

The aluminium value chain and implications for CBAM design

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Alexandra Maratou and Andrei Marcu

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Executive Summary

When designing the Carbon Border Adjustment Mechanism (CBAM), the EU has to determine not only the type of materials/sectors to be covered, but also how far downstream in the value chain to go in terms of product coverage.

The aluminium sector has complex downstream value chains where trading of semi-finished products is significant. At the same time, the EU aluminium industry depends on imports of primary aluminium in a significant way, with EU dependency on imports of aluminium ingot requirements reaching close to 50% in 2020.

Against this backdrop, the knock-on effects in the value chain of a CBAM applied only upstream or to some aluminium products but not all, can be considerable.

In particular, this paper demonstrates how the application a CBAM only on primary aluminium would lead to higher costs for downstream producers, either incentivizing the relocation of that production outside Europe, or increasing imports of products at the next step in the value chain¹. For instance, if only primary aluminium were covered by a CBAM, road wheel producers in the EU might move production out of Europe, or European original equipment manufacturers (OEMs) would source finished aluminium road wheels from abroad.

Three semi-finished products - namely *aluminium rolled products*, *window frames*, and *automotive body sheets* - have been studied to illustrate the magnitude of the cost implications of a CBAM applied only on primary aluminium. The cost attributed to CBAM on primary aluminium for EU producers of these semi-finished products was found to represent a sizeable 10-13% of the products' sales price. The impact was lessened under a CBAM that would coexist with existing carbon leakage measures, yet the CBAM cost still represented a sizeable 4-5% of the sales price.

At a more aggregate level, the annual additional cost faced by EU downstream producers of semi-finished aluminium products that source primary aluminium from outside the EU was estimated at around EUR 1.5 billion (at current CO₂ price levels of EUR 50/tCO₂). This is equal to about 5% of the total value of EU production of semi-finished aluminium products. The estimate would increase further at higher CO₂ prices expected through to 2030.

What is more, a CBAM only upstream would disregard a sizeable part (between 1/3 and 1/2) of emissions embedded in imports of aluminium products.

Effectively, the application of CBAM to primary only materials, would merely shift the risk of carbon leakage downstream in the value chain. This is expected to be felt in particular by those sectors producing semi-finished products that contain a high share of the primary material, and the processing results in limited value-added such as flat rolled and extruded aluminium products. Those downstream sectors would be protected by a CBAM levied on imports of like downstream products. It must however be noted that the risk of carbon leakage decreases once one goes further downstream in the value chain, at a point where the carbon costs borne by

¹ ERCST (2021b), Border Carbon Adjustments in the EU: Sectoral deep dive, March 2021, p. 50

products diminishes in proportion to their total value, and as goods begin to compete on more than simply price².

As long as there are aluminium semi-finished products or products made out of aluminium semi-finished products that are exempted from CBAM, the EU aluminium processing industry will lose out in competitiveness.

In turn, an uncompetitive EU industry of semi-finished aluminium products would translate into reduced demand for EU primary aluminium, putting at risk also the upstream part of the value chain.

Another issue that needs to be considered is the versatility of exporting countries in adapting their aluminium production in order to avoid potential CBAM payments (adapt product offering to products not covered by CBAM), as well as the ability of industry to find creative ways to circumvent CBAM, for example by slightly modifying the products so as to fall under a different customs code and therefore not be covered by the CBAM.

When deciding how far downstream CBAM product coverage should go, policy makers will need to strike the right balance between the aspiration to maximize effectiveness and minimize technical/administrative complexity. The following considerations could help in striking a balance in that respect:

- CBAM would cover imports of those products with high share of aluminium content, e.g. initially those products whose content is near 100% (or other threshold) aluminium. Gradually expanding to more complex manufactured goods that encompass large quantities of the basic material (e.g. imports of aircraft engines, or cars) can be examined, however the vulnerability to substitution by imports is reduced for products with higher value added.
- At minimum all products under tariff chapter HS 76 should be covered from the outset of the mechanism. Additional products traded outside HS 76 with close to 100% aluminium composition should also be considered for inclusion.
- Since the direct and energy-related indirect emissions from producing semi-finished and finished products are often moderate relative to value added, their inclusion in a CBAM would have to reflect emission costs from the upstream production of the intermediate goods incorporated in such products³, such as the emissions embodied in the primary aluminium used as a raw material for flat rolled aluminium products. Including these upstream emissions is important when covering downstream semi-finished or finished goods, as the embedded carbon cost passed through in the price of carbon-intensive raw materials is a major and often the primary carbon cost faced by such downstream producers⁴.
- Maintaining the existing carbon leakage measures would reduce the risk of carbon leakage further down the value chain;
- Horizontal product scope should take due consideration of the risk of circumvention.

² ERCST (2021a), CBAM for the EU: A Policy Proposal, April 2021, p. 14

³ ERCST (2021b), Border Carbon Adjustments in the EU: Sectoral deep dive, March 2021, p. 67

⁴ ERCST (2021a), CBAM for the EU: A Policy Proposal, April 2021, p. 16

1 Introduction

When designing the Carbon Border Adjustment Mechanism (CBAM), the EU as the implementing jurisdiction, has to determine: 1) the type of materials/sectors to be covered; 2) how far downstream in the value chain to go in terms of product coverage.

With respect to the second dimension, in theory, CBAM could cover all traded products throughout the entire value chain, maximizing its ability to prevent leakage and level the competitive playing field. In practice, however, the administrative cost and technical complexity of covering a majority of traded products – especially in the case of complex manufactured goods – would be disproportionate to the environmental and competitiveness benefits of the CBAM⁵.

In this paper, we explain why applying a CBAM on aluminium only upstream (i.e. primary aluminium from the smelting process via electrolysis) would lead to higher costs for downstream producers, either incentivizing the relocation of that production outside Europe, or increasing imports of products at the next step in the value chain⁶. Therefore, when deciding how far downstream CBAM product coverage should go, policy makers will need to strike the right balance between the aspiration to maximize effectiveness and minimize technical/administrative complexity.

Aluminium, together with many other sectors, has complex downstream value chains where trading of semi-finished products is significant. When these semi-finished products have a high content of the carbon-intensive primary material, and the processing results in limited value-added, such as is the case for flat rolled and extruded aluminium products, their exclusion from CBAM may render them vulnerable to substitution by imported products at the same level in the value chain. Effectively, the application of CBAM only to upstream primary materials, would merely shift the risk of carbon leakage downstream in the value chain.

The introduction of a tariff on primary aluminium by the Trump Administration serves as an immediate illustration of the potential impact: from June 2018 to May 2019, imports to the US of aluminium wire, plaited bands and similar aluminium products increased by 152%, which led the Trump Administration to subsequently extend the tariffs further down the value chain⁷.

2 The aluminium value chain

Aluminium production is usually described as a process of mining, refining, smelting, transformation and recycling.

In the primary production process, aluminium is produced from the ore bauxite, which is purified to yield aluminium oxide (Al_2O_3) – also known as alumina – and reduced to elemental aluminium in smelting plants through the electrochemical Hall–Héroult process, which requires temperatures in excess of 950°C, and a high intensity electrical current. Secondary aluminium

⁵ ERCST (2020), Border Carbon Adjustments in the EU: Issues and Options, September 2020

⁶ ERCST (2021), Border Carbon Adjustments in the EU: Sectoral deep dive, March 2021, p. 50

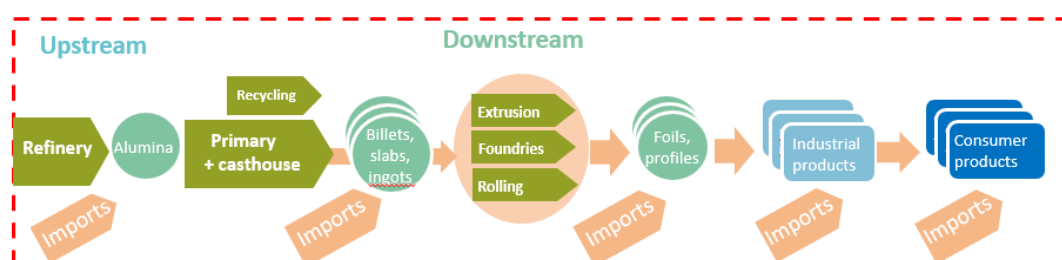
⁷ Zachmann, G. and McWilliams, B. (2020) 'A European carbon border tax: much pain, little gain', *Policy Contribution* 05/2020, Bruegel

is refined or remelted from scrap metal recovered from waste and recycling streams, requiring a melting furnace operating at temperatures ranging from 700°C to 760°C, mostly using natural gas.

