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Export Rebates and Import Charges for Border Tax Adjustments Under an Upstream US GHG Tax: Estimates and Methods

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Acronyms and Abbreviations

- BA(s)—border adjustment(s)
- BTA(s)—border tax adjustment(s)
- CBAM—Carbon Border Adjustment Mechanism
- CO_2—carbon dioxide
- CO_2e—carbon dioxide equivalent
- EITE—energy-intensive, trade-exposed [sectors; industries; etc.]
- EPA—US Environmental Protection Agency
- ETS—emissions trading system
- GGI(s)—greenhouse gas index (indexes)
- GHG(s)—greenhouse gas(es)
- GHGP—Greenhouse Gas Protocol
- ISO—International Standards Organization
- LCAs—life-cycle analyses
- LDPE—low-density polyethylene
- LNG—liquefied natural gas
- MBtu—million BTU
- MWh—megawatt-hour
- NAICS—North American Industry Classification System
- PFCs—perfluorochemicals
- t—metric tonne
- UNFCCC—United Nations Framework Convention on Climate Change
- VATs—value-added taxes
- WBCSD—World Business Council for Sustainable Development
- WRI—World Resources Institute
- WTO—World Trade Organization

1. Introduction

In recent reports, we've proposed a Framework to create and implement border tax adjustments (BTAs) in the context of an upstream US GHG tax that are compatible with US obligations under World Trade Organization (WTO) agreements.[1,2] Determining BTAs—export rebates and import charges—for covered greenhouse gas (GHG)-intensive products presents significant but feasible administrative challenges, especially at startup and during early years of the program. Challenges include developing required information for the large number of GHG-intensive products exported from and imported to the United States, the availability of reliable data (especially from firms in developing countries), and the need to develop capacity in affected firms around the world and in the US government to determine BTAs for covered products.

To illustrate how some of these challenges could be met, this report describes how indicative, representative estimates of export rebates and import charges can be determined based on available information, as well as estimates for what they would be for a sampling of commodity products from several industrial sectors. Section 2 summarizes the technical background to determine BTAs for covered products based on the GHG index (GGI)—a critical concept and administrative index proposed in the 2020 Framework report (see footnote 1). Section 3 discusses issues and approaches to address challenges to the start-up and phase-in of BTAs in the initial years. Section 4 provides an overview of methods to determine initial estimates for GGIs. Section 5 presents a summary and conclusions. Two related documents complement this report. The first, accompanying report,[3] describes how specific facilities and operations would determine their GHG tax and GGI values for covered products they create. The second, forthcoming report,[4] contains modules with estimates of GGI values for products in about 40 sectors based on the methods described here.

1 Flannery, Brian P., et al. 2020. ***Framework Proposal for a US Upstream Greenhouse Gas Tax with WTO-Compliant Border Adjustments: 2020 Update***. Report 20-14. Washington, DC: Resources for the Future.

2 Flannery, Brian P., et al. 2020. ***Policy Guidance for US GHG Tax Legislation and Regulation: Border Tax Adjustments for Products of Energy-Intensive, Trade-Exposed and Other Industries***. Report 20-15. Washington, DC: Resources for the Future.

3 Flannery, Brian P., and Jan W. Mares. 2021. ***Determining the Greenhouse Gas Index for Covered Products of Specific Manufacturers.*** Working Paper 21-31. Washington, DC: Resources for the Future.

4 Mares, Jan W., and Brian P. Flannery. 2021. *Modules with Estimates for Export Rebates and Import Charges Based on the Greenhouse Gas Index for Products in 36 Sectors*. Forthcoming.

2. Technical Background

GGI values depend sensitively on specific natural resources, purchased products, technologies, and processes used to create covered products. Consequently, where possible, they should be determined separately for each entity that produces them. For simplicity, we refer to that entity (e.g., an industrial facility or operation to produce fossil resources) as the manufacturer. Required information for individual manufacturers exists in most developed nations. However, required information (especially at the level of specific manufacturers) may not be available today in many developing nations. In those cases, we propose that the initial GGI values for covered products should be determined based on national sectoral averages where available, or averages for the United States or relevant groups of nations (see our forthcoming modules; footnote 4).

2.1. GHG Index, Covered Products, and Sectors

In the Framework report (Section 3.5; see footnote 1), we define covered products as those that satisfy thresholds for GGIs. We refer to them as GHG-intensive products and define covered sectors as those that include covered GHG-intensive products. To qualify for an export rebate or be subject to an import charge, a product's GGI must equal or exceed 0.50 tonnes carbon dioxide equivalent (CO_2e)/tonne product—or, for electricity, 0.25 tonnes CO_2e/megawatt-hour (MWh). Note that not all products in covered sectors—only those that meet the threshold criteria for GGIs—would be eligible for rebates and subject to import charges.

For a specific manufacturer, three sources contribute to the GGIs of their products: 1) the carbon content of produced fossil resources; 2) GHG process emissions; and 3) the contribution from GHG-intensive products of suppliers. Similar to value-added taxes (VATs), a GGI sums taxed sources of GHG emissions required to manufacture covered products (see Section 4 below). The manufacturer would pay the upstream GHG tax on the first two sources listed above. The third source accounts for cumulative GHG taxes paid in the supply chain to create GHG-intensive products purchased and used by the manufacturer.

Over a decade ago, an interagency report[5] analyzing the Waxman–Markey cap-and-trade bill (H.R. 2454) identified 46 sectors in the North American Industry Classification System (NAICS) as presumptively eligible for relief under the bill. The eligibility of covered sectors (not products) was determined based on criteria set in H.R. 2454 that established thresholds for GHG-intensity, energy-intensity, and trade-intensity. These are typically referred to as energy-intensive, trade-exposed (EITE) sectors. However, no generally accepted standard exists to define EITE sectors; different nations and studies define them in different ways. Although many of the 46

5 *The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries*. December 2, 2009.

sectors in that report contain products covered under our Framework, so too do other sectors—including coal, oil and gas production, petroleum refining, and electricity. Note that while H.R. 2454 would have provided relief based on facilities in covered sectors, the bill was silent concerning specific products from those facilities. Section 3.5 of the Framework report (see footnote 1) describes why we believe that GGI thresholds are more appropriate than sectoral criteria to qualify products subject to BTAs. For example, liquefied natural gas (LNG) with a GGI of 3.4 tonnes CO_2e/tonne LNG is placed under a NAICS code that is not eligible under H.R. 2454.

