German Environment Agency

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# Approaches to Carbon Leakage in Carbon Pricing Policies

## The Role of Cooperation within the Climate Club and Beyond

# 1 Introduction

Broad and ambitious climate action is urgently needed since the Paris Agreement's goals are still out of sight: 2024 was the first year in which the threshold of 1.5°C global temperature increase above pre-industrial levels was surpassed[1] while global greenhouse gas (GHG) emissions keep growing. Meanwhile, the Paris Agreement relies on countries' domestic climate policy decisions to achieve global climate targets. As a result, some countries have adopted more ambitious measures than others. Their leadership is important to encourage greater ambition among the others, blazing the trail to achieving global goals.

Yet, if other countries do not follow by increasing their own climate ambition (fast enough), carbon leakage can occur. That is, when ambitious climate policy that requires companies to make costly investments triggers the relocation of production or services to another jurisdiction without or with less ambitious climate policy. The emissions would still occur, simply in a different location, and might even increase overall.

While globally aligned and joint climate policy measures would be the best solution to avoid carbon leakage, in their absence, alternative measures can address carbon leakage risks. However, they can also result in fragmentation and inefficiencies. This paper provides an overview of how Climate Club member countries and selected other major GHG emitters address carbon leakage risks within their carbon pricing policies, and highlights areas for cooperation to reduce inefficiencies and collectively increase ambition.

The Climate Club[2], which was launched at COP28, is an intergovernmental forum for exchange on industry decarbonisation and aims to increase collective action across diverse geographies. Carbon leakage protection has been included in the Climate Club's Pillar 1 on advancing ambitious and transparent climate policies. It fosters strategic dialogue and works towards common principles for measures to address carbon leakage, with the aim of achieving alignment and avoiding friction and inefficiencies resulting from divergent policies.[3]

Carbon leakage can take different forms. First, on the level of production the disparate introduction or intensification of climate policies can translate into different levels of domestic climate-policy-induced costs and as a result increase foreign GHG emissions due to the relocation of production. This can undermine the overall ambition and effectiveness of domestic and global mitigation efforts.[4] Second, on the level of investments higher production costs in a jurisdiction due to ambitious climate policy can lead to an increase in private investment in other jurisdictions with less stringent climate policy, and a corresponding decrease of investment in the jurisdiction with ambitious climate policy. Third, price effects in a jurisdiction

[1] Tollefson, J. (2025). Earth Breaches 1.5°C Climate Limit for the First Time: What Does it Mean?. *Nature*, 10 January, 2025, https://www.nature.com/articles/d41586-025-00010-9 (last accessed on 15 October 2025).

[2] https://climate-club.org/ (last accessed on 15 October 2025).

[3] https://climate-club.org/ (last accessed on 15 October 2025).

[4] Climate Club Members Statement delivered on 12 November 2024 in the context of the high-level Climate Club event at COP29: https://climate-club.org/wp-content/uploads/2024/11/ClimateClub_memberstatement_COP29.pdf (last accessed on 15 October 2025).

due to ambitious climate policy can increase the production costs for industrial consumers of carbon-intensive inputs (e.g. electricity, heat, raw materials), resulting in a loss of market shares on domestic and international markets. A fourth leakage type can occur when ambitious climate policy in one jurisdiction leads to lower consumption of fossil fuels, potentially resulting in lower fossil fuel prices on the world market. This could lead to additional fossil fuel consumption in jurisdictions with less ambitious climate policy.[5]

Research on the emergence of carbon leakage has steadily grown since the early 2000s. While most carbon leakage studies are forward-looking ex-ante analyses, there are also several ex-post studies, which mostly have found limited evidence for carbon leakage.[6] Overall, the causal chain of climate policy-induced costs triggering production and investment shifts is not a clear, linear, and immediate process. Physical production sites and production capacity are not easily relocated and in most cases a plethora of additional factors influence business decisions.[7] Nonetheless, economic theory and practice confirm that for sectors that face strong international competition, raised prices in one jurisdiction lead to losses in market shares.[8]

So far, the predominantly rather low carbon prices and the measures that governments have adopted to prevent carbon leakage can explain the limited empirical evidence found. Some recent studies find higher carbon leakage risks with higher carbon prices.[9] As certain measures to address carbon leakage such as free allocation in emissions trading systems (ETSs) will be reduced as a result of more ambitious climate policy on the trajectory to net-zero GHG emissions by mid-century, companies will need to increase their GHG emission abatement efforts, which could affect production costs and therefore raise the carbon leakage risk. Consequently, the forward-looking ex-ante literature suggests that carbon leakage risks will increase with rising carbon prices and more stringent emission standards or in the absence of measures to address those carbon leakage risks.

Carbon leakage risks may arise in all sectors that are both energy intensive and trade exposed (EITE sectors). This so far mainly concerns industries producing raw materials and commodities such as steel, cement, plastics, fertilisers, aluminium, glass, and pulp and paper. In some contexts, such as California, the electricity sector faces a carbon leakage risk because out-of-state produced electricity is imported. Consequently, the sectors at risk of carbon leakage can vary somewhat depending on geography and industry structure.

Measures to address carbon leakage tend to be adopted as part of or in direct connection to ambitious carbon pricing policies. They provide a degree of protection for EITE sectors to

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[5] Görlach, B., & Zelljadt, E. (2018). *Forms and Channels of Carbon Leakage*. Umweltbundesamt, Climate Change 16/2018, https://www.umweltbundesamt.de/en/publikationen/forms-channels-of-carbon- leakage (last accessed 15 October 2025). Grubb, M., Jordan, N. D., Hertwich, E., Neuhoff, K., Das, K., Bandyopadhyay, van Asselt, H., Sato, M., Wang, R., Pizer, W. A. & Oh, H. (2022). Carbon Leakage, Consumption, and Trade. *Annual Review of Environment and Resources* 47: 753-795. Dechezleprêtre, A. & Sato, M. (2017). The Impacts of Environmental Regulations on Competitiveness. *Review of Environmental Economics and Policy* 11 (2): 183-206.

[6] Yu, B., Zhoa, Q. & Wei, Y.-M. (2021). Review of Carbon Leakage under Regionally Differentiated Climate Policies. *Science of the Total Environment* 782 (2021) 146765; OECD (2020), *Climate Policy Leadership in an Interconnected World: What Role for Border Carbon Adjustments?*, OECD Publishing, Paris; Ellis, J., Nachtigall, D. and Venmans, F. (2019), *Carbon pricing and competitiveness: Are they at odds?*, OECD Environment Working Papers, No. 152, OECD Publishing, Paris.

[7] Yu, B., Zhoa, Q. & Wei, Y.-M. (2021). Review of Carbon Leakage under Regionally Differentiated Climate Policies. *Science of the Total Environment* 782 (2021) 146765.

[8] OECD (2024) Summary Report of the Strategi Dialogues on Causes and Relevance of Spillovers from Mitigation Policies, https://climate-club.org/wp-content/uploads/2024/11/Climate-Club- -Strategic-Dialogues-on-Spillovers -Summary-Report_Final.pdf (last accessed 15 October 2025). OECD (2021). *Assessing the Economic Impacts of Environmental Policies: Evidence from a Decade of OECD Research*. OECD Publishing, Paris. Ellis, J., Nachtigall, D. and Venmans, F. (2019), *Carbon pricing and competitiveness: Are they at odds?*. OECD Environment Working Papers, No. 152, OECD Publishing, Paris.