The metal is generally cast as ingots or produced as a blister or cathode and follows a downstream treatment which includes rolling mills, extruders and casters. More specifically, further downstream, these ingots (also referred to as ‘unwrought aluminium’; HS Code 7601) in the form of pure or alloyed ingots, blocks, billets, slabs and similar forms are then converted into flat rolled, extruded, and cast products, including semi-finished bars, rods and profiles (HS Code 7604), aluminium tubes and pipes (HS Code 7608) and their fittings (HS Code 7609), wire (HS Code 7605), plates, sheets and strips (HS Codes 7606 and 7610) as well as foil (HS Code 7607).⁸

Semi-fabricated products obtained from the processing of aluminium ingots, i.e. flat-rolled products and extruded products, undergo then further transformation before they can be used in final industrial or consumer products. Key end-use markets include transport/automotive, building/construction and packaging. Unlike primary aluminium and most semi-finished products, such products are typically traded outside HS chapter 76 ‘Aluminium and articles thereof’.

Figure 1 Steps in the aluminium value chain



EU aluminium sector

Europe represents about 7% of global primary aluminium production, around half of which comes from within the EU (the other half from EFTA countries). The number of aluminium smelting plants in the EU has decreased from 26 plants in 2002 to 15 plants in 2019, of which two were idled in 2019. The 13 active plants are located in nine countries: France, Germany, Greece, The Netherlands, Spain, Romania, Slovakia, Slovenia and Sweden. An additional 10 smelting plants are found in Norway, Iceland and the UK⁹.

At the same time, the value chain of aluminium in the EU comprises around 600 plants ranging from processing of raw materials to production of semi-fabricates such as rolled and extruded products, and recycling.¹⁰ Smelters and rolling mills are often owned by multinational

⁸ Fraunhofer Institute for Systems and Innovation Research, ‘Methodology for the Free Allocation of Emission Allowances in the EU ETS Post 2012: Sector Report for the Iron and Aluminium Industry’ (Utrecht: Fraunhofer ISI, 2009)

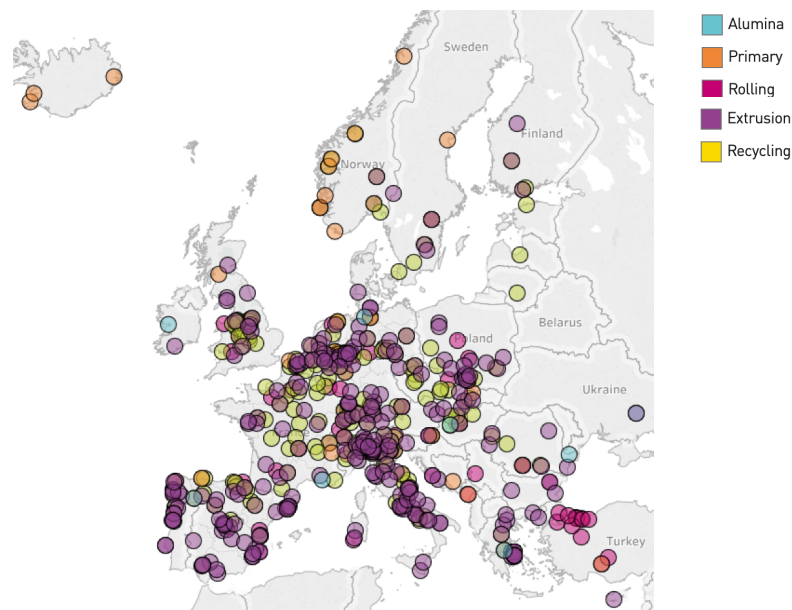
⁹ European Aluminium, ‘Digital Activity Report 2020-2021’

¹⁰ *ibid.*

companies, while the majority of the plants involved in extrusion and recycling are small to medium enterprises (SMEs).¹¹

The EU aluminium industry is largely an industry of semi-finished products, as can also be inferred from the map below.

Figure 2 Aluminium production along the value chain in Europe



Source: European Aluminium, 'Digital Activity Report 2020-2021'

It follows naturally, that the EU industry largely depends on imports of primary aluminium, with EU dependency on imports of aluminium ingot requirements reaching close to 50% in 2020¹². Even companies with operations along the value chain are often dependent on primary aluminium imports and have limited leeway in the short- to medium-term for diverting their own primary production for captive use downstream. Reasons include the pre-existence of long-term contracts that need to be honoured, or the time and costs involved in certifying specific alloys for specific uses (e.g. for automotive use).

¹¹ *ibid.*

¹² European Aluminium, 'Digital Activity Report 2020-2021'

3 CO₂ emissions in the aluminium sector

Primary aluminium production is a multi-stage and energy-intensive process, with electrochemical reduction of alumina consuming the largest share of energy, followed by alumina production from bauxite ore. These processes result in direct emissions of CO₂ from use of fuels for process heat as well as CO, perfluorocarbons (PFCs) and smaller amounts of CO₂ through carbon anode consumption and anode effects.

Direct emissions are relatively homogenous across primary aluminium production plants and range from 1,5 to 2,5 tCO₂e per tonne of aluminium. Globally, they average 2,1 tCO₂e per ton of primary aluminium¹³. Because of the electrolytic reduction process, however, indirect emissions greatly outweigh direct emissions in primary aluminium production.

In the EU, indirect emissions from electricity consumption during smelting (Scope 2 emissions) average ~4,1 tCO₂e per ton of primary aluminium¹⁴, they average 10,4 tCO₂e per ton of aluminium globally¹⁵, whereas they are as high as ~12,8 tCO₂e on average per tonne of aluminium produced in China¹⁶. They can be as low as zero in regions with very high shares of hydroelectric generation.

In this report we have assumed the Middle East to be the marginal producer. This means that the price of primary aluminium in the EU is set by a Middle-East producer at a level to cover their costs and a small profit (i.e. London Metal Exchange price + duty paid + CBAM). We have assumed a total Scope 1 & Scope 2 carbon intensity of about 8,2 tCO₂/ton of primary aluminium coming from this region, including global average Scope 1 carbon intensity of about 2,1 tCO₂/ton of aluminium, and Scope 2 carbon intensity of about 6,1 tCO₂/ton of aluminium (using gas fired power plants)¹⁷.

One step further in the value chain, the transformation of primary aluminium into semi-finished products results also in direct and energy-related indirect emissions. These are however often moderate relative to value added, with the lion share of a semi-finished product's carbon footprint stemming from the emissions embodied in the primary aluminium used as an input for their production.

¹³ Based on data by the International Aluminium Institute (2020), taking into account direct process CO₂ emissions and non-CO₂ GHG emissions from electrolysis, carbon anode consumption and anode effects.

¹⁴ Estimated based on the electricity intensity of 15MWh/ton of primary aluminium and the EU electricity grid emissions factor of 0,275 t CO₂/MWh in 2019 based on European Environment Agency data.

¹⁵ Based on data by the International Aluminium Institute (2020), concerning emissions in the Middle East from electricity electrolysis.

¹⁶ *ibid.*

¹⁷ *ibid.*

4 Aluminium imports and embedded emissions

Around half of EU primary aluminium demand is covered through imports, while exports of primary aluminium to countries outside the EU account for a mere 5% of domestic production.