2.2. Export Rebates and Import Charges Based on GGIs

The GGI determines both export rebates and import charges. Given the GGI for a covered, exported product, the rate for its export rebate (US$/tonne product) would be the GGI multiplied by the US GHG tax rate (US$/tonne CO_2). Similarly, given the GGI for a covered, imported product, the rate for its import charge would be its GGI multiplied by the US GHG tax rate.

2.3. Roles of the Regulator

In Section 3.1 of the Policy Guidance report (see footnote 2), we recommend establishing lead and support agencies within the US government to administer the GHG legislation—i.e., the US Department of the Treasury, with support from the US Department of Commerce and the US Environmental Protection Agency (EPA), which we refer to collectively as "the Regulator." The Regulator would have many tasks. Here we focus primarily on its role in determining export rebates and import charges—in particular, import charges in the initial, start-up phase of the program before reliable firm-specific data would be available for all covered products, especially those from developing nations.

Without reliable information provided directly by US exporters seeking a rebate for covered products, the administrative challenges to determine rebates would be formidable. As explained in our earlier reports (see footnotes 1 and 2), US export rebates would be based on the national average for a firm's entire domestic production of specific products. For that reason—just as they already do for GHG emissions—US manufacturers would be required to report to the Regulator on a facility basis the GGI values for covered products that they manufacture, based on verifiable information used to determine them. Initial import charges for covered products would be established by the Regulator based on estimated national and sectoral averages. After a two-year start-up phase, US importers also would be required to provide GGI values based on firm-wide national averages for products that they import from foreign manufacturers. Going forward, this information would enable the Regulator to confirm proposed rebates and continue or modify import charges for covered products.

For a prompt start to the program before regular reporting comes into force, this report provides examples of methods and information that the Regulator could use

to determine what requests for rebates might be and to determine and publish initial import charges based on available public information. Examples in the forthcoming modules (see footnote 4) and Table 1 provide approximate, indicative values for BTAs of products in about 40 sectors in the NAICS system and about 20 products in Table 1.

2.4. Setting the Minimum Threshold for GGI

The number and types of covered products increase rapidly with lower GGI thresholds, significantly increasing the administrative effort to determine and enforce BTAs, especially for import charges from developing nations. For that reason, the minimum GGI threshold should be set at a level that addresses concerns regarding competitiveness and GHG leakage through international markets, while keeping administrative costs and challenges within reason. We chose the proposed thresholds on this basis, and in our Policy Guidance report (footnote 2) recommended that Congress, not the Regulator, should set the threshold.

The proposed GGI threshold would include important commodity products from many EITE industries identified in the interagency report (footnote 5)—as well as commodity products from coal, oil and gas resource producers, oil refineries, and electricity that we recommended should be covered under the Framework. (Note that the proposed threshold for electricity would qualify electricity produced from fossil fuels.)

On one hand, as a result of the GGI threshold, situations may arise in some sectors where some products of a more efficient firm fail to qualify for export rebates (GGI < 0.50 tonnes CO2e/tonne product), even though like products of less efficient producers may qualify.[6] This would primarily affect the export-related business of the more efficient firm. On the other hand, because more efficient firms would pay lower GHG taxes, they should be at an advantage in domestic markets relative to producers of the same product that do qualify for the rebate. (Also, it is worth noting that domestic, not export, markets typically dominate US domestic businesses). To the extent that exports are a significant share of production, the effect on companies that receive or do not receive rebates would be more averse to more efficient companies. Unfortunately, policies typically have winners and losers. In this case, a winner on efficiency would be a loser on rebates. As time passes and the GHG tax increases, however, more efficient firms would continue to improve their domestic advantage. Also, over the long term, as nations strengthen their GHG policies, products with higher GGIs will experience increasing pressure both in the United States and in export markets elsewhere.

Over the past 50 years, US environmental rules and regulations have imposed constraints on producers and product specifications, in almost all cases without providing for a rebate for exports or a related import charge. There will always be firms exporting to the United States that, because of lower costs or different processes, will have an economic advantage in their respective markets over the products of US firms.

6 For example, US producers of raw steel and paperboard may face this situation for some of their products that compete with each other (as well as with products from foreign competitors) in export markets.

The US economy is filled with cases of competing products made in different ways or the same product made in different ways. For the following reasons, we recommend that there be no adjustment of the proposed thresholds for GGIs to accommodate for differences among competing products with GGI values that may be above or below the proposed 0.50 threshold:

- any regulation or rule can affect the competitiveness of different products in domestic and foreign trade;
- individual firms and industry typically are adept at adjusting to new rules and regulations; and
- the government has—at best—limited ability, skill, or competence in comparing and adjusting the impacts of regulations on industry sectors or firms.

Almost all GHG tax bills in Congress do provide relief in some way for EITE industries while also recognizing the need to coordinate with foreign countries to address climate risks. Many observers believe that, over time, at least the OECD countries will coordinate their climate policies to some extent in ways that would tend to favor more efficient firms with lower GHG emissions.

