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Framework Proposal for a US Upstream GHG Tax with WTO-Compliant Border Adjustments: 2020 Update

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Foreword

When we published the original Framework Proposal (in March 2018), we stated our intention to update it as needed based on ongoing exchanges with experts on trade and climate-related matters. This current version of the report reflects revisions that have benefited from discussions, workshops, and other interactions over the past two years with colleagues at Georgetown University Law Center, the Brookings Institution, the Climate Leadership Council, trade associations, colleagues in academia, and current and former government officials involved with climate policy, trade, and the World Trade Organization.

This version of the Framework retains the original structure and major portions of text. Here we highlight significant additions in the following sections. Section 3 describes the relation between two existing international standards one developed by World Resources Institute (WRI) and the World Business Council for Sustainable Development and the other by the International Standards Organization (ISO) both based on life-cycle analyses for product greenhouse gas (GHG) footprints, and the greenhouse gas index (GGI) proposed in the Framework report. The GGI substantially incorporates relevant aspects of the existing standards. However, in a fashion analogous to value-added taxes (VATs), GGI tracks only taxed sources of GHG emissions along the supply and manufacturing chain to produce GHG-intensive products. In this updated report, Section 3.4 describes how the design of this Framework satisfies conditions so that import charges also fall within the scope of the environmental exceptions covered under Article XX of the General Agreement on Tariffs and Trade. Section 3.5 contains further elaboration of consequences for competitiveness from the GHG tax. In Section 3.5, we also explain that the Framework establishes criteria to qualify covered products and sectors for border tax adjustments (BTAs) based solely on their GHG intensity as measured by GGI. Unlike some previous studies, we do not include specific consideration of the level of a sector's economy-wide trade exposure or energy intensity. In practice, products that satisfy the criteria for GHG intensity will, for the most part, be products from energy-intensive sectors and they will be at a competitive disadvantage with respect to similar products from nations with less ambitious GHG policies.

In the proposed Framework, BTAs apply to products with a GGI of at least 0.5 tonnes of CO_2e (i.e., carbon dioxide equivalent) per tonne of product and, in the case of electricity, 0.25 tonnes CO_2e per MWh (Megawatt hours). In turn, we define covered sectors as those containing covered GHG-intensive products. With these thresholds, covered sectors (typically referred to as energy-intensive, trade-exposed [EITE] sectors) include the 46 listed in the interagency report (see footnote 30) published a decade ago, plus several other sectors. While most covered products occur in sectors with an energy intensity of at least 5 percent (the threshold used in the interagency report)—as a result of various technical quirks—some covered products occur in sectors that may not meet the 5 percent threshold. Section 4 resolves and simplifies

several points with respect to treatment of cross-cutting issues, including electricity, recycling, combined heat and power, and transport. Section 5 provides an updated discussion of the regulatory tasks and involvement of US federal agencies required to develop authorized procedures to implement and manage the process.

Finally, we make an important change to the language used in the original Framework report. This is to clarify definitions and avoid confusion in the treatment of embedded carbon and GHG process emissions. Several approaches exist to quantify GHG emissions from operations and those associated with products—e.g., based on WRI/WBCSD and ISO GHG protocols for facilities and product GHG footprints as determined from life-cycle analyses. The Framework describes covered upstream GHG process emissions and embedded carbon in products that are taxed and will be used as the basis for BTAs. BTAs account for the taxed emissions sources, both those associated with the final manufacturer and those required to create GHG-intensive products purchased and used by the manufacturer. Language in the original Framework report referred to the tax as paid on "the carbon content of fossil resources as measured at the mine mouth or wellhead" and GGI as containing contributions from products purchased from EITE providers in the supply chain.

The perspective in the Framework differs somewhat from discussions of Scope 1, 2, and 3 emissions that are used in other contexts for GHG reporting and life-cycle analyses. The clarification here aims to avoid confusion—especially concerning the treatment of on-site CO_2 emissions from purchased fuels—that could give rise to double counting of emissions subject to taxation or contributing to GGI. The updated Framework now describes emissions subject to the upstream GHG tax on producers of natural fossil resources as covering two elements, both derived from the produced natural resource during or as a result of extraction and processing. The first is the carbon content of products sold to customers, under the assumption that end users will emit 100 percent of the carbon embedded in such products as CO_2. The second are GHGs emitted by the producer of fossil resources that derive directly from the untaxed natural resource—these may include venting, flaring and leakage of associated gas, and CO_2 emissions from utilization of fractions of the fossil resource to generate process heat, steam, and electricity. To avoid double taxation, the key point is that the tax on producers of fossil resources (and producers in other sectors) does not apply to emissions resulting from "on-site" use of purchased fuels or other GHG-intensive products.

In other contexts—and using different definitions (e.g., life-cycle analyses)—discussions often consider CO_2 released from combustion of "purchased fuels" as process emissions of the manufacturer. Here we include as taxable process emissions only as-yet untaxed sources of GHG emissions. Suppliers of commercial fuels already experience the impact of the GHG tax based on purchases from their suppliers. In other EITE sectors (e.g., manufacturers of chemicals or steel), similar considerations apply. So, in the proposed and updated Framework, CO_2 emissions from carbon embedded in purchased fuels, chemicals, and other GHG-intensive

resources consumed by manufacturers are not accounted for and taxed as process emissions. Note that such purchased supplies do contribute to the GGI based on their contributions as purchased products. With this procedure, we account for all taxed GHG emissions and for contributions to the GGI of GHG-intensive products without double counting or taxation.

In related work, simultaneous with this Framework update we are posting the report **Policy Guidance for US GHG Tax Legislation and Regulation: Border Tax Adjustments for Products of Energy-Intensive, Trade-Exposed and Other Industries**, and in the near future we will post two additional RFF working papers:

- WTO-Compliant Border Tax Adjustments: Perspectives and Implications
- Border Tax Adjustments and the WTO: Round Pegs for Round Holes

These companion papers provide more detailed policy guidance for US legislation and regulations required to implement the Framework, additional perspectives on the rationale for our proposals and their implications, and the required policy architecture for WTO-compatible BTAs.

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1. Introduction

Discussions regarding policies to limit greenhouse gas (GHG) emissions have been ongoing for decades, and GHG policies of various types have been implemented for years in many countries. In practice, countries that adopt GHG policies typically use a portfolio approach that includes a mix of standards, subsidies, mandates, and price-based controls methods, each directed at particular economic sectors.

In view of inefficiencies and lack of synergies in the portfolio approach, economists and other experts have argued that setting a price on carbon—and other GHG emissions—using an economy-wide, upstream GHG tax would be the most effective and efficient policy to address GHG emissions. Its effectiveness stems from being able to cover all emissions from the production and use of fossil fuels, by applying the tax on producers of coal, oil, and gas resources based on the carbon content of products derived from produced resources before they are combusted—rather than dealing with actual emissions from millions of individual sources and actors throughout the economy. Its efficiency stems from allowing markets (rather than political processes) to identify and implement the most cost-effective steps to reduce emissions through decisions that affect current operations and purchases—and through strategic decisions about investment as well as research and development to invent and deploy more effective solutions to reduce future GHG emissions.

Myriad issues must be addressed to design and approve legislation to implement an upstream, economy-wide GHG tax. This report does not address that galaxy of challenges and opportunities. Rather, assuming that an upstream GHG tax could be implemented, the report addresses the challenge of border adjustments (BAs) for exports and imports in the context of a domestic upstream GHG tax, as described below.

The domestic GHG tax could cause production to shift in energy-intensive industries to countries without comparable pricing, resulting in "leakage" of GHG emissions that the domestic tax aims to prevent. By shifting production from the United States, the tax would also disadvantage domestic manufacturers, their employees, and the communities where they operate. Hence, the call in many US legislative proposals (and proposals in other nations) to introduce BAs through the imposition of equivalent GHG pricing on imported products from energy-intensive, trade-exposed (EITE) industries, and by providing rebates for the impact of the upstream tax on the cost of such products exported by domestic producers. However, this has raised concerns about consistency with the rules of the World Trade Organization (WTO).

Here we propose a Framework for a US climate policy with border tax adjustments (BTAs) that are compatible with US obligations under WTO agreements. The Framework is based on an upstream tax on GHG emissions with rebates for exports and charges on imports for covered GHG-intensive products. Note that BTAs apply

to products—not to sectors or facilities. We find that, for various technical reasons, a few sectors besides those often defined as EITE sectors also contain GHG-intensive products that qualify for BTAs in the Framework. Proposed border measures are designed in a non-discriminatory fashion, with the intent and effect of reducing global GHG emissions. The Framework is designed to be consistent with the WTO's Agreement on Subsidies and Countervailing Measures (ASCM) and Articles II and III of the General Agreement on Tariffs and Trade (GATT). As discussed below in Section 3.5, the GATT and the ASCM allow rebates of the GHG tax on exported products and imposition of a charge on imported products based on the US GHG tax rate. The Framework is also designed to fall within the scope of the environmental exceptions of Article XX of the GATT in order to further reduce the potential for WTO conflict.

The Compendium[1] to the original framework provided additional details on implementing BTAs with specific recommendations to determine BTAs for products in 35 EITE industries.

Issues in the design of BAs for internationally traded products also bring into focus the distinctly different roles and practices of the United Nations Framework Convention on Climate Change (UNFCCC) and the WTO. Climate policies have the potential to create trade disputes. However, if they occur, they would be resolved through the WTO—which (in principle) has the authority, experience, and tools to resolve them—not through the UNFCCC (which does not).

To avoid lengthy and potentially divisive battles between trading partners striving to fulfill commitments to two independent, international institutions, it would be desirable to formulate domestic climate policies that are compatible with both WTO and UNFCCC obligations. However, as addressed in countless scholarly papers, this—specifically compliance with WTO obligations—can be complicated.[2]

In particular, proposals that argue for trade measures based on environmental exceptions under the WTO, (e.g., to prevent GHG leakage), may be challenged if they appear to be arbitrary discrimination or disguised restrictions on trade.