*Table 1 EU27 production, imports and exports of primary aluminium**

	Volume (2017-2019 avg.)	Value (2017-2019 avg.)
Production	6.534.535 tons	EUR 10.481.107.788
Imports	6.140.140 tons	EUR 11.720.552.433
Exports	356.050 tons	EUR 731.908.170
Imports as a share of domestic consumption (%)	50%	55%
Exports as a share of domestic production (%)	5%	7%

*Aggregate figures for 2 primary aluminium products: '24421130 - Unwrought non-alloy aluminium (excluding powders and flakes)' and '24421154 - Unwrought aluminium alloys (excluding aluminium powders and flakes)'

Source: own elaboration based on Eurostat 'Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data [DS-066341]'

A significant share of these imports originates in European Free Trade Agreement (EFTA) countries, in particular Norway and Iceland, the two largest exporters of primary aluminium to the EU.

Since these countries already participate in the EU ETS or have a linked emissions trading system, they are of less concern regarding emissions leakage than other trade partners. Other major exporters to European countries are Russia, the United Arab Emirates and Mozambique.

As of 2019, the largest producers of aluminium outside the EU were China, India, Russia, Canada, and the United Arab Emirates, with China having experienced dramatic growth in production capacity to represent about 60% of total global aluminium production.

4.1 Primary aluminium and semi-finished products traded under HS 76

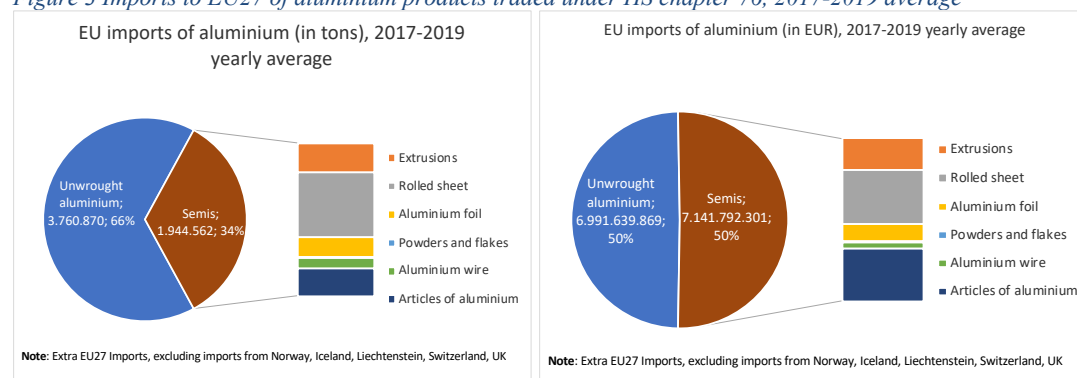
The following figures show the level of aluminium imports to EU27 in 2017-2019 (excluding imports from Norway, Iceland, Liechtenstein, Switzerland, UK). The figures take into account the trade flows recorded under HS¹⁸ chapter 76 'Aluminium and articles thereof', a chapter that classifies products based on their material composition (in this case aluminium).

A total of 5,7 million tons of aluminium per year were imported, in either primary or semi-processed form, for a total value of about EUR 14 billion. The figures provide a breakdown

¹⁸ The Harmonized Commodity Description and Coding System, also known as the Harmonized System (HS) of tariff nomenclature is an internationally standardized system of names and numbers to classify traded products. As of 2015, 180 countries or territories worldwide applied the Harmonized System. HS codes are used by Customs authorities, statistical agencies, and other government regulatory bodies, to monitor and control the import and export of commodities through customs tariffs, international trade statistics, rules of origin, etc. The HS is organized into 21 sections, which are subdivided into 99 chapters. The 99 HS chapters are further subdivided into 1,244 headings and 5224 subheadings. Chapter 76 concerns 'Aluminium and articles thereof'.

between imports of primary (unwrought) aluminium and imports of semi-finished aluminium products (semis), such as extruded products, rolled sheet products, foil etc¹⁹.

Figure 3 Imports to EU27 of aluminium products traded under HS chapter 76, 2017-2019 average

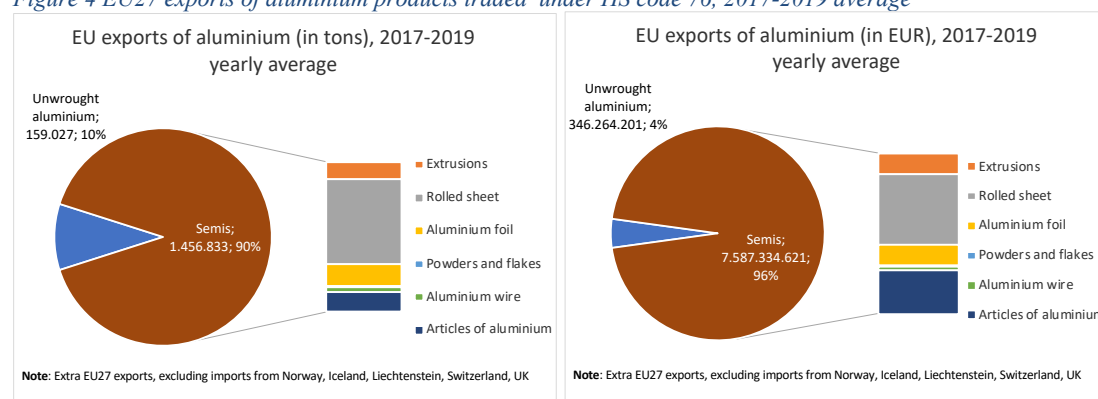


Source: own elaboration based on Eurostat dataset 'EU trade since 1988 by HS2,4,6 and CN8 [DS-645593]'

Under HS chapter 76, two thirds of imports in terms of volume (tons) were in the form of unwrought aluminium, representing about 50% of imports value, while more processed products accounted for one third of imports to the EU in terms of volume and 50% of the total imports value.

The picture is reversed when it comes to EU exports of aluminium. Ninety percent (90%) of total EU exports in terms of volume under HS chapter 76 were in the form of semi-finished products, with just 10% of the total in the form of primary aluminium. Semi-finished products represented 96% of the total exports value.

Figure 4 EU27 exports of aluminium products traded under HS code 76, 2017-2019 average



Source: own elaboration based on Eurostat dataset 'EU trade since 1988 by HS2,4,6 and CN8 [DS-645593]'

In summary, EU imports aluminium products upstream in the value chain, and exports aluminium products that are higher in the value chain.

¹⁹ Based on Eurostat database 'EU trade since 1988 by HS2,4,6 and CN8'. Presented product group categories are derived by grouping together the HS codes as follows: Unwrought aluminium (HS 7601), Extrusions (HS 7604, 7408, 7409), Rolled sheet (HS 7606, 7610), Aluminium foil (HS7607), Powders and flakes (HS 7603), Aluminium wire (HS 7605), Articles of aluminium (HS 7611, 7612, 7613, 7614, 7615, 7616). HS 7602 'scrap' is not included in the figures.

Embedded emissions

Using the emissions intensity value for Middle East as the marginal producer of 8,2 tCO₂/ton of primary of aluminium (cf. chapter 0 for more details), we can derive an estimate of the emissions embodied in aluminium imports to the EU (Table 2 and Figure 5). The emissions embedded in imports of primary aluminium amounted to about 31 Mt CO₂ annually for the period 2017-19.

During the same period, emissions from the primary aluminium input embedded in imports of semi-finished products were about half this amount. They constituted nevertheless a considerable level of emissions, close to 16 Mt CO₂ when using the emissions intensity for the Middle East. Therefore, a CBAM only upstream would disregard a sizeable part (about 1/3) of emissions in imports.

Table 2 Aluminium extra-EU ETS imports (tons, and embedded Scope 1 & 2 emissions (tCO₂/year), 2017-2019 annual average

Product ⁽¹⁾	Extra EU ETS imports (tons) ⁽²⁾	Scope 1 emissions (tCO ₂)	Scope 1 & 2 emissions (tCO ₂)
Unwrought (primary) aluminium	3.760.870	7.897.827,8	30.839.137,3
Extrusions	368.776	774.430,3	3.023.965,9
Rolled sheet	837.327	1.758.387,7	6.866.085,2
Aluminium foil	245.798	516.176,6	2.015.546,9
Powders and flakes	18.166	38.148,6	148.961,2
Aluminium wire	129.784	272.546,7	1.064.229,9
Articles of aluminium	344.710	723.890,8	2.826.621,2

Notes:

⁽¹⁾ Product group categories are derived by grouping together the HS codes as follows: Unwrought aluminium (HS 7601), Extrusions (HS 7604, 7408, 7409, Rolled sheet (HS 7606, 7610), Aluminium foil (HS 7607), Powders and flakes (HS 7603), Aluminium wire (HS 7605), Articles of aluminium (HS 7611, 7612, 7613, 7614, 7615, 7616). HS 7602 'scrap' is not included in the figures.

