

RFF REPORT

---

# Framework Proposal for a US Upstream Greenhouse Gas Tax with WTO-Compliant Border Adjustments

Brian Flannery, Jennifer Hillman, Jan W. Mares, and  
Matthew Porterfield

MARCH 2018; REV OCT 2018

# Framework Proposal for a US Upstream Greenhouse Gas Tax with WTO-Compliant Border Adjustments

Brian Flannery, Jennifer Hillman, Jan W. Mares, and Matthew Porterfield\*

## Contents

<b>1. Introduction.....</b>	<b>1</b>
<b>2. Scene Set .....</b>	<b>2</b>
<b>3. Overview of the Framework .....</b>	<b>3</b>
3.1. Methodologies to Determine GHG Emissions .....	5
3.2. Issues in WTO Compliance .....	7
3.3. Upstream GHG Tax with Border Adjustments for Exports and Imports .....	8
3.4. WTO Rules and Border Tax Adjustments (A Deeper Dive) .....	11
3.5. Specification of EITE Industries and Information to be Reported .....	13
3.6. Border Adjustments in the Framework of a Cumulative Emissions Charge .....	15
<b>4. Cross Cutting Issues: Electricity, Co-Generation and Recycling.....</b>	<b>15</b>
4.1. Electricity.....	15
4.2. Cogeneration .....	16
4.3. Recycling .....	16
<b>5. Application of the Framework to Illustrative EITE Sectors .....</b>	<b>17</b>
<b>6. Summary and Conclusions .....</b>	<b>18</b>

---

\* Flannery: Resources for the Future (RFF) Visiting Fellow, [flannery@rff.org](mailto:flannery@rff.org); Hillman: Georgetown University Law Center; Mares: RFF Senior Advisor, [mares@rff.org](mailto:mares@rff.org); Porterfield: Harrison Institute for Public Law, Georgetown University Law Center.

Acknowledgements: The authors benefited enormously from discussions with representatives of a number of trade associations who helped us better understand circumstances in their particular sectors. However, nothing in this Framework report has been endorsed by them, nor was any endorsement sought from associations. We are grateful for assistance in analyzing WTO-related legal issues from students at Georgetown Law School: Ngo Chin, Mikaela Zhiying Feng, Kara McDonough, Joshua Newton, Xiushan Sun, Alana Toabe, and Airane Yvon. Their contributions were supported in part by the Harrison Institute for Public Law and a grant from Resources for the Future.

© 2018 Resources for the Future (RFF). All rights reserved. No portion of this report may be reproduced without permission of the authors. Unless otherwise stated, interpretations and conclusions in RFF publications are those of the authors. RFF does not take institutional positions. RFF is an independent, nonprofit research institution in Washington, DC. Its mission is to improve environmental, energy, and natural resource decisions through impartial economic research and policy engagement.

## 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 utilize a portfolio that typically includes a mix of standards, subsidies, mandates and price-based policies, each directed at particular economic sectors. In view of obvious inefficiencies and lack of synergies resulting from the portfolio approach, economists and many others have convincingly 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 production and use of fossil fuels by applying the tax on producers of coal, oil, and gas resources at the mine mouth and wellhead 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 the political process, to identify and implement the most cost-effective steps to reduce emissions through decisions that affect current operations and purchases, and through decisions now about investment, 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 for exports and imports in the context of a domestic upstream GHG tax, as described below.

The domestic GHG tax could cause energy-intensive industries to shift production 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 by many to introduce border adjustments: through the imposition of equivalent GHG pricing on imported products from energy-intensive, trade-exposed (EITE) industries, and by providing rebates from the impact of the upstream tax on the cost of products exported by domestic producers. However, doing this has raised concerns about consistency with rules of the World Trade Organization (WTO).

Here we propose a Framework for a US climate policy with border adjustments that are compatible with US obligations under WTO agreements. It is based on an upstream tax on GHG emissions with rebates for exports and charges on imports for products from EITE industries. A companion Compendium<sup>1</sup> (forthcoming) provides additional details on implementing border adjustments with specific recommendations for 35 EITE industries. Proposed border measures are designed in a non-discriminatory fashion, with the intent and effect of reducing global GHG emissions. Therefore, the border adjustments proposed as part of the Framework will not give rise to any valid claims of WTO violations. Even if such

---

<sup>1</sup> 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 (forthcoming).

claims should be raised, a strong defense could be made under the exceptions to the WTO rules.

Issues in the design of border adjustments 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. While climate policies have the potential to create trade disputes, if they occur, they will be resolved through the WTO, which has the authority, experience and tools to resolve them, not through the UNFCCC, which does not. To avoid lengthy, 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, particularly compliance with WTO obligations, can be complicated.<sup>2</sup> In particular, proposals that argue for trade remedies based on environmental exceptions under the WTO, (e.g., to prevent GHG leakage), would not be allowed if they resulted in 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 many sectors, e.g., how to treat electricity, cogeneration and recycling; Section 5 illustrates how the Framework applies to EITE sectors including some that present unique

features; Section 6 presents a summary and conclusions. A companion Compendium to this report is forthcoming and will provide an overview with 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.

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. We note that revenues would be significant even at levels under discussion to initiate such a tax and they 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. Rebates would likely reduce income from domestic revenues by at least \$20 billion per year. These estimates are dominated by fossil fuel resources and products. 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 domestic GHG tax.

