# Extending the Scope of the EU CBAM: The Case of Downstream Goods

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Abstract:

The EU's carbon border adjustment mechanism (CBAM) levels the playing field in several carbon intensive sectors, including iron & steel and aluminium. However, the phase-in of CBAM and accompanying phase-out of free allowances in the EU introduces new risks of leakage in sectors that use metals covered by CBAM as an input. Higher input prices for metals may lead to relocation of downstream manufacturing outside the EU. We here quantify this effect based on model simulations with the computable general equilibrium (CGE) model JRC-GEM-E3. We then quantify how much this of this leakage can be reduced under scenarios that extend CBAM to downstream products. We also show trade and output effects for the affected downstream sectors as well as changes in consumer prices. The study uses a novel approach to implement CBAM scenarios in CGE models, making use of bottom-up information at the product level to calibrate implementation at the broader sectoral level.

## Introduction

The EU Carbon Border Adjustment Mechanism (CBAM) aims to reduce the risk of carbon leakage by levelling the playing field for emission-intensive, trade-exposed industries. The CBAM ensures that the carbon price of imports is equivalent to the EU carbon price, mirroring the EU Emissions Trading System (EU ETS). By doing so, the EU puts its domestic industry that incurs higher production costs due to carbon pricing on the same footing as foreign competitors that do not face the same cost increase in their jurisdictions.

The CBAM became fully operational in 2026, imposing financial obligations on imports of a set of basic goods (cement, aluminium, fertilizer, iron and steel, electricity, and hydrogen) into the EU. The CBAM aims to prevent carbon leakage, but the phase-out of free allowances in the EU ETS alongside its introduction will raise prices of the affected basic goods, impacting producers reliant on CBAM-covered inputs. This is crucial for sectors like metal products due to potential production relocation – for example, increased steel import costs might shift vehicle parts production, causing carbon leakage if steel is produced with higher emissions outside the EU. Under the current approach, this also opens the door to avoid CBAM payments by adding additional value for further processing to turn the basic good into a product not covered by CBAM, posing a risk for already struggling EU manufacturing (European Commission, 2025a).

To address this leakage channel, the European Commission proposed an extension to the current CBAM coverage to also include upstream emissions (i.e. from the production of intermediate inputs already covered by CBAM) in downstream goods (European Commission, 2025b). This initial proposal focuses exclusively on steel- and aluminium-intensive downstream products, as they face the highest risk of carbon leakage and implementation including the obtention of embedded emissions was deemed technically feasible.

Apart from practical implementation challenges, the degree to which the CBAM impacts industries outside the EU depends mainly on their trade exposure and their emission intensity. Since the European Commission proposed the introduction of the CBAM in July 2021, the literature about its effects has grown exponentially, including country and sector specific assessments of different kinds (Zhong and Pei, 2024). This includes analyses of non-EU countries' exposure to the EU CBAM using carbon emissions intensity and exports of CBAM products, such as the World Bank's Relative CBAM Exposure Index (Chepeliev et al., 2023) and risk index from Eicke et al. (2021), but also an extensive debate around potential impacts (e.g., on carbon leakage of energy intensive industries in the EU (Böhringer et al., 2022).

Nonetheless, the proposal to extend the CBAM to downstream goods has not been yet evaluated in the existing literature. Here we look at the implications of CBAM on downstream sectors and how an extension of CBAM to cover downstream goods can reduce leakage in downstream sectors using a computable general equilibrium (CGE) model. We pay particular attention to changes in CBAM and affected downstream sectors. Since the implementation of the policies is defined at the product level, we derive certain parameters such as coverage at the product level in a novel way. These parameters are then aggregated into input parameters that describe the broader sector in the CGE model. The CGE model can then assess the spillovers to other sectors and consumer prices.

