

Carbon leakage under CBAM and free allocation



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ERCST contributions to this report from

Andrei Marcu
Alexandra Maratou
Cecilia Meinardi
Tommaso Paperini
Marco Sangiovanni

Climate Economics Chair contributions to this report from

Marc Baudry
Anna Creti
Dajana Jata

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Executive Summary

Europe's climate ambition must be delivered while ensuring that EU climate policy does not lead to de-industrialisation. This report shows that the central risk for the EU is loss of industrial competitiveness in a world where climate policies (and, crucially, *effective* carbon costs) remain highly asymmetric. It therefore makes a policy-critical distinction between the ETS allowance price (the visible market signal) and the effective ETS cost actually borne by industrial value chains. If policy raises the *effective* carbon cost for EU industry—including for downstream sectors—the result is likely to be emissions reduction through offshoring and value-chain leakage, shifting production (and emissions) outside the EU with limited climate benefit, while creating a major affordability challenge inside the EU. A reasonable level of free allocation for the industrial sector would seem to provide a better outcome: it can materially reduce the transition burden and help finance decarbonisation during the period where global carbon cost convergence has not materialised.

Key messages (policy-relevant takeaways)

- ETS price $\neq$ effective ETS cost and policy debates must focus on the effective cost. The report stresses that visible EUA prices send a signal, but competitiveness and offshoring are driven by the carbon costs actually borne by firms, direct and indirect, and how these evolve as free allocation declines. Policy should aim for a strong price signal while keeping the effective cost sustainable during the transition.
- CBAM is necessary, but it is not sufficient to prevent carbon leakage on its own. CBAM primarily addresses leakage linked to imports into the EU market, but the report explicitly notes that it does not fully replicate the broader leakage protection historically provided by free allocation, notably for exports and complex value chains. As free allocation is scaled down, these leakage dimensions are only partially addressed by CBAM, implying that additional or complementary measures may be required beyond “CBAM + full phase-out”.
- A reasonable level of free allocation for industry protects channels that CBAM does not cover and stabilises the transition. The report explains that CBAM and free allocation operate through different economic channels: CBAM acts on marginal competitive conditions at the border, whereas free allocation affects inframarginal compliance costs, profitability and balance-sheet constraints—which matter for survival and investment capacity in globally exposed industries. This is precisely why the report describes them as complements rather than substitutes.
- Modelling results: CBAM protects upstream activity, but without sufficient free allocation the adjustment becomes more inflationary and more disruptive for downstream sectors. The report's modelling finds that CBAM can support EU upstream production and reduce import dependence, and it can encourage cleaner production inside and outside the EU. However, when CBAM is combined with the phase-out of free allocation, the adjustment becomes more concentrated, more inflationary, and more costly for downstream industries. Maintaining free allocation does not eliminate trade-offs, but it substantially attenuates them.
- Downstream/value-chain leakage is a core risk: rising upstream costs shifts the competitiveness problem to downstream manufacturing. The report highlights that higher upstream input prices erode downstream competitiveness, leading to lower EU downstream output and higher net imports of finished goods—i.e., leakage reappears along the value chain. This adverse effect is stronger when free allocation is phased out at the same time.
- The report recalls the “independence principle” logic: under free allocation, abatement can generate revenue through the ability to sell allowances freed up by lower emissions (whereas under auctioning it is an avoided expenditure). This matters because it can support decarbonisation financing capacity and limit the cost transmitted to downstream sectors during transition.

- Affordability and distributional impacts are material and must be managed explicitly. The report shows that downstream impacts can translate into significant distributional consequences (e.g., in fertilisers, impacts on EU farmers' revenues are substantial under the model assumptions), highlighting an affordability challenge that would require compensation mechanisms not embedded in the current framework.
- International reality check: most non-EU carbon pricing systems imply low marginal/effective carbon costs for industrial sectors. The report documents that many systems rely heavily on free allocation or equivalent measures, implying zero or close-to-zero incurred costs for industrial sectors in several jurisdictions. This asymmetry is central to the EU competitiveness problem.

Bottom line for ongoing EU policy discussions:

- CBAM alone will not “do the job”: it cannot fully address export exposure and value-chain leakage, and does not contribute to limiting effective costs during transition.
- A reasonable level of free allocation for industrial sectors would contribute to preventing deindustrialisation, keeping transition costs sustainable, and avoiding shifting emissions outside the EU.

1. Introduction

This report is the final output of a study aimed at supporting the EU's evolving climate policy by assessing carbon leakage under the EU Carbon Border Adjustment Mechanism (CBAM) and free allocation of allowances within the EU Emissions Trading System (EU ETS).

In light of increasing emphasis on carbon leakage prevention, and industrial competitiveness, this report:

- Provides background on carbon leakage (**sections 2.1 and 2.2**)
- Provides a comparison of the carbon price and carbon costs in the EU versus other jurisdictions – (**section 2.3**)
- Reviews the evolution of carbon leakage measures in the EU (**section 3.1**) as well as carbon leakage approaches and allowance allocation methods in ETSs of other jurisdictions considering Border Carbon Adjustments (BCAs) (**section 3.2**)
- Presents modelling results for two sectors (**chapter 4**). An analytical model that explicitly integrates international trade and carbon leakage was developed with a view to:
 - Study how free allocation and CBAM address different leakage channels.
 - Assess the long-term effects of allocation choices on industrial structure, carbon pricing, and investment signals.
 - Analyze downstream carbon leakage through value chains.
- **Chapter 5** finally provides a synthesis of the findings on carbon leakage under CBAM and free allocation and provides high-level takeaways.

2. Background on carbon leakage

2.1. Carbon leakage definition

Broadly speaking, carbon leakage occurs when emission reductions in countries resulting from stricter greenhouse gas mitigation policies, are partially or completely offset by emission increases in countries that apply less stringent policies¹.

According to the Commission², the term ‘carbon leakage’ refers to the transfer of CO₂ emissions from one country to another when, due to strict climate policies, companies relocate their production to countries with weaker emission constraints which may or may not contribute to an increase in global greenhouse gas emissions. The formula for calculating it is the emissions increase in other countries divided by the emissions reduction in the implementing country, expressed as a percentage.

$$\text{Carbon leakage} = \frac{\text{Emission increase in non EU regions}}{\text{Emission reduction in the EU}}$$

¹ For instance, the IPCC Fifth Assessment Report defines leakage as the “*phenomena whereby the reduction in emissions (relative to a baseline) in a jurisdiction/sector associated with the implementation of mitigation policy is offset to some degree by an increase outside the jurisdiction/sector through induced changes in consumption, production, prices, land use and/or trade across the jurisdictions/sectors*”. Source: p.125, IPCC, 2014.

² Table 4, Part 1 in European Commission. (2021).

The reduction in emissions in the EU may result from a reduction in production within the EU or from a reduction in demand for the products concerned.

There are multiple dimensions and channels of carbon leakage including:

- **Production leakage:** whereby the asymmetry of climate policies between the EU and other countries leads companies to relocate production or reduces their market share vis a vis imports and exports. This includes direct relocation, whereby companies move carbon-intensive production to countries with less stringent regulations to avoid carbon costs; and trade-related production substitution, whereby stricter domestic policies render domestic products more expensive and prone to (partial or complete) substitution by cheaper imports from countries with lower or no carbon costs, increasing production and emissions in those exporting countries.
- **Investment leakage:** similar to production relocation, companies redirect their investments to countries with less stringent climate policies to avoid associated carbon costs. With time, as domestic plants reach end of life, this gives way to production relocation. Investment leakage may also occur because of (future) policy uncertainty.
- **Exports leakage:** this refers to the carbon leakage risk associated with goods manufactured in the EU for export, arising from the competitive disadvantage and potential loss of market share that EU producers may face due to higher carbon costs on the global market. In the export case, it many products that constitute significant EU exports are commodities that are traded globally in intensely competitive markets. As such, the ability to pass through costs on the global market is limited.
- **Value chain leakage:** this refers to the displacement of carbon leakage risk to downstream value chains when climate measures such as an ETS cover the upstream.

One consideration with respect to carbon leakage is the extent to which it may or may not contribute to an increase in global greenhouse gas emissions, i.e. whether the emissions reduction domestically is partially offset, completely offset, or more than counterbalanced by increases in emissions elsewhere.

According to the carbon leakage formula provided above, leakage of 50% would mean that half of the emissions reduction achieved domestically was cancelled out by foreign emission increases. A figure greater than 100% would mean that carbon leakage actually caused global emissions to increase³.

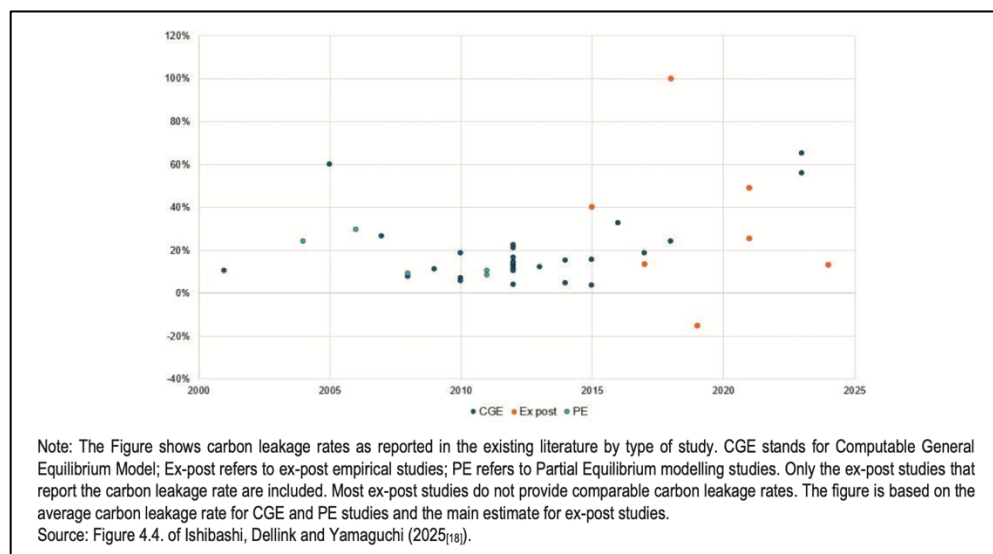
Emissions reduction in the EU that appears in the denominator of the leakage formula can stem from different mechanisms, including demand destruction. Carbon leakage below 100% does not necessarily equate to a desirable outcome – while it is not harmful in terms of global emissions, it is harmful economically as it would lead to EU de-industrialization.

2.2. Evidence of carbon leakage

There is a rapidly growing literature analysing the effects of climate policies on carbon leakage using either ex-ante (forecast) or ex-post (empirical) analysis.

³ Table 4, Part 1, in European Commission (2021).

Figure 1 Carbon leakage rate estimates by type of study



Source: figure 2 in Hemmerlé, Yannick, Tobias Kruse, Mauro Pisu (2025); reproducing original figure 4.4. in Ishibashi, Y., R. Dellink and S. Yamaguchi (2025).^t

Ex-ante analysis of carbon leakage generally finds positive carbon leakage rates, with meta-analyses of ex-ante modelling studies giving carbon leakage estimates from 5 to 30%, with a mean of 14%⁴.

Ex-post (empirical) analyses, on the other hand, until recently found little evidence of carbon leakage or competitiveness impacts from carbon pricing policies, with the limitation that most studies were focused on the early phases of the EU ETS, and as such were influenced by a high level of free allocation, the exceptional economic downturn, and CO₂ prices significantly below what was anticipated.

More recently, however, and with rising carbon prices, ex-post studies have also started to detect stronger evidence of carbon leakage: for example, in an ex-post study covering plants in 140 countries, Teusch et al. (2024)⁵ found that everything else equal, a USD 1/tCO₂e increase in the carbon price difference between the importing and exporting countries raises the emissions embodied in imported cement and steel products by 2.5%. The same study also found that that, on average, carbon leakage through international trade offset 13% of domestic emission reductions. Similarly, Wang and Kuusi (2024)⁶, found robust evidence of carbon leakage due to the EU ETS for the period 2005-2018 by applying a gravity model to international trade and emissions flows.

2.3. The role of carbon price vs. carbon cost as a decarbonisation incentive

2.3.1. Carbon price

Visible carbon prices are significantly different between different economic jurisdictions worldwide where ETSS exist. The EU ETS is the highest-priced carbon market globally. For instance, in 2024, the EU ETS

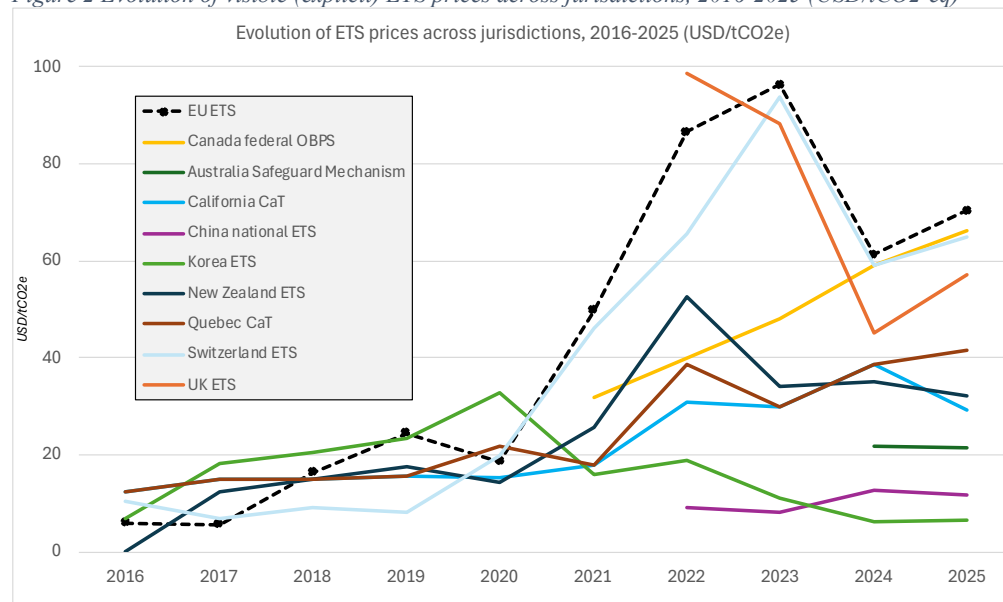
⁴ Branger and Quirion (2014), find a range of carbon leakage estimates from 5 to 25%, with a mean of 14%; Carbon and Rivers (2017), find that carbon leakage rates are typically between 10 and 30%; see also Böhringer, C. et al. (2015).

⁵ Teusch, J. et al (2024)

⁶ Wang, M. and T. Kuusi (2024).

price (USD 61/tCO₂e) was 1.4 times that of the UK ETS (USD 45/tCO₂e), almost double that in the New Zealand ETS and California CaT (see Figure 2).

Figure 2 Evolution of visible (explicit) ETS prices across jurisdictions, 2016-2025 (USD/tCO₂-eq)



Source: ERCST, based on data from World Bank Group, State and Trends of Carbon Pricing Dashboard

2.3.2. Carbon cost

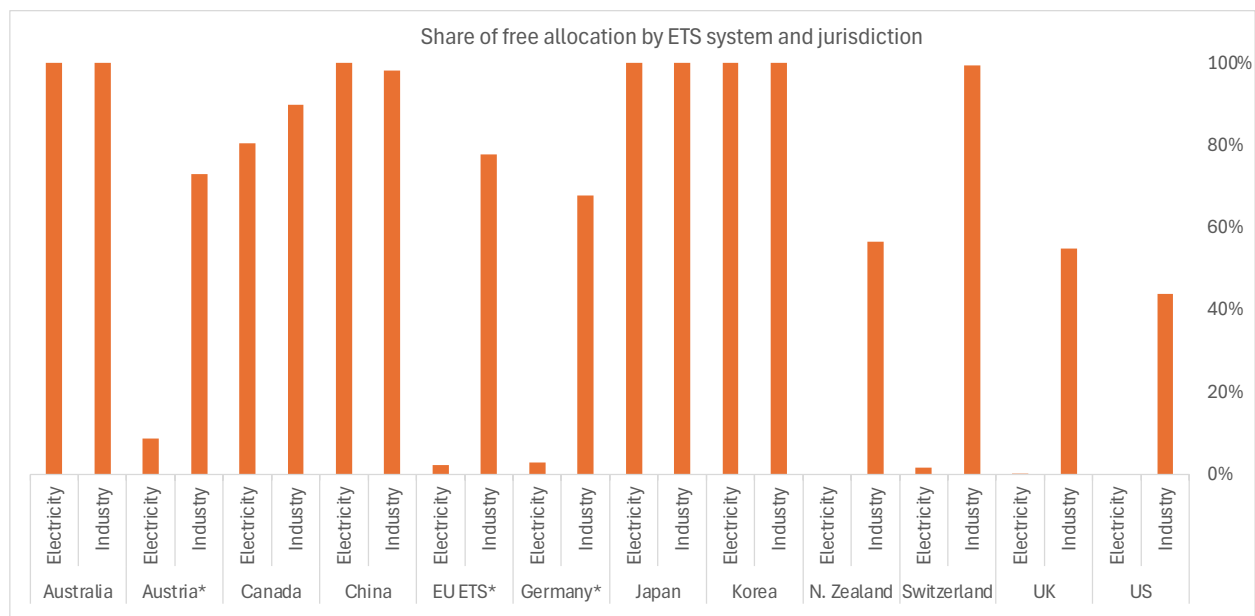
In most ETSs, covered entities receive emission allowances for free to reduce the risk of carbon leakage and to protect firms against competitiveness losses. As illustrated in the following graph as well as other data by the OECD (2025) there is a wide variation in the share of free allowances in total verified emissions across systems in different jurisdictions: it ranged for example from 100% in Japanese ETSs or the Chinese national ETS, to almost 0% in RGGI⁷. It is also to be noted that the shares indicate sectoral variations across systems, with the electricity sector for instance receiving negligible shares of free allowances in the EU ETS, the RGGI⁸, the Swiss ETS, New Zealand and the UK ETS, but 100% shares in Australia, China, Japan and Korea⁹.

⁷ See Figure 2.8. in OECD (2025) for the ETS-level as well as the resulting country-level shares of free allocation of allowances in total verified emissions.

⁸ RGGI only covers the power sector, with the absence of FA provisions hindering system extension to industrial sectors.

⁹ p29 and table 2.A.1 in OECD (2025)

Figure 3 Share of free allowances by system and jurisdiction in 2023



Note: The EU ETS applies to all EU countries as well as Iceland, Liechtenstein and Norway. The individual EU ETS countries are not presented in the graph unless they have a national ETS in place as well, which is the case in Austria and Germany. Similarly, Canada, China, Japan and the United States each have sub-national ETSs (along with the national ETS for China), and the resulting country-level shares of free allocation of allowances in total verified emissions are presented here.

Source: ERCST, based on data by OECD, Table 2.A.1. in OECD (2025).

In addition, there is a divergence in the share of emissions covered by the different ETSs.

The question then arises regarding how the systems compare when taking into account not only the visible carbon price (permit price) but also:

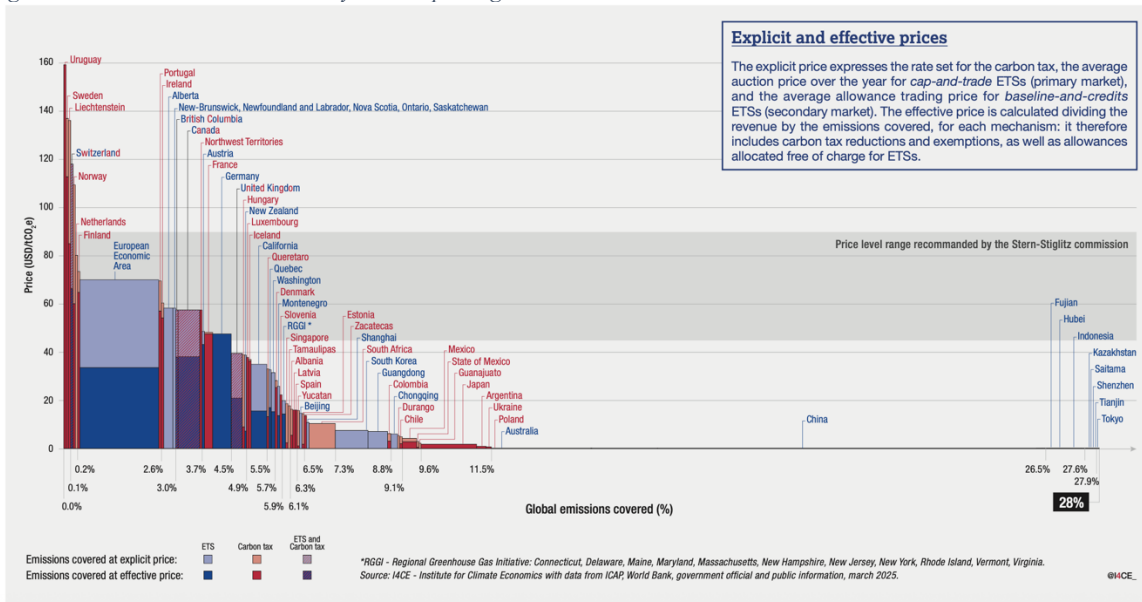
- free allocation of allowances or equivalent carbon leakage measures, but also
- the share of the economy-wide emissions priced through the carbon pricing system.

There are different ways of trying to compare the real “level of effort” inherent in different jurisdictions’ carbon pricing schemes and provide an estimate of the carbon costs incurred by firms or the effectively paid carbon price.