2.5. Sectors and Products to be Covered Initially

A critical initial decision for Congress will be to establish the principles to determine domestic sectors and the covered products that should benefit from BTAs. In general, commodity goods (e.g., steel, cement, gasoline, and LNG) produced in EITE sectors (and a few others) are those most affected by competitive changes in international trade and susceptible to GHG leakage as a result of a US GHG tax. Suppliers of these products compete primarily based on price—not customer service, proximity, delivery time, unique features, advertising, or marketing. Even a small difference in the price of commodities can have significant impacts on competitiveness (see Section 3.5 of the Framework report; footnote 1) that can affect not only a firm's profit but also its ability to compete (e.g., for steel contracts to construct major infrastructure projects, or for fuel contracts with fleets or airports). Determining and providing BTAs will be administratively challenging, so the Regulator should be required to obtain congressional approval to reduce the threshold for the GGI or to take other criteria into account (in particular, the number of covered products would increase significantly with lower thresholds for GHG-intensive products).

Unlike the 2009 interagency report (that used criteria for energy-intensity, trade-exposure, and GHG-intensity based on US economy-wide criteria; see footnote 5), our Framework utilizes the GGI as the sole basis to identify both GHG-intensive products and covered sectors. As discussed in the Framework report (footnote 1), any domestic firm that exports GHG-intensive products or competes with imports will be trade-exposed, regardless of the scale of the sector. For example, Canada exports roughly 11 percent of the electricity it produces to the United States[7]—representing only about

7 *See:* Natural Resources Canada (2018): **https://www.nrcan.gc.ca/energy-facts/electricity-facts/20068.**

2 percent of total US electricity supply.[8] However, Canadian imports can be as high as 12–15 percent of supply in border areas such as New England and New York. In those regions, US electricity producers are certainly trade-exposed. Note that under our Framework, some covered products are manufactured in major energy-intensive sectors that are not among the 46 listed in the interagency report (see footnote 5). And, as a result of various technical quirks, some covered products occur in sectors under NAICS codes that may not meet the 5 percent threshold for energy intensity used in the interagency report[9] (e.g., LNG).[10]

2.6. Approximate, Indicative Estimates of GGI

Table 1 contains a list of approximate, indicative values for the GGIs of a sampling of major commodity products. (The forthcoming modules [see footnote 4] provide such values for over 150 products from over 30 sectors in the NAICS system with details on how they were determined.) The adjectives "approximate" and "indicative" apply because the estimates are based on national sectoral estimates of inputs and outputs from a variety of sources, whereas actual GGI values for products should be evaluated with more timely information from the specific facilities that create them. Determinations for a particular facility will depend on the specific natural resources, products purchased from suppliers, and processes used to transform them into new products. For example, GHG emissions from electricity production vary considerably depending on the fuel and technology used (see Table 2).[11] Even within a common set of fuels and technologies (e.g., coal-fired power), GHG emissions across different power plants can differ substantially. Similarly, purchased materials, energy sources, and processes used to manufacture similar products (e.g., gasoline or raw steel) that are produced in different facilities or by different operations may have quite different values for their GGIs. Estimated GGI values in Table 1 are not based on specific facility data (as will be needed if the Framework is implemented).

8 US Energy Information Administration for 2014 imports: **https://www.eia.gov/todayinenergy/detail.php?id=21992.**

9 "An industry's energy intensity is defined as its energy expenditures as a share of the value of its domestic production." (see page 8 of that report, cited here in footnote 5).

10 The NAICS system lists liquefied natural gas (LNG) within Code 488999 (All Other Support Activities for Transportation), rather than within a code associated with an EITE manufacturing sector. Nonetheless, LNG is an important, trade-exposed, GHG-intensive product, and the transformation of natural gas to LNG and its regasification before use are energy-intensive activities—typically amounting to more than 10 percent of the energy of the final product and with a GGI over 3 tonnes CO_2e/tonne LNG. Consequently, under the Framework, we classify LNG as a covered product eligible for export rebates and subject to import charges.

11 Comparison of life-cycle greenhouse gas emissions from various electricity generation sources, World Nuclear Association Report, July 2011. Results display a wide range for emissions from technologies and fuels used to produce electricity, even among estimates for production based on a single fuel, e.g., coal fired power.

We sourced data to determine the GGIs in Table 1 and the emissions from electricity production in Table 2 from a variety of publicly available sources (that were published in different years and that rely on a variety of methodologies and data sources). Some were based on life-cycle analyses (LCAs) of the product's GHG footprint,[12] others on estimates that primarily consider the carbon content of fossil resources and CO_2 emissions from electricity required to manufacture the product, and still others based on sectoral or national averages. Although not based on facility-specific information, Table 1 provides illustrative examples of approximate, indicative GGI values for important products from a variety of sectors.

Factors not accounted for in Table 1 could lead to estimates of GGIs that may be higher or lower than those in the table. On one hand, for example, many of the public data sources are several years old—so they may not reflect more current information on recent trends toward greater use of natural gas and less use of coal to produce electricity in the United States or on ongoing improvements in the energy efficiency of facilities and purchased materials, which would result in reduced values for GGIs. On the other hand, in some sectors, more recent regulatory constraints require greater energy use (e.g., to produce low-sulfur diesel fuels), which would lead to higher estimates for GGIs. For WTO compatibility, BTAs in the Framework rely on the analogy with VATs that allows export rebates and the imposition of import charges for appropriately designed domestic taxes. Thus, LCAs and analyses based solely on the carbon content of fossil fuels and electricity use would differ at least somewhat from those based on GGIs (see Section 3 of the Framework report; footnote 1).

Going forward, affected firms, trade associations, government agencies, and others may find it desirable to provide improved analyses and estimates of both values and ranges of values for GGIs of products in relevant sectors. These should be based on more recent and comprehensive information for manufacturing facilities around the world (including information on possible advanced processes and materials) in sectors that produce GHG-intensive products. As this body of information grows, it will be easier for the Regulator and firms to make more reliable estimates of GGIs where firm-specific information may be lacking (e.g., in developing nations that may not yet have implemented reporting obligations). Such information would also inform strategies to reduce GHG emissions of covered products.

12 LCA GHG footprint analyses provide useful estimates of greenhouse gas emissions but they are not necessarily identical with GGIs. Options permitted in the LCA protocols may differ from specifications prescribed in the GHG tax regulations. Also, LCA protocols include contributions from sources (e.g., land use changes) that likely would not be subject to the GHG tax and therefore would not contribute to GGI.

