the one taken for the definition of the Carbon Leakage List is discussed, showing the relationship between relative cost burden and import intensity. Such operationalisation shows that only very few products have a high estimated cost burden, and that of those, a limited number are more exposed to international trade than the products currently included in CBAM.

If a product's inclusion creates a disproportional administrative burden, it might be a sufficient reason to avoid or delay the inclusion of such product or product group. The CBAM regulation explicitly requires costs and trade-offs to be considered for both regulated firms and competent authorities. Firms face costs related to collecting and reporting information, while authorities bear the burden of reviewing and enforcing compliance. Administrative burden could be estimated using the estimated number of shipments, and costs could be reduced by the inclusion of a high de-minimis threshold and favouring the use of standard values. However, these methods face challenges: standard values risk weakening the instrument if set too low, and high thresholds might exclude significant portions of downstream products. Finally, identifiability of different products and the possibility to define reference values are essential criteria, but at times infeasible to fulfil for certain products, due to the lack of detailed methodologies. Further analysis and detailed qualitative assessments from experts would be needed to apply this criterion.

Finally, whether the inclusion of a product can prevent circumvention is an important criterion, especially in cases in which minor and simple modifications could be made to a product that result in that product being placed in another CN code not covered by CBAM. These instances might, however, be limited and would require the assessment of experts and feedback from industry associations and other stakeholders on a case-by-case basis.

After discussing each criterion independently with the use of exemplary product groups, the paper discusses how those criteria could be combined in different ways. When more than one criterion needs to be applied, they can either be combined in a weighted (or simple) combined scoring or by subsequent staggered selection rounds. This discussion shows ample room for discretion for the combination of different criteria. Such a decision should be guided first and foremost by a prioritisation of the political objectives that an expansion downstream wants to achieve. Furthermore, more detailed evaluation and discussion of the administrative burden and technical limitations for the inclusion of specific products and product groups would need to be analysed in detail, as they can play an important role in the final decision.

There are inherent trade-offs between achieving broad product coverage and thus adopting a precautionary approach to leakage and circumvention and managing the significant administrative burden that such an extensive scope would entail. Any criteria and approach chosen for prioritising inclusion would benefit from iterative refinements through collaboration with industry associations and trade partners.

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