I4CE¹⁰ for example presents the percentage of global emissions covered by carbon pricing mechanisms, with the associated explicit and effective prices. The explicit price expresses the rate set for the carbon tax, the average auction price over the year for cap-and-trade ETSs (primary market), and the average allowance trading price for baseline-and-credits ETSs (secondary market). The effective price is calculated dividing the revenue by the emissions covered, for each mechanism: it therefore includes carbon tax reductions and exemptions, as well as allowances allocated free of charge for ETSs. This approach comes with the caveat that the specific definition of effective prices does not apply to baseline-and-credits ETSs (Canadian ETSs except Quebec, Australia, Tokyo and Saitama), since the revenue generated by this type of mechanism is not correlated with the number of allowances sold by the public authority.

¹⁰ I4CE (2025)

Figure 4 Global emissions covered by carbon pricing mechanisms in 2024



Note: This graph shows the percentage of global emissions covered by carbon pricing mechanisms, with the associated explicit and effective prices. For example, the California ETS alone covers 0.5% of global emissions at a primary market price of USD 35. However, considering the share of allowances allocated for free, the effective price is around USD 16. The notion of effective prices does not apply to baseline-and-credits ETSs (Canadian ETSs except Quebec, Australia, Tokyo and Saitama), since the revenue generated by this type of mechanism is not correlated with the number of allowances sold by the public authority. The Chinese national ETS alone covers nearly 15% of global emissions, yet the carbon price remains zero due to the continued absence of allowance auctions. For ease of reading, some histograms have been enlarged and are not perfectly at scale.

Source: p.6, IACE (2025)

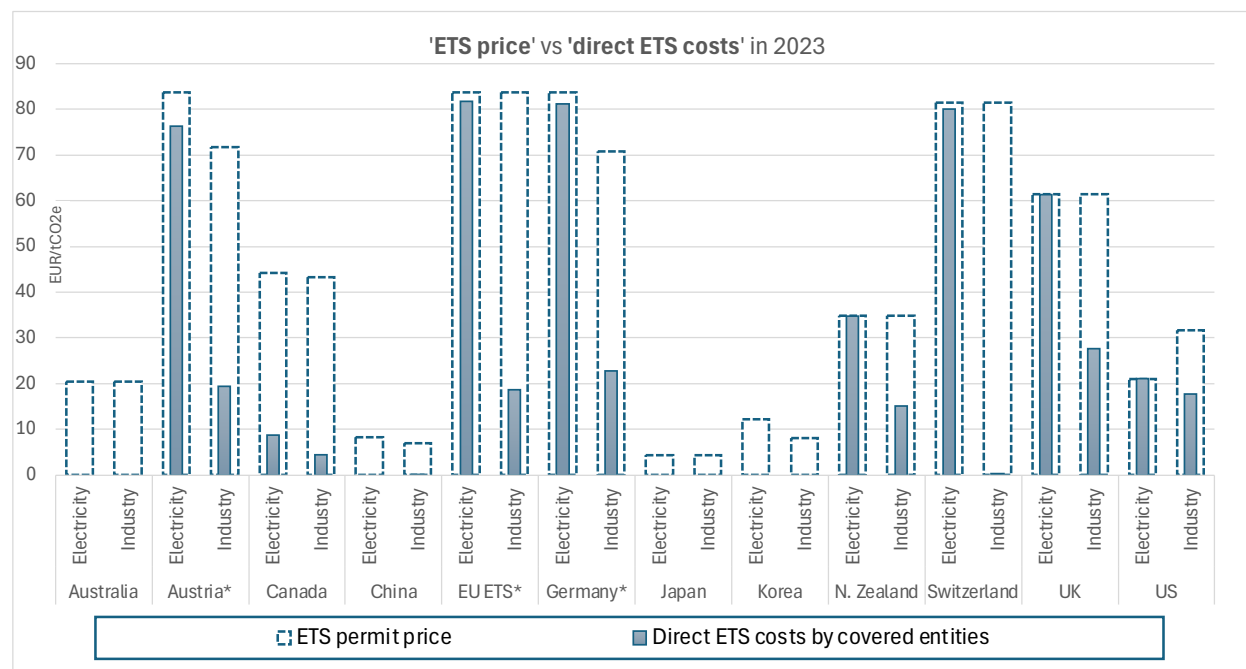
We use data by OECD¹¹ for a set of ETS systems in 12 countries or supranational jurisdictions, to depict in the following graph:

- ‘ETS permit price’, which is the respective system’s visible or explicit price.
- ‘ETS costs by covered entities’, which provides an estimate of the direct costs incurred by covered entities in the industry and electricity sectors, by adjusting for any free allocation of allowances¹².

¹¹ Table 2.A.1. in OECD (2025).

¹² $\text{Incurred carbon cost by covered entities} = [\text{ETS permit price} \times (1 - \text{share of free allowances})]$

Figure 5 'ETS price' vs 'direct costs incurred by covered entities', in 2023



Notes:

* The EU ETS is considered without Austria and Germany, which also have national ETSS. Austrian and German ETS coverage is meant as coverage by the EU ETS and national ETSS which cover transport and buildings that will be moved under EU ETS 2.

** Covered systems by country or jurisdiction:

- Australia: Safeguard Mechanism
- Austria: Austrian national ETS (NEHS) and EU ETS coverage
- Canada: Alberta Technology Innovation and Emissions Reduction (TIER) Regulation, Canada Federal Output-Based Pricing System (OBPS), New Brunswick Output-Based Pricing System, Newfoundland and Labrador Performance Standards System (PSS), Nova Scotia Output-Based Pricing System for Industry, Ontario Emissions Performance Standards (EPS), Québec Cap-and-Trade System, Saskatchewan Output-Based Performance Standards
- China: Chinese national ETS, the Chinese Pilot ETSS (Beijing, Chongqing, Fujian, Guangdong, Hubei, Shanghai, Shenzhen, Tianjin)
- EU ETS: considered without Austria and Germany, which also have their own national ETSS
- Germany: German national ETS (nEHS) and EU ETS coverage
- Japan: the Japanese subnational ETSS (Saitama Target Setting ETS and Tokyo Cap-and-Trade System)
- Korea: Korean Emissions Trading System
- New Zealand: New Zealand ETS
- Switzerland: Swiss ETS
- United Kingdom: UK ETS
- United States: all US subnational ETSS, i.e. California Cap-and-Trade, the Regional Greenhouse Gas Initiative (RGGI), Massachusetts Limits on Emissions from Electricity Generators, Washington Cap-and-Invest

Source: ERCST, based on data by OECD, Table 2.A.1. in OECD (2025).

From the above figure, the following observations can be drawn concerning 2023:

- The EU leads the way, in terms of highest 'ETS visible price', and 'incurred costs by covered entities'. The costs incurred by covered entities and at the sector level in industry are highest in those EU countries that implement both the EU ETS and also have in place national ETSS, namely Germany and Austria.

- A considerable number of systems imply zero or close to zero ‘*incurred costs by covered entities*’, namely Australia, China, Japan, Korea, but also Switzerland for the industrial sector.

2.3.3. The role of carbon price and carbon cost

Under the EU ETS, prices of EUAs and decarbonization costs may differ and play different roles that need to be highlighted:

- Costs resulting from complying with the EU ETS, direct and indirect, will impact the competitiveness of covered installations, and sectors overall.
 - EU ETS direct cost of compliance has been partially muted with free allocation, while indirect cost partially muted with state aid. Both direct and indirect costs expected to increase as free allocation declines, and price of EUAs increase and electrification increases, thus impacting (if temporarily) the competitiveness of EU industry.
 - Costs are fundamental to economic decision-making and determine the competitiveness of European industries in international markets. EU industries facing global competition may struggle if they are subject to higher costs than their counterparts in other countries.
- While EUA prices are impacted by the EUA scarcity, and ultimately by the cost of decarbonization, this is not a direct relationship as the overall cap provides the long-term visibility and market participants’ behaviour determines prices. This sends a decarbonisation signal but is not always predictable.
 - EUA prices not only to disincentivise carbon intensive approaches, but also incentivise the development and deployment of low carbon technologies. The two are not the same and at current levels the latter is not happening.
- High visible/explicit prices not to be confused with high costs (effective price) – aim for high visible prices but for costs that can be sustained by those that need to undertake decarbonization.

2.4. Reexamining the independence principle and implications of shifting from free allocation to auctioning of EU ETS allowances

While the European Commission increasingly frames full auctioning as the natural counterpart to CBAM, the two instruments address different channels of carbon leakage (including offshoring, marginal-cost-driven import substitution, and reshuffling along value chains) and therefore should coexist within a coherent policy mix rather than being treated as substitutes.

The Commission’s case hinges on an “independence principle”, namely that free allocation and auctioning provide equivalent investment incentives. Abstracting from leakage, a central result in the economic theory of cap-and-trade is that the initial allocation of allowances does not affect the equilibrium ETS price, provided the cap and the regulated sites are unchanged (Coase, 1960). This logic can be extended to low-carbon investment decisions. Under free allocation, the return to abatement comes from the ability to sell allowances freed up by lower emissions. Under auctioning, the return comes from the avoided cost of purchasing allowances. In short, abatement generates revenue under free allocation and avoided expenditure under auctioning; neither mechanism, in principle, increases the return on investment relative to the other.

Ex post empirical studies broadly support this independence principle in the EU ETS and other cap-and-trade systems (Ellerman & Reguant, 2008; Fowlie & Perloff, 2013; Eichhammer et al., 2018; Zaklan, 2023). These papers typically exploit within-sector variation in allocation rules, that are often linked to firm size

or location, to identify causal effects. Only one study (De Vivo & Marin, 2018) reports evidence against independence. Overall, the empirical literature provides no robust basis for claiming that auctioning is systematically preferable to free allocation with respect to regulated firms' decisions.

Importantly, independence relies on frictionless trading and the absence of market power. These no-friction conditions typically do not fully hold in the EU ETS. Transaction costs can deter small installations from active trading, leading them to rely more on their own free allowances and on-site abatement (Jaraite et al., 2011; Jaraite & Kažukauskė, 2015; Baudry et al., 2021). Because these frictions primarily affect smaller installations, their aggregate impact at the sector level appears limited (Zaklan, 2023). Yet the literature has not established that such transaction costs would disappear under full auctioning; similar frictions may apply to participation in auctions and secondary markets. We return to this point in chapter 4.

3. Carbon leakage measures in the EU and in other jurisdictions considering BCAs

3.1. Addressing (the risk of) carbon leakage in the EU

3.1.1. Evolution under the EU ETS

Free allocation, whereby allowances are allocated for free to compliance entities, has represented one of the main means through which the risk of carbon leakage has been addressed over the years in EU ETS. The role, method and volume of free allocation has evolved across phases, moving towards a gradual strengthening of the system.

In the first two phases (Phase 1 from 2005 to 2007 and Phase 2 from 2008 to 2012), allowances were allocated mostly for free. In this timeframe, free allowances were allocated through grandfathering, based on historical emissions. During Phase 1, auctioning was allowed for 5% of allowances, and in Phase 2 this limit was raised to 10%, although the European Commission reports that Member States only exercised this right marginally and only 4% was actually auctioned¹³. This “soft start” served the purpose of avoiding major economic disruption at a time when most industries were not ready to face the additional costs linked to carbon pricing. It also reflected the limited availability of reliable emissions data, therefore in the first phases a cautious and incremental approach was preferred.

During Phase 3, with the introduction of the benchmarking method, where free allowances were given based on efficiency standards per unit of output, auctioning became the default method for allocating allowances, marking a shift in the architecture of the EU ETS. In this phase, the power sector became the main contributor in terms of decarbonization, having moved to full auctioning with some limited exceptions¹⁴. At the same time, free allocation continued to play a significant role for other ETS participants, and during this period the percentage of free allocation rose to up to 50%.

The first half of Phase 4 (2021-2025) has seen auctioning as the main method of allocating allowances, indicating that free allocation is gradually declining. Auctioning limits are set at 57% of the cap, while the actual annual auction volume can vary, mostly due to Market Stability Reserve (MSR) adjustments. Overall,

¹³ p.28, European Commission (2015).

¹⁴ Such as the Article 10c derogation, which foresees a derogation of the 100% auctioning method for projects on the modernization of the energy sector in certain Member States

the approach in Phase 4 is a further consolidation of auctioning as the central allocation method, while narrowing the space for free allocation over time.¹⁵

Table 1 Free allocation under the EU ETS (2021-2025) [million allowances]

Year	2021	2022	2023	2024	2025	Total
Initial free allocation (EU27 + EFTA)	559.6	558.9	558.2	557.5	556.8	2791.1
Actual free allocation	545.7	542.4	537.0	499.7	494.8	2619.8
Adjusted and corrected free allocation	-13.9	-16.5	-21.2	-57.8	-62.0	-171.5

Source: Table 3 in European Commission, 2025, 'Report on the functioning of the European carbon market in 2024', COM(2025) 735 final

Free allocation by sector

To describe how free allocation is distributed, we divide the receiving sectors into two main groups: the energy sector and the industrial sector. This distinction is useful because the rationale and the policy treatment of free allocation differ across these parts of the ETS.

- **Energy sector:** Since the beginning of Phase 3 (2013), the generation of electricity is fully auctioned. However, Member States can appeal to the derogation (Article 10c), which provides a limited pathway for free allocation linked to modernization needs. In Phase 4, the Commission reported a total volume of 77,947,838 allowances under Article 10c¹⁶. This mechanism is therefore an exception whereas auctioning is otherwise the standard for electricity generation.
- **Industrial sector:** Free allocation is treated as a transitional measure to address the risk of carbon leakage. During Phase 3 (2013–2020), industrial sectors "less exposed" to the risk of carbon leakage (i.e. sectors not on the Carbon Leakage List) received a decreasing percentage of their benchmarked allocation for free, from 80% in 2013 down to 30% in 2020. On the other hand, sectors at risk of carbon leakage were included in the Carbon Leakage List, with the more exposed sectors getting up to 100% of free allocation of their benchmark.

In Phase 4 (2021-2030), the EU ETS tightened rules for free allocation to align with the "Fit for 55" target of a 62% emissions reduction by 2030. Benchmarks are reduced by a minimum of 0.2% (increased to 0.3% from 2026) and a maximum of 1.6% (increasing to 2.5% from 2026) per year (annual reduction rates). In addition, the benchmarking system has been reviewed to account for technological progress, by means of the being updated twice during Phase 4.

For sectors not on at risk of carbon leakage, free allocation is capped at 30% of the relevant benchmark for the period 2021-2026, with free allowances to be reduced linearly thereafter until they reach 0% by 2030.

A major shift in the second part of Phase 4 is the introduction of the Carbon Border Adjustment Mechanism (CBAM), which replaces free allowances for specific energy-intensive sectors (e.g.,

¹⁵ Source: European Commission (2025).

¹⁶ European Commission DG CLIMA webpage on 'Allocation to modernise the energy sector', https://climate.ec.europa.eu/eu-action/carbon-markets/eu-emissions-trading-system-eu-ets/free-allocation/allocation-modernise-energy-sector_en#:~:text=under%20Article%2010c,-Member%20States%27%20use%20of%20the%20derogation,allowances%20auctioned%20the%20normal%20way.

steel, cement, aluminum, fertilizers, hydrogen). While sectors at high risk of carbon leakage not covered by CBAM can continue receiving free allocation up to 100% of the benchmark, CBAM-covered sectors will see a gradual phase-out of free allocation by 2034. CBAM sectors accounted for 54% of free allocation in 2021–2025.¹⁷

The following table provides a summary of free allocation for industry in the two halves of Phase 4 of the EU ETS and beyond.

Table 2 Overview of free allocation for industry in the EU ETS, 2021-2034

Sector Category	2021–2025	2026–2030	2031–2034
Sectors not at risk of carbon leakage	30% of benchmark	Gradual decline (30% → 0%)	0%
Non-CBAM sectors at risk of carbon leakage	100% of benchmark	100% of benchmark	TBD (Phase 5)
CBAM sectors	100% of benchmark	Gradual decline (97.5% → 51.5%)	Hits 0% in 2034

Source: ERCST

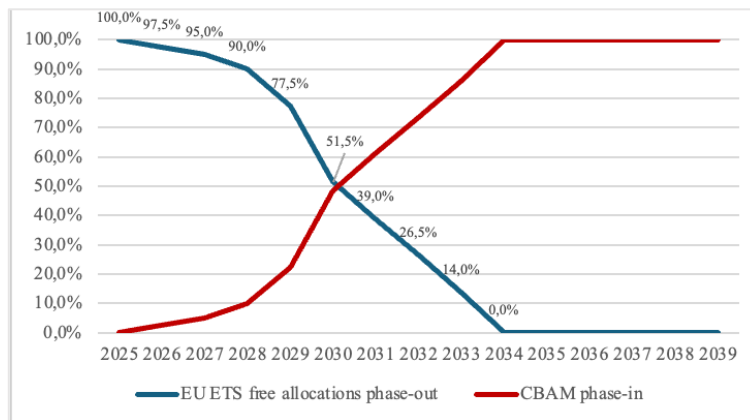
3.1.2. Interplay between Free Allocation and CBAM

The Carbon Border Adjustment Mechanism (CBAM) was introduced by the European Union as a core instrument to address carbon leakage, complementing and progressively substituting the role historically played by free allocation under the EU Emissions Trading System (EU ETS). CBAM seeks to mitigate the Carbon Leakage risk by imposing a carbon price on certain imports that mirrors, as closely as possible, the carbon cost faced by EU producers under the ETS. CBAM is not a tax but a certificate-based system, as it requires EU importers of certain emissions-intensive products to declare the CO₂ emitted during their production and to purchase and surrender CBAM certificates that correspond to those emissions.

From its inception, CBAM was designed to operate in parallel with the gradual phase-out of free allocation under the EU ETS. Rather than abruptly replacing free allocation, the mechanism follows a sequenced transition: while free allowances for EU producers are progressively reduced between 2026 and 2034, CBAM obligations on imports are phased in over the same period (Figure 6). This sequencing is intended to preserve a level playing field during the transition, ensuring that domestic producers and importers are exposed to comparable effective carbon costs as the policy mix evolves.

¹⁷ Source: ESMA (2025).

Figure 6 Free allocation phase out schedule for CBAM sectors (CBAM factor)¹⁸ and CBAM phase-in



Source: ERCST

When free allocation remains in place, CBAM obligations are explicitly adjusted to reflect the degree of protection still granted to EU producers. In practice, this means that importers are not immediately required to bear the full carbon cost associated with the embedded emissions of their products. Instead, they are required to surrender CBAM certificates only for the portion of emissions that would be effectively priced for EU producers after accounting for free allocation. This adjustment is a key design feature of CBAM, aimed at avoiding double protection, where both free allocation and CBAM would simultaneously shield EU producers from carbon costs, and at maintaining coherence between the two instruments.

Technically, this alignment is implemented through a benchmark-based adjustment that mirrors the free allocation methodology used in the EU ETS. While embedded emissions of imported goods are calculated on the basis of actual or default emissions, the CBAM obligation is reduced by an amount corresponding to the free allocation that EU producers would receive for the production of the same goods. Formally, before accounting for any carbon price already paid in the country of origin, emissions subject to CBAM can be expressed as¹⁹:

$$\text{Emissions subject to CBAM} = \text{Embedded emissions} - (\text{CBAM Benchmark} \times \text{CBAM Factor})$$

- **CBAM benchmarks** are defined by the European Commission and are derived from a combination of EU ETS product benchmarks. Because ETS benchmarks are defined for a limited number of production processes rather than for individual traded products, combinations are required to map ETS benchmarks onto the customs product categories (CN codes) covered by CBAM.
- **The CBAM factor** reflects the progressive reduction in free allocation under the EU ETS and declines over time, falling from close to full coverage in the early years of CBAM implementation to zero by 2034, when free allocation is fully phased out.

The CBAM factor for currently covered products, is as follows:

¹⁸ The phase-out of free allocation for sectors covered by the CBAM is taking place by applying a ‘CBAM factor’, which decreases gradually from 97.5% in 2026, to 51.5% in 2030 and down to 14% in 2033.

¹⁹ Source: European Commission (2024).

Table 3. CBAM factor for currently covered goods under the EU CBAM

2026	2027	2028	2029	2030	2031	2032	2033	2034
97.5%	95%	90%	77.5%	51.5%	39%	26.5%	14%	0%

Source: Article 10a of the EU ETS Directive (Directive (EU) 2023/959).

Box 1 Illustrative example of embedded emissions adjustment for free allocation

If the embedded emissions of a good amount to 1.2 t CO₂ eq/t and the corresponding CBAM benchmark is 1 t CO₂ eq/t good, then the emissions subject to CBAM in 2026 (with a CBAM factor of 97.5%) would amount to: $1.2 - 1 \times 0.975 = 0.225$ t CO₂ eq/t, equivalent to around **19%** of the embedded emissions²⁰ (substantially different from the 2.5% linear interpretation of the CBAM factor).

This design ensures that CBAM mirrors not only the carbon price signal of the ETS but also the temporal profile of carbon cost exposure faced by EU producers. Free allocation thus continues to function as a form of compliance cost relief during the transition, mitigating leakage risks and supporting competitiveness while firms invest in decarbonization. CBAM, by contrast, introduces an explicit carbon cost on imports, with the interaction between the two instruments shaping both the distribution and the timing of carbon costs across domestic and foreign producers.

At the same time, it is worth pointing out that CBAM does not fully replicate the broader leakage protection historically provided by free allocation. While CBAM addresses the risk associated with imports into the EU market, free allocation has also served to buffer EU producers competing in export markets and along complex value chains. As free allocation is scaled down, these dimensions of leakage risk are only partially addressed by CBAM, suggesting that additional or complementary measures may be required to ensure competitiveness and environmental effectiveness beyond the simple phase-out of free allocation and the corresponding adjustment of CBAM obligations.

