

Carbon Pricing at the Border

How system design shapes
competitiveness, credibility and trade

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Kari Hyde



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The Pembina Institute recognizes that the work we steward and those we serve span the lands of many Indigenous Peoples. We respectfully acknowledge that our organization is headquartered in the traditional territories of Treaty 7, comprising the Blackfoot Confederacy (Siksika, Piikani and Kainai Nations); the Stoney Nakoda Nations (Goodstoney, Chiniki and Bearspaw First Nations); and the Tsuut'ina Nation. These lands are also home to the Otipemisiwak Métis Government (Districts 5 and 6).

These acknowledgements are part of the start of a journey of several generations. We share them in the spirit of truth, justice and reconciliation, and to contribute to a more equitable and inclusive future for all.

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Executive summary

Carbon pricing is now in place across many major economies, and is increasingly shaping how goods are produced, how companies invest, and how countries trade. With the introduction of carbon border measures, carbon pricing is no longer only a domestic policy tool for reducing greenhouse gas emissions — it is becoming a core component of industrial competitiveness and trade alignment.

This report examines how carbon pricing is designed and implemented in seven key jurisdictions: Canada, the European Union, the United Kingdom, California–Québec, Korea, China, and Australia. It also explores how border adjustments are starting to be considered and implemented.

What we found

Across jurisdictions, carbon pricing is generally part of a comprehensive framework in which pricing, coverage, compliance, and governance are designed to work together. While all frameworks share these core elements, how they are applied varies.

We also found that there is a growing connection between carbon pricing and trade. The European Union has implemented a Carbon Border Adjustment Mechanism (CBAM), and at least one other jurisdiction is exploring a similar approach. These developments signal that carbon costs are beginning to move across borders as jurisdictions look to use them to protect their own low-carbon policies and ensure that production and supply chains do not simply move to jurisdictions with weaker policies.

What this means for Canada

Canada's carbon pricing framework is more decentralized than many of the jurisdictions reviewed. The federal Output-Based Pricing System operates alongside provincial and territorial systems that vary in design, pricing, coverage and implementation.

As carbon pricing becomes more closely linked to trade, these differences take on greater significance, while the ability to clearly demonstrate the emissions and carbon costs associated with Canadian goods is growing in importance. Variations in electricity emissions, pricing approaches, compliance requirements and the reinvestment of carbon pricing revenues can affect how Canadian goods are assessed in international markets. These variations may also affect competitiveness differently across regions and emissions-intensive industries.

Next steps

The research identified three areas that require further exploration:

- where greater consistency and comparability across Canada's carbon pricing systems may be valuable
- how carbon pricing revenues can best support industrial decarbonization
- what actions Canada may need to take (if any) for its carbon pricing system to be recognized as credible and comparable by trading partners

The next phase of the research will explore these issues through engagement with emissions-intensive sectors, industry associations, subject matter experts and other impacted stakeholders. This input will help validate the findings, identify where Canada's current approach creates benefits or challenges, and inform future discussion on policy design, implementation and coordination in support of both decarbonization and competitiveness.

1. Introduction

Carbon pricing is now in place across most major economies globally, covering 29% of global greenhouse gas emissions. It is shaping how industries produce goods, how companies invest, and increasingly, how countries trade. At the same time, the conversation is shifting.

Carbon pricing is no longer just about domestic emissions reduction. It is directly connected to competitiveness, supply chains and access to international markets. This shift is being driven in part by the introduction of carbon border measures (also known as “border carbon” measures).

Key terms

Carbon border measure: A policy that applies a carbon cost to imported goods based on their emissions, with the aim of aligning the carbon costs faced by domestic and foreign producers.

Carbon leakage: The relocation of production to regions with lower or no carbon pricing, resulting in emissions being shifted rather than reduced.

The most widely known example of a carbon border measure is the European Union’s Carbon Border Adjustment Mechanism (CBAM), which applies a carbon price to certain imports — such as steel, cement, aluminum, fertilizers and electricity — based on the EU’s domestic carbon pricing system.

Together, the expansion of carbon pricing systems and the introduction of carbon border measures signal a new phase — one in which carbon costs are increasingly reflected in cross-border trade and the design of carbon pricing is becoming more closely linked to trade relationships.

This raises a practical question:

How are carbon pricing systems designed and applied across different economies, and what do their similarities and differences tell us about competitiveness, investment and trade alignment?