In what follows, Section 2 sets the scene with background and additional details on the current state of the international climate regime under the Paris Agreement. Section 3 provides an overview of the proposed Framework and issues to address for WTO compatibility. Section 4 describes some common cross-cutting elements that affect

1 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, Jan W. Mares and Brian P. Flannery, October 30, 2018. **https://www.rff.org/publications/working-papers/wto-compatible-methodologies/.**

2 *See*: Addressing Competitiveness Concerns in a Carbon Tax: What Are the Options? (October 27, 2015) and the references mentioned. **http://www.rff.org/events/event/2015-10/addressing-competitiveness-concerns-carbon-tax-what-are-options.**

many sectors (e.g., how to treat electricity, combined heat and power, recycling, and transport). Section 5 illustrates how the Framework applies to EITE and some other sectors that produce GHG-intensive products, including some that present unique features. Section 6 presents a summary and conclusions. The Compendium provides an overview with a detailed discussion of the application of the Framework to oil and gas production, coal production, oil refining and electricity, and modules of varying length for 31 other EITE sectors. In a forthcoming report, we intend to supplement the Compendium with updated discussions of procedures, relevant information, and estimates for GGIs and potential export rebates and import charges for products in about two dozen EITE and other sectors.

This discussion does not address the merits or political challenges of gaining support for an upstream tax on US GHG emissions, or how revenues would be used. Note that revenues would be significant even at modest levels under discussion to initiate such a tax (e.g., $20 per tonne CO_2 would correspond to revenue of about $100 billion US$ per year), and the tax rate would grow significantly over time if the ambitious goals of the Paris Agreement were to be met. Though smaller, sums involved in rebates for exports and those imposed on imports would also be significant. They would vary considerably from sector to sector. The Framework makes no proposal for how the import charge should be collected or used. It seems reasonable to assume that it should be collected with other charges on imported products, entered into US general revenue, and, if directed, used for the same purposes as revenue from the GHG tax.

2. Scene Set

The seeds of this challenge were planted in the 1980s as nations began to consider how to foster international cooperation to address climate change. While developed nations realized that domestic climate policy could decrease economic growth and affect their international competitiveness, developing nations voiced far greater concern that domestic and international climate policies could hinder their overriding priorities for economic development and poverty alleviation as well as adversely affect trading relations. Consequently, developing nations insisted that the UNFCCC incorporate Principles (see Article 3) to limit adverse outcomes. Articles 3.1 (common but differentiated responsibilities and respective capabilities (i.e., CBDR-RC) and 3.5 highlight the challenge for trade and climate:

- *3.1 The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.*
- *3.5 Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade.*

CBDR-RC played a significant role in both the UNFCCC (adopted in 1992) and, later, the Kyoto Protocol (adopted in 1997). Both required only developed nations as listed in Annex I of the UNFCCC to limit GHG emissions, and those listed in Annex II to provide aid to developing nations. Despite enormous changes in geopolitical, technological, and economic circumstances since 1990, efforts by developed nations to evolve to a less stringent approach to CBDR-RC have been only partially successful, and challenges to trade remain.

Today, trade and climate concerns not only persist, they proliferate. Under the Paris Agreement of 2015, pledges for national action prolong (at least through 2030) and reinforce differences among nations both in stringency and types of policies used to limit GHG emissions.[3] In this respect, challenges exist not only between developed and developing nations, but also from growing differences among (and within) developed nations. This dynamic is highlighted by withdrawals from the Kyoto Protocol's second commitment period, by the planned withdrawal of the United States in November 2020 from the Paris Agreement—and by political differences within many nations. Important differences also exist that create challenges among developing nations. If, in pursuing

3 The analyses on the economic costs for achieving the nationally determined contributions and the expected global emission pathways. Keigo Akimoto, Fuminori Sano and Bianka Shoai Tehrani, *Evolutionary and Institutional Economics Review*, 14, 193–206 (2017). **https://doi.org/10.1007/s40844-016-0049-y.**

the very ambitious long-term goals of the Paris Agreement, some nations increase ambition over time more than others, then trade tensions may escalate as effects for specific sectors and nations become clearer and more pronounced.

In the United States and most developed nations, GHG emissions occur primarily as carbon dioxide (CO_2) from combustion of fossil fuels. In the United States, energy-related CO_2 emissions account for over 80 percent of total GHG emissions. While the overall economic impacts of climate policy on trade today may be small for nations like the United States (with large, diversified economies), they can be much greater in specific sectors and regions—and in nations where exports of fossil fuels and energy-intensive products play a major role (e.g., OPEC nations, Russia, and Canada). This is especially so for EITE industries like oil and gas, chemicals, steel, aluminum, cement, plastics, and paper.

3. Overview of the Framework

There are several elements to the Framework. Section 3.1 details methodologies to determine GHG emissions from facilities and operations of EITE industries and, as described here and in the Compendium, to allocate them to specific products. Section 3.2 covers issues to be addressed to be compatible with WTO rules. Section 3.3 includes descriptions of the upstream GHG tax and associated rebates for products that are exported and charges on imported products. Section 3.4 discusses WTO rules and BTAs in a deeper dive. Section 3.5 is a specification of covered GHG-intensive products of EITE (and some other) industries. Section 3.6 details BTAs determined in a manner analogous to the familiar value-added taxes (VATs), but here applied to taxed GHG emissions required to manufacture GHG-intensive products and to the carbon content of produced fossil resources.

To avoid any confusion, note that the upstream GHG tax itself is not a VAT. The statutory incidence of the tax falls only on producers of fossil resources and EITE and other industries with GHG process emissions. To determine BTAs, the Framework utilizes an administrative index (the Greenhouse Gas Index: GGI, described below) that accounts for GHG taxes paid by covered manufacturers and their suppliers to create GHG-intensive products.

As described in Section 3.2, in the United States and other nations that adopt it, this proposal would fundamentally shift the focus of efforts to mitigate emissions connected to international trade from a system based on where goods are produced to one where they are consumed.

The Framework covers not only CO_2 but also emissions of other significant GHGs covered by US domestic and international reporting obligations. These include methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6), which can be especially important for some sectors. Regulations provide factors[4] that denote the contribution of each gas relative to CO_2 by weight. This allows the GHG tax (in US$ per tonne CO_2) to be applied to the full set of emissions expressed as tonnes CO_2-equivalent (CO_2e).[5]

Throughout the discussion it is important to recognize distinctions between existing GHG policies and methods that address emissions from facilities and operations of manufacturers—in the context of GHG taxes, cap-and-trade systems, and emissions reporting—and BTAs that apply to specific covered products. The Framework

4 The UNFCCC and most nations set these weighting factors based on the 100-year global warming potential as published and updated from time to time by the Intergovernmental Panel on Climate Change (IPCC). However, regulatory updates may lag those by IPCC.

5 To be consistent with the large number of international papers in this field, we have chosen to denominate weight in metric tonnes (1 tonne equals 1.102 short tons).

requires a perspective based on products—not facilities. This requires two extensions beyond current practice: first, to specify how GHG emissions related to purchased electricity and covered products contribute to cumulative GHG emissions required to create products; second, to determine how GHG emissions from entire facilities (and operations) can be allocated to the products they produce.

The Framework addresses these issues by defining an administrative index GGI[6] (with units tonnes CO_2e per tonne of product) for GHG-intensive products of covered facilities and operations. GGI for products from a specific manufacturer includes contributions from three sources (see Table 1): 1) inputs (GGI) from GHG-intensive products purchased by the manufacturer from suppliers in EITE and other sectors; 2) process GHG emissions (if any) from on-site operations of the manufacturer; and (3) upstream producers of oil, gas, and coal products include a third contribution to GGI from the carbon content of produced fossil resources (under the assumption that 100 percent of the contained carbon will be emitted as CO_2 upon combustion by downstream users).

The GGI tracks taxed GHG process emissions and the contribution from the carbon content of products derived from fossil fuels in a manner analogous to that used in VATs. The GGI includes contributions from taxed GHG emissions paid both by manufacturers and their suppliers. Total taxes paid to produce a product are given by its GGI multiplied by the US GHG tax rate.

While the statutory incidence of the GHG tax falls only on a few sectors, it is important to recognize that the economic impact of the tax flows through the chain linking suppliers, producers, and customers to affect the entire economy (that also includes firms, shareholders, employees, and the communities where they do business).

In the Framework, covered products to be exported would be eligible for rebates determined by the following rate (in US$ per tonne of product): GGI multiplied by the GHG tax. For like imported products, the GGI (as determined for foreign producers) provides the basis for the import charge by applying the US GHG tax. This is discussed further in general immediately below—for specific sectors at length, see Section 5; with examples for many EITE sectors, see the Compendium (referenced in footnote 1). Besides its use to evaluate BTAs, the GGI also serves a second purpose in the Framework: it provides the requisite information for suppliers to communicate to their customers the amount of taxed emissions required to produce covered products.

International standards to determine the GHG "footprint" of products based on life-cycle analyses (LCA) have been developed by the International Standards

6 The initial publication of the Framework (March 2018) used the acronym PCGE (product cumulative GHG emissions) rather than GGI. In light of further exploration of this topic, going forward we have decided to use the term "greenhouse gas index" and associated acronym "GGI."

Organization (ISO)[7] and by World Resources Institute (WRI) with the World Business Council for Sustainable Development (WBCSD).[8] Though similar in many respects to the GGI described here, both were developed for other purposes: namely, to assist entities (e.g., corporations and cities) voluntarily to quantify, report, and improve (i.e., reduce over time) GHG emissions associated with their products. These procedures apply to a variety of situations (including, e.g., services) outside of EITE sectors. In our application, the GGI is designed as a VAT-like surrogate to track the economic incidence of the added costs that result from the upstream GHG tax. This includes a contribution from the GGI of products and electricity in the supply chain of facilities that produce covered products.

Some requirements from the ISO standard and WRI/WBCSD protocol would not be relevant to determine BTAs. In the Framework described here, legislation and regulations would prescribe choices that may have several options under the ISO and WRI/WBCSD procedures. These would include, for example: covered entities and products, procedures to estimate GHG emissions for facilities and products (i.e., GGI), methods and timelines for reporting, audit procedures, and so on. Indeed, the GGI can be described in many respects as a tailored application of the ISO or WRI/WBCSD procedures that utilizes a restricted set of options (i.e., those that would be required by regulations created under the GHG tax law for BTAs). Note that procedures proposed here for determining a GGI do substantially implement relevant parts of the two product standards—notably those concerning GHG sources to account for, methods to determine GHG emissions from facilities, and procedures to allocate emissions to products.