3.2. Carbon leakage measures and allowance allocation methods in ETSs of other jurisdictions considering BCAs

This chapter provides a review of allowance allocation methods and carbon leakage measures more widely in ETSs and other carbon pricing mechanisms of other jurisdictions considering a Border Carbon Adjustment (BCA) mechanism. In addition, a comparison of carbon pricing systems internationally in terms of their effective carbon price levels is provided in chapter 2.3.

The review encompassed a desk research of national legislation, government reports and publications by recognised organisations (e.g. ICAP, IISD, World Bank), as well as bilateral exchanges/meetings with government officials or national experts²¹.

For each of the covered mechanisms/countries, the review examined three key questions:

²⁰ Source: European Commission (2024).

²¹ ERCST exchanges/meetings with the governments of New Zealand, United Kingdom, Australia, and South Korea, and national experts in Canada and the United States.

- 1) Type of carbon pricing mechanism / if an ETS, is it a cap and trade system?
- 2) Is there free allocation of allowances?
 - a. If yes, what is the trajectory of free allocation over time for the different ETS sectors? Is there a phase out or decrease over time?
- 3) Is the country considering the implementation of a BCA?
 - a. If yes, has it been considered how a potential BCA would impact the trajectory of free allocation of allowances?
 - b. Are there other measures under consideration to address the risk of carbon leakage?

This section provides an overview of the review findings, while detailed country reports are provided in Annex 1 - Country reports. The following table provides for each reviewed country an overview of their carbon pricing mechanisms (currently in place or under development), their inherent carbon leakage measures and how these have been or might be adjusted in the future with the introduction of a BCA.

Table 4 Overview of carbon pricing mechanisms, carbon leakage measures and their adjustment with the introduction of a BCA.

	Country	Carbon pricing mechanism type	Free allocation or other carbon leakage provisions	Adjustment of free allocation trajectory or other carbon leakage provisions with the introduction of a BCA
Countries with concrete BCA plans	United Kingdom	Cap & trade ETS UK CBAM legislated, to be introduced in January 2027	Free allocation	Nov. 2025 decision to gradually phase out free allocation for UK CBAM covered sectors between 2027-2035 (closely mirroring EU CBAM). Explored options during the legislative process: 1) No adjustment of free allocation; 2) Top-down free allocation adjustment to zero; 3) Top-down adjustment to non-zero (phase-down).
	Australia	Intensity-based baseline and credit ETS As part of 2026-27 review of Safeguard Mechanism (SM), the Government reviewing feasibility of a BCA that would likely initially cover cement and clinker; Political commitment in 2023 to work towards introducing a BCA	Facilities facing an elevated risk of carbon leakage can receive a slower annual baseline decline rate	Preliminary findings of Australia's <i>Carbon Leakage Review</i> , mentions three options of 1) removing; 2) gradually phasing out; or 3) retaining reduced baseline decline rates for sector covered by a BCA. The final <i>Carbon Leakage Review</i> report notes that implementation could be phased and could involve the removal of slower baseline decline rate provisions once a BCA is fully implemented. Notwithstanding, given that the SM is a baseline and credit ETS, a border carbon liability could be applied to emissions in exceedance of the baselines.
Countries with advanced discussions or political commitments to introduce BCAs	Canada	Federal-level: output-based carbon pricing system. Liberal Party BCA commitment in its election manifesto (2025). Govt. consultation on a BCA in 2021. Quebec: cap & trade ETS	Federal-level: carbon price due on emissions above sectoral standards. Quebec: free allocation, similar to EU ETS.	Federal-level: no provisions on whether there would be a rollback of sectoral standards in case of a BCA. This specific aspect was not part of the BCA design considerations in the 2021 government consultation on a BCA. Quebec: the interaction between Quebec's ETS and a potential BCA at the federal level is unclear and subject to speculation (no concrete/ proposed BCA design).
	Taiwan	In place: carbon fee (launched in 2025) Planned cap & trade ETS + CBAM:	Carbon fee: Lower carbon fee rates on industries at risk of carbon leakage Planned ETS: n/a	Given that both the national ETS and CBAM regulations are under development, it is not possible to foresee whether there will be free allocation and how a possible free allocation trajectory over time would be impacted by the introduction of a CBAM.

	Country	Carbon pricing mechanism type	Free allocation or other carbon leakage provisions	Adjustment of free allocation trajectory or other carbon leakage provisions with the introduction of a BCA
Countries exploring /researching the potential of a BCA		- Pilot ETS in 2026, - Full mandatory ETS in 2028 - Taiwan CBAM under development, with plans to implement it as of 2027.		
	Thailand	Planned carbon pricing framework according to Dec 2025 draft Climate Change Act: - carbon tax; - mandatory cap & trade ETS - Thai CBAM Full implementation of Thai ETS and CBAM foreseen in early 2030s.	Planned ETS: Free allocation (tbc)	Detailed ETS allocation rules and details of the Thai CBAM will be determined in the phase of secondary legislation drafting that is expected to follow the formal approval of the Climate Change Act by the Thai Senate.
	New Zealand	Cap & trade ETS Note: The cap limits the volume of net emitted emissions, without a limit on gross emissions (i.e. no limit on NZ allowances generated from removal activities). BCA broadly under consideration/ examined but not yet at a granular level of detail.	Free allocation to EITE sectors Planned phase out of FA by 2050 and 2060 for moderately and highly emissions intensive sectors respectively.	No concrete discussions on a BCA design incl. on how it might impact free allocation. Irrespective of the discussion on a potential BCA, the ongoing NZ ETS reform is expected to review and accelerate the phase out of free allocation to EITE sectors.
	South Korea	Cap & trade ETS	Free allocation	The Climate Ministry starts researching the introduction of a BCA, with a study launched in October 2025. No concrete discussions on a BCA design incl. on how it might impact free allocation.
	Türkiye	Planned: expected to be an intensity-based baseline and credit ETS. (Türkiye's ETS design and legislation still being developed).	Free allocation	Türkiye's Climate Law reference to potential establishment of a BCA; No concrete discussions on a BCA design incl. on how it might impact free allocation.

Source: ERCST based on sources indicated in detailed country reports (see Annex 1 - Country reports)

The countries have been grouped in three main categories in terms of the level of concreteness of their plans to introduce a BCA:

- Countries with concrete BCA plans
- Countries with advanced discussions or political commitments to introduce BCAs
- Countries exploring/researching the potential of a BCA

It bears noting that the above categories offer considerable scope for discretion, and given that the carbon pricing frameworks in several of the countries are still under development and evolving, the inclusion of a country in one category or the other entails a degree of subjectivity.

The situation in each country with respect to the potential introduction of a BCA and how this could impact free allocation of allowances or other carbon leakage protection measures are further discussed in the remainder of this chapter, while individual country reports setting out the full details are provided in Annex 1 - Country reports.

3.2.1. Countries with concrete BCA plans

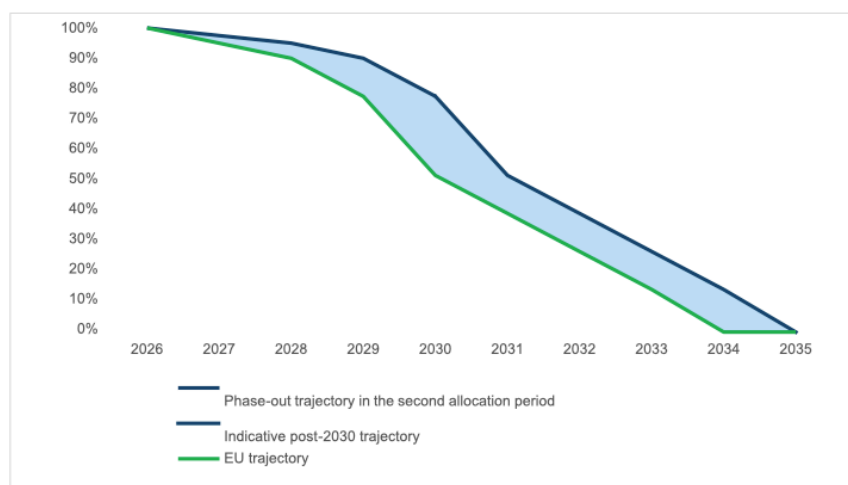
United Kingdom

The United Kingdom is the only country with an operational ETS similar to the EU ETS (cap & trade, free allocation) and concrete plans to introduce a BCA (UK CBAM as of January 2027).

With respect to the free allocation adjustment for UK CBAM sectors, the approach taken is:

- **Gradual free allocation phase out for CBAM sectors:** On 26 November 2025, the UK ETS Authority issued a decision for a gradual free allocation phase out for UK CBAM sectors between 2027-2035. The UK trajectory mirrors the EU one, deferred by a year to align with UK CBAM introduction.

Figure 7 Trajectory of the phase out of free allocation for sectors covered by the UK CBAM

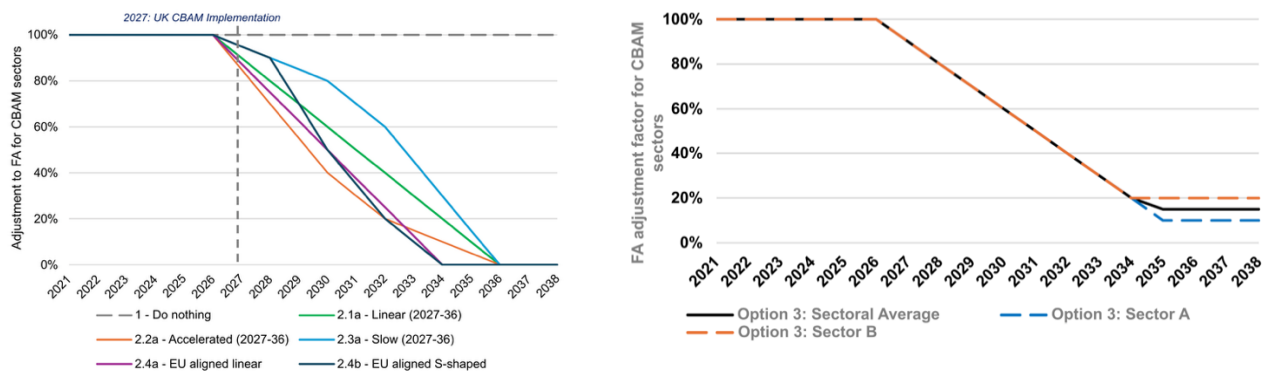


Source: figure 7 in UK ETS Authority (2025).

- **Explored options:** Earlier in the legislative process, the UK considered and assessed 3 main options:
 - 1) No adjustment of free allocation for CBAM sectors;
 - 2) Top-down free allocation adjustment to zero (phase out);
 - 3) Top-down adjustment to non-zero (phase-down).

The first two options are illustrated in the left hand side of the following graph, with phase out variations encompassing linear, accelerated or slow reduction rates. Option 3 (partial adjustment to non-zero /phase down) is illustrated in the right hand side of the following graph, with variations of this option in the level of Free Allocation received by different CBAM covered sectors. This variation in the level of Free Allocation received by CBAM sectors could, for example, be calibrated on their sectoral level carbon leakage risk.

Figure 8 Illustration of options 1 'no adjustment' & 2 'phase out' [left] and option 3 'phase down' [right]



Source: figures 3 and 7 in UK government (2024).

The above options were assessed qualitatively by the government against a set of criteria as shown in the table below. From this table, it can be inferred that the option of partial adjustment to non-zero, was found to potentially entail lower carbon leakage risks in the long-run compared to the other options, albeit it scored less well with respect to technical or legal feasibility.

Table 5 Qualitative assessment of Free Allocation Adjustment options for UK CBAM sectors

Criteria / Option	Do nothing – no adjustment to Free Allocation (FA)	Adjustment to zero (Linear / faster)	Adjustment to zero (slower or EU aligned, delayed)	Partial adjustment to non-zero
Carbon leakage mitigation	Continues comprehensive carbon leakage coverage for Energy Intensive sectors	Faster reduction of FA, a comprehensive carbon leakage mitigation, means leaving potential risk of CL through other channels (if unaddressed) in short run	Relative to fast adjustment, more gradual adjustment means more time for adjustment and lower carbon leakage risks in transitional period	In short run, similar to any adjustment, dependent on trajectory
Long-run carbon leakage mitigation	As above	Export carbon leakage is not covered as FA is adjusted to zero	Export carbon leakage is not covered as FA is adjusted to zero	Potentially lower carbon leakage risks in long-run, if feasible and accurate
Impact on ETS effectiveness	Doesn't actively lower FA (although FA may fall through other means): continues support for covered sectors but mutes price signal, lowering decarb incentive relative to adjustment and CBAM. Reduces effect of CBAM as Rate may remain near-zero	Compatible with broader ETS operation and FA rules. Increases decarbonisation signal through higher effective UK ETS prices initially	Compatible with broader ETS operation and FA rules. Slower adjustment means reduced decarbonisation signal relative to a faster adjustment	Compatible with ETS operation, but may reduce ETS effectiveness in long-run, and raise issues through the continuation of FA for CBAM sectors, through having two closely interacting carbon leakage policies indefinitely
Technical feasibility	Feasible for ETS in the short-run, as no direct adjustment to FA required, but in long-run requires ongoing FA adjustment for CBAM	Feasible to implement, through adjustment within FA methodology. Precise results to be developed	Feasible to implement, through adjustment within FA methodology. Precise results to be developed	Some difficulties in accurately and clearly deriving adjusted Carbon Leakage Indicator values – see Potential Implementation of Option 3
Affordability & fiscal impact	No difference in ETS revenue; implies zero/low CBAM revenues	Greatest impact to Government affordability and revenue through fewer FA allocated and greater CBAM revenues	Similar to any adjustment to zero; lower benefits relative to a faster adjustment due to slower CBAM effects and revenue	This option is likely affordable to Government, but raises lower revenues relative to a long-run adjustment to zero
Other impacts				Potential risk to consistency with World Trade Organisation Rules and other trade related obligations.

Green: significant benefits or no risk; Amber: potential benefits or minor risks; Red: significant costs or risks; White: NA

Source: Table 2, page 16 in UK government (2024).

In addition, the same analytical annex provides some quantitative evidence with respect to the potential export and downstream leakage risk:

- With respect to exports leakage, it notes that “*export intensity figures highlight the EU as the predominant export market for most CBAM goods, and suggests that a CBAM may improve UK competitiveness relative to competitors (with unpriced emissions) into this market. Nonetheless, ROW markets represent a significant destination for UK exporters for many CBAM goods, suggesting the competitiveness and/or leakage to these countries should be considered, although noting export leakage is complex and dependant on many factors*”.²²

²² Source: p. 19 in UK government (2024). Analytical Annex: Free Allocation for CBAM Sectors, December 2024, <https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review-carbon-leakage/analytical-annex-free-allocation-for-carbon-border-adjustment-mechanism-cbam-sectors-html>)

- With respect to downstream leakage, it acknowledges the challenge in quantifying it, noting that *“a similar channel for leakage could be identified for ‘downstream’ products [...]. [The] UK Government commissioned NERA to undertake an assessment of whether quantitative carbon leakage indicators for CBAM sectors could be constructed to quantify potential export and downstream leakage risk, using primarily public data and through a transparent methodology. [...] The analysis indicated that it is feasible to develop quantitative indicators for export intensity [...]. In contrast, the research found it is complex to build indicators which consistently capture potential downstream leakage risk for UK CBAM sectors with publicly available and transparent data. While further analysis and policy development could explore this, this initial study indicates that it may be difficult to reliably develop robust, clear indicators which comprehensively capture the remaining leakage risk in this scenario – in practice, such indicators may only be able to capture export leakage risk”*²³.

3.2.2. Countries with advanced discussions or political commitments to introduce BCAs

Countries with advanced discussions or political commitments to introduce BCAs, do not have cap and trade systems with free allocation similar to the EU.

Australia

The Australian government announced in summer 2023 that it would work towards introducing a BCA and launched a formal and independent Carbon Leakage Review as part of its carbon pricing tool (the Safeguard Mechanism) reform. With the government change in 2025, a decision is pending, however the introduction of a BCA is not unlikely given the new government’s strengthened mandate on climate. As part of the 2026-27 review of the Safeguard Mechanism, the government is reviewing the feasibility of a BCA that would likely include at its outset cement and clinker to prevent “carbon leakage”. A second tier of commodities - lime, hydrogen, ammonia and derivatives, steel and iron, and glass – have been identified as candidates for possible later inclusion.

- **Carbon pricing mechanism type:** Australia’s carbon pricing mechanism is an intensity-based baseline and credit ETS. Operators incur costs if they emit above a certain emissions-intensity baseline, and can sell emissions credits to other operators if they emit below the baseline.
- **Mechanism’s carbon leakage provisions:** the baseline is reduced at an annual rate of 4.9%, however facilities facing an elevated risk of carbon leakage can apply to receive a slower baseline reduction (equivalent of free allocations).
- **Changes to carbon leakage provisions with a BCA introduction:**
 - Such a border carbon liability would be applied to emissions in exceedance of the Safeguard Mechanism baselines.
 - A preliminary finding of the Carbon Leakage Review was that an Australian BCA on imports could be an appropriate measure to address carbon leakage. It notes that the *“reduced baseline decline rates for [facilities facing an elevated risk of carbon leakage] constrain the contribution of Safeguard Mechanism sectors to Australia’s overall emissions reduction efforts”*. According to the same preliminary findings, it would become feasible to remove or phase out the arrangements that reduce the baseline decline rates under the Safeguard Mechanism for trade-exposed sectors covered by a BCA. The review

²³ Source: p. 20 in UK government (2024).

also mentions the possibility of retaining the reduced baseline decline rates, however it notes that this would create complexity in determining the relevant BCA liability (this would also be the case when gradually phasing it out) and could raise international trade law concerns.

- Update: The Australian Government released the Carbon Leakage Review's final report in February 2026²⁴. The report notes that "implementation could be phased and could involve the removal of TEBA provisions for facilities once a border carbon adjustment is fully implemented", indicating a possible phase out of existing carbon leakage provisions. However, given that the SM is an intensity-based baseline and credit ETS, *"should a border carbon adjustment be pursued, a border carbon liability could be applied to emissions in exceedance of the Safeguard Mechanism baselines"*. As a next step, the government will consider the recommendations as part of the 2026-27 review of the Safeguard Mechanism.

Canada

In its election manifesto the Canadian Liberal Party that won the 2025 election, committed to develop a BCA. A consultation on the possibility of introducing a BCA was previously conducted in 2021.

- **Carbon pricing mechanism type:**
 - **Federal:** Canada's federal-level carbon pricing system is an output-based pricing system rather than an ETS like the EU's. Carbon prices are only due on emissions that are above the sectoral standards.
 - **Quebec,** on the other hand, implements a ETS in the context of the Western Climate Initiative (together with California, and possibly Washington State). The Cap and Trade system of Quebec mirrors almost entirely the EU ETS, with a cap, free allocation of allowances, a secondary market and a LRF.
- **Changes to carbon leakage provisions with a BCA introduction:**
 - **Federal:** Canada's regime does not have provisions on whether or not there would be a rollback of sectoral standards (the system's equivalent of free allocations) in case of a BCA. Similarly, this detailed technical aspect was not part of the BCA design considerations in the 2021 government consultation on the possibility of introducing a BCA.
 - **Quebec:** The current situation in regards of the interaction between ETS and BCA is unclear and subjected to speculation, as there is no concrete proposed BCA design and timeline on how the two would eventually interact. Based on discussion with experts in Canada, if the Canadian Federal Government would mandate lower performance standards in OBPS regimes, as a result of the 2026 Carbon Pricing Review, then Quebec would have to phase out some free allocation, mirroring what the EU is currently doing with FA under ETS. However, there is uncertainty on whether this option is allowed, as any fundamental change regarding Quebec ETS would have to be discussed with California as well, being linked markets.

Taiwan

Taiwan has introduced a carbon fee that imposes lower carbon rates on industries at risk of carbon leakage, and plans to transition to an ETS in the near future (mandatory ETS foreseen by 2028) that would cover installations in certain sectors with emissions (direct and indirect) in excess of 25,000 tonnes CO₂e/year.

²⁴ <https://www.dcccew.gov.au/about/news/carbon-leakage-review-final-report>

At the same time Taiwan is developing its own CBAM, with plans to implement it in 2027.

Given that both the national ETS and CBAM regulations are under development, it is not possible to foresee whether there would be a degree of free allocation and how this would be impacted by the introduction of a CBAM. The simultaneous rather than sequential development and introduction of the two instruments could mean that no other carbon leakage protection mechanism such as free allocation of allowances be introduced.

Thailand

In December 2025, Thailand's Cabinet approved the principles of the Climate Change Act, which provides the legal basis for implementing:

- 1) a carbon tax (that will allow Thai exporters to offset costs under the EU CBAM);
- 2) a mandatory cap & trade Emissions Trading System (Thai ETS), and
- 3) a cross-border carbon pricing mechanism (Thai CBAM).

Under the Thai ETS, allowances will be allocated through free allocation and/or auctioning, and the system will incorporate a mechanism for the progressive reduction of allowances in the system. The full implementation of the Thai ETS and introduction of the Thai CBAM is foreseen in the early 2030s. Detailed ETS allocation rules and details of the Thai CBAM will be determined in the phase of secondary legislation drafting that is expected to follow the formal approval of the Climate Change Act by the Thai Senate.

3.2.3. Countries exploring or researching the potential of a BCA

There are several countries exploring or beginning to research the potential of a BCA, including New Zealand, South Korea, and Türkiye.

New Zealand

There are two parallel ongoing developments in New Zealand:

- 1) Reform of NZ ETS and
- 2) consideration of introducing a BCA.

