POLICY ARTICLE

CLIMATE POLICY

Building a scalable climate coalition for heavy industry

Emissions could be reduced, with minimal impact on production, while generating billions in public revenues

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The important interaction between trade and climate policy has sharpened the case for a coalition of countries that commit to price industrial emissions at home and use border adjustments to apply a carbon price to imports from nonmembers (*1*). We propose a coalition that initially targets four emissions-intensive industries—iron and steel, aluminum, cement, and nitrogen fertilizers (hereafter, fertilizers)—which together account for roughly 20% of global greenhouse gas (GHG) emissions (*2*). Using plant-level microdata and trade modeling, we examine two institutional designs that have emerged in policy discussions: a uniform price regime with a common carbon price floor and a graduated price regime with income-tiered floors (*3*). We show that a first-wave coalition could cut global GHG emissions by roughly 1.5% [2.0% of carbon dioxide (CO_2) emissions] relative to 2023 levels while keeping industrial output impacts small, limiting leakage, and raising almost $200 billion per year in public revenues.

International climate policy continues to confront a coordination problem: Unilateral action is politically fragile, whereas universal agreements struggle to align heterogeneous national incentives and political objectives (*4, 5*). But coordination is vital to achieve decarbonization, especially on traded industrial commodities. The rising global momentum for carbon pricing, particularly in industrial sectors, shows that this could be a feasible policy for near-term implementation (*6*). Middle- and low-income countries, including China, Brazil, Indonesia, Vietnam, Türkiye, and India, have implemented or plan to implement national-level carbon pricing schemes for heavy industry (*7*). Many high-income countries, with the notable exception of the United States, already have or are developing carbon pricing for industry.

In earlier work, we developed a climate coalition architecture and quantified its implications for emissions, prices, output, revenues, and participation (*8*). This article and our earlier work build on related academic and policy work that leverages quantitative trade models (*9–11*). Existing work typically examines a narrower policy scope, such as analyzing the European Union (EU) Carbon Border Adjustment Mechanism (CBAM) in isolation, and relies on less granular data, limiting the ability to accurately evaluate distributional implications across countries. In this article, we use plant-level microdata to compare two policy architectures and evaluate their different distributional consequences. Under our proposal, coalition members would adopt explicit carbon pricing [via taxes or emissions trading systems (ETSs)] for direct industrial emissions (scope 1) and emissions from associated electricity use (scope 2) and implement border carbon adjustment (BCA) on covered imports. To acknowledge fairness considerations and allow countries to begin with differentiated capabilities and converge over time as capabilities and institutions mature, we examine a graduated price regime [illustratively, $25, $50, and $75 per metric ton of CO_2 (tCO_2) for low-income and lower-middle-income countries, upper-middle-income countries, and high-income countries, respectively] as well as a common carbon price floor (illustratively, $50/$tCO_2$). The framework embeds border adjustments to address carbon leakage and encourage policy adoption, mutual recognition of price floors on carbon-intensive upstream materials to implement credible climate ambition, and the use of complementary policies—technology diffusion, climate finance, and capacity building—to relax participation constraints for low- and middle-income countries.

THE CLIMATE-TRADE COORDINATION ENVIRONMENT

The building blocks for such a coalition already exist. As of 2025, 80 carbon pricing instruments—43 carbon taxes and 37 ETSs—were in place across 50 jurisdictions, together covering about 28% of global GHG emissions and generating more than $100 billion in annual revenue (*7*). Jurisdictions with a carbon tax or ETS now account for nearly two-thirds of global gross domestic product (GDP) (*7*). Although most of these systems are in high-income countries, all large middle-income countries have either adopted or are actively considering carbon pricing, covering a large volume of emissions. At the same time, many of these policies suffer from low carbon prices that stifle the incentives for immediate emissions abatement and investment in decarbonization technology (*4*).

The politics of climate-linked trade are now moving faster than results from the United Nations (UN) climate talks. For instance, the EU CBAM provision allowing for importing countries to be credited for their domestic carbon prices and thus pay a smaller BCA fee to the EU has prompted several countries to consider implementing carbon prices or increasing the stringency of their existing schemes (*6*). The case of the EU CBAM has demonstrated that climate-linked trade policy can incentivize countries to increase their ambition for domestic carbon pricing policies to avoid paying carbon tariffs, in a virtuous cycle for policy adoption (*4, 12*).

