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CARBON FOOTPRINT TAXES

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Growing Forward

Abstract

We analyze whether a consumption tax---levied on the carbon footprint of goods---is logistically feasible and consistent with international trade agreements. Our analysis suggests that a carbon footprint tax (CFT), modeled after a credit-method Value Added Tax, is less likely to run afoul of the World Trade Organization than competing policy proposals that include border measures. While implementing a pure CFT would likely be prohibitively costly, a hybrid CFT seems economically feasible. The hybrid CFT would give firms the option to either calculate the carbon footprint of their outputs---and have their products taxed based on those footprints---or use product-class specific *Default* carbon footprints as the tax basis, thereby saving on calculation costs. Because the CFT would be levied on all goods consumed domestically, the CFT would keep import-competing firms on an even footing with imports from countries without active climate policy. Zero-rating exports would similarly keep domestic firms competitive on international markets, but would exacerbate consumption leakage.

Table of Contents

1. Introduction

Absent a binding international agreement capping global carbon emissions, countries wanting to slow climate change must proceed without enforceable commitments from much of the global community. Unilateral action carries costs that would not exist under global cooperation. If domestic policy raises production costs, local firms will be less competitive than rivals from unregulated economies. As market share shifts to foreign producers, overseas output---and emissions---will rise, offsetting some of the emission reductions achieved locally. Concerns over lost *competitiveness* and emission *leakage* have led many architects to include protections for energy intensive trade exposed (EITE) sectors in draft climate policies. For example, the third phase of the European Union's (EU) Emissions Trading System (ETS) provides a higher share of free allowances to EITE sectors (European Commission, 2012). Similarly, the expired Waxman-Markey and Lieberman-Boxer bills included output-based allowance allocations for EITEs, as does Australia's EITE Assistance Program. Fine-tuning how allowances are allocated, though, doesn't force foreign producers to internalize the costs of their own carbon emissions, thus many draft policies also include provisions for border measures, such as tariffs on goods from unregulated economies and/or rebates to domestic exporters.

Most observers argue such border measures will prompt complaints to the World Trade Organization (WTO) and/or trade wars (Pauwelyn 2007, Hufbauer, Charnovitz and Kim 2009, Low, Marceau and Reinaud 2011). One reason for pessimism is that it will be hard to determine---and justify to a trade partner---what is the appropriate tariff. How should a country calculate the carbon embodied in imported goods, especially when production methods vary across firms? And what is the right import charge if domestic regulation comes in the form of Cap and Trade with local firms receiving some of their permits free of charge? Moreover, the WTO may reject entirely the notion that the two most common price based instruments---carbon emission taxes and tradable carbon permits---are eligible for border adjustment in the first place; although *border tax adjustments* (BTAs) are allowed for taxes levied on products, they are not allowed for taxes or regulations levied on firms directly.

This paper examines whether a consumption-based carbon policy might solve the challenge of how to set domestic carbon policy that doesn't violate trade rules or sacrifice the competitiveness of domestic firms. We focus on a carbon footprint tax (CFT), which can be viewed as a tax on consuming *embodied* carbon. The core idea is not new. Hufbauer, Charnovitz and Kim (2009) put forward embodied carbon taxes as an example of "a way to apply climate policies to imports that would probably comply with GATT rules" (p.68)[1].

[1] Hufbauer, Charnovitz and Kim (2009) suggest that countries could simultaneously require that all goods sold domestically "be accompanied by a certificate stating its carbon footprint" (p.68) and then tax each product based on the carbon reported in its certificate. Aside from using this straw policy to show that "the

Courchene and Allan (2008) and Stiglitz (2009) go farther and propose that governments adopt carbon added taxes that are similar in design to a Value Added Tax (VAT). For Courchene and Allan the appeal lies in protecting domestic firms from "unfair competition in domestic and external markets from firms located in non-participating countries" (p.60). Stiglitz defends the idea on the grounds that the system would "provide strong incentives for each firm to make sure that its suppliers complied with the carbon tax regime" (p.5). A further argument for taxing goods instead of direct emissions is that doing so focuses attention on patterns of embodied carbon consumption---patterns that are obscured by production data. For example, over the 1990-2006 period, the United Kingdom's territorial emissions fell by three to four percent, yet estimates suggest the UK's embodied carbon consumption rose by between sixteen and thirty percent (Peters et al (2011 Supplementary Materials), Brinkley and Less 2010). Similarly, even though the production emissions of the 15 pre-2004 EU Member States fell during the 1990-2006 period, embodied carbon consumption rose by 47% (Brinkley and Less 2010).

McClure (2010) rejects carbon added taxes on the simple grounds that the transaction costs would be too high; he argues that tracking the carbon intensity of every good consumed in an economy would be "a truly gargantuan undertaking that would not be cost-effective" (p.255). Parties on neither side of the debate, however, give much detail as to how a footprint tax would operate, and so it is hard to know whether a carbon footprint tax is indeed a viable policy option. This paper aims to fill in some of the missing details. We offer specifics as to how a CFT would work. We consider first a pure CFT in which a carbon footprint (CF) is calculated for every good. Because a pure CFT may be prohibitively costly, we also consider a hybrid CFT scheme in which, for each product class[2], the government publishes a Default footprint that a firm can use as the basis for taxation in lieu of calculating the idiosyncratic footprint of each good it produces. We also lay out the merits and disadvantages of *exempting* some sectors and producers from the CFT system.

We then examine whether a CFT would be deemed consistent with the General Agreement on Trade and Tariffs (GATT) and other agreements managed by the WTO. Of all destination based carbon policies, we believe a consumption tax---levied on products instead of firms---is the most likely to withstand trade challenges via the WTO. As we argue in sections 5 and 6, current proposals to pair border measures with emission taxes or permit trading are likely to run afoul of National Treatment. In contrast, there is clear precedent for extending

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parallel application of a product-specific carbon tax to domestic and imported products does not inevitably lead to a conflict with GATT rules" (p.69), the authors do not give the footprint tax further consideration.

[2] By "product class" we mean any convenient way of grouping similar products. These product classes could be defined by the North American Industry Classification System (NAICS) or another similar industry classification system. For example, the US Census has developed a system that extends the NAICS mining and manufacturing codes to the ten digit level. One sample product class from this system is "Candles, including tapers" (NAICS-based code 3399994100). We discuss this further in section 4.1.

product taxes to imported goods, as well as rebating such taxes to exporters. However, we also find that even a tax based on a good's embodied carbon may be deemed WTO-inconsistent given ambiguity over whether goods with high- and low-embodied carbon can be deemed un-*like*. Accordingly, we analyze a series of policy amendments that may allow a country to implement destination based carbon pricing without running afoul of the WTO.

2. Policy Design of a Pure CFT

The footprint tax we will discuss is a *destination-based, credit-method* Carbon Footprint Tax (CFT). *Destination-based* means that the tax would target consumers, rather than producers, such that the tax would be levied on all products at the point of purchase by the final end-user, regardless of where the goods are produced. *Credit-method* means that each buyer would pay taxes on the full carbon footprint of items purchased, and each producer would receive rebates on taxes paid for intermediate goods. The tax basis would be the sum of a product's *embodied* carbon as well as any latent emissions associated with the product. A good's *embodied* emissions would be all the greenhouse gases[3] released during that good's production. Using Life Cycle Analysis (LCA) terminology, this would include all of a product's Scope 1, 2 and 3 emissions: emissions released by the manufacturer directly (Scope 1), those released when generating the electricity, heat or steam used by the manufacturer directly (Scope 2), and all emissions from upstream or parallel activities by third-parties, e.g. emissions from resource extraction, upstream intermediate good production, business travel and transport using non-owned vehicles, and non-owned waste disposal (Scope 3).[4] *Latent* emissions would be those released when the good is consumed under typical conditions; for example, if the product in question is a fossil fuel, its "latent" emissions would be the C02e typically released during fuel combustion.[5]

To illustrate how the CFT would work, consider the following stylized example of two industries producing goods U and D (for "upstream" and "downstream"), respectively. U-type firms produce good U using one unit of a clean numeraire input Y and releases e_U C02e emissions per unit of output. The carbon footprint of good U is thus e_U. D-type firms produce good D using 1 unit of U, a units of Y and generates e_D units of additional emissions.

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[3] In the remainder of this paper we refer to greenhouse gasses as C02 equivalents (C02e).

[4] The footprint could even be negative if the production process led to net carbon sequestration instead of release.

[5] In this paper we will abstract from emissions latent in the consumer-to-grave portion of a product's life cycle, as we will assume that such emissions are assigned to waste disposal services. Similarly, we will not assign to a product---e.g, a pair of jeans---the emissions arising from use of complementary products or services---e.g. the emissions arising when those jeans are laundered.

Assume input and output markets are competitive. If we also assume--for now--that neither U nor D-type products carry latent emissions then the carbon footprint of good D is e_U+e_D.

Suppose the tax rate on C02e emissions is *t*. *U* producers would post prices of $p_U=1$ and buyers would face tax inclusive price $1+te_U$. If the item was to be used as an input into downstream production, the purchaser would submit its receipt to the revenue agency and be reimbursed the CFT-paid; its net price for a unit of U would thus be $p_U = 1$. The D-producer would in turn post a retail price of $p_D=p_U+a=1+a$ and consumers would face a tax-inclusive price for good D of $p_D+t[e_U+e_D]=1+a+ t[e_U+e_D]$.

Now we introduce latent emissions into the analysis. Suppose, for example, that U is a fossil fuel; when U is ultimately combusted there will be additional emissions of L_U. Given our earlier definition, the tax basis for U should be e_U+L_U, such that the tax-inclusive price of U will be $p_D+t[e_U+ L_U]$ with e_U+L_U equaling the good's *carbon footprint*. Any non-exempt firm purchasing *U* would be eligible for a CFT-rebate of $t[e_U+ L_U]$. Suppose the D-type firm releases all of *U*'s latent emissions during use of *U*; these actual releases would be included in the parameter e_D, while the remaining latent emissions, L_D, would be zero. The tax-inclusive price paid by final consumers of D will be $1+a_D +t[e_D+e_U]$, such that consumers would be charged for C02e's emitted during final consumption.

2.1 Traded Goods

Suppose goods U and D are traded internationally. For simplicity assume that producers in the Rest of the World (ROW) are homogenous and face the same unit-input requirements as Home producers; we also assume there are no transport costs or tariffs, and ROW is policy-inactive (i.e. does not impose any C02e policy of its own). We denote values associated with ROW-produced goods with asterisks. To reduce notation, we'll also assume in this subsection that latent emissions are zero.

A destination-based CFT would tax goods imported into Home from ROW at the same rate as domestically produced goods. Thus the retail and tax-inclusive prices in Home of a ROW-produced unit of good D would be $p_D*=1+a$ and $p_D*+t[e_U+e_D]$ respectively. In sum, under a destination based carbon-footprint tax consumers pay the same amount for domestically and foreign produced goods even though ROW does not regulate carbon itself.

Regarding exports, the principles of a credit-method destination-based tax system suggest Home's exports would be *zero-rated*. Specifically, a Home D-producer would be eligible for reimbursement of the taxes she paid when purchasing her input of good U, but would not have to levy CFT on any sales of her output in the ROW market since the goods are being consumed in a non-levying country.[6] As a result, the tax-inclusive price in ROW of a Home-produced unit of D would be only $P_D=1+a$. Under our maintained assumption that unit input

[6] More accurately, exports from Home would be taxed at a rate of zero.

requirements are the same across Home and ROW, Home's D-exporter would charge the same price in ROW as do their ROW competitors.

Because imports are taxed based on their footprints, while exports are rebated any CFT paid in earlier stages of production (and final-stage emissions are taxed at rate zero), the CFT is a destination based pricing system. The target of the tax would be domestic consumption, however, the tax would be levied at the point of purchase. Because some of the imported goods consumed locally would have a foreign point of purchase, there would have to be an adjustment at the border; similarly, exported goods would also need to receive adjustment at the border since the point of final purchase might similarly occur abroad. As per Low, Marceau and Reinaud (2011), the CFT would thus be an example of an internal tax with applications at the border.

3. Competitiveness and Leakage

Given the absence of meaningful multilateral action on climate change, countries pursuing policies to address climate change will have many trade partners who do nothing. In this setting, policy active countries are justifiably anxious about keeping their domestic firms competitive and preventing domestic carbon reductions from being offset by increased emissions abroad. In this section we assess whether a CFT will prove useful in mitigating these twin concerns over *competitiveness* and *leakage*.

3.1 Competitiveness

Under a destination-based carbon policy, imports would be taxed based on their carbon content using the same methodology as for domestically produced goods. Similarly, because exports are zero-rated, Home firms selling their goods abroad would be able to recover CFT-paid on scope 1 and 2 emissions, while their own scope 3 emissions would be taxed at a rate of zero. As a result, carbon compliance costs will be similar for Home producers and their unregulated ROW competitors.