The Framework uses the same approach to determine rebates for exported products and charges on imported products. When a specific covered manufacturer transforms products from many suppliers into new products, it must allocate the total cumulative GHG emissions from all inputs plus GHG process emissions from on-site operations (if any) and carbon embedded in products to determine cumulative GHG emissions (i.e., the GGI) for products it produces.

To manufacture products, EITE industries (by definition) require energy and other energy-intensive inputs, notably electricity and commercial fuels in all sectors, and, in some sectors, other energy-intensive materials such as electrodes, ethylene, and benzene. When electricity or energy is derived from fossil fuels, GHG emissions result as a byproduct. To be clear: utilizing energy from fossil fuels requires a chemical transformation of the hydrocarbon bond through the addition of heat and oxygen: emissions of CO_2 occur as an inevitable byproduct. Indeed, in some limited commercial applications, CO_2 is separated from flue gas and sold as a product. Several sectors

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

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

generate additional GHG emissions from extraction and processing of resources—for example, from calcination of limestone and from venting, flaring, or leaks of associated gas during extraction and processing of natural gas, crude oil, and coal. Emissions depend heavily on the particular natural resources, geology, commercial energy sources, and technologies used to create inputs from natural resources and suppliers and to manufacture products. GHG emissions in a given sector can vary considerably not only between firms, but also across domestic facilities and operations of a given firm, depending on their specific circumstances.

3.1. Methodologies to Determine GHG Emissions

Central to our proposal is the concept that rebates for exported products and charges on imported products that are covered can be determined based on information available from regulatory GHG reporting procedures that already exist in many nations, or from voluntary international guidelines that have been developed and endorsed by many EITE industries. These methods were developed to determine emissions from facilities and operations (e.g., power plants, chemical plants, and oil and gas fields). Today, in the United States and many other nations, they provide an established foundation that underpins systems for GHG emissions reporting, taxation, and allowance requirements in cap-and-trade systems.

Over the past two decades, many industrial sectors (especially EITE sectors) have developed voluntary GHG measurement and reporting guidelines that have been endorsed by international industry associations (e.g., see WRI/WBCSD GHG Protocols).[9] Their development involved collaboration with non-governmental organizations and interactions with government regulators. These guidelines are widely used by firms to roll up and report corporate GHG emissions from facilities and activities around the globe—for example, in corporate annual reports and as a basis for voluntary submissions to the Carbon Disclosure Project (CDP).[10]

The methods undergo ongoing scrutiny and are revised and updated from time to time. Those involved from industry interact with regulatory authorities around the world as they develop and revise "official" procedures. The methods account for operational emissions from activities to produce natural resources (e.g., to extract and process in-ground coal, oil, and gas to create processed coal, crude oil, natural gas, and a number of other byproducts), and manufacturing activities to produce specific products or product slates, including from the use of commercial fuels. They also account for

9 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.**

10 CDP is a not-for-profit charity that runs a global disclosure for system investors, companies, cities, states, and regions to manage their environmental impacts. **https://www.cdp.net.**

indirect emissions (e.g., from purchased electricity). After many years of experience, including regular interactions between industry, government and non-state actors, methodologies required by regulatory processes and the voluntary guidelines adopted by EITE industries yield consistent results,[11] although they are often tailored to different boundaries and accounting in different settings. They are available for use by firms in any nation, and firms that export GHG-intensive products typically are companies with the expertise and capacity to utilize these guidelines in nations without regulatory protocols.

Methodologies and issues are discussed in greater detail below as well as in Section 5 and the Compendium, where we consider specific sectors. For rebates and import charges, available methods for entire facilities must be extended: first, to accumulate GHG emissions from the entire supply chain contributing to produce products; second, to allocate emissions to specific products of a specific facility or operation (e.g., a steel plant or coal mine).

In general, we find that it is possible to estimate these emissions and allocate them to products without having to examine details for every step in the sequence to manufacture each product. The first few very energy-intensive steps usually account for the vast majority of GHG emissions emanating from a particular facility or manufacturing chain. Once those are accounted for, in many cases emissions for final products can be allocated using simple rules (e.g., based on the carbon content of the processed fuel or energy-intensive product, or average emissions per unit weight of precursors incorporated in the final product, such as raw steel transformed to bars or pipes). In this respect, the approach is consistent with the logic of applying BTAs only to EITE industries and GHG-intensive products with significant emissions, rather than to exports and imports from all sectors and their products (e.g., automobiles, laptop computers, clothing, and services). This restricted focus serves the dual environmental and administrative goals of reducing GHG emissions to limit risks from climate change while also limiting administrative costs and complexity.

While it will be possible to identify the firm responsible for producing exported or imported products, it may be difficult and even counterproductive to identify the facility where specific products originate. For example, a given manufacturer may produce identical products in several plants that utilize electricity from different sources based on renewables, nuclear, natural gas, or coal. The GGI will be different for otherwise identical products that are produced in different plants. US exporters would have an incentive to claim rebates for products sourced from their most GHG-intense plants, while foreign firms would be assessed lower import charges if they could claim that exports to the United States originated from their least GHG-intensive facilities.

11 Mark A. Cohen and Michael P. Vandenbergh, Energy Economics 34: (2012) S53–S63: *The Potential Role of Carbon Labeling in a Green Economy*.

To avoid "gaming" that might occur in these cases, and in recognition of the lack of clear provenance in many situations, we propose that products exported by US companies should be assigned the average value for the GGI based on the firm's entire domestic production. Similarly, we would assign the value for the GGI of imported products based either on the average GGI for that product across the entire sector in the country of origin, or across the entire company, if such information is available.

National GHG inventories required by the UNFCCC provide another official source of information on GHG emissions that may be useful in this context. These inventories, based on guidelines[12] produced and updated from time to time by the Intergovernmental Panel on Climate Change (IPCC), include information for many sectors and activities. However, they do not extend to emissions from particular facilities or firms. Unfortunately, available inventories for some developing nations are several years old. This should change under new reporting procedures that will come into effect as the Paris Agreement is implemented. Nevertheless, national inventories provide relevant information that would be especially valuable to help estimate average emissions for products in many EITE sectors in developing countries that have not yet implemented detailed GHG regulatory reporting requirements for industrial activities.

3.2. Issues in WTO Compliance

Our approach to BTAs for covered GHG-intensive products is based on providing a rebate for exports by US manufacturers and applying a charge on imports from foreign firms. Both the export rebate and import charge rates (US$ per tonne of product) are determined by multiplying the GGI (tonne CO_2e per tonne of product) for the specific product by the US GHG tax rate (US$ per tonne CO_2e).

The border adjustment process has been designed to satisfy several essential criteria for complying with WTO rules (discussed in greater detail in Section 3.4):

- Rebates for covered, exported products are determined by their GGI multiplied by the US GHG tax rate. Similarly, import charges for covered products are determined by their GGI multiplied by the US GHG tax rate.
- GGI values, used as the basis for the export rebates and import charges on covered products, are determined based on objective international standards for GHG emissions.

12 *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.

- Import charges are applied without discrimination based on national origin.
- Rebates for covered exported products do not exceed the amount of the indirect domestic tax paid on like products sold domestically.
- Import charges on covered products do not exceed the amount of the indirect domestic tax paid on like domestic products.

WTO rules allow nations to provide rebates for indirect taxes on products that are exported (not to exceed the domestic tax paid on products that are consumed domestically) and to apply a charge to imported products (not in excess of the indirect tax on like domestic products).[13, 14] In the Framework, the rebate and import charges are paid at the same tax rate for imports and exports, and both are determined based on the same procedure for the GGI, including accounting for sources of energy and materials in the same way.

To apply equally to all nations, this approach does not take account of GHG policies, regulations, and costs already imposed in the exporting nation—which differ enormously among nations that trade with the United States. Providing credit for such policies runs the risk of violating Most Favored Nation principles of non-discrimination on the basis of the national origin of imports (see footnote 13). While this runs counter to many discussions of BAs, it also has advantages. In particular, it is extremely difficult objectively to assess the actual cost of GHG policies in many nations, let alone their cost to specific products. No nation yet applies the economists' ideal policy—and the one assumed in this proposal—of an economy-wide tax on all GHG emissions (i.e., an actual GHG "price"). Most nations, including the United States, utilize a portfolio of policies that include a variety of mandates, subsidies, and end-use efficiency regulations, as well as some price-based approaches. Cap-and-trade systems result in a variable, volatile, unpredictable GHG price for facilities in some sectors.

Evaluating the cost of the ensemble of these policies for specific products gives rise to a quagmire of challenges. It would be exceedingly difficult, for example, to determine the amount of a cap-and-trade credit appropriate to reduce the US import charge on products exported from a country with a cap-and-trade system that includes substantial free allowances for facilities of various industries.

If adopted, the Framework proposed here could cause other countries to consider whether and how they might provide relief (from their own national GHG policies) to their firms that export to the United States. Indeed, if the United States adopted this approach it might encourage other nations also to adopt a GHG tax as a basis to facilitate trade neutrality using BTAs for exports to the United States and other nations that adopt this approach.

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

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

As stated above, for the United States and other nations that adopt it, in essence, this proposed Framework fundamentally shifts costs to mitigate emissions connected to international trade from a system based on where goods are produced to one where they are consumed.

3.3. Upstream GHG Tax with Border Adjustments for Exports and Imports

In the United States but not in all nations, the majority of GHG emissions (over 80 percent) occur as CO_2 from combustion of fossil fuels. However, if the ultimate objective is to achieve radical, long-term reductions that have been proposed as the goal of GHG policy, other sources (such as cement production, and other gases, including methane, nitrous oxide, HFCs, PFCs, and SF6), must also be addressed. Indeed, the upstream GHG tax should also apply to activities that generate significant GHG emissions (e.g., land-use change and agriculture) that do not involve GHG-intensive products and, therefore, are not covered by BTAs.