Irrespective of the discussion on a potential BCA, the NZ ETS reform is expected to review and accelerate the phase out for EITE sectors (current phase out by 2050 and 2060 for moderately and highly emissions intensive EITE sectors respectively). It is to be noted that the New Zealand ETS cap limits the volume of net emissions emitted by regulated entities, without imposing a limit on gross emissions (no limit on NZ allowances generated from removal activities).

South Korea

South Korea has in place a cap and trade ETS encompassing free allocation. The Climate Ministry starts researching the introduction of a BCA, with a study launched in October 2025.

Türkiye

Under Türkiye Climate Law, there is a provision for the potential establishment of a BCA in the future.

While Türkiye's ETS design and legislation is still being developed, there are no concrete discussions on the design details of a possible BCA and as such no details on how such a BCA would impact free allocation.

4. Free allocation versus full auctioning – modelling of two sectors

The previous sections highlight the growing importance of the interaction between CBAM, the phase-out of free allowances, and the competitiveness of European industry.

While these instruments are designed to mitigate carbon leakage, their combined effects on firms' production choices, cost structures, and market outcomes are complex and not fully captured by existing analytical approaches.

A key point is that CBAM and free allocation operate through different economic channels. CBAM primarily affects relative prices and trading conditions by narrowing the marginal cost gap between EU production subject to carbon pricing and imports that are (partly or fully) exempt. Free allocation, by contrast, primarily affects firms' inframarginal compliance costs²⁵, profitability, and balance-sheet constraints.

In that light, CBAM and free allocation can be seen more as naturally complements than substitutes in addressing leakage over the long run. CBAM corrects the marginal cost differential between EU production and imports. This holds even when verified embedded emissions for imports are adjusted to reflect the free allocation granted to EU producers: as long as the net embedded emissions remain positive, CBAM continues to affect marginal unit pricing and, therefore, the marginal competitiveness of imports. CBAM is thus compatible with free allocation, and their coexistence is explicitly provided for by Article 31 of the CBAM Regulation.

This complementarity is sometimes underplayed in European Commission communications, which increasingly present full auctioning as the natural counterpart to CBAM. In contrast, some trade partners explicitly emphasize the coexistence of CBAM and free allocation when describing how the border adjustment is computed.²⁶

Assessing the interaction between CBAM and free allocation requires a framework able to represent both marginal incentives and inframarginal cost relief, and to trace their implications along value chains. We have developed such a unified modeling framework for tracing how CBAM and free allocation affect firm behavior, market structure, and leakage, both at the border and along value chains (for more details about the modelling framework see Annex 2 – Modelling technical annex).

We then run the model for two value chains, namely steel and fertilizers.

4.1. Modelling framework's assumptions and scenarios

This section provides a description of the model's key assumptions and the analysed scenarios. More details about the modeling framework itself and its calibration for the two sectors is provided in Annex 2 – Modelling technical annex.

²⁵ Costs that firms incur regardless of whether they increase their output, emissions, or activity levels.

²⁶ For instance, this logic underpins the positions of the BASIC group (Brazil, South Africa, India and China) who have collectively criticised CBAM in multilateral climate fora as a unilateral measure that disregards common but differentiated responsibilities, pointing in part to the asymmetry between the costs borne by non-EU exporters and the relief granted to EU incumbents (BASIC group, 2023; China, 2024). In WTO Committee discussions, Turkey and other members have similarly requested clarification on how free allocation interacts with the computation of CBAM obligations (IETA, 2024).

4.1.1. Key assumptions

The modeling framework relies on several assumptions that allow us to focus on the mechanisms identified in the previous section, while maintaining a level of complexity compatible with the analysis.

1. Firms do not all pass carbon costs through to prices in the same way. The degree of pass-through depends on the price of the good²⁷. This matters because firms with different market positions react differently to carbon costs.²⁸
2. We model a full value chain rather than a single sector. We distinguish:
 - a. an **upstream sector**, which is covered by carbon pricing;
 - b. a **downstream sector**, which is not directly covered and uses the upstream good as an input.

This allows us to capture the different channels of carbon leakage.

3. Production technologies are assumed to be given. In other words, firms do not make investment decisions regarding decarbonization in the model. This assumption allows us to focus on the effects of public policy rules on costs, prices, and profitability, without introducing the dynamics of innovation or technological change.
4. The analysis is conducted within a partial equilibrium framework. The carbon market here is influenced by adjustments in the steel sector considered in the model, without attempting to represent all interactions with other sectors covered by the ETS. This implies that the observed price changes should be interpreted as sectoral outcomes, linked to the mechanisms studied.
5. Firms' heterogeneity is represented by distinguishing between production units that are more or less carbon-intensive. Whereas carbon intensity is constant at the site level, it is flexible at the sector level due to modifications in the market shares of carbon-efficient and carbon-intensive production sites.
6. Public policy rules are introduced in a stylized manner, distinguishing between the CBAM, which affects the conditions of competition between EU production and imports, and free allowances, which directly affect the costs borne by EU producers.
7. The distinction between short-term and long-term depends on the ability to adjust the number of production sites. In the short term, production structures are fixed, whereas in the longer term, entry and exit decisions allow for the capture of more structural effects on the sector's organization.

These assumptions are not intended to exhaustively reproduce the reality of the sectors studied, but rather to isolate the main channels through which the analyzed policies can affect competitiveness and the distribution of production.

We introduce a distinction between adjustment horizons: the short term and the long term. In the short term, the number of production sites is fixed so shifts happen essentially through prices, quantities and trade. In the longer term, firms may open or close production sites based on profitability. This distinction is important

²⁷ In the spirit of Klenow and Willis (2016)

²⁸ Note that in the model the EU-ETS is assumed to cover only the upstream sector. Changes in the carbon price are thus tightly linked to the marginal abatement cost of that sector.

for capturing the structural effects of the policy, in particular the reallocation of production towards more carbon-efficient units and the potential exit of less competitive units.

4.1.2. Policy scenarios

For both the sectors that we analyze, we compare two scenarios:

Scenario 1. CBAM + phase-out of free allocation (orange curves)

This represents the official policy path.

The CBAM factor decreases over time. This declining factor is used both:

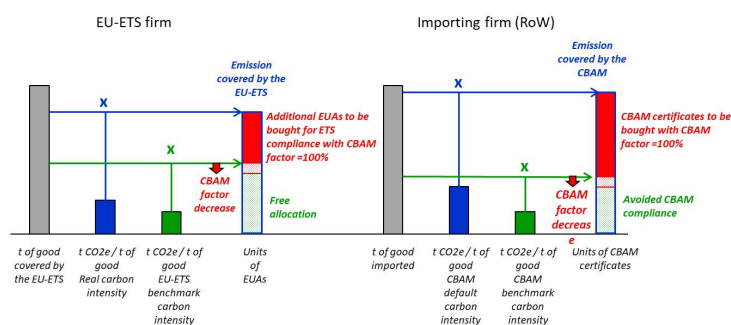
- to calculate the carbon content of imports;
- and to calculate the amount of free allocation under the EU ETS.

Scenario 2. CBAM + maintained free allocation (green curves)

In this alternative scenario, the CBAM factor still decreases for imports, but free allocation is not phased out.

Scenario 1 is illustrated by Figure 9. The difference between the two scenarios is therefore simple. In both cases, imports are subject to CBAM. Only in the official scenario do EU producers also lose free allocation over time.

Figure 9: Parallel between CBAM phase in and free allocation phase out in scenario 1



Source: Climate Economics Chair

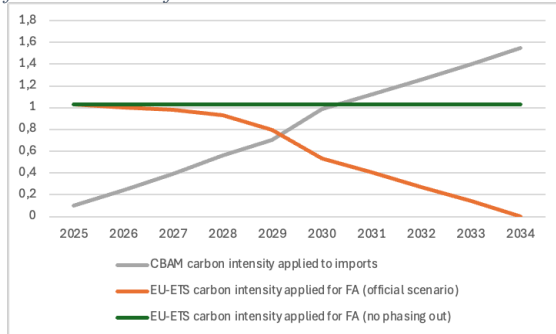
Maintaining these two scenarios follows a complementary logic: the second scenario facilitates the interpretation of the results by breaking down the effects, while the first allows for an assessment of their interaction within a more realistic framework. Comparing the two scenarios sheds light on the results presented in the following section, highlighting the differences between the specific effects of the CBAM program and those related to changes in free allowances.

In both cases, the simulations are conducted in coherence with the model's assumptions, particularly regarding short- and long-term adjustments. The model does not seek to represent all sectors covered by the ETS, but rather to isolate the mechanisms specific to the sector under study and their interaction with the public policy instruments considered.

The comparison between scenarios highlights the differences between the instruments' isolated and combined effects and sheds light on the mechanisms underlying the observed changes.

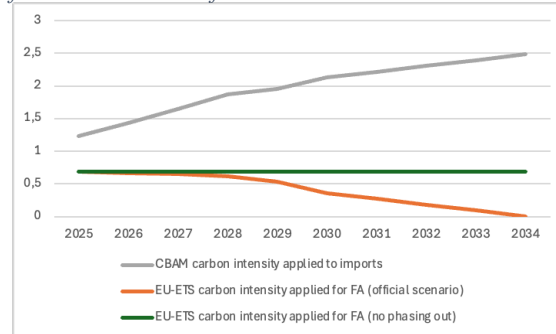
The difference between the two scenarios is illustrated by Figure 10 and Figure 11, which show the reference carbon intensity, i.e. the emissions per ton of product subject to CBAM and free allocation as the CBAM factor changes from year to year. For flat steel, it takes several years before the regulation considers emissions per ton of product subject to CBAM to be higher than the reference carbon intensity used for free allocation of allowances. In contrast, for AN fertilizers, this occurs as soon as the regulation is implemented²⁹.

Figure 10 Reference carbon intensities subject to CBAM and free allocation - flat steel



Units: *ton of CO2 equivalent per ton of flat steel (BF-BOF route)*
Source: Climate Economics Chair

Figure 11 Reference carbon intensities subject to CBAM and free allocation – AN fertiliser



Units: *ton of CO2 equivalent per ton of AN fertilizer*
Source: Climate Economics Chair

4.2. Results - Steel value chain

The model is calibrated for the steel value chain as follows:

- **flat steel production** is the upstream sector, more specifically the Blast Furnace – Basic Oxygen Furnace (BF-BOF) route;
- **automotive production** is the downstream sector.

The results presented in this section should be interpreted as relative variations around a calibrated reference point, not as absolute levels. The reported changes reflect sectoral effects linked to the model's scope. They are not intended to represent all adjustments within the ETS system, but rather to illustrate the mechanisms at work in the sector studied, consistent with the assumptions made.

We display trajectories associated with the progressive implementation of policies. This representation does not correspond to the complete dynamics of the system, but rather to a sequence of situations arising from varying levels of instrument application. The observed variations should therefore be interpreted as comparative effects between configurations.

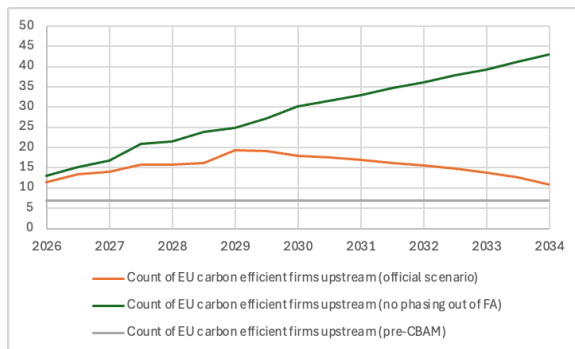
In the short term, when carbon costs affect only marginal production costs, we find that the independence principle holds. However, this no longer holds when we analyze the long-term effects, allowing for firm entry and exit. In this case, average carbon costs yield the most interesting outcomes, which we describe below.

²⁹ To mitigate the impact of the gap, the model accounts for the option for non-EU producers to comply with the EU Monitoring, Reporting, and Verification (MRV) process. In that way, carbon-efficient non-EU firms benefit from their actual carbon intensity, which is lower than the high CBAM default value.

4.2.1. Impact on production, imports and price of the upstream good (flat steel)

The following graphs denote the impact on upstream production sites, distinguishing between carbon efficient and carbon intensive sites.

Figure 12 Number of carbon-efficient upstream sites in the EU

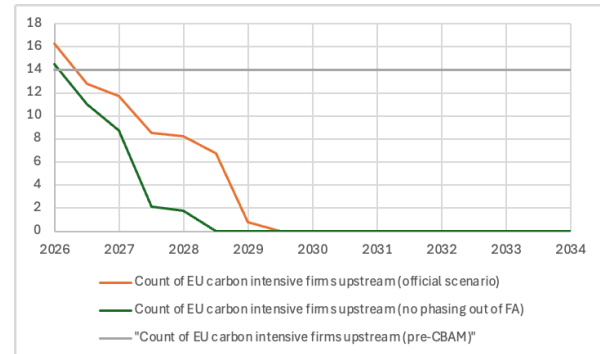


Units: count of operating sites

Legend: the number of efficient EU upstream sites increases sharply when CBAM is introduced, without phasing out free allocation. In the official scenario, the initial benefit is gradually offset, and the number of sites returns toward its initial level.

Source: Climate Economics Chair

Figure 13 Number of carbon-intensive upstream sites in the EU



Units: count of operating sites

Legend: the number of carbon-intensive upstream sites decreases in both scenarios. Maintaining free allocation delays closure, but does not prevent it.

Source: Climate Economics Chair

The biggest difference between the two scenarios concerns the most carbon-efficient upstream sites in the EU (Figure 12). When free allocation is maintained, these sites benefit strongly. Their production increases as they absorb, in part, the production of carbon-inefficient sites that are forced to close (“decarbonize or die” effect).

The reason is straightforward:

- CBAM improves the relative position of EU producers compared with foreign competitors;
- if free allocation is preserved, these efficient sites keep this competitive advantage without facing a rising carbon bill.

In the official scenario, the outcome is more mixed. Efficient sites still benefit from CBAM, but this effect is partly offset by the gradual loss of free allocation. Their number rises only moderately at first, then falls back toward the starting level.

This highlights two opposite forces:

- CBAM supports efficient EU sites;
- the phase-out of free allocation reduces their profitability.

On the other hand, the number of carbon-intensive sites decline in both scenarios, and the difference between the two scenarios is smaller (see Figure 13). Maintaining free allocation does not fundamentally change the long-run picture. It mainly delays closures. The same logic applies, to a lesser extent, in the downstream sector: keeping free allocation slows adjustment, but it does not reverse it. Therefore, the policy choice mainly affects the pace of adjustment, rather than the long-term outlook of the least efficient sites.

Despite these site-level adjustments, total EU production in the upstream sector increases in both scenarios (Figure 14). This effect shows that CBAM achieves one of its core objectives: strengthening EU production in the covered sector. The increase is stronger when free allocation is maintained. At the same time, net EU imports of the upstream product decrease, again more strongly when free allocation is not phased out (

Figure 15).³⁰

Figure 14 Total EU production of the upstream good

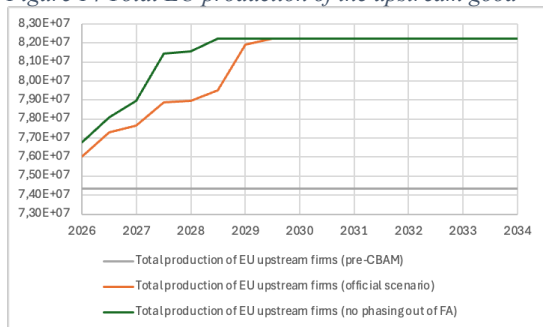


Figure 15 Net EU imports of the upstream good

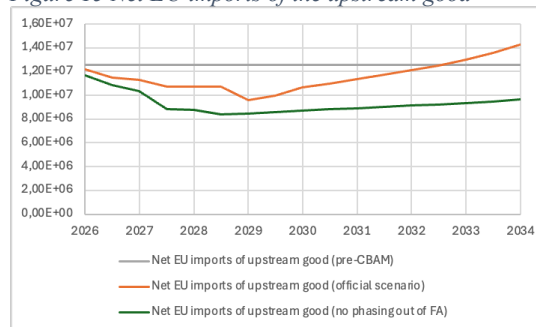
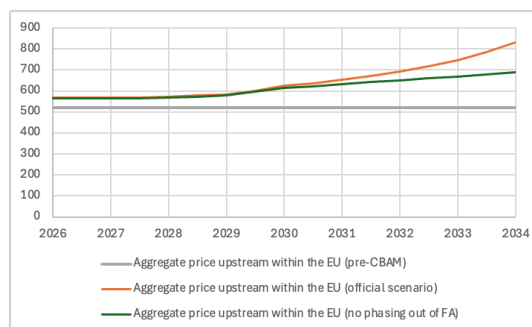


Figure 16 shows that the price of the upstream good rises in both scenarios. The increase is more significant when CBAM is combined with the phase-out of free allocation.

Figure 16 Price of the upstream good

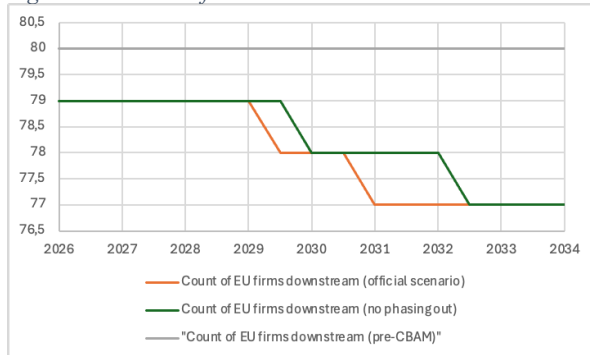


³⁰ The plateau corresponds to all production made by carbon efficient sites that can no longer increase their production due to their constant carbon intensity and the cap on their emissions.

4.2.2. Impact on production of the downstream good (automotive production)

One of the most important findings of the model is that the main downside appears in the downstream sector. The following two graphs denote the impact on the number of downstream production sites, as well as total production in the downstream sector.

Figure 17 Number of downstream sites in the EU

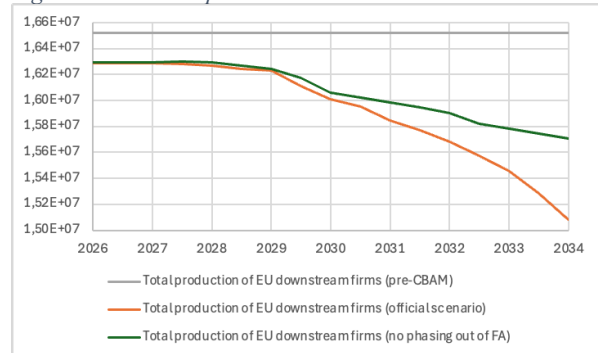


Units: count of operating sites

Legend: the downstream sector loses sites in both scenarios. Maintaining free allocation in the upstream sector mitigates this decline, but only partially.

Source: Climate Economics Chair

Figure 18 Total EU production in the downstream sector



Units: number of passenger vehicles

Legend: in both scenarios, downstream EU production decreases. This reflects the higher cost of the upstream input.

Source: Climate Economics Chair

Whether or not free allocation is phased out, stronger EU production in the upstream sector comes with weaker EU production in the downstream sector. The reason is intuitive. The upstream good becomes more expensive, and the downstream sector uses this good as an input. As input costs rise, downstream production in the EU becomes less competitive.

This leads to:

- lower EU downstream production;
- higher net imports of downstream products.

In other words, CBAM helps reduce leakage in the upstream sector, but part of the problem reappears in the downstream sector through higher input costs.

Maintaining free allocation reduces the downstream damage, but does not eliminate it. If free allocation is maintained, more efficient upstream sites remain active in the EU. Competition within the upstream sector is stronger, market power is lower, and the price increase of the upstream product is smaller. This effect helps the downstream sector.

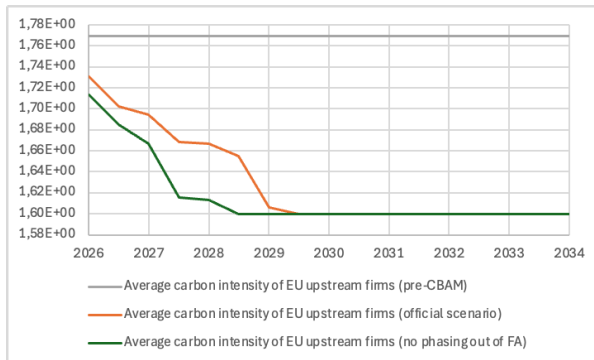
But the relief is only partial. Downstream firms still face higher input prices than before CBAM, and downstream production continues to decline relative to the pre-CBAM situation. So, maintaining free allocation softens the trade-off.

4.2.3. Impact on carbon intensity

The following two figures denote the impact on carbon intensity of upstream (flat steel) production in the EU, as well as outside the EU.

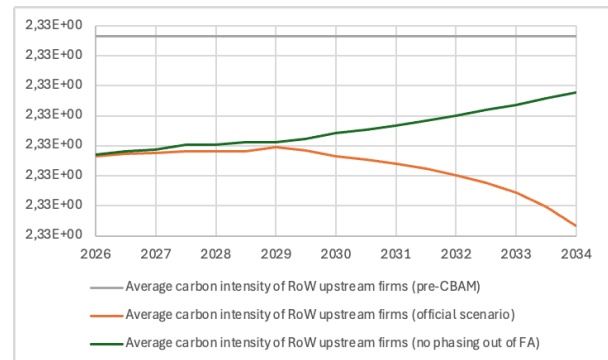
In the EU, the average carbon intensity drops in both scenarios. This reduction is larger when free allocation remains, as cleaner sites expand more (Figure 19).