At first glance, taxing the CFs of imports yet zero-rating exports might seem like a program of import tariffs and export subsidies. A similar concern arose with respect to VATs in the 1950s and 1960s as members of the European Community tried to harmonize their tax systems and adopt credit-method destination-based VATs. However, a series of authors, including Grossman (1980), Whalley (1979), and Lockwood et al (1994), confirmed *neutrality* between destination-based VATs, origin-based VATs, and zero-tax regimes: if exchange rates are flexible and taxes uniformly applied, then all three systems deliver identical relative prices to consumers and producers and trade volumes are unaffected. Moreover, if a country adopts a destination-based system but neglects to zero-rate exports, Feldstein and Krugman (1990) show that this is equivalent to a tax on imports. That is, *omitting* a BTA on exports is protectionist.

The neutrality result suggests that a country cannot give itself a competitive edge by adopting a destination-based VAT, because the exchange rate will adjust so as to prevent changes in nominal prices from having any real effects. Given this neutrality, Lockwood and Whalley (2008) argue that players in the climate policy debate are misguided when they talk about needing Border Carbon Adjustments (BCAs) in order to maintain a country's competitiveness: "If the BTA accompanying carbon emissions reductions are broadly based, ... the price-level effect will have no real effects" (p.812). They argue what matters are the effects of BCAs on relative prices.

In the carbon context, however, taxes are unlikely to be uniform: even though all embedded carbon will be taxed at the same rate per ton, because CFs vary across goods within and across product classes, CFT per dollar of value-added will vary widely. Thus we cannot expect neutrality to hold. However the essence of the Lockwood and Whalley (2008) critique remains valid: an economy-wide CFT would likely affect the exchange rate and so should not be viewed as a mechanism for promoting the competitiveness of the country as a whole. This is consistent with simulations conducted by Böhringer, Carbone and Rutherford (2011), who compare welfare when a 20% emission reduction in OECD countries is undertaken with and without full BTAs (i.e. tariffs on imports of embodied carbon plus rebates to exporters). In the simulations underlying their analysis, BTAs would appreciate the currencies of Canada, United States, France, and Germany by over 5% with respect to China and Russia.[7]

The CFT would encourage consumers to switch to low-carbon goods at the expense of higher-carbon substitutes both within and across product classes. However, not all of the competitiveness effects of a CFT would be environmentally favourable. Under an origin-based system, low-carbon exporters would have a cost-advantage relative to high-carbon competitors from the same home economy. Zero rating would erode this cost-advantage. Low carbon exporters might also be hurt by any exchange rate appreciation resulting from the CFT, as would domestic firms competing against low-carbon imports. In contrast, the exchange rate appreciation would help firms that import clean intermediate goods.

3.2 Leakage

Production leakage occurs when one country's carbon reductions are offset (in part or in full) by increased emissions abroad. For example, when one country taxes domestic carbon emissions, domestic supply shifts inward, thereby raising the world price of carbon intensive goods. This price rise induces overseas producers to increase their own production, which increases emissions in non-taxing countries. If production methods overseas are more carbon-intensive than in the taxing economy, it is possible that total

[7] Personal communication with authors.

global emissions actually rise as a result of the tax, in which case the leakage rate would be greater than 100%. A carbon footprint tax would be effective at preventing *production* leakage because it would tax the carbon emitted during production regardless of where that production occurs (at least with respect to goods ultimately consumed in the taxing economy).

But a unilateral CFT will not solve the parallel problem of *consumption* leakage. The classic example of consumption leakage is as follows: a tax on fossil fuel consumption in one country shifts inward that country's demand for fuel and lowers world fuel prices, which would spur fuel consumption in non-taxing countries. The CFT, as we have defined it, would tax the latent emissions in goods and act like a fuel tax. Thus it would cause classic consumption leakage through fossil fuels. But destination-based carbon pricing would also cause consumption leakage through trade in goods other than fuel. A domestic consumption tax would reduce the profitability of selling in the domestic market, which would lower the opportunity cost of producing for non-taxing economies and would instead *promote* exports of dirty goods (Rauscher 1997, Copeland and Taylor 2004, McAusland 2008). Even though a destination based carbon policy would prevent dirty good *production* from shifting to non-taxing countries, it would not prevent dirty good *consumption* from shifting. To be clear, this consumption leakage problem would not be unique to a CFT; it would arise whenever a production-based policy such as an emission tax was paired with export rebates. In the CFT context, consumption leakage could be reduced if the taxing economy opted not to zero-rate exports. Fully taxing the embodied carbon content of exports would raise prices for carbon-intensive goods overseas, thereby reducing embodied carbon consumption abroad.[8]

In theory, zero-rating might also produce perverse outcomes such as cross-hauling. Suppose, for example, Canada was to adopt a CFT but its trading partners did not. Depending on the magnitude of transport costs and other trade frictions, carbon-intensive Canadian producers might have an incentive to export their goods to the untaxed foreign markets, thereby increasing Canadian net import demand and attracting imports of low-carbon substitutes. Such a scenario could arise in the case of petroleum exports. Roughly half of Canadian oil production is from bituminous oil sands, with extraction-related emissions that are approximately four times as high as those for extraction from conventional petroleum deposits (Brandt 2011). If embodied carbon was priced at $30/tCO2, oil sands crude would bear extra taxes of approximately $1.50/barrel as compared to conventionally extracted oil[9]. In comparison, oil sand extraction costs range from $40/barrel (for low-cost producers) to upwards of $80/barrel (for some newer

[8] If foreign demand is sufficiently price inelastic and production techniques are considerably less carbon-intensive in the CFT-levying country than abroad, then zero-rating exports could end up reducing global emissions.

[9] Authors' own calculations based on figures reported in Brandt (2011).

extractors (Financial Post, 2012)). While the extra taxes facing oil sand crude would be unlikely to induce cross-hauling in the short run, they might nonetheless influence decisions regarding future pipeline investments such as whether to send oil sand crude westward for export to Asia or eastward for processing and consumption in Canada. More generally, if only one country adopts destination-based carbon pricing, zero-rating exports may promote export of the dirtiest goods and import of cleaner substitutes, inducing unnecessary (and polluting) transport in the process.

4. Feasibility

The obvious disadvantage of a CFT would be the associated transaction costs, which would come in two forms. Firstly, it would be costly to compute footprints; in the CFT's purest application every product would have its own footprint, right down to each product line produced by each firm/plant. Secondly, it would be costly for firms to collect and remit taxes. We look at each of these costs in turn.

4.1 Cost of Computing Footprints

One way to proceed would be to allow firms to calculate and self-report annually the (average) footprints of each of their products, subject to random audit. For this firms would have to know their latent plus Scope 1, 2 and 3 emissions. Scope 2 and 3 emissions would be straightforward, as these would be reported on invoices for inputs purchased. Calculating Scope 1 emissions that arise from on-site fuel use would also be simple as it would be reported on fuel-purchase invoices (under the heading "latent" emissions). Calculating non-fuel related Scope 1 emissions and latent emissions would likely be more complicated, potentially requiring consultation with experts or input-output tables linking land-use practices, for example, to CO2e releases.

Once a firm calculates the sum of its latent plus Scope 1, 2 and 3 emissions, it would then apportion these to its various products using the same methods as employed to apportion attributable and non-attributable input costs when estimating average cost/unit. This would be an exercise in spreadsheet management that could be facilitated by mass market software. For example, Intuit, the producer of the QuickBooks accounting software, has developed an add-on module---"Green Snapshot"---which calculates firm-level carbon footprints based on the firm's expenditure data. Similar products could be developed to calculate average CFs on a product-by-product basis. Similarly, large companies may choose to adapt their proprietary inventory/accounting programs by introducing new datafields that track the CFs of inputs used and calculate the CFs of outputs generated.

One of the problems that might arise with a system in which individual firms calculate their own CFs is that it may be difficult for auditors in an importing country to evaluate the claims of foreign producers. It would be expensive for auditors to conduct on-site investigations of overseas operations. It is also unclear whether auditors would have the authority to levy punitive penalties on foreign firms found to have understated their carbon footprints.

An alternative is to have firms hire third parties to calculate their CFs.[10] If each importing country were to require that CFs be certified by domestic agents, there would be wasteful replication. Mutual recognition[11] of national footprinting authorities would solve the duplication problem, but wouldn't rule out the potential for bias in the methodologies themselves. For example, coal-burning countries might decide to ignore emissions embodied in electricity, while forest-converting countries might opt to ignore land-based emissions. Requiring that footprinting authorities use methodologies that are consistent with the International Standards Organisation (ISO)'s forthcoming guidelines for carbon footprinting---ISO 14067---would be one solution.

Over the last fifteen years the International Standards Organization (ISO) has developed a number of international environmental standards. These standards are intended to help harmonize the many independent environmental standards, labels, and certifications being pursued at national and international levels. The WTO Technical Barriers to Trade (TBT) agreement requires that all standardizing bodies use any relevant international standard in existence as a basis for their own technical regulations and standards[12], provided the existing international standard is effective at meeting the objective pursued (see TBT Article 2.4 for technical regulations and paragraph F in Annex 3 for standards). The WTO recognizes ISO standards as being not overly trade restrictive, which means that harmonizing with these standards is likely to result in a more favorable judgment by the WTO (Dankers, 2003, p. 18). Although there are currently no mandatory standards or labels based on ISO environmental standards, a number of voluntary labeling programs have been designed according to the ISO 14025 standard for environmental certification. In addition, the ISO 14064/14065 C02e quantification and verification standards have been frequently

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[10] Even if third parties carry out certifications, CF calculations would still draw upon proprietary data, thereby opening the door to fraud. In order to avoid similar problems with organic certification, the International Federation of Organic Agriculture Movements (IFOAM) instituted three levels of monitoring: certification bodies perform farm inspections (sometimes unannounced) and review the farm/producer's written documentation while retail and trade quality managers perform quality tests (IFOAM, 2012). Certification bodies themselves are also subject to review by accreditation bodies, often by a national food inspection body, such as the Canadian Food Inspection Agency.

[11] In the Tuna-Dolphin case, a WTO Panel ruled that the US' Dolphin Protection Consumer Information Act (DPCIA), which required all dolphin-friendly labeled tuna to conform to certain DPCIA standards was more trade restrictive than necessary as it could be used in conjunction with another available label (the Agreement on the International Dolphin Conservation Program [AIDCP] dolphin safe label). The WTO Appellate Body later reversed this ruling; they found the DPCIA standard would indeed be less trade restrictive if used in conjunction with the AIDCP label, but would also be less effective at meeting the US' objectives.

[12] A mandatory certification or label administered by a government body is referred to in the TBT as a technical regulation; a voluntary certification or label administered by a government or non-government body is referred to as a standard.

used in the carbon offset market, either as a basis for carbon offset standards or in evaluating offset projects. The ISO 14067 and 14069 carbon footprint standards currently in development will augment the ISO's Life Cycle Analysis methodology---as outlined in the ISO 14040 and 14044 standards---and will offer standardized rules as to how a product or organization's carbon footprint should be calculated.

The forthcoming ISO standards solve the consistency problem of third party CF certification. The standards don't, however, assure that the footprinting process would be cheap.

We conducted an informal survey of consulting firms in an effort to identify the market price for third-party carbon footprinting. The lowest quoted price for a footprint was in the $50 to $100 range, and would use data from sectoral level input-output tables; the highest quoted price was $200,000 for a footprint which used firm level data and assumed a very high level of complexity. The average estimates for a CF using methods that include Scope 1, 2 and 3 emissions and conform to one or more international LCA or carbon accounting standard/protocol were $18,000 for low complexity[13] products and $46,000 for high complexity products.[14]

The reported 18k-46k range likely overestimates the actual costs of third-party CF calculation. For starters, the firms quoted assumed the CF in question was a first-time assessment for a particular product or firm; many of the consultants contacted indicated that costs could fall by half if the consultant had prior experience with a particular product or firm. Moreover, under our proposed CFT regime, firms will only have to calculate their own Scope 1 emissions as Scope 2 and 3 emissions would have been reported by upstream suppliers. Moreover, costs would likely fall as the footprinting industry matures. As a point of comparison, the cost of conducting a nutritional analysis has fallen by between 67 and 90 percent since nutritional labels became mandatory in 1990 in the United States.[15]

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[13] A Low Complexity product is loosely defined as one using few material inputs, simple manufacturing methods and a straightforward distribution system. High Complexity products require many material inputs, several manufacturing steps, a multi-mode transportation system and packaging.

[14] These figures represent prices charged for footprinting services. There would also be costs associated with accrediting firms providing these services, for which the costs of accrediting organic certifiers may be relevant. Stolze, Hartmann, and Moschitz (2012) assess the supervision costs--- per organic farmer or processor---to manage an organic certification scheme in each of six European countries and arrive at country-level supervision and accreditation costs of $624,978 CAD per year per country.

[15] In the Impact Analysis performed for the 1990 Nutrition Labeling and Education Act it was estimated that the costs of performing the required nutritional analyses was $1,785 USD for products that had yet to undergo any nutritional analyses (Federal Register, p. 9). This estimate assumed each product required a full lab assessment to acquire the necessary nutritional information. Currently, new products can undergo either a full lab assessment or a database nutrition analysis. Both of these methods satisfy the Food and Drug Administration's nutritional label requirements (Food and Drug Administration, 1998). To perform a

Even if the cost of a third-party certification falls considerably, certifying all products sold in an economy would be enormous. In Canada, for example, there are over 70,000 company Universal Product Code (UPC) prefix licenses[16]. If each license is used to generate just 10 distinct UPCs and the price of a third party CF certification is only $9,000, the transaction costs of having each product's CF certified would exceed six billion dollars.