To explore this, we conducted a comparative review of carbon pricing systems across several major jurisdictions, representing a range of approaches and differing levels of maturity. The jurisdictions and systems examined were as follows:

- Canada: Output-Based Pricing System (OBPS)
- European Union Emissions Trading System (EU ETS) and CBAM
- United Kingdom: Emissions Trading System (UK ETS)
- California–Québec: Western Climate Initiative (WCI)
- Korea: Emissions Trading System
- China: National Emissions Trading System
- Australia: Safeguard Mechanism

For each jurisdiction, we assessed:

- the type of carbon pricing instrument used
- the level and trajectory of the carbon price
- industrial coverage and participation thresholds
- approaches to trade exposure, including measures to manage carbon leakage
- approaches to revenue generation and reinvestment
- governance and market structures
- readiness for trade-linked carbon border measures

This report provides an overview of how carbon pricing systems are designed and operate across different jurisdictions. It identifies common structural elements, highlights key differences in design, and examines how jurisdictions are addressing trade exposure and preparing for carbon border measures. The review also highlights that while system design influences how carbon pricing functions, outcomes depend not only on design, but also on how the systems operate in practice.

The findings establish a foundation for understanding how carbon pricing design influences competitiveness, investment signals and trade alignment. They also identify areas for further examination through engagement with emissions-intensive and trade-exposed industries, industry associations, subject matter experts, and other impacted stakeholders.

2. The core elements of carbon pricing systems

Across the jurisdictions reviewed, carbon pricing systems differ in their design and implementation. However, they share a common set of core elements:

- coverage (which sectors and facilities are subject to carbon pricing)
- compliance and governance (how emissions are measured, reported and verified)
- pricing (how carbon costs are determined and applied)
- measures to address trade exposure and carbon leakage
- mechanisms that support investment in emissions reduction

Coverage, compliance and governance

Carbon pricing is not implemented as a standalone policy. It operates as part of a broader system with defined rules, processes and institutional structures. Each carbon pricing mechanism sets out which sectors and facilities are covered and establishes how emissions are measured, carbon costs are applied, and compliance is enforced.

Across jurisdictions, formal measurement, reporting and verification (MRV) systems are in place through governance and compliance requirements to track and confirm emissions data.

Pricing

Carbon pricing systems apply a cost to greenhouse gas emissions, and the way that cost is determined depends on system design. In systems like the EU and California–Québec, that price is determined through the market trading of emissions allowances under a declining emissions cap. Conversely, in large emitter trading systems like Canada’s OBPS, governments set emissions performance standards and a price for emissions above those standards, while allowing facilities to trade credits or use other compliance options. Carbon pricing systems also include ways to manage price levels and provide a degree of predictability over time.

Trade exposure and carbon leakage

Trade exposure is also addressed directly within carbon pricing design. Across the jurisdictions reviewed, carbon pricing systems include, or are moving to include, specific provisions for industries that produce high emissions and compete internationally. These provisions usually take the form of free allocation — where companies receive emissions allowances at zero cost,

often based on production levels or efficiency benchmarks — or output-based approaches that adjust carbon costs based on how efficiently a facility manufactures goods.

Investment in emissions reduction

Carbon pricing can also support investment in emissions reduction. Depending on the system design, carbon pricing may directly generate revenue that can be funneled to climate-related investments, including industrial decarbonization and clean technology deployment. However, in some systems, the relationship between the two is less direct.

3. How carbon pricing systems differ in practice

While carbon pricing systems share common structural elements, they differ across jurisdictions in how they are governed, how carbon prices are determined and changed over time, how trade exposure is addressed, and how revenue is generated and used.

System structure and governance

One of the most visible differences among the jurisdictions is how carbon pricing systems are structured and governed. In the EU and the UK, carbon pricing is implemented through centralized systems that apply consistent rules across covered sectors. Under the WCI, California and Québec coordinate pricing, trading and compliance under a shared market structure.¹

In contrast, Canada's approach combines a federal system with provincial and territorial frameworks. Provinces can design and implement their own carbon pricing programs provided they meet federal requirements. The federal OBPS acts as a backstop, applying to provinces and territories that do not have their own equivalent carbon pricing mechanism in place. This more flexible structure results in variation in how carbon pricing is designed and applied across the country, including coverage and pricing approaches.

Differences are also evident in how carbon pricing is managed in practice. In the EU and the California-Quebec market, centralized systems track emissions and support the trading of allowances. These include registries to track ownership, auction platforms where allowances are sold, and oversight bodies that monitor activity, making the carbon price visible through trading. In other jurisdictions, market activity is more limited or more tightly managed.