In our Framework, the direct statutory incidence of the upstream tax falls only on a few sectors: producers of coal, oil and natural gas, and a few others (e.g., cement)—but all EITE sectors experience its economic incidence based on their use of fossil resources, fuels, electricity, and, in some cases, other energy-intense inputs such as ethylene and benzene. For example, besides paying the upstream GHG tax, producers of coal, oil, and gas would pay more for the electricity, commercial fuels, and other energy-intense inputs they use to extract and initially process fossil resources. As key downstream examples, electricity producers would pay no GHG tax, nor would refiners pay a GHG tax on crude oil that they process, fuels they produce, or electricity, commercial fuels, and other energy-intensive materials they utilize. Nonetheless, because of the upstream tax, refiners would pay more for crude oil and natural gas, and power plants for fossil fuels that they utilize. Consequently, their customers—including upstream producers of oil, gas, and coal—would pay more for purchased fuels and electricity (see Figure 1).

Determining precisely the economic impact of the upstream GHG tax on the price producers charge their customers may be an impossible task, since prices in commodity goods fluctuate from day to day for many reasons. It is, however, feasible using the GGI to track taxed GHG emissions along the supply chain to manufacture EITE products. As a policy for GHG regulation, we require that producers determine and communicate to their customers, and regulators, the GGI (tonnes CO_2e per tonne of product and tonnes CO_2e per MWh for electricity) for products they sell. The GGI builds up over the supply chain in a straightforward analogy to similar methods used for VATs as described in Section 3.6 below. Note that, unlike the buildup of VAT along the complex supply chain for many end-use products, GHG-intensive products are produced early in manufacturing supply chains involving covered sectors. For example,

only two sectors are required to produce crude and refine it to gasoline as a final end-use product. Similarly, end-use electricity generation is just one step from fossil fuel suppliers of coal and natural gas, or two steps for liquid petroleum.

Upstream GHG Tax

Coal, oil, and gas producers would be the EITE sectors that pay the greatest share of the GHG tax. This section focuses on them. The Compendium discusses a few other sectors (e.g., cement, aluminum, and steel) that would also pay the tax because they emit CO_2 and other GHGs from processing limestone or alumna or consuming electrodes. Because the carbon content of fossil fuels is taxed before combustion, no tax is paid at the downstream point of emission from use of commercial fuels for transport, to produce heat and electricity, or for other purposes. The tax itself will be paid at a convenient upstream point in the supply chain (e.g., perhaps for crude oil, at the point of transfer to a US refinery).[15] The tax on crude oil would include a contribution from process GHG emissions released to produce it, as well as its carbon content.

Process emissions subject to the GHG tax also occur from upstream operations to produce coal, oil, and natural gas during extraction and initial processing of the natural resource. They occur from venting or flaring of associated gas, fugitive emissions from leaks, and, in some cases, utilization of some of the produced resources to create heat, electricity, or steam.

Unlike BTAs that must be defined for specific products, for administrative efficiency the upstream GHG tax is calculated by reference to process emissions from entire upstream facilities and operations, and to the carbon content of products derived from produced fossil resources. As described below, the tax can be allocated to the slate of products (e.g., crude oil and associated gas), based on their carbon content.

An offset fee, paid at the same rate as the GHG tax, should be available to US domestic manufacturers who capture CO_2 emissions from purchased fossil fuels and permanently store them as part of carbon capture and storage (CCS) operations. "Permanent" storage would be defined by permitting procedures for CCS that will have to address the potential for leakage over periods ranging from centuries to longer. The GHG tax law could also provide an offset fee for fossil resources that are converted into durable products like concrete. As with "permanent" for CCS, that would depend on the regulator establishing criteria for "durable." Similar considerations regarding avoided emissions, through CCS and durable products, should also apply to evaluate net emissions for imported products.

15 According to the Energy Information Administration there were 135 refineries operating in the United States in 2020.

Rebates for Exported Products

The methodologies described above (Section 3.1), provide objective approaches based on international standards to determine GHG emissions from facilities and operations in EITE industries. In the United States, such methodologies have been available for many years. They are the foundation for required reporting of GHG emissions by facilities and provide a basis to levy the upstream GHG tax.

To determine rebates for products we must extend the methods by allocating cumulative GHG emissions from all inputs and operations of specific facilities to the products they create. In situations where a plant produces an entire slate of products (such as a steel mill or petroleum refinery), it is often appropriate to allocate emissions based on the tonnage of products produced, or on their carbon content in the case of processed fossil fuels. The Compendium discusses more complex circumstances that occur in sectors where facilities produce multiple products using a variety of technologies and processes that may require separate approaches.

In any case, existing methods can be extended to determine how taxed facility-wide emissions and cumulative GHG emissions from products of EITE suppliers (based on their GGI) would be apportioned across the portfolio of goods produced by the facility. This almost certainly will require effort by firms, trade associations, other stakeholders, and regulators to develop appropriate, agreed-upon information and procedures in EITE sectors, as discussed below.

To determine the GGI for BTAs, the Framework calls for the use of firm-wide domestic averages for specific products, or sector-wide national averages if firm-wide data are not available. The firm-wide average avoids concerns with provenance of products or firms shifting sourcing for domestic sales and exports to maximize rebates or reduce import charges (as described in Section 3.1). Consequently, it appears to be more appropriate to use domestic averages for an entire firm. This requires the firm to roll up cumulative emissions for their entire domestic production of each exported product and calculate the domestic average GGI for that product. Because of the large variety of production methods employed in many sectors, and the regional variation of emissions associated with sources for purchased electricity, it seems appropriate to use firm, not sector, averages to determine the domestic rebate for specific products.

To meet WTO criteria, it is essential that the rebate for exported products does not exceed the tax paid on like products sold for domestic consumption determined in the same fashion (i.e., the US GHG tax times the GGI for the product). Firm-wide averages could simplify the issues associated with provenance of exported products.

Border Charge on Imported Products

In this Framework, both the charge on imported products and the rebate for exported products are determined in the same fashion, based on objective, accepted

methodologies to determine GHG emissions that do not discriminate against any nation, nor favor domestic over foreign producers.

The border charge would impose the US GHG tax rate on products imported from other nations based on cumulative GHG emissions (i.e., the GGI) required to produce them, and, in the case of fuels, to combust them. To avoid issues associated with determining (or shifting) the provenance of produced goods, emissions would be determined based on the company's average for products manufactured in the exporting nation. If company-specific information is not available for an exporting company, then average data for the entire country would be estimated and used to create import charges. Estimating the GGI for imported EITE products (e.g., default national averages or values for specific production processes and commercial fuel and electricity use) will be central in the effort to determine initial import charge for such products.

Economic Scale of GHG Tax and BTAs

Even at a modest starting level of $20 per tonne CO_2, the scale of US domestic GHG taxes, export rebates, and import charges would be significant. With respect to taxes on fossil resources, in 2016 US energy-related CO_2 emissions (approximately 5.2 billion tonnes CO_2) would have yielded revenues of $100 billion per year. Exports, on the other hand (using a simple estimate—based only on carbon content, not a complete analysis of cumulative GHG emissions, and only for petroleum products) of crude oil and other petroleum liquids in 2016 amounted to just over 5 million barrels per day, and imports to about 10 million barrels per day, with trends showing exports rising and imports falling. Export rebates in 2016 would have been about $20 billion and import charges about $40 billion. Thus, responsible administrative agencies would be processing domestic taxes, rebates and import charges of many billion dollars per year.

3.4. WTO Rules and Border Tax Adjustments (A Deeper Dive)

The rules of the WTO permit internal taxes and charges to be "border adjusted" (i.e., rebated on exported products and applied to imported products). Significantly, BTAs need not be imposed or rebated directly on the product that is subject to the domestic tax, but may under certain conditions also be imposed or rebated on manufactured goods made using the products—including energy inputs—that are subject to the domestic tax. BTAs on imports and exports, however, may not exceed the tax paid on similar products that are sold for domestic use.[16]

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

The border adjustment of the upstream GHG tax on imports and exports of products from EITE sectors could raise concerns about potential violations of the rules of the WTO. The WTO's Agreement on Subsidies and Countervailing Measures (ASCM) prohibits countries from providing export subsidies for their products. The General Agreement on Tariffs and Trade (GATT) restricts the ways in which WTO-member nations impose taxes on imported products. Both agreements, however, follow the "destination principle," which permits taxes to be border adjusted on products based on where they are consumed rather than where they are produced.[17] Moreover, both agreements permit the "downstream" border adjustment of an "upstream" internal tax on products so long as the tax is designed and implemented in a nondiscriminatory manner. Accordingly, BTAs based on a properly designed GHG tax would be permissible under the relevant rules of the WTO.

Border Adjustment of the GHG Tax on Exports

Although the ASCM generally prohibits export subsidies,[18] the prohibition does not apply to the rebate of "indirect"[19] taxes that are imposed on "like" products that are consumed domestically.[20]

Annex I of the ASCM indicates that the "exemption or remission" of indirect taxes "in respect of the production" of exported goods does *not* constitute an impermissible export subsidy so long as the remission is *not* "in excess" of the tax applied to the production of like products sold domestically.[21] This is consistent with the principle that products should be taxed where they are consumed rather than where they are produced. A footnote in the ASCM indicates even more explicitly that taxes on "energy, fuels and oils used in the production process" may be border adjusted on exports.[22] Accordingly, the remission of taxes on fossil fuels used in the production of exported

17 *See*: WTO Secretariat, *Taxes and Charges for Environmental Purposes – Border Tax Adjustment*, WT/CTE/W/47, para. 36 (2 May 1997)("WTO provisions on border tax adjustment follow the destination principle for [product based] taxes"), available **here**.

18 *See*: ASCM, Article 3.1 (prohibiting subsidies contingent on export performance).

19 "Indirect taxes" are defined broadly to cover essentially all taxes on products, including "sales, excise . . . value added, transfer . . . and all taxes other than direct taxes and import charges." *See* page 34: Agreement on Subsidies and Countervailing Measures, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1A, 1869 U.N.T.S. 14. **https://www.wto.org/english/docs_e/legal_e/24-scm.pdf**.

20 *See* ASCM, n.1 ("the exemption of an exported product from duties or taxes borne by the like product when destined for domestic consumption, or the remission of such duties or taxes in amounts not in excess of those which have accrued, shall not be deemed to be a subsidy.").

21 *See*: ASCM, Annex I ("Illustrative List of Export Subsidies"), para. (g) ("the exemption or remission, in respect of the production and distribution of exported products, of indirect taxes i*n excess of those levied in respect of the production and distribution of like products when sold for domestic distribution.*")

22 ASCM, n.61. For a discussion of the ASCM provisions addressing border adjustments of energy inputs, see Porterfield, *supra*, at 19-23.

