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Unworkable Solution: Carbon Border Adjustment Mechanisms and Global Climate Innovation

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Levying carbon tariffs is a difficult and counterproductive way for nations with ambitious climate policies to create a level playing field for their higher-cost industrial sectors. A more workable solution would be to design a flexible open-trade club for climate innovators.

KEY TAKEAWAYS

- Nations are wary of putting their energy-intensive, trade-exposed (EITE) industries at a competitive disadvantage in global markets as they adopt increasingly ambitious climate and energy policies.
- CBAMs are intended to protect EITE industries from competitors that do not face similar environmental or emissions costs. They are tariffs on imports that are roughly equivalent to carbon fees domestic producers pay.
- The European Union has issued a detailed CBAM proposal covering the cement, iron and steel, aluminum, fertilizer, and electricity sectors—and more nations may follow suit.
- While they are attractive on paper, CBAMs present debilitating implementation challenges such as accounting for carbon, tracing global value chains, and ensuring compatibility with WTO and global environmental agreements.
- A CBAM-based global trade regime, no matter how well administered, would be incomplete as a system for driving climate innovation.
- CBAMs could exacerbate global trade tensions by incentivizing circumvention, which would create clean and dirty industrial blocs, disrupt supply chains, and undermine incentives for climate innovation.
- A better approach would be to create a climate innovation club that gives flexible open-trade benefits to nations with ambitious, transparent, and enforceable climate targets.

INTRODUCTION

As policymakers hone their domestic climate policies to strengthen nationally determined contributions under the 2015 Paris Agreement, a persistent fear weighs on them. No leader wants to be the one who, in the name of combating climate change, ends up putting their domestic industries at a global competitive disadvantage, costing good paying jobs, reducing the tax base, and creating new security risks.

Carbon border adjustment mechanisms (CBAMs) appear to provide a way out of this dilemma for the growing number of jurisdictions that have made carbon pricing a cornerstone of their polices. By adding a tariff to the price of imports made in places that are not subject to a carbon price, CBAMs aim to preserve domestic climate gains by leveling the playing field between home-based producers that must pay the price and foreign competitors that do not.

Long a staple of academic research, CBAMs are now catching on among policymakers. The European Union, which has placed a carbon price on many products through its Emissions Trading System (ETS), published a CBAM proposal in July. The United Kingdom is considering one, with its announcement perhaps coming before the next global climate conference in November, to be held in Scotland.[1] Candidate Joe Biden supported an ETS on the campaign trail, and his climate envoy, John Kerry, reiterated the administration's interest this spring.[2]

The problem is that, while CBAMs are attractive in theory, they are unworkable in practice. Before policymakers enact such policies, they should understand the problems that could arise in implementing them. In particular, CBAMs are likely to impede the most important objective of climate policy: the development and deployment of innovations that could cut greenhouse gas (GHG) emissions. This impact would be particularly severe for energy intensive, trade exposed (EITE) industries, such as steel and chemicals, that would be most affected by CBAMs and for which innovation is most desperately needed.

While CBAMs are attractive in theory, they are unworkable in practice. Before policymakers enact such policies, they should understand the problems that could arise in implementing them.

One practical problem is that calculating the carbon content of imports can be wickedly difficult, leading to uncertainty, gaming, and price distortions. These difficulties could induce producers to shift away from countries that impose CBAMs, or lead to a bifurcated global economy in which low-carbon goods are traded freely in one zone and carbon-intensive goods in another. Trade-impacted industries might also take advantage of CBAM policymaking to unfairly protect themselves, thereby blunting the policy's impact. CBAMs could run afoul of World Trade Organization (WTO) rules, too, and even undermine the Paris Agreement itself by increasing mistrust among parties and undermining core international environmental principles.

The uncertainty and opportunities to game a CBAM-heavy trading system would likely deter long-term investments in research, development, and demonstration (RD&D) and first-of-a-kind commercial projects that drive climate innovation. A bifurcated global economy with a large carbon-intensive bloc would limit opportunities for the diffusion of industrial innovations that cut emissions, thereby reducing the incentive to make them in the first place. So would protectionism and the erosion of international trade rules.

While CBAMs are unworkable, the global debate about them poses a vital question: How can the nations of the world create an open, innovation-friendly, global net-zero-emissions economy? A workable solution must address the problem of free-riding by carbon-intensive producers while supporting stronger national climate ambitions and cooperation. One possible solution is the development of a "climate innovation club" that would be flexible enough to accommodate varying national climate policies but robust enough to accelerate clean energy innovation and industrial decarbonization.

This report begins by discussing the nexus of international trade and innovation. It then provides an overview of the mechanics of carbon pricing, the challenge of carbon "leakage" across borders, and CBAMs as a potential fix to that challenge. The next section covers the difficulties of implementing a CBAM, before considering how a CBAM-heavy trade regime might impact climate innovation. The report concludes by developing the "climate innovation club" concept as a promising alternative.

INTERNATIONAL TRADE AND CLIMATE INNOVATION

Under the Paris Agreement, participating nations seek to limit the rise in average global temperature to 1.5 degrees Celsius. To do so, net GHG emissions must drop to near zero by 2050. As of August 2021, 132 countries, covering 73 percent of global emissions, adopted or were considering net-zero targets.[3] President Biden promises that the United States will join the European Union, Japan, South Korea, and others targeting net zero by 2050, while China has pledged to hit that target by 2060.[4]

These ambitions bring the scale of the challenge into sharp focus. Not only must the global electric power sector be cleaned up in the first half of this century—a mammoth and still far-from-complete task that has consumed climate policymakers for the past two decades—but so too must transportation, industry, buildings, and agriculture. And, because it is unlikely that all of these sectors will be able to hit net zero, methods to remove GHGs from the atmosphere will have to be deployed to make up the difference.

The way forward is clear in some respects. The United States National Academies' panel on deep decarbonization set forth a menu of "no-regrets" actions that are robust across a broad range of pathways, such as improving energy efficiency, accelerating the growth of low-carbon electricity, and electrifying energy end uses.[5] But the same panel also emphasized that solutions for many sources of emissions are exorbitantly expensive or simply not available at present due to a lack of affordable, effective technology.

This conclusion is reinforced by the International Energy Agency (IEA)'s 2021 Net Zero Emissions scenario, in which almost half of all emissions reductions are driven by technologies that have not yet been commercialized.[6] Both the Academies' and the IEA's call for policies that accelerate climate-friendly innovation is vitally important to consider in any net-zero national strategy. Such policies include public investments in RD&D, but extend far beyond that. Taxation, regulation, and public procurement policies aimed at reducing emissions, to name a few, must also foster innovation, rather than simply prop up sales of existing technologies—lest policymakers drive the economy into a cul-de-sac in which each marginal reduction in emissions becomes prohibitively costly.