Figure 19 Average carbon intensity of EU upstream production



Units: tons of CO₂ equivalent per ton of flat steel
 Legend: average carbon intensity drops in both scenarios.
 This reduction is larger when free allocation remains, as cleaner sites expand more.
 Source: Climate Economics Chair

Figure 20 Average carbon intensity of non-EU upstream production



Units: tons of CO₂ equivalent per ton of flat steel
 Legend: CBAM reduces the average carbon intensity of non-EU production as foreign companies relocate output to cleaner locations to remain competitive in the EU market.
 Source: Climate Economics Chair

In addition, the model points to an important external effect: CBAM lowers carbon intensity outside the EU (Figure 20). CBAM not only promotes cleaner production within the EU but also encourages non-EU producers to shift output toward their cleaner facilities to stay competitive in the EU market. As a result, the average carbon intensity of non-EU upstream production decreases. This effect is less pronounced when free allocation continues but is still observable. Therefore, the environmental impact of CBAM extends beyond Europe, as the mechanism also incentivizes cleaner production abroad.

4.3. Results – Fertilizers

The model is calibrated for the fertilizers value chain as follows:

- **AN fertilizers production** is the upstream sector, with vertically integrated production being the reference, non-integrated production is also considered without explicitly separating the ammonia production step;
- **agricultural production** is the downstream sector, more specifically staple grain production that heavily relies on AN fertilizers in Europe.

The specifics of the AN-fertilizers staple grain value chain are that the downstream sector comprises many agricultural firms that compete fiercely and have limited product differentiation. By the way, the fertilizers' value chain is almost completely overlooked by the CBAM literature, with just a few recent contributions that highlight the EU costs of the mechanism (Crispi et al., 2026; Fournier Gabriel et al. 2024).

Rather than considering an unrealistic monopolistic-competition framework, we thus assume that the sector operates under pure and perfect competition. We model a decrease in demand for AN fertilizers among EU

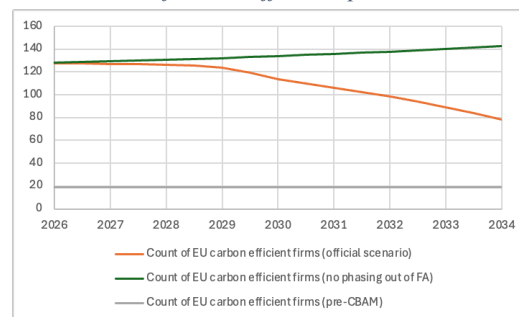
staple grain producers³¹. Finally, we illustrate the downstream impact through changes in both its production value (assuming the price of staple grain is set on global markets and is not sensitive to the CBAM regulation) and its revenue (its production value net of AN fertilizer costs).

Precautions similar to those mentioned for the flat steel value chain also apply to the AN fertilizers value chain. Results have to be treated as indicative of changes relative to the pre-CBAM period, not as forecasts.

4.3.1. Impact on production, imports and price of the upstream good (AN fertilizers)

The EU CBAM is expected to significantly expand the number of less carbon-intensive sites within the EU. In contrast, more carbon-intensive sites are entirely excluded from the EU, whereas they accounted for the majority in the pre-CBAM period (around 90 sites). Because their exit occurs regardless of the CBAM factor applied, we do not report the corresponding graph. With a parallel phasing out of free allocation that counteracts increased price competitiveness, the CBAM nevertheless reduces the profitability of even the most efficient sites, so that in 2034 the total number of sites is lower (80) than in the pre-CBAM period (109). Without the phase-out of free allocation of allowances, the total number of sites is roughly one third higher than in the pre-CBAM period.

Figure 21 Number of carbon-efficient upstream sites in the EU



Units: count of operating sites

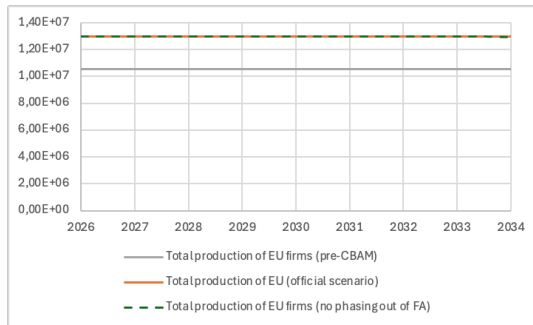
Legend: the number of efficient EU upstream sites drastically increases when CBAM is introduced, without phasing out free allocation. In the official scenario, the initial benefit is gradually offset, but the number of sites remains much higher than its initial level.

Source: Climate Economics Chair

These results are qualitatively consistent with those obtained for flat steel but are quantitatively more pronounced. In the case of AN fertilizers, more specifically the CBAM regulation abruptly levels the playing field and favours carbon-efficient sites. It not only results in the total exit of other production sites from the EU market but also in the ousting of imported AN fertilizers. Indeed, the most carbon-efficient non-EU producers remain more carbon-intensive than EU producers and cannot compete with them in the EU market, even when opting for a voluntary MRV process for their emissions. Some imports remain when the CBAM is not combined with the phase-out of free allocation because the size of the EU markets is larger compared to when the CBAM is coupled with the auction of allowances.

³¹ The demand is calibrated to observed pre-CBAM consumption of AN fertilizers in Europe and to estimates of price elasticity available in academic studies or institutional reports. This price elasticity is small, reflecting the staple grain sector's high dependence on AN fertilizers. To magnify the impact of the CBAM regulation on the downstream sector, we rely on the highest-magnitude elasticity estimate (-0.5%), though it remains low compared to other products. In addition, we use a linear demand function to allow the magnitude of the elasticity to increase as the price of AN fertilizers in the EU rises.

Figure 22 Total EU production of the upstream good

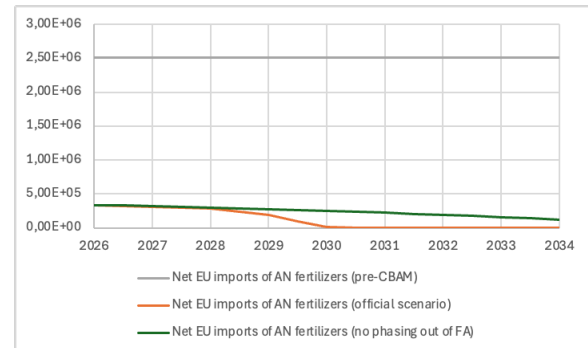


Units: tons of AN fertilizers

Legend: CBAM adds about 20% to total EU upstream production in both scenarios. The total production does not vary because production is entirely by carbon efficient firms, their carbon intensity is fixed, so that the cap on emissions is also a cap on production

Source: Climate Economics Chair

Figure 23 Net EU imports of the upstream good



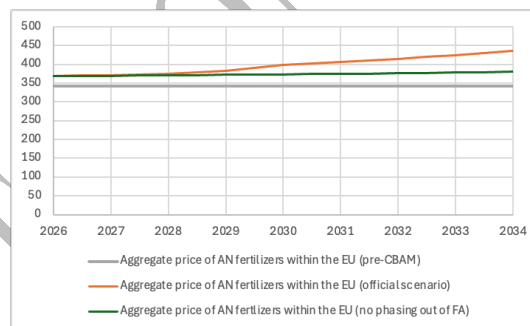
Units: tons of AN fertilizers

Legend: net imports of the upstream product are sharply cut off in both scenarios, especially when CBAM is combined with the phase-out of free allocation which makes net imports fall to zero from 2030 onwards.

Source: Climate Economics Chair

Figure 24 shows that the regulation has an inflationary impact on upstream prices in both scenarios. The increase is nevertheless one shot when free allocation of allowances is maintained, whereas it accelerates as the CBAM factor decreases when CBAM is combined with the phase-out of free allocation. In conjunction with the dynamics of the total number of production sites highlighted in Figure 21, this leads to significant differences between the two scenarios with regard to the downstream sector.

Figure 24 Price of the upstream good



Units: constant 2026 Euros per ton of AN fertilizer

Source: Climate Economics Chair

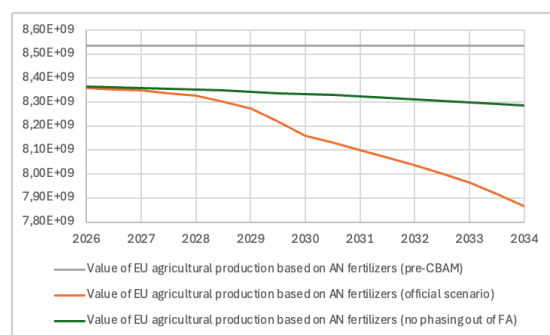
4.3.2. Impact on production of the downstream good (staple grain)

Consistent with the main drawback effect observed in the downstream sector of the flat steel – automotive industry value chain, the model also highlights a decrease in the production level of the EU downstream sector in the AN fertilizers – staple grains value chain. Because the price of staple grains is assumed to be set on global markets independently of European regulation, the decrease is reflected in both value and volume. Note also that the assumption of a fixed staple grain price on global markets means that any decrease in staple grain production by EU farmers is exactly offset by an equivalent increase in consumption of non-EU staple grains, including by final EU consumers.

Without the phase-out of free allocation, the decrease is limited to 2,5% of the pre-CBAM production. The relatively low price elasticity of demand for AN fertilizers among EU producers of staple grains also explains the limited impact. Coupling CBAM with the phase-out of free allowances results in a larger drop in downstream production, amounting to 7,5% of pre-CBAM production at the end of the period, as the CBAM factor progressively reaches zero.

The main factor explaining the difference between the two scenarios is the much larger total number of production sites under free allocation of allowances (see Figure 25). This helps maintain significant competitive pressure in the EU upstream sector despite the ousting of foreign producers from the EU market. This is confirmed by the lower inflationary impact on the aggregate price of AN fertilizers in the EU market, as already stressed in Figure 24.

Figure 25 Value of the production of staple grains in the EU

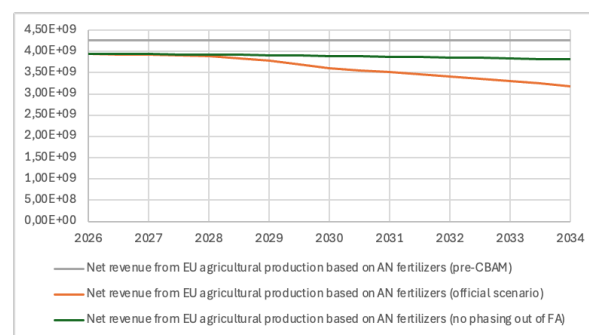


Units: constant 2026 Euros

Legend: the downstream sector value of production drops in both scenarios. Maintaining free allocation in the upstream sector dampens this decline, more specifically for latter years associated with a low CBAM factor.

Source: Climate Economics Chair

Figure 26 Revenue from the production of staple grains in the EU



Units: constant 2026 Euros

Legend: in both scenarios, revenue in the downstream EU sector decreases. This reflects both the decrease in production due to a lower use of AN fertilizers and the higher cost of that upstream input.

Source: Climate Economics Chair

Nevertheless, the impact on the revenues of EU farmers producing staple grains is more pronounced because it compounds the decrease in production value with the increase in input costs. The decrease in these revenues amounts to roughly 11% compared to the pre-CBAM period when the free allocation of allowances was not phased out for the upstream sector. It amounts to roughly 25% when phasing out the free allocation in parallel to the CBAM implementation. While not entirely avoiding the detrimental effect on the downstream sector, maintaining free allocation mitigates it (see Figure 26).

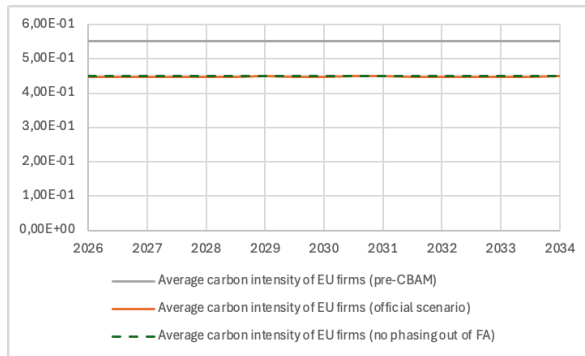
4.3.3. Impact on carbon intensity

As all carbon-intensive sites within the EU close due to the CBAM implementation in both scenarios, the outcome regarding carbon intensity is straightforward. Carbon intensity within the EU falls to a low, constant level of carbon efficient producers.

The impact on the carbon intensity of non-EU producers is the sole outcome of the model that qualitatively departs from the one observed for the flat-steel automotive industry. The impact remains downward, but it weakens if the CBAM factor is reduced year by year, and the gap compared to the pre-CBAM period narrows when free allocation is phased out in parallel. This is because carbon-efficient non-EU producers

that are displaced from the EU market reroute their production to foreign markets, thereby eroding the market shares of their carbon-intensive non-EU competitors. The contrasting impacts of the two scenarios mirror the EU's net imports of AN fertilizers (see Figures 27 and 28).

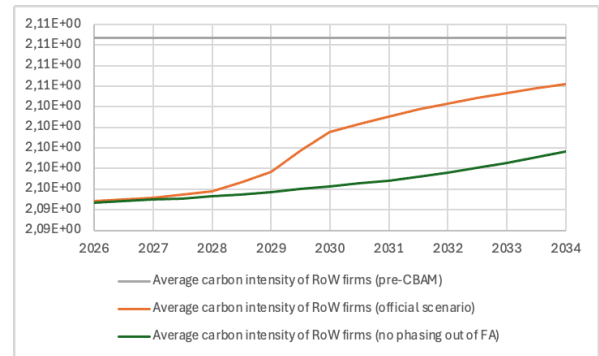
Figure 27 Average carbon intensity of EU upstream production



Units: tons of CO₂ equivalent per ton of AN fertilizer
 Legend: average carbon intensity drops in both scenarios to the same constant level. This is because only carbon-efficient sites produce and their carbon intensity is constant.

Source: Climate Economics Chair

Figure 28 Average carbon intensity of non-EU upstream production



Units: tons of CO₂ equivalent per ton of AN fertilizer
 Legend: CBAM reduces the average carbon intensity of non-EU production as foreign carbon-efficient companies reroute their production to the foreign market and take market shares from carbon-intensive firms.

Source: Climate Economics Chair

5. Takeaways: Carbon leakage under CBAM and free allocation

The current debate centers on the effectiveness and legal integrity of a new carbon leakage regime:

- Stakeholders are asking whether CBAM can truly provide a "watertight" protection against carbon leakage?
- Do CBAM and free allocation serve the same purpose?
- What are the tangible economic impacts as CBAM replaces the long-standing system of free allocations?
- A key point of contention is whether CBAM and free allocation can or should coexist, or if such an overlap would constitute an unfair "double protection."

This study has strived to address these issues and has combined desk research, with stakeholder consultations and used modeling of the impacts of the combinations of free allocation and CBAM on two sectors to try and answer the questions.

It is clear that carbon leakage and the preservation of industrial competitiveness have remained a central preoccupation for policymakers and industrial stakeholders alike. The approach in the EU to mitigating the risk of carbon leakage and safeguard domestic production by emissions intensive and trade exposed sectors has undergone a significant transformation: from grandfathering based on historical emissions, to the transition toward performance-based benchmarks, and finally to the implementation of the EU CBAM (section 3.1.1). These measures were never static; rather, they represent an evolution designed to address specific pressures and climate goals under certain circumstances at various stages.

This policy shift reflects the initial vision and expectation of an evolving global climate policy outlook, involving linked carbon markets and a global carbon price. However, in hindsight, this perspective was overly optimistic.

With the continued asymmetry in climate policies and carbon pricing globally, the risk of industrial offshoring is becoming an even greater preoccupation for the EU. The EU leads the way in terms of having the highest 'ETS visible price', but also in terms of highest 'incurred carbon costs' by covered entities, with most systems in other jurisdictions relying heavily on free allocation or equivalent measures that imply zero or close to zero carbon costs for the industrial sector (see Figure 5, section 2.3.2).

As domestic carbon prices and most importantly costs escalate, the risk of carbon leakage is no longer theoretical. Recent empirical studies have begun to provide the first concrete evidence of material carbon leakage (see section 2.2).

The EU is not alone in grappling with these challenges, and the report briefly examines how other jurisdictions that are implementing or planning BCAs are responding (see section 3.2). Notable is the case of the UK, a country with an operational ETS similar to the EU ETS and concrete CBAM plans. With respect to the free allocation adjustment for UK CBAM sectors, the decided approach is a gradual phase-out that mirrors the EU approach and enables the prospect of future system linking. During the legislative process, additional options were explored that involved retaining free allocation to some degree. The option of phasing-down free allocation to non-zero was qualitatively assessed to entail lower carbon leakage risks in the long-run compared to the other options, albeit it scored less well with respect to technical or legal feasibility (see section 3.2.1).

These international developments raise critical questions about the long-term sustainability of current solutions. We must ask whether mechanisms like CBAM are permanent fixes or simply a way of "kicking the can down the road". Unless a definitive solution is offered, a point will eventually be reached where this approach is no longer viable.

Effective decarbonization under the EU ETS requires a distinction between the market price of allowances and the actual carbon costs borne by industry. High visible (explicit) EUA prices are a necessary market signal to drive decarbonisation investments. Costs are fundamental to economic decision-making and determine the competitiveness of EU industries. To incentivise decarbonisation while preventing deindustrialisation, policy should aim for a high explicit price, while ensuring that the effective cost remains sustainable for companies currently undergoing transition rather than erode their profitability.

In order to analyze whether CBAM and free allocation are complementary or substitutes, and whether they address different avenues of leakage, the report presents technical insights derived from two distinct modeling scenarios aimed at testing different approaches to carbon leakage: a scenario representing CBAM with the phase out of free allocation (current policy configuration), and a scenario assuming the continuation of free allocation alongside CBAM. These simulations focus specifically on high-stakes sectors like steel and fertilizers, providing insights into how the transition from free allocation to CBAM affects key performance indicators.

By examining the modeling results, we gain a clearer understanding of the potential for leakage in a post-free-allocation environment and the overall resilience of the European industrial base during this transition. The following insights are drawn:

- CBAM can both protect and decarbonize EU upstream production. However, when CBAM is combined with the phase-out of free allocation, the adjustment becomes more concentrated, more inflationary, and more costly for downstream industries. Maintaining free allocation does not remove this trade-off, but it substantially attenuates it.
- CBAM achieves its primary objective in the covered upstream sector (flat steel): strengthening EU production and reducing reliance on imports. It also drives decarbonization both inside and outside the EU: In the EU, the average carbon intensity of upstream production drops in both scenarios, and this reduction is larger when free allocation remains, as cleaner sites expand more. The average carbon intensity of upstream production outside the EU also decreases, as foreign suppliers respond by reallocating shipments to more efficient facilities to remain competitive in the EU market.
- However, with CBAM as currently designed early gains for carbon efficient EU firms upstream are eventually offset by the financial strain of losing free permits and rising compliance carbon costs that erode their profitability. In contrast, when maintaining free allocation efficient firms thrive long-term while gaining market share from closing inefficient sites.
- A main drawback is the impact on downstream activities (automotive). Regardless of the free allocation regime, higher upstream input prices erode the competitiveness of EU downstream production, leading to lower domestic output and higher net imports of finished goods.
- The official phase-out scenario amplifies these effects. By 2030, the effective carbon cost rises sharply, exceeding pre-CBAM levels, which accelerates the exit of carbon-intensive upstream sites. This exit increases production concentration and strengthens market power among the remaining upstream producers, pushing upstream prices further upward and intensifying inflationary pressures for downstream sectors. By contrast, maintaining free allocation softens the trade-off: it allows carbon-efficient EU sites to expand more strongly, preserves competitive pressure among upstream

producers, keeps upstream prices lower, and reduces the overall cost burden transmitted to downstream firms.

- In short, CBAM protects the covered upstream sector, but pairing it with a rapid phase-out of free allocation concentrates and increases the cost of the broader value-chain adjustment. Keeping free allocation does not eliminate downstream challenges, but it makes the transition significantly less disruptive. A more net-zero-consistent alternative would be to extend the border adjustment to indirect emissions from downstream imports (embedded emissions in intermediate inputs) or to impose an EU-wide carbon footprint standard as a condition for marketing downstream goods in the EU.
- In the case of fertilizers, the analysis shows that maintaining free allocation alongside CBAM keeps more EU production sites open and limits upstream price increases, but at the cost of a structurally less competitive EU market. When free allocation is phased out as planned, the total number of EU production sites falls below pre-CBAM levels by 2034. The sequencing and pace of the free allocation phase-out is as consequential as the CBAM itself, and policymakers must explicitly manage the trade-off between decarbonization ambition and supply-side concentration risk in the EU fertilizer market.
- EU farmers producing staple grains face revenue losses of 11% to 25%, depending on the scenario, due to a compound effect of lower production volumes and higher input costs. Because staple grain prices are set on global markets, EU farmers cannot pass these costs through to consumers. This is a significant distributional consequence of CBAM that would require specific compensation mechanisms not included in the current regulatory framework.

Takeaways:

The policy takeaways from this study can be summarized in a few points:

1. What CBAM helps achieve:

- It supports EU production in the covered sector.
- It reduces import dependence in that sector.
- It encourages cleaner production both inside and outside the EU.

2. What remains difficult:

- Rising carbon costs erode the profitability of carbon efficient EU firms upstream:
 - The financial strain from the phase out of free allocation eventually offsets any early gains for carbon efficient EU firms.
 - In contrast, when free allocation is maintained carbon efficient firms thrive long-term as they gain market share from closing inefficient sites.
- It increases costs for downstream sectors.
 - It shifts part of the competitiveness problem from the upstream sector to the downstream sector.
 - This effect is stronger when free allocation is phased out at the same time.

3. When CBAM is combined with maintaining free allocation:

- It makes the adjustment less severe for the upstream sector.
- It reduces the inflationary effect on the upstream product.

- It contains the negative impact on downstream industries, but does not reverse it.
- It leads to a comparable or greater reduction in the EU average carbon intensity, as cleaner sites expand more.