## 2. Scene Set

The seeds of this challenge were planted in the 1980s as nations began to consider how to frame 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

---

<sup>2</sup> See Addressing Competitiveness Concerns in a Carbon Tax: What Are the Options? (October 27, 2015) and references mentioned.

<http://www.rff.org/events/event/2015-10/addressing-competitiveness-concerns-carbon-tax-what-are-options>

domestic and international climate policies could hinder their overriding priorities for economic development and poverty alleviation, and 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: 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 (1992) and, later, the Kyoto Protocol (1997), both require only developed nations to take commitments to limit GHG emissions. Despite enormous changes in geopolitical 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 (2015) pledges for national action prolong (at least through 2030) and reinforce differences among nations both in stringency and types of policies they use to limit GHG emissions. In this respect, challenges exist not only between developed and developing nations, but also from growing differences

among developed nations (as highlighted by withdrawals from the Kyoto Protocol's second commitment period, and recently by the announced intention of the United States to withdraw from the Paris Agreement, possibly contingent on further developments). Important differences also exist that create challenges among developing nations. If, in pursuing the very ambitious long-term goals of the 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<sub>2</sub>) from combustion of fossil fuels. In the United States, energy-related CO<sub>2</sub> emissions account for over 80 percent of total GHG emissions. While overall economic impacts of climate policy 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, Canada). This is especially so for EITE industries, that include oil & gas, chemicals, steel, aluminum, cement, plastics, and paper.

### 3. Overview of the Framework

There are several elements to the Framework. They include: Section 3.1 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 issues to be addressed to be compatible with WTO; Section 3.3 descriptions of the upstream GHG tax and associated rebates for products that are exported and charges on imported products; Section 3.4 WTO rules and border tax adjustments (BTA), a deeper dive; Section 3.5 specification of EITE industries and information to be reported; and Section 3.6 border adjustments determined in a manner analogous to the familiar value-added tax

(VAT), but here applied to cumulative GHG emissions. (To avoid any confusion: note that the upstream GHG tax itself is not a VAT. The value-added concept uses cumulative GHG emissions as an administrative index to track costs generated by the upstream GHG tax as they flow through the economy to affect downstream suppliers, producers and customers.)

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<sub>2</sub> but also emissions of other significant GHGs covered by US regulations. These include methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), HFCs, PFCs and SF<sub>6</sub>, which can be especially important for some sectors. Regulations provide factors<sup>3</sup> that denote the contribution of each gas relative to CO<sub>2</sub> by weight. This allows the GHG tax (in US\$ per tonne CO<sub>2</sub>) to be applied to the full set of emissions expressed as tonnes CO<sub>2</sub>-equivalent (CO<sub>2</sub>e).<sup>4</sup>

Throughout the discussion it is important to recognize distinctions between existing GHG policies and methods that address and apply to emissions from facilities and operations of manufacturers—in the context of GHG taxes, cap-and-trade systems, and emissions reporting—rather than the perspective required in this Framework for border adjustments that apply to specific products of firms in EITE sectors. This requires two extensions beyond current

practice: first, to specify how GHG emissions from upstream suppliers and on-site operations contribute to determine cumulative GHG emissions required to produce products; and second, to determine how GHG emissions from entire facilities (and operations) can be apportioned to the products they produce.

The Framework addresses these issues by defining an index for the cumulative GHG emissions of specific products manufactured in a specific facility in an EITE industry—a greenhouse gas index (GGI).<sup>5</sup> GGI for products from specific manufacturers includes contributions from: 1) inputs (GGI) from products purchased by the manufacturer from suppliers in EITE 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. The carbon content of produced fossil resources is determined at the wellhead for oil and gas and at the mine mouth for coal—the contribution from contained carbon is converted into CO<sub>2</sub> emissions under the assumption that 100 percent of the carbon will be emitted as CO<sub>2</sub> upon combustion by downstream users. These contributions embody an approach analogous to that used in VAT: here based on following GHG emissions that occur along the supply chain to produce and, in the case of the carbon content of fossil fuels, the tax is prepaid for administrative convenience before later combustion of fuel products. Following cumulative emissions provides an effective administrative tool to track the economic impact of the upstream tax on downstream

<sup>3</sup> 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.

<sup>4</sup> 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).

<sup>5</sup> In light of further exploration of this topic in the accompanying Compendium (published in October 2018), we have decided to use this term and related shorthand, GGI—a switch from the acronym used (PCGE) throughout the originally published version of this Framework report in March 2018. This file has been updated to reflect the change throughout.



users. While the GHG tax is paid only for process emissions from any sector and for the carbon content of fossil resources, the economic impact of the tax flows through the chain linking suppliers, producers and customers to affect the entire economy. GGI is a useful administrative tool to follow added costs of products that suppliers charge their customers (based on applying the GHG tax rate to GGI).

In this Framework, products to be exported would be eligible for rebates determined by the rate (in US\$ per tonne of product): (GGI) times (GHG tax). For imported products, GGI (as determined for foreign producers) provides the basis for the import charge by applying the US GHG tax (see Table 1). This is discussed further immediately below in general, and for specific sectors at length in Section 5 and with examples for many EITE sectors in the Compendium (see footnote 3).