How International Trade Can Drive Innovation

Trade policy must be added to this list of policies that have a role to play in fostering climate innovation. Trade policy has proven to be an important driver of innovation across many industries in the past. Its impact flows through multiple channels.[7]

One of these channels is economies of scale. Larger markets for commodity products, which are made possible by international trade, drive innovation in capital goods and production processes. As producers scale up, they seek increasingly specialized equipment and find ways to economize on inputs. These dynamics underlie "experience curves" in some industries, which link cumulative production with declining costs. The faster the market grows, the faster production grows, the more process innovation occurs, and the faster costs come down. Solar photovoltaic panel production is a classic example of this dynamic.[8]

International markets can also drive product innovation. Thanks to trade, commodity goods may be differentiated to serve the specialized needs of market segments that would be too small to serve if confined to a single country but warrant producers' attention when aggregated across borders. A country with only 1 geothermal site and 50 coal mines is unlikely to develop a geothermal energy industry, but a world in which 50 countries have 50 geothermal sites is more likely to do so, even if there are 1,000 coal mines as well.

The broadening of competition enabled by international trade can be another innovation driver. Importers with different ways of doing things shake up domestic incumbents that have settled into too-comfortable production patterns. The opportunity to export and establish foreign operations may also spark incumbents to innovate and draw new entrants with new approaches into an industry.

International trade can contribute to regional specialization, further accelerating innovation. Economists have long observed the tendency for firms in the same industry to cluster together, drawing in skilled workers and suppliers. Clusters that serve global markets can grow larger and focus more tightly than those limited to single markets. The concentration of specialized talent and information in a small geographical area spurs creativity and provides access to resources so promising technological and business opportunities can be more easily explored.

Ideally, all of these drivers—scale, segmentation, competition, and specialization—interact to provide an additional boost to innovation. Big, growing markets continually spin off narrower niche markets, all of which are targeted by firms based in diverse locations around the planet. Some of these locations emerge as global innovation hubs, which continue to compete while at the same time sharing knowledge, whether intentionally or inadvertently.

The history of international trade in information technology (IT) approximates this ideal well. IT trade was enabled by free trade agreements, such as the 1996 Information Technology Agreement, which removed tariffs on a wide variety of products and yielded substantial innovation benefits.[9]

Toward a Climate-Innovation-Friendly Global Trade Regime

Free trade agreements, while effective in advancing IT innovation, will not necessarily accelerate climate innovation. The reason is the costs of GHGs to the global environment are not incorporated into market prices. More open international competition may well drive down prices by allowing dirty-but-cheap producers in one country to undercut clean-but-expensive innovators in another. To avert the worst consequences of climate change, a global trade regime must be created that is sufficiently open to drive innovation through as many trade channels set forth as possible, but also constrained so that traded sectors move in climate-friendly directions.

Carbon pricing on a global scale is, on the surface, an appealing basis for such a regime. It seems relatively simple, particularly since a small number of traded sectors are responsible for the bulk of traded emissions. But appearances can be deceiving. The problem is that global carbon pricing, implemented through CBAMs around the world, would be devilishly difficult to negotiate and, even if it were implemented, would be unlikely to spur innovation at the scale and pace the global climate needs.

CARBON PRICING, CARBON LEAKAGE, AND BORDER ADJUSTMENTS

Carbon pricing is premised on the core economic principle that consumers prefer lower prices. An effective carbon price, whether imposed through a tax or a cap-and-trade scheme, raises the cost of carbon-intensive energy. Producers might respond by passing along the increase to consumers. But, knowing that consumers may cut back their purchases in response, producers have an incentive to find ways to cut their emissions and thereby minimize the cost increase. The incentive is even stronger when producers compete with one another.[10]

Innovation is the most important way they might do this. "Induced innovation," which is spurred by the relative increase in the cost of one factor of production (in this case, carbon-intensive energy), is a well-established phenomenon.[11] A recent review of the literature led by Michael Grubb concludes that "the case for carbon pricing is enhanced … in light of the push it may give to low carbon innovation."[12]

Induced innovation has an important role to play in driving incremental change, but it will not lead to the more-radical breakthroughs