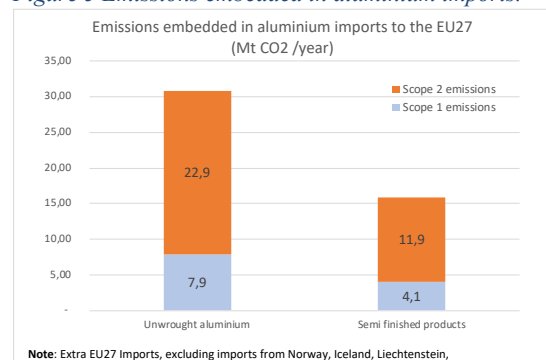
⁽²⁾ Source: Eurostat dataset 'EU trade since 1988 by HS2,4,6 and CN8 [DS-645593]'

An estimate of the corresponding additional cost (as a result of increase in primary material cost due to CBAM payments) that would be faced by EU downstream producers that source primary aluminium from outside the EU is also provided (Figure 6). The estimate is based on the 2017-19 annual average volume of imports from extra EU-ETS countries²⁰, and a CO₂ price of EUR 50/tCO₂.

²⁰ Imports from Norway, Iceland, and Liechtenstein that participate in the EU ETS are excluded, and so are imports from Switzerland whose ETS is linked to the EU ETS, and the UK whose ETS is likely to be linked to the EU ETS.

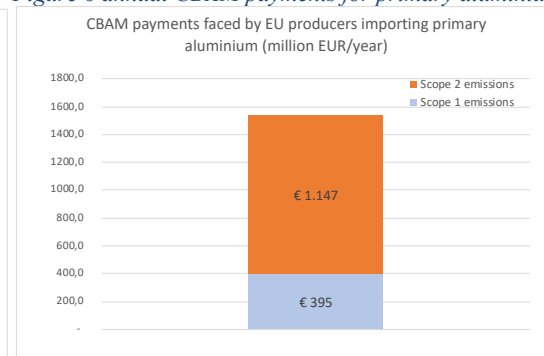
The annual cost would amount to about EUR 1.5 billion²¹, equal to about 5% of the average EU production value in 2017-19 of semi-finished aluminium products included under NACE code 2442²².

Figure 5 Emissions embedded in aluminium imports.



Source: own elaboration

Figure 6 annual CBAM payments for primary aluminium



Furthermore, much of the imported semi-finished products originate from countries with much higher carbon footprint from the production. The largest importer of aluminium semi-finished products is China. Assuming the average emission intensity in China (14.9 tCO₂/t), the embedded emissions in imports of semi-finished products would be of the same magnitude as emissions from imports of primary, close to 29 Mt CO₂. In this case, a CBAM only upstream would disregard about half of imported emissions.

Moreover, if a CBAM were imposed only upstream this would incentivise an increase in imports of downstream products, and thus emissions from imports of semi-finished products would likely grow further.

4.2 Semi-finished products traded outside HS chapter 76

The figures presented in the previous section focused on aluminium products traded under HS chapter 76 'Aluminium and articles thereof'. By definition all products classified in chapter 76 have a near 100% aluminium content.

Also, additional products with close to 100% aluminium content are traded under trade codes that cover competing products made from alternative materials. For example, aluminium auto body sheets are traded under chapter 76, but products made completely from these sheets

²¹ In this paper, the indirect (Scope 2) part of the CBAM cost has been calculated based on Scope 2 emissions and therefore the carbon intensity of electricity. However, because of the way electricity prices are determined in the European wholesale power market the carbon cost passed through in electricity prices does not fully correlate with the actual carbon intensity of electricity. Hence, the carbon costs associated with electricity are decoupled from the indirect physical emissions of electricity intensive producers. Including Scope 2 emissions in the calculation of a CBAM therefore would not fully level the indirect carbon cost faced by European and non-European producers. (see ERCST (2021a), section 3.1.5, and ERCST (2021b), Section 3.6)

²² About EUR 29,5 billion on average in 2017-19, based on Eurostat data 'EU Estimated Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data [DS-066341]'

(doors, hoods etc.) are not classified under HS chapter 76 as they cannot be classified according to their material composition, but rather according to their function or form.

For illustration purposes, we consider aluminium products made from semi-finished auto-body sheets used in the automotive industry and traded under HS codes of chapter 87 ‘Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof’. In this case:

- Products traded under HS code ‘87.07: Bodies incl. cabs, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles of heading 8701 to 8705’.
- Products ‘traded under HS code ‘87.08: Parts and accessories for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles of heading 8701 to 8705.’

Thus, during customs clearance their assigned trade code would not be sufficient to determine whether CBAM would be applicable. Additional information regarding the product material composition of shipments would therefore be needed.

4.3 Products further downstream

The previous two sections focused on aluminium products with a near 100% aluminium content.

In addition, aluminium is also imported in Europe as part of more complex products whose composition might encompass some aluminium content as well as other metals and materials.

It is therefore difficult to have a complete picture of the aluminum imports in final products from official trade data.

In the following analysis we rely on a public dataset²³ for the approximate composition of 4000 commodity groups in the Eurostat ProdCom database (NACE v2) in terms of their content of primary materials and metals.²⁴

Using the above-mentioned dataset, a list of products with an approximate aluminium content of 70% in terms of volume can be derived for illustration purposes.

Table 3 Products with an approximate aluminium composition of about 70%

PRCCODE	Product description
30301100	Aircraft spark-ignition internal combustion piston engines, for civil use
30301200	Turbo-jets and turbo-propellers, for civil use

²³ The ‘Metal/material composition’ dataset (3_MC_NACEv2_4000Groups) was developed by Norwegian University of Science and Technology (NTNU) Trondheim and the University of Freiburg (2016), for the following work: "Quantifying Impacts of Consumption Based Charge for Carbon Intensive Materials on Products" Stefan Pauliuk, Karsten Neuhoff, Anne Owen, Richard Wood, DIW Discussion paper 1570, German Institute for Economic Research, Berlin.

²⁴ These include: steel, plastics, paper, cement, and the metals Fe, Cu, Al, Cr, Mn, Mo, and V.

PRCCODE	Product description
30301300	Reaction engines, for civil use (including ramjets, pulse jets and rocket engines) (excluding turbojets, guided missiles incorporating power units)
30301400	Ground flying trainers and parts thereof, for civil use
30301500	Parts for aircraft spark-ignition reciprocating or rotary internal combustion piston engines, for use in civil aircraft
30301600	Parts of turbo-jets or turbo-propellers, for use in civil aircraft
30302000	Balloons, dirigibles and other non-powered aircraft, for civil use (including sounding, pilot and ceiling balloons, meteorological kites and the like)
30303100	Helicopters, for civil use
30303200	Aeroplanes and other aircraft of an unladen weight $\leq 2\,000$ kg, for civil use
30303300	Aeroplanes and other aircraft of an unladen weight $> 2\,000$ kg, but $\leq 15\,000$ kg, for civil use
30303400	Aeroplanes and other aircraft of an unladen weight $> 15\,000$ kg, for civil use
30304000	Spacecraft, satellites and launch vehicles, for civil use
30305030	Propellers and rotors and parts thereof for dirigibles, gliders, and other non-powered aircraft, helicopters and aeroplanes, for civil use
30305050	Undercarriages and parts thereof for dirigibles, gliders, hang gliders and other non-powered aircraft, helicopters, aeroplanes, spacecraft and spacecraft launch vehicles, for civil use
30305090	Parts for all types of aircraft excluding propellers, rotors, under carriages, for civil use

Source: based on NTNU Trondheim/University of Freiburg (2016), and Prodcum Annual Data by Eurostat

This list encompasses primarily products destined for the aircraft industry such as engines, or even complete aircrafts. These are sophisticated products with high value added that are not traded under HS chapter 76 ‘Aluminium and articles thereof’ despite their high aluminium content.