[9] Teusch, J, D'Arcangelo, F. M., Kruse, T. and Pisu, M. (2024). *Carbon prices, emissions and international trade in sectors at risk of carbon leakage: Evidence from 140 countries*, OECD Economics Department Working Papers. https://www.oecd.org/en/publications/carbon-prices-emissions-and-international-trade-in-sectors-at-risk-of-carbon-leakage_116248f5-en.html (last accessed 15 October 2025).

maintain domestic producers' competitiveness vis-à-vis international competitors from jurisdictions with lower climate policy-induced costs and thereby prevent carbon leakage that would undermine the effectiveness of domestic climate policy. This paper focuses on measures to address carbon leakage in conjunction with carbon prices. It provides an overview of their diversity and explores potential areas of cooperation.

The next section differentiates types of measures to address carbon leakage in carbon pricing policies and groups them into three categories: (i) exemptions from the carbon price (including free allocation), (ii) border carbon adjustments, and (iii) cost compensation mechanisms. Section 3 surveys the implemented measures to address carbon leakage in all Climate Club members with a domestic carbon pricing policy and selected non-Climate Club countries. The discussion ponders the challenges and necessities of streamlining measures to address carbon leakage facilitated by the Climate Club and highlights areas for future research.

# 2 Diversity of Measures to Address Carbon Leakage

Three groups of measures to address carbon leakage can be identified: (partial) exemptions from the carbon price, border carbon adjustments, and cost compensation mechanisms. These measures exert different impacts on competitiveness and decarbonisation incentives. Border carbon adjustment measures address imports and exports of EITE goods from and to other jurisdictions, while exemptions and compensation mechanisms granted to EITE industries address domestic production.[10]

Measures can be conditional, with clear eligibility criteria to qualify for carbon leakage protection, or unconditional, applying to all entities subject to a particular climate policy. The former directly focus on the sectors at carbon leakage risk, while the latter pursue a broader goal of mitigating a policy's impact on covered entities and are not strictly focused on addressing carbon leakage. They of course still address carbon leakage risks, among the other objectives. While measures to address carbon leakage in carbon pricing policies tend to be linked to the carbon price level, there are some exceptions. This section further specifies the competitiveness and decarbonisation incentives of the three groups of measures to address carbon leakage.

## 2.1 (Partial) Exemptions from the Carbon Price

Exemptions from the carbon price can take different forms that, among others, include free allocation of allowances in emissions trading systems (ETS), full or partial exemptions in carbon taxes, and reduced baseline decline rates in baseline-and-credit systems. By partially or fully shielding covered entities from the carbon price signal, these measures can effectively safeguard the respective entities' competitiveness in domestic and international markets.[11] However, remaining compliance costs in the case of free allocation and partial exemptions may still put covered entities at a competitive disadvantage vis-à-vis competitors not subject to a carbon pricing policy, albeit a reduced disadvantage.

As a result of the lower price impact, free allocation, exemptions, and reduced baseline decline rates diminish an entity's incentive to decarbonise as they shield them from (a part of) the price signal, which is the mechanism through which carbon pricing policies largely operate. This can ultimately lead to incompatibility with a particular emissions reduction pathway and the necessary carbon price level to incentivise investments in the pursuit of the targeted emissions reductions. This was one of the reasons, in addition to the decreasing cap and the necessity to increasingly rely on auctioning, for the European Union's (EU) decision to gradually phase out free allocation in its EU ETS 1 starting in 2026 and replace it with the EU carbon border adjustment mechanism (CBAM) as an alternative carbon leakage protection measure.

## 2.2 Border Carbon Adjustments

Border carbon adjustments (BCAs) impose a carbon price on imported goods analogue to that paid by domestic producers and/or compensate an exporter for the carbon price.[12] Levying a carbon price on imports levels the playing field so that all producers pay the same carbon price in the domestic market. This solution avoids reduced carbon prices and allows for a price that

[10] Böhringer, C., Rosendahl, K. E., and Storrøsten, H. B. (2017). Robust Policies to Mitigate Carbon Leakage. *Journal of Public Economics* 149: 35-46.

[11] Meadows, D., Yordi, B., & Vis, P. (2024). Addressing Carbon Leakage under the EU ETS 1. In Delbeke, J. (ed.) *Delivering a Climate Neutral Europe*. Abingdon, Routledge: 83-103.

[12] Cosbey, A., Droege, S., Fischer, C., & Munnings, C. (2019). Developing Guidance for Implementing Border Carbon Adjustments: Lessons, Cautions, and Research Needs from the Literature. *Review of Environmental Economics and Policy*, 13(1), 3-22; Branger, F., & Quirion, P. (2014). Would border carbon adjustments prevent carbon leakage and heavy industry competitiveness losses? Insights from a meta-analysis of recent economic studies. *Ecological Economics*, 99, 29-39.

incentivises decarbonisation. However, domestic producers still face a competitive disadvantage and associated risk of carbon leakage in international markets, if a BCA only applies to goods imported into the domestic market.

Creating a WTO-compliant export solution is not trivial[13]: Multiple pathways could be considered, including rebates, free export certificates, and maintaining a share of free allocation for domestic exporters so that they do not pay the carbon price on products produced for external markets, or targeted decarbonisation support for export reliant industries.[14] Depending on the chosen export solution and its concrete design, incentives to decarbonise may be weakened.

A carbon price on imported goods preserves the decarbonisation incentive for covered entities, as it does not shield them from the price signal. As jurisdictions near ambitious net-zero emission targets, phasing out other leakage protection measures such as free allocation and tax exemptions can be important measures to strengthen the necessary decarbonisation incentive to tackle hard-to-abate emissions.

The diversity of existing emissions trading systems today complicates the determination of a BCA fee, making it harder for some jurisdictions to implement a border adjustment addressing carbon leakage. This includes baseline-and-credit schemes, where, in contrast to cap-and-trade systems, covered entities do not pay a fixed carbon price for every tonne of covered emissions, but only for those emissions that exceed a facility-level emissions limit, the so-called baseline (e.g. Australia, Canada). This complicates establishing the effective carbon price level that could be imposed on imported goods through a BCA, and it also complicates the recognition of a carbon price paid under such schemes in another jurisdiction's BCA.[15]

## 2.3 Cost Compensation

Cost compensation measures are usually conditional and targeted at specific sectors to safeguard their competitiveness in domestic and international markets. An example is the German electricity price compensation, which applies to certain entities covered by the EU ETS 1 of which Germany is part. Companies in energy-intensive (especially electricity-intensive) sectors considered at risk of carbon leakage (e.g. aluminium and steel) can claim compensation for the carbon price component of their electricity costs, subject to a benchmark for electricity use and conditional on a commitment to environmental improvement requirements in return, which describes a set of binding environmental targets for the respective company. They are, however, not exempted from their own compliance obligations under the EU ETS 1 if they are subject to it. Such indirect cost compensation can be an effective measure to strengthen producers' competitiveness in domestic and international markets, thereby preventing carbon leakage, without significantly weakening the decarbonisation incentive.