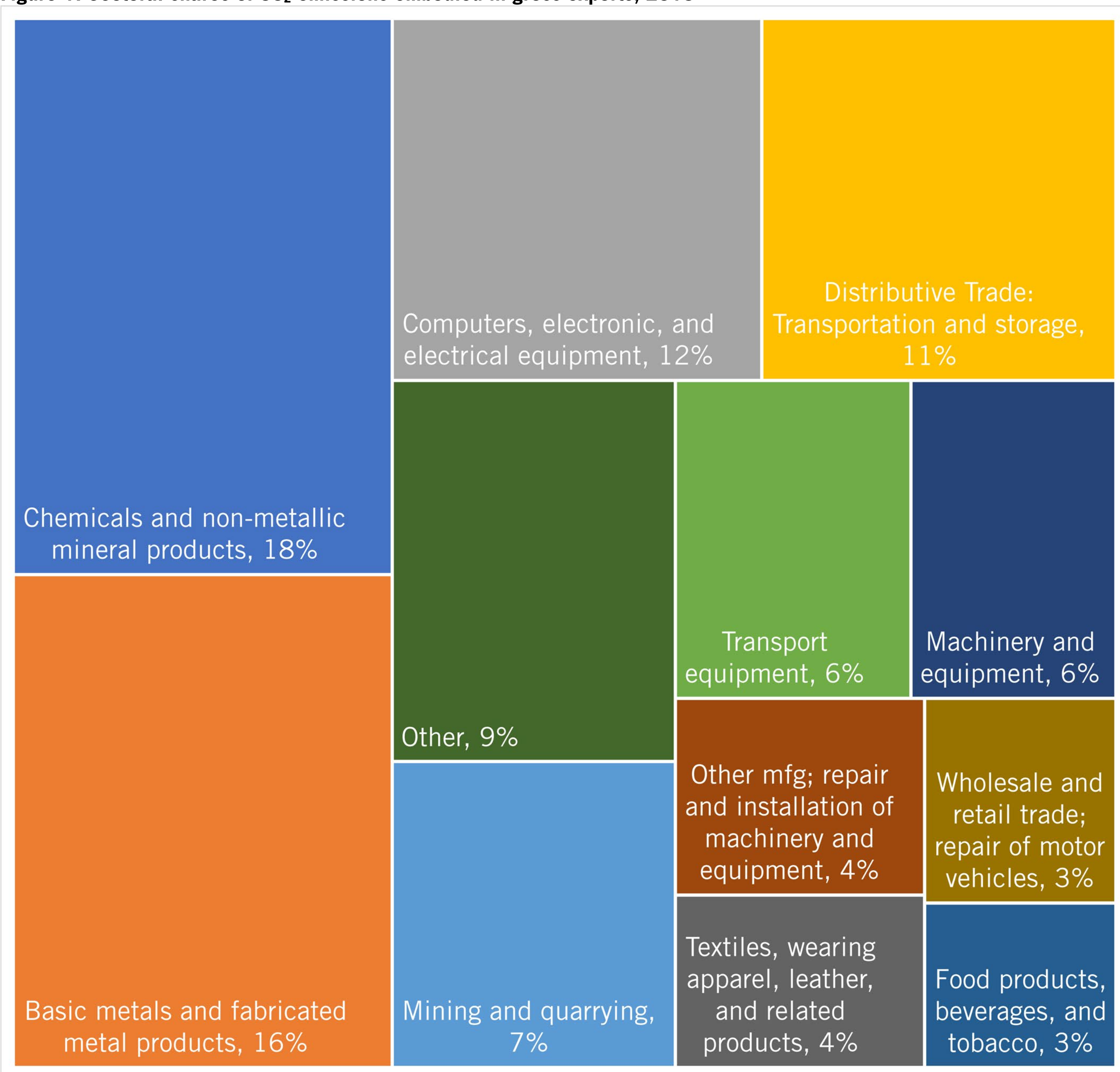
"However," Grubb and his co-authors continued, "carbon pricing alone may be a very blunt way of stimulating innovation."[13] As the Information Technology and Innovation Foundation (ITIF) has long argued, induced innovation has an important role to play in driving incremental change when low-carbon technologies are close to cost-competitiveness with "dirty" incumbents. But it will not lead to the more-radical breakthroughs needed in sectors wherein the incremental cost of cutting emissions is far greater than any plausible carbon price. The push of public RD&D investment, along with a range of other policies, must complement the pull of carbon pricing to drive rapid innovation in these sectors.[14]

Carbon Leakage

Even induced innovation will be undermined if carbon pricing merely shifts emissions from within one set of borders to another location. "Carbon leakage," as such shifting has become known, is a likely result in the real world, since there is no global government to impose a global carbon price. Firms that emit GHGs located outside jurisdictions that impose a price gain a competitive advantage by exporting to them, while exporters that are subject to the price but seek to sell in jurisdictions that do not impose one are put at a competitive disadvantage.

The fear of industrial production shifting to jurisdictions without a carbon price is a persistent concern for climate policymakers. (The same issue also impacts regulatory approaches to climate policy; low-regulation jurisdictions are more attractive to high-emitting sectors than high-regulation ones.) It is not an idle fear. Research by the Organization for Economic Cooperation and Development (OECD) estimates that up to 25 percent of global GHG emissions are embodied in goods traded across borders. Emissions-intensive trade is concentrated in a handful of sectors, including chemicals, metals, and electronics, as seen in figure 1.[15] Many of these sectors are poised for growth and expanded trade, particularly involving producers based in developing countries, which could dramatically increase global emissions.

Figure 1: Sectoral shares of CO_2 emissions embodied in gross exports, 2015[16]



As table 1 shows, export-intensive nations such as China account for a large fraction of emissions embodied in trade flows (leading to the negative numbers on the table), while import-intensive nations such as the United States tend to receive emissions-intensive goods. Emissions from goods produced in China and shipped elsewhere made up 10 percent of that nation's total. The countries that imported these goods avoided those emissions—in the case of the United States, to the tune of 6.3 percent of its national total.

Table 1: Select national shares of CO_2 emissions embodied in international trade, 2018

Nation	Share of Overall Emissions Embodied in Trade	CO_2 Associated With Trade (Millions of Metric Tons)
China	-10.1%	-997*
Kazakhstan	-25.8%	-83
Nigeria	-4.6%	-6
Ukraine	-5.0%	-12*
Turkey	3.4%	14
Canada	0.3%	2
Brazil	4.8%	22
United States	6.3%	342
Germany	14.1%	107
United Kingdom	42.1%	160

** Negative emissions implies export of emissions in the form of exported products.*

The more emissions-intensive and trade-exposed a nation's domestic industry is, the more vulnerable it is to carbon leakage. Some have speculated that carbon-importing nations such as Germany and the United Kingdom have already become victims of direct carbon leakage as a result of the EU's carbon pricing policy, since they import 14 and 42 percent, respectively, of their overall emissions in the form of products from other countries. While research suggests that this effect was blunted by the large allocation of free ETS allowances to EITE industries, they may well become vulnerable when these allowances are eliminated, giving the ETS real teeth in these sectors.[17]

How a CBAM works

CBAMs seek to solve the problem of carbon leakage and free-ridership by adding a tariff to imports. The tariff equalizes the carbon price paid by importers with that paid by domestic producers, taking into account any carbon price paid by the importer in the production location.

CBAMs may also provide export rebates for domestic manufacturers, allowing them to be competitive in international markets that do not have a comparable carbon price.

For example, a steel manufacturer located in a jurisdiction with a carbon price of $40 per ton must pay an extra cost for fossil fuel and other inputs. A CBAM would adjust for this extra cost by imposing a tariff on each ton of imported steel that is equivalent to the carbon price the importer would have paid if the steel had been produced domestically. Domestic manufacturers that export steel to a jurisdiction that does not have a carbon price would receive an equivalent rebate. Steel imported from a jurisdiction that has a carbon price of $15 per ton would be credited for that amount but would have to pay the remaining $25 per ton of imported emissions for the CBAM.

CBAMs seek to solve the problem of carbon leakage and free-ridership by adding a tariff to imports.

The revenue raised by a CBAM can be used to support the associated export rebates or for any other purpose, such as funding clean-energy RD&D. To be effective, a CBAM would have to be product-specific. The carbon content across steel industry segments, (e.g., flat hot-rolled products and long products, such as rebar and wire) differs greatly due to diverse manufacturing methods. A national or regionally-specific carbon intensity benchmark for each of these specific products would need to be determined on a life-cycle basis that accounts for upstream emissions and uses transparent and verifiable data from the source country.