## Model framework and scenarios

To assess the implications of the cost push for downstream sectors due to the introduction of CBAM and of possible extension reforms of CBAM to cover additional downstream goods, we use the JRC-GEM-E3 model (Capros et al., 2013). JRC-GEM-E3 is a global recursive dynamic computable general equilibrium (CGE) model. The model covers the EU 27 Member States individually and 23 other major regions, providing detailed sectoral energy disaggregation and carbon emission mechanisms. Within each sector, a representative firm minimises costs to produce output. Final consumption by the representative household in a region is modelled in a linear expenditure system (LES) and 14 consumption purpose categories are connected to production sectors through a consumption matrix (Cai and Vandyck, 2020). Regions are linked via Armington trade, assuming imperfect substitution between goods produced in different regions (Armington, 1969). Capital and labour are assumed to be mobile between sectors, but not between regions. In this application, we assume a perfect labour market closure, but unemployment can also be made endogenous in the model, following a wage curve representation. With a detailed sectoral disaggregation of energy as well as endogenous mechanisms to meet carbon emission constraints, JRC-GEM-E3 has been used extensively for the economic analysis of climate and energy policy impacts, including the impact assessment underlying the CBAM proposal of the European Commission in 2021 (European Commission, 2021).

To capture the effect on some important sectors related to CBAM, the sectoral granularity of the JRC-GEM-E3 model was increased for this assessment, relying on the new GTAP 11 Circular Economy database (Chepeliev et al., 2026), which explicitly captures aluminium, fertilisers, cement, iron and steel. This dataset draws on several sources including trade statistics and thus captures differences in the input structure of these sectors as well as differences in their trade intensity.

During the JRC-GEM-E3 model calibration, we apply a multi-regional, generalised RAS (MR-GRAS) algorithm to project input-output tables with constraints that ensure that the calibration objectives (e.g., exogenous GDP projections) are reached over time (Temursho et al. 2020). The time dependent parameters of the model are then calibrated to reproduce the forward-projected input-output tables. In the baseline, we assume the implementation of the EU's Fit-for-55 package, except the phase-out of free allowances in the CBAM sectors and the corresponding phase-in of CBAM. The rest of the world follows the reference scenario from the Global Energy and Climate Outlook 2024 (Keramidas et al., 2024), which reflects current (legislated) policies. This scenario assumes that third countries follow existing policies, but not necessarily reach their National Determined Contributions (NDCs) submitted to the UNFCCC under the Paris Agreement, if these targets are not backed by specific policies. The UK and EFTA countries are assumed to have climate policy of equal stringency in place as the EU, e.g. a carbon price that is effectively paid equal to those in the EU ETS, hence there are no CBAM payments from these countries.

In a first scenario, the introduction of the CBAM was modelled together with a phaseout of free allowances, as CBAM becomes the main EU policy instrument aimed at addressing the risk of carbon leakage in some sectors. The CBAM is introduced gradually, and the analysis here focuses on 2030 and 2035. In 2035 the phase-out of free allowances and the phase-in of CBAM is complete. This scenario serves to show the impact of the introduction of CBAM as currently legislated on the downstream sectors.

We then run several policy scenarios to model a possible extension of CBAM with varying coverage of potential downstream products. The identification was based on an indicator of carbon intensity and trade intensity of each product from a long-list of potential products. Option 1 has is more targeted and only includes products (classified by Combined Nomenclature - CN code) which have a high trade carbon intensities; this would capture only the products with the highest risk of leakage. In addition, this option would exclude products whose upstream use of metals would cause less than 150 kt of CO2 emissions and therefore may not have material climate consequences. This option would cover about 70-80 CN codes. Option 2 applies lower thresholds for trade and carbon intensities but keep the threshold. It would cover 150-180 CN codes. Option 3 is based on the same thresholds as Option 2 for the intensities, but does not include the emission threshold. It would be the broadest coverage and include 230-250 CN codes.

For each CN code, the weight share of metals covered by CBAM and the relative importance of the product is considered to calculate the share of emissions that would be covered by CBAM in the more aggregate sector of JRC-GEM-E3 (e.g., ferrous metal products). This accounts for the fact that the downstream products considered to be covered fall into various JRC-GEM-E3 sectors (electric goods, other equipment goods, fabricated metal products, motor vehicles and parts, other transport equipment), but then often account only for a fraction of the overall emissions embodied in EU imports of this sector.