EITE products would be permissible so long as it was not "in excess of" the taxes levied on fossil fuels used in the production of like products sold for domestic use.

Border Adjustment of the GHG Tax on Imports

The GATT similarly permits border adjustment of internal taxes on imported products. Article II of the GATT restricts the imposition of customs duties (tariffs) on imported products to the rates specified in schedules annexed to the GATT.[23] Under Article II:2(a), however, a charge "equivalent to an internal tax" imposed on a competitive domestic product may be imposed on an imported product or, significantly, on "an article from which the imported product has been manufactured or produced in whole or in part." Thus, GATT Article II:2(a), like the ASCM, permits the border adjustment of taxes on materials like energy inputs that are used to make imported products.

Article III of GATT similarly recognizes the ability of governments to border adjust on imported products taxes that are imposed on inputs used in producing competitive domestic products. BTAs pursuant to GATT Article II:2(a) must comply with Article III:2,[24] which states that imported products may "be subject, directly or indirectly, to internal taxes so long as they do not exceed the taxes applied to like domestic products."[25] The reference to taxes imposed "indirectly" encompasses taxes on "raw materials used in the product during the various stages of its production."[26] As with export BTAs under the ASCM, import BTAs under GATT may not be imposed in a discriminatory manner—that is, "in excess" of the taxation imposed on like domestic products.

Even if an import BTA were held to be inconsistent with GATT Articles II or III (or possibly if an export rebate were found inconsistent with the rules on export subsidies), it could still be permissible under Article XX(g), which provides an exception for measures "relating to the conservation of exhaustible natural resources." The analysis under Article XX(g) involves two stages. First, the challenged measure must be "provisionally justified" as falling within the scope of Article XX(g). Second, under the introductory paragraph or "chapeau" of Article XX, the measure must not be applied in a manner that constitutes "arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade."

23 *See* GATT Article II:1.

24 Under GATT Article II:2, charges levied on imported products must be imposed "consistently with the provisions of paragraph 2 of Article III…."

25 GATT Article III:2 (emphasis added).

26 Japan—Customs Duties, Taxes and Labelling Practices on Imported Wines and Alcoholic Beverages, L/6216 - 34S/83, para. 5.8 (adopted on 10 November 1987).

With regard to the first stage of analysis, Article XX(g) clearly covers measures designed to protect the climate, given that laws designed to protect air quality have been found by the WTO's Appellate Body to be within the scope of Article XX(g).[27]

In applying the second stage of analysis under the chapeau of Article XX, the Appellate Body has stressed the need for environmental measures to be applied in a flexible manner that does not coerce foreign countries to use a particular regulatory approach to achieve an environmental standard.[28] Border adjustments based on the GGI of imported products would be consistent with this principle. They would not require the exporting country to implement any specific regulatory mandate, but instead would simply use the GGI, however achieved, to calculate the border adjustment. Accordingly, a properly designed import border adjustment would be permissible under GATT Article XX(g).[29]

3.5. EITE and Other Industries with GHG-Intensive Products

The concept of EITE industries has existed for some time, but it remains unclear exactly how they should be defined, and systems differ between nations with different GHG policies. Over a decade ago, H.R. 2454 (the Waxman-Markey cap-and-trade legislation) included provisions for relief to domestic firms in EITE sectors that would be disadvantaged in international trade by the proposal. Eligible firms would be entitled to free allowances or rebates based on a complex procedure that covered emissions from operations and purchased electricity. At the time, an interagency task force led by the US Environmental Protection Agency (EPA) identified 46 sectors[30] within the North American Industry Classification System (NAICS) that were presumptively eligible for

27 *See*: Appellate Body Report, *United States – Standards for Reformulated and Conventional Gasoline*, WT/DS2/AB/R (adopted 20 May 1996) at 9-10 ("Understandably, the United States has . . . not appealed from the Panel's ruling that clean air is an exhaustible natural resource within the meaning of Article XX(g)….")

28 *See* Appellate Body Report, *United States—Import Prohibition of Certain Shrimp and Shrimp Products*, ¶ 161 , WTO Doc. WT/DS58/AB/R (adopted Oct. 12, 1998) ("Perhaps the most conspicuous flaw [under the chapeau of Article XX] in this measure's application relates to its intended and actual coercive effect on the specific policy decisions made by foreign governments"). The Appellate Body also identified a number of other factors that should be taken into consideration in designing a border adjustment to ensure that it would be consistent with the chapeau of Article XX, including the need to attempt to negotiate with affected countries and to provide adequate due process in applying environmental measures to imported products. *See* id., ¶¶ 166–81.

29 For a discussion of Article XX(g) and its potential application to border adjustments of a carbon tax, see Porterfield, *supra*, at 27-36 and 39.

30 The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries (December 2, 2009). **https://www.epa.gov/sites/production/files/2016-07/documents/interagencyreport_competitiveness-emissionleakage.pdf**.

relief. Selection criteria were based on sector-wide, domestic economic information that considered both: 1) a measure of energy intensity based on expenditures for energy as a share of the value of the sector's overall production; and 2) a measure of trade-exposure using the ratio of the value of all exports and imports relative to the value of domestic production and imports in that sector.[31] It also contained a provision with respect to GHG-intensity of the sector based on overall emissions times the allowance price relative to overall production. Although not listed as an EITE sector, electricity producers were also entitled to a share of free allowances.

As described immediately below, we do not believe that economy-wide indicators based on energy intensity and the total value of imports, exports, and production capture important implications of the GHG tax for the competitiveness of domestic firms affected by international trade. Rather, as the basis to determine sectors and products covered by BTAs, the Framework focuses on GHG-intensive products where greater incentives would exist to shift production abroad or to import goods from countries or companies with lesser costs or controls on GHG emissions. This characterization includes products from, but is not limited to, the 46 energy-intensive NAICS Code sectors listed in the interagency report.

Typically, major products of EITE manufacturers are commodity goods such as cement, rolled steel, gasoline, or liquified natural gas (LNG). Such goods compete in markets where they must satisfy common performance standards that are not differentiated (e.g., with respect to style, quality, or performance). They compete largely on the basis of price. While economy-wide indicators are important to judge impacts on the US economy, they are not a good measure of impacts on the competitiveness of firms. So, it is important to consider the impact of the GHG tax on the cost to manufacture the product compared to the cost of similar products of competitors not subject to the tax. For example, a $30 per tonne CO_2 tax would add $0.27 to the cost of a gallon of gasoline (see footnote 37). That is significant relative to the profit margin for gasoline and would place the firm at a major disadvantage with competitors not facing the same tax.

31 From the Interagency report: *"Specifically, H.R. 2454 considers an industry to be "presumptively eligible" … for emission allowance allocations (or "rebates") to "trade-vulnerable" industries if the industry's energy intensity or its greenhouse gas intensity is at least 5 percent, and its trade intensity is at least 15 percent. In addition, H.R. 2454 considers an industry to be "presumptively eligible" if its energy or greenhouse gas intensity is at least 20 percent, regardless of its trade intensity. … An industry's energy intensity is defined as its energy expenditures as a share of the value of its domestic production. An industry's greenhouse gas intensity is defined as its total greenhouse gas emissions (including indirect emissions from electricity consumption) times $20 per ton of emissions, divided by the value of the industry's domestic production. An industry's trade intensity is defined as the combined value of its exports and imports as a share of the value of its domestic production and imports."*

In other cases, manufacturers of commodity products such as LNG, jet fuel, cement, and steel often compete with foreign firms for large contracts to supply major infrastructure projects or to provide goods to manufacturers or facilities such as power plants and airports. Even a small increase in costs relative to competition can result in the loss of entire deals with significant implications. Also, note that competitiveness is not just a bilateral matter. Two nations with different GHG policies may also compete in a third nation to which they both export.

Finally, consider the situation for electricity suppliers. Economy-wide indicators may not capture significant competitive concerns that could affect producers and distributors of electricity in US regions linked to Canada or Mexico. Although trade in electricity with Mexico is not large, in recent years Canada has exported about 11 percent of its domestic electricity production to the United States.[32] While this is less than 2 percent of US electricity production, imports amount to 12–16 percent of electricity used in New York and New England, and 12 percent in Minnesota and North Dakota.[33]

Covered Sectors and GHG-Intensive Products

The Framework recognizes as covered sectors those with products that are eligible for export rebates and subject to import charges. Covered products eligible for export rebates and subject to import charges are those with a GGI of at least 0.5 tonnes CO_2e per tonne of product, and, in the case of electricity, 0.25 tonnes CO_2e per MWh. With these thresholds, covered sectors would include the 46 identified in the interagency report plus several others. The additional sectors include some that would meet the 5 percent energy intensity threshold in the interagency report for EITE sectors, and others that (for various technical reasons, described below) might not. With these thresholds, it appears that major commodity products of all traditional EITE sectors would be covered, as would be electricity produced from burning fossil fuels. However, GHG-intensive products will also be covered in some sectors that do not meet the EITE threshold.

Because of their prominent place in the literature and public discussion, we find it convenient to continue, as appropriate, to refer to EITE industries or sectors, even though our revised criteria do not contain an explicit assessment of economy-wide trade exposure or energy intensity. Note that, going forward, as US and foreign manufacturers and consumers respond to growing restrictions, they will aim to reduce GHG-emissions—not necessarily energy use. A prime example would be deployment of CCS in some sectors as an energy-intensive technology to capture and store CO_2.

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

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

The Framework includes the EITE sectors identified in the interagency report plus four additional EITE sectors that are essential to track cumulative GHG emissions (and taxes paid) from producers to their products across the supply chain. The additional sectors are oil & gas production, petroleum refining, coal production and electricity. We also include the product LNG as a GHG-intensive product of an energy-intensive industrial activity, even though for technical reasons LNG is listed in a NAICS code sector that may not as a whole be energy-intensive.[34]

There are several reasons to include GHG-intensive products from these additional sectors. First, each creates GHG-intensive products that are exported from and/or imported into the United States. Second, conditions have changed dramatically over the past decade, notably for oil and gas, with the United States now exporting significant and growing amounts of crude oil, finished petroleum products, and LNG. Third, to determine the GGI for covered products, the Framework requires information on the GGI from all covered sectors to be available to regulators and customers in other covered sectors.