Ironically, the threat of carbon leakage may grow if CBAMs are restricted to only EITE sectors, as some have proposed. In addition to direct carbon leakage, in which producers in sectors facing the carbon price depart or expand abroad to avoid having to pay, a sector-limited CBAM may lead to indirect carbon leakage. In such a setup, imports of final goods-producing sectors (e.g., cars that use EITE inputs such as steel) are exempted from the CBAM. The importers gain an advantage because their input costs are lower, since domestic producers must pay for inputs that are subject to the carbon price if made domestically or the CBAM if imported. Imported cars that use cheap, dirty steel could outcompete domestically made cars that must pay higher prices for clean steel.

Whether emissions embodied in international trade are associated with direct or indirect carbon leakage, they weaken incentives for climate innovation. The fact that EITE industries such as steel, aluminum, and cement, are also generally sectors for which few viable technological options to abate emissions exist—and therefore have the greatest need for innovation—makes the challenge to climate policy more acute.

CBAMS IN PRACTICE

CBAMs in practice would differ even more from the economists' ideal policy fix than does domestic carbon pricing. The tariff making up the difference between the carbon price faced by domestic producers and that faced by importers would be virtually impossible to administer with anything resembling precision. Key problems include:

- Counting carbon in traded goods;
- Setting prices based on transparent accounting;

- Tracing global value chains across borders;
- Aligning them with global environmental agreements;
- Avoiding protectionism; and
- Ensuring compatibility with WTO rules.

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Counting Carbon

Counting and verifying the carbon content of imported products is extremely difficult, as carbon content varies by method, time, and place. If, for example, the EU wanted to impose a CBAM on imported U.S. steel, it would calculate a tariff that is an average of diverse production processes and regions. While the inputs for steel production are known and largely the same across manufacturers, producers are located in areas that have power grids with different carbon intensities, which change throughout the day and over the year. On-site, producers may also use varied resources such as coal or natural gas with differing carbon intensities. All in, the carbon intensity of steel can range from between 500 kg of carbon dioxide equivalent (CO_2e) per ton of steel to up to 2,000 kg of CO_2e.

Any carbon-counting process that relies on a national average of carbon intensity from the exporting country would thus likely mis-estimate actual emissions, penalize low-carbon producers, and force up their costs. Policymakers would need to determine whether the CBAM applies equally to all plants within a firm or whether it can differentiate between different plants within a single firm. If the CBAM were set at the firm-level, rather than the plant-level, then it would mean that products made at highly polluting plants would face a lower carbon price than would be economically efficient. Those made at cleaner plants would face an unjustly high carbon price. Such a setup could also lessen the incentive for plant managers within a firm to implement inventive ways to reduce emissions. CBAM waivers might be permitted if applicants can prove that their products have fewer embodied emissions than the benchmark average. But such a waiver process would require emissions to be verified, thereby adding even more complexity to the CBAM process.

CBAM measurement and verification would likely involve numerous suppliers and vendors, third-party auditors, customs and environmental agencies, and freight and logistics operators, among others. It might be vulnerable to manipulation, with manufacturers having strong incentives to minimize reporting of carbon emissions. It might create the risk of exposing market-sensitive information to untrusted third parties, including in the importing countries. Finally, these processes would have to be updated regularly to account for changes in efficiency and production technologies in order to avoid disincentivizing innovation and diffusion.

Setting Prices

CBAMs that complement cap-and-trade programs are intrinsically more complex than those that work with carbon taxes. In such programs, the carbon price is not fixed but fluctuates as those that need permits to emit GHGs buy from traders in allowances and place pressure on the system administrator to sell or grant more of them. EU ETS carbon allowance prices rose 71 percent in the first half of 2021 alone.[18] Large price fluctuations undercut business certainty, weakening the incentive for firms to invest in advanced industrial processes.

Protectionism

To date, most jurisdictions with a carbon price have chosen to blunt its impact on domestic EITE industries by allocating free allowances or rebates, allowing some firms to avoid having to pay the full price for their emissions. The EU ETS gave away 43 percent of all allowances in the 2013–2020 trading period, for instance, mainly to manufacturers.[19] While the EU ETS is gradually phasing down these giveaways, the current plan for 2021–2030 would continue to protect sectors at the highest risk of relocating production abroad by giving them up to 100 percent free allowances. The list of eligible industries includes more than 60 manufacturing, fuel, and food sectors.[20] The EU's CBAM proposal would revise this plan by phasing down free allowances to industries covered by the CBAM by 10 percent each year, starting in 2026. Not surprisingly, this part of the proposal already faces pushback from EU-based industries that prefer the status quo.[21]

Any continuation of free allowances along with a CBAM raises potential WTO protectionism concerns, with domestic producers receiving a double benefit. Even if distortions to the domestic carbon pricing system meant to protect home-country producers are fixed, they might be recreated through subtle misapplication of the CBAM. If CBAM administrators have some discretion over how the carbon content is estimated, as seems inevitable, they may bow to pressure for protection by biasing these estimates upward.

Tracing Global Value Chains and the Risk of Indirect Carbon Leakage

A CBAM could be targeted to specific EITE sectors rather than applying to all imports. For example, it might apply only to steel, aluminum, cement, and basic chemicals, rather than to finished products such as automobiles or computers that have many constituent parts, due to the difficulty of measuring the carbon content of each part. A typical automobile includes around 30,000 parts, including many made by suppliers spread across many nations, making the carbon content virtually impossible to calculate.

As noted, however, such a system opens the door to indirect carbon leakage, as importers of these products gain a competitive advantage by circumventing the CBAM on their raw material inputs. The avoidance risk would be increased if traders shipped goods that should be subject to the CBAM through countries that are exempted from it.

Alignment with Global Environmental Agreements

A CBAM-heavy global trade regime imposed by the developed countries could end up having a consequential effect of undermining climate cooperation if developing countries decided to back out of the Paris Agreement as a result. CBAMs undermine the principle of common but differentiated responsibilities (CBDR), which was formalized by the United Nations Conference on Climate Change (UNFCCC) in 1992 and more recently enshrined in Paris. CBDR emphasizes that, while all nations have a legal obligation to reduce GHG emissions, this responsibility is not shared equally, as developed nations have benefited from the vast majority of past emissions.