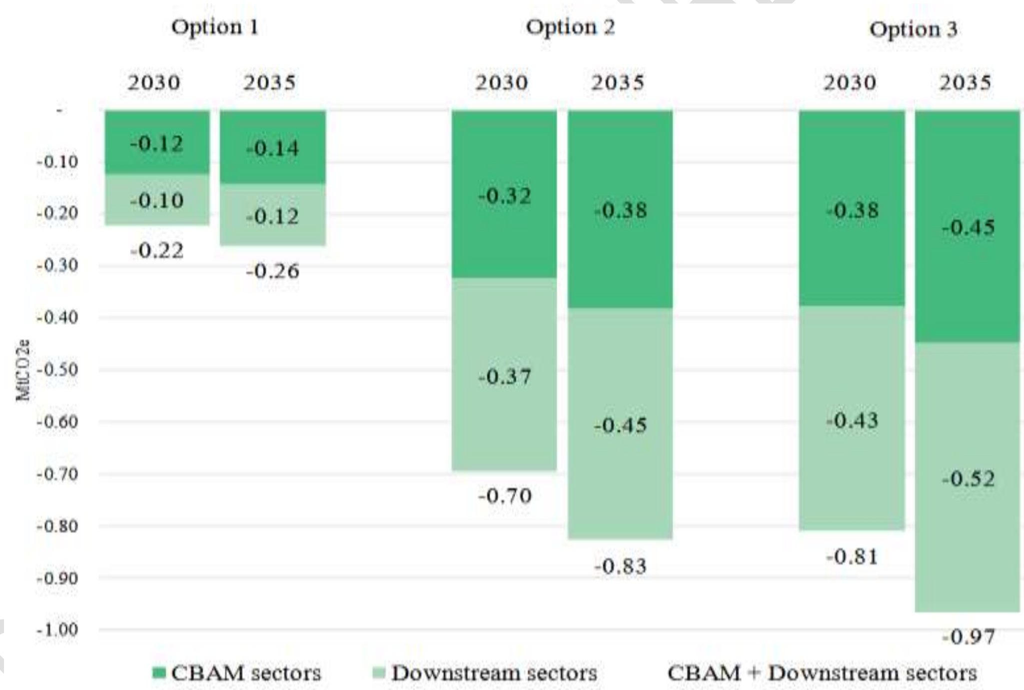
The current CBAM regulation already covers some products that are outside the basic CBAM sectors in the sectoral classification of the JRC-GEM-E3 model. Specifically, about two thirds of emissions embodied in the EU imports of fabricated metal products are already covered by the current legislation. This is reflected in our scenario of CBAM as legislated, where a CBAM is implemented in the model on a share of the imports of fabricated metal products. This share is calculated outside the CGE model, assuming material contents by CN code from a bottom-up analysis as mentioned above.

To further reflect the role of ETS free allocations and the corresponding CBAM factor for imports of goods covered (i.e. a factor that lowers payments for importers to the extent that EU producers enjoy free allowances during the gradual phase-in until 2034), an adjustment is applied to the emissions subject to CBAM in the JRC-GEM-E3 model. The factor is derived from CN code specific trade flows and corresponding emission intensities derived from Vidovic et al. (2023). To assess the policy scenarios, the share of emissions originating from metals production embodied in the trade of downstream products was again determined by using detailed trade data at product level from Eurostat. Note that CBAM for downstream goods only covers emissions that would be covered under the EU ETS, and therefore does not cover the direct emissions from the further production process of the downstream good. In other words, the emission coverage would be limited to emissions associated with the production of the metals (steel and aluminum) embodied in the downstream products, but not the emissions from further processing of the downstream products itself.

## Results

The model simulations indicate that a downstream extension prevents leakage as it reduces global greenhouse gas (GHG) emissions. Figure 1 shows that emission reductions occur in both downstream and CBAM sectors, although only emissions from CBAM sectors are considered for the calculation of the CBAM payment. The Figure also shows that most of the environmental impact can be achieved with Option 2, adding further CN codes to the regulation would increase the administrative burden but only has a limited additional environmental benefit.