Industrial materials such as steel, cement, aluminum, and fertilizers are obvious candidates for early inclusion in a coalition. The industries are essential to modern economies and are also carbon intensive with existing technologies. These four emissions-intensive, trade-exposed industries account for more than 20% of global GHG emissions (although less than 5% of GDP) (*2*). Steel, aluminum, and fertilizers are heavily globalized, whereas cement is traded internationally in some regions. About 25% of steel and 40% of aluminum are consumed in a country different from the one that produced it (*8*) (table S1).

Carbon pricing coverage is even greater for these carbon-intensive commodities relative to the rest of the global economy: Countries with existing and planned carbon pricing programs that cover these industries produce roughly 82% of emissions from these four industries (although average carbon prices remain low) (*8*) (see the first figure). Focusing on these industries, whose products tend to be further upstream in the value chain, also limits the immediate impact on consumer prices, making participation more politically feasible. Finally, structuring the coalition around sectoral emissions, rather than national emissions, helps establish a clear metric for assessing effectiveness in terms of GHG reductions within target industries.

A multilateral coalition can build on existing momentum for climate-coordinated trade policies and carbon pricing. By recognizing these shared policies and shared incentives, countries can reduce emissions, ensure their industrial competitiveness, and reduce administrative burdens on companies. Furthermore, the coalition can be designed to align with existing climate and trade regimes. Countries would continue to meet their obligations under the UN Framework Convention on Climate Change and pursue their Paris Agreement commitments. Meanwhile, participation in the coalition, with its clear price signals, would likely accelerate the timeline for achieving their Nationally Determined Contributions (NDCs) under the Paris Agreement. The coalition's border measures can be structured to advance environmental objectives, not disguise protectionism. That is important because World Trade Organization (WTO) rules allow certain trade measures for environmental purposes if they avoid arbitrary or unjustifiable discrimination, and the WTO's longstanding "special and differential treatment" principle permits more favorable treatment for developing countries (*13*).

A POTENTIAL COALITION ARCHITECTURE

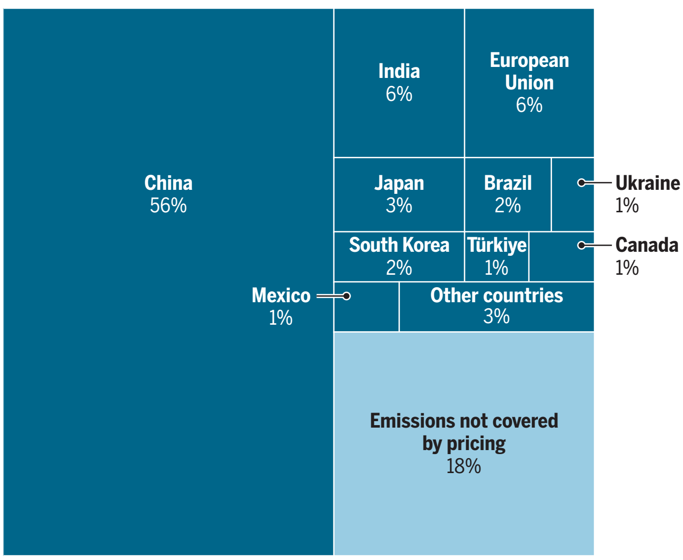
The proposed coalition we analyze is intentionally narrow in sectoral scope at the start. It focuses on the four industries already mentioned—iron and steel, aluminum, cement, and fertilizers—for which emissions are large, trade exposure is high, and credible monitoring is relatively feasible. The proposal consists of the following three main components.

A coordinated price floor in targeted industries

Members agree to a minimum carbon price for direct emissions (scope 1) and emissions from electricity use (scope 2) in steel, aluminum, cement, and fertilizers. Each country chooses and designs its instrument—tax or ETS and variants—and commits to mechanisms that keep the effective price at or above the internationally agreed floor (for ETSs and permit trading, that could mean an auction reserve price or government buyback commitments). Coalition members can decide if and how to include differentiated price floors based on country income level.

Emissions covered by carbon pricing

Most global emissions associated with the production of aluminum, cement, steel, and fertilizers are covered by planned or implemented carbon pricing policy (see supplementary materials for details on data).



GRAPHIC: V. PENNEY/*SCIENCE*

BCAs on nonmembers

To align costs and discourage production from relocating to noncoalition countries, members impose BCAs on covered imports from nonmembers and allow intracoalition trade with no BCAs. The BCA rate is tied to the coalition price, with product-level emissions data used where available and default values where not. This preserves competitiveness and rewards cleaner producers everywhere, including in developing countries with low-carbon power or efficient plants.