The Framework determines rebates for exported products and charges on imported products using the same approach for both. When a specific manufacturer in an EITE sector transforms products from many suppliers into new products, they must reallocate the total cumulative GHG emissions from all inputs plus GHG emissions from on-site operations (if any) to the determine cumulative GHG emissions (GGI) for products they produce.

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, oxygen, and hydrogen. 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<sub>2</sub> occur as an inevitable byproduct. Indeed, in some limited commercial applications CO<sub>2</sub> is separated from flue gas and sold as a product.

Several sectors generate additional GHG emissions from extraction and processing of resources, for example from calcination of lime and from venting, flaring or leaks of associated gas produced during extraction and processing of natural gas and crude oil. Emissions depend heavily on the particular natural resources, commercial energy sources and technologies used to create inputs from suppliers and 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 imports from EITE firms and industries can be determined based on information available from regulatory reporting procedures which exist in many nations, or 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 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 also developed voluntary GHG measurement and reporting guidelines that have been endorsed by international industry associations (e.g., see

WRI/WBCSD GHG Protocols).<sup>6</sup> 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, e.g., in Corporate Annual Reports and as a basis for voluntary submissions to the Carbon Disclosure Project. 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. Methods account for operational emissions (often referred to as Tier 1) from activities to produce natural resources (e.g., to extract and process coal, oil and gas) and manufacturing activities to produce specific products or product slates including from the use of commercial fuels. They also account for indirect emissions, e.g., from purchased electricity (Tier 2). 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,<sup>7</sup> 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 EITE products are typically multi-national companies with the expertise and capacity to utilize these guidelines in nations without regulatory protocols.

Methodologies and issues will be discussed in greater detail below, and 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 to produce products, and second, to allocate the share of emissions assigned to specific products of a given producer’s facilities. In general, we find that it is possible to estimate these emissions 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, emissions for final products can be allocated using simple rules, e.g., based on the carbon content of the processed fuel, or average emissions per unit weight of precursors incorporated in the final product, e.g., raw steel transformed to bars or pipes. In this respect, the approach is analogous to the logic of applying border adjustments only to EITE industries with significant emissions, rather than to exports and imports from all sectors and their products, e.g., automobiles and laptop computers. 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, fuels distributed in a pipeline may originate from different refineries of many companies, and a given manufacturer may produce identical products in several plants that utilize electricity from sources based on renewables, nuclear, gas or coal. US exporters

---

<sup>6</sup> 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>

<sup>7</sup> Mark A. Cohen and Michael P. Vandenbergh (Energy Economics 34 (2012) S53–S63: *The Potential Role of Carbon Labeling in a Green Economy*.



would have an incentive to claim rebates for products sourced from their most GHG-intensive 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. To avoid “gaming” that might be done in these cases, and in recognition of the lack of clear provenance in many cases, we propose that products exported by US companies should be assigned emissions 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 US sector. Similarly, we would assign emissions for imported products based either on the average emissions 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<sup>8</sup> 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. Nonetheless, they provide national 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 border adjustments for products from EITE industries is based on providing a rebate for exports by US manufacturers and applying a charge on imports from foreign firms. Both the rebate and import charge are determined by applying the US GHG tax rate (in \$ per tonne CO<sub>2</sub>e) to GGI: Cumulative GHG Emissions resulting from process emissions during production and (in the case coal, oil and natural gas) the carbon content of the produced resource.

The border adjustment process has been designed to satisfy several criteria:

- Rebates and import charges are determined in the context of the indirect domestic tax on GHG emissions associated with the product;
- Import charges are applied without discrimination based on national origin;
- Objective international standards are used to determine domestic rebates for exports and border charges on imports;
- Rebates for products do not exceed the amount of the indirect domestic tax;
- Import charges on products do not exceed the amount of the indirect domestic tax on like products.

---

<sup>8</sup> See <http://www.ipcc-nggip.iges.or.jp/index.html>. The development of the new Methodology Report to refine the current inventory guidelines (*2006 IPCC Guidelines for National Greenhouse Gas Inventories*), is being carried out by the Task Force on National Greenhouse Gas Inventories (TFI) in accordance with the decision taken at the 44th Session of IPCC in Bangkok, Thailand, in October 2016. The final draft of this new Methodology Report titled “*2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*” (*2019 Refinement*) will be considered by the IPCC for adoption/acceptance at its Plenary Session in May 2019.

WTO rules allow nations to provide rebates for the cost of indirect taxes on products and to apply a charge to imports that is not in excess of the indirect tax on domestic producers. This Framework does not address environmental exceptions under the WTO, but we believe that it should be compatible with them—this will be addressed in a companion report. The environmental exceptions cannot be used if, in fact, border adjustments were implemented in a manner that constitutes arbitrary or unjustifiable discrimination between countries where the same conditions prevail or that is a disguised restriction on trade. Arguments have been made that some procedures proposed and even implemented to address border issues in some nations jeopardize their WTO compatibility.

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 US. While this runs counter to many discussions of border adjustments, it also has advantages. In particular, it is extremely difficult to assess the actual cost of GHG policies in many nations, let alone their cost to specific products. No nation yet applies the economist’s ideal policy—and the one assumed in this proposal—of an economy-wide tax on all GHG emissions: an actual GHG “price.” Most nations, including the US, 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 on the facilities in some sectors. Evaluating the cost 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 allowances for various EITE industries. Such credits run the risk of violating Most Favored Nation principles of

non-discrimination on the basis of national origin of imports.

