What the European Union’s Proposed Trade Tax on Carbon Means for the United States

By Marc Jarsulic  August 2021
Introduction and summary

The European Union is moving to impose a tax on imports with greater carbon intensity than is allowed in certain energy-intensive domestic industries. The intent of this carbon border adjustment mechanism (CBAM) is to prevent “carbon leakage” and to provide those domestic industries with a level playing field. Goods with carbon intensity exceeding EU emissions standards will be taxed at a rate determined by the EU Emissions Trading System (ETS), and the border adjustment will be offset by carbon emissions taxes in the exporter’s home country.

The proposed EU CBAM is a major innovation that raises important issues for U.S. policy. First, since climate change is a priority for the Biden administration, should the United States implement something similar? The United States does not have a EU-style cap-and-trade system, but it still has an interest in discouraging imports with high levels of embedded carbon.

Second, is it equitable to confine offsets to direct emissions taxes? Although the EU CBAM offsets direct carbon taxes in the exporting country, the implicit costs of domestic emissions regulation are ignored.

Close attention to the likely effects of the EU CBAM offers insight into both these questions. While the EU regime is innovative, its focus on industries with high direct emissions is a limitation that makes it an incomplete model for a future U.S. border regime. There is a strong likelihood that limiting border charges to energy-intensive, high-emission manufacturing will omit much of the carbon embedded in total imports because many of the covered energy-intensive processes provide inputs for other industries. These “upstream” embedded emissions are ignored. Moreover, the limited coverage of a European Union-style CBAM may incentivize carbon leakage. Firms located in countries with few emissions limits such as China will produce energy-intensive products at lower costs. These lower-cost inputs will incentivize outsourcing of industries that make heavy use of them.
Since many economies—including the United States—rely heavily on regulation to limit emissions, the cost of those regulations should be credited when a border tax is applied. Failure to recognize these implicit costs will lead to double emission taxation for exporters who bear them. There are well-established methods that can be used to measure the cost of emissions regulation, even when there is no cap-and-trade system to price carbon emissions. International cooperation can help standardize and verify these cost measurements.

Consideration of these factors could help inform the construction of a U.S. CBAM as well as the U.S. response to the EU CBAM initiative.
Overview of the EU carbon border adjustment mechanism

The European Union is currently in the process of implementing a carbon border adjustment on imports of manufactured goods, and there are indications that the United States is considering doing so as well. The intent of the CBAM is clear enough: The EU ETS, which applies to a limited set of energy-intensive, high-emission industries, imposes a carbon tax on manufacturers in these industries with emissions above a specified level. Since most other countries do not operate similar cap-and-trade systems, EU officials want to level the playing field. Otherwise, EU manufacturers have an incentive to offshore carbon-intensive processes to avoid domestic carbon charges, and domestic manufacturers operate at a competitive disadvantage relative to foreign firms subject to less rigorous emissions standards.

Structuring any CBAM is complex, but there are two elements that are especially important in determining how it will work. The first element is the base for the border tax since this will determine where the economic incentives of the tax are directed. The EU proposal initially will apply charges to direct plant-level emissions for a subset of the industries covered by the ETS, including steel, aluminum, cement, fertilizer, and electricity. Indirect emissions from power consumption may be added on in 2026.

Once implemented, the EU proposal will discourage the offshoring of the industries subject to the CBAM. However, it will miss the substantial amounts of carbon embedded in noncovered imports, and it can also incentivize companies to outsource goods that heavily use covered products as inputs. Avoiding these outcomes ultimately will require broadening the tax base to include embedded carbon in a wider range of manufactured imports. Fortunately, existing empirical methods can help identify where carbon leakage is highest and where an expanded tax base could be most effective.
The second key element is how the costs of an exporter’s domestic carbon rules are credited against the border tax. Crediting is necessary to prevent the CBAM from being dismissed as purely protectionist. But the range of costs that are eligible for credit can play a large part in determining who pays how much at the border.

The European Union proposes to credit only carbon taxes paid in the exporting country. This is a clear and easily implemented approach, but it has drawbacks. Carbon taxes still have limited impact in many economies, while at the same time many countries use regulation to limit greenhouse gas emissions. Moreover, regulation may well remain a central tool for controlling carbon emissions in advanced economies such as the United States. Therefore, a fair and effective CBAM needs to include provisions to measure and credit the cost of carbon regulations. This report argues that workable methods for estimating these costs exist and in some instances are already in use.
An EU-like tax base misses a large amount of embedded carbon

The starting point in the EU proposal is the tax base used for the Emissions Trading System—the amount of direct emissions, above a permitted level, embedded in energy-intensive covered products. The draft regulation for the forthcoming CBAM proposes that all exporters to the European Union must pay a tax on the tons of direct carbon dioxide emissions embedded in covered products that exceed the EU-allowable limit. The tax would equal the cost per ton of CO2 emissions determined in the ETS.

