BOFIT Policy Brief
2021 No. 10

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CBAM! – Assessing potential costs of the EU carbon border adjustment mechanism for emerging economies

Bank of Finland, BOFIT
Bank of Finland Institute for Emerging Economies

BOFIT Policy Brief
Editor-in-Chief Mikko Mäkinen

BOFIT Policy Brief 10/2021
25 October 2021

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ISSN 2342-205X (online)

Bank of Finland
BOFIT – Institute for Emerging Economies

PO Box 160
FIN-00101 Helsinki

Phone: +358 9 1831

Email: bofit@bof.fi
Website: www.bofit.fi/en

Contents

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Abstract

With the EU adopting more ambitious emission reduction targets this year, the European Commission in July published a proposal on measures for adjusting EU climate policy. Measures include a carbon border adjustment mechanism (CBAM) that imposes a price on emissions embodied in products imported to the EU. In this policy note, we review the main lines of the CBAM proposal and discuss its potential economic effects on China, India, Russia, Turkey and Ukraine – the EU's largest import sources for products subject to CBAM. We calculate illustrative estimates for the potential cost effects of several specifications of the CBAM for these countries and compare them against earlier estimates. We also discuss the potential aggregate economic effects of the CBAM for these economies based on earlier literature. Despite considerable variation across countries and sectors, our analysis suggests that the aggregate economic effects of the CBAM would be limited for most exporting countries.

Keywords: Carbon border adjustment mechanism, climate policy, international trade, emerging economies

1. Introduction

The EU-27 generated 8 % of global CO_2 emissions in 2019, putting it third after China (30 %) and the US (13 %). The EU adopted more ambitious greenhouse gas (GHG) emission targets in 2021, aiming now at a 55 % reduction from the 1990 level of emissions by 2030 and climate neutrality (zero net GHG emissions) by 2050. These targets have been incorporated into EU legislation.

Curbing GHG emissions to reach these targets requires more ambitious policy measures. The European Commission (EC) published in July 2021 a proposal on new climate policy measures that included modifications to the EU's emission trading system (ETS). One factor holding down ETS effectiveness is, according to the EC, the mechanism of free allocation of emission allowances.

Free allowances are given to most industries under the ETS to mitigate the risk of *carbon leakage*, the shifting of carbon-intense production from countries with stringent emission restrictions to countries with lax policies or enforcement. Carbon leakage reduces global decarbonization benefits as emissions are merely generated elsewhere. Carbon leakage undermines the EU's climate policy goals and could hurt the competitiveness of companies based in the EU.

The EC July proposal on new climate policy measures calls for reducing free allowances to improve incentives from the EU ETS for emission reduction. As this can increase the risk of carbon leakage, the EC has proposed the introduction of a *carbon border adjustment mechanism* (CBAM) as an alternative means to address this risk. In practice, the CBAM is a fee charged for emissions embodied in products imported to the EU.

The EU is a key export market for emerging economies, where production tends to be more emission-intense. In this note, we examine the implications of the CBAM for the five emerging economies (China, India, Russia, Turkey and Ukraine) that account for the largest shares of EU imports in products covered by the CBAM proposal. We limit the discussion to the potential costs arising from the CBAM for these countries and aggregate economic effects noted in the previous literature, while assessing the overall pros and cons of the CBAM is out of the scope of this paper.

This note is constructed as follows. Section 2 provides a brief description of the EU ETS as a background. The main features of the EC proposal on CBAM are presented in Section 3 and EU trade in CBAM products is summarized in Section 4. Section 5 presents our benchmark calculations of the potential costs arising from the CBAM. Extensions to the benchmark calculations are provided in Section 6. Analysis of aggregate economic effects presented in previous literature is discussed in Section 7. Section 8 provides concluding remarks.

2. The EU emission trading system

GHG emissions are a negative externality as their social costs are not accurately reflected in the prices of the products that embody them. The optimal policy from the viewpoint of economic theory is to tax GHG emissions in a way that incorporates these associated social costs. Global implementation of such a tax, albeit unfeasible at the moment, would eliminate the risk of carbon leakage.

The EU introduced its emission trading system (ETS) in 2005. The system has evolved over the past two decades and now covers about 40 % of GHG emissions generated within the EU. For CO2 emissions, the ETS covers electricity and heat generation, certain energy-intensive products (e.g. oil products, steel and cement), commercial aviation, as well as other GHGs for selected sectors. It imposes a ceiling for the total allowed emissions for installations participating in the ETS. The ceiling descends over time, thereby reducing permitted emissions overall. All installations in the system must either purchase allowances or be granted free allowances.

The risk of carbon leakage is addressed in the ETS through free allowances and compensation measures for indirect cost increases from higher electricity prices. Free allowances are calculated relative to an emission benchmark of the top decile (top 10 %) of installations covered by the EU ETS producing the product[1]. Highly efficient installations that outperform the benchmark can get even more free allowances than they need to cover their emissions. Low-efficiency installations, in contrast, must buy additional allowances to cover their emissions in excess of the benchmark. For several industries, the granting of free allowances will be gradually phased out by 2030. The most vulnerable sectors,[2] however, will continue to receive 100 % (relative to benchmark) of their free allowances at least until 2030.

ETS allowances, relatively cheap for years, began to climb recently (Figure 1). Low allowance prices raised criticism that the ETS was not an efficient tool for reducing GHG emissions. In conjunction with more ambitious emission reduction targets, the EC proposed amendments to the ETS in July 2021 to bring it into line with the new climate policy goals. The proposal notes that distribution of free allowances has attenuated the ETS price signal, thereby weakening the system's effectiveness in reducing emissions. To correct this problem, the EC offered the CBAM as an alternative approach to address the risk of carbon leakage. CBAM should also counter more effectively the heightened risk of carbon leakage from rising ETS prices and the gradually reducing absolute amount of free allowances available in the ETS.

Figure 1. The price of allowances in the EU ETS (2010–2021).

Source: Belgian climate change think tank Sandbag.

[1] There are 52 manufacturing product benchmarks and two benchmarks for heat and fuel consumption.

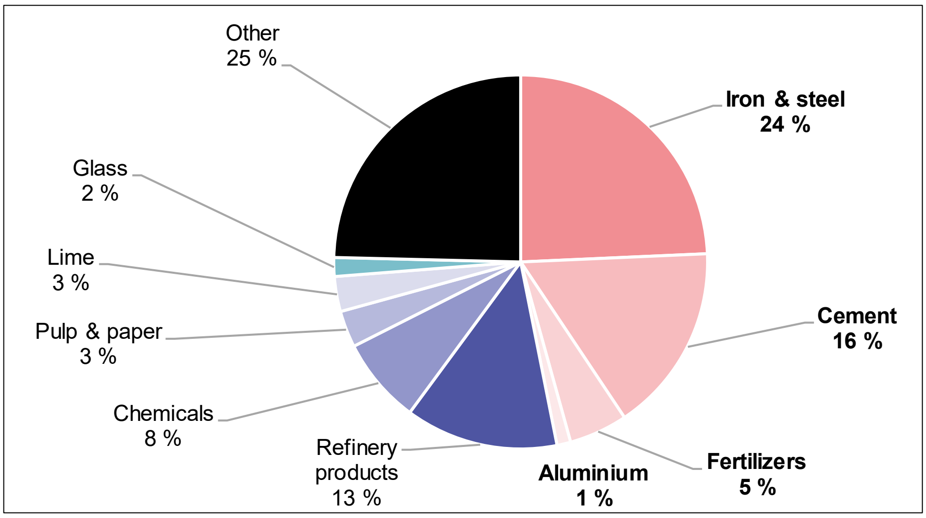
[2] These include several dozen NACE 4-digit industrial sectors such as paper, metals and construction materials manufacturing. The full list of sectors is presented in Appendix 1.