Incentives that make joining attractive

The coalition could package incentives for low- and middle-income country participants. Options include the following: lower initial price tiers or targeted free allocation (distributing emissions allowances at no cost to certain producers to ease the compliance burden); reduced trade barriers and harmonized standards for clean technologies; joint ventures to speed technology diffusion; a financing window (for example, a trust fund at a multilateral development bank to back decarbonization projects); capacity-building for monitoring, reporting, and verification (MRV) and administration; and a tight offset policy that channels capital into high-integrity projects without weakening the core price signal. A coalition can also help ensure market access and trade commitments in critical industries among coalition members.

Taken together, these features align industrial competitiveness with climate ambition, rather than treat them as a trade-off. The BCAs defend against undercutting by high-carbon producers, the floor ensures that domestic producers face a strong incentive to decarbonize, and the incentive package lowers political barriers to entry for low- and middle-income countries without abandoning the principle that polluters should pay.

QUANTIFIED BENEFITS OF A CLIMATE COALITION

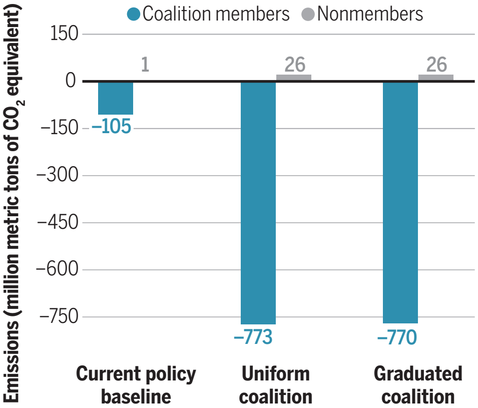
Using a trade model that leverages plant-level microdata, we simulate a "first-wave" coalition whose membership reflects countries that are likely to participate based on their existing or planned carbon pricing policies for heavy industry, as well as countries with relatively clean industrial sectors that stand to benefit competitively from a global market with a green premium. The trade model assumes that commodity suppliers will sell to the market where their profits are highest, either to coalition members or noncoalition countries, and uses demand elasticities from the literature [see supplementary materials (SM)]. The modeling builds outward from the EU, the UK, and countries already linked to the EU ETS (Iceland, Norway, Switzerland, and Liechtenstein) and adds major emerging and advanced economies such as Australia, Brazil, Canada, China, India, Indonesia, and Thailand to form a coalition. The coalition also includes a bloc of African countries—Algeria, Cameroon, Egypt, Ghana, Kenya, Libya, Morocco, Mozambique, Nigeria, and Uganda—whose industries already produce and sell relatively low-carbon basic materials into global markets and therefore stand to benefit competitively from a climate coalition (*10*). African countries are included in the coalition if they produce in target industries below the global average emissions intensity and traded with at least one non-African partner in those industries in 2023. For instance, according to our plant-level data, Algeria, Egypt, Kenya, Libya, Morocco, Nigeria, and Uganda operate fully electric arc furnace-based steel sectors, which are relatively low emission. Cameroon, Egypt, Ghana, and Mozambique have relatively clean aluminum industries powered largely by hydroelectricity.

We compare two coalition scenarios (the uniform price and graduated price regimes) to a "current policy baseline" that represents one possible trajectory of international climate policy. It incorporates the EU ETS with the EU CBAM and assumes their integration with the UK and other countries already linked to the EU ETS. Our baseline scenario extends coverage to scope 2 (indirect) emissions for steel and aluminum (where only scope 1 is presently regulated) and as-

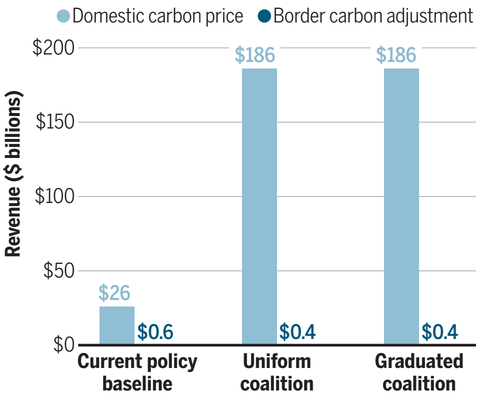
Estimated benefits of a climate coalition

A trade model is used to estimate two coalition scenarios (uniform or graduated price) relative to a current policy baseline. Modeling suggests that the coalition would meaningfully reduce emissions, increase fiscal revenues, and minimally reduce domestic production (see details in supplementary materials).