The NAICS code classification system may place finished GHG-intensive products in a non-EITE sector that transforms unfinished GHG-intensive products from an EITE sector. For example, energy use alone by manufacturers of finished aluminum products may not be large enough to qualify them in an EITE sector. Nonetheless, finished products qualify because of the large contribution to their GGI from unwrought aluminum purchased from an EITE supplier. The regulator may discover, or be informed of on appeal by manufacturers, other clear cases of GHG-intensive products that should also be eligible for export rebates and subject to import charges—even if, for some reason, the sector as a whole is not energy-intensive.

As discussed in the Compendium, products in some EITE sectors may be excluded or grouped for administrative reasons. Manufacturers in covered sectors would be required to determine a GGI for their products and communicate their GGI values to regulators and to customers they supply in other EITE sectors: even if the manufacturer does not export products, its EITE customers may.

Most of the information required to determine a GGI is currently available, though not all of it is published or communicated in suitable forms. For example, besides information on GHG emissions, allocation procedures will also require information on the product slate of the manufacturer at the facility for which GHG emissions are determined (e.g., the amount and composition of products sold). This standard

34 The NAICS Code 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. Consequently, under the Framework, we classify LNG as a covered product eligible for export rebates and subject to import charges.

commercial information is readily available to the manufacturer. As well, firms exist that collect and market such data for many sectors.

The initial set of qualified sectors and products will need to be updated periodically to reflect changing markets, technologies and products. Additionally, manufacturers should be entitled to propose the addition or removal of sectors and products from the qualified lists and to challenge regulatory decisions with respect to both imported and exported products (see Section 5 for more details).

Facilities of US EITE sectors already collect and report to US agencies a great deal of the GHG emissions data necessary to implement the Framework. Industrial facilities and power plants are required to report GHG emissions (and other information) to EPA. This information is available at EPA's websites—for manufacturing facilities, under the Greenhouse Gas Reporting Program,[35] and for power plants at the Emissions and Generation Resource Integrated Database (eGRID).[36] However, currently, neither federal regulation nor all states require that US electricity suppliers (or suppliers of products from other EITE sectors) provide customers with information on their GHG emissions.

Covered sectors and regulators will need to consider what, if any, additional information and allocation methods would be required to determine the GGI for the products they produce—and how to provide that information to customers, primarily business-to-business customers, to implement the Framework. The significant new task is to establish authorized procedures to allocate overall emissions to covered products that they sell. Manufacturers will know the weight, carbon content, and other properties required to determine the GGI for products they make and sell from the facilities for which they measure and report GHG emissions.

One of the reasons for publishing the Framework is to encourage US firms and trade associations in EITE and other covered sectors to develop voluntary procedures to produce and share information on cumulative GHG emissions to produce and consume products: the GGI. Manufacturers and their national associations will have an incentive to provide this information because it forms the basis to claim rebates for exports and to impose import charges on products that may otherwise enjoy a competitive advantage. Voluntary pilot efforts—perhaps public-private partnerships—in this area would help suppliers, producers, competitors, customers, and regulators begin to understand the implications, challenges and benefits of developing such an upstream approach for BTAs.

Even in a preliminary, voluntary form, better information on GHG emissions required to produce products would increase transparency with regard to national GHG policy. In particular, it would provide the public, entrepreneurs, and innovators with information

35 **https://ghgdata.epa.gov/ghgp/main.do**.

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

that would inform their decisions and actions. The information on cumulative GHG emissions (i.e., the GGI) will also inform citizens and consumers of the impact of the upstream tax paid only by a few businesses on the many downstream products purchased by consumers (e.g., electricity and gasoline).

3.6. Border Tax Adjustments in the Framework of a Cumulative Emissions Charge

Table 1 explains the terms and definitions in the proposed Framework to account for the buildup of cumulative, taxed GHG emissions along the supply chain leading to products in EITE and other covered sectors. It also describes how they can be used to determine rebates on exported products and to impose charges on imports.

The following example from petroleum fuel products makes clear that the GGI can be materially greater than the carbon content of the fuels. Conventional petroleum fuels manufactured anywhere in the world have essentially identical carbon content. For example, a gallon of gasoline contains 2.42 kg of carbon that would release 8.89 kg of CO_2 upon combustion; whereas a gallon of jet fuel contains 2.61 kg of carbon that would release 9.57 kg of CO_2[37] (these values are for petroleum fuels without added biofuel). The GGI includes contributions from a refinery's process emissions (if any) and from products (e.g., crude oil, electricity, and commercial fuels) that the refiner purchases from oil and gas producers and other EITE suppliers. These can differ significantly depending on how crude oil was extracted, processed, and transformed into a product slate. Life-cycle analyses[38] show that, on average in the United States, emissions (CO_2e) associated with production and refining of crude oil add another 20 percent (one third from production, two thirds from refining) to those from combustion of petroleum fuels. So, on average, the GGI for gasoline or other finished products made in the United States would be at least 20 percent higher than a value based solely on its carbon content. For comparison, in Canada the production and refining of oil sands on average adds 30 percent to the GGI. Moreover, the GGI varies considerably depending on the particular resource produced, emissions associated with purchased electricity, and the product slate of the refinery.

For commodity products like gasoline sold by a distributor, where profit margins for end-use sales are only a few percent, the variation from different suppliers could be an important determinant of competitiveness. Similarly, the GGI for electricity suppliers will vary significantly and have an impact on the amount of the GHG charge passed on to EITE producers depending on the source of fuel and technology used to produce electricity.

37 For a convenient list of fuels and CO_2 emissions see: **www.rff.org/blog/2017/calculating-various-fuel-prices-under-carbon-tax**.

38 *See*: Canadian Oil Sands: Life-Cycle Assessments of Greenhouse Gas Emissions Richard K. Lattanzio, March 10, 2014, Congressional Research Service **https://fas.org/sgp/crs/misc/R42537.pdf**.

4. Cross Cutting Issues: Electricity, Combined Heat and Power, Recycling and Transport

This section describes, in general, how the Framework addresses four important cross-cutting issues that affect nearly every EITE sector: electricity, combined heat and power, recycling, and transport.

4.1. Electricity

Because every covered sector relies to some extent on electricity as an input, an upstream GHG tax will alter the competitiveness of domestic producers of electricity and sectors that use electricity depending on the fuels and technologies used to generate power. To date, discussions of BAs in the United States have always considered the need to address the implications of electricity, especially since lower-cost, GHG-intense electricity in many developing nations could create competitiveness issues.

The Framework accounts for this by including electricity as a covered sector. In practice, the key to implementation is to require that electricity suppliers provide the relevant information—the GGI (CO_2e per MWh for electricity)—to their customers. Information on GHG emissions from fuel use in power plants is already reported to the EPA (as described above in Section 3.5). However, electricity suppliers are not currently required to communicate that information to their customers. For this Framework, electricity suppliers would need to know and report not only the carbon content of their fuels, but also the cumulative GHG emissions (i.e., the GGI) required to produce the fuel. For this reason, we would require electricity producers (like all other EITE suppliers) to determine and communicate the GGI to regulators and EITE customers. Unless a customer purchases electricity under a specific agreement (e.g., for renewable energy, GGI = 0), the GGI for purchased electricity should be based on an average from all generators in a given distribution network.

In the vast majority of cases, power plants produce a single product: electricity, for sale to customers. The next section provides an important example of electricity produced by combined heat and power facilities, and describes our proposal to evaluate the GGI from these facilities.

4.2. Combined Heat and Power

Combined heat and power present an opportunity and a challenge. The opportunity exists because operations in many EITE sectors require copious amounts of process heat to carry out transformations. Heat is frequently provided by steam generated

for use in multiple processes throughout the facility. In many settings the residual, otherwise-wasted heat can be used to co-produce electricity used within the facility or, when regulations allow it, sold for use by customers outside the facility. Compared with producing them separately, cogeneration dramatically improves the overall, combined energy efficiency to produce steam and electricity, and reduces GHG emissions and costs. The challenge arises because of potential ambiguity and complexity concerning GHG emissions from combined heat and power systems embedded in industrial facilities and, even more, how to allocate them to products.

When a facility such as a refinery implements cogeneration of steam and electricity, it does so to take advantage of the residual heat available after producing steam to satisfy the enormous demand in numerous units across the entire facility. In this case, combined heat and power operations are not managed to optimize profit from the capability to create two products (steam and electricity) but, rather, to serve the larger need to run the entire facility safely, efficiently, and profitably. As well, the cogeneration unit may utilize fuels from internal operations or purchased fuels to meet the needs of the entire facility. In this situation, it seems appropriate to treat the unit as an internal operation that affects overall operating costs and to regard any electricity sold "outside the fence" to have been generated with zero emissions. That is: none of the GHG emissions from the cogeneration unit should be allocated to the product, electricity sold by the refinery (if any). All of the emissions should be allocated to the slate of petroleum products produced by the entire refinery.

That being the case, electricity sold as a product to others outside the facility should be treated as having no GHG emissions (i.e., its GGI is zero). Note that any GHG emissions associated with the operation are still accounted for, since they are allocated to the refinery's entire petroleum product slate. Note also that electricity sales from a refinery typically are not significant compared with sales of petroleum products. This approach not only simplifies bookkeeping, it also encourages the use of cogeneration, which reduces overall GHG emissions compared with acquiring electricity from outside providers.

The situation, however, would be entirely different for a stand-alone combined heat and power facility run by an independent operator, perhaps to provide electricity and heat in some form to a variety of customers in an industrialized locale. In that case, the independent operator should be required to obtain GGI values for its purchased inputs and to specify the basis to allocate them to all the products it sells to others. In this case, as a pragmatic approach, we propose to allocate total emissions proportional to the value of total sales of each product relative to total sales of all products.

4.3. Recycling

Many EITE sectors (e.g., steel, aluminum, glass, pulp and paper) make extensive use of recycled materials. Manufacturers benefit from using recycled materials because they require far less energy to be reprocessed into new products than is required to convert fresh raw materials. This lowers the cost of the new products and GHG emissions to make them. The gathering process to collect recycled materials is such that materials from many sources may be combined in a way that makes it impossible to determine the recycled materials' provenance (e.g., the facility that originally produced it, the number of times some of the materials may have been recycled, or even the year the source material was produced).