CBDR undergirds the belief that developing countries should not be penalized for seeking to close the economic gap between their citizens and those of richer countries. A CBAM that does not distinguish between carbon-intensive products based on their source, in this regard, could be viewed as blocking opportunities for development. Already, the governments of India and Brazil have raised concerns about the EU's CBAM proposal on these grounds.[22] Yet, CBAMs that exempt products from developing countries create huge loopholes that limit the policy's effectiveness and reduce the political willingness to impose carbon prices in developed nations. In addition to expanding production in exempt countries, trans-shipping finished or semi-finished products through them is likely to become common.

Compatibility with the WTO

A well-designed trading system would clearly allow nations to impose discriminatory tariffs based on global negative externalities such as climate change. Unfortunately, the WTO is not so well designed. Many trade scholars believe that CBAMs are incompatible with key WTO rules—most notably, the principle of nondiscrimination among a country's trading partners.[23] While WTO member states are supposed to be allowed to adopt policies that are inconsistent with standard trade rules for environmental reasons, these policies may not be "a means of arbitrary/unjustifiable discrimination or a disguised restriction on international trade."[24,]

Many trade scholars believe that CBAMs are incompatible with key WTO rules.

This vague clause is already the subject of litigation within the WTO's dispute settlement process, which may have a bearing on cases brought against CBAMs.[25] To date, countries seeking to defend policies that have the effect of discriminating on environmental grounds have lost their cases, so those hoping to defend a CBAM may find themselves in an uphill battle.[26] No matter what the final outcome, the legal ambiguity such cases create, and the slow pace with which they are adjudicated (exacerbated by vacancies that paralyze the WTO Appellate Body), would muddy CBAM implementation.[27]

Even if a CBAM is successfully negotiated and applied, further risks persist. The burden of administrative compliance may reduce overall trade. Solutions that seek to avoid weakening the economies of developing countries by exempting their products or gradually implementing a CBAM for them could prompt a WTO challenge based on this differential treatment.[28] Impacted countries could retaliate unilaterally or multilaterally. Such trade wars could spiral far beyond the initial sectoral confines and into non-related products as nations ratchet up tariffs on a wide swath of products.

CBAMS AND CLIMATE INNOVATION

Leakage from domestic carbon pricing systems in a world in which international trade makes up a major part of the global economy is an important and difficult problem. Closing borders to solve this problem is not merely impractical, it would forsake the benefits of international trade for innovation, which have proven to be very valuable since World War II. Given the importance of innovation for getting to net-zero emissions, that would be an unacceptable loss.

CBAMs provide an alternative approach, extending carbon prices to imports and relieving exporters from having to pay them. Jurisdictions that adopt comparable carbon prices would be able to trade goods without a carbon tariff—and as more do so, this climate-friendly free trade zone would grow. Yet, as we have argued, CBAMs in practice would be a far cry from CBAMs in theory. The following section seeks to assess how a global trade regime built around CBAMs may affect climate innovation in practice.

Complementary Policies

Like domestic carbon pricing, a CBAM, no matter how well administered, is incomplete as a system for driving climate innovation. CBAMs would provide an incentive for producers to cut emissions until the marginal cost of doing so equals the cost of the CBAM. But in sectors wherein the marginal cost of abatement is very high, the tariff would simply be added to the market price. Demand would decline in response, but emissions per physical unit (such as a ton of steel) would change very little. Key sectors being considered for CBAMs, such as cement, steel, and aluminum, fall into this category, wherein decarbonization technologies today are very expensive and not yet widely deployed. Complementary policies, such as those encompassed by the international Mission Innovation initiative, must be implemented to push innovation to cut the marginal cost of abatement before CBAMs provide much of a pull.

A CBAM, no matter how well administered, is incomplete as a system for driving climate innovation.

Automobile innovation provides an example of the limits of carbon pricing. Gasoline taxes, which function like carbon prices, have for decades been much higher in Europe than in the United States. Facing fuel prices that were often twice as steep, Europeans bought smaller and more efficient cars than Americans did, and drove them less. But until recently, no carmaker offered electric vehicles (EVs) for sale in Europe. EV technology was so crude that even a huge fuel price advantage fell far short of making up for EVs' poor performance and high sticker price. Public RD&D investments, regulatory mandates, and tax incentives are among the policies that have helped close the performance gap between EVs and conventional cars and set the stage for widespread EV adoption. A similar public policy strategy is necessary to push innovation in technologies for hard-to-abate sectors.

Global Segmentation and Resource Shuffling

A more profound concern about a CBAM is that it could divide the world into dirty and clean trading blocs. To some extent, these blocs would correspond with national borders. Nations that choose not to impose a carbon price would trade freely with one another, while those with carbon pricing systems transparent and consistent enough with one another would do the same. If the dirty bloc is large enough, which seems likely given the reaction of countries such as India, Brazil, Turkey, South Africa, and Russia to the EU's proposed CBAM, the impact of the clean bloc's actions on climate change could be blunted.

Trade across the boundaries of these blocs might be possible, especially if managers of exporting firms are creative. In some cases, dirty-bloc production may be so cheap that a carbon tariff would not hurt their competitiveness very much in countries employing CBAMs. In others, firms in dirty-bloc countries that have some output that is relatively clean may split up to reduce their CBAM liability. The clean successor firm would be well positioned to export into the clean bloc, while the dirty one would continue to produce GHG-intensive products for domestic consumption and export within the dirty bloc. Such resource shuffling does nothing to reduce overall global emissions. Rusal, the Russian aluminum conglomerate, recently announced a plan to do just this in light of the planned EU CBAM proposal.[29]

Harmonizing National Variations

While carbon pricing is a key feature of many climate policies around the world, it is not a necessary one. The United States, for example, is likely to rely more heavily on clean energy and product standards, as well as incentives, than on carbon pricing to cut its emissions. The Paris Agreement rests on a bottom-up principle, with each nation determining its own contribution to the global effort. A diversity of approaches to carbon regulation and taxes is inevitable within such a framework.

If the CBAM is tightly linked to carbon pricing, producers in nations following a nonpricing approach to climate policy would be penalized. For instance, the EU's draft proposal requires imports from nations relying on regulatory policy to pay the CBAM even though the latter's production costs could very well be higher and its emissions lower. Under this proposal, even if the United States adopted stringent regulations, U.S. producers that might be inspired to innovate by this international pressure would not be able to export to the EU without being subject to the CBAM. Low-carbon American products could even face a price disadvantage in the European market compared with higher-carbon products made elsewhere, such as China.

A narrow approach to CBAMs could result in further segmentation of the world economy, beyond simply dirty and clean blocs, depending on how nations choose to pursue their contributions under the Paris Agreement. At the same time, a diversity of climate policy approaches across nations would further complicate the measurement and pricing challenges of CBAM implementation. Regulatory systems can in principle be translated into shadow carbon prices, but that translation is even more fraught than harmonizing different carbon pricing systems and would likely face challenges by other countries in the WTO.