One way to economize on these transaction costs would be to pursue a hybrid system in which a *Default* footprint dCF_i is established for each product class *i.* A firm producing a good in product class *i* could either calculate the unique footprint of her own product, or use the Default for product class *i* as the basis on which her product would be taxed.

Firms---both foreign and domestic---would have the option to use the Default CF; if chosen, the Default would form the tax basis for that firm's good. A consumer who purchases the good would then be charged the retail price plus the tax rate times the Default CF. Of course, if a firm's product has a CF much smaller than the relevant Default then that firm might choose to have its idiosyncratic footprint calculated by a third party. This footprint would then be the basis for taxation.

The set of products described in the US Census' augmented NAICS tables serves as a likely candidate for the set of product-classes to which Defaults would be assigned. There are 3,299 Mining and Manufacturing industries at the 10-digit NAICS-based level. Assume each 10-digit level industry requires a single Default[17,18] and that Default is calculated by

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database nutrition analysis, which uses data from similar or input food products to assess the nutritional information of a previously un-analyzed product, costs are between $75 USD (Sweetware, n.d.) and $125 USD (nutridata, n.d.). A lab-based analysis was quoted at $560 USD in 2003 (Food and Drug Administration, 2011, p. 26). The cost of a lab-based analysis fell by 67% after nutritional labels became mandatory in the US. In addition, because these labels were made mandatory, a database has been collected that can be used to calculate – very inexpensively – the nutritional information of many products. In a case where a database analysis is sufficient, the cost, compared to the 1990 lab cost, has fallen over 90%.

[16] Personal communication with Kathleen McManus of GS1 Canada, October 25 2012.

[17] The North American Industry Classification System (NAICS) classifies national industries to the 6-digit level. The US Census Bureau has developed additional NAICS-based codes for further classification; we base our count of 10-digit industries on the count of 10-digit codes in the US Census Bureau's 2007 "Numerical List of Manufactured and Mineral Products", available at http://www.census.gov/prod/ec07/07numlist/m31r-nl.xls.

[18] The 10-digit NAICS-based codes are *industry* codes, describing industries according to the goods produced. However, for many codes the industry code can be attributed to a fairly homogeneous product – e.g. "Candles, including tapers" (NAICS-based code 3399994100) – and so we take the liberty of referring to the 10-digit NAICS-based codes as *product codes* as well. However, for some industries the 10-digit code includes a variety of products which may need to be further disaggregated, eg. "Wood jewelry boxes, silverware chests, instrument cases, cigar and cigarette boxes, microscope cases, tool or utility cases, and

measuring the actual CF of a representative firm. Using current average costs for calculating low and high complexity footprints---$18,000 and $46,000---the cost of calculating a Default CF for each 10-digit industry would be between $59 million and $152 million. If we instead assume footprinting costs will fall by 2/3 (as did the costs of performing lab-based nutritional analyses), the cost of providing a complete set of 10-digit Default footprints would range between twenty and fifty million dollars. Notably, the costs of calculating Defaults could be shared across multiple countries if all adopted a CFT and used the same product-class definitions. The obvious downside to this bottom-up approach lies in the choice of which firms should be treated as representative.

Alternately, the Default CFs could be calculated from input-output data. In this top-down approach, input-output data would be used to calculate average CFs for each product class and country. The Default CF for each product class would then be a weighted average of these country-level CFs, where the weights are the country shares of international production.

The advantage of this approach would be its cost effectiveness---analyzing a global set of input-output tables would be much less costly than calculating detailed CFs for representative firms. Moreover, the same structure could be used in determining Defaults in later years; only the input-output tables would have to be updated. This would reduce the cost of calculating Defaults in the future.

There are obvious disadvantages to this top-down approach. The CFs calculated would be less accurate, and so would only be an approximation to the true industry CF. Countries may also have an incentive to underreport the carbon intensity of their production techniques. However, as this method would be used to calculate the Default CF, not an actual footprint for a firm, these issues would be less problematic. For example, if the input-output method is believed to underestimate the true industry CF, then the Defaults could be scaled to account for this.

The clear advantage of a hybrid system---relative to a pure CFT---is that firms eschewing individual certification would be saved the costs of calculating their idiosyncratic CFs. This would be particularly important for small firms that have few units over which to amortize the fixed costs of certification.

This hybrid system with Defaults would also have two significant disadvantages. Firstly, when choosing from amongst the set of goods utilizing the Default, consumers would have no incentive to choose varieties with lower CFs.

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similar boxes, cases, and chests" (NAICS-based code 3219207151) or classified based on weight and/or volume.

Secondly, if the carbon tax that would ultimately be levied on a firm's output would be independent of the product's actual embodied emissions, the firm would have no incentive for *within-product* greening: the firm would have no incentive to reduce in-house emissions or use inputs with small carbon footprints.

This last failure---the absence of an incentive for downstream firms to buy low-CF inputs---may have consequences for the production decisions of upstream firms as well. Consider the extreme example in which all of an upstream firm's downstream users will utilize the Default. Those downstream customers will be unwilling to pay a price premium (in terms of a higher retail price) in exchange for a low CF input, especially since any associated CF-taxes will just be rebated. If the downstream firms aren't willing to pay a higher retail price for low CF inputs, then the upstream firm would have no incentive to undertake efforts to reduce its own CF, even if those efforts would lower the tax-inclusive price of its goods.[19]

This extreme example illustrates how allowing downstream firms to utilize Defaults and receive rebates for carbon taxes paid may unravel some of the incentives for carbon-reduction upstream. This problem would be most significant in industries with many small downstream producers---so most downstream firms eschew individual certification---and there is sufficient heterogeneity in upstream production methods. In the following section, we'll address a possible solution to the unraveling-incentives problem. But first, we will take a look at the costs associated with collecting and remitting CF taxes.

4.2 Collection and Remittance Costs

In addition to the footprinting costs, a carbon footprinting scheme would also impose significant filing costs; firms selling goods would have to collect CFT from purchasers and remit those taxes to the revenue authority. Moreover, firms buying intermediate goods would need to submit invoices to the tax authority in order to recover CFT paid on inputs.

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[19] The following stylized example illustrates how Defaults can unravel the incentives for upstream carbon-reductions. Suppose there are multiple competitive downstream and upstream producers and that neither good is traded. Assume upstream producers have access to two separate production methods: method "Small" (S) or method "Medium" (M), whereby $a^S > a^M$, $e^S < e^M$ and $a^S + te^S < a^M + te^M$. Assume the tax rate t is equal to marginal social damage from carbon emissions. As described, the Small method is socially preferable, since the value of non-carbon inputs summed with damages from emissions is less than with Medium. If a downstream user intends to utilize the Default CF, then she has no incentive to purchase an upstream good produced using the Small method. This is because any CFT a downstream pays on her purchase of the upstream input will be rebated, while the CFT paid by her own consumers is independent of her own product's CF. Thus, she can reduce her net costs by purchasing upstream goods produced using the Medium method. If, in addition, there are fixed costs associated with employing a particular upstream production method, then if enough downstream firms utilize the Default rather than calculating/certifying their idiosyncratic CFs, each upstream firm will employ the Medium production method and emissions will be higher than they would have been if downstream users were required to calculate their own CFs.

All of these transaction costs are mirrored in the costs of administering a credit-method VAT.

Estimated costs of complying with VAT regimes vary across countries. One useful metric is the amount of time that a standardized case study firm must spend annually in order to comply with a VAT. The World Bank and International Finance Corporation estimate that in 2010 the standardized case study firm[20] would have allocated 50, 30, 35, and 26 hours annually to VAT compliance in Canada, the United Kingdom, Japan and France respectively.[21] For the full sample of 145 high, medium and low income countries using a VAT or equivalent, the average annual VAT compliance time would have been 125 hours (Price Waterhouse Coopers 2011 p.6). Another metric takes the ratio of firms' compliance and governments' administration costs to GDP; for example, in the mid-2000's compliance costs in the UK, Denmark, the Netherlands, and Sweden were between 0.08 and 0.2 percent of GDP while administration costs ranged from 1/3 to 2/3 of a percent of GDP[22].

Countries with federal VATs could reduce some of the transaction costs of a CFT system by having CFT remitted to and recovered from the same tax authority using the same forms as for VAT remittance/recovery.[23] Nevertheless, the CFT would impose an additional reporting burden in that Carbon Footprints are distinct from Value Added, and are arguably more complex. For example, there would inevitably be cases in which a firm produces a good that does not fall into a clearly defined product-class; if this firm didn't pursue individual certification, it would need to use discretion as to which Default to employ. Similar problems arise with multiple-rate VATs. A 2005 study of VAT compliance in Norway, Denmark, Sweden and Netherlands found that compliance costs (per filing) rose by between 0 and 4 hours/filing when an establishment was required to levy two or three VAT rates instead of one (SCM Network 2005 pp. 7-9). The study found the "burden is primarily connected to sales...[and] consists of programming of cash register, informing staff and a concrete judgment of what VAT rate should be applied" (SCM Network 2005 p.15). Although the CFT is simpler than a multi-rate system in that a single tax rate applies to all embodied/latent CO2e, there would still be one-time costs associated with reprogramming

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[20] Their standardized case study firm has 60 employees and "turnover of 1,050 times income per capita" (Price Waterhouse Coopers 2011 p.98).

[21] *Doing Business* database http://www.doingbusiness.org/data. Figures for Canada are for Ontario and the Harmonized Sales Tax.

[22] Authors' calculations based on data from KPMG (2006) for UK compliance costs, the SCM Network (2005) for Denmark, Holland, and Sweden's compliance costs, and the EU Project on Baseline Measurement and Reduction of Administrative Costs (2009) for administrative costs in all four countries.

[23] Countries like the United States which do not have a federal sales or value added tax would not have this advantage.

inventory systems and cash registers to report and tax goods based on their CFs, as well as ongoing costs of updating databases when products' CFs change over time.

A common method of reducing compliance costs is to *exempt* some sectors and firms from the tax system entirely. A firm being *exempt* from the CFT means that the firm would pay CFT on inputs purchased, but would not be eligible for rebates on CFT-paid, nor would it have to charge CFT when selling goods to consumers. Following the usual markup rules, we would expect these exempt firms to pass CF taxes-paid along to consumers, even though CFs would not be reported on either retail price tags or consumers' receipts.

With HST/VAT, firms with revenues below some threshold are often exempt. In the UK firms are not required to charge VAT on their goods if their annual turnover is below £77,000 (HM Revenue and Customs n.d.); the VAT registration threshold in Denmark is DKK 50,000 (KPMG 2012a p.4) and NOK 50,000 in Norway (KPMG 2012b p.3). Each country pursuing a CFT program may therefore wish to exempt firms for whom annual gross revenues fall short of some universal cutoff such as $100,000.

In a CFT system, if an industry produced a non-traded final good and its Scope 1 emissions were either low or came predominately from on-site fuel use, that sector would also be a good candidate for exemption. Recalling our earlier example, suppose that D-type firms are exempt from charging CFT and have no Scope 1 emissions, i.e. $e_D=0$; assume for now that $L_U=0$ as well. In this scenario, D-type firms would face input costs of a_D and a_U+te_U for generic and upstream inputs, respectively. The CFT portion of the firm's expenditure on good U would not be rebated by the government and so downstream firms would charge consumers a retail price of $a_D+a_U+te_U$. Consequently, even though good D is exempt from the CFT, consumers of good D would still face a net price for the good that fully internalizes the social costs of the carbon released when that good is produced.[24]

Exempting downstream firms also retains incentives for upstream carbon reductions. Recall from Section 4.1 the example in which an upstream firm has many small downstream customers who would utilize the Default if they were not exempt from the CFT-system. If they were instead exempt, those downstream customers would opt for inputs that delivered the lowest tax-inclusive price, which would in turn provide the upstream supplier the appropriate incentive to seek out low-carbon production methods.

In light of this discussion, there is a strong argument for exempting services from a CFT.

It may also be advisable to *quasi*-exempt retailers: require retailers to track, display, and charge CFT on retail items using the CF *as reported by the manufacturer*. This would be

[24] Notably, if $L_D>0$ and $e_D>0$ but all of D's Scope 1 emissions come from releasing C02e that are latent in good U, then consumers of good D will similarly face a retail price for good D that reflects the full social costs of producing good D even if sector D is exempt from the CFT system.

aided if the economy employed a voluntary or mandatory labeling program. The advantage of this quasi-exemption is that any CFs appearing on product labels would match those on the consumer's final receipt. Moreover, retailers would presumably build into their markups the CFT-paid on non-attributable inputs (such as heating and lighting) such that consumers would still face a net price that internalizes most of the social costs of producing and distributing final goods. However, if retailers were either exempt or quasi-exempt, then, while the cradle-to-gate emissions associated with imported final goods would be taxed, the emissions associated with transporting that final good from an overseas manufacturer to the importer's border would not be taxed either directly or indirectly.

Although we think there are compelling arguments for quasi-exempting retailers, we do not advocate exemptions for all sectors with low Scope 1 emissions.[25] As we will argue in Section 6, exempting sectors from the explicit carbon tax system would remove a government's ability to levy border tax adjustments on goods produced by those industries, which would have consequences for competitiveness. As Houser et al. note, "using trade measures for imported steel but not for imported automobiles, for example, would increase the steel acquisition costs for the US auto industry vis-à-vis foreign competition, putting it at a competitive disadvantage" (2007 p.76).