Although scrap and other recycled materials may originate from products of EITE sectors, the original EITE products were sold to, used, and transformed in other sectors (e.g., construction, automobile manufacturing, or shipbuilding), that are not EITE, and later disposed of or sold as waste or for recycling. The recycled materials themselves are products of the entity that gathers and sells them. Consequently, they are not products produced within an EITE sector, and the GGIs for them need not be evaluated. As products purchased from firms that are not EITE, recycled materials carry with them no contribution to the GGI of products in the EITE sector that purchases them. Of course, energy and other inputs used by the manufacturer to reprocess recycled materials do contribute to the GGI of new EITE products.

4.4. Transport

There is no doubt an upstream GHG tax would increase the cost of transportation by increasing the price of fuels and electricity. Clearly, costs of domestic transport contribute to the costs that manufacturers pay for products they purchase and charge for products they sell. However, as a service industry, we do not classify transport itself as an energy-intense industry, nor would it appear to be trade-exposed. As well, we regard the effort involved by manufacturers to evaluate the GGI for transport, and thus track the impact of the GHG tax on domestic transport of a firm's specific products, as very daunting. In most cases, results would depend on factors outside their operation that would need to be provided by vendors who do not collect this information on a product basis. Moreover, the contribution of transport is likely to be not material for the GGI of the exported product in most cases. The required effort and availability of information to determine the contribution to the GGI from transport for products imported from other nations would be even more challenging.

Consequently, at this time we propose to not include transport as contributing to the GGI of covered products, either for export rebates or import charges. Based on future experience, firms that believe transport should be considered for their industry should be given an opportunity for their industry to make the case to regulators.

5. Application of the Framework to Illustrative EITE Industries

This section discusses procedures to determine GHG taxes, export rebates, and import charges based on the GGI for products in EITE and other covered sectors: first in general and then in more detail for several illustrative sectors. As discussed above in Section 3.5, the information necessary to determine factors required to implement the Framework (primarily the carbon content of fossil resources and fuels, and process emissions from operations in EITE sectors) and to determine the GGI appears to be available, although not necessarily in convenient or appropriate form.

The approach to determine the GGI (taxed GHG emissions required to produce the product) as produced natural resources and purchased products are transformed into new ones, is analogous to the manner in which a VAT for products sold to customers builds up along the supply chain of inputs to produce them.

As an administrative procedure for BTAs, the Framework determines the GGI for specific products from specific manufacturers and combines them to determine a national average <GGI > for the firm's entire domestic production from all its facilities. If the product is exported, then the <GGI> multiplied by the US GHG tax is the rate (US$ per tonne) for the rebate. Similarly, for imported products of a specific foreign manufacturer, their domestic average <GGI> is the basis for the import charge rate: <GGI> multiplied by the US GHG tax. However, if firm-specific information is not available, then an average for the product based on the entire EITE sector of the exporting country would be used for the import charge.

For each sector, the GGI applies to products of specific manufacturing facilities and operations in the same way. A manufacturer transforms inputs (i.e., produced natural resources and products purchased from a variety of EITE suppliers) into new products that will be sold to customers. The approach requires the manufacturer to determine total cumulative GHG emissions: GHG Total (tonnes CO_2e), from all inputs and process emissions of the facility. GHG Total is the amount of emissions to be allocated to the entire slate of products produced by the facility. For many sectors, it is appropriate to allocate GHG Total to products by simple procedures, such as by weight in proportion to the weight of all products, or, in the case of produced fossil resources and processed fossil fuels, in proportion to their carbon content. However, for other sectors this may require additional information and procedures.

As discussed in the Compendium, and illustrated in Figure 1 for a few sectors, all sectors include contributions to the GGI from their use of purchased commercial fuels and electricity, and only a few sectors— notably producers of coal, oil and natural gas, and manufacturers who convert limestone to CO_2 and lime—pay upstream GHG taxes. In the United States, the information necessary to determine upstream GHG taxes for facilities and operations and to determine rebates for exported products

(GGI) appears to be available in most cases. However, it will need to be combined in new ways, especially to determine allocations of total cumulative GHG emissions from suppliers and manufacturers to a GGI for products in some sectors and to identify and resolve any outstanding issues (e.g., those associated with combined heat and power or electricity).

Effort will be required to determine the GGI for imported products, especially those manufactured in nations without well-developed procedures for firms to measure and report GHG emissions from facilities and operations, or by firms without adequate capacity and experience. Nonetheless, even in nations without formal regulatory procedures, international guidelines have been developed and endorsed by many EITE industries (see Section 3) that could be used to help determine GI values for products in those sectors.

The Compendium contains descriptions of the way the Framework could be implemented for Oil & Gas Production, Coal Production, Petroleum Refineries, and Electricity, and includes shorter modules for another 31 EITE sectors.

6. Responsibilities and Tasks for Administrative Agencies

There is no doubt that the effort to establish US domestic export rebates and import charges for covered GHG-intensive products will be significant for any approach to BAs, not just the one proposed here for BTAs based on a GGI. This is because of the large number of products to be covered, nations that export such products to the United States, and the challenge of obtaining reliable data, especially in nations currently without GHG reporting obligations for firms in EITE industries.

Previous efforts, now well established, that began in the late 1990s to develop GHG emissions reporting from facilities required a major, multi-year effort. Existing capabilities provide a strong foundation for the challenge of implementing BTAs.

To implement the proposed Framework there are tasks that must be managed by one or more administrative agencies that would need to be specified in legislation and regulation. No single agency currently performs all the tasks required to implement this Framework. These issues and others are discussed in more depth in a companion paper containing policy guidance for legislation and regulatory tasks required to implement the Framework.[39]

Here we provide a short summary.

We propose that the Treasury Department should establish a new office to lead implementation and management of the GHG tax and BTAs with substantial assistance from EPA and the Office of Enforcement and Compliance of the International Trade Administration at the Department of Commerce. As it has for many years, EPA would have an ongoing role overseeing procedures to measure and report GHG emissions from facilities and to account for inevitable changes as resources, technologies, processes, and products evolve. The Office of Enforcement and Compliance would be particularly useful in evaluating data submissions by foreign producers about their energy use, GHG emissions, and GGIs. Collection of the upstream GHG tax and disbursement of rebates should be assigned to the Department of the Treasury and Internal Revenue Service. Import charges should be collected by Customs and Border Protection. Determination of covered EITE sectors and products eligible for domestic rebates and import charges and development of procedures to determine the GGI for them, as well as the export rebates and import charges, should be the responsibility of the new office established to manage the Framework.

Activities associated with BTAs would include determining charges for imports and

39 **Policy Guidance for US GHG Tax Legislation and Regulation: Border Tax Adjustments for Products of Energy-Intensive, Trade-Exposed and Other Industries**, Brian P. Flannery, Jennifer A. Hillman, Jan W. Mares and Matthew C Porterfield, October 2020.

rebates for exports based on approved procedures and receiving information on covered products from affected firms and trade associations. This would also require periodic, likely annual, updates of required information recognizing that important changes may occur as technologies, practices and products of manufacturers evolve, and that these will also affect their suppliers (e.g., of electricity and commercial fuels).

Because the effort required to develop information and procedures to implement BTAs would be significant, we believe it will be advisable to phase in BTAs beginning with a "prompt start" based on available data and procedures for a subset of the most significant sectors and products. That can be followed with a "ramp up" period to improve and adjust information and procedures over time based on experience and to add additional sectors and products.

As a final note, we believe that the overall system to implement the Framework must include appeals processes that allow domestic and foreign firms to challenge US determinations of covered sectors, products, and their GGIs, since they provide the basis to award export rebates and impose import charges. This would include appeals of the GGI not only for their own products, but also those of domestic and foreign competitors, if they believe them to be inappropriate.

For the process to function effectively, it would be desirable for information on the GGI for products of domestic and foreign firms to be available as the basis for challenges. Furthermore, current US GHG reporting procedures do not include a requirement to certify reported GHG emissions. Because of their importance and financial implications, we believe that reported information on GHG emissions and GGIs for a firm's products should be subject to audit and sanctions for incomplete, negligent, or fraudulent information.

7. Summary and Conclusions

For decades, proponents and opponents of actions to address climate change have recognized that ambitious climate policies may shift production in EITE industries to nations with less stringent policies, resulting in leakage of GHG emissions and loss of business, jobs, and investment. These concerns continue under the Paris Agreement because national pledges—most extending to 2030—differ significantly both in stringency and types of policies they use to limit GHG emissions (see footnote 3). Proposed remedies typically rely on BAs with relief for exports and charges on imports. However, devising WTO-consistent BAs has proven to be challenging (see footnote 2). To avoid lengthy, potentially divisive battles between trading partners, it would be desirable to formulate domestic climate policies that are compatible with both WTO and UNFCCC obligations. The Framework proposed here does that.

The Framework proposal describes procedures to implement WTO-compliant BTAs in the context of an upstream domestic US GHG tax—an indirect domestic tax that can be allocated to products and can be rebated for exports and applied to imports (see footnotes 13 and 14). BTAs would be based on objective, internationally recognized methodologies to measure GHG emissions from facilities and operations of manufacturers in EITE and other covered industries.

However, to apply them to products traded in international commerce these methods require extensions as proposed here: 1) to include contributions to GHG emissions from suppliers of covered products and electricity utilized by specific manufacturers; and 2) to allocate GHG emissions from facilities of a given manufacturer to the specific products that they produce. The Framework does this using an administrative index: a GGI to track cumulative GHG emissions (those subject to the GHG tax) from suppliers to manufacturers of domestic products eligible for export rebates and to products imported from foreign nations.

In general, the Framework estimates emissions associated with specific products without having to examine each step in the sequence to produce the product. The first few, very energy-intensive steps usually account for the vast majority of GHG emissions in the entire production chain required to manufacture GHG-intensive products. Once those are accounted for, emissions for final products can be allocated using simple rules—for example, based on the carbon content of the processed fuel, or average emissions per unit weight of precursors incorporated in the final product, such as raw steel transformed to bars or pipes (see Compendium footnote 1). This simplification serves the dual environmental and administrative goals of reducing GHG emissions to limit risks from climate change without undue administrative burden.