Gaming the System

The complexities of implementing a CBAM create opportunities to game the system, thereby weakening incentives for climate innovation. Indirect carbon leakage is an example. If CBAMs applied to basic materials cause production of more complex goods to move out of the jurisdiction applying the CBAM, producers at both of these levels of the supply chain would be less likely to seek ways to reduce emissions. For instance, steel and aluminum are important inputs for EVs. If they were subject to the CBAM but EVs were not, the incentive to innovate in order to reduce embodied carbon would be diminished for both types of products.

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On a tactical level, producers and traders may seek to arbitrage the expected carbon tariff over time or across sectors or exporting jurisdictions. Tariffs based on the average carbon content of a particular good from a particular country, for instance, might be exploited by low-cost, high-carbon producers in the same industry and country. Products might also be transshipped from higher-carbon jurisdictions through lower-carbon ones to avoid paying the CBAM. In the extreme case, the creative energy invested in gaming a complex CBAM system could exceed that devoted to emissions-reducing innovation.

Uncertainty

Uncertainty about the functioning and durability of a CBAM presents another potential disincentive to climate innovators. Many industries in which innovation is most badly needed are capital intensive with decades-long investment cycles. Producers making big bets on long-lived plants are understandably risk averse. If they lack confidence that a low-carbon trade regime will be in place throughout the expected lifetime of their investments, they may hedge or play it safe, limiting their commitments to clean manufacturing. The risk aversion of producers would have knock-on effects for technology developers, whether they are internal RD&D groups or suppliers.

The uncertainty about a CBAM is multilayered. The domestic political processes by which CBAMs would be created and maintained are fraught with uncertainty. Many of the domestic industries impacted by carbon pricing and CBAMs are politically powerful. While these industries have an incentive to support CBAMs once carbon pricing is in place, they may also seek allowances that protect their operations from it, thereby gaining an extra benefit if a CBAM is enacted, weakening innovation incentives for both themselves and their foreign competitors. Domestic industries may also seek to roll back carbon pricing after its enactment, leading jurisdictions to backslide, as has been the case in Australia and some Canadian provinces.

The international negotiating process adds another layer of uncertainty. Top-down negotiations to coordinate the introduction of CBAMs across jurisdictions have proven ineffective. Coordinating from the bottom up might be possible if a powerful, durable international CBAM coalition forms. At the moment, though, there are few signs of such a coalition emerging among any combination of the United States, the European Union, China, India, or developing nations.

Global implementation of CBAMs is the final layer of uncertainty. National approaches to measuring and verifying embodied carbon, determining carbon prices, and collecting adjustment certificates may vary so widely or be applied so inconsistently that producers are deterred from making the long-term, large-scale investments required to accelerate innovation in emissions-intensive, internationally traded sectors.

Adding It Up

A well-designed, well-administered CBAM would have a positive impact on climate innovation. Transparent and durable tariffs based on the carbon content of emissions-intensive goods provide clear incentives to producers to reduce emissions, while leveling the playing field for domestic producers. If complemented by robust RD&D and other policies, CBAMs would be a valuable element in a broader climate innovation system.

However, the path to transparency and durability on a global basis is perilous and long. Perverse incentives caused by delay and uncertainty are likely to dominate producers' mindsets if CBAMs become the major focus of global climate negotiations. Energy that ought to be devoted to accelerating innovation with simpler, more popular, and less interdependent policies could be diverted into minutiae of CBAM administration that may never come to pass. The pursuit of the perfect CBAM would become the enemy of good innovation policy in this case.

Research suggests that a CBAM would have limited global climate benefits in the short run. The EU CBAM proposal estimates that the policy would reduce emissions by 1 percent within the EU and 0.4 percent in the rest of the world.[30] Ultimately, a more ambitious global clean energy innovation agenda requires a different set of policy tools. While a carbon pricing mechanism alongside some sort of carbon border protection mechanism could help, it is unlikely that a price-based approach alone would be able to drive investment in the clean energy sectors necessary to reduce global emissions.

Perverse incentives caused by delay and uncertainty are likely to dominate producers' mindsets if CBAMs become the major focus of global climate negotiations.

CLIMATE INNOVATION CLUBS: AN ALTERNATIVE PATH

A "club" approach that emphasizes the importance of global innovation and cooperation to avert the worst consequences is a promising alternative to one that relies primarily on CBAMs. The idea is similar to one pitched by Nobel prize-winning economist William Nordhaus.[31] The club would be a more workable way to combine the carrot of trade and innovation with the stick of sanctions. Trade among the club countries would be as open as possible, while imports into the club would face a flat tariff or quota.

The goals of a climate innovation club include sustaining international trade, encouraging the flow of innovative technologies across borders, driving increasingly ambitious climate targets, and spurring investment in hard-to-abate sectors, all while building on the Paris Agreement's bottom-up approach, which respects national sovereignty and allows for policy flexibility. Some general principles that have undergirded successful international clubs in the past, and for which the goals of an international climate innovation club would be well suited, include:

- A common good that club members agree to be in their individual interests, but which requires collective action to protect;
- Tangible benefits to each club member;
- Exclusion of nonmembers from those benefits; and
- Relatively low transaction costs to organize.[32]

Next, we explore two types of climate innovation clubs in a preliminary fashion. The more-ambitious approach would cover as many traded goods as possible to accelerate the energy and industrial transition across the entire economy. A less-ambitious approach that may be more feasible in the short run would be to create sectoral innovation clubs for EITE industries, such as steel. In addition to driving change in these industries, the sectoral approach could serve as a stepping-stone to the inclusion of additional industrial sectors, building up to a comprehensive system.

Joining an Economy-Wide Climate Innovation Club

Entrance into the most expansive version of the climate innovation club would be contingent on a high level of ambition, transparency, and enforceability of climate targets. Good intentions alone would not be enough to grant access. The club would adopt action-oriented criteria that are flexible enough to accommodate the unique means by which different nations address climate change.[33] The club would establish a baseline standard for national climate policy, including vital strategies to spur innovation.