Moreover, trade in downstream, non-energy intensive goods is one of the main channels through which production leakage occurs. Peters et al (2011) estimate that in 2008 there were 7,847 Mt of CO2 embodied in goods traded globally, with Annex B countries importing 2,555 MtCO2 of embodied carbon from non-Annex B countries. 37% of these Annex B embodied carbon imports from non-Annex B countries were embedded in goods produced by non-energy intensive manufacturing industries. In comparison, only 32% of Annex B embodied carbon imports were via goods produced by energy-intensive manufacturers.[26]

Given that there is so much embodied carbon traded via non-energy intensive goods, governments shouldn't categorically tie their hands with respect to protecting competitiveness in these sectors. If a downstream product-class is heavily traded and uses carbon-intensive inputs, competitiveness concerns may argue in favour of keeping that class of goods within the CFT system---i.e. not exempting it---even if non-fuel Scope 1 emissions

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[25] Aldy, Ley and Parry (2008) argue in favour of taxing only industries involved in extracting, processing or selling fossil fuels; Metcalf and Weisbach (20009) advocate extending the tax base to also include steel mills, cement manufacturers and some other non-combustion sources of C02e, but exempting most downstream users of electricity, cement and steel.

[26] It is also worth noting that non-Annex B countries are supplying an increasing percentage of Annex B carbon consumption: in 1990 Annex B countries imported 1,100Mt of embedded CO2 from non-Annex B countries (equal to 7.5% of total carbon consumption in Annex B countries); in 2008 those imports had risen to 2,555MtCO2 (or 16.5% of total consumption in Annex B countries) (Authors' own calculations using estimates provided in Peters et al (2011) Supplementary Materials).

are low. If, in addition, upstream production is more carbon intensive abroad than at home, there may also be an efficiency argument for keeping the downstream good within the CFT-system, even when Default CFs unravel incentives for upstream carbon reductions at home.[27]

Exempting certain sectors/producers can cause additional problems above and beyond competitiveness. Firstly, exempting an industry's product may waste valuable information: consumers who care about the CF of a product (above and beyond the associated CFT burden) would not be able to distinguish between low- and high-carbon products. A non-regulated solution would be for producers selling exempt goods to undergo certification voluntarily and label their products accordingly, possibly using a table of Carbon Facts akin to the current Nutrition Facts labels mandatory on prepared foods.[28] As mentioned earlier, a voluntary carbon labeling scheme is unlikely to run afoul of the TBT; a mandatory scheme

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[27] The following stylized example shows that exempting the D-industry may raise global emissions when D is traded. Assume $e_D=L_U$ regardless of where goods D and U are produced. Assume U is non-tradable while D is traded without transport costs. As in the example from footnote 19, assume Home's upstream firms can use one of two production methods: method "Small" (S) or method "Medium" (M), whereby $a_U^S>a_U^M$, $e_U^S<e_U^M$ and $a_U^S+te_U^S<a_U^M+te_U^M$ and that the tax rate t is equal to marginal global social damage from C02e releases. Assume that in ROW, there is only one upstream technology---"Large"---which exhibits $a_U^M=a_U^L$ while $e_U^M<e_U^L$. Assume that, if the D sector is not exempt, it has Default $dCF_D=e_U^M$. As per the discussion in footnote 19, if D production is sufficiently diffuse then Home's D producers will eschew certification, demand U-goods produced using the Medium method, and charge a tax-inclusive price of $a_U^M+a_D+te_U^M$. ROW firms will also utilize the Default and charge $a_U^L+a_D+te_U^M$. By construction, a_U^L and a_U^M are equal and so domestic and ROW firms will charge identical prices and split the market with respective shares s and 1-s. Assume for convenience $s>0$. Assuming total demand for good D of Q_D, total emissions under this scenario are $Q_D[se_U^M+[1-s]e_U^L]$.

Now consider social costs of supplying the domestic D market if industry D is instead exempt. Assume unit demands so that total quantity consumed does not change. If the D industry is exempt then domestic firms are not rebated CFT-paid and so will purchase units of U with the lowest tax-inclusive price; in our example this is goods produced using the "Small" method. The domestic retail price for D will be $a_U^S+a_D+te_U^S$. D-producers based in ROW will not face any carbon taxes and will set a retail price of $a_U^L+a_D$. If consumers view domestically and ROW-produced versions of D as perfect substitutes then the lower price charged by ROW firms will win them the entire D-market in Home, causing total emissions to rise to $Q_De_U^L$ (and without any compensating reduction in the use of the generic input). In sum, exempting downstream industries from the CFT system may provide incentives for upstream producers to adopt low-carbon production methods, however, it will hurt the competitiveness of domestic firms and, in our example, raises global emissions.

[28] Given that these labels would be printed at the factory, and thus not include transport emissions associated with getting the product from the factory to the retailer, these labels would only be able to report emissions from cradle-to-gate, not cradle-to-consumer.

would likely face opposition. Secondly, exempting sectors/firms also introduces the problem of domestic double taxation. If an exempt good is used as an input to production in a non-exempt industry, the final good will effectively be taxed twice: once when its producer pays the CFT built into the retail price of the exempt input, and then again when the CFT is levied on the product's full CF. As with most VAT systems, a solution is to allow exempt firms to *opt-in* to the CFT system. Firms with significant sales to non-exempt consumers will pursue this option if the transaction costs do not outweigh the benefits from facilitating their customers in recovering CFT-paid throughout the entire production chain.

4.3 Revenues

Depending on the carbon tax rate, a CFT may be a net revenue generating program. In 2008, CO_2 consumption in Canada, US, UK, Germany, France and Japan was 600, 6,153, 704, 994, 536 and 1,516MtCO_2 respectively (Peters et al (2011), Supplementary Table 8). Suppose a 30$ tax per tonne of CO_2e would reduce overall CO2e consumption by 14%;[29] then in 2008 a pure CFT would have raised 15, 159, 18, 26, 14, and 39 billion dollars in revenues in these countries, respectively[30]; under a hybrid CFT, some products would be taxed on smaller basis than their true footprint and so actual revenues would have been smaller than suggested by these figures.

A carbon footprint tax should be *revenue neutral:* other taxes should be reduced or eliminated so as to keep the tax burden unchanged, both for the country as a whole and for different income groups. Revenue neutrality would raise the political acceptability of any carbon-pricing scheme, since it would help dispel the perceptions that carbon policies are disguised tax hikes[31]. A revenue neutral CFT might also generate a *double dividend.* On the one hand, *revenue recycling* would allow governments to reduce other distortionary taxes

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[29] Jorgenson and Wilcoxen (1993) find that a tax equivalent to $30 in current Canadian dollars would achieve a 14.4% reduction in US C02 emissions over a 25 year time horizon; Böhringer and Rutherford (1997) find that a carbon tax equivalent to $24.8 in current CAD would achieve a 10% reduction in German emissions, while Metcalf (2009) finds that a tax equivalent to $20.35 in current CAD would achieve a 14% reduction in US C02E emissions.

[30] To put these revenues into perspective, note that in the 2008-2009 fiscal year Canada's federal value added tax (called the GST) raised $9.5B, while federal personal income taxes raised $116B (Government of Canada 2009).

[31] Political viability would also be improved by appropriate framing. Economists recognize Pigouvian taxes as price instruments designed to force consumers/producers to internalize the environmental costs of their actions. However, to the general population, *tax* indicates a revenue generating mechanism designed to transfer wealth from citizens to government. Describing a carbon footprint price as a *fee* or *charge* may convey the correct signal that the policy is designed to charge consumers for use of a public good.

such as those on personal income taxes and capital.[32] However, carbon policies also carry with them additional *tax-interaction* effects: efforts to reduce carbon will raise the prices consumers pay for goods, thereby eroding the real return to their labor supply and savings, exacerbating distortions already present in labor and capital markets.[33] In empirical analysis, which dominates---the revenue recycling or the tax-interaction effects---depends on the characteristics of the taxes being offset; see, for example, Bovenberg and Goulder (2002) and Parry (2003).

Countries that are net importers of embodied carbon would generate more revenue by taxing embodied carbon consumption than they would by taxing carbon releases. While this might increase the attractiveness of a CFT for some countries, the increased revenues would effectively transfer wealth from exporters to importers. Indeed, Böhringer, Carbone and Rutherford (2011) find that pairing 20% OECD emission reductions with embodied carbon tariffs would lower GDP in China---the world's largest net embodied carbon exporter--- by 4%. Depending on international differences in marginal propensities to consume carbon, such a transfer might itself reduce carbon emissions.[34] But given that the three largest net exporters of embodied carbon---China, the Russian Federation and India---are all middle or low income countries, there is also an equity argument for pairing a CFT with lump sum transfers to affected developing countries.

5. WTO Consistency

One of the most relevant areas of WTO jurisprudence relates to VATs. When European countries were adopting destination-based VATs in the 1950s and 1960s, countries such as the United States that raised most of their revenues through direct taxes complained that destination based taxation constituted a program of import tariffs and export subsidies. They also argued that import BTAs led to the double-taxation of some traded goods (Whalley 2009). Nonetheless, in their 1970 Report, the Working Party on Border Tax Adjustments characterized VATs as indirect taxes---i.e. taxes levied on goods as opposed to

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[32] Some voters will be wary of government introducing a new tax with the promise that rates of some other taxes will be reduced. Such voters may suspect that future administrations will erode cuts in personal income taxes through incremental increases in future years. One solution to this commitment problem might be to have CFT revenues managed by a third-party which then issues lump-sum rebates to residents. This approach would also convert the CFT program from being regressive to progressive.

[33] In the case of carbon taxes, an additional interaction is possible: to the extent that introducing a carbon pricing policy induces innovation that reduces the CF of goods in the future, consumers may delay the purchase of some durables so as to reduce the lifetime tax bill.

[34] Böhringer, Carbone and Rutherford (2011) assume that consumers have CES preferences over energy and non-energy consumption goods and find that returning BTA revenues to non-OECD countries increases consumption of emission intensive energy, thereby increasing carbon leakage.

individuals/firms---that are therefore eligible for border adjustment as per Article III:2 of the GATT.[35]

5.1 Zero-Rating Exports

Like a VAT, the CFT would be an indirect tax: it would be levied on a product rather than its producer. As such, the CFT would automatically be eligible for border adjustment upon export. GATT Article VI:4 stipulates that exempting exporters from indirect taxes is not to be construed as an export subsidy:

> No product of the territory of any contracting party imported into the territory of any other contracting party shall be subject to anti-dumping or countervailing duty by reason of the exemption of such product from duties or taxes borne by the like product when destined for consumption in the country of origin or exportation, or by reason of the refund of such duties or taxes.

Complaints may arise nonetheless on the grounds that zero-rating exports would be inconsistent with the environmental motivation for the tax, or that a destination based carbon tax would constitute double taxation for foreign producers. To some extent we agree on both points. Allowing exporters to use carbon intensive inputs and production methods without paying corresponding taxes eliminates incentives for innovation and abatement. Similarly, foreign producers that are also subject to either direct regulations or origin-based carbon taxes will be charged for their emissions twice, incenting them to undertake carbon reduction strategies that are overly aggressive from a global efficiency perspective.

Nevertheless, precedent suggests that the WTO is likely to reject challenges to the CFT based on such complaints. In the Superfund case (GATT Case No. 34), the European Economic Community (EEC) argued that rebate for exports violated the Polluter Pay's Principle because exported products would go untaxed in both the exporting and importing country. They also argued that the Superfund tax constituted double taxation on the grounds that "a substance containing the chemical exported from the EEC to the United States would have to bear the costs of environmental protection twice: once in the exporting country in accordance with the Polluter-Pays Principle and again upon importation into the United States under the Superfund Act." (GATT Panel Report 1987 pp 8-9)

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[35] GATT Article III:2 stipulates that countries are eligible to levy "charges equivalent to internal taxes" (GATT 1947 p.4) on imports provided imported goods are charged at a rate that is less than or equal to a domestic tax on a like good. For example, if a VAT of 12% applies to all vehicles sold in the domestic economy, then a BTA less than or equal to 12% can be levied on any imported vehicle sold domestically.

In response, the Panel reasoned that, while the "General Agreement's rules on tax adjustment ... give the contracting party ... the possibility to follow the Polluter-Pays Principle, ...they do not oblige it to do so" (GATT Panel Report p. 17). Instead, what determines whether a tax is eligible for adjustment is whether it is levied directly on products and thus constitutes an indirect tax. The underlying motive for the tax was deemed unimportant: "[w]hether a sales tax is levied on a product for general revenue purposes or to encourage the rational use of environmental resources, is ... not relevant for the determination of the eligibility of a tax for border tax adjustment" (GATT Panel Report p.17). [36]

The Panel's conclusions in the Superfund case uphold the longstanding principle that one country's origin based tax system does not render its trade partner's destination based system inconsistent with the GATT.[37] The Superfund precedent aside, we acknowledge that the problem of double-taxation will arise when an importer practices destination-based carbon pricing while its trade partner exercises origin-based pricing. As with VAT and Superfund taxes, it would appear that the WTO would place the onus for correcting this problem on the country with the origin-based system. In the case of carbon taxes, this would suggest exporters from origin-based countries should ask their governments for rebates on emission/footprint taxes already paid. In exchange, importing governments using destination-based carbon pricing should not challenge those rebates.