Figure 1. Estimated changes in global GHG emissions due to CBAM downstream extension in 2030 and 2035.




While the EU would see a marginal increase in its emissions, it is the rest of the world where the induced emission reductions happen. This is a consequence of introducing the CBAM and its extension to the downstream sectors, which disincentivise carbon-intensive imports, hence leading to a small increase in EU production in the CBAM-covered sectors. Even though only the emissions in the CBAM basic sectors are covered, emission reductions would occur both in the upstream and downstream sectors. Emissions in upstream sectors (steel and aluminium) would be reduced as demand as input in downstream production declines. Emissions in downstream sectors declines as relatively dirty production of downstream goods outside the EU declines.

Among the CBAM sectors, the ferrous metal sector delivers most of the emission reductions, whereas in downstream, the other equipment goods sector and the fabricated metal products are the main sectors delivering emission reductions. For Option 1, the main driver is the fabricated metal products sector with 45–50% of the emission reductions, while for Option 2 and Option 3, it is the other equipment goods sector that drives most of the emission reductions. It is worth noting that, while the downstream extension of CBAM would generate additional global emission reductions, it is on a limited scale. The introduction of CBAM without downstream extension is expected to bring about 38.3 Mt CO2e emission reductions, while the downstream extension's expected impact is about 0.22–0.81 Mt CO2e of additional emission reductions.

Looking at the impacts on downstream sectors, the fabricated metal products sector shows the largest increase in output relative to the baseline. Output in that sector in 2035 is estimated to increase by 0.07% under Option 1, 0.16% under Option 2 and 0.19% under Option 3. This is driven by lower import demand, as imports in the affected sectors decline by up to 1.4% (Table 1). When looking at trade impacts, the difference between the CBAM and downstream sector aggregations (highlighted rows in Table 1) is quite small.

Table 1: EU27 imports in 2030 and 2035 (% change compared to baseline).

| **Sectors / Years** | **2030** | | | **2035** | | |
|---|---|---|---|---|---|---|
| *Options* | 1 | 2 | 3 | 1 | 2 | 3 |
| Ferrous metals | 0.02% | 0.07% | 0.09% | 0.03% | 0.10% | 0.11% |
| Iron and steel casting | 0.03% | 0.09% | 0.11% | 0.04% | 0.11% | 0.13% |
| Cement | 0.00% | 0.01% | 0.01% | 0.00% | 0.02% | 0.02% |
| Fertilizer | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| Aluminium | 0.02% | 0.07% | 0.08% | 0.02% | 0.09% | 0.10% |
| CBAM sectors | 0.02% | 0.07% | 0.08% | 0.03% | 0.09% | 0.10% |
| Electric Goods | 0.00% | -0.08% | -0.11% | 0.00% | -0.10% | -0.14% |
| Transport equipment | -0.13% | -0.12% | -0.11% | -0.15% | -0.13% | -0.13% |
| Other Equipment Goods | -0.04% | -0.34% | -0.40% | -0.05% | -0.40% | -0.47% |
| Fabricated Metal Products | -0.41% | -0.91% | -1.08% | -0.53% | -1.17% | -1.39% |
| Motor vehicles and parts | -0.11% | -0.23% | -0.23% | -0.13% | -0.30% | -0.29% |
| Downstream sectors | -0.06% | -0.23% | -0.27% | -0.08% | -0.28% | -0.33% |
| CBAM + Downstream sectors | -0.06% | -0.21% | -0.25% | -0.07% | -0.26% | -0.31% |

Finally, the extension of CBAM to downstream sector also leads to additional revenue (Table 2).

Table 2: Revenue Generation Impacts of the Downstream Extension

| **Years** | **2030** | | | **2035** | | |
|---|---|---|---|---|---|---|
| *Options* | 1 | 2 | 3 | 1 | 2 | 3 |
| Revenue in bn EUR | 0.17 | 0.58 | 0.68 | 0.22 | 0.69 | 0.81 |

### Conclusion

This study assesses the CBAM scope extension's implications for carbon leakage and global GHG emissions, along with its macroeconomic impacts. Focusing on the sectoral impacts, it also identifies the most effective policy option for environmental impact without adding excessive administrative burden.