Criteria for membership in a climate innovation club should include the following:

- **A credible national plan to reach net-zero emissions by 2050.** Six nations have enacted net-zero legislation, while 24 nations (including the United States) have issued policy directives with this goal, and another 99 nations are considering net-zero policies.[34]
- **Either a carbon price that covers a substantial share of economic activity, whether through a cap-and-trade system or carbon tax and a schedule to expand that share; or robust and well-enforced regulatory policies, such as emissions standards for major emissions sectors such as transportation and electricity, and a schedule for regulation to reach all major polluting sectors**. Forty-five countries are covered by some form of carbon pricing. The United States does not have a national carbon price, although some states have one. The Biden administration has announced a goal of carbon-free electricity nationwide by 2035 and issued a plan to make half of all new cars electric by 2030, but the federal government has not yet taken detailed steps to fully implement them.
- **Tax incentives or other policy supports for emerging clean energy and emissions-reducing technologies.** Most high-income countries, as well as China and India, offer tax incentives for some forms of low-carbon energy, such as production or investment tax credits or feed-in tariffs.
- **A significant and sustained national climate innovation RD&D budget of at least 0.04 percent of gross domestic product.** In 2020, at least 15 nations, including the United States, met this threshold.[35]
- **Significant corporate commitments to net-zero emissions and adoption of low-carbon production methods for carbon-intensive products.** As of March 2021, 20 percent of the globe's largest 2,000 companies had a net-zero commitment.[36]
- **A national strategy to achieve decarbonization of hard-to-abate sectors, including carbon-content targets for key products of EITE industries and direct or indirect support for sector-level innovation.** Most major economies have begun to develop national strategies to decarbonize sectors such as iron and steel, cement, refineries, petrochemicals, agriculture, and construction, although few of these strategies have yet been implemented.
- **A GHG emissions accounting system for the entire economy that is internationally verifiable.** All member states of OECD have adopted such accounting systems. In the past, there have been concerns with the veracity of China's GHG emissions data.[37]

Growing the Economy-Wide Club and Enforcing Its Rules

The climate innovation club should start with a handful of like-minded nations. This strategy would ease its start-up and reduce its costs by simplifying the negotiation process and limiting the range of competing interests that would need to be accommodated. Once the rules for membership are established, the club could expand to a wider set of nations. Nations seeking to join the club would have an incentive to strengthen their climate-related innovation policies, including clean energy innovation policies, to gain access to liberalized trading among club members.

The carrot for joining the club would be that its members would continue to be able to trade more freely with each other, free of the threat of carbon tariffs. In addition, club members would be required to impose tariffs on imports from non-club members, helping to minimize or eliminate any competitive disadvantage from domestic carbon reduction policies. The most effective sanction may be a flat tariff, rather than a carbon-based tariff, as proposed by Nordhaus:

> [A] countervailing duty on the carbon content of imports … would be both complicated and ineffective as an incentive to join a club…. A second and more promising approach would be a uniform tariff on all imports from nonclub countries into the club…. The advantage of uniform tariffs over countervailing duties is simply simplicity. The point is not to fine-tune the tariffs to a nonparticipant country's production structure but to provide powerful incentives for countries to be part of the Climate Club.[38]

The sanction would incentivize nonmembers to bring their national climate policies up to the club's level. While the blunt stick of the flat tariff in the club approach lacks the theoretical elegance of the CBAM's idealized emphasis on the marginal cost of carbon emissions, it has the virtue of administrative feasibility. To keep the focus on traded goods with doing the most environmental damage (and to limit administrative ease), the club's tariffs might be restricted to physical goods, rather than digital-goods and services imports. This way, the club would accomplish two goals: 1) encourage nations to increase their commitments to mitigating climate change, and 2) level the playing field in trade in energy-intensive industries.

The climate innovation club could respect the principle of common but differentiated responsibilities by softening the criteria for least-developed countries that bear little historic responsibility for climate change to join.[39] However, such members would need to show definite, rapid, and verifiable progress in enacting and implementing climate plans and policies, consistent with the overall net-zero objective, albeit on an extended timeline, perhaps out to 2070 or 2100.

Although it would be far from easy to create and maintain, a climate innovation club could look to the history of the Montreal Protocol on ozone depleting substances as a successful example of an international environmental negotiation process that began with a small number of countries and eventually grew to include every nation in the world.[40] Nations that were not a party to the Protocol could not access the multilateral transition fund that provided funds for alternative products. In addition, the Protocol imposed a ban on importing ozone-depleting products from non-member states. These sanctions pushed new members to join the Protocol throughout the 1990s and into the new century.[41]

Sectoral Climate Innovation Clubs: The Case of Clean Steel

While a climate innovation club that encompasses goods-producing sectors would be best, the creation of sectoral climate innovation clubs for a smaller number of EITE industries could be a stepping-stone toward a broader club. This proposal, first introduced by Timothy Meyer and Todd Tucker in their work considering alternatives to a border carbon tariff, considers how the creation of a clean steel club could alleviate trade tensions and spur investment in decarbonized steel.[42]

The steel industry would be a good starting point. It is concentrated within a relatively small number of firms and facilities, which would simplify the negotiation process. And the GHG emissions of its core production technologies are well understood.[43] This sectoral club could relatively easily establish rules for membership, outlines for cooperation, and means of enforcement with respect to nonmembers.

Criteria for membership in a clean steel innovation club would likely include the following:

- National targets for GHG emissions reductions by the domestic steel industry, with interim sectoral goals for 2030 and 2040, and a net-zero goal by 2050 (or later for developing nations)
- A national policy roadmap that details how the industry can achieve these targets
- Corporate commitments from major iron and steel producers to reduce emissions in-line with national targets
- A national iron and steel RD&D program focused on innovative low-emission production processes
- Robust national policy supports to incentivize deployment of clean steel
- Implementation of a robust recycling program to increase iron and steel scrap usage to maximal levels
- Support for cooperation among member nations to share technical information on emissions from steel production

As in the case of the economy-wide climate club, the steel club would be able to accommodate the variations in national starting points in the steel sector, while emphasizing concrete progress in reducing emissions. Transparency in emissions reporting and information sharing across the steel industry could build trust among club members and open up opportunities to identify further emissions reductions and expand international cooperation in RD&D.

Iron and steel imported from nations outside the clean steel innovation club would face a flat tariff, creating an incentive for these nations to increase their policy ambitions for this sector in order to be able to join the club. The proposed rate could be equivalent to the "green premium" of clean steel over traditional carbon-intensive steel. Multinational corporations with production located across multiple member and non-member states could leverage new technologies designed and implemented in one country and deploy them in another, perhaps pushing along nonmembers to increase their ambition so as to be able to join the club.

A starting point for transatlantic negotiations on clean steel could be the tariff the Trump administration placed on imported steel and the retaliatory tariffs implemented by the European Union.