Using trade data by Eurostat, extra-EU27 imports of products with an approximate aluminium composition of about 70% amounted collectively to about EUR 60 billion, while EU27 exports amounted to about EUR 93 billion.

Table 4 Production and trade in products with 70% aluminium composition

PRCCODE – Product description	Exports quantity	Exports value (EUR)	Imports volume	Imports value (EUR)	Production quantity	Production value	Quantity unit
30301100 - Aircraft spark-ignition internal combustion piston engines, for civil use	13.479	185.561.490	2.806	77.799.797	7.155	154.614.748	p/st
30301200 - Turbo-jets and turbo-propellers, for civil use	15.374	9.342.128.680	9.592	11.238.730.493	434.667	6.206.444.474	p/st
30301300 - Reaction engines, for civil use (including ramjets, pulse jets and rocket engines) (excluding turbojets, guided missiles incorporating power units)	37.953	33.635.873	114.644	38.965.707	120	3.945.219	p/st
30301400 - Ground flying trainers and parts thereof, for civil use	:	124.375.587	:	142.058.350	:	131.321.958	:
30301500 - Parts for aircraft spark-ignition reciprocating or rotary internal combustion piston engines, for use in civil aircraft	:	51.386.703	:	47.224.453	:	92.776.954	:
30301600 - Parts of turbo-jets or turbo-propellers, for use in civil aircraft	:	13.958.151.277	:	14.057.855.480	:	11.425.891.694	:
30302000 - Balloons, dirigibles and other non-powered aircraft, for civil use (including sounding, pilot and ceiling balloons, meteorological kites and the like)	75.954	14.544.390	301.235	7.123.560	876	27.669.518	p/st
30303100 - Helicopters, for civil use	7.345	1.966.924.137	28.556	472.568.810	789	4.202.330.670	p/st
30303200 - Aeroplanes and other aircraft of an unladen weight <= 2 000 kg, for civil use	3.479	217.252.800	4.488	73.584.687	1.906	291.601.045	p/st
30303300 - Aeroplanes and other aircraft of an unladen weight > 2 000 kg, but <= 15 000 kg, for civil use	275	2.361.973.510	223	1.210.141.250	185	3.408.566.627	p/st
30303400 - Aeroplanes and other aircraft of an unladen weight > 15 000 kg, for civil use	840	49.858.463.747	534	19.302.791.727	500	12.333.333.333	p/st
30304000 - Spacecraft, satellites and launch vehicles, for civil use	112.533	1.086.491.867	4.267	128.162.160	36.212.887	6.000.000.000	kg

PRCCODE – Product description	Exports quantity	Exports value (EUR)	Imports volume	Imports value (EUR)	Production quantity	Production value	Quantity unit
30305030 - Propellers and rotors and parts thereof for dirigibles, gliders, and other non-powered aircraft, helicopters and aeroplanes, for civil use	:	256.320.553	:	176.290.367	:	113.385.194	:
30305050 - Undercarriages and parts thereof for dirigibles, gliders, hang gliders and other non-powered aircraft, helicopters, aeroplanes, spacecraft and spacecraft launch vehicles, for civil use	:	1.827.921.307	:	1.140.517.407	:	1.117.071.875	:
30305090 - Parts for all types of aircraft excluding propellers, rotors, under carriages, for civil use	:	11.507.057.330	:	11.727.355.993	:	34.337.628.772	:

Notes:

Special value ‘:’ denotes ‘not available’

Special value ‘p/st’ denotes ‘number of items’

Source: based on Eurostat dataset ‘Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data [DS-066341]’, NTNU Trondheim/University of Freiburg (2016)

In the remainder of this section, we focus on the example of product ‘30304000 - *Spacecraft, satellites and launch vehicles, for civil use*’, for which import quantity data is denoted in kg (while for the rest of the import data the quantity is in number of items).

An estimate of the emissions embodied in aluminium imports to the EU is derived using - similarly to previous examples - the emissions intensity value for Middle East as the marginal producer of 8,2 tCO₂/ton of primary of aluminium. The primary aluminium emissions embedded in imports of products under code ‘30304000 - *Spacecraft, satellites and launch vehicles, for civil use*’ amounts to about 24,5 tCO₂ annually for the period 2017-19 (Scope 1 & 2 emissions).

An estimate of the corresponding additional cost (CBAM payments) faced by EU aircraft producers that source products under code 30304000 from outside the EU is also derived. Assuming a CO₂ price of EUR 50/tCO₂, the additional cost would amount to about EUR 1.225 per annum when both Scope 1 & 2 emissions are accounted for, representing less than 0,001% of imports value of the products in this category.

We do not have an estimate of the share of CBAM payments for the products listed in

Table 3 relative to the production value of the downstream industries that use these products as inputs. Intuitively, this share should be limited, given that the aircraft industry produces high tech products, and that the added value is derived primarily from inputs other than the material or metal content.

5 CBAM design options and implications

5.1 CBAM horizontal product scope options

With respect to CBAM's 'horizontal' product scope, i.e. how far downstream in the value chain to go in terms of product coverage, there are broadly speaking three options:

- Only imports of primary (unwrought) aluminium,
- Imports of primary aluminium, as well as semi-finished aluminium products, or
- Imports of primary aluminium, semi-finished aluminium products, as well as the aluminium content of more finished imported products (e.g. engines, aircrafts, cars)

Since the direct and energy-related indirect emissions from producing semi-finished and finished products are often moderate relative to value added, their inclusion in a CBAM would have to reflect emissions from the upstream production of the intermediate goods incorporated in such products²⁵, such as the emissions embodied in the primary aluminium used as a raw material for flat rolled aluminium products.

A CBAM applied only upstream would lead to higher costs for downstream EU producers, as they would be purchasing inputs at higher prices because of the ETS applied upstream domestically as well as the CBAM applied at the border. Their foreign competitors would be purchasing cheaper inputs and would enjoy a competitive advantage.

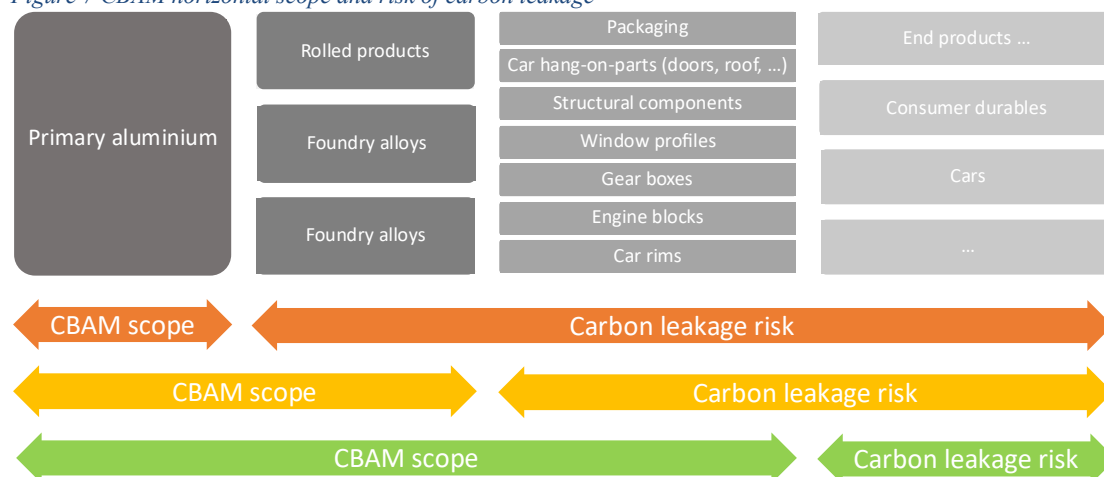
Effectively, the application of CBAM to upstream only primary materials, would merely shift the risk of carbon leakage downstream in the value chain, incentivizing the relocation of production out of Europe or increasing imports of products at the next step in the value chain²⁶.