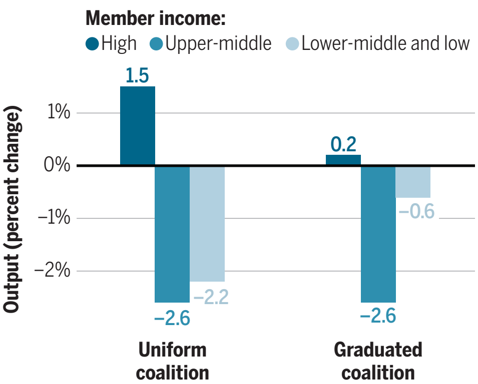
Emission reductions
A first-wave coalition implementing a uniform or graduated carbon price floor cuts emissions by about 1.5% of global greenhouse gases (2.0% of CO_2). Emissions changes represented are annual reductions generated by the price floor relative to 2023 levels.



Public revenue
A coalition with either a uniform or a graduated price raises nearly $200 billion per year in public revenue, mostly from domestic pricing rather than border carbon adjustment. The figures show annual amounts with 2023 as the reference year.



Output changes are minor
Output effects for coalition producers are small (less than 3%). The graduated price scenario reduces output losses for the poorest members. Production changes are relative to a current policy baseline, using 2023 as the reference year.



GRAPHIC: V. PENNEY/SCIENCE

sumes no free allowances, in line with EU plans for a full phaseout by the mid- to late-2030s. To simplify modeling, it assumes that all countries outside the EU, UK, and European Free Trade Association either do not implement planned carbon pricing scenarios or retain rules that result in an effective carbon price on production near zero, even though many countries are on trajectories to lower free allocations or are undertaking relevant policy changes (including Australia, Brazil, Canada, China, India, and Indonesia). Because several countries are implementing frameworks to gradually strengthen carbon prices, the current policy baseline may underestimate the existing trajectory of emissions reductions. The modeling does not consider certain aspects of our design, such as financial instruments that would provide incentive for joining a coalition (see SM for more detail on the assumptions, data, and structure of the two modeled coalition scenarios and the current policy baseline scenario).

Our modeling abstracts from several details that a coalition would need to address. We assume that carbon price floors are implemented in their purest form, as a tax on all scope 1 and scope 2 GHG emissions associated with industrial production in covered sectors. This differs substantially from reality, where virtually every industrial carbon pricing regime provides free allowances (e.g., EU ETS, California, and South Africa), tradable performance standards with no charge on unabated emissions below the intensity benchmark (e.g., Australia, Canada, and China), or exemptions for specific fuels or installation sizes (e.g., Mexico and Chile), such that the average carbon price per tonne paid across all industrial emissions is lower than the nominal carbon price reported by sources such as the World Bank Carbon Pricing Dashboard. Earlier work proposed a "mutual recognition" approach through which coalition members would agree on how to recognize different approaches to carbon pricing (*8*).

Our modeling suggests that the coalition would meaningfully reduce emissions and increase fiscal revenues, minimally reduce domestic production, and moderately increase product prices. Both coalition designs deliver substantial emissions reductions relative to 2023 levels: The uniform price scenario reduces aggregate GHG emissions from the four covered sectors by ~750 Mt per year, which is roughly 1.5% of total global GHG emissions, and the graduated price scenario achieves nearly identical reductions (749 Mt) (see the second figure, top). These results do not rely on speculative technological breakthroughs but rather represent near-term gains from coordinated policy.

Carbon leakage is limited: Noncoalition producers expand output by only about 0.5 to 4% under either scenario, whereas output falls by about 1.5 to 4% for coalition members in both the graduated and uniform scenarios. Both designs generate ~$186 billion per year in domestic carbon tax revenues, with modest additional border adjustment revenues (less than $1 billion in all scenarios) (see the second figure, middle).