The chosen tax base means that CBAM incidence will vary across trading partners, depending on the structure of trade. For example, only a small share of U.S. exports to the European Union will be affected. In 2020, U.S. exports for the five industries initially covered were slightly more than $1.1 billion. When the CBAM is extended to all manufacturing covered by the ETS, other U.S. industries, such as organic chemicals, will be taxed. However, in 2020, U.S. exports of organic chemicals—the largest U.S. exporter among ETS-covered industries—were slightly more than $9.6 billion. The vast majority of the $231 billion of U.S. merchandise exports to the European Union in 2020 was from noncovered industries. The outcomes for other exporting countries could be much different.

While the European Union’s choice of tax base seems natural, there is a strong likelihood that it will omit much of the carbon embedded in total imports. For example, one study estimates that in the U.S. economy, an average of 26 percent of the embedded carbon emissions of an industry are accounted for by direct emissions and energy purchases. The other 74 percent come from nonenergy upstream purchases of inputs used in the production process. The U.S. auto industry, for example, requires inputs from many sectors, including steel, truck transportation, cattle ranching, and organic chemicals. Manufacturing each of these inputs emits carbon, which is indirectly embedded in autos. For all of U.S. manufacturing, the share of the carbon footprint from upstream sources other than energy purchases is 70 percent to 80 percent.
Moreover, the limited coverage of the CBAM may lead, somewhat perversely, to carbon leakage. Many of the covered products are inputs for other industries. Therefore, firms located in countries without comparable emissions limits such as China will have lower input costs than firms operating inside the European Union. But the higher carbon content of their exports will not be subject to the CBAM at the EU border. This will make EU manufacturing less competitive within the European Union and may lead to outsourcing.

Data from the U.S. economy illustrate the possibility of outsourcing. According to one analysis, well more than half of total carbon emissions embedded in U.S. imports comes from industries that are not subject to ETS emissions limits. Yet many of these industries use covered products as inputs. In the U.S. automobile manufacturing sector, for example, direct emissions and power account for only about 34 percent of embedded emissions and, for construction, equipment only about 35 percent. A substantial fraction of the remaining carbon content for both these industries comes from inputs that are subject to emissions caps under the ETS.

These limitations do not detract from the importance of what the European Union is attempting. However, they do point to the importance of integrating comprehensive measures of embedded carbon into any CBAM regime. Luckily, there are empirical methods that can provide useful insight. Intercountry input-output models—which show the amount of inputs used in a unit of output in each country for an aggregated but well-defined set of goods—make it possible to estimate the amount of carbon embedded directly and indirectly in the production of a unit of a good, no matter where the inputs were produced.

Global input-output tables have been used to estimate—at a fairly high level of aggregation—carbon intensity in computable general equilibrium models used to study climate change. Researchers at Carnegie Mellon University have used a 46-sector, nine-country global input-output table to examine the embedded carbon in U.S. imports. The Organization for Economic Cooperation and Development has used intercountry input-output data to estimate carbon intensity for 36 industries and 64 countries, covering the period 2005 through 2015. The Exiobase global input-output tables are also suitable for this purpose. They cover 163 industries and 200 products for 44 countries and five regions—altogether including about 90 percent of global gross domestic product.
There are recognized limitations to these models, including high levels of aggregation and temporal and spatial variability in the data used to construct them. But while the results are less refined than many would prefer, they can help identify industries and countries that are most likely to generate carbon-intensive imports. Additional resources devoted to the construction of more disaggregated and consistent global input-output tables would help make calculation of the tax base for any CBAM more accurate.

The United States has yet to address the question of carbon border adjustment. However, recent draft legislation—the Fair, Affordable, Innovative, and Resilient Transition and Competition Act, which shares common features with the EU proposal—shows that it is a live policy issue. The act uses a slightly different tax base for manufacturing: total direct emissions rather than emissions above an allowable level, covering a similar initial list of industries with administrative discretion to add others. Also, since the United States lacks a carbon tax rate generated by a cap-and-trade system, the legislation instead uses an estimate of the average implicit tax, per unit of CO2, generated by U.S. greenhouse gas regulation. The cost of compliance with current regulations is unclear at the moment.