For instance, if only primary aluminium were covered by a CBAM, road wheel producers in the EU might move production out of Europe, or European original equipment manufacturers (OEMs) would source finished aluminium road wheels from abroad. In contrast, if imported downstream products are subject to the same CO₂ emission costs as EU producers of like products, price increases could absorb part of the additional input costs within the EU. Even in this case, however, the EU industry is still likely to suffer a loss in competitiveness in export markets, where higher prices are not anticipated.

²⁵ ERCST (2021b), Border Carbon Adjustments in the EU: Sectoral deep dive, March 2021, p. 67

²⁶ ERCST (2021), Border Carbon Adjustments in the EU: Sectoral deep dive, March 2021, p. 50

Figure 7 CBAM horizontal scope and risk of carbon leakage



On the other hand, typically the content of primary aluminium diminishes while the value added resulting from processing increases the further downstream one goes in the value chain. The risk of carbon leakage is mitigated the further one goes downstream in any value chain, as the carbon costs borne by products diminish in proportion to their total value, and as goods begin to compete on more than simply price²⁷. Therefore, the vulnerability of substitution by imported products attributed to an exclusion from CBAM fades the further downstream in the value chain.

Another issue raised by EU industry is the versatility of exporting countries in adapting their production with the view to avoiding potential CBAM payments, as well as the “creativity” of industry in finding ways to circumvent CBAM. For example, if certain products are covered by CBAM, producers can make slight changes to their product (e.g. change their thickness) so that it does not attract duties. Moreover, a plausible scenario whereby exporters convert primary aluminium into scrap and export their production as scrap (bearing no CBAM payments) could materialise when the conversion cost to scrap is lower than CBAM payments.

The following section illustrates the potential costs of a CBAM applied only upstream for EU downstream producers of rolled aluminium products and aluminium window frames.

5.2 Case studies on implications of a CBAM on primary aluminium only for EU producers of semi-finished products

As previously mentioned, the production of aluminium semi-finished products in the EU depends on imported primary aluminium. That means that the introduction of CBAM for primary aluminium only would translate into a significant increase in input costs for EU producers of semi-finished products, that importers of equivalent products from outside the EU would not face.

²⁷ ERCST (2021), CBAM for the EU: A Policy Proposal, April 2021, p. 14

To illustrate the magnitude of this cost increase we consider the case of two products that are 100% made of aluminium, and which enjoy the highest import rates from non-EU ETS countries:

- Window frames (HS code 76.10.10); and
- Rolled products (HS code 76.06)

For the calculation we make use of a EU ETS price of EUR 50/tCO₂, and a carbon intensity of imports based on that of Middle East as the marginal producer, i.e. of about 8,2 tCO₂/ton of primary of aluminium, including global average direct carbon intensity of about 2,1 tCO₂/ton of aluminium and in indirect carbon intensity of about 6,1 tCO₂/ton of aluminium.

The calculation is done for two CBAM designs²⁸:

- **Design 1:** A CBAM design that applies the adjustment on the full CO₂ intensity
- **Design 2:** A CBAM design which foresees the co-existence of CBAM with existing carbon leakage measures (continued free allocation of EU ETS allowances, and indirect cost compensation), and whereby the charge is applied on the difference between the imported product's direct carbon intensity and the EU ETS benchmark value, as well as the difference between the product's indirect carbon intensity and the average Scope 2 carbon intensity in Europe.

Table 5 Emissions intensities

	Scope 1 emissions intensity (tCO ₂ /t or primary aluminium)	Scope 2 emissions intensity (tCO ₂ /t or primary aluminium)
EU	1,464 (ETS benchmark ⁽¹⁾)	4,1 ⁽²⁾
Marginal Middle-East producer	2,1 ⁽³⁾	6,1 ⁽⁴⁾

Notes:

⁽¹⁾ Source: European Commission (2021) 1557 final, ANNEX to the Commission Implementing Regulation (EU) determining revised benchmark values for free allocation of emission allowances for the period from 2021 to 2025

⁽²⁾ Average Scope 2 emissions intensity calculated based on primary aluminium electricity intensity of 15MWh/ton, and EU electricity grid emissions factor in 2019 of 0,275 tCO₂/MWh (based on European Environment Agency data)

⁽³⁾ Global average Scope 1 emissions intensity based on data by the International Aluminium Institute (2020), taking into account direct process CO₂ emissions and non-CO₂ GHG emissions from electrolysis, carbon anode consumption and anode effects.

⁽⁴⁾ Based on data by the International Aluminium Institute (2020), concerning emissions in the Middle East from electricity electrolysis.

Using the above emissions intensities, the following applicable Scope 1 and Scope 2 intensities under 'CBAM design 1' and 'CBAM design 2' are derived.

²⁸ In this paper, the indirect (Scope 2) part of the CBAM cost has been calculated based on Scope 2 emissions and therefore the carbon intensity of electricity. However, because of the way electricity prices are determined in the European wholesale power market the carbon cost passed through in electricity prices does not fully correlate with the actual carbon intensity of electricity. Hence, the carbon costs associated with electricity are decoupled from the indirect physical emissions of electricity intensive producers. Including Scope 2 emissions in the calculation of a CBAM therefore would not fully level the indirect carbon cost faced by European and non-European producers. (see ERCST (2021a), section 3.1.5, and ERCST (2021b), Section 3.6)

Table 6 Applicable emissions intensities under 'CBAM design 1' and 'CBAM design 2'

	Scope 1 emissions intensity (tCO ₂ /t of aluminium)	Scope 2 emissions intensity (tCO ₂ /t of aluminium)
CBAM design 1 (charge for the full intensity of Middle East marginal producer)	2,1	6,1
CBAM design 2 (charge for differential between marginal producer direct intensity and EU benchmark; and for differential between marginal producer Scope 2 intensity and EU Scope 2 intensity)	0,64	2,0

Case 1: Aluminium rolled products

Aluminium rolled products fall under PRODCOM product codes '24422430 - Aluminium plates, sheets and strips > 0,2 mm thick' and '24422450 - Aluminium alloy plates, sheets and strips > 0,2 mm thick'. They are traded under HS tariff code '7606 - Plates, sheets and strip, of aluminium, of a thickness of > 0,2 mm (excl. expanded plates, sheets and strip)'.

Imports to the EU27 amount to 29% of domestic consumption (in terms of value), while EU27 exports amount to 36% of domestic production.

Table 7 Exports and imports to the EU27 of aluminium doors, thresholds, windows and their frames

PRCCODE	Exports quantity in tons	Exports value in million EUR	Imports quantity in tons	Imports value in million EUR	EU production quantity in tons	Production value in million EUR
24422430 - Aluminium plates, sheets and strips > 0,2 mm thick	86.440	306	235.854	613	1.373.756	2.656
24422450 - Aluminium alloy plates, sheets and strips > 0,2 mm thick	1.235.123	3.884	781.322	2.324	4.137.342	9.088

Source: Based on Eurostat 'Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data [DS-066341]' dataset

The sales price of aluminium rolled products is in the range of about EUR 2.650 /ton²⁹.

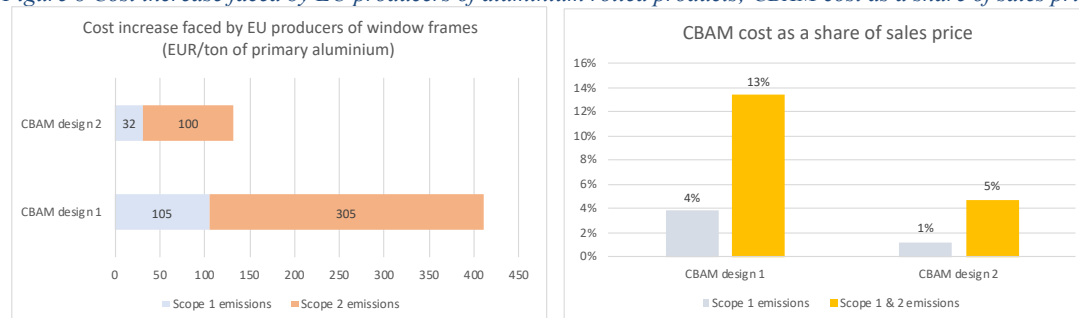
At an EU ETS price of EUR 50/tCO₂, and a carbon intensity based on that of Middle East as the marginal producer, i.e. of about 8,2 tCO₂/ton of primary of aluminium, the cost increase for primary aluminium in EU as material input for window frames under 'CBAM design 1' will then be approximately EUR 410 per ton, or about 13% of the product sales price³⁰ (assuming

²⁹ Price estimate provided by *European Aluminium* based on 2019 London Metal Exchange prices for primary aluminium plus a value added markup.