It shows that the introduction of CBAM as currently legislated (i.e. without the downstream extension) impacts EU producers that rely on metals as a key input and this leads to leakage in the downstream sectors. The modelling shows that extending the coverage of CBAM to these downstream goods can reduce this leakage.

The study also serves as an illustration of how legislation at the product level can be modelled in a CGE model operating with broader sectoral scope. By relying on bottom-up parameters (e.g. to calculate emissions shares covered in broader sector), it is then possible to assess spillover effects, e.g. in other sectors.

The current modelling does not consider other modifications that have recently been made to the CBAM legislation, e.g. the threshold of excluding small importers that only import a limited amount of CBAM goods. However, these account only for a small share of the overall import volume, hence considering this would likely only have small effects.

### References

Armington, P.S. (1969). A theory of demand for products distinguished by place of production. IMF Staff Papers.

Böhringer, C., Fischer, C., Rosendahl, K.E. et al. (2022) Potential impacts and challenges of border carbon adjustments. Nat. Clim. Chang. 12, 22–29. https://doi.org/10.1038/s41558-021-01250-z

Cai M. and Vandyck T. (2020). Bridging between economy-wide activity and household-level consumption data: matrices for European countries. Data in Brief 30, 105395. https://doi.org/10.1016/j.dib.2020.105395

Capros P., Van Regemorter D., Perry M., Ciscar J., Paroussos L., Pycroft J., Karkatsoulis P., Abrell J. and Saveyn B. (2013). GEM-E3 Model Documentation. Joint Research Centre, Institute for Prospective Technological Studies. Publications Office of the European Union. https://doi.org/10.2788/47872

Chepeliev, M. et al. (2023). Carbon Border Adjustment Mechanism (CBAM) Exposure Indices Methodological Note (English). World Bank Group. http://documents.worldbank.org/curated/en/099062625130529813

Chepeliev, M., Aguiar, A., Farole, T., Liverani, A., & van der Mensbrugghe, D. (2026). Circular economy transition in Europe requires ambitious policies beyond climate mitigation. Resources, Conservation and Recycling, 225, 108591. https://doi.org/10.1016/j.resconrec.2025.108591

Eicke, L., Weko, S., Apergi, M., & Marian, A. (2021). Pulling up the carbon ladder? Decarbonization, dependence, and third-country risks from the European carbon border adjustment mechanism. Energy Research & Social Science, 80, 102240. https://doi.org/10.1016/j.erss.2021.102240

European Commission (2021). Impact Assessment Report accompanying the document Proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism. SWD(2021) 643.

European Commission (2025a). Communication on A European Steel and Metals Action Plan, COM(2025) 125.

European Commission (2025b). Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) 2023/956 as regards the extension of its scope to downstream goods and anti-circumvention measures. COM(2025)989. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52025PC0087

Keramidas et al., 2024. Global Energy and Climate Outlook 2024: Updating NDCs and closing the ambition gap - indicators for 1.5°C alignment. https://data.europa.eu/doi/10.2760/9028706.

Temursho U., Cardenete M.A., Wojtowicz K., Rey Los Santos L., Weitzel M., Vandyck T. and Saveyn B. (2020). Projecting Input-output Tables for Model Baselines. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/5343

Vidovic, D., Marmier, A., Zore, L., & Moya, J. A. (2023). Greenhouse gas emission intensities of the steel, fertilisers, aluminium and cement industries in the EU and its main trading partners. Luxembourg: Publications Office of the European Union. https://data.europa.eu/doi/10.2760/359533

Zhong, J., & Pei, J. (2024). Carbon border adjustment mechanism: a systematic literature review of the latest developments. Climate Policy, 24(2), 228–242. https://doi.org/10.1080/14693062.2023.2190074