3. Issues in Determining GGIs at Start-Up

3.1. Sources of Relevant Information

Our Framework report (see footnote 1) describes information and procedures that could be used to allocate GHG emissions from a facility to its product slate. Many nations, including the United States,[13,14] require covered facilities[15] to determine and report their GHG emissions. As discussed in Section 3.1 of the Framework, proposed procedures to evaluate GGIs substantially follow relevant parts of related, existing regulations and international standards for GHG emissions from facilities.[16] The procedures to evaluate GGIs also benefit from standards for carbon footprint analyses of products based on LCAs that have been developed more recently by the International Standards Organization (ISO)[17] and by the World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI).[18]

The Regulator will be responsible for establishing authorized guidelines to determine GGIs for covered products in covered sectors. Developing them should benefit from the experience and previous work on voluntary guidelines by many experts in energy-intensive sectors and other stakeholders (see footnotes 15–17). Reported information on GHG emissions and GGIs for a firm's products should be published by the Regulator and be subject to an audit and sanctions for incomplete, negligent, or fraudulent information. This includes information used to administer both the GHG tax and BTAs. In the United States, one way to accomplish this would be for information on GHG-intensive products to be included as part of the report already required on GHG emissions from covered facilities (see footnotes 11 and 12).

The estimates of GGIs for products in a number of sectors provided in the forthcoming modules (see footnote 4) will give the Regulator preliminary information for products likely to be covered, and provide approaches to design required guidelines and procedures for official determinations. Using these approaches, the Regulator

13 https://ghgdata.epa.gov/ghgp/main.do

14 https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

15 The United States requires facilities that emit at least 25,000 tonnes CO_2e per year to report their GHG emissions.

16 Through the Greenhouse Gas Protocol (GHGP), World Resources Institute (WRI), and the World Business Council for Sustainable Development (WBCSD) work with businesses to develop standards and tools that help companies measure, manage, report, and reduce their carbon emissions. **http://www.ghgprotocol.org**

17 ISO Greenhouse gases–Carbon Footprint of products–Requirements and guidelines for quantification, originally ISO/TS 14067:2013, superseded by ISO 14067:2018.

18 WRI WBCSD: GHG Protocol Product Life Cycle Accounting and Reporting Standard (2011).

can review requests for rebates and begin to develop import charges so that implementation can commence immediately after the effective date of the GHG tax. These indicative estimates are based primarily on published estimates or analyses (which have the limitations of being from past years and may not be based on statistically sound surveys). The sources used in these cases include data published by government agencies, domestic and international trade associations, and various third-party studies. In some cases, they include averages for many products based on product-specific estimates for a few products within a given sector. As discussed below, importers assessed import charges so determined will have the option to appeal such determination and seek a rebate on the excess import charge for their subject product.

Although they do not determine GGIs per se, many sources exist that can provide relevant data to help the Regulator determine GGIs to establish initial import charges for GHG-intensive products. Sources include domestic trade associations, international trade associations, national GHG emissions inventory reports to the United Nations Framework Convention on Climate Change,[19] and data from many nations that already require GHG emissions reports for facilities. For at least the major sectors—of steel, aluminum, pulp and paper, chemicals, refined products, plastics, cement, lime, glass, and nitrogenous fertilizers—there are consulting and marketing firms, (e.g., IHS Markit,[20] CRUGroup,[21] and Environmental Product Declarations[22]) that collect and market data relevant to determine the GGIs for key products in such sectors. Such data could be purchased by the Regulator. Only public data were used in these determinations. In some cases, the authors made estimates of the GGI for steps in the process to make a covered product.

Published information needed to determine GGIs of imported products will be less available than for domestic products, especially from many developing nations. Since US producers compete with imported goods, they will desire that such goods carry an import charge analogous to the GHG tax that they would pay. Thus, US producers will have an incentive to provide the Regulator with their estimates of what the GGI for the imported product is and what the import charge should be. Assuming the import charges are published (as we recommend in the Framework and Policy Guidance reports), domestic producers (many with affiliates that operate in nations that export

19 See **http://www.ipcc-nggip.iges.or.jp/index.html**. Development of the new Methodology Report to refine the current inventory guidelines (*2006 IPCC Guidelines for National Greenhouse Gas Inventories)*, was carried out by the Task Force on National Greenhouse Gas Inventories. The final Report "*2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*" (*2019 Refinement*) was approved by the IPCC at its Plenary Session May 2019. Inventories are provided on a sectoral basis, but not the same basis used in NAICS codes.

20 **www.ihs.com**

21 **www.crugroup.com**

22 **www.environdec.com** "... present transparent, verified and comparable information about the life-cycle environmental impact of products." In the particular case of results for GHG emissions based on ISO or WRI/WBCSD protocols, these may be somewhat different than GGI which tracks only taxed sources of GHG emissions.

to the United States) and others would have a basis for recommending that the Regulator investigate import charges that appear inappropriate to such producers.

Although the Regulator should create import charges as soon as possible after the imposition of a US GHG tax, it may not initially have data on imports (especially from developing nations) to guide or help this determination. However, information on GHG-intensive products will be available from domestic manufacturers seeking export rebates soon after the GHG tax is imposed. This information would also provide a range of examples that can help to inform the determinations by the Regulator of the GGIs for products exported to the United States.

3.2. Prompt Start, Follow-Up, and Appeals

Because BTAs will affect their competitiveness, US domestic firms will desire the import charges to be established as soon as possible after the enactment of a US GHG tax. It will take time for the Regulator to become organized and obtain the necessary information to estimate GGIs and to assess import charges for all covered products. Examples provided later in this report and in the forthcoming modules report (see footnote 4) illustrate approaches for the Regulator to estimate GGIs and thus import charges for imported products, as well as various ways that the Regulator can aggregate estimates and reduce the number of individually determined import charges that must be determined during the first month or months once the GHG tax is implemented.