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Annex 1 - Country reports

A.1.a. United Kingdom

1) Is the ETS a cap and trade system?

The UK ETS has been in place since 1 January 2021, replacing the UK's participation in the EU ETS. It is a cap and trade system that closely mirrors the EU ETS in terms of sectoral coverage, rules for auctioning, free allocation of allowances, and the ban on using international credits for compliance. The system currently covers the heavy industry, power and aviation sectors – approximately 25% of UK territorial emissions³². It is the intention of the Authority to expand the coverage of the scheme³³, with the scheme expected to cover maritime transport as of 2026³⁴, waste incineration and energy from waste as of 2028³⁵, as well as to integrate greenhouse gas removals (GGRs) from 2029³⁶.

UK ETS Phase I (2021-2030)

The Greenhouse Gas Emissions Trading Scheme Order 2020³⁷ currently provides for the UK ETS to operate during the current trading period that started on 1 January 2021 and will end on 31 December 2030 (UK ETS Phase I).

A cap limits the total emissions allowed in the system, and was initially set at 5% below the UK's notional share of the EU ETS cap for its fourth phase. There were initially two allocation periods in Phase I. The cumulative caps for the first and second allocation periods were originally 736 MtCO₂e and 630 MtCO₂e, respectively. However, these were reduced following a 2022 consultation on reforming the UK ETS, which included aligning the cap trajectory with the UK's net-zero emissions target, as follows:

- First allocation period (2021 to 2025): 633 MtCO₂e, to be adjusted to reflect the hospital and small emitter opt-outs.
- Second allocation period (2026 to 2030)*: 303 MtCO₂e, to be adjusted to reflect the hospital and small emitter opt-outs.

In addition, at the end of 2024, the main Authority announced that the second allocation (and free allocation) period would start in 2027 to align changes with the implementation of the UK CBAM in 2027³⁸, and that a new allocation period would be created for the year 2026. Free allocation for 2026 would still be calculated on the same basis as that for 2021 to 2025.

UK ETS Phase II

³² <https://www.gov.uk/government/publications/uk-emissions-trading-scheme-uk-ets-policy-overview/uk-emissions-trading-scheme-uk-ets-a-policy-overview>

³³ As set out in the Developing the UK ETS consultation and 2023 Long-term Pathway

³⁴ See UK government interim response on maritime, July 2025, <https://assets.publishing.service.gov.uk/media/687de724a5561a5a7e726bd9/uk-ets-maritime-interim-authority-response.pdf>

³⁵ See UK government interim response on waste, July 2025, <https://assets.publishing.service.gov.uk/media/687de90da8ee0c6e06f452d6/uk-ets-energy-from-waste-interim-authority-response.pdf>

³⁶ See UK government interim response on removals, July 2025, <https://assets.publishing.service.gov.uk/media/689cda8487bf475940723f5b/uk-ets-ggrs-main-response.pdf>

³⁷ <https://www.legislation.gov.uk/ukxi/2020/1265/contents/made>

³⁸ <https://www.gov.uk/government/publications/uk-emissions-trading-scheme-uk-ets-policy-overview/uk-emissions-trading-scheme-uk-ets-a-policy-overview>

In December 2025³⁹, to ensure that the UK ETS continues to operate after 2030, the UK ETS Authority decided to extend the UK ETS into a Phase II from 2031 onwards. The Authority decided the length of Phase II to be 10 years, running from 1 January 2031 to 31 December 2040. It also decided to allow banking of allowances between Phases I and II of the UK ETS.

The UK ETS Phase II will have to be provided for in legislation. Before legislating to extend the Scheme, the Authority plans to consult on a specific trajectory for a Phase II cap.

- 2) Is there free allocation of allowances?
 - a. If yes, what is the trajectory of free allocation over time for the different ETS sectors? Is there a phase out or decrease over time?

UK ETS allowances are allocated primarily through auctioning, with a proportion allocated for free as “free allowances”. The UK ETS is designed to mitigate the risk of carbon leakage through increased free allocation to operators in sectors identified as being at risk. The number of free allowances that an installation is entitled to is determined using the historical activity level, an industry benchmark, and a carbon leakage exposure factor (CLEF). With respect to auctioning, the system also includes both a cost containment mechanism (CCM) and an auction reserve price, to support market stability.

There is a maximum number of allowances allocated for free, called the “industry cap”, which has been set since 2024 at 40% of the total cap. The “industry cap” reduces annually in line with the cap trajectory. If the total amount of free allocation exceeds the industry cap for a particular year, any unallocated allowances from the industry cap of the previous year, as well as allowances from a flexible reserve, can be used. As a last resort, a cross-sectoral correction factor would be applied to ensure a uniform reduction across participants.

- 3) Is the country considering the implementation of a BCA?
 - a. If yes, have you considered how the potential BCA would impact free allocation of allowances?
 - b. Are there other measures under consideration to address the risk of carbon leakage?

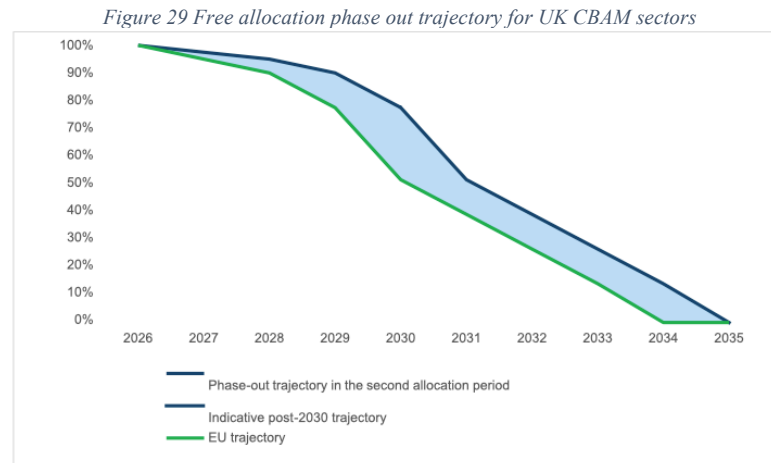
In October 2024, the UK government confirmed its plans to introduce a CBAM that would take effect on 1 January 2027. With the exception of electricity, the UK CBAM’s sectoral scope will be similar to the EU CBAM, covering products from aluminium, cement, fertilisers, hydrogen, and iron and steel sectors.

While the overall scope and design of the UK CBAM had been largely decided as of October 2025 (with legislation expected to be included in a Finance Bill), the UK government’s decision with respect to the approach to adjusting Free Allocations under the UK ETS for the sectors covered by the UK CBAM as part of a wider Free Allocation Review under the UK ETS was still pending.

³⁹ Extending the UK Emissions Trading Scheme cap beyond 2030. A joint response of the UK Government, the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland. <https://assets.publishing.service.gov.uk/media/693197610cf0b7e681ff4269/extending-uk-ets-cap-beyond-2030-response.pdf>

On 26 November 2025, the UK ETS Authority published its decision for a gradual phase out of free allocations for sectors covered by the UK CBAM beginning in 2027, with an indicative phase out trajectory of 9 years⁴⁰. It decided to apply this only to relevant sub-installations, to ensure a fair and proportionate transition.

The trajectory of the phase out of free allocation for sectors covered by the UK CBAM mirrors the EU's pace of phase out for EU CBAM covered sectors. However the UK's phase out will begin one year after the EU's to align with the introduction of the UK CBAM, as shown in the figure below:



Source: figure 7 in UK Emissions Trading Scheme: Free Allocation Review Main Authority Response, November 2025
<https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review/outcome/uk-emissions-trading-scheme-free-allocation-review-main-authority-response-accessible-webpage>

Earlier in the legislative process, the government considered different options with respect to the adjustment of free allocation for CBAM sectors. Outlined in a 2024 Analytical Annex, the different options under consideration with respect to the adjustment of free allocation included⁴¹:

1. **Option 1: No adjustment of free allocation for CBAM sectors:** Retain current methodology for Free Allocation, with no adjustment to CBAM-covered sectors. While other changes to Free Allocation methods may affect installation and sectoral Free Allocation, there would be no differentiation between CBAM and non-CBAM sectors.
2. **Options 2: Top-down Free Allocation adjustment to zero:** For sectors within scope (defined as covered by the UK CBAM), any installation would receive a reduction to final Free Allocation according to a defined adjustment factor. Under this option, covered sectors would see Free Allocation gradually adjusted. Several sub-options were considered under this option including
 - 2.1. **A linear reduction**
 - a) from 2027 (the first year of UK CBAM implementation).
 - b) from 2029 (delayed start variation)

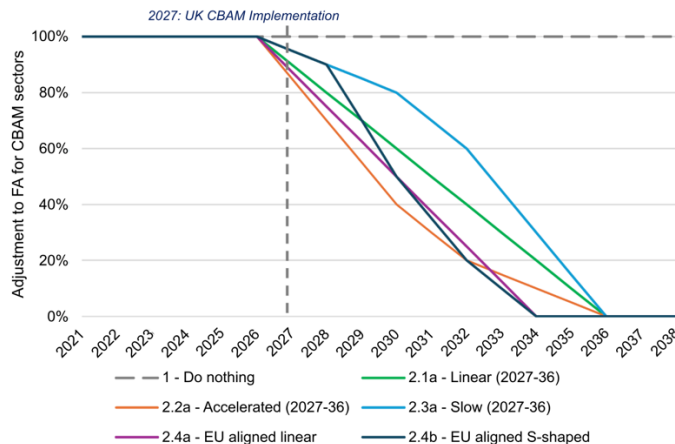
⁴⁰ UK Emissions Trading Scheme: Free Allocation Review Main Authority Response, November 2025
<https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review/outcome/uk-emissions-trading-scheme-free-allocation-review-main-authority-response-accessible-webpage>

⁴¹ Source: page 10 in Analytical Annex: Free Allocation for CBAM Sectors - Analytical Annex to the Free Allocation for CBAM Sectors Chapter of the UK Government, the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland Consultation on Carbon Leakage as part of the Free Allocation Review, December 2024, <https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review-carbon-leakage/analytical-annex-free-allocation-for-carbon-border-adjustment-mechanism-cbam-sectors-html>

- 2.2. **Accelerated adjustment** with a greater reduction in early years, but slowing in later years.
 - a) from 2027
 - b) from 2029 (delayed start variation)
- 2.3. **Slow adjustment**, slower initially, accelerating in later years.
 - a) that begins in 2027
 - b) that begins in 2029 (delayed start variation)
- 2.4. **EU Aligned Free Allocation adjustment to zero**: align timing or adjustment curve to the announced EU CBAM, which begins in 2026 and reaches zero in 2034. In this case, the trajectory of the curve, and the length of phase out could be altered to meet this objective:
 - a) Adjustment beginning in 2027, linear reduction of 12.5 p.p. per year, to zero by 2034
 - b) Adjustment beginning in 2027, with S-shaped curve (similar to the EU) to zero by 2034
3. **Option 3: Top-down adjustment to non-zero**: As above, adjusting Free Allocation for CBAM covered sectors during a transitional period, but keeping in a non-zero Free Allocation level in the long run. This would aim to provide mitigation against potential remaining carbon leakage risk not covered by the CBAM.

The first two options are illustrated in the following graph, with phase out variations encompassing linear, accelerated or slow reduction rates.

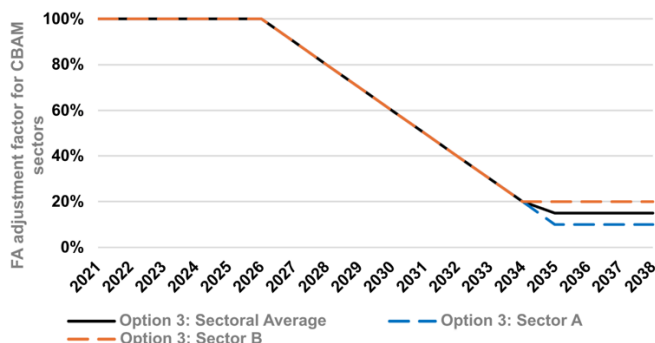
Figure 30 Illustration of options 1 (no adjustment) & 2 (phase out)



Source: figure 3 in Analytical Annex: Free Allocation for CBAM Sectors - Analytical Annex to the Free Allocation for CBAM Sectors Chapter of the UK Government, the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland Consultation on Carbon Leakage as part of the Free Allocation Review, December 2024, <https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review-carbon-leakage/analytical-annex-free-allocation-for-carbon-border-adjustment-mechanism-cbam-sectors-html>

Option 3 partial adjustment to non-zero (phase down) is illustrated in the following figure, with variations of this option in the level of Free Allocation received by different CBAM covered sectors. This variation in the level of Free Allocation received by CBAM sectors could, for example, be calibrated on their sectoral level carbon leakage risk.

Figure 31 Illustrative presentation of option 3 (partial adjustment to non-zero)



Source: figure 7 in Analytical Annex: Free Allocation for CBAM Sectors - Analytical Annex to the Free Allocation for CBAM Sectors Chapter of the UK Government, the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland Consultation on Carbon Leakage as part of the Free Allocation Review, December 2024, <https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review-carbon-leakage/analytical-annex-free-allocation-for-carbon-border-adjustment-mechanism-cbam-sectors-html>

These options were assessed qualitatively by the government against a set of criteria as shown in the table below. From this table, it can be inferred that the option of partial adjustment to non-zero, was found to potentially entail lower carbon leakage risks in the long-run compared to the other options, albeit it scored less well with respect to technical or legal feasibility.

Table 6 Qualitative assessment of free allocation adjustment options for UK CBAM sectors

Criteria / Option	Do nothing – no adjustment to Free Allocation (FA)	Adjustment to zero (Linear / faster)	Adjustment to zero (slower or EU aligned, delayed)	Partial adjustment to non-zero
Carbon leakage mitigation	Continues comprehensive carbon leakage coverage for Energy Intensive sectors	Faster reduction of FA, a comprehensive carbon leakage mitigation, means leaving potential risk of CL through other channels (if unaddressed) in short run	Relative to fast adjustment, more gradual adjustment means more time for adjustment and lower carbon leakage risks in transitional period	In short run, similar to any adjustment, dependent on trajectory
Long-run carbon leakage mitigation	As above	Export carbon leakage is not covered as FA is adjusted to zero	Export carbon leakage is not covered as FA is adjusted to zero	Potentially lower carbon leakage risks in long-run, if feasible and accurate
Impact on ETS effectiveness	Doesn't actively lower FA (although FA may fall through other means): continues support for covered sectors but mutes price signal, lowering decarb incentive relative to adjustment and CBAM. Reduces effect of CBAM as Rate may remain near-zero	Compatible with broader ETS operation and FA rules. Increases decarbonisation signal through higher effective UK ETS prices initially	Compatible with broader ETS operation and FA rules. Slower adjustment means reduced decarbonisation signal relative to a faster adjustment	Compatible with ETS operation, but may reduce ETS effectiveness in long-run, and raise issues through the continuation of FA for CBAM sectors, through having two closely interacting carbon leakage policies indefinitely
Technical feasibility	Feasible for ETS in the short-run, as no direct adjustment to FA required, but in long-run requires ongoing FA adjustment for CBAM	Feasible to implement, through adjustment within FA methodology. Precise results to be developed	Feasible to implement, through adjustment within FA methodology. Precise results to be developed	Some difficulties in accurately and clearly deriving adjusted Carbon Leakage Indicator values – see Potential Implementation of Option 3
Affordability & fiscal impact	No difference in ETS revenue; implies zero/low CBAM revenues	Greatest impact to Government affordability and revenue through fewer FA allocated and greater CBAM revenues	Similar to any adjustment to zero; lower benefits relative to a faster adjustment due to slower CBAM effects and revenue	This option is likely affordable to Government, but raises lower revenues relative to a long-run adjustment to zero
Other impacts				Potential risk to consistency with World Trade Organisation Rules and other trade related obligations.

Green: significant benefits or no risk; Amber: potential benefits or minor risks; Red: significant costs or risks; White: NA

Source: Table 2, page 16 in Analytical Annex: Free Allocation for CBAM Sectors - Analytical Annex to the Free Allocation for CBAM Sectors Chapter of the UK Government, the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland Consultation on Carbon Leakage as part of the Free Allocation Review, December 2024, <https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review-carbon-leakage/analytical-annex-free-allocation-for-carbon-border-adjustment-mechanism-cbam-sectors-html>

In addition the same analytical annex provides some quantitative evidence with respect to the potential export and downstream leakage risk.

With respect to exports leakage, it notes that *“export intensity figures highlight the EU as the predominant export market for most CBAM goods, and suggests that a CBAM may improve UK competitiveness relative to competitors (with unpriced emissions) into this market. Nonetheless, ROW markets represent a significant destination for UK exporters for many CBAM goods, suggesting the competitiveness and/or leakage to these countries should be considered, although noting export leakage is complex and dependant on many factors”*.⁴²

With respect to downstream leakage, it acknowledges the challenge in quantifying it, noting that *“a similar channel for leakage could be identified for ‘downstream’ products [...]. [The] UK Government commissioned NERA to undertake an assessment of whether quantitative carbon leakage indicators for CBAM sectors could be constructed to quantify potential export and downstream leakage risk, using primarily public data and through a transparent methodology. [...] The analysis indicated that it is feasible to develop quantitative indicators for export intensity [...]. In contrast, the research found it is complex to build indicators which consistently capture potential downstream leakage risk for UK CBAM sectors with publicly available and transparent data. While further analysis and policy development could explore this, this initial study indicates that it may be difficult to reliably develop robust, clear indicators which comprehensively capture the remaining leakage risk in this scenario – in practice, such indicators may only be able to capture export leakage risk”*⁴³.

⁴² **Source:** p. 19 in Analytical Annex: Free Allocation for CBAM Sectors, December 2024, <https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review-carbon-leakage/analytical-annex-free-allocation-for-carbon-border-adjustment-mechanism-cbam-sectors-html>)

⁴³ ⁴³ **Source:** p. 20 in Analytical Annex: Free Allocation for CBAM Sectors, December 2024, <https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review-carbon-leakage/analytical-annex-free-allocation-for-carbon-border-adjustment-mechanism-cbam-sectors-html>)

A.1.b. Australia

1) Is the ETS a cap and trade system?

Australia's national carbon pricing tool, the Safeguard Mechanism, was introduced in 2016 and reformed in 2023. It prices carbon emissions from facilities that emit more than 100,000 tonnes of CO₂ equivalent annually. It covers over 200 large industrial and waste facilities, as well as domestic transport (rail/road freight, shipping and aviation). The mechanism also applies to electricity generation. It sets legislated limits—known as baselines—on the greenhouse gas emissions of these facilities.

The Safeguard Mechanism is an intensity-based baseline and credit ETS⁴⁴: the mechanism assigns mandatory facility-level⁴⁵ emissions baselines (limits), with operators incurring costs if they emit above the baseline in the form of either purchasing and surrendering domestic emissions credits, including Safeguard Mechanism Credits (SMCs) or Australian Carbon Credit Units (ACCU). If they emit below the baseline, they can sell emissions credits to other operators. Baselines are set each year, based on a facility's production multiplied by an emissions-intensity value⁴⁶. These emissions limits decline predictably and gradually over time and will help achieve Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050.

The total net emissions limit under the Safeguard Mechanism is the sum of the bottom-up facility-level emissions limits for all covered entities. However, the bottom-up emissions limits do not represent an absolute cap (ICAP, 2025).

2) Is there free allocation of allowances?

- a. If yes, what is the trajectory of free allocation over time for the different ETS sectors? Is there a phase out or decrease over time?

The baseline is reduced at an annual rate of 4.9% until 2030.

Facilities facing an elevated risk of carbon leakage, known as trade-exposed baseline-adjusted facilities, may apply and receive a slower baseline reduction rate. The decline rate can be reduced from the default 4.9% down to as low as 1% per year for manufacturing sectors or 2% per year for other non-manufacturing sectors.

3) Is the country considering the implementation of a BCA?

⁴⁴ Before its 2023 reform, the Safeguard Mechanism was not classified as a baseline-and-credit system as the government did not issue tradeable permits. Following legislative changes that entered into force in July 2023, the government issues Safeguard Mechanism Credits (SMCs) to facilities that emit below the baseline.

⁴⁵ For electricity generation, the mechanism applies a sector-wide baseline rather than individual facility limits. The Safeguard Mechanism applies to the electricity sector in a different way. It applies a single 'sectoral' baseline across all electricity generators connected to one of Australia's main electricity grids. Individual grid-connected electricity generators are not covered as long as total emissions from grid-connected electricity generators do not exceed the sectoral baseline.

⁴⁶ For existing facilities, the emissions-intensity value is set at the average of Australian industry emissions performance, while for new facilities and new products at existing facilities, the value is set at international best practice emissions performance (benchmarks).

- a. If yes, have you considered how the potential BCA would impact free allocation of allowances?
- b. Are there other measures under consideration to address the risk of carbon leakage?

Australia is considering a BCA that would likely include at its outset cement and clinker to prevent "carbon leakage". Such a border carbon liability would be applied to emissions in exceedance of the Safeguard Mechanism baselines. The government is reviewing the feasibility of such a mechanism, as part of the 2026-27 review of the Safeguard Mechanism.

The Australian government announced in 2023 it intended to work towards introducing a BCA. In the same year it also launched as part of the Safeguard Mechanism reform an independent Carbon Leakage Review, that sought to assess the feasibility of an Australian BCA, particularly in relation to steel and cement⁴⁷.

The review's interim findings have been published as part of a November 2024 consultation paper, however final recommendations are still pending. Following the government change in 2025, the feasibility of such a mechanism is still been reviewed and a decision pending. Notwithstanding, the introduction of a BCA is not unlikely given the new government's strengthened mandate on climate.