The next section traces the implementation of measures to address carbon leakage with a focus on exemptions from the carbon price and border adjustments because cost compensation usually targets indirect carbon costs linked to electricity prices (e.g. EU ETS, UK ETS), and also tends to be subject to a separate piece of policy instead of being part of the carbon pricing policy design itself. The latter can be explained in part by the fact that entities eligible for electricity

[13] Böhringer, C., Fischer, C., Rosendahl, K. E., & Rutherford, T. F. (2022). Potential impacts and challenges of border carbon adjustments. *Nature Climate Change*, 12(1), 22-29.

[14] Evans, S., Mehling, M. A., Ritz, R. A., & Sammon, P. (2021). Border carbon adjustments and industrial competitiveness in a European Green Deal. *Climate Policy*, 21(3), 307-317.

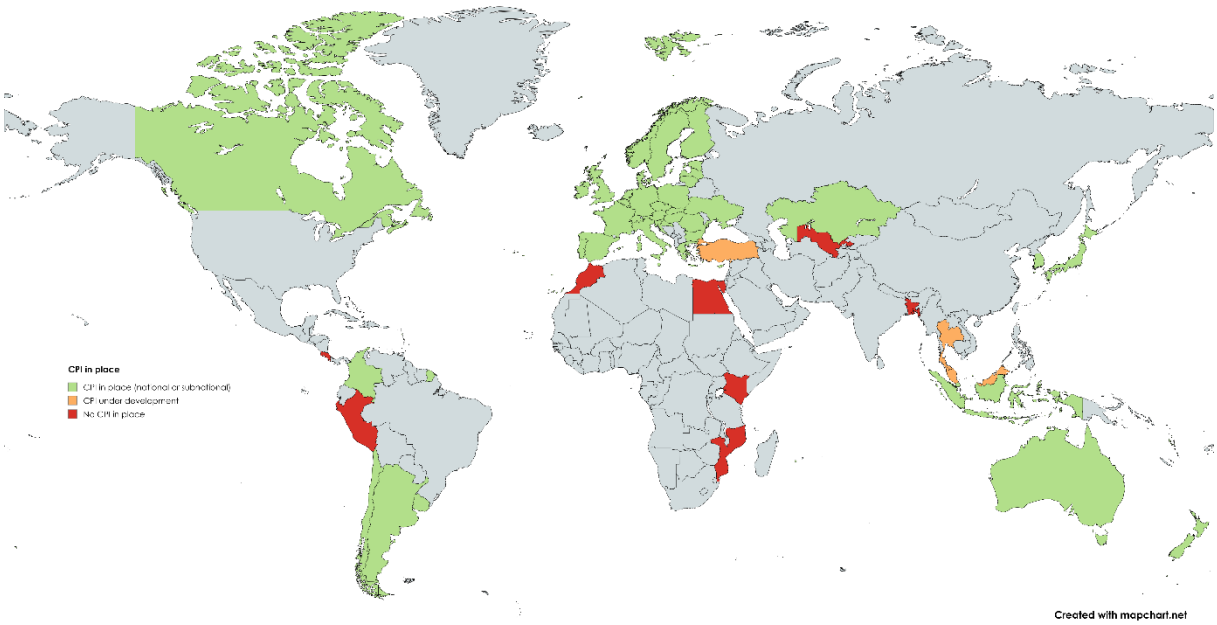
[15] For more details on this, see Wildgrube, T., Holovko, I., Heckmann, L. (2024). *Third-country carbon pricing under the EU CBAM: approaches for and challenges of recognising domestic payments*. Interim Report, DEHSt, March 2024 https://www.umweltbundesamt.de/sites/default/files/medien/11850/publikationen/15_2024_cc_carbon_pricing_cbam.pdf (last accessed 15 October 2025).

price compensation do not necessarily align with those subject to carbon pricing policy. Moreover, in the EU, for example, there are various electricity price compensation policies at national level, as the EU mostly provides the overall framework and the Member States ultimately implement policies separately, though in accordance with EU state aid guidelines. In theory, compensation for direct carbon costs (rebates) could also be conceivable but were not identified in the analysis.

# 3 Implemented Measures to Address Carbon Leakage

This section is based on a review of implemented carbon pricing policies and relevant publications, especially the World Bank's State and Trends of Carbon Pricing report[16] and the International Carbon Action Partnership's (ICAP) Emissions Trading Worldwide: Status Report.[17] Section 3.1 focuses on the countries that have joined the Climate Club, since this forum works towards common principles in the design and implementation of measures to address carbon leakage, with the aim of achieving a degree of alignment and avoiding friction among different policies. Section 3.2 adds insights from six non-Climate Club members because they are significant emitters with a national or subnational carbon pricing policy in place or under development.

**Figure 1: Map of Climate Club Members with Carbon Pricing Policies in place (green), Under Development (orange), and Without Carbon Pricing Policies (red)**




**Legend:** Carbon pricing in member countries of the Climate Club (as of October 2025)

- CPI in place (national or subnational)
- CPI under development
- No CPI in place

Source: mapchart.net (authors' own creation)

Jurisdictions have adopted various carbon pricing policy designs and with them a multitude of measures to address carbon leakage.[18] Most jurisdictions with a carbon pricing policy use free allocation in the case of ETSs or exemptions in the case of carbon taxes. For example, 32 out of 36 ETSs in force use free allocation. Yet not all these measures directly target EITE sectors and

[16] World Bank (2025). State and Trends of Carbon Pricing. Washington, DC. https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing (last accessed on 15 October 2025).

[17] International Carbon Action Partnership (2025). Emissions Trading Worldwide: ICAP Status Report. Berlin. https://icapcarbonaction.com/en/publications/emissions-trading-worldwide-icap-status-report-2025 (last accessed on 15 October 2025).

[18] World Bank (2025). State and Trends of Carbon Pricing Dashboard. https://carbonpricingdashboard.worldbank.org/ (last accessed on 15 October 2025).

therefore cannot be considered as explicitly designed to mitigate carbon leakage risks but rather a broader range of objectives, including carbon leakage.

BCAs are a recent phenomenon that so far have only been adopted or are planned in four jurisdictions (California, EU, Norway[19], and the UK), but others consider following suit. While carbon leakage risks have so far mostly been addressed through free allocation for EITE sectors in ETSs and exemptions in carbon taxes, some jurisdictions started to realise that these measures are difficult to reconcile with their net-zero GHG emissions goals. Achieving those goals requires deep decarbonisation and cannot be realised by exempting some of the biggest emitters. For this reason, alternative approaches have long been discussed and recently advanced on political agendas. Border carbon adjustment has not only been adopted or announced in California, the EU, Norway, and the UK but has also been discussed in Australia, Canada, Japan, New Zealand, Türkiye, and the USA.[20] Table 1 provides an overview of the predominantly used explicit measures to address carbon leakage in carbon pricing policies.