Moreover, in contrast to the EU proposal, the draft bill exempts countries that do not apply a CBAM to U.S. exports and which have a greenhouse gas emissions regime at least as ambitious as that of the United States.

Although the draft bill may well be changed if it moves through Congress, its similarities with the proposed EU CBAM regime raise some of the same issues of coverage and emissions measurement.
An effective CBAM needs to recognize the cost of carbon regulation

A second tough issue in the construction of a carbon border adjustment mechanism is how to credit an exporter’s domestic carbon costs when calculating the charge at the border. The European Union proposes to credit only carbon charges in the exporting country. This provides a certain incentive for exporters to value explicit carbon pricing in their own countries and makes for tractable calculations. However, there are some serious drawbacks to this approach. Although there are plenty of reasons to prefer carbon taxes as the mechanism to control emissions, carbon taxes currently have limited impact. While the number of jurisdictions imposing carbon taxes is increasing, levels and coverage vary markedly. According to the World Bank, in 2019, carbon prices ranged from less than $1 per ton of CO2 to $119 per ton, with almost half of covered emissions priced at less than $10 per ton. Only 22 percent of total carbon emissions are covered by carbon pricing.19

Moreover, some jurisdictions have managed to reduce carbon and other emissions by implementing regulatory and subsidy programs for industries, regions, and consumers. Emissions from electric power generation in Germany, for example, have been reduced by requirements that utility companies purchase renewable power at government-determined rates, by subsidies to renewable producers, and support for research and development in fuel cells and clean hydrogen technology.20 There is no national carbon tax in the United States, but power plant emissions are constrained by regulation at the national level by the Clean Air Act.21 California and other states have a portfolio of programs that includes cap and trade for certain industries, requirements for renewable electricity levels, and limits on other emissions that are correlated with CO2.22 Therefore, it would be important for an effective CBAM to include well-defined methods to calculate the cost of regulation.

The draft U.S. CBAM legislation makes an analogous omission. Although it assumes that the costs of regulation can be calculated, it does not include a way to credit carbon charges levied in the exporter’s jurisdiction.23 There are
workable ways to calculate the cost of emissions regulation, although they can be technically complex and require significant amounts of data. One approach is to use well-established methods to estimate cost functions, which describe the cost of producing a particular good. These cost functions can then be used to calculate production costs both with and without carbon regulation. The increase in costs resulting from setting carbon measures the marginal cost of regulation.

This has been done by the U.S. Environmental Protection Agency (EPA) as part of its cost-benefit analysis of air pollution regulations. Using dynamic linear programming analysis, based on detailed information about the technology of power generation, the EPA has calculated the changes in costs of power generation resulting from the Clean Air Act. The EPA describes the Integrated Planning Model, which it uses for this purpose, in the following way:

The Integrated Planning Model (IPM) is a multi-regional, dynamic, deterministic linear programming (LP) model of the electric power sector in the continental lower 48 states and the District of Columbia. It provides forecasts up to year 2050 of least-cost capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints. IPM can be used to evaluate the cost and emissions impacts of proposed policies to limit emissions of sulfur dioxide (SO2), nitrogen oxides (NOX), carbon dioxide (CO2), and mercury (Hg) from the electric power sector.

IPM provides a detail-rich representation of the U.S. electric power system. Over 15,000 existing and planned/committed generating units in the U.S. electric system are mapped to over 40,000 model plants, each designed to capture the specific cost, performance, and emission characteristics of the units it represents. The model also provides a very detailed representation of coal supply choices available to the power sector. It distinguishes coal by rank (bituminous, subbituminous, and lignite), sulfur and mercury content, and differentiates approximately 40 distinct supply regions (each with its own set of supply curves) and a comparable number of demand regions. The model’s representation of emission control options is also extensive.24

The data requirements for a model this complex are large. The base and policy case runs for this model involve nearly 2 million decision variables and 200,000 constraints. But the EPA has demonstrated that work at this scale can be done effectively, producing results that can be updated regularly as conditions change.
In its regulatory impact analysis of the Clean Power Plan rule, which required a 32 percent reduction in CO2 emissions by 2030, the EPA calculated the costs of meeting the goal. Because the rule allowed state governments latitude in the implementation of the plan, the EPA simulated two possible alternatives: a rate-based scenario in which all states limited CO2 emissions per megawatt hours of generated electricity and a mass-based scenario in which all states capped the total emissions from the electricity sector. Under the rate-based approach, annual compliance costs were $2.5 billion in 2020, $1 billion in 2025, and $8.5 billion in 2030. Under the mass-based approach, the annual compliance costs were $1.4 billion, $3 billion, and $5.4 billion, respectively. While these estimates depended on the conditions existing when they were made and on yet-to-be implemented regulatory decisions made by state governments, the costs of carbon regulation can clearly be estimated using these techniques.