5.2 Taxing the Carbon Embodied in Imported Goods

A CFT would be an example of an internal measure with application at the border, and thus would be governed by GATT Article III (National Treatment). As the CFT is a tax, the relevant paragraph would be GATT III:2, which stipulates

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[36]The complete text is as follows: "If a contracting party wishes to tax the sale of certain domestic products (because their production pollutes the domestic environment) and to impose a lower tax or no tax at all on like imported products (because their consumption or use causes fewer or no environmental problems), it is in principle free to do so. The General Agreement's rules on tax adjustment thus give the contracting party in such a case the possibility to follow the Polluter-Pays Principle, but they do not oblige it to do so" (GATT Panel 1987 p.17).

[37] Indeed, export BTAs for indirect taxes are regularly cited as eliminating the double taxation problem. While this may be true for indirect taxes, the same does not necessarily hold for direct taxes. Such was the case with the US's 2000 Extraterritorial Income Exclusion Act (ETI Act). This legislation allowed for the exclusion of income taxes on certain foreign trade related income (Sheppard 2003 p. 6), and which the US defended on the grounds that US firms would otherwise be subject to double taxation. The Appellate Body adopted a narrow interpretation of what constitutes double taxation, deemed the ETI act as delivering prohibited subsidies, and rejected the US's appeal. Two previous attempts by the US to introduce similar legislation---The 1971 Domestic International Sales Corporation (DISC) entity and the 1984 Foreign Sales Corporation (FSC) entity---were similarly deemed GATT inconsistent (Jelsma 1986).

> [Imports]… 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. Moreover, no contracting party shall otherwise apply internal taxes or other internal charges to imported or domestic products in a manner contrary to the principles set forth in paragraph 1.

As we will argue below, the most important term in III:2 is "like". "Like" appears many times in the GATT and related agreements, and how it is interpreted varies according to context.

Consider, for example, the context of GATT Article III:2, second sentence. Together with Article III:1, Article III:2 second sentence stipulates that "no contracting party shall otherwise apply internal taxes or other internal charges to imported or domestic products in a manner" (III:2 second sentence) that are "applied to imported or domestic products so as to afford protection to domestic production." (III:1) where an interpretive *ad* note indicates that the second sentence of GATT III:2 refers to products that are *directly competitive or substitutable products* (DCSP). We believe it highly probable that high- and low-carbon versions of the same good would be viewed as competitive substitutes under this definition.

However, as per III:1, dissimilar taxation of directly competitive goods is only GATT-inconsistent if taxes are "applied to imported or domestic products so as to afford protection to domestic production." Interpreting this language, some rulings have emphasized the phrase "*so as* to afford protection" (emphasis added), suggesting a system of taxes is inconsistent with III:2 second sentence only if it is designed with the intent of affording protection. However, in the Japan-Alcohol case (WTO Case No. 8, 10, and 11) the Appellate Body argued that *intent* to convey protection is not the criterion by which a policy should be judged:

> It is irrelevant that protectionism was not an intended objective if the particular tax measure in question is nevertheless, to echo Article III:1, "*applied* to imported or domestic products so as to afford protection to domestic production" (WTO 1996a p.28).

How would a CFT be judged in these terms? A CFT would disadvantage some imports at the expense of domestically produced goods, but only if the former were produced in a more carbon intensive manner than domestically produced equivalents. As the disadvantage would not stem from differences in country of origin, it is unlikely that a CFT would be judged as affording protection *by design*. However, there would probably be industries in which imports were disadvantaged on average, suggesting that protection was occurring *in effect* in those sectors. However, because the CFT would be applied economy-wide it is also probable that, for any CFT levying country, there would also be product classes in which domestically produced goods are put at a disadvantage vis-à-vis imports. Thus, even if, on

average, one nation's goods are taxed more heavily in the CFT-levying country than another, we argue it is unlikely that the CFT program would be judged as being applied so as to afford protection.

Even if a CFT was not viewed as being "applied...so as to afford protection", it might nonetheless be challenged on the grounds that it is inconsistent with GATT III:2 first sentence in that it differentially taxes what may be considered "like" goods.

Tax rules in numerous countries have been challenged based on III:2 first sentence, and the related jurisprudence is worth exploring. In the US-Taxes on Automobiles[38] case (GATT Case No. 31), a tax threshold was challenged on the grounds that goods just above and below the threshold were taxed differentially even though they are "like" products. In its unadopted report on this case, the Panel argued that "two individual products could never be exactly the same in all respects" (GATT Panel 1994 paragraph 5.6) and upheld the tax threshold on the grounds that it did not appear protectionist *on the margin*.

In contrast, in an earlier report regarding the US-Malt Beverages dispute (GATT Case No. 23), the Panel found that the State of Minnesota's practice of offering excise-tax credits to brewers with annual production below some indicated level was inconsistent with GATT III:2 first sentence. Even though, for the sake of argument, the credit was assumed to also be available to foreign breweries meeting the same production restriction, the GATT Panel judged the tax credit policy as imposing a higher tax rate on "beer produced by large breweries [that] is not unlike beer produced by small breweries [while]…the United States did not assert that the size of the breweries affected the nature of the beer produced or otherwise affected beer as a product" (GATT Panel 1992 Paragraph 5.18). In short, the

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[38] In the US-Taxes on Automobiles case, the European Community (EC) challenged a US Luxury Tax on vehicles costing more than $30,000. The EC contended that "All automobiles represented a single like product. Therefore, by carving out an artificial tax category for automobiles sold for $30,000 and above, which hit European imports with a punitive tax, while exempting almost all US cars or subjecting them to a minimal tax, the United States had violated Article III:2, first sentence." (United States – Tax on Automobiles 1994 parag. 3.5)

In its unadopted report, the Panel "noted that the central issue raised by the parties was whether under Article III:2 cars selling for more than $30,000 were "like" products to domestic cars selling for less." (parag. 5.5) The Panel recognized that "two individual products could never be exactly the same in all aspects. They could share common features, such as physical characteristics or end us, but they would differ in others"(parag. 5.6)). The Panel went on to conclude that, because the Luxury Tax threshold did not appear to have been chosen so as to target European autos, it was not in violation of GATT III:2.

Panel regarded the origin-neutrality of the policy as irrelevant if the policy taxed like goods differentially.[39]

The report of the Appellate Body (AB) in the 1996 Japan-Alcoholic Beverages case similarly suggests that any difference in the taxes facing like goods is unacceptable:

> If the imported and domestic products are "like products", and if the taxes applied to the imported products are "in excess of" those applied to the like domestic products, then the measure is inconsistent with Article III:2, first sentence.

whereby

> [e]ven the smallest amount of 'excess' is too much. 'The prohibition of discriminatory taxes in Article III:2, first sentence, is not conditional on a 'trade effects test' nor is it qualified by a *de minimis* standard' (AB 1996 *Japan-Alcoholic Beverages*, p.23).

Some analysts have inferred from these cases that GATT III:2 first sentence allows *no* distinction in the tax treatment of like goods, regardless of whether the distinction is origin-neutral, is non-protectionist in design, and has no discernible effect on trade or market shares. A CFT would effectively impose higher taxes on goods with high-embodied carbon on those with lower embodied carbon; thus, viewed through the aforementioned lens, a CFT would be deemed inconsistent with GATT III:2 first sentence if goods with high- and low-embodied carbon are deemed "like" goods, a question to which we now turn.

WTO jurisprudence suggests that "like" is narrowly defined in the context of GATT III:2 first sentence. Indeed, most WTO jurisprudence has followed the recommendation of the 1970 Working Party on Border Tax Adjustments which suggested the criteria for determining whether products are "like": "the product's end-uses in a given market; consumers' tastes and habits, which change from country to country; the product's properties, nature and quality (GATT Working Party 1970 paragraph 18, McClure 2011b pp 255-262)[40]. That is, likeness is to be judged based on commercial criteria. However, the Working Party further suggested that "interpretation of the term ["like or similar products"] should be examined on a case-by-case basis" (paragraph 18).

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[39] Howse and Regan (2000) note that the Report in the US-Malt Beverages case is the "only … adopted report invalidating an origin-neutral process measure…and the result in that case can be explained by the fact that the United States offered essentially no policy justification for a law that had a disparate impact on foreign brewers" (p.262).

[40] A fourth criterion---tariff classification---was added by the Panel in 1987 (*Japan – Customs Duties, Taxes and Labelling Practices on Imported Wines and Alcoholic Beverages*, 10 November 1987 BISD 34S/83, paragraph 5.6) (Howse and Turk 2006, Condon 2009).

Although, in many cases, "like"-ness has been judged based solely on these commercial criteria, there have also been several recent cases in which non-commercial criteria were also given weight. For example, in the EC-Asbestos case (WTO Case No. 135), the Panel originally rejected the request to consider *chrysotile asbestos fibres* and *PVA, cellulose and glass fibres* as distinct on health grounds, instead considering only the four criterion laid out by the 1970 Working Party on BTAs and declining to "apply 'a criterion on the risk of a product'" (WTO 2001 paragraph 85). Instead, the Panel concluded that the French ban on the import and sale of asbestos was justified under an appeal to Article XX. The Appellate Body found several faults with the Panel's analysis and ultimately reversed the Panel's conclusion of "likeness" on the grounds that chrysotile asbestos fibres were carcinogenic and thus physically different and because sufficient health risks likely affect consumer preferences.[41] The AB also disagreed with the Panel's approach of judging "likeness", holding that all four criteria should be considered when determining likeness, not just the criteria of whether the goods were physically identical or had the same end uses.[42]

To be clear, the Asbestos ruling hardly sets a clear precedent for tax differentials based on non-product related Process and Production Methods (npr-PPMs)[43]. Firstly, health is compromised by *consuming* products containing asbestos, and so the restriction in question in the EC-Asbestos case was a *product* restriction, not a npr-PPM restriction. Secondly, the AB's ruling that health considerations can be considered when determining "likeness" was in the context of III:4, not III:2. As the Appellate Body has asserted on numerous occasions, the meaning of "like" varies according to context. While "like" is interpreted broadly in the context of III:4, it is interpreted more narrowly in the context of III:2 first sentence. Nevertheless, the AB's ruling in the Asbestos case is relevant because it allows a distinction between products based on health attributes when determining likeness without having to invoke an exception, thereby rejecting the view that health and safety concerns can *only* be

[41] Regarding consumer preferences, the AB reasoned "a manufacturer cannot…ignore the preference of the ultimate consumer of its products. If the risks posted by a particular product are sufficiently great, the ultimate consumer may simply cease to buy that product. This would, undoubtedly, affect a manufacturer's decisions in the marketplace" (parag 122).

[42] In the AB's opinion, the Panel had expressed a "'conclusion' that the products were 'like'" (paragraph 109) after examining only the first and second of the four criteria, and then dismissed altogether the criterion of consumer preferences

[43] Charnovitz (2002) draws a useful distinction between types of npr-PPMs: a *how-produced* standard---which focuses on the method by which a good is produced, a *government policy* standard---whereby an importer restricts market access based on the *laws* in the exporting country, and a *producer characteristics* standard---whereby market access is contingent on the characteristics of the foreign producer, such as its historic emissions. Charnovitz argues that a *how-produced* "might be subject to less scrutiny [than other npr-PPMs] because its means are more clearly related to its policy ends" (p.102). Although a consumption tax on embodied carbon would not be a *standard*, per se, it would fit into Charnovitz's taxonomy as a *how-produced* npr-PPM.

addressed through appeals to Article XX.[44] Moreover, when the AB rejected the Panel's approach of concluding two goods are "like" based on just two criteria (rather than the full set), the AB rejected the principle that satisfying a subset of criteria---e.g. physical similarities and end uses---is a sufficient condition for two goods to be deemed "like".[45]

Similarly, in the EC-Biotech case (WTO Case No. 291, 292, and 293), the Panel's findings suggest a willingness on the part of the WTO to distinguish between goods based on origin-neutral PPMs. In this case, Argentina complained of a III:4 violation, presuming along the way that biotech and non-biotech products were "like" goods. But instead of investigating whether biotech and non-biotech products were indeed "like", the Panel rejected Argentina's complaint on the grounds that there was no evidence that domestic biotech goods had been treated less unfavourably than imported biotech.[46] In doing so, we believe the Panel implicitly distinguished between products based on their production methods (biotech versus non-biotech) and held that discriminating between products in an origin neutral manner was not inconsistent with III:4.

As with the Asbestos case, the Panel's findings in the Biotech case do not give a clear precedent regarding likeness in the context of GATT III:2 first sentence. Biotech and non-biotech products will inevitably differ at a molecular level, and so could be deemed unlike on the basis of having different product characteristics. Moreover, in the EC-Biotech case---as in the Asbestos case---the Panel was asked about GATT III:4, not III:2 first sentence. Nevertheless, we find it instructive that the Panel did not interpret likeness using purely commercial criteria. For example, the Panel could have kept an open mind about whether

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[44] The AB rejected the Panel's reasoning that "considering evidence relating to the health risks associated with a product, under Article III:4, nullifies the effect of Article XX(b)…", arguing that the "scope and meaning of Article III:4 should not be broadened or restricted…simply because Article XX(b) exists and may be available to justify measures inconsistent with Article III" (parag 115).