**Table 1: Overview of Types of Explicit Measures to Address Carbon Leakage in Climate Club Member Countries**

| Explicit carbon leakage protection measure | Example Jurisdictions |
|---|---|
| Free allocation to EITE sectors in ETSs | EU, New Zealand, Québec, South Korea, and the UK |
| Border carbon adjustment mechanism for imports of selected goods from EITE sectors | EU, the UK (from 2027), and Norway (from 2027)<br>Under consideration in Australia, Canada, Japan, New Zealand, and Türkiye |
| Reduced baseline decline rates/emissions intensity benchmarks for EITE facilities | Australia, Canada (federal Output-Based Pricing System (OBPS)) |

## 3.1 Climate Club Members

As of October 2025, 34 of the 46 Climate Club members have a carbon pricing policy in place (either at the supranational, national and/or subnational level). The EU ETS 1 covers all 27 EU Member States, 17 of which are part of the Climate Club, as well as Climate Club member Norway. In Japan, subnational jurisdictions in lieu of the national level have carbon pricing policies[21] and in Canada in addition to a national policy. Table 2 provides an overview of the measures to address carbon leakage implemented in conjunction with these carbon pricing policies, and the following subsections describe the contours of each measure. Domestic carbon pricing policies adopted by EU member states are not included in the table, since carbon pricing

[19] The Norwegian government announced in March 2025 that it will introduce a domestic BCA for imports of certain emissions-intensive goods, aligning with the EU CBAM's scope and design, from 2027: https://www.regjeringen.no/no/aktuelt/slik-skal-norge-innfore-cbam/id3090713/?utm_source=CP+Daily&utm_campaign=7b19fc8f6b-CPdaily09032025&utm_medium=email&utm_term=0_a9d8834f72-7b19fc8f6b-110394354 (last accessed on 15 October 2025). Norway, which participates in the EU ETS, is exempted from the scope of the EU CBAM and will conversely not apply its BCA to imports from other countries participating in the EU ETS (EU Member States and the other EFTA countries Iceland and Liechtenstein) as well as from Switzerland, which has a domestic ETS that is linked to the EU ETS.

No reporting or compliance obligations under the EU CBAM apply to CBAM goods imported directly into Norway, Iceland, Liechtenstein or Switzerland. However, any exports of CBAM goods that originated from outside the EEA into the EU Customs Union are subject to CBAM reporting requirements for the importer.

Iceland and Liechtenstein are still to position themselves regarding CBAM (as of October 2025).

[20] International Carbon Action Partnership (2025). ICAP ETS Map. https://icapcarbonaction.com/en/ets (last accessed on 15 October 2025).

[21] Japan will move to a mandatory national ETS in 2026.

and carbon leakage protection for the industrial sector are implemented at the European level through the EU ETS 1.

Only few Climate Club members have not implemented explicit measures to address carbon leakage in their carbon pricing policy. This includes systems that only cover the electricity sector (for example the Indonesian ETS), where the carbon leakage risk is limited in certain geographical contexts compared to some industrial sectors that are highly exposed to international trade. In addition, some Climate Club members have carbon pricing policies with protection measures such as free allocation or exemptions in place, but where those measures cannot be considered explicit measures to address carbon leakage, because they are not conditional and exclusive to sectors or entities considered at risk of carbon leakage. This includes the ETS in Kazakhstan, the subnational ETSs in Japan (Tokyo and Saitama), and the carbon taxes in Colombia, Chile, Argentina, and Uruguay. For this reason, these jurisdictions and the corresponding measures are not included in the table.

**Table 2: Explicit Measures to Address Carbon Leakage in Climate Club Member Countries**

| Jurisdiction | Instrument | Carbon Leakage Protection Measure | Sectors Covered by the Measure |
|---|---|---|---|
| Australia | ETS (baseline-and-credit) | **Reduced baseline decline rates** and financial support for decarbonisation through government funds | Trade exposed (TE) facilities |
| Canada federal OBPS + regional OBPS schemes | ETS (baseline-and-credit) | **Less stringent benchmarks for EITE sectors:** Baseline-and-credit scheme exclusively applicable to large industrial emitters from EITE sectors.[22] Less stringent benchmarks apply to EITE activities.[23] Smaller facilities with annual emissions below 50,000 $tCO_2e$ from sectors at risk of carbon leakage and adverse competitiveness impacts can opt in voluntarily. | EITE sectors |
| Canada (Québec) | ETS | **Free allocation (benchmarking):** up to 100% of benchmark level (based on carbon leakage risk assessment) & consignment auctioning | EITE sectors |
| EU | ETS | **Free allocation (benchmarking)**: Sector-specific performance standards that are periodically adjusted to technological progress | EITE sectors |
| EU | ETS | **Border carbon adjustment (EU CBAM):** to be implemented in the definitive phase from 2026 | aluminium, cement, fertiliser, hydrogen, iron and steel, electricity |
| New Zealand | ETS | **Free allocation (grandparenting/ benchmarking)**: up to 100% of the benchmark or historical emission levels | EITE sectors |

[22] The federal OBPS (Output-Based Pricing System) could be seen as a carbon leakage protection instrument, providing an exemption for EITE sectors from the federal fuel charge with the explicit objective to minimise competitiveness and carbon leakage risks while maintaining the price incentive to reduce emissions. The Canadian government has removed the federal fuel charge on 1 April 2025. The federal OBPS remains in place.

[23] The output-based standard under the federal OBPS is generally set at 80% of the national, production-weighted average emissions intensity of a specific activity. Adjusted stringency levels of 90 to 95% apply for selected EITE activities based on the potential competitiveness and carbon leakage risks. For details, see: https://gazette.gc.ca/rp-pr/p2/2019/2019-07-10/html/sor-dors266-eng.html (last accessed 15 October 2025).

| Jurisdiction | Instrument | Carbon Leakage Protection Measure | Sectors Covered by the Measure |
|---|---|---|---|
| Norway | ETS | **Border carbon adjustment:** Norway has announced to introduce a national BCA from 2027 (aligned with the EU CBAM). | to be decided |
| Republic of Korea | ETS | **Free allocation (grandparenting/ benchmarking)**: up to 100% of the benchmark or historical emission levels for EITE sectors<br>In non-EITE sectors up to 90% free allocation | EITE sectors |
| Switzerland | ETS | (Mirroring the EU ETS 1)[24]<br>**Free allocation (benchmarking)**: Sector-specific performance standards that are periodically adjusted to technological progress | aluminium, cement, fertiliser, hydrogen, iron and steel, electricity |
| UK | ETS | **Free allocation (benchmarking)**:<br>A certain share of allowances is allocated for free to EITE sectors, based on the historical activity level, an industry benchmark, and a carbon leakage exposure factor (CLEF). | EITE facilities |
| UK | ETS | **Border carbon adjustment (UK CBAM):** to be implemented from 2027 | aluminium, cement, fertiliser, hydrogen, iron and steel |

### 3.1.1 Australia

The Australian Safeguard Mechanism is a baseline-and-credit scheme with declining emission limits (baselines) for large industrial emitters. Output-based benchmarking based on emissions intensity results in a baseline for each facility. If they emit more, facilities must surrender credits. If they emit fewer emissions, facilities can sell credits. The baselines annually decline by 4.9%, but trade-exposed sectors can apply for a reduced rate down to as low as 1% for manufacturing sectors and 2% for other sectors. Moreover, decarbonisation is supported through government funds.

Moreover, in 2023 the Australian government commissioned a Carbon Leakage Review that includes a study on the feasibility of a BCA for the steel and cement sectors. A 2024 public consultation focused specifically on a BCA for imports in selected industries with a high carbon leakage risk. The resulting consultation paper concluded that the fixed baseline reduction rate of 4.9% per year for facilities covered by the Safeguard Mechanism could increase carbon leakage risks in the future and proposed a phased approach to introducing a BCA particularly for high-risk commodities, starting with cement, clinker, and lime.[25] The BCA's scope could later be extended to other commodities, including ammonia and its derivatives, steel, and glass. The paper emphasises that a BCA would need to mirror key Safeguard Mechanism provisions and could be applied to the emissions exceeding the baseline rates for the respective good and to the extent that the effective carbon price paid in a product's country of origin is lower than in Australia.