3. The current carbon border adjustment proposal

Under the EC proposal, the CBAM requires the importer of goods to purchase certificates to cover the emissions embodied in the imported goods.[3] It applies only to direct emissions from production (Scope 1 emissions). The producer's actual emissions determine the amount of certificates required. Where verified emission data are unavailable, embodied emissions are determined from default values. The default value may be the average level of emissions of producers in the country of origin with a mark-up (to be specified later) or the average level of emissions in the bottom decile of EU installations producing these goods.[4] The price of the certificates is calculated weekly from the EU ETS allowance price.

The proposed CBAM covers electricity, as well as select cement, fertilizer, steel and aluminum products.[5] The product selection criteria include importance for total emissions, risk of carbon leakage, trade volumes and practicality of implementation. The current proposal covers nearly half of the free allowances of the ETS (Figure 2). The CBAM would apply to all extra-EU imports except those from Iceland, Norway, Liechtenstein and Switzerland as these countries either participate directly or are linked to the EU ETS. CBAM rebates could be available for imported goods subject to a carbon pricing scheme in their country of origin.

Figure 2. Preliminary free allocation for industrial installations in 2021.



Notes: Bolded sectors are those included in the current CBAM proposal. The category "Other" includes heat, fuel and process emissions.

Source: European Commission.

The proposal calls of a gradual CBAM phase-in with a transition period lasting from 2023 to 2025. During this time, importers would only be required to report emissions embodied in their imported products. Certificate purchasing begins in 2026 and the free allocation of emission allowances from the ETS for EU producers is also cut gradually. The share of free allowances would decline from the 100 % in 2025 to zero in 2035.

[3] Similar to the EU ETS, emissions include CO2, nitrous oxide and perfluorocarbons for certain products.

[4] For electricity, the default values can be determined as the average CO2 emission factor in the country of origin or as the weighted average of the CO2 intensity of electricity generated from fossil fuels in the EU.

[5] The CN codes for the products are provided in Appendix 2.

The proposal sees most of the revenue generated by the CBAM going to the EU budget. The money raised is planned to be used to cover expected expenditures related to the repayment of the funds needed for the EU's covid-19 recovery instrument, which, among other things, is designed to support investment in the green and digital transitions.

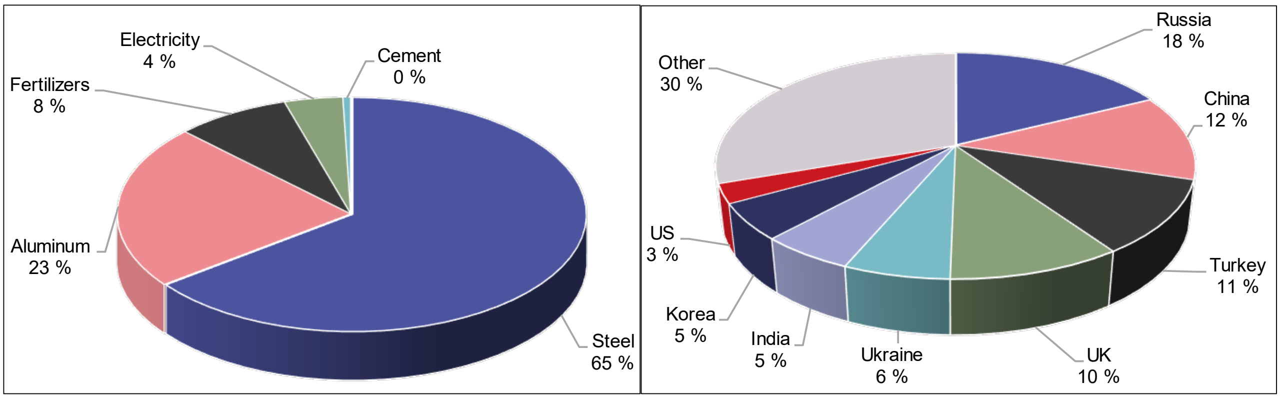
Next, the Commission's proposal will be assessed by the European Parliament and the European Council. The final parameters of the CBAM could be adjusted during the process. The proposal is subject to various pressures. Some observers call for more extensive coverage of the mechanism. The proposal includes the possibility of extending product coverage or emissions coverage to include electricity consumption (Scope 2 emissions).

On the other hand, industry representatives generally oppose the clause about eliminating free allowances. This phase-out, however, is important in assuring the WTO compatibility of the measure, which the EU has stressed.[6] Some EU trading partners, including China and Russia, have already stated that they may contest the compatibility requirement at the WTO. Unlike the gradual phase-out laid down in the EC proposal, most CBAM models considered in the preparatory phase envisaged immediate termination of free allocations. Possible negative impacts from the CBAM on the competitiveness of EU producers and exporters of final goods due to higher input costs have been mentioned by some observers. While the export rebates for preventing these impacts were not mentioned in the EC proposal, they appear in the CBAM options examined by the EC. Such rebates could be at odds with WTO compatibility of the CBAM.

4. Imports covered by the EU's carbon border adjustment mechanism

The products covered by the CBAM proposal represent a relatively limited share of EU imports. The value of EU imports of CBAM products was EUR 53 billion in 2019,[7] accounting for 3 % of the total EU goods imports. The most important products by far were steel with a 65 % of the total CBAM imports and aluminum with a share of 23 % (Figure 3, Panel A). The share of cement products was tiny.

Figure 3. EU CBAM imports in 2019. Panel A) by product; Panel B) by country.



Source: Eurostat.

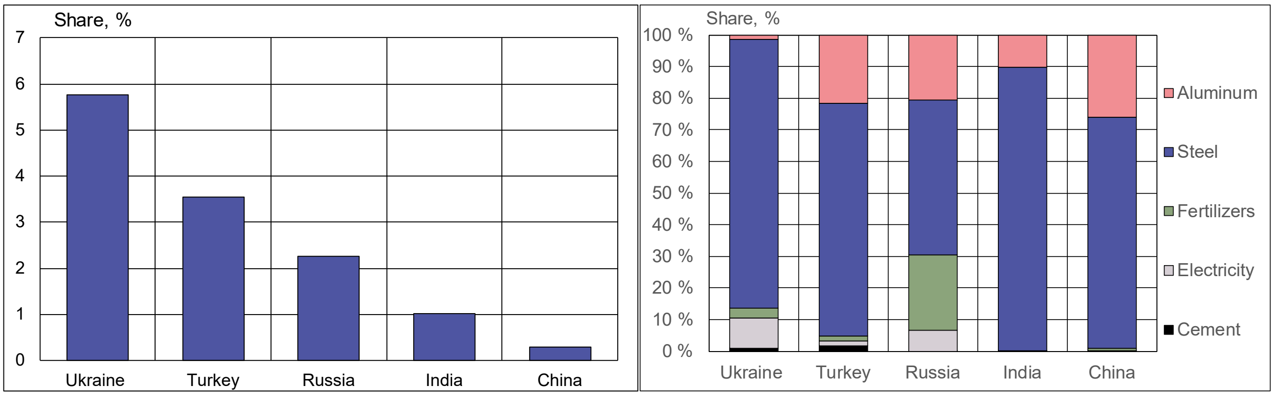
[6] For a more detailed discussion on the WTO compliance, see e.g. Assous et al. (2021). General issues related to design of CBAM mechanisms are also discussed in Parry et al. (2021).