A preliminary finding of the Carbon Leakage Review is that an Australian BCA could be an appropriate measure to address carbon leakage⁴⁸. It envisages a limited sectoral coverage initially that could be expanded over time. Specifically, it finds that cement would be suitable for initial coverage, with candidates for later inclusion including ammonia and derivatives, iron and steel, lime, and glass. In terms of emissions scope, coverage would mirror Australia's Safeguard Mechanism, which only covers scope 1 emissions.

It notes that the "reduced baseline decline rates for Trade Exposed Baseline Adjusted (TEBA) facilities constrain the contribution of Safeguard Mechanism sectors to Australia's overall emissions reduction efforts"⁴⁹.

According to the preliminary findings, in terms of adjusting current carbon leakage related provisions of the Safeguard Mechanism for trade-exposed sectors covered by a BCA it would be possible:

- to remove (immediately from the outset) or phase out (gradually) the arrangements that reduce the baseline decline rates under the Safeguard Mechanism for trade-exposed sectors covered by a BCA.
 - *"Under the Safeguard Mechanism, trade-exposed baseline adjusted (TEBA) arrangements reduce baseline decline rates under the Safeguard Mechanism where there is a significant impact on revenue (EBIT for manufacturing facilities). A border carbon adjustment for a particular sector would ensure that imports would receive equivalent policy treatment as domestic production. For import competing sectors, as the underlying challenge of carbon leakage would be fully*

⁴⁷ <https://www.dcccew.gov.au/climate-change/emissions-reduction/review-carbon-leakage>

⁴⁸ P.9, Australia's Carbon Leakage Review Consultation Paper 2 - November 2024, https://storage.googleapis.com/files-au-climate/climate-au/p/prj2f030fe5577e16a3ffbb9/page/Carbon_Leakage_Review_Consultation_Paper_2_November_2024.pdf

⁴⁹ P. 6, Australia's Carbon Leakage Review Consultation Paper 2 - November 2024, https://storage.googleapis.com/files-au-climate/climate-au/p/prj2f030fe5577e16a3ffbb9/page/Carbon_Leakage_Review_Consultation_Paper_2_November_2024.pdf

addressed, it would become feasible to remove or phase out TEBA for those sectors.”⁵⁰

- to retain the reduced baseline decline rates, however the review notes that this option would create complexity in determining the relevant BCA liability (this is also the case during a gradual phasing it out) and could raise international trade law concerns.
 - *“TEBA is only available for facilities that meet a threshold impact of carbon costs. A border carbon adjustment reduces cost disadvantage to domestic Safeguard producers relative to imports that may arise from differences in climate change policy and facilitates pass-through of carbon costs in product markets. This would significantly decrease TEBA eligibility across facilities. If facilities have a higher cost base because they remain more carbon intensive than their competitors, then supporting such a facility would need to be for reasons other than differential climate policy.*

Retaining or phasing out TEBA with a border carbon adjustment would create complexity in determining the relevant border carbon adjustment liability. Given the intention to equalise costs across domestic production and imports, any TEBA allocation would need to be reflected in the liability calculation. This calculation would be particularly complex if different facilities producing a commodity received different adjustments under TEBA.

The retention of TEBA with a border carbon adjustment could raise international trade law concerns, particularly regarding the principle of non-discrimination.”⁵¹

- **February 2026 update:** The Australian Government released the Carbon Leakage Review’s final report in February 2026. It recommends the introduction of a border carbon adjustment mechanism for select commodities at high risk of carbon leakage, with cement and clinker as initial priorities. A second tier of commodities (lime, hydrogen, ammonia and derivatives, steel and iron, and glass) are identified as candidates for possible later inclusion. The report notes that *“should a border carbon adjustment be pursued, a border carbon liability could be applied to emissions in exceedance of the SM baselines”*. *“Implementation could be phased and could involve the removal of TEBA provisions for facilities producing commodities once a border carbon adjustment is fully implemented”*. As a next step, the government will consider the recommendations as part of the 2026-27 review of the Safeguard Mechanism.

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A.1.c. Canada

1) Is the ETS a cap and trade system?

Introduction

The Canadian Federal Government does not implement any Emission Trading System, but it gives a general benchmark to which single provinces need to stick in order to meet the federal requirements.

Quebec, on the other hand, implements a ETS in the context of the Western Climate Initiative (together with California and, to some extent, Washington State, allowing compliance instruments to be mutually recognized across the jurisdictions).

Cap

The Cap and Trade system of Quebec mirrors the EU ETS, with a cap, free allocation of allowances, a secondary market and a LRF. The government sets an emissions cap, issues/auctions tradable allowances, and covered entities must surrender allowances for their verified emissions. The system covers large industrial facilities (25,000 tCO₂e reporting threshold) and, since 2015, fuel distributors above a specified distribution threshold.

2) Is there free allocation of allowances?

- a. If yes, what is the trajectory of free allocation over time for the different ETS sectors? Is there a phase out or decrease over time?

Currently applicable legislation

Québec provides free allocation (FA), primarily to industrial emitters exposed to international competition, and it is explicitly designed to decline over time. The free-allocation rate per unit produced is structured to fall annually: assistance factors for emissions-intensive, trade-exposed (EITE) emitters have been set in a range depending on leakage risk and Québec's 2024–2030 reforms tighten FA further. For 2024–2030, Québec's finance ministry reports that free allocation per unit produced is expected to decrease by about 1.30 to 4.20 percentage points per year, driven by a cap-decline factor, an "expected additional effort" that varies by competitiveness risk and process emissions, and a trajectory adjustment that slows reductions early and accelerates them toward 2030 (similar to the LRF in EU).

3) Is the country considering the implementation of a BCA?

- a. If yes, have you considered how the potential BCA would impact free allocation of allowances?
- b. Are there other measures under consideration to address the risk of carbon leakage?

In its election manifesto the Canadian Liberal Party that won the 2025 election, committed to develop a BCA. A consultation on the possibility of introducing a BCA was previously conducted in 2021.

BCA would be implemented at the Federal level, creating therefore creating further issues on the link with provincial systems as in Quebec. The current situation in regards of the interaction between ETS and BCA is unclear and subjected to speculation, as there is no streamline and

timeline on how the two would eventually interact. Canada (federal) has formally explored and consulted on BCA design (via Finance Canada’s consultation materials, and the 2025 Commitment of the Canadian Liberal Party), and Québec’s own finance documentation explicitly notes that border carbon adjustment mechanisms are a way to address carbon-pricing differentials and states that the federal government is examining the issue and initiated a public consultation.

Québec’s policy documents tend to treat BCA/CBAM as an external competitiveness/leakage context that can influence decisions like free allocation, rather than as something Québec would implement on its own. This discussion has become more salient because the EU’s CBAM moves into its definitive phase on 1 January 2026, increasing pressure on exporters and trading partners to align carbon-cost treatment.

Options that have been considered in consultations are to complement or replace (fully or partially) the OBPS, in order to both protect domestic production and to avoid double-protection.

Based on ERCST consultations with Canadian experts, if the Canadian Federal Government would tight up carbon prices by mandating lower performance standards in OBPS regimes, as a result of the 2026 Carbon Pricing Review, then Quebec would have to phase out some free allocation, mirroring what the EU is currently doing with FA under ETS. However, there is uncertainty on whether this option is allowed, as any fundamental change regarding Quebec ETS would have to be discussed with California as well, being linked markets.

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A.1.d. Taiwan

1) Is the ETS a cap and trade system?

Taiwan has introduced a carbon fee, and plans to transition to an ETS in the near future.

Taiwan introduced carbon pricing in the form of a carbon fee applicable as of 2025⁵². Covered entities will have to pay the fee based on their total GHG emissions for the year of 2025 by May 2026. Mandatory emissions reporting for entities with annual emissions above 25,000 tCO₂e from certain sectors has already been in place since 2014. The Ministry of Environment has announced that Taiwan will transition from the carbon fee to emissions trading, by establishing a pilot ETS by 2026 that would give way to a mandatory ETS by 2028.

The following carbon fee rates will take effect on January 1, 2025⁵³:

1. Standard Carbon Fee Rate: NT\$300 per ton of carbon dioxide equivalent (tCO₂e) for general entities subject to the carbon fee.
2. Preferential Carbon Fee Rate A: NT\$50 per ton of carbon dioxide equivalent (tCO₂e) for entities that apply for a self-determined reduction plan and meet the industry-specific designated reduction rate.
3. Preferential Carbon Fee Rate B: NT\$100 per ton of carbon dioxide equivalent (tCO₂e) for entities that apply for a self-determined reduction plan and meet the technology benchmark designated reduction rate.

Covered entities include installations with emissions (direct and indirect) in excess of 25,000 tonnes CO₂e/year in the iron and steel, petrochemical, cement, pulp and paper, semiconductor, flat panel display, and textile sectors. Direct emissions from the power sector are excluded.

Taiwan's current economy-wide GHG emissions targets, against a 2005 base year, are:

- -2% by 2020
- -10% by 2025
- -28 +/- 2% by 2030
- -32 +/- 2% by 2032
- -38 +/- 2% by 2035
- Net zero by 2050.

2) Is there free allocation of allowances?

- a. If yes, what is the trajectory of free allocation over time for the different ETS sectors? Is there a phase out or decrease over time?

The currently applicable carbon fee regulations address competitiveness concerns through a "carbon leakage risk adjustment mechanism" which imposes lower carbon rates on industries at risk of carbon leakage. In particular, industries classified as at high risk of carbon leakage may apply for an emission adjustment coefficient to their chargeable emissions on the condition that they submit voluntary emissions reduction plans and have them approved by the Ministry of

⁵² The Ministry of Environment, announced on 29 August 2024 the three key regulations related to carbon fees (the "Regulations Governing the Collection of Carbon Fees," the "Designated Greenhouse Gas Reduction Goals for Entities Subject to Carbon Fees," and the "Regulations for Administration of Self-Determined Reduction Plans").

⁵³ According to the "Fee-Charging Rates of Carbon Fees" released on October 21, 2024

Environment⁵⁴. The initial emission adjustment coefficient will be 0.2., gradually increasing to 0.4 in a second phase and 0.6 in a third phase.

- 3) Is the country considering the implementation of a BCA?
- a. If yes, have you considered how the potential BCA would impact free allocation of allowances?
 - b. Are there other measures under consideration to address the risk of carbon leakage?

Taiwan's Climate Change Response Act of 2023 contains provisions for imposing carbon-related fees on imported goods⁵⁵.

Indeed, Taiwan is actively developing its own CBAM, mirroring the EU's CBAM, with plans to finalize the relevant regulations by the first half of 2026 and to begin reporting the embedded carbon emissions of regulated products in the first quarter of 2027⁵⁶. The focus will be on high-risk industries like steel, cement, and chemicals, aiming to prevent carbon leakage.

In July 2025, the Climate Change Administration of Taiwan's Ministry of Environment announced it was holding consultations with relevant industry associations, particularly those in the steel and cement sectors. Key elements of the Taiwan CBAM, such as reporting entities, regulated products, calculation methods, and reporting procedures were expected to be put for consultation by the end of 2025.

Given that both the national ETS and CBAM regulations are under development, it is not possible to tell whether there would be free allocation and how this would be impacted by the introduction of a CBAM. It is possible that the simultaneous development/ introduction of the two instruments might mean that no other carbon leakage protection mechanism such as free allocation of allowances be introduced.

⁵⁴ <https://www.ecct.com.tw/carbon-market-dialogue-on-taiwans-carbon-fees/>

⁵⁵ Gao, A. M.-Z., Fan, C.-T., Yeh, T. K., & Liao, C.-N. (2024). Critical review of the effects and role of the Climate Change Response Act of 2023 in Taiwan's net-zero ambition of 2050. *Carbon Management*, 15(1). <https://doi.org/10.1080/17583004.2024.2306319>

⁵⁶ https://www.ey.com/en_nl/technical/tax/tax-updates/new-legislation7

A.1.e. Thailand

1) Is the ETS a cap and trade system?

While Thailand has in the past (between 2015-2020) implemented a voluntary intensity-based⁵⁷ ETS, a national mandatory cap and trade ETS is currently being developed and planned for launch in the late 2020s.

Mandatory ETS, central instrument in Thailand's first Climate Change Act

Thailand has been considering/advancing market-based climate action, including the introduction of a mandatory ETS, for several years. The 2018 “National Reform Plan” mandated the Thai government to develop and implement economic instruments to incentivize GHG emissions reductions, laying the groundwork for the country's first Climate Change Act⁵⁸.

On 2 December 2025, Thailand's Cabinet approved the principles of the Climate Change Act, which establishes a national framework and provides the legal basis for implementing:

- 1) a carbon tax (note: the introduction of a carbon tax rather than the current excise tax will allow Thai exporters to offset costs under the EU CBAM)
- 2) a mandatory Emissions Trading System (Thai ETS), and
- 3) a cross-border carbon pricing mechanism (Thai CBAM).

The mandatory Thai ETS, codified in Chapter 8 (Sections 74–100) of the draft Act, is established as a mandatory national cap-and-trade system that will serve as the central economic instrument for greenhouse gas reduction.

Accordingly, following a data collection period between 2026-2028, a pilot ETS is anticipated for launch in the late 2020s (around 2029), followed by full implementation of the ETS and introduction of the Thai CBAM in the early 2030s.

A national emissions cap will be set in accordance with Thailand's climate targets. Thailand's system aims to gradually reduce emissions through an annually declining cap.

The system will regulate approximately 300 large or strategically significant industrial facilities and will issue “allowances,” each representing one tonne of CO₂e. Covered entities must monitor their annual emissions and surrender sufficient allowances by 30 April of the following year to match their verified emissions and meet their compliance obligations under the cap. Entities that emit beyond their allocated allowances will be subject to fines.

The DCCE will develop and periodically update allocation plans every three to five years, incorporating a mechanism for the progressive reduction of allowances in the system. The allocation plans will define the following for each allocation period:

⁵⁷ The Thailand Greenhouse Gas Management Organization (TGO) initiated the Thailand Voluntary Emissions Trading Scheme (Thailand V-ETS) in 2013 to test MRV systems, cap-setting, allocation procedures, and trading infrastructure for 12 GHG-intensive sectors. In the Thailand V-ETS, the emissions cap of covered industries was set in relation to their emissions intensity, which was determined based on the average carbon intensity of these industries for the baseline years (2012 and 2013). An exception was, however, the ceramics industry, which chose an absolute emissions cap instead of an emissions intensity target. *Source:* <https://unfccc.int/sites/default/files/resource/Thailand.pdf>

⁵⁸ https://icapcarbonaction.com/system/files/ets_pdfs/icap-etsmap-factsheet-81.pdf

- the scope of covered activities and gases;
- annual caps;
- the maximum number of carbon credits allowed for compliance; and
- allocation methods, including the share of allowances to be auctioned for each sector.

The draft Act is expected to pass the Senate and enter into force in early 2027. The approval of the Act will pave the way for drafting secondary legislation that will determine the details of Thailand's mandatory ETS, and the other economic instruments.

- 2) Is there free allocation of allowances?
- a. If yes, what is the trajectory of free allocation over time for the different ETS sectors? Is there a phase out or decrease over time?

Tradable emissions allowances will be allocated through free allocation and/or auctioning.

During the initial phase (2028–2030), most allowances will be distributed for free to ease the transition for industry; however, free allocation will decline over time, and entities will increasingly need to purchase/trade allowances. A reserve of 5–10% will be maintained to support new entrants, plant closures, or early-action performers⁵⁹.

According to the Climate Change Act, the DCCE will develop and periodically update allocation plans every three to five years, incorporating a mechanism for the progressive reduction of allowances in the system. These allocation plans will among other things define for each allocation period the allocation methods, including the share of allowances to be auctioned for each sector⁶⁰.

Detailed ETS allocation rules will be determined in the phase of secondary legislation drafting that is expected to follow the formal approval of the Climate Change Act by the Thai Senate.

- 3) Is the country considering the implementation of a BCA?
- a. If yes, have you considered how the potential BCA would impact free allocation of allowances?
- b. Are there other measures under consideration to address the risk of carbon leakage?

Similar to the case of the Thai ETS, Thai CBAM implementation rules will also be determined in the phase of secondary legislation drafting that will follow the formal approval of the Climate Change Act by the Thai Senate.

Given that both the national ETS and CBAM regulations are under development, it is not possible to tell how free allocation would be impacted by the introduction of the CBAM.

⁵⁹ <https://thelegal.co.th/2025/12/15/draft-climate-change-act-full-overview-with-detailed-emissions-trading-system-ets-explanation/>

⁶⁰ <https://thelegal.co.th/2025/12/15/draft-climate-change-act-full-overview-with-detailed-emissions-trading-system-ets-explanation/>

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A.1.f. New Zealand

1) Is the ETS a cap and trade system?

Introduction

The New Zealand Emissions Trading Scheme (NZ ETS) was launched in 2008. It covers 44% of New Zealand's GHG emissions. The NZ ETS *“supports and encourages global efforts to reduce the emission of greenhouse gases by (i) assisting New Zealand to meet its international obligations under the Convention, the Protocol, and the Paris Agreement; and (ii) assisting New Zealand to meet its 2050 target and emissions budgets”*⁶¹.

Covered sectors include⁶²: forestry; waste; synthetic gases; industrial processes (such as manufacturers of iron and steel); liquid fossil fuels (such as petrol and diesel suppliers); stationary energy (such as electricity generation and industrial heating).

The point of obligation is generally set far up the supply chain as possible⁶³. This limits administrative costs. For example, the obligation for liquid fossil fuels (such as petrol, diesel and aviation fuel) is placed on the companies importing the fuel.

Cap

The cap is set in a top-down process to align with New Zealand's 2050 net zero targets and associated emissions budgets. Covered entities must surrender allowances for all their reported emissions.

The cap limits the number of NZUs that may be released to the market from auctioning, free allocation (the term 'industrial allocation' is used), and from the cost containment reserve - CCR, as well as from any international units (currently not allowed).

It is to be noted that there is no limit on NZUs generated from removal activities. The NZ ETS cap thus limits the volume of net emissions that are emitted by ETS regulated entities, without imposing a limit on gross emissions within the ETS⁶⁴.

The Government sets and reduces the number of units supplied into the scheme over time. This limits the quantity that emitters can emit, in line with New Zealand's emission reduction targets. The cap (which limits the number of units from auctioning, industrial allocation, and the cost containment reserve - CCR) was reduced from 27.9 million in 2024 to 19.1 million in 2025⁶⁵, and is expected to further reduce from 16.3 in 2026 to 9.6 in 2030⁶⁶.

⁶¹ Article 3, Climate Change Response Act 2002, <https://www.legislation.govt.nz/act/public/2002/0040/latest/whole.html#LMS367531>

⁶² <https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/ets/coverage-of-the-nz-ets/>

⁶³ <https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/ets/coverage-of-the-nz-ets/>

⁶⁴ ICAP, New Zealand Emissions Trading Scheme, Factsheet

⁶⁵ ICAP, New Zealand Emissions Trading Scheme, Factsheet

⁶⁶ <https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/ets/nz-ets-market/annual-updates-to-emission-unit-limits-and-price-control-settings/>

The Minister of Climate Change is required to update unit limits and price control settings in the NZ ETS every year. This is to ensure there is always five-years of settings in place. In 2025, the Government decided to update unit limits as outlined in the table below ('status quo' as of 25 November 2025).

Table 7 Updated unit limits and price control settings in the NZ ETS, 2026- 2030

Unit limits (millions)	2026	2027	2028	2029	2030
Base auction volumes	5.2	4.3	3.3	2.4	1.7
Total CCR volumes	6.5	5.9	5.3	4.7	3.9
NZUs available by auction	11.7	10.2	8.6	7.1	5.6
Industrial allocation	4.6	4.4	4.1	4.0	4.0
Approved overseas units	0	0	0	0	0
Overall limit on units	16.3	14.6	12.7	11.1	9.6

Source: <https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/ets/nz-ets-market/annual-updates-to-emission-unit-limits-and-price-control-settings/>

2) Is there free allocation of allowances?

- a. If yes, what is the trajectory of free allocation over time for the different ETS sectors? Is there a phase out or decrease over time?

Currently applicable legislation

Free allocation is provided, based on output and intensity-based benchmarks, for 26 eligible emissions intensive trade exposed (EITE) industrial activities grouped in two tiers depending on their level of emissions intensity (moderate, or high).

Until 2020:

- Moderately emissions-intensive activities received 60% free allocation.
- Highly emissions-intensive activities received 90% free allocation.

In 2021, auctioning of New Zealand units (NZUs) was introduced, while free allocation started being phased. According to currently applicable legislation and general phase out rate provisions⁶⁷:

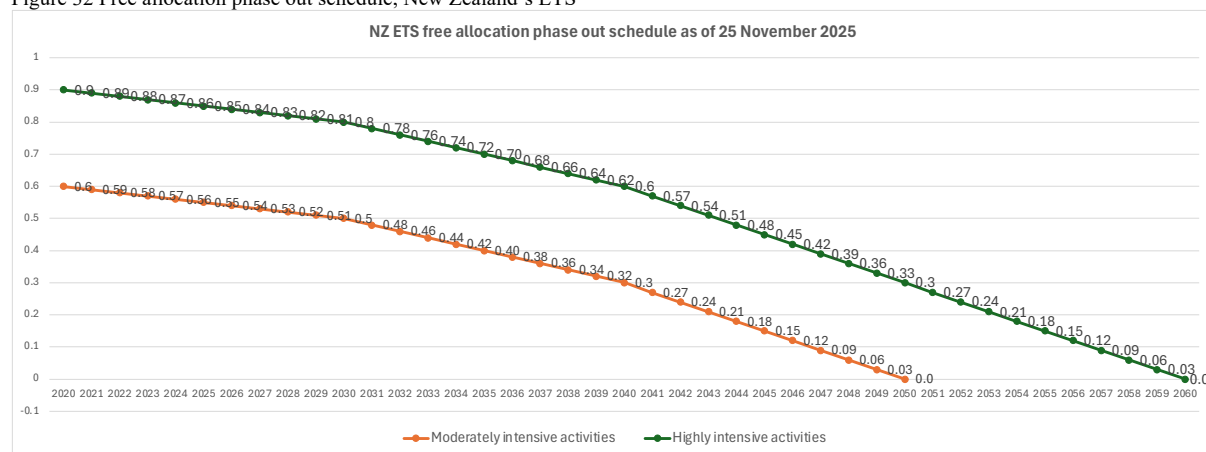
- Moderately emissions-intensive activities will stop receiving free allocation in 2050; and
- Highly emissions-intensive activities will stop receiving free allocation in 2060.