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 firms that export to the US. Indeed, if the United States adopted this approach it might encourage other nations also to adopt the more efficient GHG tax as a basis to facilitate exports to the United States and other nations that adopt this approach.

As stated above, 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.

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

In the US, but not in all nations, the majority of GHG emissions (over 80 percent) occur as CO<sub>2</sub> 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, such as methane, nitrous oxide, HFCs, PFCs and SF<sub>6</sub>, must also be addressed. Indeed, the upstream GHG tax should also apply to activities that generate significant GHG emissions, such as land use change, that are not EITE sectors.

In our Framework, the direct statutory incidence of the upstream tax falls only on a few EITE sectors: producers of coal, oil and natural gas and a few others, but all sectors experience its economic consequences based on their use of fuels, electricity and, in some cases, other energy-intensive inputs such as oxygen and hydrogen. 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-intensive 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 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. Nonetheless, as a policy for GHG regulation, in analogy with VAT, we require that producers determine and pass through to their customers GGI (tonnes CO<sub>2</sub>e per tonne of product and tonnes CO<sub>2</sub>e per MWh for electricity) for products they sell. In this framing, it is important to distinguish between the GHG tax paid by those EITE manufacturers that emit GHGs in their on-site production processes (and producers of coal, oil and gas for the carbon content of produced resources) and the amount eligible for rebates to all EITE firms that export. The latter includes both the GHG tax (if any) paid by the producer of exported products, and also the cumulative GHG emissions GGI passed-through the supply chain leading to products purchased by the manufacturer, e.g., from purchased coal, crude oil and natural gas, electricity, commercial fuels and energy-intensive materials they use. GGI builds up over the supply chain in a straightforward analogy to similar methods used for VAT as described in Section 3.6 below.

### *Upstream GHG Tax*

Only a few EITE sectors, notably coal, oil and gas producers, directly pay 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 direct tax because they emit CO<sub>2</sub>

from processing limestone or alumina 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 to produce electricity or for other purposes. The tax is prepaid on the carbon content of fossil resources as they are produced at the mine-mouth for coal and wellhead for oil and gas. Process emissions subject to the GHG tax also occur from upstream operations to produce coal, oil and gas during extraction and initial processing of the natural resources, for example, from venting or flaring of associated gas and fugitive emissions from leaks. Unlike border adjustments that must be defined for specific products, the upstream GHG tax applies to process emissions from entire upstream facilities and operations, and to the carbon content of produced fossil resources.

An offset fee, paid at the same rate as the GHG tax, would be available to manufacturers who capture CO<sub>2</sub> emissions from fossil fuels and permanently store them as part of Carbon Capture and Storage (CCS) operations. “Permanent” storage will be defined by permitting procedures for CCS that will have to address the potential for leakage over periods ranging from centuries to longer. The Framework 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 setting agreed criteria for “durable.”

### *Rebates for Exported Products*

The methodologies described above (Section 3.1), provide objective information to assess GHG emissions from facilities and operations in EITE industries, and to consolidate results to determine firm or sector-wide average emissions. In the United States, such information has been available for many years and provides 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 entire facilities to the

products they create. In situations, such as a steel mill or petroleum refinery, where a plant produces an entire slate of products, 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 require separate approaches. In any case, existing methods can be extended to provide information to determine how facility-wide emissions and cumulative GHG emissions from suppliers would be apportioned across the portfolio of products they produce—although this almost certainly will require effort by firms, trade associations and regulators to develop appropriate, agreed information and procedures in EITE sectors, as discussed below.

The Framework calls for the use of firm-wide or, in the absence of firm-wide data, sector-wide national averages to determine the amount of a potential BTA. 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), it appears to be more appropriate to use domestic averages for an entire firm. This requires the firm to roll up average cumulative emissions GGI for their domestic production of each exported 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 value associated with cumulative GHG emissions of producers (US GHG tax times GGI for the product). Firm-wide averages could simplify the issues associated with provenance of exported products.

Note that, even at a modest starting level of \$20 per tonne CO<sub>2</sub>, the scale of domestic GHG taxes, export rebates and import charges would be very significant. With respect to taxes on fossil resources, in 2016 US energy-related CO<sub>2</sub> emissions (approximately 5.2 billion tonnes CO<sub>2</sub>) would have yielded revenues of 100 billion US\$. 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 five 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 US\$ and import charges 40 billion US\$. Thus, responsible administrative agencies would be processing domestic taxes, rebates and import charges of many billion US\$ per year.

#### *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 that do not discriminate against any nation, nor favor domestic producers over imports. The charge for products of a given firm would be assessed on exported products based on the national average for emissions GGI (in CO<sub>2</sub>e per tonne) from the entire domestic production of that product by the firm, or on the national average for the entire sector if firm-specific averages are not available. As described above in Section 3.1, a variety of internationally accepted methodologies exist to determine GHG emissions and they are essentially similar in their provisions. Moreover, many, but not all, nations have already implemented regulatory requirements to report GHG emissions by EITE industries. The same approach applied to US domestic manufacturers in a given sector, would be used to allocate emissions to their product slate, yielding CO<sub>2</sub>e emissions per tonne of product exported to the US.



The border charge would impose the US GHG tax rate to products imported from other nations based on cumulative GHG emissions (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 exporting country would be estimated and used to create import charges. Estimating and assigning emissions to imported EITE products (e.g., default national averages or values for specific production processes and commercial fuel and electricity use) will be central in determining the import charge for such products.