[45] Specifically, the AB wrote that, "having adopted an approach based on the four criteria set forth in *Border Tax Adjustments*, the Panel should have examined the evidence relating to *each* of those four criteria and, then, weighed *all* of the evidence, along with any other relevant evidence, in making an *overall* determination of whether the products at issue could be characterized as "like" (parag 109)).

[46] Argentina alleged (amongst other things) that the EC had "accorded 'less favourable treatment' to the biotech products ...than to like non-biotech products" (parag 7.2512) since the latter "may be marketed in the European Communities, whereas the relevant biotech products may not be marketed" (parag. 7.2513). In its report the Panel held "that domestic biotech products have not been less favourably treated in the same way as imported biotech products, or that the like domestic non-biotech varieties have been more favourably treated than the like imported non-biotech varieties. In other words, Argentina is not alleging that the treatment of products has differed depending on their origin. In these circumstances, it is not self-evident that the alleged less favourable treatment of imported biotech products is explained by the foreign origin of these products rather than, for instance, a perceived difference between biotech products and non-biotech products in terms of their safety, etc." (parag 7.2514)

biotech and non-biotech are directly competitive or substitutable products (DCSP) and actually evaluated whether Argentina's complaint had merit. Instead, when the Panel said Argentina needed to show that imported and domestic biotech were unequally treated, the Panel tacitly suggested that regulations that are origin-neutral in design and application are not grounds for complaint, even without considering first whether the products in question are indeed "like". This reading is consistent with Pauwelyn's (2006) assessment that these precedents may represent an emerging trend in which "in the future, most of the attention is likely to go not to likeness but to whether the regulation differentiates, either de jure or de facto, based on origin" (p.11).

Although we find ourselves sharing Pauwelyn's optimism, we believe it prudent to consider the alternative. Specifically, suppose that origin-neutrality and absence of de jure or de facto discrimination are deemed irrelevant when assessing whether a tax policy violates GATT III:2 first sentence. In that case, defending a CFT would require showing that goods with high- and low-embodied carbon are indeed un-"like". As contemplated by Low, Marceau and Reinaud (2011), Howse and Eliason (2009), and Bhagwati and Mavroidis (2007), an argument might be advanced that some informed consumers will voluntarily draw a distinction between high- and low-embodied carbon goods, thereby justifying treatment of the goods as un-like. However, a slippery slope counter-argument could run as follows: if countries were allowed to distinguish between goods based on consumer biases that are unrelated to products themselves, countries could engage in a range of protectionist policies. For example, a high-wage country might levy taxes on goods produced by workers earning wages below the local minimum-wage, on the grounds that some consumers prefer goods produced by workers protected by minimum-wage laws.

To avoid this counter-argument, it might be important to distinguish between externalities that are mechanical in nature versus those that are ethical. A consumer's preference for goods produced by "fairly-paid" workers arguably stems from a moral externality suffered when consuming goods produced by workers earning a low wage. In contrast, the externality arising from CO2e releases is mechanical in nature, as climate change directly impacts the health and safety of the consumer herself. Moreover, as Howse and Regan (2000) argue, there is a *replenishment* argument linking a product's npr-PPMs to the product itself: "consumption of physically identical products which differ only in their processing history [can] have different consequences.... In the normal course of economic activity, when a product is sold to the consumer, the seller will tend to replenish his supply from the same source. That means that the purchase of a can of ...dolphin-unsafe tuna tends to encourage the subsequent production of dolphin-unsafe tuna." (p.262). Consequently, an argument might be advanced that consuming a good with a high embodied-carbon content poses a health risk to the consumer herself. As informed consumers will distinguish

between such goods accordingly, goods with high- and low-embodied-carbon are thus un-like on the grounds of consumer preference.[47]

Marceau and Trachtman (2006) argue that, if goods are sufficiently dissimilar in the eyes of consumers, then distinguishing between them for regulatory (or tax) purposes seems redundant[48]: if consumers already perceive high- and low-carbon goods as distinct, then why would government need to levy different taxes upon them? One answer is that a consumer may distinguish between goods based on the harm that they indirectly cause that consumer, but a Pigovian tax is necessary to get selfish consumer's to internalize the additional costs which CO2e emissions impose on people *other* than the consumer. In short, consumer recognition of feedback effects from CO2e emissions to their own health and safety would justify treating goods with high- and low-embodied carbon as un-like. Externalities would in-turn justify the Pigovian taxation of those goods according to global social damages instead of private damages.

In summary, we believe it is possible that the WTO would deem high- and low-carbon goods as un-like based on differences in how their production impacts the health of consumers in the CFT-levying country. Alternately, it is possible that the WTO would extend the precedent set by EC-Biotech in the context of GATT III:4 and allow variation in the tax burden facing goods with low- and high-embodied carbon because the CFT would be origin neutral and neither *de jure* nor *de facto* discriminatory.

However, we would be remiss if we gave the impression that the WTO is certain to approve of a CFT on the grounds that it is consistent with Article III. With this in mind, we now turn our attention to assessing whether there might be viable "workarounds"---i.e. alternate defenses of a CFT, or indeed different regulatory designs---that would render some type of consumption based carbon tax WTO-consistent.

5.3 Alternative Policies

[47] Howse and Türk (2006) argue that it is not essential that *all* consumers in a market differentiate between goods with high- and low-embodied carbon, as "competing firms in the marketplace often differentiate their products to appeal to sub-groups of consumers, and those differentiations may change competitive relationships substantially" (p.93, fn 63).

[48] Marceau and Trachtman observe "[i]t is... conceivable that faced with a PPM distinction referring to human rights violations or other very serious concerns, consumers' preferences will be so strong as to reverse the prima facie evidence that goods that are physically similar be nonetheless considered unlike, pursuant to the Appellate Body statement in para. 119 of its EC -- Asbestos Report. This type of situation may also constitute a justification under Article XX. The point is that if consumer preferences are strong enough to make them unlike, there is little need for regulation. This argument holds if the persons protected by the regulation are the consumers, rather than third parties" (p.56, fn 194).

5.3.1 Following Superfund and GATT II:2(a)

If a CFT is deemed inconsistent with GATT Article III on the grounds that low- and high-carbon goods are un-"like", the policy of taxing goods based on their embodied carbon might alternately be defended on the grounds that the tax is allowed by GATT Article II:2(a), which reads as follows:

> "Nothing in this Article shall prevent any contracting party from imposing at any time on the importation of any product: (a) a charge equivalent to an internal tax imposed consistently with the provisions of paragraph 2 of Article III in respect of the like domestic product or in respect of an article from which the imported product has been manufactured or produced in whole or in part..." (GATT 1994)

On the surface Article II:2(a) seems to open the door for a range of import BTAs based on any internal taxes levied on production inputs, including energy and/or emissions. If, for example, emissions can be treated as a production input, then the CFT could be defended on the grounds that it is a tax on CO2e inputs used.[49]

The US-Superfund case provides some insight into the WTOs treatment of taxes on inputs. As part of the US' 1986 Superfund Act, the US levies a revenue generating tax on the use of certain feedstock chemicals used in the manufacture of chemical derivative products.

Under Superfund, imported chemicals from abroad are assessed a tax according to the amount of the taxed feedstock chemicals used during their production (Demaret and Stewardson 1994 p. 20; Biermann & Brohm 2004 p. 7). That is, the BTA applied to imported final chemicals varies depending on the amount of feedstock embodied in the imported chemical. In 1987 the Superfund tax was challenged by Canada and the EEC on the grounds that the tax "was designed to tax polluting activities that occurred in the United States..." (GATT Panel 1987 p.17). A GATT Dispute Settlement Panel ruled in favour of the US on the grounds that the border adjustment applied a charge on imported final chemicals that was equivalent to the tax that would have been levied on those chemicals had they been produced in the US (GATT Panel 1987 p. 19).

The Panel's ruling in the Superfund case is regularly cited as precedent for taxing goods based on inputs used, even if those inputs were utilized abroad. It should be noted, however, that the Panel did not stipulate whether those inputs needed to be physically incorporated into the traded good. Thus, even though the tax levied on an imported good

[49] Low, Marceau and Reinaud (2011) argue that carbon emissions are an output, not an input, of production. If the WTO were to construe energy inputs as adjustable but not CO2e inputs, then a modified consumption tax levied on fuels---and varying across fuels according to their CO2e contributions---might be advisable, even though it would leave non-fuel related releases untaxed.

depends on how that good was produced, the Superfund case does not offer a clear precedent for treating goods as dissimilar if their non-product-related PPMs differ.[50]

Demaret and Stewardson (1994) point out that II:2(a) is similarly ambiguous on this point. The equally authentic French language version of GATT Article II:2(a) uses the term "incorporée" (translated as "incorporated"), making it unclear "whether Article II:2(a) is intended to limit Article III, so that only taxes on physically incorporated articles are eligible for adjustment on the import of the like final product, or merely to itemize one of the meanings of a tax applied "indirectly" to a product" (Demaret and Stewardson 1994 p.19).

We therefore conclude that it is an outstanding legal question as to whether Article II:2(a) permits a country to levy an internal tax on imported goods based on the non-incorporated inputs used to produce those goods, and thus whether a tax on CO2e or fuel inputs would be deemed GATT-consistent.

5.3.2 Invoking an Appeal to GATT Article XX

A central problem with basing consumption taxes on embodied carbon is that the basis for taxation depends on npr-PPMs. Many analysts have suggested that use of npr-PPMs could be allowed under an appeal to GATT Article XX, which lays out exceptions to the GATT disciplines.

In the climate change context, the relevant paragraphs of Article XX are as follows:

> "**Article XX**
>
> ...nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures:
>
> … (b) necessary to protect human, animal or plant life or health;
> … (g) relating to the conservation of exhaustible natural resources if such measures

[50] Similar to the Superfund tax, the United States also imposes an Ozone Depleting Chemicals (ODC) tax on imports of goods produced using ozone depleting substances. The amount of the border tax adjustment is "based on the amounts of substances used, as reported by the importer or calculated according to the predominant production method approach" (Biermann and Brohm 2005 p. 294). Although some of the taxed inputs are consumed during production---and so the ODC tax can be viewed as a tax on npr-PPMs---this tax has never been challenged and thus does not provide a precedent for WTO-sanctioned npr-PPM-based environmental taxes. The motive for the tax was the US' commitment under the Montreal Protocol to phase out ODCs (Biermann and Brohm p. 294), which could explain why there has been no WTO challenge to date. However, given the ODC tax was implemented two years after the WTO's Superfund ruling was adopted, the lack of a WTO challenge to the ODC tax might alternately be construed as evidence that other countries perceive the Superfund precedent as extending to non-incorporated inputs.

> are made effective in conjunction with restrictions on domestic production or consumption;..."

Article XX(b) requires the measure in question be "*necessary* to protect human, animal or plant life or health" (emphasis added), and so we focus our attention on XX(g).

In the first Shrimp-Turtle dispute, the Appellate Body ruled that an import ban based on npr-PPMs was provisionally justified under XX(g), suggesting "the legality of PPM" (Charnovitz 2000 p.97) as a means to protecting exhaustible resources.[51]

Importantly, there are also precedents that would support the claim that measures to slow climate change are also justified under GATT XX. In the US-Gasoline case (WTO Case No. 2), the Panel

> …examined whether clean air could be considered an exhaustible natural resource. In the view of the Panel, clean air was a resource (it had value) and it was natural. It could be depleted. The fact that the depleted resource was defined with respect to its qualities was not, for the Panel, decisive. Likewise, the fact that a resource was renewable could not be an objection. (WTO 1996b Paragraph 6.37)

It appears the Panel decided clean air was an exhaustible natural resource as it is a resource that is natural and its qualities or characteristics can be depleted. Following this reasoning it seems probable the WTO would rule that climate is an exhaustible natural resource as well.

There is also considerable evidence that climate change is likely to threaten the survival of numerous species (Thomas et al 2004, MacLean and Wilson 2011). Efforts to halt or slow carbon release could thus be justified on the grounds that these measures are related to the conservation of species threatened by climate change.

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[51] In the US-Shrimp-Turtle dispute (WTO Case No. 58), the Appellate Body ruled that turtles---put in harm's way by certain shrimp harvesting methods---could be construed as an exhaustible natural resource. Moreover, since US Public Law Section 609---the law under dispute in this case---was a "measure 'relating to' the conservation of an exhaustible natural resource" (WTO 1998 parag 142), "even-handed" and a "measure made effective in conjunction with [domestic] restrictions" (parag 145), the Appellate Body found the law was "provisionally justified under Article XX(g)" (parag 147). Nonetheless, the Appellate Body also found that the US violated the Chapeau of Article XX by applying Section 609 in an arbitrary and discriminatory manner. After the WTO's ruling, the United States began negotiation efforts with the complainants and issued new guidelines that recognized comparable protective actions. Malaysia appealed to the Appellate Body (Case No. 61) arguing that, "the U.S. import ban still violated the GATT because it still required exporting countries to meet standards 'unilaterally' prescribed by the United States." (Chang 2005 p.34), however, the Appellate Body rejected this complaint on the grounds that the new regulations allowed sufficient flexibility so as to avoid unjustified discrimination. (Charnovitz 2002, Chang 2005).