[24] The Swiss government announced in 2023 that it will not adopt a national BCA at this time, citing regulatory and trade policy risks. At the same time, the government committed to adjust the Swiss ETS in line with the EU so that the EU and Swiss ETSs can remain linked. This is also a prerequisite for the exemption of Swiss goods from the EU CBAM.

[25] DCEEW (2024). Carbon Leakage Review: Consultation Paper 2. https://consult.dcceew.gov.au/carbon-leakage-review-consultation-paper-november-2024 (last accessed 15 October 2025).

There are still several outstanding issues regarding a potential Australian BCA, including the implications for the current carbon leakage protection measure of lower baseline decline rates for trade-exposed facilities, and the ability of importers to purchase and surrender Australian Carbon Credit Units (ACCUs) to meet their compliance obligations. The review is due to provide final advice on the feasibility of an Australian BCA to the government by the end of 2025.

In addition to a BCA, the Australian government is considering other policy options to address carbon leakage, such as emissions product standards, targeted public investment in industrial decarbonisation including subsidies, and multilateral initiatives.

### 3.1.2 Canada

Canada's multilevel carbon pricing policy includes a federal output-based pricing system (OBPS) that acts as a backstop. Canadian provinces and territories can adopt their own carbon pricing policy or alternatively apply the federal system, which consists of an output-based baseline-and-credit scheme for energy-intensive industries. Each facility has a limit calculated based on its production and an output-based standard, which is an emissions intensity benchmark. The output-based standard declines with a fixed tightening rate of 2% per year for most facilities and 1% for high-risk EITE facilities to address carbon leakage risks.

Québec is one of Canada's provinces with its own subnational carbon pricing policy. The Québec cap-and-trade system includes carbon leakage provisions that consist of free allocation to EITE sectors whereas most allowances are auctioned. An assistance factor is calculated based on trade exposure and emissions intensity. Starting in 2024, Québec introduced consignment auctioning, in which the government sells part of the allowances allocated to EITE sectors at auctions and designates the revenues for low-carbon investments by EITE facilities.

The Canadian federal government has been exploring the introduction of a BCA to address carbon leakage and any resulting competitiveness issues since 2020. It announced plans for a BCA in its 2021 budget and held a public consultation in the fall of 2021. Canada has emphasised a cooperative approach and aimed to use its Climate Club membership as a forum to discuss the topic.

### 3.1.3 European Union

The EU ETS 1 covers the electricity, emission-intensive industrial, domestic aviation, and maritime sectors. It addresses carbon leakage risks through free allocation for EITE sectors based on sector-specific benchmarks, which are regularly updated to reflect technological progress. In the 2026-2030 period, free allocation will become conditional on energy efficiency measures and, for the worst performers, on carbon neutrality plans. With the introduction of the EU CBAM and corresponding to its scope, free allocation will gradually be phased out between 2026 and 2034.

The EU adopted a BCA (EU CBAM) covering sectors at high risk of carbon leakage, namely cement, iron and steel, aluminium, fertilisers, electricity, and hydrogen. In 2023, the EU CBAM started with a transitional phase that will be followed by the definitive phase from 2026. EU importers of goods covered by the CBAM will need to buy and surrender CBAM certificates that correspond to the EU ETS 1 carbon price. If importers can prove that an effective carbon price has already been paid in a non-EU jurisdiction for the embedded emissions of the product, the respective amount will be deducted from the CBAM liability.

### 3.1.4 New Zealand

The New Zealand ETS has a broad sectoral coverage, including forestry, stationary energy, industrial processing, liquid fossil fuels, waste, and synthetic GHGs. It grants free allocation to

EITE activities, based on output and intensity-based benchmarks. Highly emission-intensive trade-exposed activities receive 90% free allocation and moderately emission-intensive trade-exposed activities receive 60% free allocation. Industrial free allocation is being phased down.

In 2021, the New Zealand government carried out a public consultation on reforming free allocation in the NZ ETS, with a third of submissions proposing to introduce an alternative carbon leakage protection mechanism. Several submissions supported the introduction of a BCA, citing the need to phase out free allocation while still providing protection against carbon leakage. The government, however, did not include the potential introduction of a BCA in its proposed reforms of the industrial allocation policy under the NZ ETS that were announced in July 2022. A set of mostly technical reforms were adopted in 2023 and there are currently no plans to introduce a BCA. This can partly be explained by industry pressure to retain free allocation.

### 3.1.5 Norway

Norway is a member of the European Free Trade Association (EFTA) and participates in the EU ETS 1 since 2008. The Norwegian government announced in March 2025 that it will introduce a domestic BCA for imports of certain emissions-intensive goods, aligning with the EU CBAM's scope and design, from 2027.

As a result of participating in the EU ETS 1, Norway is exempted from the scope of the EU CBAM and will conversely not apply its BCA to imports from other countries participating in the EU ETS (EU Member States and the other EFTA countries Iceland and Liechtenstein) as well as from Switzerland, which has a domestic ETS that is linked to the EU ETS.

### 3.1.6 Republic of Korea

The Korean ETS covers a wide range of sectors, including the electricity, industry, buildings, waste, transport, domestic aviation, and domestic maritime transportation sectors. The system has a high degree of free allocation with a requirement to auction at least 10% of allowances in defined sectors. EITE sectors receive 100% free allocation if they meet certain criteria related to production costs and trade intensity benchmarks. Given the very high degree of free allocation across all sectors, this measure can thus be considered a mild form of direct carbon leakage protection.

While carbon leakage has been part of the discussion, other aspects of the functioning of the ETS such as the low level of trading activities and the high level of free allocation currently figure higher on the political agenda and debate. The reason for this could be the high degree of free allocation across the entire system. When auctioning is expanded, carbon leakage protection may rise on the political agenda.

### 3.1.7 Switzerland

The Swiss ETS covers the electricity, emission-intensive industrial, and domestic aviation sectors. It has been formally linked with the EU ETS 1 since 2020 and consequently mirrors the EU rules, including the gradual phase-out of free allocation for CBAM sectors starting from 2026.

The Swiss government announced in 2023 that it will not adopt a national BCA at this time, citing regulatory and trade policy risks. At the same time, the government committed to adjust the Swiss ETS in line with the EU ETS 1 so that the EU and Swiss ETSs can remain linked. This is also a prerequisite for the exemption of Swiss goods from the EU CBAM.

### 3.1.8 Türkiye

In July 2025, the Turkish parliament adopted the country's first Climate Law that, among other things, establishes the legal basis for a national ETS in Türkiye. A pilot phase is expected to start in 2026.

A study by Vivid Economics found that seven out of nine MRV sectors in Türkiye are at high risk of carbon leakage under a potential domestic carbon pricing instrument, including cement, ceramics, chemicals, lime, metals, and glass. To mitigate the carbon leakage risk and ease the introduction of the Turkish ETS, all allowances will likely to be allocated for free (through grandparenting) during the pilot phase and the first years of the definitive system. The Turkish ETS is also expected to adopt an intensity-based cap rather than an absolute one, similar to other systems in Asia (China, India).