The covered sectors include anywhere from 1 or 2 to about 2,000 individual products, although not all such products will satisfy the Framework's proposed threshold to be classed as covered products. We use various means of aggregating a sector's products into a manageable number to estimate the initial import charges. In most cases, imports come from several countries and complete public data on individual countries or producers therein are not available. Thus, the estimates here for product GGIs are for individual countries or for aggregations of countries. In several cases, this involves averaging results for products of some countries exporting to the United States to cover countries for which determinations are not initially made. In some cases, the estimated GGI for US production is used initially for imported products.

Estimates of GGIs for imported, covered products would be used initially (see Section 4 below). However, going forward, US importers would be required to provide the needed information on GHG emissions and GGIs of the products that they acquire from foreign firms. This can best be accomplished as foreign producers develop the capacity to determine GGI values. We proposed in our Policy Guidance report (see footnote 2) that such information should be submitted within two years after the beginning of the import charges.

To promote continuous improvement and eliminate potential errors, the Policy Guidance report recommends that the overall system to implement the Framework should include appeals processes. These would allow domestic and foreign firms and others to challenge US determinations of covered products, sectors, and their

GGIs that provide the basis to award export rebates and impose import charges. Thus, firms and other stakeholders could appeal determinations of GGIs for their own products—and challenge those for domestic and foreign firms if they believe them to be inappropriate. For the process to function effectively, it would be desirable for information to be publicly available on GGIs, export rebates, and import charges for products of domestic and foreign firms.

3.3. Cross-Cutting Issues:[23] Electricity, Combined Heat and Power, and Scrap

Electricity makes a significant contribution to the GGIs of many covered products. Its contribution will vary significantly depending on the technology and fuel used to generate electricity (see Table 2). If based on coal, the GGI for purchased electricity will be substantially greater than if it is based on natural gas, and greater still than if it is based on solar, wind, hydroelectric, or nuclear energy. The International Energy Agency periodically publishes a report[24] for the total electricity production for most economically significant countries with the shares provided by various sources. If necessary, that information can be used by the Regulator on a national basis until more company-specific information is provided to the Regulator. Section 4.2 of the Framework report provides more detailed information on the proposed treatment of combined heat and power (sometimes referred to as co-generation) that can be an important factor in the operation of major energy-intensive facilities that generate some or all their electricity on-site.

Because the use of recycled materials lowers manufacturing costs and GHG emissions, most governments encourage the collection and use of scrap to be reprocessed as input for energy-intensive products like aluminum, steel, glass, paper, and plastics. Although scrap and other recycled materials may originate as GHG-intensive products in covered sectors, the original products were sold to, used, and transformed in other sectors (e.g., construction, automobile manufacturing, or shipbuilding, which are not covered), and later disposed of as waste or collected and sold for recycling. The recycled materials themselves are products of the entity that gathers and sells them and their history and GGI is often unknowable. Consequently, the Framework does not treat scrap as GHG-intensive products, and the GGIs for them need not be evaluated. In essence, GGIs for scrap are considered to be zero. To the extent that recycled materials are used as inputs to manufacture GHG-intensive products, the GGI of such products (and therefore export rebates and import charges) will be lower than similar products manufactured from raw materials other than scrap.

23 See Section 4 of our Framework report.

24 National average electricity information can be found in IEA World Energy Balances 2020. **https://www.iea.org/subscribe-to-data-services/world-energy-balances-and-statistics**.

3.4. De minimis Contributions

Although almost every product purchased from suppliers would make some contribution to the GGIs of products manufactured at later stages in the supply chain, estimates in our forthcoming modules (footnote 4) and Table 1 intentionally do not include all purchased products in the calculations. As part of trying to make the initial determination of import changes manageable administratively, these estimates consider only those purchased products that are determined to be GHG-intensive (e.g., coal, natural gas, crude oil, commercial fuels, electricity generated from fossil fuels, and inputs such as oxygen and hydrogen). Ultimately, the Regulator could include more such materials in determining export rebates and import charges for a particular product—but may also decide that some have such low GGIs or are used in such small quantities that they are too small to consider. If the Regulator includes such materials in determining the rebates for a given product, it must do the same for import charges for the same product (see Section 3.2 of the Framework).

4. Overview of Sample Approaches to Determine Initial Estimates of GGI

4.1. Determination of GGIs as an Analog to VATs

For WTO compatibility, GGIs are modeled after VATs (as described in Section 3 of the Framework report). The GGI for a given product tracks cumulative taxed sources of GHG emissions along the supply and manufacturing chains to create GHG-intensive products. The WTO recognizes that governments may provide export rebates and apply import charges based on such taxes.[25,26,27] Export rebates and import charges for products from specific manufacturers are based on their individual GGIs, which depend on three factors: 1) the carbon content of produced fossil resources; 2) GHG process emissions; and 3) the contribution from GHG-intensive products purchased from suppliers. Manufacturers of GHG-intensive products will be able to determine all three of these factors. Because they must report and pay the GHG tax, manufacturers themselves will determine the first two factors for their own operations. Contributions to the third factor occur through the supply chain, based on the taxed sources of GHG emissions required to produce the GHG-intensive products used by the manufacturer. Manufacturers will know the amounts and sources for the GHG-intensive products that they purchase—and, under the Framework, suppliers would be obligated to communicate GGI values of their covered products to the Regulator and their customers.