Carbon pricing instruments and price formation

There are also differences in how carbon prices are determined and compliance costs are incurred. In the EU ETS and WCI, the carbon price is set through trading, whereby companies buy and sell emissions allowances. The price reflects supply and demand and can change over time depending on the number of goods companies are producing and the emissions associated with that production, along with the number of allowances available.

¹ As we were preparing this report, the State of Washington announced that it would be linking its Cap-and-Invest Program with the California-Québec carbon market. This expanded joint market, which is expected to begin operating in 2027, reaffirms that carbon pricing systems are becoming more integrated across jurisdictions.

In Canada's OBPS and Australia's Safeguard Mechanism, carbon pricing is structured around government-defined price trajectories; however, the actual cost to companies — referred to as compliance costs — can vary depending on how they meet their obligations, including through the use of credits, offsets or trading mechanisms. These approaches are designed to gradually strengthen the incentive to reduce emissions while providing industry with more certainty for planning and investment.

In Korea and China, pricing works differently. Companies can trade emissions allowances, but the government still shapes the market by determining how many emissions permits are available, which affects how easy they are to obtain and how much they cost.

Industrial coverage

The jurisdictions do not follow a uniform approach in terms of the breadth of sectors included under their carbon pricing systems and the emissions criteria for inclusion. While most systems focus on large industrial emitters, they vary in the sectors covered and the thresholds used to determine participation. Some systems apply carbon pricing across a broader range of sectors, while others focus on specific industries or emissions sources.

Trade exposure and carbon leakage

How jurisdictions handle trade exposure varies. In some cases, carbon pricing also includes measures to limit cost impacts for emissions-intensive, trade-exposed industries. In the EU and UK, companies receive some emission permits at no cost, reducing their exposure to carbon costs. Korea relies heavily on this same model.

Canada takes an alternative approach. Under the OBPS, facilities are given a performance standard based on how efficiently goods are manufactured. Companies pay the carbon price on emissions above that level, which lowers costs for more efficient producers.

Some jurisdictions are beginning to change how carbon costs are handled. The EU has introduced CBAM, which applies a carbon price to certain imported goods within specific sectors based on the emissions created during their production. This is being introduced alongside the gradual reduction of no-cost permits for domestic industries.

Trade equivalency and carbon border measures

The introduction of carbon border measures has also increased attention on how carbon pricing systems are assessed across trading partners.

In this context, trade equivalency does not necessarily mean that carbon pricing systems must be identical. It means that trading partners can compare whether emissions are measured

credibly, whether a meaningful carbon cost is applied, how trade-exposed industries are treated, and whether carbon costs already paid in the exporting jurisdiction can be recognized. Price levels are one part of this assessment, but so are sector coverage, performance benchmarks, compliance options, verification requirements and the emissions associated with producing a good.

The UK is moving to implement similar measures to CBAM, while Australia is also exploring adopting carbon border measures.

Revenue generation and reinvestment

Revenue generation and reinvestment also vary across jurisdictions. In programs such as the EU ETS and the California–Québec WCI, governments collect revenue by selling emissions allowances to companies. These funds are often reinvested into activities such as industrial decarbonization and clean technology deployment.

In Canada, under the OBPS, facilities are provided with an emissions performance standard and are only required to provide compliance units for emissions above that level. These compliance units may include surplus credits, offset credits, or excess emissions charge payments, rather than purchased allowances. As a result, revenue is generated differently and less consistently through the carbon pricing system, and the connection between pricing and reinvestment is less direct.

Carbon price levels and trajectories

Carbon price levels and trajectories vary across jurisdictions. In the EU and the California–Québec market, prices have trended upward over time, with periods of volatility driven by market conditions. Both markets experienced persistently low prices for the first several years of operation. In contrast, Korea and China maintain lower price levels and rely more on controls over supply and allocation to manage how prices evolve.

Table 1 provides a summary comparison of the carbon pricing systems examined.