Turkish officials have announced that the domestic ETS should be complemented by a BCA in the future to mitigate negative impacts on the competitiveness of domestic industry.

### 3.1.9 Ukraine

Ukraine is developing an ETS to prepare for possible accession to the EU. A 2024 action plan announced an ETS pilot phase to begin in 2028.

The implementation of a national BCA in parallel to the introduction of a domestic ETS is being discussed as a measure to protect local producers of carbon-intensive products in the domestic market. The measure is actively supported by Ukrainian industry associations, but so far it has not featured prominently in the domestic policy debate and does not appear in official documents.

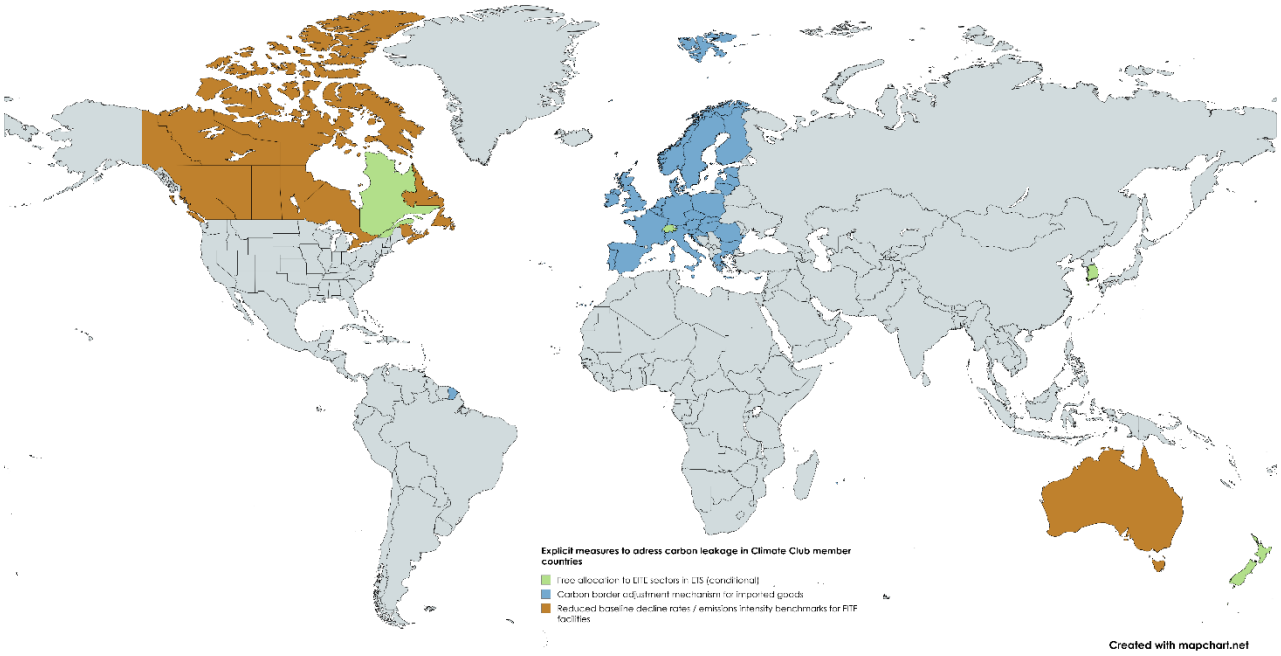
### 3.1.10 United Kingdom

Following the UK's exit from the EU, the UK ETS was adopted in 2021. It covers the industrial, electricity, and domestic/EEA aviation sectors. Industrial entities at risk of carbon leakage are eligible for free allocation, based on their historical activity level, an industry benchmark, and a carbon leakage exposure factor.

In December 2023, the UK government announced that it will introduce a BCA (UK CBAM) by 2027 with a design expected to be very similar to the EU CBAM. Initially, it will cover imports of specific goods in the aluminium, cement, fertilisers, iron and steel, and hydrogen sectors. Similar to the provision of the EU CBAM on the recognition of third-country carbon prices, UK importers will only be required to pay the difference between the UK CBAM carbon price and the carbon price effectively paid in the country of origin.[26]

[26] For more information on the UK CBAM, see: https://www.gov.uk/government/publications/factsheet-carbon-border-adjustment-mechanism-cbam/factsheet-carbon-border-adjustment-mechanism (last accessed on 15 October 2025).

**Figure 2: Map of Explicit Measures to address carbon leakage in Climate Club Member Countries**




**Legend:** Explicit measures to address carbon leakage in Climate Club member countries (as of October 2025)

- Free allocation to EITE sectors in ETS (conditional)
- Carbon border adjustment mechanism for imported goods
- Reduced baseline decline rates / emissions intensity benchmarks for EITE facilities

Source: mapchart.net (authors' own creation)

## 3.2 Selected Non-Climate Club Members

Several of the largest GHG emitting economies have not (yet) joined the Climate Club. Their policies are highly relevant for increasing global climate ambition and addressing carbon leakage risks. This section zooms into the measures to address carbon leakage of selected non-Climate Club members with carbon pricing policy in place (China, South Africa, several subnational jurisdictions in the USA[27]) or under development (India, Mexico). It shows that these countries mainly use free allocation and exemptions, even if they do not explicitly refer to carbon leakage risks because the criteria used are not explicitly linked to energy intensity and trade exposure (EITE). Other reasons such as general concerns about cost increases and the early stage of the system in which covered entities need to be accustomed to the system play additional roles. South Africa, California, and Washington State are the only jurisdictions in our selection with measures that exclusively apply to sectors at risk of carbon leakage. Yet, in the South African carbon tax, carbon leakage risk is not the only ground on which exemptions are granted.

[27] The USA withdrew from the Climate Club in July 2025.

**Table 3: Measures to Address Carbon Leakage in selected Non-Climate Club Members with Carbon Pricing in place**

| Jurisdiction | Instrument | Protection measure | Sectors covered by the measure |
|---|---|---|---|
| China | National ETS, regional ETS pilots | **Free allocation (grandparenting/benchmarking)**: up to 100%, with a small share of allowances being auctioned. | Industry (all covered sectors) |
| Mexico | ETS (pilot) | **Free allocation (grandparenting):** 100% during the pilot and transitional phase (2020-2022)[28] Auctioning is expected to be introduced in the system going forward. | Industry (all covered sectors) |
| Mexico | Carbon tax (upstream) at the federal level[29] | **Exemption** for natural gas, as well as other fossil fuels not intended for combustion processes such as paraffin. | All sectors |
| South Africa | Carbon tax (point source) | **Exemptions:** The carbon tax offers companies tax-free allowances ranging from 60-95% of their emissions, reducing the effective carbon tax rate. Additional tax-free allowances up to 10% are provided for trade-exposed companies, and up to 5% for those outperforming their respective industry's GHG emission intensity benchmarks. | Trade-exposed companies |
| United States (California) | ETS | **Free allocation (benchmarking)**: up to 100% of benchmark level | EITE sectors |
| United States (California) | ETS | **Border carbon adjustment** | Electricity |
| United States (Washington State) | ETS | **Free allocation (benchmarking/ grandparenting)**: 100% of the benchmark level for first compliance period (2023-2026) | EITE sectors |

### 3.2.1 China

China has operated subnational ETSs since 2013 and launched its national ETS in 2021. The national ETS covers the electricity sector and expanded to the cement, steel, and aluminium sectors in 2025. None of the Chinese systems includes explicit measures to address carbon leakage. The subnational ETSs largely allocate allowances for free with a small share of

[28] The rules for the operational phase of the Mexico ETS that started in January 2023, including allocation and possibly carbon leakage protection, have not been published yet as of August 2025.