### **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 also be imposed or rebated on manufactured goods that incorporate the product—including energy inputs—that is 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.

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 (SCM Agreement) 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.<sup>9</sup> 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, 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 SCM Agreement generally prohibits export subsidies,<sup>10</sup> the prohibition does not apply to the rebate of taxes imposed on “like” domestic products that are consumed domestically.<sup>11</sup> Annex I contains an “Illustrative List of Export Subsidies” that includes “(g) the exemption or remission, in respect of the production and distribution of exported products, of indirect taxes *in excess*

<sup>9</sup> 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 at [https://docs.wto.org/dol2fe/Pages/FE\\_Search/FE\\_S\\_S009-DP.aspx?language=E&CatalogueIdList=6608&CurrentCatalogueIdIndex=0&FullTextHash=&HasEnglishRecord=True&HasFrenchRecord=True&HasSpanishRecord=True](https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S009-DP.aspx?language=E&CatalogueIdList=6608&CurrentCatalogueIdIndex=0&FullTextHash=&HasEnglishRecord=True&HasFrenchRecord=True&HasSpanishRecord=True).

<sup>10</sup> See SCM Agreement, Article 3.1 (prohibiting subsidies contingent on export performance).

<sup>11</sup> See SCM Agreement, 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.”)



*of those levied in respect of the production and distribution of like products when sold for domestic distribution.”*

“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.”<sup>12</sup> This provision indicates that the remission of taxes on fossil fuels “used in the production and distribution” of exported EITE products would be permissible so long as the remission was not “in excess of” the taxes levied on products if they were sold for domestic use.

Paragraph (h) of Annex I even more explicitly permits rebates of taxes on energy inputs into exported products with regard to “prior stage-cumulative indirect taxes” (PSCI taxes).<sup>13</sup> “Cumulative” indirect taxes are defined as “multi-staged” taxes that are not credited at subsequent stages of the production process.<sup>14</sup> PSCI taxes may be remitted if they are “levied on inputs that are consumed in the production of the exported product....”<sup>15</sup> Inputs that are consumed in the product process include not only inputs that are

“physically incorporated” into the exported product, but also “energy, fuels and oils used in the production process....”<sup>16</sup> Accordingly, depending on how an upstream tax on fossil fuels was structured, it could be rebated on downstream exported products from EITE sectors under paragraph (g) or (h) of the SCM Agreement so long as the export rebate is not “in excess” of the taxes paid upstream.

Here, the proposed structure of the domestic tax—applied both at the wellhead or mine mouth on coal, oil and gas (and therefore paid by upstream producers) and applied to (and paid by) the limited number of EITE industries that emit CO<sub>2</sub> in their production process—raises a number of complications regarding the export rebate. With respect to the upstream tax on coal, oil and gas, the complication is raised by the fact that rebates are permitted for taxes “borne by the product” while the EITE products will only indirectly bear the tax through increased costs for electricity produced using coal, oil or gas. Moreover, because the tax is paid once at the wellhead or mine mouth, difficulties may arise in demonstrating that the tax is “cumulative” for purposes of falling under the permission

<sup>12</sup> SCM Agreement, n.58.

<sup>13</sup> Footnote 58 defines “prior-stage” indirect taxes as “those levied on goods or services used directly or indirectly in making the product,” which would describe taxes on fossil fuels used in making EITE exported products. The inclusion of taxes on services indicates that there is no requirement that the prior stage tax be levied on goods that are physically incorporated in the exported product.

<sup>14</sup> SCM Agreement, n.58.

<sup>15</sup> SCM Agreement, Annex I, para. (h).

<sup>16</sup> SCM Agreement, n.61. The An earlier version of the SCM Agreement—the 1979 Subsidies Code—permitted export BTAs for PSCI taxes only when the taxes were imposed on inputs that were “physically incorporated” into the exported product. The relevant language in paragraph (h) was modified during the Uruguay Round negotiations to permit the remission of taxes on inputs—including energy and fuels—that were “consumed in the production of the exported products.” The change was made in response to a proposal by India, which argued that permitting the rebate only of taxes on physically incorporated inputs “places at a disadvantage countries with multi-stage cumulative tax systems vis-à-vis those with value added tax systems [covered under paragraph (g)] as in the latter, there is no impediment to the exporter collecting full credit for all prior stage taxes paid on inputs.” WTO Secretariat, *Negotiating History of Footnote 61 of the Agreement on Subsidies and Countervailing Measures*, para. 10, WT/CTE/W/16 (Dec. 1, 1995).

provided in paragraph (h) of Annex I.<sup>17</sup> However, the concern of these provisions is to ensure that subsidies are not hidden through rebates for unseen inputs. It will thus be critical to structure the export rebate in a transparent manner and to ensure that the amount of the rebate does not exceed the amount of the charge effectively imposed on domestic products.

#### *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.<sup>18</sup> Under Article II:2, 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, like the SCM Agreement, permits the border adjustment of prior stage taxes on inputs to products that are traded internationally.

Article III of GATT similarly recognizes the ability of governments to border adjust on imports taxes that are imposed on inputs used in producing competitive domestic products.