Regulatory procedures in many nations and voluntary guidelines endorsed by many EITE sectors provide methods to estimate and report the carbon content of products and GHG process emissions from facilities and operations. Under our Framework, the US upstream GHG tax would apply to the carbon content of produced fossil resources and to GHG process emissions from all covered sectors. Producers of fossil resources in the United States and many other nations routinely determine and report their carbon content and GHG process emissions associated with extraction and initial processing of coal, oil, and natural gas. As described in our companion report covering methods for specific facilities, inputs from products purchased from suppliers also contribute to the GGI (see footnote 3). These include produced fossil resources, electricity, and commercial fuels—and, in some sectors, additional energy-intense products (e.g., oxygen, hydrogen, and electrodes) and materials (e.g., natural gas and petroleum products, raw steel, and primary aluminum) that serve as feedstocks that will be transformed into new products. Note that GGIs for similar products may differ significantly depending on the specific materials, sources of energy and electricity, and

25 Climate Change and the WTO: Cap and Trade versus Carbon Tax? Warren H. Maruyama, *Journal of World Trade* 45, no. 4: 679–726 (2011

26 Changing Climate for Carbon Taxes: Who's Afraid of the WTO? Jennifer Hillman, Climate & Energy Policy, German Marshall Fund Paper Series, July 2013.

27 Border Adjustments for Carbon Taxes, PPMs, and the WTO, 41 U. Pa. J. Int'l L. 1. Matthew C. Porterfield, (2019), available at **https://scholarship.law.upenn.edu/jil/vol41/iss1/2** .

process steps used to manufacture them.

4.2. GHG Taxes and Product Flows along Supply Chains for GHG-Intensive Products

Figures 1 and 2 illustrate the flow of products (whose price will be affected by the upstream GHG tax on produced oil, natural gas, and coal) through various manufacturing pathways or steps. These steps transform raw materials—with inputs of electricity, commercial fossil fuels, other GHG-intensive products, and, in some sectors, recycled scrap—into final products that would be eligible for export rebates or import charges.

Figure 1 illustrates the extensive interactions among the coal-, oil-, and gas-producing sectors, electricity, and petroleum refining. These flows illustrate that the GHG emissions required to produce products in these sectors arise not just from their carbon content, but also from the energy used to produce, process, and transform them into commercial fuels and electricity used in all sectors. Lines in Figure 1 illustrate payment of the upstream GHG tax and flows of purchased electricity, commercial fuels, and produced fossil resources along supply chains that link these sectors. Figure 2 illustrates the flow of GHG-intensive products affected by an upstream US GHG tax used to produce products in the steel sector.

Emissions of CO_2 and other GHGs occur from many manufacturing operations and from the use of products from other energy-intense sectors, in addition to those from the initial production of fossil fuels. For example: limestone emits CO_2 when it is converted to lime; glass melting furnaces emit CO_2, as do some processes for wet corn milling; and aluminum manufacturing emits small amounts of fluorinated chemicals (perfluorochemicals: PFCs).

4.3. Approaches to Simplify and Aggregate Determinations of GGI

The administrative effort to determine the very large number of export rebates or import charges based on each firm's production of particular products would be significant but feasible based on the information and procedures already available from decades of tracking GHG emissions from facilities. For example: If there were 50 products produced by 5 domestic and 10 foreign producers in each of the 45 covered sectors (as listed by their NAICS code), the Regulator would need to determine or review about 34,000 BTAs. It will be important to recognize the challenges and trade-offs of seeking precise estimates for GGIs. Although the contribution to the GGI may be evaluated quite reliably for the combustion of well-characterized commercial fuels (e.g., natural gas or gasoline), estimates for some less-well-characterized products and for process emissions are not nearly so precise. It may be desirable for the Regulator to specify and account for such limitations. In doing so, it would be unwise to demand similar accuracy for GGIs across all sectors and products.

After consultation with the relevant industry and other stakeholders, the Regulator could decide on the desirable administrative approach to determine initial product-specific GGIs and import charges for their products under the respective NAICS codes. The following approaches (some of them described previously in the Compendium[28] to our Framework report) and others are used in this report and in the forthcoming modules (see footnote 4):

- In the case of oil and gas production and refining of petroleum, as described below, the GGI is determined for a specific product based on the carbon content of that product and the average (tonnes CO_2e/tonne of carbon) for the entire slate of products (see footnotes 3 and 4).
- In the case of steel, taxed sources of GHG emissions required to create raw steel would be computed and converted into the GGI (tonne CO_2e/tonne raw steel). Then for all other products under the same NAICS code, GGIs would be based on their content by weight of raw steel and the GGI for raw steel. This approach assumes that little of the total emissions involved with making the products covered by the NAICS code for steel occur after the creation of raw steel.
- For covered products in some NAICS codes, the approach we use estimates the GGI for each product separately.
- In some other sectors, an average GGI is estimated for some of the large-volume products in the relevant sector and this average is applied, on a weight basis, to all other products in such sectors. In this case, however, a US manufacturer or a foreign manufacturer would have the option to provide company-specific information to evaluate the GGI for the subject product to the Regulator—which, if approved—would become the basis for a different export rebate or import charge for that product for the specific manufacturer.
- Yet another approach would be for all of the products within a given tariff class to be treated as a single product, rather than trying to determine a GGI for each. In this case, domestic and foreign manufacturers would not be allowed the right to provide information that would lead to different company-specific export rebates or import charges.

Many companies that export to the United States produce specific products in more than one facility. They could benefit from lower import charges by claiming that their exports were sourced from their facilities with the lowest GHG emissions. To avoid such gaming, our Framework and Policy Guidance reports (see footnotes 1 and 2) propose to use the average GGI for the entire production of the particular product by the company from all of its domestic facilities. As outlined in the Policy Guidance report (see footnote 2), until verifiable information is reported by firms that export to the United States, we recommend that the GGI for a product exported to the United States should be determined based on its average for the entire country.

28 Mares, Jan W., and Brian P. Flannery. 2018. **Compendium: WTO-Compatible Methodologies to Determine Export Rebates and Import Charges for Products of Energy-Intensive, Trade-Exposed Industries, if there is an Upstream Tax on Greenhouse Gases**. Working paper 18-19. Washington, DC: Resources for the Future.

GHG emissions involved with the transportation of raw materials or finished products are not included in the determinations of initial import charges or export rebates because such emissions are judged to be a very small portion of emissions created by the manufacture of these products and, in any event, would be exceedingly difficult to determine and verify.