Like their economy-wide counterparts, the sectoral climate innovation club would be easier to administer than a sector-specific CBAM because it would rely on a binary assessment at the level of each nation's industry, rather than a product-specific, time-varying price that must be constantly evaluated, monitored, and enforced. A clean steel climate club would be based on broad policy principles among members and common treatment of nonmembers, whereas a steel CBAM would require an enormous data-gathering and accounting apparatus in order to function effectively.

Revenue generated from the club's tariff on iron and steel imported from nonmembers could be used to accelerate adoption of low-carbon production technology and support demonstration projects to advance the state of the art. The club could also set minimum national clean steel procurement requirements, starting at 5 percent of annual public procurement of iron and steel, and increase over time across the membership, further driving demand for products from club members.

The United States and the European Union would be natural partners to initiate a clean steel innovation club, with South Korea, Japan, Australia, and Canada among the potential core members. While their industries have significant emissions in absolute terms, they are relatively clean compared with global competitors such as China and India.[44] They are highly exposed to trade, sensitive to international competition, and eager to strengthen their competitiveness.

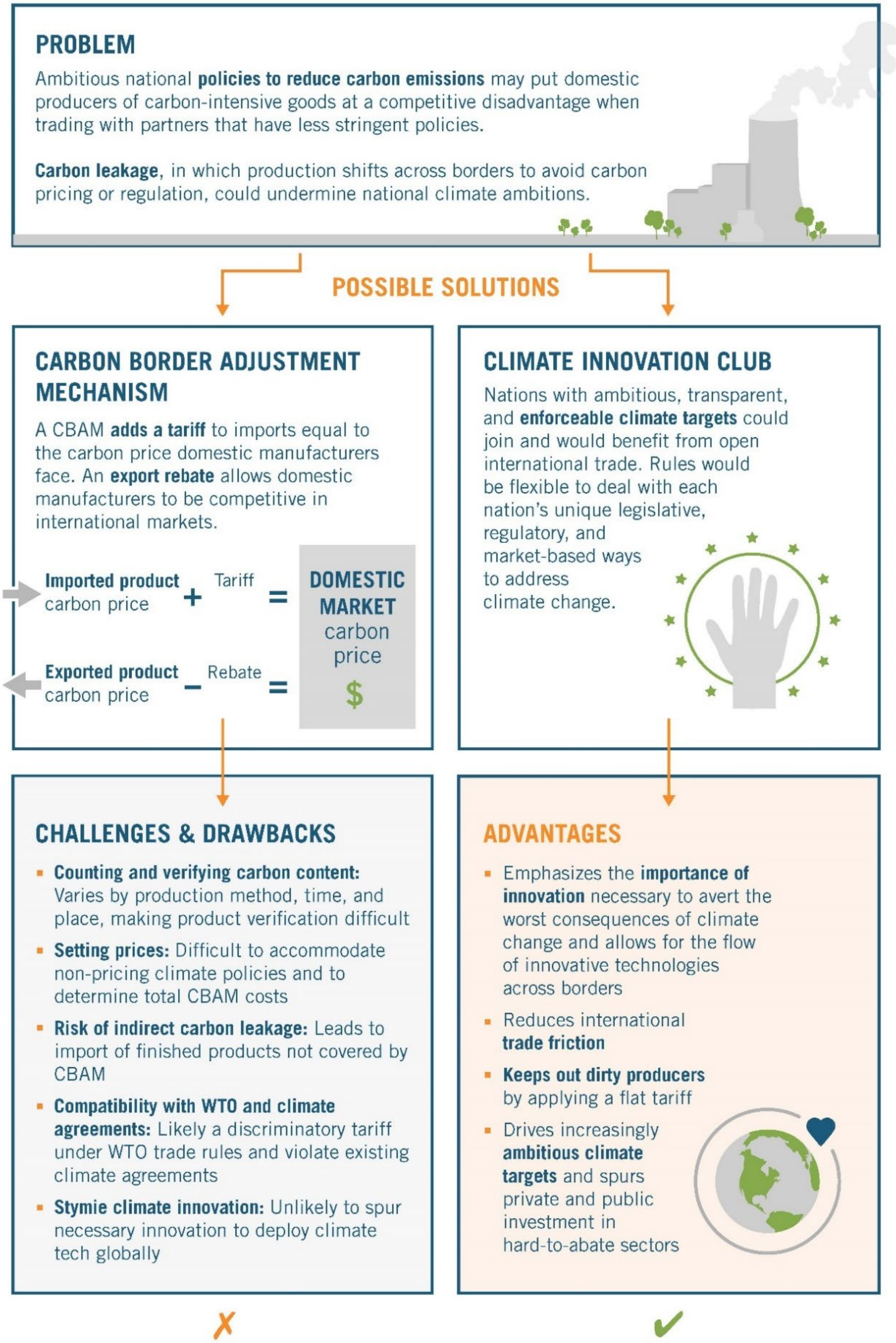
In fact, a starting point for transatlantic negotiations on clean steel could be the Section 232 tariff of 25 percent the Trump administration placed on imported steel and the retaliatory tariffs implemented by the European Union.[45] The Biden administration has not yet announced plans to remove or lower these tariffs. The EU's CBAM proposal should spark a more intensive attempt to harmonize trade policy with the United States. A clean steel innovation club with these two large economies at its core could alleviate trade friction while incentivizing investment to cut emissions in this emissions-intensive industrial sector.[46] Ultimately, the goal would be to use the success of a multilateral clean steel club as a model for other industries such as aluminum and cement, and to create a foundation for a club that covers all traded goods.

CONCLUSION

International trade has been a vital spur to innovation over the past 75 years. It should be harnessed to drive the advances needed to reduce net GHG emissions. Doing so would require significant changes in the global trade regime. If trade is entirely open, many countries will resist requiring their industries, particularly EITE industries, to reduce emissions, because they fear losing competitiveness. Such reluctance would badly impede climate innovation.

A trade regime built around CBAMs in theory addresses this challenge, but in reality it is likely to be unworkable and runs the risk of being used as a de facto protectionist tool. The climate innovation club model presents fewer challenges in implementation and would do more to spur other nations to take action. A club-based approach would encourage a multitude of ambitious approaches to national climate policy and reward them through unencumbered trading in key industrial sectors that drives innovation in low-carbon technologies.

APPENDIX: DRAWBACKS OF CARBON BORDER ADJUSTMENT MECHANISMS OUTWEIGH THE BENEFITS



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