BTAs pursuant to GATT Article II:2 must comply with Article III:2,<sup>19</sup> which states that imported products “shall not be subject, *directly or indirectly*, to internal taxes or other internal charges of any kind in excess of those applied, *directly or indirectly*, to like domestic products.”<sup>20</sup> The reference to taxes imposed “indirectly” encompasses taxes on “raw materials used in the product during the various stages of its production.”<sup>21</sup> As with export BTAs under the SCM Agreement, imports BTAs under GATT may not be imposed in a discriminatory manner—i.e. “in excess” of the taxation imposed on like domestic products.<sup>22</sup>

### **3.5. Specification of EITE Industries and Information to be Reported**

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. Nearly a decade ago, H.R. 2454 (the Waxman-Markey Cap-and-Trade legislation) included criteria to determine US industrial sectors eligible for relief in international trade under that cap-and-trade proposal and based on GHG emissions from facilities and operations, not products. An interagency task force led by EPA then identified 46 sectors<sup>23</sup>

<sup>17</sup> Cumulative taxes are generally thought of as multi-stage taxes levied where there is no mechanism for subsequent crediting of the tax if the goods or service subject to the tax at one stage of production are used in a succeeding state of production. See, A. Hoerner and F. Muller, *Carbon Taxes for Climate Protection in a Competitive World*, prepared for the Swiss Federal Office for International Economic Affairs (June 1966), at 36.

<sup>18</sup> See GATT Article II:1.

<sup>19</sup> Under GATT Article II:2, charges levied on imported products must be imposed “consistently with the provisions of paragraph 2 of Article III...”

<sup>20</sup> GATT Article III:2 (emphasis added).

<sup>21</sup> 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).

<sup>22</sup> If an import BTA were held to be inconsistent with GATT Articles II or III, it could still be permissible under Article XX, which provides exceptions for measures that are “necessary to protect human, animal or plant life or health” (XX(b)) and measures “relating to the conservation of exhaustible natural resources . . .” (XX(g)). As discussed above, however, a properly designed BTA should be permissible without recourse to Article XX.

<sup>23</sup> The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-

within the North American Industry Classification System (NAICS) that were presumptively eligible.

The Framework here requires additional information from EITE sectors beyond what was required for H.R. 2454, and requires information from additional sectors to track cumulative GHG emissions from producers to their products across the entire supply chain. Consequently, the Framework includes Oil & Gas Production, Petroleum Refining, Coal Production and Electricity as covered EITE sectors. There are several reasons to include them. First, each of them creates products that are exported from and imported to the United States and each of them are energy-intensive. 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, and most importantly, the Framework requires additional information on emissions of these and the other EITE sectors. To implement the Framework as applied to products, producers will need to know the cumulative GHG emissions (GGI) for inputs from their suppliers, and to determine and communicate them for products they sell.

Most of the information required is currently available, 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 GGI (in this case: CO<sub>2</sub>e per MWh)—although that information is submitted to and published by the US EPA. 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.

Facilities and operations in US EITE sectors already report a great deal of the information necessary to implement the Framework. Industrial facilities and power plants are required to report GHG emissions (and other information) to the US EPA. This information for facilities is available at EPA's web sites for the Greenhouse Gas Reporting Program<sup>24</sup> and for power plants at The Emissions & Generation Resource Integrated Database (eGRID).<sup>25</sup> However, sectors and regulators will need to consider what, if any, additional information and allocation methods would be needed to apply available information on GHG emissions for facilities to determine GGI for the products they produce, and how to provide that information to customers, primarily business-to-business customers, to implement the Framework.

One of the reasons for this study is to help to lay the groundwork to implement the Framework and to encourage US firms and trade associations in EITE sectors (as defined here in Section 3.5) to develop voluntary procedures to produce and share information on cumulative GHG emissions. 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 border adjustments. 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 that would inform their decisions and actions now. The information on

---

Intensive Trade-Exposed Industries (December 2, 2009).

[https://www.epa.gov/sites/production/files/2016-07/documents/interagencyreport\\_competitiveness-emissionleakage.pdf](https://www.epa.gov/sites/production/files/2016-07/documents/interagencyreport_competitiveness-emissionleakage.pdf)

<sup>24</sup> <https://ghgdata.epa.gov/ghgp/main.do>

<sup>25</sup> <https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid>

cumulative GHG emissions (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., gasoline)—though not everyone will regard this as a good idea.

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

Table 1 (discussed above) explains the terms and definitions in the proposed Framework to account for upstream cumulative GHG emissions along the supply chain leading to products in EITE sectors, and how they can be used for rebates on exported products and to impose charges on imports.

The following example from petroleum fuel products makes clear that 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 carbon that would release 8.89 kg of CO<sub>2</sub> upon combustion; while a gallon of jet fuel contains 2.61 kg carbon that would release 9.57 kg of CO<sub>2</sub><sup>26</sup> (these values are for petroleum fuels without added biofuel). GGI includes contributions from a refinery's process emissions (if any) and from inputs to the refiner from other manufacturers, e.g. crude oil, electricity and commercial fuels. These can differ significantly depending on how crude oil was extracted, processed and transformed into a product slate. Life cycle analyses<sup>27</sup> show that, on average in the US, emissions (CO<sub>2</sub>e) associated with production and refining of crude oil add another 20 percent (1/3 from production, 2/3 from

refining) to those from combustion of petroleum fuels, while in Canada production and refining of oil sands on average adds 30 percent. So, on average, GGI for gasoline or other finished products would be at least 20 percent higher than a value based solely on its carbon content. Moreover, 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, 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.