Given the strong link between climate change and resource exhaustion, many analysts suggest climate related npr-PPMs could be allowed by XX(g). However, as Charnovitz (2002), Hufbauer, Charnovitz and Kim (2009), Low, Marceau and Reinaud (2011), and many others correctly point out, an appeal to Article XX carries two important caveats.

Firstly, Article XX(g) carries the proviso that import-related conservation measures be matched by domestic action. Specifically, the full text of XX(g) allows measures "(*g*) relating to the conservation of exhaustible natural resources *if* such measures are made effective in conjunction with restrictions on domestic production or consumption" (emphasis added). Thus, any climate policy that involves rebating carbon taxes or compliance costs to exporters is likely to fail an appeal to XX(g) because such rebates would inhibit, rather than promote, conservation. Consequently, we think it is unlikely the WTO would approve of a CFT that involves zero-rating exports based on an appeal to GATT Article XX(g).

Secondly, any appeal to Article XX(g) must also satisfy the article's Chapeau, which stipulates that for any measure to be justified under Article XX it must also be

> Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade…(GATT 1947 p. 37).

With the Chapeau in mind, Low, Marceau and Reinaud (2011) argue that defending a policy through an appeal to Article XX(g) is unlikely to succeed unless the measure is "sufficiently flexible and consider[s] measures other Members have enacted, which are comparable in effectiveness, to address the same policy objectives" (p.17). As such, any destination based carbon policy would need to take into consideration all the efforts each trade partner has made towards reducing its own carbon emissions, and alter border adjustments accordingly. We believe this would be logistically infeasible.

5.3.3 Dual policy: Uniform Carbon Footprint Taxes plus Carbon Reduction Incentives

Rather than defend differential taxes on high- and low-carbon goods, a country wishing to pursue consumption based carbon policy might instead pursue the two pronged policy described below.

The first prong would involve a tax that is uniform across all goods within the same product class but varies across product classes. We will call this tax a *Uniform* CFT (abbreviated hereafter as a UCFT).

Provided the UCFT amounts are set according to objective and transparent criteria, the UCFT should not run afoul of WTO law, since each would be an internal measure applied identically to like goods. An obvious methodology would be to set the UCFT for product class *i* equal to the economy-wide tax rate (denoted *t* as in section 2) on CO2e times CF_i^u, where CF_i^u is objectively determined based on some rule, e.g. CF_i^u equals the carbon footprint of the 80^{th} percentile good in product-class i. The carbon footprint for product-

class *i* could be calculated using the same method we outline in section 4.1: using input output tables from a fixed sample of countries and weighting each country according to their share of international production in industry i.

The UCFT would be a credit-method destination based consumption tax, levied at the point of sale or import with rebates paid to firms using goods as intermediate inputs. Exports would be zero-rated.

The second prong would involve a Carbon Reduction Incentive (CRI), which would be a subsidy paid to domestic consumers of final goods. A good *j* in product-class *i* would be eligible for a CRI equal to $t[CF_i^u - CF_{ij}^c]$ where CF_i^c is the certified footprint of product *j*. Certification would be voluntary. Goods that are exported would be ineligible for the CRI, as they would not be consumed domestically, while imported goods would be eligible for the CRI under the same conditions as domestically consumed goods. The CRI would be paid at the point of sale; importers of goods that are not resold in the importing market could apply for the CRI at the point of entry.

There would inevitably be goods that could serve as either final or intermediate goods, e.g. fuel and foodstuffs. In such cases, if a purchaser received a CRI at the point of purchase, but then used the good as an input into the production of a different good or service, she would be given the choice of treating the good as either a final good or an intermediate input. If she treated the good as a final good, she would be permitted to keep the CRI received but forfeit the opportunity to have any UCFT-paid on the good rebated. If instead she refunded the CRI paid, she would be eligible to have any UCFT-paid rebated.

Like the pure and hybrid CFTs discussed in Section 4, the UCFT and CRI could be managed by the same entity that administrates value added taxes. A purchaser of a good would pay UCFT and VAT, and receive CRI, at the point of purchase, and amounts paid/received would be itemized on the product's receipt. UCFT remittances and refunds, as well as CRI repayments, would be executed at the same time as VAT remittances and refunds.

In application, pairing a UCFT with a CRI would have the same incentive effects as the hybrid-CFT discussed in Section 4. Producers of downstream goods who intend to have their own products certified would have an incentive to purchase inputs from low-carbon upstream suppliers, even if the tax-inclusive prices of the low-carbon upstream goods were no different from high-carbon substitutes; this is because the downstream supplier would be able to claim a smaller CF for her own output---and thus offer her own consumers a lower net price on her own product---if she used low-carbon inputs. Moreover, because a supplier would be better able to signal the CF of his upstream product if that CF were certified, upstream firms would face the same incentives for certification (and within-product greening) as under a hybrid-CFT.

The two policies, would, however, be distinct in that one----the UCFT---would be applied throughout the production chain while the CRI would only be applied at the final link:

consumption. This separation might be critical in distinguishing the UCFT as a set of internal fiscal measures governed by GATT article III while the CRI would be a subsidy program governed by the Agreement on Subsidies and Countervailing Measures (ASCM).

Under the ASCM, only *specific* subsidies are actionable or prohibited. Specificity is addressed by ASCM Article 2. For our purposes, the relevant criteria for non-specificity are outlined in Article 2(b):

> Where the granting authority ... establishes objective criteria or conditions[2] governing the eligibility for, and the amount of, a subsidy, specificity shall not exist, provided that the eligibility is automatic and that such criteria and conditions are strictly adhered to. The criteria or conditions must be clearly spelled out in law, regulation, or other official document, so as to be capable of verification. (ASCM Article 2(b))

There are two grounds on which a CRI subsidy program might be deemed *specific.* Firstly, because the maximum amount of subsidy available---$tCFi^u$---would vary across product classes, the subsidy may be deemed *specific* even if the program were applied economy-wide using objective criteria. Secondly, as per the footnote to ASCM Article 2(b)---

> Objective criteria or conditions, as used herein, mean criteria or conditions which are neutral, which do not favour certain enterprises over others, and which are economic in nature and horizontal in application, such as number of employees or size of enterprise.

---a subsidy will be deemed specific unless the criteria for subsidization are economic in nature. Because CO2e emissions arise from the quantity and manner in which inputs are employed---e.g, land use patterns and fossil fuel combustion---, using certified embodied carbon emissions as a criterion for subsidization could be construed as economic in the same sense as "number of employees". However, because the criterion relates to npr-PPMs, it is not certain that a Dispute Settlement Panel would agree that the criteria are economic (or horizontal).

As mentioned, if the low-carbon subsidy were deemed non-specific, it would be non-actionable. However, a CRI would not necessarily be actionable even if it were deemed specific. For this, a complainant would also have to show that the subsidy caused injury. It's worth reminding the reader that this is an important distinction between the rules prohibiting differential taxes on like goods as per the first sentence of GATT III:2, and rules against subsidies. In the tax case, many observers argue that *no* difference in taxes is allowed, regardless of whether the difference drives changes in market share or trade volumes. In contrast, a specific subsidy is only actionable if it causes injury---unequal treatment is not enough. If the subsidizing country was able to show that there were instances in which its subsidy program disadvantaged domestic producers, the WTO might dismiss claims regarding export displacement in one particular sector or another.

Moreover, it might be difficult to prove that export displacement is actually the result of the subsidy program. Some stated willingness-to-pay studies have suggested that consumers are willing to pay large premiums for low-carbon goods[52]. If, in response to the information conveyed by carbon labels (or by the data used to calculate the carbon subsidy), consumers shift their demand toward low-carbon goods for reasons other than the tax differential, it may be hard to prove that a given export displacement is the result of the subsidy program.

5.3.4 Carbon Passport Requirement

Hufbauer, Charnovitz and Kim (2009) suggest importing countries could make it mandatory that all goods consumed within their boundaries bear a *carbon passport* documenting the emissions released during production of the good[53], and goods be taxed based on these passports. Such a tax may well be deemed consistent with GATT Article III since differences in reported carbon would serve to differentiate high- and low-carbon goods as un-"like". However it is not so clear that a passport requirement would itself be deemed consistent with the WTO rules governing standards. As a mandatory labeling requirement, a carbon passport would be viewed as a technical regulation and governed by the TBT agreement (see definition 1 in Annex 1 of the TBT Agreement). A carbon passport requirement may violate Article 2.2 of the TBT, which says technical regulations must not have the "effect of creating unnecessary obstacles to international trade…[and] shall not be more trade-restrictive than necessary to fulfill a legitimate objective" (TBT Agreement 1994 p. 2). It could be argued that the same objectives could be met with a less trade restrictive measure. Moreover, Article 2.1 prohibits the differential treatment of "like" goods, which again brings up the issue of product likeness. Should the WTO deem embodied carbon insufficient grounds to differentiate otherwise like products, then carbon passports that differentially label products within a product class could violate Article 2.1. Thus, it is unclear that a carbon passport would be consistent with the TBT agreement and potential conflicts could arise over Articles 2.1 and 2.2.

5.3.5 Carbon Penalties

Another potential workaround might be to pass a regulation stipulating that all goods should have a certified carbon footprint of zero, and impose financial penalties on all goods with positive carbon footprints.[54] Because carbon charges would be punitive, not fiscal

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[52] For example, Michaud, Llerena, and Joly (2012) find that participants in a choice experiment were willing to pay an average premium of €4.09 for a rose that was a low carbon variety (p. 22).

[53] As a precedent for requiring certificates, Hufbauer, Charnovitz and Kim (2009) cite the waiver granted by the WTO to participants of the Kimbereley Process Certification Scheme, which allowed these countries to prohibit imports of diamonds not documented as conflict-free. However, that waiver was only originally granted from 2003 through 2006 (WTO 2003 p. 2).

[54] In keeping with our earlier policy designs, it would be sensible to use a baseline CF to cap the penalty payable: if a product does not have a certified carbon footprint, it is assumed to have a footprint equal to the baseline for the good's product-class, where the baseline is determined by some objective criterion.

measures, they would not be governed by GATT Article III:2 as per the Panel's report in the United States-Tobacco case (GATT Case No. 44). However, as is the case with the carbon passport requirement, this approach may face challenges on the grounds that it may violate Article 2.1 and/or 2.2 of the TBT Agreement. Moreover, because any carbon charges would be *penalties*, as opposed to fiscal taxes, there would be no grounds for rebating payments to exporters.

6. Policy Comparison

In the preceding sections, we have assessed whether a consumption based carbon policy might serve as a logistically feasible, WTO-consistent means of reducing carbon emissions without sacrificing the competitiveness of domestic firms. We were motivated to undertake this analysis because we believe that the two types of policies currently in practice or under consideration---emissions trading (also known as Cap & Trade) and carbon taxes---cannot be paired with border measures in a WTO-consistent manner. In this section, we briefly discuss the evidence supporting our claim. We begin with emissions trading.

6.1 Border Measures and Cap & Trade

In a Cap & Trade system covered entities would be required to surrender a fixed number of permits for each ton of CO2e released. Permits might be allocated freely and/or auctioned. The European Union's (EU's) Emission Trading System (ETS) is the most prominent example of Cap & Trade; carbon permit trading systems are also either in place or soon entering into force in Australia, New Zealand and California.

6.1.1 Imports

The border measure most commonly considered in tandem with Cap & Trade is a requirement that importers purchase allowances for imported goods. But what is the right price at which importers must purchase allowances? If domestic firms receive some of their permits for free, should importers also be given a discount off the market price? And who will (and how will they) calculate the number of permits necessary for a particular imported good? Varying permit requirements across goods based on country of origin would violate GATT Article I regarding Most Favoured Nation Treatment (MFN) and would hurt importers with below country-average carbon intensities. In addition, some proposed emissions trading schemes would only impose allowance requirements on imports from countries without comparable action to reduce greenhouse gas emissions.[55] This begs the

[55] The Waxman-Markey bill--- H.R. 2454 "The American Clean Energy and Security Act of 2009"(http://www.govtrack.us/congress/bills/111/hr2454/text)--- required "the submission of appropriate amounts of [international reserve] allowances for covered goods with respect to the eligible industrial sector that enter the customs territory of the United States" (Sec. 768) but only for imports from countries that had higher energy or C02e intensities in the relevant sector than the US and had not signed a multilateral agreement (to which the US was also a signatory) in which their C02e reduction commitments were at least as stringent as the US' (Sec. 767(c)).

question as to what constitutes "comparable action": if a trade partner has committed to binding emission reductions but a particular sector is exempt from compliance, will products from the exempt sector be subject to allowance requirements?