The two designs differ primarily in their distributional consequences (see the second figure, bottom). Under the uniform price scenario, lower-income coalition members see output declines of roughly 2.2%, whereas the graduated price scenario limits those losses to ~0.6% by applying a lower domestic carbon price floor to poorer members. High-income coalition members see a gain in output under both designs, though for different reasons: Under the uniform price design, the lower carbon price floor ($50/t versus $75/t, which is the illustrative level for the EU and UK ETS in the current policy baseline) reduces production costs relative to the current policy baseline, increasing output by roughly 1.5%. Under the graduated price design, where high-income countries face a $75/t floor, the smaller production gain of 0.2% reflects the competitive advantage offered by the coalition compared with an environment where only EU and UK ETS members have carbon prices. Upper-middle-income members—including China, Brazil, Indonesia, and Thailand—contract production by roughly 2.6% under both designs. Prices in coalition markets increase by roughly 11% for aluminum, 4% for steel, 5% for cement, and 10 to 13% for fertilizers relative to the current policy baseline (fig. S2).

A WAY FORWARD

Translating this vision into reality will take time, requiring extensive technical work and trust-building among potential member countries to lay the foundation for coordinated action. Progress can be made with countries ready to lead, including several large emitters already pricing industrial emissions, with a view to broadening the coalition over time.

Convene the right ministries

Each member country will decide the appropriate lead ministries to develop a multilateral climate coalition centered on carbon pricing. Lead ministries will set goals and priorities for coalition design aligned with NDCs and based on national circumstances and evaluate potential distributional impacts.

Pin down scope and price architecture

Potential member countries, partnering with technical experts, will need to conduct analysis to inform decisions. Work will need to be done to assess each industry above for inclusion, agree on uniform or graduated carbon price floors and provisions for free allocation, set embedded emissions reporting requirements and BCA scope and rate (or rates) for members to apply to nonmembers, establish treatment of exports, decide on the package of incentives for emerging economies, and determine mutual recognition rules to certify that a member's carbon pricing policy meets the price floor, taking into account the diversity of carbon pricing instruments, fiscal cushioning, and other related measures. The group could eventually evolve to tighter coordination through linked markets and expanded GHG pricing coverage.

Design and implement an MRV system

Countries should build a lean approach that is simple where it can be and strict where it must be: For members, data on carbon pricing and industry-level emissions would be subject to periodic review by an independent plurilateral body, and nonmembers seeking lower BCA rates than a default would need to provide product-level emissions and input data.

Potential member countries could leverage multilateral and plurilateral platforms, as well as available technical expertise, to support constructive dialogue on these issues. For example, the establishment during the 2025 UN Climate Conference of an Open Coalition on Compliance Carbon Markets, endorsed by Brazil, the EU, China, and others, can provide a forum for exchanging lessons and experiences on carbon pricing mechanisms, MRV, and other aspects, helping to establish a foundation for coordinated action.

REPLACE FRAGMENTATION WITH RECIPROCITY

The EU CBAM began implementation in 2026. Without coordination, the world may see a profusion of border carbon adjustments, inconsistent standards, and higher administrative costs for firms, along with more political friction and slower climate progress. A coalition can replace fragmentation with reciprocity: Members commit to clearly articulated policies, international trade supports climate policy, and revenues could help fund the clean energy transition.

Critiques are likely to focus on distributional fairness, national sovereignty, and administrative burden (*14*). The proposed coalition architecture addresses each directly. On fairness, income-based carbon price floor tiers, transitional free allocation in some cases, and access to dedicated finance (and/or other incentives) are intended to reduce the upfront cost of participation for lower-income members without blunting the price signal. On sovereignty, the mutual recognition approach respects each country's choice on how to price, so long as the policy delivers an effective price at or above the agreed floor in the covered industries. On administrative burden, the framework relies on a lean system for measurement, reporting, and verification: Members report aggregate industry-level emissions and effective carbon prices, whereas product-level data are only required for nonmembers seeking preferential border treatment. This structure focuses measurement on what is strictly necessary to accurately apply BCAs.

In recent years, global ambition on carbon pricing has increased alongside the expanded use of border-adjustment mechanisms. Carbon pricing is spreading because it is effective at cutting emissions, steering capital to clean technologies, and raising revenue. Trade policy is shifting because countries want climate ambition without offshoring industry. A coalition that marries carbon pricing and trade policies offers a practical path at a fractious time and offers a pathway to overcome the international climate-policy coordination problem. It aligns incentives, builds on what countries are already doing, and replaces a race to the bottom with a race to the cleanest. □

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ACKNOWLEDGMENTS

We are grateful to R. Bhatta, K. Hsu, F. Meng, and A. Neumann for exceptional research assistance. Data and code are available at Dryad (*15*).

SUPPLEMENTARY MATERIALS

science.org/doi/10.1126/science.aef7190

10.1126/science.aef7190

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Science **393** (6815), . DOI: 10.1126/science.aef7190

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