³⁰ In this paper, the indirect (Scope 2) part of the CBAM cost has been calculated based on Scope 2 emissions and therefore the carbon intensity of electricity. However, because of the way electricity prices are determined in the European wholesale power market the carbon cost passed through in electricity prices does not fully correlate with the actual carbon intensity of electricity. Hence, the carbon costs associated with electricity are decoupled from the indirect physical emissions of electricity intensive producers. Including Scope 2 emissions in the calculation of a

full cost pass-through³¹). The CBAM costs represent in this case a significant proportion of the product value.

Figure 8 Cost increase faced by EU producers of aluminium rolled products; CBAM cost as a share of sales price



Source: own elaboration

The impact is considerably lessened under ‘CBAM design 2’, whereby the charge is applied on the difference between the imported product’s direct emissions intensity and the EU ETS benchmark value, as well as the difference between the product’s indirect carbon intensity and the average indirect carbon intensity in Europe. The cost increase for primary aluminium in EU as material input for rolled products under ‘CBAM design 2’ will then be approximately EUR 132 per ton, or about 5% of the sales price. A 5% increase for such products is still significant as it represents an even higher percentage of the value added (after deducting the value of the primary metal).

Case 2: Aluminium window frames

Aluminium window frames fall under PRODCOM product code ‘25121050 - Aluminium doors, thresholds for doors, windows and their frames’, and under HS tariff code ‘76101000 - Doors, windows and their frames and thresholds for door, of aluminium (excl. door furniture)’.

EU27 production of products in this category is largely consumed domestically, satisfying domestic demand, with imports representing a small share of EU consumption. EU exports as a share of production amount to 5%, while imports as a share of domestic consumption amounts to 1% in terms of value.

CBAM therefore would not fully level the indirect carbon cost faced by European and non-European producers. (see ERCST (2021a), section 3.1.5, and ERCST (2021b), Section 3.6)

³¹ With zero pass-through the same share would be 15%.

Table 8 Exports and imports to the EU27 of aluminium doors, thresholds, windows and their frames

PRCCODE	Exports quantity in p/st ⁽¹⁾	Exports value in million EUR	Imports quantity in p/st ⁽¹⁾	Imports value in million EUR	EU production quantity in p/st ⁽¹⁾	Production value in million EUR
25121050 - Aluminium doors, thresholds for doors, windows and their frames	3.406.294	627	3.962.854	162	40.681.705	11.701

Notes:

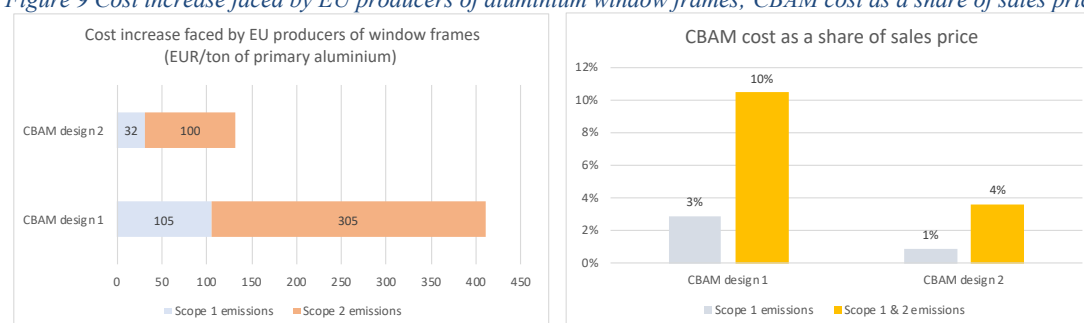
⁽¹⁾ p/st means number of items

⁽²⁾ Source: Based on Eurostat 'Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data [DS-066341]' dataset

The sales price of aluminium windows frames is in the range of about EUR 3.500 /ton³².

At an EU ETS price of EUR 50/tCO₂, and a carbon intensity based on that of Middle-East as the marginal producer, i.e. of about 8,2 tCO₂/ton of primary of aluminium, the cost increase for primary aluminium in EU as material input for window frames under 'CBAM design 1' will then be approximately EUR 410 per ton, or about 10% of the product sales price when both Scope 1 & Scope 2 emissions are accounted for (assuming full cost pass-through³³). The CBAM costs represent in this case a significant proportion of the product value.

Figure 9 Cost increase faced by EU producers of aluminium window frames; CBAM cost as a share of sales price



Source: own elaboration

The impact is considerably lessened under 'CBAM design 2', whereby the charge is applied on the difference between the imported product's direct emissions intensity and the EU ETS benchmark value, as well as the difference between the product's indirect carbon intensity and the average indirect carbon intensity in Europe. The cost increase for primary aluminium in EU as material input for window frames under 'CBAM design 2' will then be approximately EUR 132 per ton, or about 4% of the sales price. A 4% increase for such products is still significant as it represents an even higher percentage of the value added (after deducting the value of the primary metal).

³² Price estimate provided by *European Aluminium* based on 2019 London Metal Exchange prices for primary aluminium plus a value added markup.

³³ With zero pass-through the same share would be 12%.

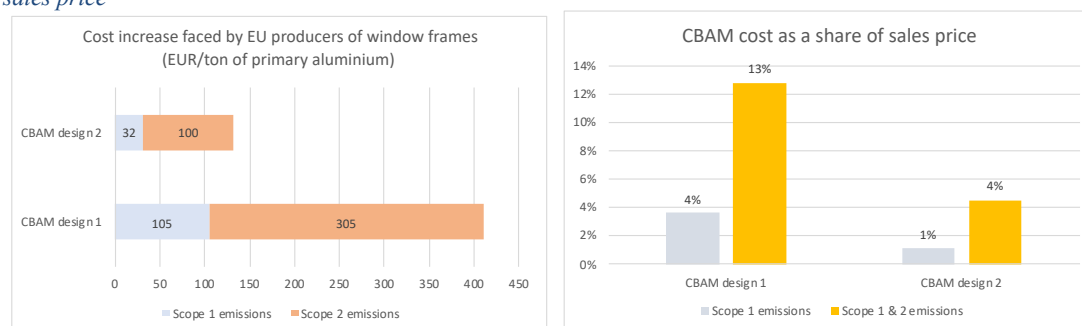
Case 3: Automotive products made from aluminium auto body sheets

As discussed in section 4.2, certain automotive products made completely from aluminium body sheets are not traded under HS chapter 76, but rather under HS codes 87.07 and 87.08, which cover trade of similar products based on competing materials (e.g. steel). Therefore, in this case a picture of the total volume of imports of aluminium automotive body sheets cannot be inferred from Eurostat trade data.

The sales price of aluminium automotive body sheets is in the range of about EUR 2.800 /ton³⁴.

At an EU ETS price of EUR 50/tCO₂, and a carbon intensity based on that of Middle-East as the marginal producer, i.e. of about 8,2 tCO₂/ton of primary of aluminium, the cost increase for primary aluminium in EU as material input for window frames under ‘CBAM design 1’ will be approximately EUR 410 per ton, or about 13% of the product sales price (assuming full cost pass-through³⁵). The CBAM costs represent in this case a significant proportion of the product value.

Figure 10 Cost increase faced by EU producers of aluminium automotive body sheets; CBAM cost as a share of sales price



Source: own elaboration

The impact is considerably lessened under ‘CBAM design 2’, whereby the charge is applied on the difference between the imported product’s direct emissions intensity and the EU ETS benchmark value, as well as the difference between the product’s indirect carbon intensity and the average indirect carbon intensity in Europe. The cost increase for primary aluminium in EU as material input for rolled products under ‘CBAM design 2’ will then be approximately EUR 132 per ton, or about 4% of the sales price. A 4% increase for such products is still significant as it represents an even higher percentage of the value added (after deducting the value of the primary metal). Also, it should be noted that with the introduction of the CBAM, traders might have the incentive to import directly car body parts instead of coils of auto body sheet so as to circumvent the additional cost at the border.