[29] There are also subnational carbon taxes in place in several Mexican states, covering fuel combustion emissions from stationary installations.

auctioning, and the national system fully allocates allowances for free. Auctioning is to be introduced but no timeline has been announced so far.

The discussion on carbon leakage risks remains in the academic realm. Competent authorities of neither the ETS pilots nor the national ETS have initiated official discussions on policy designs to avoid carbon leakage. With the high degree of free allocation, this does not seem necessary since it has the same effect as explicit measures to address carbon leakage.

### 3.2.2 Mexico

The Mexican ETS covers the electricity and industrial sectors. So far, covered entities receive 100% of allowances for free. This is expected to be reduced in the future; however, no specific timeline has been announced yet.

The concept of carbon leakage was considered in the design of Mexico's 2020 pilot ETS. In preparation for the launch of the pilot ETS, the government commissioned an analysis in 2018 to assess the risk of carbon leakage in the covered sectors. According to this analysis, the iron, steel, cement, glass, and chemical industries are at high risk, while the pulp and paper subsector is considered at medium risk of leakage. Key recommendations, including a gradual reduction of grandparenting and the collection of data during the pilot phase for a detailed assessment of leakage, have been incorporated into the regulation. The government is currently developing regulations for the operational phase, including an auctioning mechanism.

### 3.2.3 South Africa

South Africa's 2019 carbon tax covers all types of fossil fuels combusted by large businesses across the industrial, electricity, and transport sectors. Exemptions are granted based on various factors, including trade exposure.

There are currently no public discussions in South Africa regarding other or additional measures to address carbon leakage. This can be explained with the low effective price level and the carbon tax's relatively narrow scope.

### 3.2.4 United States of America[30]

Carbon pricing in the USA consists of several subnational systems, which, however, do not cover the entire country. Among these, California and Washington State are the two US states with measures to address carbon leakage in their carbon pricing policies. The Northeastern states that form the Regional Greenhouse Gas Initiative (RGGI), covering the electricity sector have not adopted BCAs. In California and Washington State, possible carbon leakage to other US states as well as internationally are a matter of concern. California's cap-and-trade system covers the electricity, industrial, transport, and building sectors. It uses free allocation to industrial facilities as carbon leakage protection measure. The amount of free allocation is determined by product-specific benchmarks, recent production volumes, a cap adjustment factor, and an assistance factor based on the leakage risk. This leakage risk is categorised in low, medium, and high, calculated as the result of emission intensity and trade exposure for each industrial sector. For electrical distribution utilities and natural gas suppliers, free allocation with consignment applies. The allowances auction revenues must be used for investments benefiting the covered entities and supporting GHG emission reductions.

Washington State's cap-and-invest system covers the energy, industrial, building, and transport sectors. It includes free allocation for EITE facilities using facility-specific benchmarks based on their average carbon intensity in the 2015-2019 period. In addition, free allocation with

[30] The United States withdrew from the Climate Club in July 2025.

consignment applies to electricity utilities and natural gas facilities, because they are subject to carbon leakage risks at the US subnational level. For electricity utilities this free allocation is based on electricity supply forecasts and administrative costs for compliance with the system. For natural gas facilities it is based on a gradually reducing share of their average emissions in the period 2015-2019. Revenues from consigned auctions must benefit covered entities and customers with special consideration for low-income households.

Prior to the second Trump administration, the EU CBAM sparked renewed bipartisan interest in Congress for a similar approach at the US national level.[31] During the Biden administration, there was also discussion of forming a 'common carbon border agreement' with trading blocs such as the EU and Canada, possibly in a 'climate club' arrangement. In fact, a potential border carbon adjustment on emissions-intensive imports has been discussed at the federal level since the late 2000s.[32] In recent years, lawmakers from both parties introduced proposals for a BCA on carbon-intensive goods, citing the relatively low emission intensity of US industry. In June 2022, Democratic Senator Sheldon Whitehouse (D-RI) introduced the *Clean Competition Act*[33] to impose a BCA on goods from energy-intensive sectors, including fossil fuels, refined petroleum products, petrochemicals, and various other industries such as cement, iron, steel, aluminium, and more. The proposal entailed a $55 per tonne carbon tax on both imported and domestically produced goods. Companies would have been required to pay for emissions above their industry's average, with importers taxed based on their home country's industry emissions relative to the domestic industry. US companies covered by the bill would have received rebates for exported products. The bill did not move forward.

In November 2023, Republican Senator Bill Cassidy introduced the *Foreign Pollution Fee Act*[34] with the aim of establishing a BCA framework without a domestic carbon tax. The bill aimed to leverage the cleaner emissions of US manufacturers compared to those of their foreign competitors. A fee would have been imposed on imported products with emission intensity more than 50% higher than that of a US product, increasing over time. However, with Donald Trump's second inauguration as US President in January 2025, such initiatives have become unlikely in the near future.

### 3.2.5 Brazil

In 2024, Brazil approved a law establishing an ETS for the mining and extractives, electricity, industrial, waste and, in principle, aviation, transport and maritime sectors. Allowance allocation is to be determined by a National Allocation Plan.

While the planned introduction of a domestic ETS in Brazil is still in early stages, the government is actively considering the implementation of a national BCA to safeguard the competitiveness of domestic industry and mitigate carbon leakage risks. In the first stages of the ETS, it can be expected that carbon leakage risks will be addressed through free allocation of allowances to trade-exposed sectors.

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[31] For more information on the proposals that have been introduced to the U.S. Congress and a comparison with the EU CBAM, see Pomerleau, S. (2024). *Carbon border adjustment bills: How do the U.S. proposals compare to the EU one?* Blog post Niskanen Center: https://www.niskanencenter.org/carbon-border-adjustment-bills-how-do-the-u-s-proposals-compare-to-the-eu-one/ (last accessed on 15 October 2025).

[32] Tagliapietra, S. and McWilliams, B. (2021). *Carbon border adjustment in the United States: Not easy, but not impossible either*. Blog post. Bruegel: https://www.bruegel.org/blog-post/carbon-border-adjustment-united-states-not-easy-not-impossible-either (last accessed on 15 October 2025).

[33] https://www.whitehouse.senate.gov/news/release/whitehouse-and-colleagues-introduce-clean-competition-act-to-boost-domestic-manufacturers-and-tackle-climate-change/ (last accessed on 15 October 2025).

[34] https://www.congress.gov/bill/118th-congress/senate-bill/3198/text#:~:text=Introduced%20in%20Senate%20(11%2F02%2F2023)&text=To%20amend%20the%20Internal%20Revenue,products%2C%20and%20for%20other%20purposes. (last accessed on 15 October 2025).

Moreover, as part of its COP30 Presidency Brazil proposed to establish an Open Coalition for Carbon Market Integration that aims to harmonise standards and increase interoperability between existing ETSs. One of the objectives is to reduce the risk of carbon leakage.[35]

### 3.2.6 India

The Indian government has adopted a decision to establish a domestic carbon market that will include a compliance component in the form of an intensity-based baseline-and-credit system (CCTS). It is expected to become operational in 2025 and will initially cover nine energy-intensive industrial sectors. Entities must surrender compliance units for emissions that exceed individual installations' baselines. This annual emissions limit is based on an emissions intensity benchmark.