4.4. Voluntary Public-Private Partnerships to Inform Determination of GGIs and BTAs

Major efforts began over two decades ago within industry, trade associations, the WBCSD, ISO, and other groups to develop reliable methods to measure and report GHG emissions in EITE industries[29,30] and other sectors. These efforts provide useful, relevant, and ongoing input to formal regulatory procedures to estimate and report GHG emissions from facilities. Implementing BTAs for products within this Framework will require additional efforts and cooperation (perhaps in voluntary public-private partnerships) among firms, trade associations, regulators, and other stakeholders. Although the effort may take time, it is far less complex than the efforts made in the 1990s (and still ongoing as technology and circumstances evolve) to estimate and report GHG emissions from facilities and operations.

We recommend that EITE sectors should begin now to develop prototype methods to determine GGIs for their GHG-intensive products on the basis of efficient and effective procedures suited to their particular circumstances. In particular, advice on allocation procedures would be important, noting that the Regulator will need to specify such procedures and bearing in mind that the allocation method for a sector would apply to all manufacturers, domestic and foreign with like covered products. Such efforts would help to provide timely, needed information to the US Regulator to allow it to provide reliable export rebates and publish and impose import charges.

29 **https://ghgprotocol.org/about-us**

30 **https://www.ipieca.org/resources/good-practice/petroleum-industry-guidelines-for-reporting-greenhouse-gas-emissions-2nd-edition/**

5. Summary and Conclusions

This report describes approaches and sources of information that could be used to facilitate a prompt start to initiate BTAs soon after US GHG tax legislation is implemented. Information required to develop export charges based on GGI values for covered US products is available today. This requires US firms to determine GGI values for covered products on a facility-specific basis and to claim rebates based on the firm-wide average for products to be exported (see footnote 4). Similar information to determine import charges exists in many nations that export products to the United States, especially developed nations with regulatory procedures to report GHG emissions from facilities. However, verifiable data for facilities will be unavailable in many developing nations. In that case, procedures described in this report could be used by regulators to develop initial values for import charges based on national sectoral averages for GHG-intensive products (as illustrated with indicative, representative value for the GGIs of commodity products in several sectors). In some cases, it may be necessary to apply import charges based on average values for US products or those of relevant groups of nations. After a two-year start-up period, we recommend that US importers should be required to provide firm-wide average GGI values for covered products. These could be determined using available international methodologies as we outline in our Framework report (see footnote 1).

Provisions recommended in our Policy Guidance report (see footnote 2) include processes to help identify questionable data and promote continuous improvement in the determinations of BTAs as time passes. In particular, these would allow firms in developing nations with adequate information to request import charges based on their own firm-wide averages for GGIs, rather than national sectoral determinations made by the Regulator in the United States. Other provisions would allow challenges of information that appears to be incomplete, incorrect, or fraudulent. Ongoing administrative efforts will be required to update information as technologies, products, and markets change—and as GHG policies evolve around the globe. These processes should help the system move from its initial start-up phase to full implementation based on continuously improving information on covered products from domestic exporters and from imported products.

Table 1. Approximate, Indicative Values for the Greenhouse Gas Index (GGI) of Representative GHG-Intensive Products and Electricity

Products from Fossil Resources

	Embedded Carbon c_f	Embedded Carbon CO_2	GGI	
Oil & Gas				
Crude oil	0.85	3.1	3.3	(More for heavy oil and oil sands)
Natural gas	0.76	2.8	3.05	
LNG	0.76	2.8	3.4	(GGI natural gas +10% compression and liquefaction)
Coal (highly variable depending on resource and methane leaks)				
Anthracite	0.78	2.9	3.0	
Bituminous	0.70	2.6	2.7	
Lignite	0.41	1.5	1.7	
Oil Refining (CO_2 from embedded carbon + 15% from production and refining of crude oil)				
Gasoline	0.863	3.16	3.64	
Kerosene	0.868	3.18	3.66	
Petroleum coke	0.919	3.37	3.88	

Products from Other Covered Sectors

Product	*GGI*	*Product*	*GGI*
Ammonia	1.6	Flat glass	0.82
Nitric acid	0.65	Cement // *Electricity (coal)*	0.83
Ammonium nitrate	0.86	Cement // *Electricity (gas)*	0.64
Paper (using electricity based on natural gas)	1.6	Electric-arc furnace steel	0.61
Unwrought primary aluminum (average NA electricity)	4.7	Low-density polyethylene (LDPE) (based on cracking ethane)	4.40
Propylene (based on cracking naphtha)	4.43		

Electricity Production by Fuel (US Average) Determined from GGI of purchased fuel (tonnes CO_2e/MWh)

Fuel	*GGI*	*Fuel*	*GGI*
Natural gas	0.42	Coal bituminous	1.06
Oil	1.0	Coal sub-bituminous & lignite	1.0

Notes:

Values in this table differ slightly from those in Table 1 of the Policy Gudiance report (see footnote 2) to agree with updated values as reported in the forthcoming modules (see footnote 4).

c_f (Embedded carbon) = the fraction by weight of carbon in the fuel or produced fossil resource.

CO_2 (tonnes CO_2 per tonne of product) from combustion of embedded carbon.

GGI (tonnes CO_2e per tonne of product) includes contributions from embedded carbon, and from other GHGs, GHG process emissions, and purchased products (see discussion in technical background).