[7] The EU imports refer to EU-27 imports excluding imports from Iceland, Norway and Switzerland (countries outside the CBAM).

The largest countries of origin of EU's CBAM imports in 2019 were Russia, China, Turkey, UK, Ukraine and India (Figure 3, Panel B). As the UK participated in the ETS as an EU member and has applied a similar carbon pricing scheme domestically post-Brexit, additional costs from the CBAM for imports from the UK are likely to be limited. Thus, the five emerging market nations that account for about half of EU CBAM imports are most sensitive to the CBAM.

The value of CBAM exports to EU from these countries in 2019 varied from EUR 3 billion for India to EUR 9 billion for Russia. In relative terms, the share of the CBAM products exported to the EU in the total goods exports of these countries varied from 0.3 % in China to 6 % in Ukraine in 2019 (Figure 4, Panel A). For all these countries, steel accounts for the largest share of their CBAM products export to the EU (Figure 4, Panel B). The share of aluminum exceeds 20 % of the total CBAM exports for China, Turkey and Russia. Fertilizers are an important share of CBAM exports to the EU in Russia's case.

Figure 4. Panel A) The share of CBAM exports to the EU relative to total goods exports in 2019. Panel B) Structure of CBAM exports to the EU in 2019 by country.



Source: World Bank WITS.

5. Evaluating CBAM costs to emerging market exporters

To illustrate the magnitude of the potential impact of the CBAM on the key exporting countries, we calculate several estimates of CBAM costs. Estimates in the literature typically concern only one or a few countries, and may not cover all the products listed in the CBAM proposal. Moreover, it is difficult to compare these estimates as they use different assumptions. To overcome this, we present comparable estimates for the key exporting countries calculated with the same methodology and assumptions. We also provide comparisons with previous estimates to evaluate the robustness of our calculations.

5.1. Methodology

The annual costs of the CBAM are assessed by multiplying the volume of EU imports of a product with the emission intensity of the product and the carbon price of the CBAM certificate. For import volumes, we use the figures from 2019 (2020 was exceptional due to the covid-19 crisis). The carbon price is assumed to be 60 euros per ton – the average ETS price in recent months. This also facilitates comparison with some of the previous studies.

Due to the lack of readily available data, the most difficult part of the estimation of CBAM costs is evaluation of the emission intensities of products. For most products, we use default values of the average of bottom decile (worst-performing 10 %) of EU producers according to the latest EU ETS benchmark curves (EC, 2021b).[8] In other words, our estimates can be interpreted as proxies for maximum CBAM cost values. For electricity, we use the average emission intensity of the exporting country. The baseline calculations do not account for corrections due to the free allowances for EU producers as the current proposal offers no details on the correction mechanism. Thus, the baseline estimates apply to 2035 when free allocations should be fully eliminated. We analyze the effect of free-allowance correction in Section 6.1.

To evaluate the robustness of our estimates, we provide comparisons to the estimates previously presented in the literature. To improve comparability across estimates, we use identical assumptions for import volumes, carbon prices and zero free allocation. The differences thus reflect the varying assumptions on the carbon intensity of the products used in different studies. The effect of changes in other assumptions are discussed in Section 6.

5.2. Baseline estimates

Our baseline estimates suggest that the annual costs of the CBAM would be limited in our focus countries, but there still is considerable variation across countries (Table 1). In absolute terms, *Russia* incurs the largest costs, which we put at EUR 2.1 billion, i.e. 24 % of the total value of the EU's CBAM imports from Russia. For all EU goods imports from Russia, this translates into a "tariff" of 1.5 %. Our estimates fall in the mid-range of previous estimates, which vary between EUR 1.6 and EUR 3.0 billion, i.e. 17–33 % of the value of CBAM imports.[9] The relatively wide range of estimates reflects the disparity of carbon intensity estimates in the BCG analysis (BCG, 2021).

For *Ukraine*, our illustrative estimate for CBAM costs is about EUR 850 million, 27 % of the total value of EU CBAM imports from Ukraine. Compared to total EU imports from Ukraine, it implies a 4 % tariff. This result comports with previous estimates in the range of EUR 880 and EUR 920 million, or 28-29 % of CBAM imports (Assous et al., 2021; Dröge 2021; Zimmer et al., 2021).

Table 1. Estimates on CBAM costs for selected emerging economies, EUR million.

	EUR million				
	Russia	**Ukraine**	**Turkey**	**China**	**India**
Cement	0.1	41	141	1	1
Electricity	359	21	34	0	0
Fertilizers	465	55	30	13	1
Steel	1,144	731	430	311	192
Aluminum	174	1	51	77	23
Total CBAM costs	**2,142**	**849**	**686**	**402**	**217**
	Percent (%) of import value*				
	Russia	**Ukraine**	**Turkey**	**China**	**India**
Cement	111	170	132	21	82
Electricity	59	6	49	0	0
Fertilizers	31	48	34	19	6
Steel	25	27	12	20	9
Aluminum	7	7	5	3	7

[8] More detailed description of the methodology is provided in Appendix 3.

[9] More detailed comparison between our estimates and those from the previous literature is provided in Appendix 4.

Total EU CBAM imports	24	27	14	10	9
Total EU goods imports	**1.5**	**4.0**	**1**	**0.1**	**0.6**

* Import value refers to the cost including freight (CIF) value of imports as reported in the Eurostat database. This value includes transport costs and potential import tariffs or other similar fees.

Source: Author's calculations.

Our estimate for *Turkey* suggests that total CBAM costs would be about EUR 690 million, or 14 % of the total value of the EU CBAM for imports from Turkey. With respect to total EU imports from Turkey, this implies a tariff of 1 %. There is some variation in the few previous estimates of the CBAM costs for Turkey. ERCST (2021) estimates a mere EUR 300 million, or 6 % of the value of CBAM imports. Assous et al. (2021) put the value at EUR 800 million, or 16 %. The difference basically reflects the disparity in assumptions on the carbon emission intensity of steel production in Turkey.

For *China*, our illustrative estimate of the total costs of the CBAM is EUR 400 million, or 10 % of the total value of EU CBAM imports from China. This represents a mere 0.1 % of the EU's total imports from China. We find just one earlier estimate; Assous et al. (2021) put the CBAM costs for China at EUR 485 million, or 12 % of the CBAM imports (similar to our estimate).

Our estimate for *India* puts CBAM costs at about EUR 220 million, or 9 % of the total value of EU CBAM imports from India. This represents 0.6 % of total EU imports from India. We found only one previous estimate for India; Marcu (2021) puts the CBAM costs at EUR 190 million, or 8 % of the CBAM import value (quite similar to our estimate).

In general, CBAM costs are highest for cement products and lowest for aluminum products in all countries. For aluminum, the CBAM costs comport with current baseline tariffs (excluding anti-dumping measures and other specific measures, which are also often imposed) for imports from third countries that are in the range of 5-7.5 %. For other products, the CBAM costs are much higher in relation to prevailing import tariffs. The baseline tariff is 1.7 % for EU cement imports from extra-EU countries and 5.5–6.5 % for fertilizers. Most steel products are not subject to baseline tariffs, but for certain individual products tariffs of 1.7–3.7 % apply. There have, however, frequently been other measures restricting steel imports such as current quotas imposed in response to US import tariffs.