## **4. Cross Cutting Issues: Electricity, Co-Generation and Recycling**

This section describes, in general, how the Framework addresses three important cross-cutting issues that affect nearly every EITE sector: electricity, co-generation and recycling.

### **4.1. Electricity**

Because every EITE 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. To date, discussions of border adjustments 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. This is incorporated in

<sup>26</sup> For a convenient list of fuels and emissions see: [www.rff.org/blog/2017/calculating-various-fuel-prices-under-carbon-tax](http://www.rff.org/blog/2017/calculating-various-fuel-prices-under-carbon-tax)

<sup>27</sup> 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>

the Framework by including electricity as an EITE sector. In practice, the key to implementation is to require that electricity suppliers provide the relevant information: GGI (CO<sub>2</sub>e per MWh) to their customers. Information on direct emissions from power plants (CO<sub>2</sub> per MWh, not CO<sub>2</sub>e) is already reported to the EPA by suppliers (as described above in Section 3.5); however, electricity suppliers are not currently required to communicate that information to their customers. For this Framework, as described in the previous section, electricity suppliers would need to know and report not only the carbon content of their fuels, but also the cumulative GHG emissions required to produce them. For this reason, we would require electricity suppliers (like all other EITE suppliers) to determine and communicate cumulative emissions GGI to customers, especially those in other EITE industries.

## 4.2. Cogeneration

Combined heat and power, presents an opportunity and a challenge. The opportunity exists because operations in many EITE sectors require copious amounts of process heat to carry out transformations. Once generated to supply the heat necessary for its primary purpose, e.g., generation of steam for use in several processes throughout the facility, in many settings the residual, otherwise wasted heat can be used to co-produce electricity that can then be used in the facility or, when regulations allow it, sold for use by others outside the facility. Cogeneration dramatically improves the overall, combined energy efficiency to produce steam and electricity, compared with producing them separately. The challenge arises because of ambiguity about how to determine the emissions from co-generation facilities and, even more, how to allocate them among products, e.g., electricity and steam.

When a facility such as a refinery implements cogeneration, 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 the cogeneration facility is not managed to optimize profit from its ability to produce 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 and electricity acquired to meet the needs of the entire facility. In this situation, it seems appropriate to consider treating 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, or the inputs from purchased fuels and electricity, should be allocated to the product: electricity sold by the refinery; all of them should be allocated to the slate of petroleum products produced by the entire refinery.

The situation would be entirely different for a stand-alone cogeneration 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 producer should be required to obtain GGI indices for purchased inputs and to specify the basis to allocate them to products it sells to others.

## 4.3. Recycling

Many EITE sectors, e.g., steel, aluminum, pulp and paper, make extensive use of recycled materials. Typically, these require far less energy to be transformed into new products than is required to convert fresh raw materials. However, the gathering process is such that recycled materials from many sources may be combined in such a way that it is impossible to determine their provenance. Consequently, there may be no reliable way to determine values GGI for them. Accordingly, in most cases we recommend that a single US national average should be assigned to recycled materials. However, in some situations other approaches may be



preferable—details are discussed for several sectors in the Compendium.

## 5. Application of the Framework to Illustrative EITE Sectors

This section discusses procedures to determine GHG taxes, and cumulative GHG emissions, export rebates and import charges for products in EITE 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, process emission from operations in EITE sectors and the cumulative emissions index: GGI) appears to be available, although not necessarily in convenient or appropriate form. As discussed above this is analogous to the approach used with VAT to track that tax. As an administrative procedure, the Framework determines cumulative GHG emissions using GGI for specific products from specific manufacturers and combines them to determine a national average  $\langle \text{GGI} \rangle$  for the firm's entire domestic production from all its facilities. If the product is exported, then  $\langle \text{GGI} \rangle \times (\text{US GHG tax})$  is the rate (US\$ per tonne) for the rebate. Similarly, for imported products of a specific foreign manufacturer, their domestic average  $\langle \text{GGI} \rangle$  is the basis for the import charge rate:  $\langle \text{GGI} \rangle \times (\text{US GHG tax})$ ; however, if firm-specific information is not available, then an average for the product based on the entire EITE sector will be used for the import charge.

For each sector, the Framework applies to specific manufacturing facilities and operations in the same way. A manufacturer transforms inputs, i.e., products, from a variety of suppliers into new products that will be sold to customers. The approach requires the manufacturer to determine total cumulative GHG emissions: GHG Total (in tonnes CO<sub>2</sub>e), from all inputs and the emissions (tonnes CO<sub>2</sub>e) implied by GHG taxes paid (if any) to operate the facility, i.e., Total Tax divided by GHG charge rate. (Keep

in mind that upstream producers of fossil resources “pre-pay” the GHG tax for emissions that will later occur from processing, e.g., by refiners, and combustion by end-users of fuels.) 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 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<sub>2</sub> 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 for cumulative GHG emissions from suppliers and manufacturers to GGI for products in some sectors and to resolve associated issues, e.g., with cogeneration and recycling. Work will be required to determine 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.