Table 2. CO_2e Emissions from Electricity Generation

Technology	Emissions (tonne CO_2e/MWh)		
	Mean	Low	High
Lignite	1.054	0.790	1.372
Coal	0.888	0.756	1.310
Oil	0.733	0.547	0.935
Natural gas	0.499	0.362	0.891
Solar PV	0.085	0.013	0.731
Biomass	0.045	0.010	0.101
Nuclear	0.029	0.002	0.130
Hydroelectric	0.026	0.002	0.237
Wind	0.026	0.008	0.124

Source: World Nuclear Association (WNA). 2011. *Comparison of Life-Cycle Greenhouse Gas Emissions from Various Electricity Generation Sources*. London, UK: WNA. **www.world-nuclear.org/uploadedFiles/org/WNA/Publications/Working_Group_Reports/comparison_of_lifecycle.pdf**

Figure 1. Upstream GHG Tax and Product Flows among Producers of Oil, Natural Gas, Coal, Petroleum Products, and Electricity

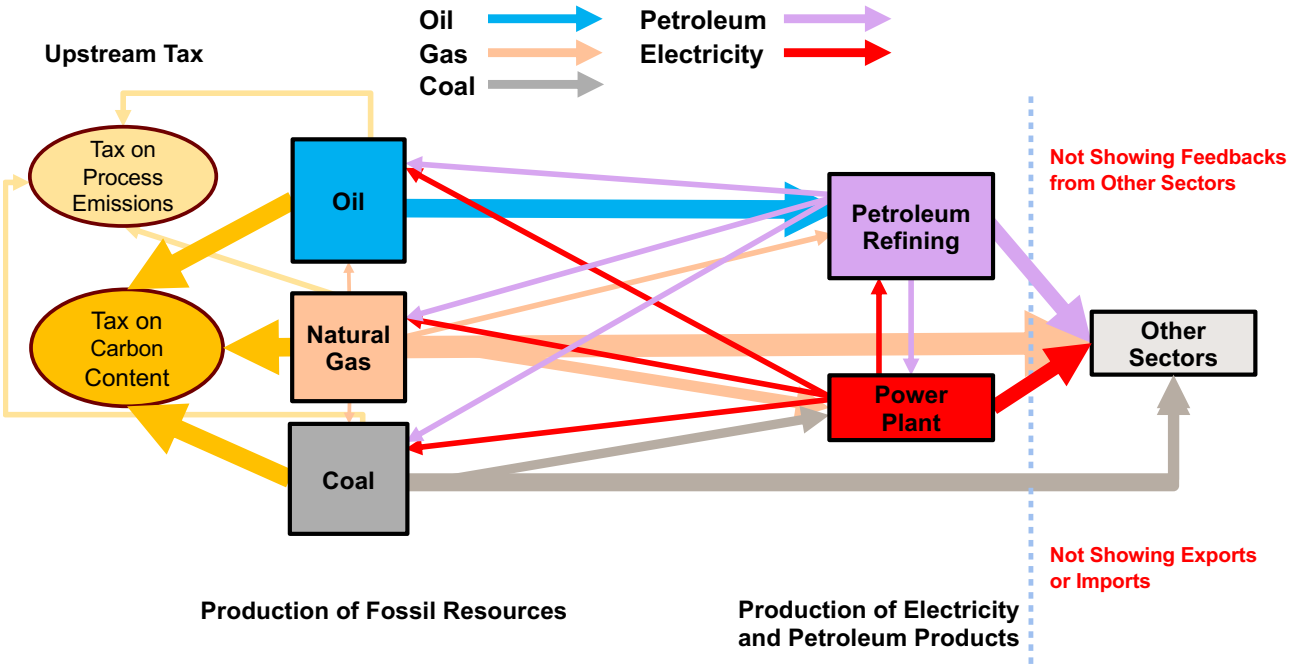
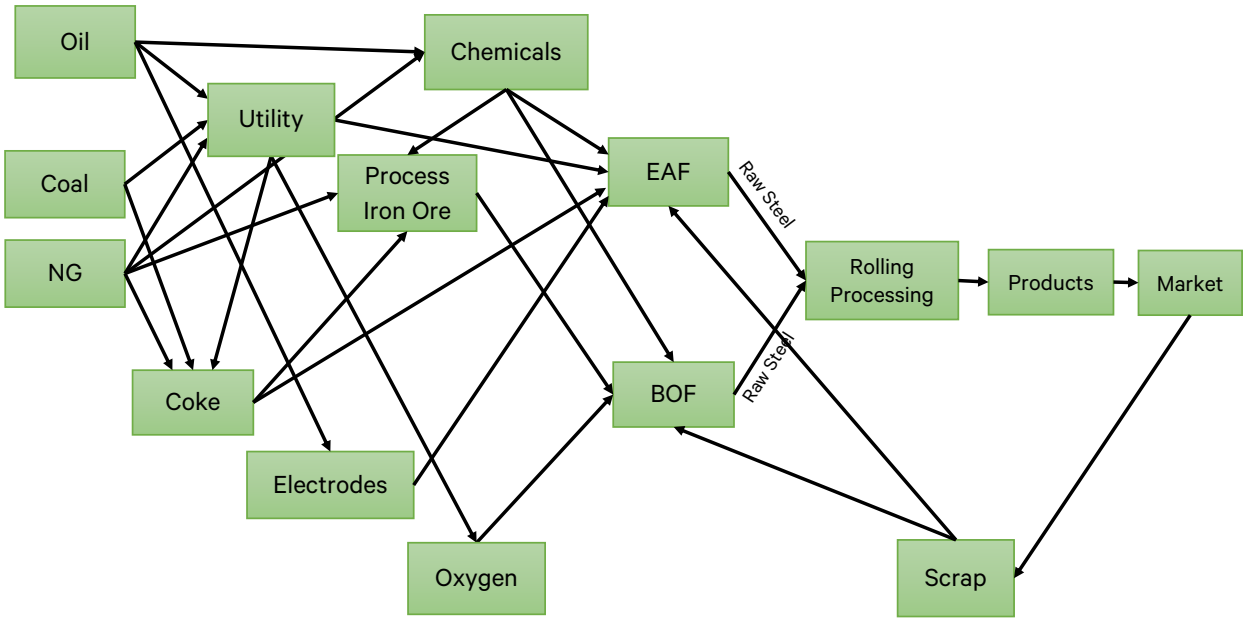


Figure 2. Flow of Goods Affected by Upstream GHG Tax and Their GHG Emissions through to Steel Products for Market



Notes:
EAF: Electric arc furnace
BOF: Blast oxygen furnace