6. Factors affecting the baseline estimates

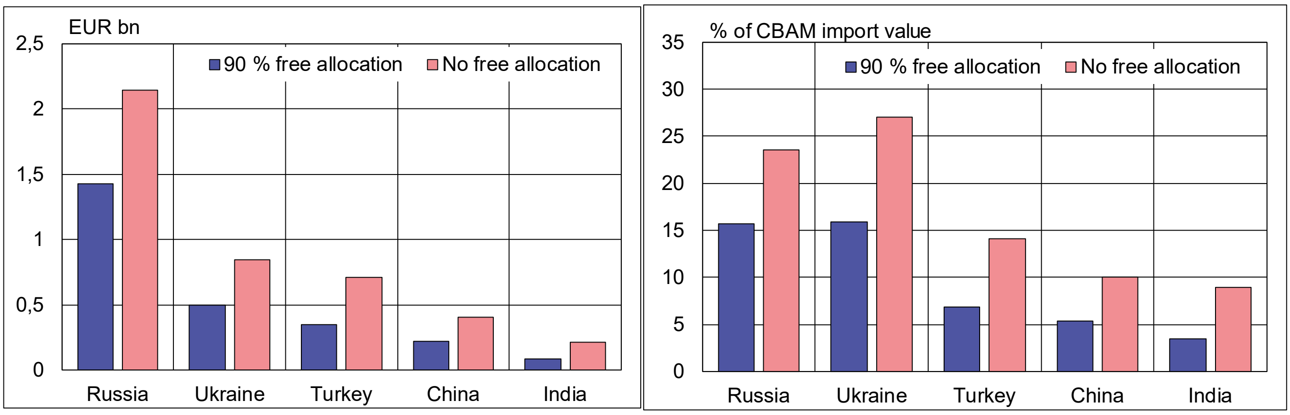
Our baseline estimates are subject to uncertainties that could raise or lower costs. Key factors that reduce CBAM costs are the correction for the ETS free allocation for EU producers, use of realized company-specific emissions and the existence of carbon pricing schemes in the countries of origin. CBAM costs could increase if the price of EU ETS allowances rises rapidly or the scope of the CBAM is extended. We discuss each of these possibilities briefly below and present additional calculations on their effects compared to the baseline estimates.

6.1. Factors that lower CBAM costs

The ETS free-allocation correction for EU producers could substantially reduce CBAM costs in the early years of the scheme. The EC proposal suggests that the amount of CBAM certificates required for imports be adjusted to reflect the extent of free allocation to EU producers. This helps assure the equal treatment of domestic and foreign products crucial to WTO compatibility. The share of free allocation gradually declines to zero in 2035. While there are no details on the compensation mechanism in the current proposal, it is likely that CBAM fees will be substantially lower in the early years of the scheme as the share of free allocation will still be high.

We calculate estimates for the first year of the CBAM scheme using a 90 % free allocation for EU producers. This is based on the assumption that 90 % of the ETS benchmark value for 2021–2025 will be deducted from the emissions embodied in imports. With this deduction, CBAM costs are about 35–50 % lower at the start of the CBAM scheme than the benchmark estimates with zero free allocation (Figure 5). Previous studies put the effect of free allowance compensation higher, suggesting that CBAM costs in the early years are just a quarter or third of the costs in 2035 when free allocation ends (Assous et al., 2021; Dröge, 2021). The steel sector seems to be the main cause of our higher estimates. We take into account the country-specific production methodology structure in calculating the free allocation, which reduces the amount of deducted free allowances for most countries.

Figure 5. Illustration of the effect of changes in the share of free allocation on CBAM costs.



Sources: Author's calculations.

Our baseline estimates reflect the high-end values of CBAM costs as they are calculated from the average emissions of the bottom decile (worst-performing 10 %) of EU companies. Companies (or importers of their products) with carbon-intensity below the default value have an incentive to obtain a verification of their actual emissions to use them in the determination of the CBAM. If actual emissions are used, e.g. some steel and aluminum companies could face much lower CBAM costs. On the other hand, companies with emissions exceeding the default value will want to use the default values in determining their CBAM. As the CBAM scheme only starts in 2026 and is phased in gradually, affected producers have time to reduce their emissions and lower their CBAM costs. For example, several Russian and Chinese steel companies have announced emission target cuts for coming years. If these targets are realized, their CBAM costs would be lower.

The existence of a carbon pricing system in the country of origin could also lower CBAM costs, although the precise mechanism has yet to be determined. China's national ETS launched in July 2021 only covers the power sector at present, but it is planned to be extended to also industrial sectors, including those covered by the CBAM (no timeline specified yet). In its first months of operation, the allowance price in the Chinese ETS has been around 7 or 8 euros per ton. Ukraine already places a carbon tax on industry emissions. Its current level is only 0.3 euro per ton, with an increase to 0.9 euros per ton by 2023 under consideration in the country's parliament. Ukraine has announced plans to introduce a national ETS from 2025 in line with the EU CBAM. Turkey has announced that it will implement its own national ETS, but no timeline is specified for the launch. Russia and India do not price carbon, but Russia is planning next year to launch a pilot project of carbon trading e.g. for the Sakhalin Island in Russia's Far East. It has also announced plans to develop carbon pricing in domestic markets (World Bank, 2021).

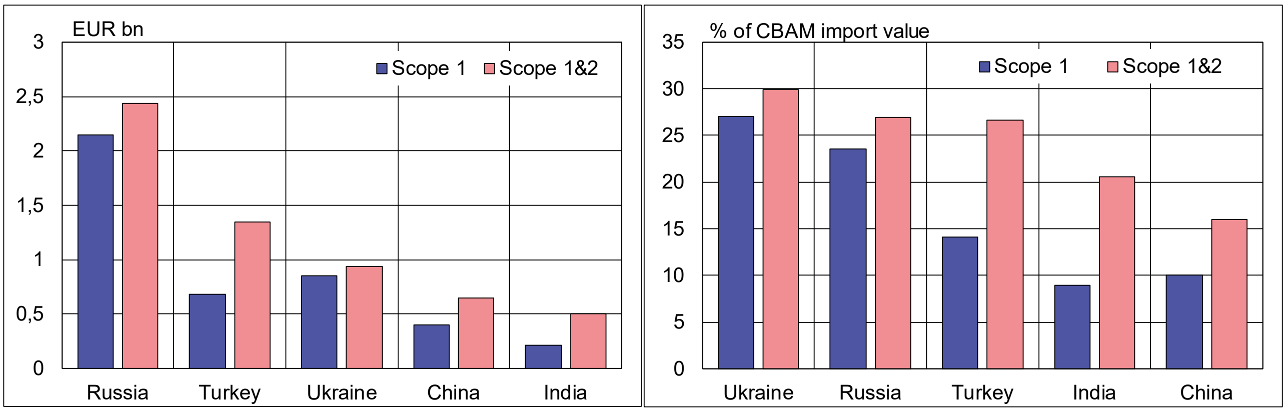
6.2. Factors that increase CBAM costs

Higher carbon prices in the EU ETS lead to higher CBAM costs. We used a relatively conservative assumption of 60 euros per ton, a level of recent months in the EU ETS. With the EU setting more ambitious climate targets, the carbon price could be higher when the CBAM is implemented. This would lead to a proportional increase in CBAM costs from benchmark values.