There has been some discussion in India about possible response measures to the EU CBAM, targeting EU exports on the basis of their carbon content. However, this has been rather in the realm of India's public opposition to CBAM, instead of carbon leakage protection associated with the country's ongoing efforts to establish an Indian Carbon Market with a compliance component for energy-intensive industries. So far, there has been no public debate on the potential risk of carbon leakage or protection measures in this context.

[35] For more information on the proposal, see: https://cop30.br/en/news-about-cop30/brazil-proposes-global-integration-of-carbon-markets-at-cop30(last accessed on 15 October 2025).

# 4 Discussion and Conclusions

More than two thirds of Climate Club members have a carbon pricing policy in place and almost all of them have adopted measures to address carbon leakage. Yet, section 3 illustrates that the adopted carbon pricing policies and their measures to address carbon leakage differ. This variety of measures creates compliance inefficiencies: Companies that operate in multiple countries must comply with different rules and regulations. In the absence of globally harmonized climate ambition and given the diversity of measures to address carbon leakage, streamlining and harmonising those measures is a second-best alternative so as to avoid inefficiencies and maximise ambition. Diverging measures to address carbon leakage with different methodologies and requirements impose a high compliance burden on producers covered by diverse measure. Exemptions and compensation mechanisms also decrease the incentives for covered entities to lower emissions, which creates additional inefficiencies.

So far, the most common measure to address carbon leakage has been free allocation of emission allowances to EITE sectors. Free allocation reduces the carbon costs for eligible companies. Yet, when the cap continuously declines, allowances will get scarce and the incentive to decarbonise (or relocate) will result from the tightening cap. The closer we move to net-zero, the more decarbonisation is necessary, also in EITE sectors. If such reduction does not happen (fast enough), there will be a point where the cap of an ETS is lower than the emissions of the EITE sectors covered. It then becomes increasingly difficult to reach the climate goals and at the same time provide adequate carbon leakage protection.

That was one of the reasons for the recent adoption of the EU CBAM. Some other countries are following suit (UK and Norway) or consider doing so (Australia, Canada, Japan, Brazil, Türkiye, Taiwan). This trend can however lead to a new patchwork in which multiple ETSs and BCAs with different requirements pose a high burden for companies globally, which would undermine social acceptance of these measures and lower the overall efficiency. Using the same or mutually recognising requirements and methodologies (for example on the measurement of carbon intensity of products, but also how carbon prices in external countries are calculated and considered) can ease this burden.

The Climate Club works towards this end. It has identified different cooperation approaches: information exchange to foster learning, interoperability of monitoring, reporting, and verification (MRV) systems and carbon intensity measurement, mutual recognition of carbon intensity measurement, and international solutions.[36] Climate Club members should explore how they can apply those approaches to the area of measures to address carbon leakage so as to avoid inefficiencies in anticipation of future BCAs and carbon pricing policy adoptions. Avoiding inefficiencies through the implementation of common or interoperable standards for the MRV of emissions is in the mutual interest of all EITE companies acting on the global market as it reduces compliance costs. The same applies to mutual recognition of standards for the accreditation of verifiers.

The Climate Club has already identified that establishing interoperable MRV systems can help lower compliance costs.[37] Interoperability of MRV systems means that data collected in one MRV system can be transferred to another MRV system. A detailed study of different MRV systems identifying similarities and differences could support achieving this. The Climate Club's Pillar 1,

[36] Climate Club (2024). *Summary Report of the Strategic Dialogues on Causes and Relevance of Spillovers from Mitigation Policies*. Paris, OECD. https://climate-club.org/wp-content/uploads/2024/11/Climate-Club-_-Strategic-Dialogues-on-Spillovers_-Summary-Report_Final.pdf (last accessed on 15 October 2025).

[37] Climate Club (2024). *Summary Report of the Strategic Dialogues on Causes and Relevance of Spillovers from Mitigation Policies*. Paris, OECD. https://climate-club.org/wp-content/uploads/2024/11/Climate-Club-_-Strategic-Dialogues-on-Spillovers_-Summary-Report_Final.pdf (last accessed on 15 October 2025).

Module 1 aims to develop a common understanding of methodologies for calculating the emission intensity of cement and steel products. Pillar 2, Module 2 aims to promote international cooperation on interoperable standards. This is however far more than a technical process. It also is a matter of policy alignment and trust building.

The establishment of interoperable MRV systems faces several challenges: Interoperable systems rely on credible and verifiable data, which can pose challenges for some countries' capacity in terms of data collection, monitoring technologies, and institutional oversight. Nonetheless, trust in the accuracy and integrity of reported data is essential for mutual recognition. In some cases, there may also be legal incompatibilities in the area of data protection and intellectual property. Developing interoperable MRV systems is technically demanding, requiring standardisation of data formats, interfaces, and protocols. It also necessitates investment in digital infrastructure and capacity building, especially in emerging economies. The costs and expertise required for such upgrades may be high for some countries, potentially exacerbating inequalities and limiting the inclusivity of global climate action. These efforts' success hinges on sustained political will, transparent dialogue, and the ability to accommodate diverse national circumstances.

Some heterogeneity of climate policies will remain but reducing frictions that result from the policy patchwork is important. The newly emerging diffusion of BCAs is an opportunity to bake compatibility into their designs. Designing policies in a compatible manner from the outset is easier than changing existing policies and reverting established path dependencies.

Not all major GHG emitters have joined the Climate Club so far. They account however for a sizeable share of global GHG emissions and play an important role in the carbon leakage discussion.

Finding technical solutions to make processes and regulations more compatible is often complicated by politics. Implementing a carbon pricing policy and developing requirements such as MRV generally is done at the technical level. Yet, the higher-level decisions on which implementing decisions are based are the result of national or regional political processes. For this reason, understanding under which circumstances which policies can be politicised and trigger retaliation and fragmentation and, on the flip side, which policies encourage cooperation is another essential factor to fostering cooperation.

Our exploration of measures to address carbon leakage in carbon pricing policies highlights several areas for future research:

- While this paper focuses on measures to address carbon leakage in carbon pricing policies, some jurisdictions use measures to address carbon leakage in non-carbon pricing policies such as minimum environmental requirements for imported goods. Climate policies such as energy efficiency standards, renewable energy promotion, and support of low-carbon technology development also influence the incentives and disincentives to relocate carbon emissions but probably affect the risk of carbon leakage in different manners. Expanding the scope of the analysis to non-carbon pricing climate policy can generate additional insights that are important for identifying the scope of cooperation and harmonisation within the Climate Club and beyond.

- As mentioned above, a detailed study of different MRV systems and methodologies identifying similarities and differences could support establishing interoperable MRV systems which can help lower compliance costs.

- Research on the conditions under which carbon leakage protection measures foster and incentivise collaboration rather than trigger backlash and retaliation can provide useful insights into how processes of ratcheting up climate ambition can be initialised.

Initiatives such as the Climate Club that foster strategic dialogue and work towards common principles in the design and implementation of measures to address carbon leakage, with the aim of achieving alignment and avoiding friction between different policies, can be crucial in harnessing and ratcheting up countries' ambitions.

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