Similar modeling and calculation could be done for manufacturing sectors that are subject to regulatory emissions limits.

A second approach to estimating the cost of regulation is to calculate a “shadow price” of reducing carbon emissions. This can be done by treating carbon emissions as part of a joint production process that simultaneously delivers a “good” with a positive market price and an environmental “bad” that generates external costs for which the firm is not charged. The shadow price is determined as the value of the good, which must be sacrificed in order to reduce the production of the bad given the existing production process and inputs. In the case of electrical power generation, for example, the shadow price would measure the cost of reduced electricity production per unit of CO2 reduction.

There are alternative procedures for making these calculations using firm-level data on current inputs, outputs, and emissions for an industry. These procedures may be less burdensome than the development of the detailed linear programming models exemplified by the EPA’s work on the power sector and might be used to estimate the cost of carbon regulation while more detailed linear programming models are developed. The average shadow price of the carbon emissions across firms could be used to calculate the marginal cost of carbon regulation for an industry.
Model construction is important in determining results from both linear programming and shadow price estimation. Both techniques require firm-level data on economic variables and emissions. These data then need to be used in a consistent manner in well-specified models that accurately describe conditions by industry and country. Creating and using these models requires expert knowledge. By mutual agreement, data-gathering and calculations could be overseen by a secretariat at a neutral third party—such as the International Energy Agency, the World Bank, or the International Monetary Fund—and be subject to independent audit. There would be strong incentive for firms and governments to collaborate effectively with this secretariat because doing so would result in a fair application of CBAM across countries and industries.
Conclusion

The European Union has taken significant steps to limit carbon emissions using the ETS, subsidies, and regulation, and it will soon move to implement a CBAM mechanism. The intent is to prevent carbon leakage and to limit competitive harm to EU industries—both reasonable goals. The European Union’s leadership on the issue of climate change is extraordinary and deserves to be applauded.

However, the proposed EU CBAM highlights two difficult issues for any carbon border tax regime. The first is the construction of the CBAM tax base. The European Union proposes to use direct emissions and power usage for a set of energy-intensive industries as the tax base. But as data on embedded carbon intensity indicate, this strategy is likely to overlook significant embedded carbon in other imports and limit the impact of the border tax on carbon leakage. Existing empirical methods can help identify how the tax base could be expanded to deal with this issue.

It is also important to quantify and credit the implicit taxes imposed by regulation—in both exporting and importing countries—when determining CBAM charges. Regulation is and will continue to be an important tool for limiting emissions. Credible techniques needed to measure the implicit costs of regulation exist and have been implemented successfully as part of U.S. emissions regulation. Using such techniques will make border charges more accurate and help reduce otherwise inevitable frictions that will arise because of the mix of regulation and carbon pricing that is already in place around the world.
About the author

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4 Ibid. When producers cannot provide verifiable installation-level measures of the direct emissions embedded in their exports, the default tax base will be the average emission intensity of each exporting country for each good increased by a markup yet to be determined. When data on average emissions are unavailable, the default value becomes the average emission intensity of the 10 percent worst-performing EU installations for that type of good. Indirect emissions from power purchases may be added to the tax base later.

5 U.S. Census Bureau, “USA Trade Online,” available at https://usatrade.census.gov/data/Perspective60/View/dispview.aspx (last accessed July 2021).

6 In existing climate protocols, direct emissions are “scope 1” and energy purchases are “scope 2.” This report avoids these terms because the remaining category, “scope 3” emissions, includes upstream emissions other than energy (e.g., those embedded in inputs to a manufacturing process) along with downstream emissions (e.g., pollution from autos sold by automakers), and in the CBAM context upstream emissions are the relevant consideration.


17 Fair, Affordable, Innovative, and Resilient Transition and Competition Act.

18 It also adds certain fuels to the covered list and includes some associated upstream emissions.


23 Fair, Affordable, Innovative, and Resilient Transition and Competition Act.


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