CBAM costs for exporters could also rise with extended CBAM coverage. The functioning of the CBAM will be monitored and evaluated during the transition phase. The EC states that after evaluating the transition period experiences, it could propose extending the CBAM to include indirect emissions and a wider selection of goods. The inclusion of indirect emissions from power use (Scope 2 emissions) would obviously increase CBAM costs.

Figure 6 presents our estimates for the inclusion of Scope 2 emissions. These estimates are rough approximations as there is no readily available default value for the worst-performing 10 % of EU installations that covers Scope 1 and Scope 2 emissions. Thus, we have relied largely on the ratios of Scope 1 & 2 emissions presented in the earlier literature.[10]

Figure 6. Estimates on the CBAM costs with direct (Scope 1) and direct and indirect (Scope 1 & 2) emissions. Panel A) by value in euros; Panel B) as a percentage of CBAM import value.



Source: Author's calculations.

The effect of including Scope 2 emissions varies greatly across our focus countries. For Russia and Ukraine, the effect is relatively moderate, but for the other countries the costs of CBAM could increase substantially. This mainly reflects the contributions of the steel and aluminum sectors. In Turkey and India, most steel production is based on electric arc furnace (EAF) process that has low Scope 1 emissions. EAF Scope 2 emissions are often large in comparison to Scope 1 emissions, however. In the aluminum sector, Scope 2 emissions are typically also many times higher than Scope

[10] More detailed description of the methodology is provided in Appendix 3.

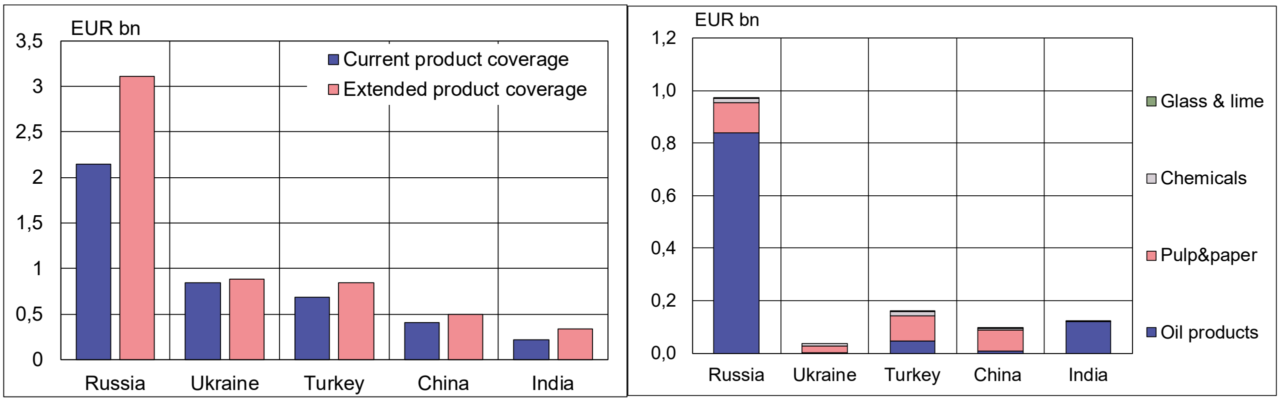
1 emissions. This is not reflected in the figures for Russia, however, because the Russian aluminum production relies heavily on electricity generated from hydropower.

Next, we examine the effects of a potential extension of the product coverage of the CBAM. For simplicity, we focus on the next largest products receiving free allocation in the ETS, i.e. refinery products, chemicals, pulp and paper, lime and glass (see Figure 2). In the EC proposal's background materials, certain refinery, chemical and plastic products are identified as prospective extensions for the CBAM. Data limitations make inclusion of several chemicals in the EC list difficult. The prospects of including pulp and paper are lower as carbon leakage effects are considered limited. Lime and glass are not included among the primary candidates, but are included in the carbon leakage list (see Appendix 1).

Our calculations are again based mostly on the EU ETS benchmark curves.[11] We have included only a few chemical and plastic products due to the complexity of the data. These products account about a third of the total free allocation to chemical products in the EU ETS. Moreover, the benchmarks for refinery products are not readily applicable to imports. Therefore, we have concentrated only on oil products and used EU average emission intensities from the literature (Concawe, 2017) rather than the bottom decile (10 % worst-performing) EU installations.

Our estimates suggest that extension of the product coverage increase absolute CBAM costs, particularly for Russia (Figure 7, Panel A). For Russia, the cost increase could be around EUR 1 billion in comparison to the current proposal. While this mainly reflects inclusion of refinery products, pulp and paper also account for a non-negligible share (Figure 7, Panel B). For most other countries, the additional costs could be around EUR 100–200 million, with the exception of Ukraine with even lower additional costs. For India, the costs rise mainly from the inclusion of refinery products. For other countries, the inclusion of pulp and paper accounts for the largest additional costs.

Figure 7. Estimates of CBAM costs with extended product coverage. Panel A) Comparison to the product coverage of the current proposal. Panel B) by product groups.



Source: Author's calculations.

Only a few estimates in the literature consider the effect of extending CBAM product coverage. Our estimate comports with the estimate of Marcu (2021) for India as we use the same emission intensity assumption for refinery products. Our estimates on Russia are on the lower bound of the range of BCG (2021) estimates for refinery products and chemicals. While our estimate of CBAM costs for Russian oil products is EUR 800 million, the BCG (2021) estimates a range of EUR 0.8 to 1.7 billion depending on emission intensity assumptions.[12] For chemical products, our estimate is roughly EUR

[11] More detailed description of the methodology is provided in Appendix 3.

[12] We have again used the same assumptions on the import volume and carbon price for the sake of comparability.

120 million, the low end of BCG (2021) range of EUR 70–500 million. The BCG (2021) estimate apparently covers a much wider selection of chemical products. Its low-end estimate is based on a very low average emission intensity assumption.

Finally, our estimate for the total additional CBAM costs for the extended product coverage for China is about EUR 120 million. Assous et al. (2021) see the extension of the CBAM to other carbon-intensive basic materials generates additional costs of EUR 170 million for China. The higher value probably reflects a wider selection of products in their estimate, but no detailed product coverage is presented. Assous et al. (2021) also provide a cost estimate for China on further extension of the CBAM down the value chain. This generates an additional EUR 170 million in CBAM costs for China.

7. Discussion on the aggregate economic effects for exporters

Our estimates suggest that the costs arising from the CBAM for imports from selected emerging economies would be limited, but not necessarily insignificant. Higher selling prices are likely to offset some of the cost effect for the producers, however. EU producers face similar cost increases as imported products as the share of free ETS allowances gradually declines. While all producers are likely to be able to pass some of the cost increases on to consumers of their products, the higher prices would likely diminish demand for their products. Higher prices of imported inputs in the EU could also weigh on the competitiveness of EU producers of final goods that use these inputs. This could support the competitiveness of extra-EU producers of final goods.

A few studies examine the aggregate economic effects of the CBAM with computable general equilibrium models (CGE). These studies are typically concerned with CBAM schemes with relatively extensive product coverage because they are applied at the aggregate industry level (as opposed to individual products) due to the model structure. As a result, CGE model results are applicable to the effects of a more comprehensive CBAM than the current proposal. The main finding from the previous literature is that the aggregate economic effects on our focus countries would be limited in most cases. It is difficult to compare the detailed quantitative results across studies due to the different assumptions, baselines, time horizons and coverage of reported results, but we try to summarize some key findings in quantitative terms below.