The level of initial free allocation assistance applicable until 2020 for the two activity tiers together with the applicable (general or other legislated rate) phase out rate⁶⁸ determines the overall free allocation phase out trajectory.

⁶⁷ A general phase-out rate starting at an annual rate of one percentage point (0.01) for the period 2021 to 2030, 0.02 for each year after 2030 until and including 2040; and 0.03 for each year after 2040.

⁶⁸ In general, the phase out schedule is determined in one of two ways : 1) A general phase-out rate as specified in section 83 of Climate Change Response Act 2002, starting at an annual rate of one percentage point (0.01) for the period 2021 to 2030, 0.02 for each year after 2030 until and including 2040; and 0.03 for each year after 2040; and 2) a legislated process that enables the Minister of Climate Change to set decreased or increased phase-out rates for one or more activities. See <https://www.epa.govt.nz/industry->

Figure 32 Free allocation phase out schedule, New Zealand's ETS



Source: ERCST, based on section 83 of Climate Change Response Act 2002,
<https://www.legislation.govt.nz/act/public/2002/0040/latest/whole.html#LMS367531> and NZ EPA page information
<https://www.epa.govt.nz/industry-areas/emissions-trading-scheme/changes-to-the-ets/>

More specifically⁶⁹:

1) for moderately emissions-intensive eligible industrial activities, free allocation is being phased by 2050 as follows:

- (i) Until 2020 (incl.): free allocation assistance of 0.6 in each year;
- (ii) in each year between 2021 to 2030, the level of assistance from the previous year less the applicable phase-out rate of one percentage point (0.01). This translates to a reduced level of assistance of 0.59 in 2021, gradually reducing to 0.50 in 2030.
- (iii) in each year between 2031 to 2040, the level of assistance from the previous year less the applicable phase-out rate of two percentage points (0.02). This translates to a reduced level of assistance of 0.48 in 2031, gradually reducing to 0.30 in 2040.
- (iv) in each year after 2040, the level of assistance from the previous year less the applicable phase-out rate of three percentage points (0.03). This translates to a reduced level of assistance of 0.27 in 2031, gradually reducing to 0 in 2050.

2) for highly emissions-intensive eligible industrial activities, free allocation is being phased out by 2060 as follows:

- (i) Until 2020 (incl.): free allocation assistance of 0.9 in each year;
- (ii) in each year between 2021 to 2030, the level of assistance from the previous year less the applicable phase-out rate of one percentage point (0.01). This translates to a reduced level of assistance of 0.89 in 2021, gradually reducing to 0.80 in 2030.

[areas/emissions-trading-scheme/changes-to-the-ets/](https://www.epa.govt.nz/industry-areas/emissions-trading-scheme/changes-to-the-ets/)

<https://www.legislation.govt.nz/act/public/2002/0040/latest/whole.html#LMS367531>

⁶⁹ Based on section 83 of Climate Change Response Act 2002, <https://www.legislation.govt.nz/act/public/2002/0040/latest/whole.html#LMS367531> and NZ EPA page information <https://www.epa.govt.nz/industry-areas/emissions-trading-scheme/changes-to-the-ets/>

(iii) in each year between 2031 to 2040, the level of assistance from the previous year less the applicable phase-out rate of two percentage points (0.02). This translates to a reduced level of assistance of 0.78 in 2031, gradually reducing to 0.60 in 2040.

(iv) in each year after 2040, the level of assistance from the previous year less the applicable phase-out rate of three percentage points (0.03). This translates to a reduced level of assistance of 0.57 in 2031, gradually reducing to 0 in 2060.

Expected reforms/changes⁷⁰

Two ongoing developments in NZ: 1) Reform of NZ ETS and 2) considering a BCA.

Irrespective of BCA, the NZ ETS encompasses a slow FA phase out. The NZ ETS reform is expected to review and likely accelerate the phase out tracks for the two tiers of EITE sectors.

More information is to be published in the coming weeks, which would likely render some of the existing documents/information (status quo, FA trajectories) out of date.

3) Is the country considering the implementation of a BCA?

- a. If yes, have you considered how the potential BCA would impact free allocation of allowances?
- b. Are there other measures under consideration to address the risk of carbon leakage?

BCA under consideration/examined in NZ but not yet at a granular level of detail to allow having a position with respect to the implications of a BCA on the current FA trajectory⁷¹.

Apart from acknowledging that when introducing a BCA they will have to look at FA, there are no specific design options under consideration⁷². Some of the ongoing analytical work seeks to define the risk of carbon leakage and its various dimensions⁷³.

Finally, NZ officials are aware that Australia plans to maintain non-zero free allocation and CBAM, which would result in a small levy on embedded emissions after adjusting for free allocation.

⁷⁰ Online meeting with NZ ETS Policy Team, NZ Ministry for the Environment, 5 November 2025.

⁷¹ Online meeting with NZ ETS Policy Team, NZ Ministry for the Environment, 5 November 2025.

⁷² Online meeting with NZ ETS Policy Team, NZ Ministry for the Environment, 5 November 2025.

⁷³ Online meeting with NZ ETS Policy Team, NZ Ministry for the Environment, 5 November 2025.

A.1.g. South Korea

1) Is the ETS a cap and trade system?

The Korean ETS (K- ETS) is a cap-and-trade system.

The K- ETS is organized into fixed periods, and each year within a period has a specific emissions limit. The government determines each company's annual total emission allowances, and companies are allowed to trade the allowances they receive.

For reference, the current period is Phase 3 (2021–2025), and Phase 4 (2026–2030) will begin soon.

2) Is there free allocation of allowances?

- a. If yes, what is the trajectory of free allocation over time for the different ETS sectors? Is there a phase out or decrease over time?

K- ETS includes free allocation of allowances.

Based on Phase 4, differentiated free allocation rates are applied by sector.

For the power sector, the free allocation rate is scheduled to gradually decrease (from 85% in 2026 to 50% in 2030).

For sectors other than power, the free allocation rate is planned to remain at around 85% until 2030.

In addition, sectors with a high risk of carbon leakage (such as steel, petrochemicals, oil refining, cement, and semiconductors) are planned to maintain 100% free allocation.

3) Is the country considering the implementation of a BCA?

- a. If yes, have you considered how the potential BCA would impact free allocation of allowances?
- b. Are there other measures under consideration to address the risk of carbon leakage?

In October 2025, the Ministry of Climate, Energy and Environment (MCEE) launched a study on the introduction of a Korea-style Carbon Border Adjustment Mechanism (K-CBAM). The study includes considerations on the linkage with the K-ETS as well as coverage of products at risk of carbon leakage.

Once the study results are released, it should be possible to review more detailed information.

A.1.h. Türkiye

1) Is the ETS a cap and trade system?

Introduction

The Turkish ETS has been introduced under the Climate Law that went into effect in July 2025. The TK ETS regulation is still a draft.

The Turkish ETS will start its pilot phase from 2026 to 2027. It will cover installations that emit more than 50,000 tons of CO₂ annually, in the following sectors: electricity generation, cement, iron and steel, aluminum, fertilizers and ceramics, chemicals, and oil refining (that is aligned with EU CBAM). The full implementation phase is planned between 2028 and 2035.

The system will operate similarly to the EU ETS, utilising auctioned allowances and establishing a secondary market managed by EPIAS, Türkiye's energy exchange.

Cap

In the new draft regulation published by the Directorate of Climate Change, the operational framework to the TK ETS is detailed as following: an intensity-based cap system and free allocation methodology based on benchmarks from the full implementation phase onwards. Domestic offsets are expected to be allowed up to 10% after but not during the pilot phase. Currently, there is political discussion on emission based cap target instead of initially planned intensity-based target and discussion still on-going.

2) Is there free allocation of allowances?

- a. If yes, what is the trajectory of free allocation over time for the different ETS sectors? Is there a phase out or decrease over time?

Currently applicable legislation

From the implementation phase running from 2028 to 2035, there will be free allocation of allowances. For the pilot phase, all emissions corresponding to benchmark values will be freely allocated.

After the pilot phase, the system will use a benchmark-based approach to determine the amount of free allocation for each installation. The final allocation is determined on multiplying the benchmark value by the installation activity level, the sectoral activity factor and the FA rate. Benchmarks, amount of offsets, sectoral correction factors have not yet been decided and will be decided by the Carbon Market Board that was established by the Climate Law in July 2025.

Expected reforms/changes

It is still a draft, so changes and reforms could be expected, since political discussion on emission based cap vs intensity-based are still ongoing.

3) Is the country considering the implementation of a BCA?

- a. If yes, have you considered how the potential BCA would impact free allocation of allowances?
- b. Are there other measures under consideration to address the risk of carbon leakage?

Currently, there is no BCA developed in Türkiye. However, under the Climate Law there is a provision for the potential establishment of a Border Carbon Adjustment Mechanism (BCAM) within the Türkiye's climate law.

Since it is not yet implemented or properly discussed, there is no detail on how the BCAM would impact FA trajectory

Annex 2 – Modelling technical annex

A.2.a. Modelling framework

Overview of main mechanisms represented in the modelling framework

While CBAM and free allocation are instruments designed to mitigate carbon leakage, their combined effects on firms' production choices, cost structures, and market outcomes are complex and not fully captured by existing analytical approaches.

A key point is that CBAM and free allocation operate through different economic channels. CBAM primarily affects relative prices and trading conditions by narrowing the marginal cost gap between EU production subject to carbon pricing and imports that are (partly or fully) exempt. Free allocation, by contrast, primarily affects firms' inframarginal compliance costs, profitability, and balance-sheet constraints. Assessing their interaction therefore requires a framework able to represent both marginal incentives and inframarginal cost relief, and to trace their implications along value chains.

As discussed in Section 2.4, the “independence principle” has largely been studied in isolation from carbon leakage. Yet carbon leakage is fundamentally embedded in intra-industry trade across jurisdictions, and insights from this literature are directly relevant to comparisons of allocation regimes. Long-run equilibrium in intra-industry trade is typically analyzed within a monopolistic competition framework. This approach has been used to study long-run consequences of carbon pricing (Konishi and Tarui, 2015) and to revisit the choice between an environmental tax and an ETS (Shinkuma and Sugeta, 2016; Lin et al., 2024). It is well suited to capture both (i) imperfect substitution between domestic varieties and imports and (ii) differentiated pricing and incomplete cost pass-through, features that are central to competitiveness and leakage.

From this perspective, CBAM and free allocation are more naturally complements than substitutes in addressing leakage over the long run. CBAM corrects the marginal cost differential between EU production and imports. This holds even when verified embedded emissions for imports are adjusted to reflect the free allocation granted to EU producers: as long as the net embedded emissions remain positive, CBAM continues to affect marginal unit pricing and, therefore, the marginal competitiveness of imports. CBAM is thus compatible with free allocation, and their coexistence is explicitly provided for by Article 31 of the CBAM Regulation.

The choice between free allocation and auctioning does not primarily affect marginal production costs (under the standard independence logic), but it does affect the total cost of regulation borne by domestic firms. By increasing compliance payments, auctioning can reduce the number of EU firms that remain active in the long-run equilibrium relative to foreign firms. This matters because even with CBAM, foreign producers may continue to serve foreign downstream stages in their value chains, which are generally outside CBAM's scope, thereby circumventing the policy. This form of value-chain leakage is widely recognized in policy debates but remains insufficiently represented in many economic models.

Conversely, by limiting inframarginal compliance costs, free allocation can sustain a larger mass of EU firms in equilibrium. A larger domestic sector implies more sustained demand for allowances and (other things equal) a higher equilibrium allowance price. This challenges the common claim that full auctioning necessarily strengthens the carbon price signal: in a long-run general equilibrium with entry and exit, free allocation can, under plausible conditions, support a stronger allowance price and thus stronger decarbonization incentives than full auctioning.

Free allocation does not eliminate value chain leakage. Addressing this channel requires extending CBAM (or an equivalent mechanism) to downstream sectors, including those not covered by the EU ETS. Within the EU, cost pass-through implies that downstream firms already pay carbon costs embodied in inputs, whether local or imported. Maintaining a level playing field therefore requires a border adjustment that also reflects carbon cost pass-through in intermediate inputs.

To address these challenges, we develop a modeling framework to analyze the joint impact of CBAM and free allowances on industrial competitiveness. The model provides a coherent representation of the main mechanisms identified above and enables a structured analysis across upstream and downstream sectors and across different adjustment horizons. Overall, our aim is to offer a unified framework for tracing how CBAM and free allocation affect firm behavior, market structure, and leakage, both at the border and along value chains.

Representation of leakage channels, value chain and trade

We build on a standard framework used in international economics to study competition among EU and non-EU firms and the phase-out of free allocation. This standard framework assumes monopolistic competition between heterogeneous firms to explain intra-branch trade, allowing a selection process of firms through entry and exit (Melitz, 2003). Monopolistic competition allows for some degree of cost pass-through thanks to product differentiation while assuming the pricing of their product by firms is constrained by a potentially high degree of substitution. Coupling this framework with the analysis of equilibrium in a carbon market remains consistent with the absence of market power on the ETS⁷⁴.

We adapt this framework in two important ways:

First, firms do not all pass carbon costs through to prices in the same way. The degree of pass-through depends on the price of the good, in the spirit of Klenow and Willis (2016). This matters because firms with different market positions react differently to carbon costs.⁷⁵

Second, we model a full value chain rather than a single sector. We distinguish:

- an **upstream sector**, which is covered by carbon pricing;
- a **downstream sector**, which is not directly covered and uses the upstream good as an input.

This allows us to capture the different channels of carbon leakage. Notice that the relocation of production sites is tackled by considering equilibrium with free entry and exit of production sites within the EU, leveraging the result that the Coase principle of independence no longer holds in that case.

⁷⁴ It would not be the case with a Cournot-Nash oligopolistic framework.

⁷⁵ Note that in the model the EU-ETS is assumed to cover only the upstream sector. Changes in the carbon price are thus tightly linked to the marginal abatement cost of that sector.

A.2.b. Model calibration

Model calibration – steel value chain

The model is calibrated on pre-CBAM data for the steel value chain:

- **flat steel production** is the upstream sector, more specifically the Blast Furnace – Basic Oxygen Furnace (BF-BOF) route;
- **automotive production** is the downstream sector.

The calibration reproduces the main actual (pre-CBAM) features: the EU ETS carbon price, production levels inside and outside the EU, and European imports and exports of both upstream and downstream goods.

The calibration is based on parameters relating to production costs, carbon intensities, production volumes, and trade between the EU and the RoW. In particular, the model incorporates assumptions about the carbon intensity of steel production, as well as the reference values used in the CBAM and the ETS. It also accounts for the modalities of the gradual implementation of policies, including the evolution of the CBAM factor and the reduction of free allowances over time.

The calibration is based on parameters relating to production costs, carbon intensities, production volumes, and trade between the EU and the RoW. In particular, the model incorporates assumptions about the carbon intensity of steel production, as well as the reference values used in the CBAM and the ETS. It also accounts for the modalities of the gradual implementation of policies, including the evolution of the CBAM factor and the reduction of free allowances over time. The detailed calibration values for the flat steel value chain, are listed in the table below.

Table 8 Calibration values for the flat steel value chain

Upstream sector: flat steel produced following the BF-BOF route	Downstream sector: automotive industry
Operating margin ⁷⁶ and unit costs	
1) Operating margin Average value across EU and non-EU producers of ammonia: 11%	1) Operating margin Average value across EU and non-EU car makers: 6%
2) Unit costs Average operating cost (OPEX) for producing a ton of flat steel in the EU: 450€/t Average operating cost (OPEX) to produce a tonne of flat steel outside the EU: 450€/t	2) Unit costs Average operating cost (OPEX) to produce one passenger car in the EU: 25000€ Average operating cost (OPEX) to produce a tonne of fertilizer from ammonia outside the EU: 14000€

⁷⁶ The calibration process makes use of the operational margin in two steps. First, we leverage its direct link with the Constant Elasticity of Substitution to calibrate the sole parameter of a CES aggregation function. Then keep this calibrated parameter unchanged in the more general Klenow and Willis aggregation function and leverage the second parameter to obtain a reasonable sensitivity of the price elasticity.

Carbon intensity, benchmarks and default values	
1) Carbon intensity Carbon intensity of carbon-efficient sites in the EU: 1.6 ton of CO ₂ eq / ton of flat steel Carbon intensity of carbon-intensive sites in the EU: 1.9 ton of CO ₂ eq / ton of flat steel Carbon intensity of carbon-efficient sites in the RoW: 1.8 ton of CO ₂ eq / ton of flat steel Carbon intensity of carbon-intensive sites in the RoW: 2.4 ton of CO ₂ eq / ton of flat steel 2) benchmarks and default value EU-ETS benchmark value for flat steel: 1.288 ton of CO ₂ eq / ton of flat steel CBAM benchmark value for flat steel: 1.288 ton of CO ₂ eq / ton of flat steel CBAM average default value for flat steel: 2.94 ton of CO ₂ eq / ton of flat steel	
Production and trade	
1) Production Production of flat steel within the UE: 72.1132 Mt Number of UE carbon-efficient sites: 7 Number of UE carbon-intensive sites: 14 Production of flat steel in the RoW: 1269.01 Mt Number of RoW carbon-efficient sites: 50 Number of RoW carbon-intensive sites: 400 2) Trade Imports of flat steel by the UE. 21.682 Mt	1) Production Production of passenger cars within the UE: 15 M Number of EU car production sites: 80 Production of passenger cars within the UE: 60.8 M Number of RoW car production sites: 450 2) Trade Imports of passenger car by the UE. 3.847622 M
Content of upstream product in downstream product	
Average content of flat steel in a passenger car: 0.667 t	

Sources: annual reports (ThyssenKrupp, Volkswagen), JRC, Worldsteel, ACEA

Model calibration – fertilizers value chain

Similarly, the model is calibrated on pre-CBAM data for the fertilizers value chain as follows:

- **AN fertilizers production** is the upstream sector, with vertically integrated production being the reference, non-integrated production is also considered without explicitly separating the ammonia production step;
- **agricultural production** is the downstream sector, more specifically staple grain production that heavily relies on AN fertilizers in Europe.

The detailed calibration values for the fertilizers value chain are listed in the following table.

Table 9 Calibration values for the fertilisers value chain

Upstream sector: AN fertilizers	Downstream sector: Staple grain
Operating margin and unit costs	EU demand of AN fertilizers
1) Operating margin Its value across EU and non-EU producers varies greatly: in average 12% 2) Unit costs Average operating cost (OPEX) for producing a tonne of AN fertilizer in the EU: 700€/t (2022-2023) Average operating cost (OPEX) to produce a tonne of AN fertilizer outside the EU: 450€/t	1) Demand level Pre-CBAM consumption of AN fertilizers amounts to pre-CBAM production of AN fertilizers within the EU, plus pre-CBAM imports of AN fertilizers by the EU minus pre-CBAM exports of AN fertilizers by the EU. 2) Price elasticity Estimates found in the academic and institutional literature point to a low price elasticity. - Gonzales-Martinez, A-R and Miaris, G. (2024), “Estimating demand elasticities of mineral nitrogen fertilizers: some empirical evidence in the case of Sweden”, <i>Studies in Agricultural Economics</i> , vol. 126 (n°3) - European Commission (2025), “EU Agricultural Outlook for Markets, Income and the Environment, 2024-2025” - World Bank (2025), “Commodity Markets Outlook”, Fertilizers Markets section. In view of these estimates, a -0.5% price elasticity is assumed for AN fertilizers demand in the EU.
Carbon intensity, benchmarks and default values	
1) Carbon intensity Carbon intensity of carbon-efficient sites in the EU: 0.45 ton of CO ₂ eq / ton of AN fertilizer Carbon intensity of carbon-intensive sites in the EU: 0.58 ton of CO ₂ eq / ton of AN fertilizer Carbon intensity of carbon-efficient sites in the RoW: 0.86 ton of CO ₂ eq / ton of AN fertilizer Carbon intensity of carbon-intensive sites in the RoW: 2.2 ton of CO ₂ eq / ton of AN fertilizer	

2) benchmarks and default value EU-ETS benchmark value for AN fertilizer: 0.856 ton of CO₂eq / ton of AN fertilizer (production of ammonia included) CBAM benchmark value for AN fertilizer: 0.856 ton of CO₂eq / ton of AN fertilizer CBAM average default value for AN fertilizer: 2.39 ton of CO₂eq / ton of AN fertilizer	
Production and trade	
1) Production Production of AN fertilizers within the UE: around 10 Mt Number of UE carbon-efficient sites: 19 Number of UE carbon-intensive sites: 90 Production of AN fertilizers in the RoW: around 20 Mt Number of RoW carbon-efficient sites: 10 Number of RoW carbon-intensive sites: 140 2) Trade Imports of AN fertilizers by the UE: around 2.56 Mt Exports of AN fertilizers by the UE: around 99 000 t	

Sources: annual reports (Yara International, Agrofert / LAT Nitrogen, Grupa Azoty, EuroChem, OCI global); Fertilizers Europe; EU Commission