Relatedly, it is unclear that the WTO will allow governments to impose permit requirements on imported goods in the first place. As Hufbauer, Charnovitz and Kim (2009) point out, "the requirement that importers purchase [permits] seems to fit within "other duties and charges" on importation that are regulated by GATT Article II:1(b). If so, the requirement amounts to an automatic violation..." (p.81). Citing the United States-Tobacco case, Howse and Eliason (2009) offer the following defense. Writing in the context of a hypothetical US tradable permit program, they argue that permit requirements would be regulations and thus governed by GATT Article III:4; moreover, "the proposed application of an 'allowance' requirement to imports [should] not [be seen] as a tax or charge, and even less an Article XI quantitative restriction, but as ancillary to the enforcement or administration of a US regulatory scheme that applies to both domestic and imported products" (p 31). The problem with this defense is that all of the emission trading programs currently in place or under consideration involve obligations on *firms*, while border permit requirements would be levied on products. Unless the permit requirements facing domestic firms are levied on a product-by-product basis, there would be a disconnect between the treatment of domestic and imported goods.

An alternative proposal is to pair domestic permit requirements with a border measure applied in the form of a tax. The tax might be defended on the following grounds: domestic producers ultimately pass through to consumers the costs of permit obligations. Thus a "border requirement to hold an allowance is ... arguably a 'charge' which is 'equivalent' to the internal requirement for US businesses to hold allowances which, in turn, is a kind of 'internal tax'" (Pauwelyn 2007 pp.22-23)[56].

As with imposing permit requirements on imported goods, it would be unclear how to calculate the carbon content of imported goods, as proposals to base CFs on national averages would violate GATT Article I. Even if the CF were assumed to be universal for all foreign produced goods this may violate Article III (National Treatment) as a domestic carbon tax would "involve *variable* burdens based on individual domestic firms' carbon emissions" (Moore 2011 p.1681) and thus the products of foreign producers must also be judged on a firm-by-firm basis.[57] Ismer and Neuhoff (2007) propose an elegant remedy: tax

[56] Given that the WTO has repeatedly rejected efforts by the US to treat profit and other types of taxes levied as adjustable---see, for example, the Panel and Appellate Body reports in the US-Foreign Sales Corporations case---we anticipate the WTO would be unwilling to translate a regulation or tax levied *on firms* as an indirect tax on products in the case of carbon policy.

[57] Moore (2011) suggests that calculating BTAs on a firm-by-firm basis would result in "extremely difficult cross-border data collection requirements" (p.1681) and impose additional problems similar to those

imported goods based on the costs they would incur if they used the global best available technology (BAT) and were required to purchase permits in the market into which they import their goods.[58] Ismer and Neuhoff call this border adjustment a BAT BTA. The advantage of this approach is that the tax levied on imported goods would never be higher than the burden facing domestic producers of like goods. An obvious downside to the BAT BTA approach is that it would put domestic firms at a disadvantage vis-a-vis imports, as all but the least carbon-intense domestic firms would face higher compliance costs than any of their foreign counterparts.

From a legal perspective, another obstacle would be that regulations are not eligible for border tax adjustment---only indirect taxes are eligible. Absent a comparable indirect tax on domestically produced goods, the BAT BTA would most likely be interpreted as a tax on products---a product tax from which domestically produced goods are exempt on the grounds that domestic producers already incurred comparable costs when complying with domestic permit obligations. However, foreign producers who similarly incurred costs---either directly or indirectly---of complying with climate regulations or directives in their own countries would not be eligible to have their own goods exempted from the product tax. We believe this proposal would thus violate the National Treatment principle. To bring Ismer and Neuhoff's proposal into compliance with GATT rules, importing countries would have to evaluate the compliance costs embedded in incoming goods on a case-by-case basis. We believe this would be logistically and economically infeasible.

6.1.2 Exports

The above discussion pertains to leveling the playing field with respect to imports. For exporters, a commonly proposed action is to rebate permit costs to exporters.[59] However, as mentioned permit requirements are likely to be deemed *regulations*, not indirect taxes, and thus ineligible for border tax adjustment (de Cendra 2006 p. 135). Moreover, because permits have a market value, exempting a firm from surrendering allowances if and only if it exports may well be construed a prohibited export subsidy.

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currently arising with anti-dumping claims, including the difficulty of how to treat foreign firms that are uncooperative with investigators and how to adjust assessments over time.

[58] Moore (2011) suggests an amendment in which the BTA should be based on the best available technology in the importing country. If a foreign firm's emission intensity is even lower than this baseline, that firm would be welcome to submit proprietary data confirming its lower emission intensity, which would then become the basis for the tax adjustment on imports from that firm.

[59] Ismer and Neuhoff (2007) instead propose that "exported products should receive the same remission irrespective of how they were actually produced" (p.145) so as to maintain incentives for actual emission reductions, and that the remission should be based on compliance costs when using the global BAT, priced at the average cost of permits.

6.2 Border Measures & Emission Taxes

The other leading carbon policy is a carbon tax, particularly one levied on the latent emissions in fossil fuels. Sweden, Denmark, Norway, Finland, Italy, and the Netherlands all have carbon taxes, although all of these exempt some sectors and the implicit tax on carbon varies widely across fuels. British Columbia's carbon tax is instead levied on fuels based on their carbon content; two thirds of the province's C02e emissions are covered (British Columbia Ministry of Finance 2008 p. 13). Ireland has similarly introduced a carbon tax on fuels as well as carbon-related charges on waste disposal and auto purchases.

As discussed in section 5.3.1, a carbon or energy tax might be eligible for border tax adjustment on the grounds that GATT Article II:2(a) allows governments to impose charges "equivalent to an internal tax…in respect of an article from which the imported product has been manufactured." Applying a BTA based on global or domestic BAT (as per Ismer and Neuhoff (2007) and Moore (2011)) would likely comply with National Treatment, eliminating the question of how border adjustments should be calculated.

However, as we also discussed above, it is unclear that carbon and/or fuel taxes meet the criteria laid out in II:2(a), as it has not been settled whether taxes levied on inputs that are not physically incorporated in the traded product are eligible for border tax adjustment. Indeed, when the Working Party on Border Tax Adjustments issued its 1970 report, it did not include energy taxes in the list of indirect taxes. Energy taxes were instead given as an example of *taxes occultes*---clearly distinguishing them from indirect taxes and direct taxes. The Working Party refrained from drawing a conclusion as to the admissibility of taxes occultes for border tax adjustments because of the "scarcity of complaints reported in connection with adjustment of taxes occultes" (GATT Working Party 1970 p.3)

Some analysts suggest that the legal case for pairing emission/fuel taxes with export BTAs is stronger. Ismer and Neuhoff (2004) and Biermann and Brohm (2005) argue that the ASCM prohibits parties from interpreting rebates of energy taxes as export subsidies, on the grounds that ASCM Annex I ("Illustrative list of export subsidies") item (h) indicates it is acceptable for countries to exempt, remit or defer "prior-stage cumulative indirect taxes ...levied on inputs that are consumed in the production of exported product" even if the same country doesn't allow rebates to non-exported like goods. Meanwhile, Footnote 61 to Annex II of the ASCM clarifies that energy is a "consumable" input: "[i]nputs consumed in the production process are inputs physically incorporated, energy, fuels and oils used in the production process and catalysts which are consumed in the course of their use to obtain the exported product" (ASCM Annex II, fn 61). However, de Cendra (2006), Hufbauer, Charnovitz and Kim (2009) and McClure (2011b) point out that ASCM Annex I item (h) only refers to *cumulative* taxes. Importantly, the carbon-motivated energy taxes in place/under consideration are not cumulative. Indeed, in the "Uruguay Round, the US government went on record suggesting that item (h) and footnote 61 were *not* meant to allow export BTAs on energy inputs " (Hufbauer, Charnovitz and Kim 2009 p.45). The American statement doesn't bind the WTO, however, it does indicate that there has not been widespread consensus that

the ASCM approves rebates of energy taxes. Consequently, whether the WTO will interpret energy or emission taxes as indirect taxes thus eligible for border adjustment is an open legal question.

In summary, we think it unlikely that the WTO would regard favourably border measures applied in tandem with domestic emission trading. Permit requirements for imported goods would likely violate GATT II:1(b), while import taxes---even ones that are no greater than the burden facing domestic firms---will violate National Treatment. Pairing domestic fuel and/or emission taxes with BTAs stand a better chance, but only if the WTO allows border adjustment on non-incorporated inputs. In that event, the CFT would similarly be defensible as per the arguments outlined in section 5.3.2. Which policy is preferable would then depend on how policymakers value the tradeoffs. With a hybrid-CFT all of the firms selling domestically would have an incentive to reduce their carbon footprints, and domestic exporters would be on an even footing with unregulated competitors; however, firms would need to undertake costly certification in order to reap these competitiveness benefits. Ismer and Neuhoff's (2007) and Moore's (2011) BAT BTAs would save on computational costs as there would be no need for any footprints to be calculated other that associated with the BAT for each product class. The downside of the BAT BTA approach would be that all but the greenest domestic firms---including exporters---would be put at a competitive disadvantage with respect to dirty foreign-produced goods.

7. Conclusion

In a 2001 speech, US President Bush justified the US' refusal to ratify Kyoto on the grounds that "complying with those mandates would have a negative economic impact, with layoffs of workers and price increases for consumers" while "the world's second largest emitter of greenhouse gases is China. Yet China was entirely exempted from the requirements of the Kyoto protocol" (Sanger 2001). In the intervening years the global scientific community has provided increased precision regarding the likely consequences of climate change. But governing bodies have not been able to arrive at a binding global agreement to limit releases from many of the world's largest emitters, and so much policy research has instead focused on unilateral approaches. As illustrated in President Bush's remarks, for many countries a unilateral approach that does not protect competitiveness is untenable.

In this paper we have fleshed out the mechanics of a consumption tax on embodied carbon. This instrument has been lauded as a carbon policy that addresses competitiveness concerns without violating commitments under GATT. But until now neither its advocates nor its critics have provided sufficient detail for analysts to evaluate whether taxes on embodied carbon are legally or logistically feasible.

Amongst the set of policies that tax imported goods according to their associated emissions, the CFT would be the most likely to withstand challenges under GATT. Because the CFT would be an indirect tax levied on products, there would be no ambiguity as to whether it

would be eligible for border tax adjustment. Moreover, the rules by which the CFT would be applied are identical for all products, regardless of where they are produced. A CFT might, however, violate National Treatment on the grounds that the net tax due on each good would depend on its carbon footprint, and that carbon footprint would vary across goods that consumers otherwise perceive as interchangeable. While consumer preference for low-carbon goods makes a compelling argument that such tax variation might be GATT-consistent, consistency of a CFT with the GATT's rules on National Treatment is not assured. With this in mind, we have investigated a series of alternate incarnations of consumption based carbon policy, including a dual policy approach in which intermediate goods face a uniform carbon tax---identical across goods in the same product class---while consumers receive a Carbon Reduction Incentive when they purchase final goods with certified footprints smaller than the baseline. In economic terms this dual-policy program should have an identical effect as a hybrid-CFT. However, the former may have a legal advantage in that subsidies are governed by a different---and, arguably, more flexible---agreement than are internal taxes. As such, the "tax plus subsidy" program may be more likely to be deemed WTO consistent.

Although the administrative costs of implementing a CFT would be higher than alternate schemes such as upstream fuel taxes, our analysis suggests a hybrid CFT would still be logistically and economically feasible. For example, using a bottom-up approach (in which 10-digit NAICS industry codes define product classes and baselines are based on the actual footprints of representative firms), the administrative costs of calculating the set of Default CFs would likely be between 0.1% and 1% of CFT revenues in a country such as Canada. Moreover, in many countries---but not, notably, the United States---the envisioned CFT could minimize compliance costs by building on existing tax collection infrastructures; like emission taxes the CFT could also finance reductions in distortionary income, payroll and capital taxes. Alternately, a country might consider using a top-down approach in which baselines are calculated using data from country-level input-output tables from a sample of nations.

Despite its merits, a CFT would also have several drawbacks. Employing a system of Default CFs might be necessary for keeping compliance costs low and avoiding allegations of GATT-violations. However, the Default system would remove incentives for the most carbon-intensive producers to lower their own carbon emissions. Defaults could also unravel incentives for upstream abatement when producers are credited for CFT paid on inputs.

Additionally, zero-rating exports would dis-incent exporters from reducing their carbon intensity; zero-rating might also lead exports of high-CF goods to crowd out exports of low-CF goods from the same country. Further, zero-rating would exacerbate consumption leakage. Accordingly, countries might want to forego some of the competitiveness benefits of a CFT by phasing out the practice of zero-rating unless trade partners have adopted their own destination-based carbon pricing schemes. After an adjustment period has passed, it

might make more sense for large CFT-levying countries to utilize their full policy-reach and require that exported products be taxed similarly to those consumed domestically.

Finally, when judged relative to origin-based carbon pricing (or no carbon policy at all), some of the revenues raised by a CFT should be interpreted as a transfer from net exporters of embodied carbon to net importers. As Böhringer, Carbone and Rutherford note, a similar transfer would occur if BTAs were tied to an emissions tax or cap and trade system (p. 25). While such transfers might be an effective "stick" in multilateral negotiations and/or induce trade partners to adopt destination-based climate pricing themselves, the distributional implications of climate policies that transfer rents from (predominately) industrializing countries to (predominately) rich industrialized countries should not be dismissed.

With these caveats in mind, whether a CFT is preferable to a production-based policy such as Cap and Trade or a fuel tax ultimately depends on the extent to which equal treatment of traded goods is important. For countries with high trade intensities, putting forward policy that places domestic and foreign-produced goods on an equal footing may be the critical factor determining whether effective climate policy is enacted at all.

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