The EC (2021a) estimates that the EU imports of CBAM products would be 14 % lower in 2030 with implementation of the CBAM compared to a situation where the current free-allowance-only arrangement continues. Using the 2019 share of 3 % of CBAM products in the total goods imports of the EU, this implies a decline in total goods imports of around 0.4 %. Even with a much wider product coverage, the decline in total EU imports is only a few percent (Bellora & Fontagne, 2021; Kuusi et al., 2020; Pyrka et al., 2020) with relatively moderate carbon prices (25–40 euros per ton).

Correspondingly, the effect on the total exports of trading partners is limited, even with extended CBAM coverage. The EC (2021a) estimates on the decline in EU imports of the CBAM products by country suggest that the decline in total goods exports would be 0.9 % for Russia, 0.3 % for India and 0.04 % for China in 2030 compared to the current regime. [13] UNCTAD (2021) estimates that the introduction of a CBAM on energy-intensive products would lead to a decline of their exports from our focus countries from 2 % in China's case to 8 % for Ukraine (with a carbon price of 40 euros per ton).

[13] Combining the EC (2021a) model results on import decline of the CBAM products with the share of these products in the goods exports of the emerging economies in 2019 (see Figure 4, Panel A).

In terms of GDP, effects of the CBAM should be quite limited for most of our focus countries. Marcu (2021) finds that a CBAM that includes refined oil products incurs export losses for India equal to about 0.01 % of GDP. Kuusi et al. (2020) calculate that a CBAM covering almost all manufacturing products leads to an income loss of 0.01 % of GDP for Russia and 0.04 % of GDP for China (with a carbon price of 25 euros per ton). The UNCTAD (2021) specification with all energy intensive products under the CBAM leads to losses varying from 0.002 % of GDP for China to 0.8 % for Ukraine with a carbon price of 40 euros per ton. The effects increase roughly proportionately with the carbon price.

8. Concluding remarks

The above discussion provided illustrative estimates of potential costs from the introduction of a CBAM mechanism on EU imports under the current EC proposal. Our benchmark estimates for the largest origin countries of EU imports of CBAM products suggest that the CBAM could lead to additional costs varying from EUR 200 million in India to EUR 2.1 billion in Russia at a carbon price of 60 euros per ton. In relative terms, the additional costs implied by the CBAM range from 0.1 % of the value of Chinese imports to the EU to 4 % of the value of Ukrainian imports to the EU.

These estimates should be regarded as upper-end for the benchmark case as they are based on the average emissions of the bottom decile (worst-performing 10 %) of EU installations. Moreover, a correction for the free allocation for EU producers that is suggested in the EC proposal, could lead to at least 35–50 % lower CBAM costs in the beginning of the mechanism. On the other hand, inclusion of indirect emissions and wider product coverage under the CBAM could substantially increase the costs. In aggregate economic terms, the effects of the introduction of the CBAM are evaluated in the previous literature to be limited for most exporting countries.

The CBAM proposal remains subject to change. While evaluation of the pros and cons of the proposal itself exceeds the scope of this paper, exporting countries can actively influence their CBAM costs. CBAM costs could be cut by putting a price on carbon in their domestic markets and reducing GHG emissions of production processes. This would benefit the exporting countries in terms beyond the CBAM and contribute to urgently needed global emission reductions. Indeed, there are both national and company-specific initiatives in all of our focus countries that already support decarbonization. Realizing these initiatives and introduction of additional measures would obviate any need for the CBAM.

References

Assous, A., Burns, T., Tsang, B., Vangenechten, D. and Schäpe, B. (2021). A storm in a teacup. Impacts and geopolitical risks of the European carbon border adjustment mechanism. *Sandbag*, August 2021. E3G-Sandbag-CBAM-Paper.pdf

BCG (2021). Novaya redaktsya CBAM mozhet okazatsya bolee myahkoy dlya Rossiiskovo exporta. Boston Consulting Group, August 2021. https://www.bcg.com/ru-ru/press/16august2021-new-revision-of-cbam-may-be-softer-for-russian-exports

Bellora, C. and Fontagne, L. (2021). EU in search of a WTO-compatible carbon border adjustment mechanism. Mimeo. http://www.lionel-fontagne.eu/uploads/9/8/3/3/98330770/cblf_cba_2021.pdf

Concawe (2017). Estimating the marginal CO2 intensities of EU refinery products. Report 1/17, Brussels, January 2017. report layout (concawe.eu)

Dröge, S. (2021). Ein CO_2-Grenzausgleich fur den Green Deal der EU. SWP-Studie 9, July 2021, Berlin. https://www.swp-berlin.org/10.18449/2021S09/

ERCST (2021). Implications of EU carbon border adjustment mechanism for Turkey. *ERCST*, July 2021. http://bestanden.turkishcarbonmarket.com/20210728_Turkey_CBAM%20final%20results_v1.pdf

European Commission (2021a). Proposal for a Regulation of the European Parliament and of the council establishing a carbon border adjustment mechanism, July 2021. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0564

European Commission (2021b). Update of benchmark values for the years 2021–2025 of Phase 4 of the EU ETS, June 2021. https://ec.europa.eu/clima/sites/default/files/ets/allowances/docs/-bm_curve_factsheets_en.pdf

Kuusi, T., Björklund, M., Kaitila, V., Kokko, K., Lehmus, M., Mehling, M., Oikarinen, T., Pohjola, J., Soimakallio, S. and Wang, M. (2020). Carbon border adjustment mechanisms and their economic impact on Finland and the EU. Publications of the Government's analysis, assessment and research activities 2020:48. Prime minister's office, Helsinki, October 2020. https://julkaisut.valtioneuvosto.fi/-bitstream/handle/10024/162510/VNTEAS_2020_48.pdf

Marcu, A. (2021). Preliminary study on the economic impact that the EU CBAM could potentially impose on foreign exporters of products to the EU market – The case of Thailand, India and Vietnam. World Bank Publications, May 2021. https://ercst.org/preliminary-study-on-the-economic-impact-that-eu-cbam-could-potentially-impose-on-foreign-exporters-of-products-to-the-eu-market-thailand-india-and-vietnam/

Parry, I., Dohlman, P., Hiller, C., Kaufman, M., Kwak, K., Misch, F., Roaf, J. and Waerzeggers, C. (2021). Carbon pricing: What role for carbon border carbon adjustments? IMF Staff Climate Note 2021/004, International Monetary Fund, Washington DC. https://www.imf.org/en/Publications/staff-climate-notes/Issues/2021/09/24/Carbon-Pricing-What-Role-for-Border-Carbon-Adjustments-464805

Pyrka, M., Boratynski, J., Tobiasz, I., Jeszke, R. and Sekula, M. (2020). The effects of the implementation of the border tax adjustment in the context of more stringent EU climate policy until 2030. Center for

Climate and Energy Analyses, Warsaw, August 2020. The effects of the implementation of BTA in the context of more stringent EU climate policy until 2030 (climatecake.pl)

UNCTAD (2021). A European Union carbon border adjustment mechanism: Implications for developing countries. United Nations Conference on Trade and Development, July 2021. https://unctad.org/system/files/official-document/osginf2021d2_en.pdf

World Bank (2021). Carbon pricing dashboard. https://carbonpricingdashboard.worldbank.org/

Zimmer, M., Holzhausen, A. and Tuohy, E. (2021). EU CBAM: Well intended is not necessarily well done. Allianz Research, July 2021. https://www.allianz.com/en/economic_research/publications/-specials_fmo/2021_07_15_EU_CBAM_WellIntended.html

Appendix 1. List of sectors deemed at risk for carbon leakage in the EU for 2021–2030

Crop and animal production

1. Extraction of salt

Mining and quarrying

2. Mining of hard coal
3. Extraction of crude petroleum
4. Mining of iron ores
5. Mining of other non-ferrous metal ores
6. Mining of chemical and fertilizer minerals
7. Other mining and quarrying n.e.c.