³⁴ Price estimate provided by *European Aluminium* based on 2019 London Metal Exchange prices for primary aluminium plus a value added markup.

³⁵ With zero pass-through the same share would be 15%.

5.3 CBAM horizontal product scope: where to ‘draw the line’

CBAM coverage of all products encompassing aluminium in their composition, however small the content might be, would be impractical in terms of administrative/technical complexity. A CBAM only upstream would lead to higher costs for downstream producers, either incentivizing the relocation of production out of Europe or increasing imports of products at the next step in the value chain³⁶, thereby compromising the effectiveness of the measure. This risk of carbon leakage is mitigated the further one goes downstream in any value chain, as the carbon costs borne by products diminish in proportion to their total value, and as goods begin to compete on more than simply price³⁷. As the CBAM coverage goes further downstream, there are trade-offs between carbon leakage and complexity.

Table 9 Complexity vs. carbon leakage trade trade-offs for CBAM horizontal scope options

CBAM horizontal scope	Complexity	Carbon leakage risk
Primary aluminium	Low - relative more straightforward to implement, involving relatively few entities and shipments	High - higher raw material costs in EU vs. imports of products, which are not subject to CBAM
Primary aluminium and semi-finished aluminium products	Medium - increase in the number of entities and products/shipments covered; determination of emissions embodied in the primary aluminium used for semi-finished products, remains straightforward as semis have a near 100% aluminium content	Medium - risk partly mitigated as the carbon costs diminish in proportion to product value
Primary aluminium, semi-finished, and finished products	High - considerable increase in the number of entities and products/shipments covered; determination of individual products' aluminium content and therefore embedded emissions becomes more complex	Low ⁽¹⁾ - risk mitigated the further downstream in the value chain, as the carbon costs borne by products diminish in proportion to their total value because of higher value added of more complex products and lower aluminium content.

Notes:

⁽¹⁾ Rated “low” assuming a CBAM design that minimizes the risk of resource shuffling. Resource shuffling would occur if foreign producers shifted trade patterns to ship existing low-carbon production to the EU, and high-carbon production elsewhere, thereby gaining reduced adjustment at the EU border but not ultimately changing their emissions profiles.

Against this backdrop, we put forward the following criteria for determining the products to be covered by CBAM:

- High content of primary aluminium (e.g. >90% of volume which would capture most products of first processing, or other threshold, which could decrease with time)
- Products where the processing of the primary material results in limited value-added, i.e. products with high vulnerability to substitution

Product codes under existing HS chapters lend themselves to a straightforward identification of a minimum number of relevant products. Indeed, those products included under HS chapter 76 encompass both primary aluminium and semi-finished products with high aluminium

³⁶ ERCST (2021), Border Carbon Adjustments in the EU: Sectoral deep dive, March 2021, p. 50

³⁷ ERCST (2021), CBAM for the EU: A Policy Proposal, April 2021, p. 14

content the processing of which results in limited value added, and should thus be covered by CBAM as the minimum.

In addition, consideration needs to be given to products traded outside chapter HS 76, especially categories of products that might be produced from competing basic materials e.g. car body sheets that could be made 100% from aluminium or 100% from steel.

Products to be covered would need to be identified through a detailed review and examination of product categories against the above criteria in consultation with industry and trade/customs experts. Existing datasets, such as the ‘Metal composition of products’ dataset NTNU Trondheim/University of Freiburg (2016), as well as newly developed datasets would inform the identification process.

6 Key takeaways and recommendations

The EU aluminium sector depends on imports of primary aluminium in a significant way. Therefore, the knock-on effects in the value chain of a CBAM applied only upstream can be considerable. Applying a CBAM on primary aluminium only would lead to higher costs for downstream producers, either incentivizing the relocation of production out of Europe or increasing imports of products at the next step in the value chain³⁸. For instance, if only primary aluminium were covered by a CBAM, road wheel producers in the EU might move production out of Europe, or European original equipment manufacturers (OEMs) would source finished aluminium road wheels from abroad.

The annual additional cost (CBAM payments) faced by EU downstream producers of semi-finished aluminium products that source primary aluminium from outside the EU was estimated at around EUR 1.5 billion (at current CO₂ prices of EUR 50/tCO₂). This is equal to about 5% of the total value of EU production of semi-finished aluminium products. The estimate would increase with increasing CO₂ prices expected through to 2030.

The case studies also showed that the impact on individual semi-finished products could be detrimental. Three semi-finished products - namely *aluminium rolled products*, *window frames*, and *automotive body sheets* - have been studied to illustrate the magnitude of the cost implications of a CBAM applied only on primary aluminium. The cost attributed to CBAM on primary aluminium for EU producers of these semi-finished products was found to represent a sizeable 10-13% of the products’ sales price. The cost impact for EU producers of semis was lessened under a CBAM design that would coexist with existing carbon leakage measures, yet it still represented a sizeable 4-5% of the sales price.

Effectively, the application of CBAM to upstream only primary materials, would merely shift the risk of carbon leakage downstream in the value chain. This is expected to be felt in particular by those sectors producing semi-finished products that contain a high share of primary material and the processing results in limited value-added such as flat rolled and extruded aluminium products. Those downstream sectors would be protected by a CBAM levied on imports of like

³⁸ ERCST (2021), Border Carbon Adjustments in the EU: Sectoral deep dive, March 2021, p. 50

downstream products. It must however be emphasized that the risk of carbon leakage decreases once one goes further downstream in the value chain, at a point where the carbon costs borne by products diminishes in proportion to their total value, and as goods begin to compete on more than simply price³⁹.

A design that does not account for downstream impacts would put the EU aluminium industry – largely an industry of semi-finished products - at risk. As long as there are semi-finished products or products deriving from such products that are exempted from CBAM, the EU aluminium processing industry will lose out in competitiveness, especially in case of a sudden alteration of the existing carbon leakage framework.

In turn, an uncompetitive EU industry of semi-finished aluminium products would translate into reduced demand for EU primary aluminium, putting at risk also the upstream part of the value chain.

Another issue that needs to be considered is the versatility of exporting countries in adapting their aluminium production in order to avoid potential CBAM payments (adapt product offering to products not covered by CBAM), as well as the ability of industry of finding creative ways to circumvent CBAM.

In terms of horizontal product scope coverage, the following considerations could help strike a balance between maximising effectiveness and minimising complexity:

- CBAM would cover imports of those products with high share of aluminium content, e.g. initially those products whose content is near 100% (or other threshold) aluminium. Gradually expanding to more complex manufactured goods that encompass large quantities of the basic material (e.g. imports of aircraft engines, or cars) can be examined, however the vulnerability to substitution by imports is reduced for products with higher value added.
- At minimum products under tariff chapter HS 76 should be covered from the outset of the mechanism. Additional products traded outside HS 76 with close to 100% aluminium composition should also be considered for inclusion (e.g. car body sheets).
- Since the direct and energy-related indirect emissions from producing semi-finished and finished products are often moderate relative to value added, their inclusion in a CBAM would have to reflect emissions from the upstream production of the intermediate goods incorporated in such products⁴⁰, such as the emissions embodied in the primary aluminium used as a raw material for flat rolled aluminium products. Including these upstream emissions is important when covering downstream semi-finished or finished goods, as the embedded carbon cost passed through in the price of carbon-intensive raw materials is a major and often the primary carbon cost faced by such downstream producers⁴¹.
- Horizontal product scope should take due consideration of the risk of circumvention.

³⁹ ERCST (2021), CBAM for the EU: A Policy Proposal, April 2021, p. 14

⁴⁰ ERCST (2021b), Border Carbon Adjustments in the EU: Sectoral deep dive, March 2021, p. 67

⁴¹ ERCST (2021a), CBAM for the EU: A Policy Proposal, April 2021, p. 16

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