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. In every case there are elements that must be managed by one or more administrative agencies that would need to be

specified in legislation to implement the proposed Framework. In view of the significant sums involved and the close link to the upstream GHG tax, collection and disbursement of import charges and rebates should be assigned to the Treasury Department and Internal Revenue Service. Because of its extensive involvement with trade issues, tariffs, domestic and foreign companies and foreign governments, including via investigations carried out in foreign countries, the most logical US federal agency to administer these border adjustment methodologies is the Office of Enforcement and Compliance, International Trade Administration, Department of Commerce. Activities associated with border adjustments would include determining charges for imports and rebates for exports based on approved procedures and receiving information on covered products from affected firms and trade associations. This would also require annual updates of required information recognizing that important changes may occur as technologies and practices by manufacturers evolve, and that these will also affect their suppliers, e.g. of electricity and commercial fuels.

## 6. 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 (2015) because national pledges—most extending to 2030—differ significantly both in stringency and types of policies they use to limit GHG emissions. Proposed remedies typically rely on border adjustments with relief for exports and charges on imports. However, devising WTO-consistent border adjustments has proven to be challenging (see footnote 4). 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 border adjustments in the context of an upstream US domestic GHG tax—an indirect domestic tax on products that can be rebated for exports and applied to imports. Border adjustments are based on objective, internationally recognized methodologies to measure GHG emissions from facilities and operations of manufacturers in EITE 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 upstream suppliers of products 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 efficient administrative tool (analogous to VAT in other settings) to track cumulative GHG emissions 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 EITE products. Once those are accounted for, emissions for final products can be allocated using simple rules, e.g., based on the carbon content of the processed fuel, or average emissions per unit weight of precursors incorporated in the final product, e.g., raw steel transformed to bars or pipes. 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<sub>2</sub> but also emissions of other significant GHGs covered by US regulations. This allows the

GHG tax (in US\$ per tonne CO<sub>2</sub>) to be applied to the full set of emissions expressed as tonnes CO<sub>2</sub> equivalent (CO<sub>2</sub>e). To track the flow of cumulative emissions from suppliers to producers in all EITE sectors the Framework includes Oil & Gas Production, Petroleum Refining, Coal Production and Electricity as well as the 46 sectors within the North American Industry Classification System (NAICS) that were determined to be presumptively eligible under H.R. 2454 (2009). Most of the information required for the Framework is currently available and reported to the US 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<sub>2</sub>e per MWh) associated with their purchase of electricity.

To avoid “gaming” that might be done to cherry pick products from the most or least GHG intense manufacturers of firms in specific nations, and in recognition of the lack of clear provenance in many cases, we propose that products exported by US companies, or those imported from foreign firms, should be assigned emissions 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 and that imports are not subject to internal taxes or charges in excess of those applied to like domestic products.

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 US. While this runs counter to many discussions of border adjustments, it also has additional advantages besides being WTO-compliant. In particular, it is extremely difficult to assess the actual cost of the portfolio of GHG policies used in many

nations, let alone their 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. A companion Compendium 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.

One of the reasons for this study is to help to lay the groundwork to implement the Framework and to encourage US firms and trade associations in EITE sectors to proactively develop voluntary procedures to produce and share information on cumulative GHG emissions. As with development of GHG emissions reporting that began in earnest in the 1990s, this effort will no doubt require several years to understand and find solutions for complications and challenges that will surely arise. International sectoral trade associations and multi-national companies can play an essential role building expertise and capacity in other nations and 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 border adjustments. Such information would 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. The information 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., gasoline)—though not everyone will regard this as a good idea.

Finally, the need to find WTO-compatible procedures for border adjustments 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 on a vast scale. On the other hand, they are likely to exacerbate tensions associated with GHG leakage and jobs, trade and investment. Developing policies and agreed procedures that are compatible with both WTO and UNFCCC obligations will be essential to smooth the transition.

**Table 1. Factors in the Framework to Apply an Upstream Tax on domestic GHG Emissions with WTO-Compliant Border Adjustments**

*Rebates of associated GHG charges for exported products and a charge on imported products*

#### Upstream GHG Tax

- The Upstream Tax rate (US\$ per tonne CO<sub>2</sub>e) applied to:
  - GHG process emissions that occur to extract and initially process natural resources: coal, oil and gas, and in some other sectors such as cement.
  - The carbon content of produced fossil resources: coal, oil and natural gas, applied at mine mouth and wellhead—under the assumption that 100 percent of the carbon will ultimately be emitted as CO<sub>2</sub> during further processing or combustion.
- Unit: US\$ per tonne CO<sub>2</sub>e where CO<sub>2</sub>e includes contributions from all covered greenhouse gases on an equivalent-CO<sub>2</sub> basis per unit weight.
- Note that the rate per tonne of Carbon would be larger by a factor 3.667.

#### Cumulative GHG Emissions for Product P: GGI

- For product **P** produced in an EITE sector by a specific manufacturer, **GGI** denotes cumulative GHG emissions (CO<sub>2</sub>e 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 both from inputs purchased from EITE suppliers, as well as process emissions (if any) from on-site activities of the manufacturer, and the carbon content of produced coal, oil and natural gas.
- Unit: tonnes CO<sub>2</sub>e per tonne of product, and for electricity: CO<sub>2</sub>e per MWh.

#### GHG 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 <GGI> X (US GHG Tax).
- Unit US\$ per tonne of product, and for electricity: US\$ per MWh.

**Figure 1. Upstream Tax on GHG Process Emissions and Carbon Content of Produced Fossil Resources, Interactions with Refining and Utilities**