Manufacture of food products

8. Manufacture of oils and fats
9. Manufacture of starches and starch products
10. Manufacture of sugar
11. Manufacture of malt
12. Kaolin and other kaolinic clays
13. Frozen potatoes
14. Dried potatoes
15. Concentrated tomato puree and paste
16. Skimmed milk powder
17. Whole milk powder
18. Casein
19. Lactose and lactose syrup
20. Whey and modified whey
21. Baker's yeast
22. Vitrifiable enamels and glazes, englobes and similar preparations
23. Liquid lustres and similar preparations

Manufacture of textiles, wearing apparel and leather products

24. Preparation and spinning of textile fibres
25. Manufacture of non-wovens and articles made from non-wovens, except apparel
26. Manufacture of leather clothes
27. Finishing of textiles

Manufacture of wood and paper

28. Manufacture of veneer sheets and wood-based panels
29. Manufacture of pulp
30. Manufacture of paper and paperboard

Manufacture of coke and refined petroleum products

31. Manufacture of coke oven products
32. Manufacture of refined petroleum products

Manufacture of chemical and pharmaceutical products

33. Manufacture of industrial gases
34. Manufacture of dyes and pigments
35. Manufacture of other inorganic basic chemicals
36. Manufacture of other organic basic chemicals
37. Manufacture of fertilizers and nitrogen compounds
38. Manufacture of plastics in primary forms

39. Manufacture of synthetic rubber in primary forms
40. Manufacture of man-made fibres
41. Manufacture of basic pharmaceutical products

Manufacture of other non-metallic mineral products

42. Manufacture of flat glass
43. Manufacture of hollow glass
44. Manufacture of glass fibres
45. Manufacture and processing of other glass, including technical glassware
46. Manufacture of refractory products
47. Manufacture of ceramic tiles and flags
48. Manufacture of bricks, tiles and construction products, in baked clay
49. Manufacture of ceramic household and ornamental articles
50. Manufacture of ceramic sanitary fixtures
51. Manufacture of cement
52. Manufacture of lime and plaster
53. Manufacture of other non-metallic mineral products n.e.c.

Manufacture of base metals and metal products

54. Manufacture of basic iron and steel and ferro-alloys
55. Manufacture of tubes, pipes, hollow profiles and related fittings, of steel
56. Cold drawing of bars
57. Aluminium production
58. Lead, zinc and tin production
59. Copper production
60. Other non-ferrous metal production
61. Processing of nuclear fuel
62. Casting of iron
63. Open die forged ferrous parts for transmission shafts, etc.

Source: https://ec.europa.eu/clima/news/adoption-delegated-decision-carbon-leakage-list-2021-2030_en

Appendix 2. Products covered by the CBAM in the European Commission's July 2021 proposal

Cement
2523 10 00 – Cement clinkers
2523 21 00 – White Portland cement, whether or not artificially coloured
2523 29 00 – Other Portland cement
2523 90 00 – Other hydraulic cements

Electricity
2716 00 00 – Electrical energy

Fertilizers
2808 00 00 – Nitric acid; sulphonitric acids
2814 – Ammonia, anhydrous or in aqueous solution
2834 21 00 - Nitrates of potassium
3102 – Mineral or chemical fertilisers, nitrogenous
3105 – Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium; other fertilisers
Except: 3105 60 00 – Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium

Iron and steel
72 – Iron and steel
Except: 7202 – Ferro-alloys
7204 – Ferrous waste and scrap; remelting scrap ingots and steel
7301- Sheet piling of iron or steel; welded angles, shapes and sections, of iron or steel
7302 – Railway or tramway track construction material of iron or steel
7303 00 – Tubes, pipes and hollow profiles, of cast iron
7304 – Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel
7305 – Other tubes and pipes having circular cross-sections of iron or steel
7306 – Other tubes, pipes and hollow profiles of iron or steel
7307 – Tube or pipe fittings of iron or steel
7308 – Structures and parts of structures of iron or steel
7309 – Reservoirs, tanks, vats and similar containers of iron or steel
7310 – Tanks, casks, drums, cans, boxes and similar containers of iron or steel
7311 – Containers for compressed or liquefied gas, of iron or steel

Aluminium
7601 – Unwrought aluminium
7603 – Aluminium powders and flakes
7604 – Aluminium bars, rods and profiles
7605 – Aluminium wire
7606 – Aluminium plates, sheets and strip
7607 – Aluminium foil
7608 – Aluminium tubes and pipes
7609 00 00 – Aluminium tube or pipe fittings

Source: European Commission: Proposal for a Regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0564

Appendix 3. Methodology for calculating CBAM cost estimates

All calculations are based on the formula:

Import volume (t) x Emission intensity (CO2 equivalent/t) x Carbon price (EUR/t) (1)

Import volumes are from 2019 in all calculations. They are extracted from the Eurostat database according to the CN codes covered by the CBAM proposal (see Appendix 2). The carbon price is assumed to be 60 euros per metric ton.

Benchmark CBAM costs

For the emission intensities is used the average emission level of the bottom decile (worst-performing 10 %) of installations in the EU. The values are taken from the latest ETS benchmark curves for 2021–2025. The ETS benchmarks, however, are calculated for *installations*, not products as in the CBAM proposal. These do not always map directly to CBAM products, so certain benchmarks are used as proxies for several products as described in Table A1.

Table A1. Common emission intensities used for all countries (Scope 1 only)

	Emission intensity (CO2e/t)	Note
Cement	1.2	ETS BM10
Ammonia	2.4	ETS BM41
Nitric acid and other fertilizers	1	ETS BM39
Aluminum	2.2	ETS BM9

Source: European Commission update of benchmark values for the years 2021–2025 of Phase 4 of the EU ETS.

For steel, we use country-specific emission intensities. As the import volumes are relatively large, the intensities vary across countries and can have a substantial effect on the cost calculation. The country-specific emission intensity of steel products is a weighted average of the emission intensity benchmarks for the main production processes, with the share of the production processes in each country as weights. It is not clear, however, if the production process will be taken into account in determining the default values when applying the CBAM. If not, the *emission intensity default values* would be somewhat higher for all countries. For electricity, average emission intensities of the countries of origin are used. The country-specific emission intensities are presented in Table A2.

Table A2. Country-specific emission intensities for steel and electricity (Scope 1 only)

	Steel (CO2e/t)	Electricity (tCO2/GWh)
China	2.1	NA (no imports to EU)
India	1.4	NA (no imports to EU)
Russia	1.8	0.4
Turkey	1.2	0.5
Ukraine	2.2	0.3

Notes: Country-specific emission intensity is calculated as a production methodology-weighted average of ETS BM 4 hot metal and the ETS BM5 EAF carbon steel. The weights are the shares of production methodologies by country as reported in 2020 World Steel in Figures. The emission intensities for electricity are from the IAE.