The Framework covers not only CO_2 but also emissions of other significant GHGs covered by US regulations. This allows the GHG tax (in US$ per tonne CO_2) to be applied to the full set of emissions expressed as tonnes CO_2 equivalent (CO_2e).

As described in Section 3.5, the Framework also covers GHG-intensive products such as LNG, from a few other sectors that, for technical reasons, may not qualify as traditional EITE sectors. The Framework determines products eligible for export rebates and subject to import charges based on their GHG emissions intensity. Covered products are those with a GGI of at least 0.5 tonnes CO_2e per tonne of product, and, in the case of electricity, 0.25 tonnes CO_2e per MWh. Covered sectors are those that contain covered products. Such sectors include, but are not limited to, the 46 EITE sectors identified in the interagency report (see footnote 31). These thresholds appear to include the major commodity products of all EITE sectors and electricity produced from burning natural gas, coal and liquid petroleum fuels, plus a few other products such as LNG (which, for technical reasons, may not be listed in an EITE NAICS Code sector).

In the United States most of the information on GHG emissions required for the Framework is currently available and reported to EPA, though not all of it is published or communicated in suitable form. For example, neither federal regulation nor all states require that US electricity suppliers provide customers with information on the GHG emissions (CO_2e per MWh) associated with their purchase of electricity. Allocation procedures also require information on product slates (e.g., their amounts and composition). This is readily available, standard commercial information. Efforts will be required to design procedures to communicate information to regulators and customers and to develop agreed-upon procedures to allocate emissions to products.

There is a possibility for "gaming" that might be done to cherry pick products from the most or least GHG-intense facilities and operations of firms in specific nations, or from the lack of clear provenance in many cases. To avoid or at least minimize this, we propose that products exported by US companies, or those imported from foreign firms, should be assigned GGI values based on the average for the firm's entire domestic production of that product—or, if specific firm averages are not available, then based on the average for the entire national sector. This also serves the purpose of assuring for WTO-compliance that rebates for exports do not exceed the domestic tax paid for like products and that imports are not subject to internal taxes or charges in excess of those applied to like domestic products.

WTO rules require equal treatment of imports from all members (see footnote 13). Thus, the approach proposed here does not take account of and provide a credit for GHG policies, regulations, and costs already imposed in the exporting nation—which differ enormously among nations that trade with the United States. While this runs counter to many discussions of BAs, it also has additional advantages besides being WTO-compliant. In particular, it is extremely difficult to assess the "equivalent cost" of the portfolio of GHG policies used in many nations, let alone to allocate that cost to specific products.

For the United States and other nations that adopt it, in essence, this proposal fundamentally shifts costs to mitigate emissions connected to international trade from a system based on where goods are produced to one where they are consumed.

The Compendium (see footnote 1) discusses how the Framework would be applied in many EITE sectors. In particular, it provides detailed discussions for producers of coal, oil & gas, electricity, and petroleum refining and modules of varying length for 31 other EITE sectors. While much of the required information on GHG emissions appears to be available, it is not in the appropriate form in many cases and will require effort to develop approved procedures to allocate emissions to products and product slates of manufacturers.

A reason for publishing this proposed Framework is to help to lay the groundwork to implement it and to encourage US firms and trade associations in EITE and other covered sectors to proactively develop voluntary procedures to produce and share information on cumulative GHG emissions associated with manufacturing products (i.e., GGI). As with development of GHG emissions reporting that began in earnest in the 1990s, this effort will no doubt require effort to understand and find solutions for complications and challenges that will surely arise.

We have developed policy guidance for procedures that would allow implementation to proceed in phases (see footnote 39). This would commence with a "prompt start" based on available information and a subset of the most significant sectors and products, moving to full implementation via an "on ramp" to include the full range of covered sectors and products and to revise procedures based on initial experience.

Another matter to be resolved involves the timing of data available for use to evaluate GGI and facility emissions (see footnote 39). For example, annual GHG emissions reports to EPA by facilities must be filed by three months after year end. Timing issues (e.g., associated with delays in availability of final verified information) might be addressed by using estimated values initially to claim rebates and impose import charges that could be adjusted later once verified information is available.

International sectoral trade associations and multi-national companies can play an essential role building expertise and capacity in the United States and other nations by sharing their experience from efforts in many nations to develop internationally accepted procedures. Both will be invaluable to establish accepted procedures for internationally traded products. Voluntary pilot efforts—perhaps public-private partnerships—in this area would help suppliers, producers, competitors, customers, and regulators begin to understand the implications, challenges, and benefits of developing such an upstream approach for BTAs.

This information would also increase transparency with regard to national GHG policy. In particular, it would provide many actors with information that would inform their decisions and actions now. It would also inform citizens and consumers of the impact of the upstream tax paid only by a few businesses on the many downstream products purchased by consumers, e.g., plastics, glass, and gasoline.

Finally, the need to find WTO-compatible procedures for BAs is likely to grow as domestic and international climate policies evolve. The ambitious goals of the Paris Agreement will require rapid transformational change at a scale that is difficult to comprehend: one that will surely have growing implications and challenges for trade and investment. On the one hand, trade and international investment will need to work even more effectively than today to develop and deploy advanced technologies rapidly and on a vast scale. On the other hand, differing ambitions and policies are likely to exacerbate tensions associated with GHG leakage as well as jobs, trade, and investment. Developing policies and agreed-upon procedures that are compatible with both WTO and UNFCCC obligations will be essential to smooth the transition.

Appendix

Table 1. Factors in the Framework to Apply an Upstream Tax on Domestic GHG Emissions with WTO-Compliant Border Tax Adjustments: Rebates of Associated GHG Taxes for Exported Products and a Charge on Imported Products

Upstream GHG Tax rate applies to:

- The carbon content of products derived from produced fossil resources: coal, oil and natural gas, under the assumption that 100 percent of the embedded carbon in products will ultimately be emitted as CO_2 by end users.
- GHG process emissions that occur to extract and initially process natural fossil resources: coal, oil and gas (e.g., venting, flaring and leaking of associated gas, and combustion of portions of the resource to produce steam, heat, or electricity), and in some other EITE sectors such as CO_2 from calcination of limestone.
- Unit: US$ per tonne CO_2e, where CO_2e includes contributions from all covered greenhouse gases on an equivalent-CO_2 basis per unit weight.
- Note that the rate per tonne of Carbon would be larger by a factor 3.667 (simply the ratio by weight of CO_2 relative to carbon).

Greenhouse Gas Index (GGI) for Product P:

- For product P produced in an EITE sector by a specific manufacturer, the GGI denotes cumulative, taxed GHG emissions (CO_2e per tonne of product) along the entire supply chain to produce and, in the case of fossil resources, to utilize the product. It includes contributions of products purchased from EITE suppliers at a rate GGI for their product, GHG process emissions (if any) from on-site activities of the manufacturer, and the carbon content of products sold by producers of fossil resources: coal, oil, and natural gas.
- Unit: tonnes CO_2e per tonne of product, and for electricity: tonnes CO_2e per MWh.

Rebate and Import Charge for Product P:

- The Framework uses the average value <GGI> for a firm's entire domestic production of product P as the basis for US export rebates and foreign import charges (or the national sector-average if firm-specific information is not available). The rebate or import charge rate is given by the product <GGI> multiplied by the US GHG tax rate.
- Unit US$ per tonne of product; for electricity, US$ per MWh.
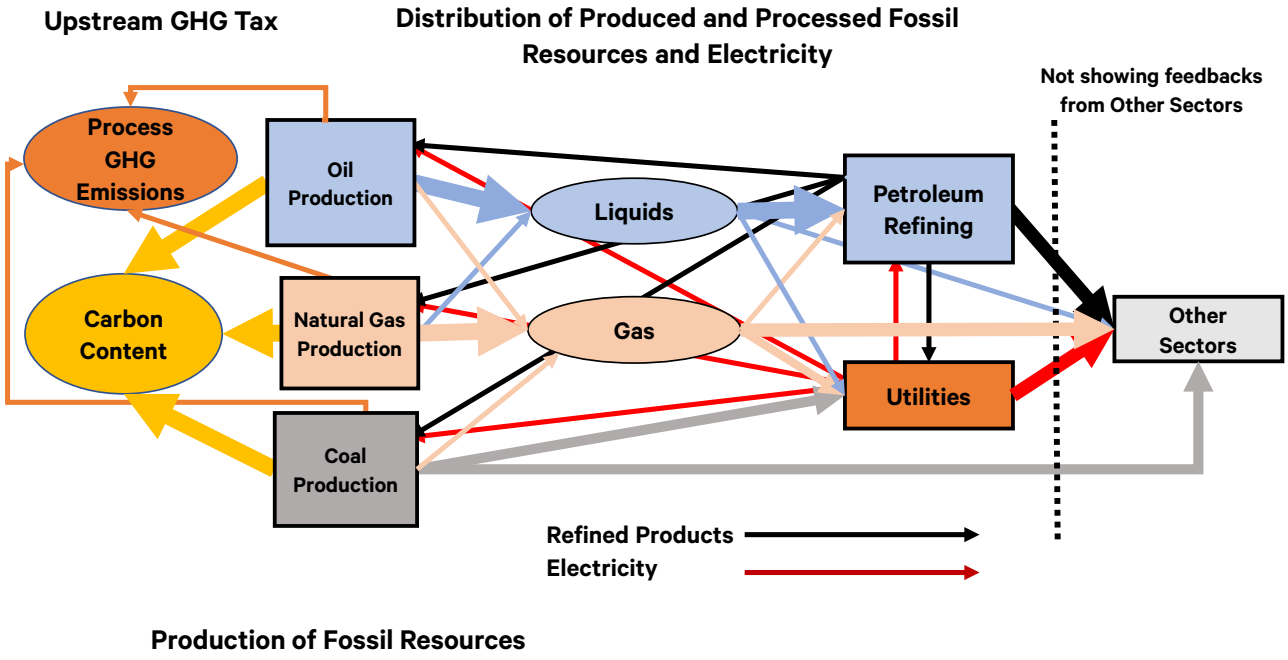
Figure 1. Illustrating the upstream tax on GHG process emissions and carbon content of the oil, gas and coal sectors that produce fossil resources, and exchanges of GHG-intensive products between them and the petroleum refining and electric utilities sectors