Table 1. Comparison of assessed carbon pricing systems according to key features

Feature	EU ETS / UK ETS	California–Québec WCI	Australia Safeguard Mechanism	Canada OBPS	Korea ETS / China ETS
System structure	Centralized cap-and-trade systems with consistent rules across sectors	Linked cap-and-trade system spanning two jurisdictions with coordinated governance	National baseline-and-credit system with centralized governance	Federal backstop alongside provincial and territorial systems	National emissions trading systems with centralized oversight
Instrument type	Cap-and-trade with declining emissions cap	Cap-and-trade with linked markets and joint auctions	Intensity-based system with tradable compliance credits	Output-based pricing system (intensity-based) with compliance obligations above benchmark	Korea: Cap-and-trade China: Intensity-based with administrative controls
Headline carbon price	Market-determined price with increasing stringency and price stability mechanisms	Market-determined price guided by auction design and a price floor	Government-set price trajectory with compliance costs influenced by credit trading	Government-set price trajectory with scheduled increases; provincial pricing can differ from federal pricing	Market-influenced price shaped by allocation and administrative controls; price level limited by government
Industrial coverage	Electricity generation, aviation (within EU) and heavy industry, including cement, steel, aluminum, chemicals and refining (CBAM applies to a subset of these sectors)	Electricity generation, fuel suppliers and large industrial facilities above emissions thresholds	Large industrial facilities above emissions thresholds, including mining, oil and gas, and heavy industry	Large industrial facilities above emissions thresholds (varies by province), including oil and gas, electricity and heavy industry	Korea: Electricity and major industrial sectors China: Electricity, steel, cement, aluminum

Feature	EU ETS / UK ETS	California–Québec WCI	Australia Safeguard Mechanism	Canada OBPS	Korea ETS / China ETS
Carbon leakage protection	Free allocation based on benchmarks, with planned phase-down as CBAM is introduced	Free allocation for emissions-intensive, trade-exposed sectors	Baseline setting and crediting mechanisms that limit costs for emissions-intensive, trade-exposed facilities	Output-based standards that apply the carbon price only to emissions above a facility-specific emissions limit	Korea: High levels of free allocation for covered sectors, including emissions-intensive and trade-exposed industries China: Free allocation through output-based benchmarks, which limits direct compliance costs for covered facilities
Revenue generation and reinvestment	Revenue from auctioned allowances reinvested in climate programs, innovation funds and industrial decarbonization	Revenue from auctioned allowances reinvested in clean energy and climate programs	Limited direct revenue generation as compliance is based on baselines and crediting rather than allowance auctions	Limited direct revenue due to the use of performance standards and compliance units (credits, offsets, payments) rather than allowance auctions	Revenue generation is less likely to be reinvested for innovation
Market stability / governance	Central registry, auction platform, market stability reserve and MRV requirements	Coordinated governance, centralized registries and joint auction platform	Centralized governance with compliance tracking and crediting framework; limited market trading compared to cap-and-trade systems	Mixed governance across federal and provincial programs; MRV and compliance requirements in place	Centralized oversight with registry and compliance frameworks in place

Feature	EU ETS / UK ETS	California–Québec WCI	Australia Safeguard Mechanism	Canada OBPS	Korea ETS / China ETS
Carbon border measures	EU: CBAM in force UK: Similar approach under development Both aligned with domestic carbon pricing and sector coverage	None	None but considering CBAM-like measures	None	None

Data source: See Appendix A: Resources used.

4. What this means for Canada

The recent inclusion of carbon border measures by key trading partners points to a clear shift in how carbon pricing is being designed and applied globally. What was once primarily a domestic policy tool is becoming more integrated with trade, industrial competitiveness, and investment decisions, with consequences for Canada.

Carbon pricing frameworks can make carbon costs more transparent and comparable, giving companies a clear, stable signal for long-term investment planning.

In Canada, the federal OBPS acts as a backstop, with the provinces and territories permitted to implement their own equivalent system. While this structure provides flexibility, it also results in differences across the country in how carbon pricing is calculated and applied, including in terms of sectors covered. Recent policy changes, including the pause of industrial carbon pricing in Saskatchewan and a revised headline price trajectory in the federal benchmark criteria, due to recent agreements with the Government of Alberta, further contribute to this variability.

These differences become more visible in a trade-exposed context. As other jurisdictions move toward more integrated and aligned approaches on carbon pricing systems, including through carbon border measures, the ability of Canadian producers to clearly define and demonstrate the carbon costs embedded in their products becomes increasingly important. Where pricing is applied unevenly across regions or sectors, those costs may differ significantly depending on where in Canada a product was made, making it harder for producers to show that they are already paying a meaningful carbon price.

Electricity is one area where this challenge is pronounced. Canada's electricity system varies significantly by province. Some provinces rely on lower-emitting sources such as hydro, while others rely more heavily on fossil fuels, which affect the emissions associated with producing goods, particularly in electricity-intensive industries.