Sources: European Commission update of benchmark values for the years 2021–2025 of Phase 4 of the EU ETS, World Steel Association, IEA.

The default values of the average of the bottom decile of EU installations for emission intensities could be regarded as upper-end values used in determining the emissions embodied in imports. Emission intensities reported by several major Russian steel companies, for example, are slightly smaller. For some companies, the actual emission intensity is likely higher than these default values. Such companies have an obvious incentive to use the default values as reference where possible. In any case, it should be emphasized that the estimates are only illustrative of the potential magnitude of CBAM costs. The use of various simplifying assumptions and proxies also illustrates the difficulties related to practical CBAM implementation.

CBAM costs with extension to indirect emissions

We cannot use ETS benchmarks to extend the calculations to indirect emissions from electricity as the benchmarks only cover direct emissions. Power generation is separately covered in the ETS. Instead, we apply the ratios of Scope 2 emissions to Scope 1 emissions from the previous literature to approximate the effect on CBAM costs when indirect emissions are included. For cement and fertilizers, we used the same multipliers for Scope 2 emissions for all countries (Table A3).

Table A3. Common emission intensities used for all countries

CO2e/t	**Scope 1**	**Scope 1+2**
Cement clinker	1.2	1.2
Other cement	1.2	1.3
Nitric acid	1	1.8
Ammonia	2.4	2.5
Other fertilizers	1	1.1

Notes: Cement clinker calculated from the ratio of Scope 1 and Scope 2 emissions for Turkey in ERCST (2021a). Other cement calculated from the average ratio of Scope 1 and Scope 2 emissions for Turkey and India in ERCST (2021) and Marcu (2021). Fertilizers calculated from the ratio of Scope 1 and Scope 2 emissions for China in Assous et al. (2021).

Sources: European Commission update of benchmark values for the years 2021–2025 of Phase 4 of the EU ETS, Assous et al. (2021), ERCST (2021), Marcu (2021).

For steel and aluminum, we made additional modifications so that the emission intensities would better reflect large differences between countries (Table A4). For China, India and Turkey we take the country-specific ratios of Scope 1 and Scope 2 emissions from the previous literature and apply them to our Scope 1 emission intensities. For Russia, we use the average value reported by largest companies in the sector on the level of combined Scope 1 and Scope 2 emissions. For Ukraine's steel sector we use the same ratio as for Russia, as the distribution of the production methodologies between countries is very similar. For Ukraine's aluminum sector, we apply the average ratio of aluminum sector across the other countries.

Table A4. Country-specific emission intensities for steel and aluminum

CO2e/t	**Steel**		**Aluminum**	
	Scope 1	Scope 1&2	Scope 1	Scope 1&2
China	2.1	2.7	2.2	6.5
India	1.4	2.5	2.2	15.4
Russia	1.8	2.0	2.2	4.0
Turkey	1.2	2.6	2.2	9.6

Ukraine	2.2	2.4	2.2	9.0

Notes: The ratios of Scope 2 emissions to Scope 1 emissions for China are from Assous et al. (2021); for India from Marcu (2021); and for Turkey from ERCST (2021).

Sources: European Commission update of benchmark values for the years 2021–2025 of Phase 4 of the EU ETS, World Steel Association, ERCST (2021), Marcu (2021) and Assous et al. (2021).

CBAM costs with extension to wider product coverage

In addition to products already covered by the CBAM proposal, our estimate for extended product coverage accounts for the products that receive the largest shares of free allocations in the ETS (refinery products, chemicals, pulp and paper, lime and glass). We again use the average emissions of the bottom decile of EU installations from the EU ETS benchmark curves as our default value for calculating the CBAM costs (Table A5), i.e. only direct emissions are taken into account. Some benchmarks do not readily map to import data, so we again must make simplifying assumptions. This limits the product coverage of our analysis, particularly with respect to chemical products.

For simplicity, we use simple averages across respective benchmarks where the variation is relatively moderate. This is indeed the case for glass products, paper and PVC products. For pulp, we attempt to account for production technology, which varies in Russia's case. We assume that pulp from softwood can be proxied by long-fiber kraft pulp benchmark and pulp from hardwood can be proxied by short-fiber kraft pulp. For other countries in our sample, imports appear to be mainly recovered paper pulp. These are proxied with the corresponding benchmark.

From refinery products we take into account only oil products. The benchmark for refined products is difficult to apply to imports. Therefore, we use the average emission intensity for EU producers taken from Concawe (2017). For simplicity and as the differences across products are quite small, we further average over LPG, gasoline, kerosene, diesel fuel and heating oil. We use the resulting value as a proxy for all imported oil products.

Table A5. Common emission intensities used for all countries (Scope 1 only)

	Emission intensity (CO2e/t)	Note.
Lime	1.3	ETS BM12
Glass	0.7	ETS BM15-17, simple average
Pulp	0.1 (Russia 0.3)	ETS BM30, for Russia weighted average of BM27-30
Paper	2.4	ETS BM31-BM37, simple average
Carbon black	2.7	ETS BM38
Phenol	0.4	ETS BM45
PVC	0.4	ETS BM48-49, simple average
Hydrogen	25.0	ETS BM50
Soda ash	1.1	ETS BM52
Oil products	0.3	EU average for LPG, gasoline, kerosene, diesel fuel and heating oil

Sources: European Commission update of benchmark values for the years 2021–2025 of Phase 4 of the EU ETS, Concawe (2017).

Appendix 4. Comparison of various estimates of CBAM costs

All estimates presented in the comparisons are calculated as in (1). They all are based on the import volumes for 2019, a carbon price of 60 euros per ton and zero free allowances. These are readily provided only by Assous et al. (2021). Other estimates are recalculated using the respective emission intensity assumptions. These other estimates may be quite different from those reported in the original publications that use different assumptions for import volumes and carbon prices.

Russia

EUR million	Our estimate	BCG (2021) lower	BCG (2021) upper	Assous et al. (2021)	Dröge (2021) - Zimmer et al. (2021)
Cement	0.1	NA	NA	0	0
Electricity	359	180	449	50	270
Fertilizers	465	405	663	500	NA
Steel	1,144	826	1,526	1 100	1 587
Aluminum	174	158	316	250	NA
Total CBAM	**2,143**	**1,569**	**2,953**	**1,900**	**1,856**

China

EUR million	Our estimate	Assous et al. (2021)
Cement	1	0
Electricity	0	0
Fertilizers	13	35
Steel	311	300
Aluminum	77	150
Total CBAM	**402**	**485**

Turkey

EUR million	Our estimate	Assous et al. (2021)	ERCST (2021)
Cement	141	60	100
Electricity	34	0	34
Fertilizers	30	50	NA
Steel	430	600	143
Aluminum	51	100	48
Total CBAM	**686**	**810**	**326**

India

EUR million	Our estimate	Marcu (2021)
Cement	1	6
Electricity	0	0
Fertilizers	1	NA
Steel	192	165
Aluminum	23	20
Total CBAM	**217**	**191**

Ukraine

EUR million	Our estimate	Assous et al. (2021)	Dröge (2021) - Zimmer et al. (2021)
Cement	41	30	30
Electricity	21	10	21
Fertilizers	55	70	NA
Steel	731	800	830
Aluminum	1	10	NA
Total CBAM	**849**	**920**	**881**

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ISSN 2342-205X