As carbon pricing becomes more closely linked to product-level emissions, these provincial variations will increasingly influence how Canadian goods are assessed in international markets. Goods produced in regions with higher-emitting electricity will carry higher associated emissions, while those produced in lower-emitting regions are likely to be viewed as more competitive.

Unlike more centralized systems where carbon pricing and emissions accounting are applied consistently, Canada's provincial and territorial variation makes it harder to present a coherent national picture of carbon intensity to trading partners.

In terms of revenue generation and reinvestment, as noted, Canada's OBPS generates revenue differently from allowance-based systems. Rather than auctioning allowances, covered facilities meet compliance obligations through performance standards and compliance units. Federal OBPS proceeds are returned through programs such as the Decarbonization Incentive Program, which supports long-term industrial decarbonization. This creates a less direct and less consistent connection between carbon pricing revenue and reinvestment than systems where allowance auction revenue is collected and reinvested through a central framework. This is further complicated at the provincial level, where approaches vary in both the amount of revenue generated and how it is reinvested. In Alberta, for example, funds collected under the Technology Innovation and Emissions Reduction system have been directed to carbon capture projects, including \$40 million allocated by Emissions Reduction Alberta.

As other jurisdictions use carbon pricing both to signal cost and support the clean energy transition, Canada's inconsistency in how revenue is generated and reinvested may make it harder for trading partners to assess the extent to which carbon costs are being used to drive industrial decarbonization.

Alongside revenue and reinvestment, the ability to provide credible and comparable emissions information is growing in importance. In jurisdictions with more centralized approaches, emissions are measured, reported and verified within a consistent framework, making it easier to demonstrate the carbon intensity of production. In Canada, where carbon pricing frameworks and reporting requirements vary, presenting a consistent and comparable picture of product-level carbon intensity is more complex.

These findings highlight how differences in carbon pricing design may affect clarity, comparability, and trade alignment. They also reveal several areas where stakeholder input is needed.

5. Next steps

This research has highlighted several areas where further input is required to understand how carbon pricing is experienced in practice and what recent developments may mean for Canadian industries as carbon costs become more closely linked to trade.

Three areas have been identified where engagement with emissions-intensive and trade-exposed industries, industry associations, subject matter experts and other affected stakeholders is needed. The goal is to validate the findings, identify where Canada's current approach to carbon pricing creates benefits or challenges and, most importantly, move the discussion from assumptions about how the system works to a better understanding of its practical impacts.

This engagement will help clarify where greater consistency or alignment may be valuable to Canada's carbon pricing approach, how carbon pricing revenues can best support emissions-reduction investment, and what Canada may need to demonstrate as carbon costs become more intertwined with trade. The insights gathered will be critical in identifying opportunities to strengthen policy design, implementation and coordination in support of both decarbonization and competitiveness.

National consistency and comparability

Canada's carbon pricing framework includes federal, provincial and territorial systems that vary in design, price levels, coverage and implementation. This flexibility allows systems to reflect regional circumstances, but it can also make carbon costs more difficult to define and compare across the country.

Stakeholder engagement will examine how these differences affect investment decisions, competitiveness, compliance planning, emissions reporting and the perception of Canadian goods in international markets. It will also explore where greater consistency would be most valuable, including in areas such as price levels, coverage, emissions measurement and verification, treatment of emissions-intensive sectors, reinvestment and compliance flexibility.

Carbon pricing revenue and industrial investment

Across Canada, the connection between carbon pricing and reinvestment in industrial decarbonization varies.

Stakeholder engagement will delve into how carbon pricing influences investment decisions and how revenues could most effectively support industrial transition. This includes support for clean technology deployment, electricity infrastructure, process improvements, and other

measures that strengthen competitiveness. It will also explore what would make reinvestment more credible and useful for the sectors covered by carbon pricing.

Trade alignment and equivalency

Carbon border measures are raising the importance of demonstrating the emissions and carbon costs associated with producing goods. To demonstrate trade equivalency, Canada needs credible and comparable information on emissions, carbon costs and compliance obligations.

Stakeholder engagement will explore how prepared Canadian industries are for carbon border measures and where the main gaps lie, including in the availability of product-level emissions data, emissions verification processes, administrative capacity and recognition of carbon costs already paid. It will also examine what actions Canada may need to take, if any, for its carbon pricing system to be viewed as credible and comparable by trading partners.

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