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Border Tax Adjustments: A Feasible way to Address Nonparticipation in Emission Trading

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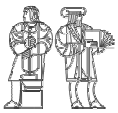

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Border Tax Adjustments: A feasible way to address nonparticipation in Emission Trading

Roland Ismer and Karsten Neuhoff [1]

CO2 emission certificates internalise effects of fossil fuel consumption on global climate and sea levels. If they are only implemented in some countries, then their effectiveness is limited; Consumption, production and investment decisions do not reach the optimal allocation, production with inefficient technologies in non-participating countries can even be increased. Furthermore industry lobbying might result in limited application of CO2 emission certificates or less ambitious reduction targets.

Border tax adjustment at the level of additional costs incurred for procurement of CO2 emission permits during production of processed materials using best available technology limits the distortions. We show that it can be compatible with WTO constraints. Crucial features of a practicable implementation are simplicity achieved by a focus on the CO2 emissions caused by processed materials and a separate treatment of electric energy input to take account of regionally varying fuel mixes.

1. Introduction

The European Union has recently adopted a directive obliging the member states to introduce greenhouse gas emissions certificates.[2] From January 1st 2005, certain business activities[3] leading to emissions of carbon dioxide (CO_2) will require permits for these emissions.[4] The permits contain the obligation of the business to hand over allowances covering the emissions within four months following the end of the calendar year.[5] The allowances, which are freely tradable within the Union[6], will mostly be allocated to the businesses free of charge.[7] A small part of at first 5 per cent, rising to ten per cent by 2008 can be sold to the businesses if the individual member state so chooses.[8] The directive aims to implement the obligations under the Kyoto Protocol, according to which the European Union has to reduce its greenhouse gas emissions by 8 percent by 2008 to 2012 relative to the 1990 levels.

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[2] DIRECTIVE 2003/83/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.

[3] Cf. Annex I of the directive.

[4] Art. 4 of the directive.

[5] Art. 6 para 2 (e) of the directive.

[6] Art. 12 of the directive.

[7] Art. 10, first sentence of the directive.

[8] Art. 10, second sentence of the directive.

However, the US as the biggest CO_2-emitter has decided not to ratify the Kyoto Protocol. This raises concerns as to the unequal treatment of producers in the developed Kyoto countries, among them the European Union, and the US. Whereas the former have to incur the costs of CO_2-abatement plus whatever carbon charges are in place, the latter do not suffer that burden. Both equity and an efficiency consideration result. First, it might appear unfair that European producers have to compete at an unequal footing, which would mean their profits would be lower. Second, the unevenness of the playing field threatens to at least partially defeat the purpose of the introduction of emission certificates. Energy efficient and therefore low CO2 intensive production in participating countries might be replaced by less energy efficient production in non-participating countries.

Border tax adjustments (BTA)[9] can contribute towards mitigating these problems. A border tax adjustment consists of the imposition of a charge on imported products correspondig to a tax borne by like domestic products and the exemption from or remission of taxes on products when they are exported.[10] In practice, this means that exporters from the European Union will get charges they incurred at least partially refunded. Importers, on the contrary, will face a tax payable on entering the Union.[11]

This paper will propose a system of border tax adjustments. The suggested taxes imposed at the border and the charges refunded seek to mirror those that would have arisen when producing the product in the Union. In practice, due to information constraints, this is not directly possible. However, we shall argue there is an indirect – albeit admittedly less efficient – way. The lower bound of emissions embodied in a product can be estimated by determining the different quantities of raw materials employed in its production multiplied respectively by the emissions in production per unit of that particular raw material. Such a scheme would have the advantage of conducing participants to reveal information: Producers from abroad would argue for an advanced (i.e. low emissions per unit) level whereas domestic producers would profit from a less advanced (i.e. high emissions) level. It could therefore be expected that the body entrusted with the determination of emissions per unit of raw material would dispose of sufficient information for fulfilling its task. To protect the decision process from domestic lobbying, the independence of that body should be safeguarded. A slightly different

[9] In the context of emissions trading certificates, it might appear slightly more appropriate to speak of border adjustment taxes rather than border tax adjustments. For, strictly speaking, there are no taxes that needed to be adjusted. Rather, taxes are the instrument, to adjust for the internal charges. However, the term border tax adjustment is by far more common and shall be employed here.

[10] *Demaret/Stewardson*, Border Tax Adjustments under GATT and EC Law and General Implications for Environmental Taxes, JWT 28:4, 1994, p. 5 – 65, p. 2. See also the equivalent but slightly more technical definition in GATT Working Party on Border Tax Adjustments 1970, para. 4.

[11] Such a system is currently in force for VAT: For example, a tourist from Austria travelling to Switzerland and buying a computer there, will on purchase have to pay Swiss VAT. When she leaves the region she can claim an reimbursement of Swiss VAT, but will have to pay import tax when entering the Austria with a tax rate equal to that of Austrian VAT. Hence, the decision for the Austrian consumer whether to buy in Austria or in Switzerland should be unaffected by differences in VAT between the countries.

approach has to be adopted for electricity input however. There, the price increase due to the introduction of the emissions trading scheme per kWh multiplied by the electricity consumed in production with best available technology should be adopted.

The paper will argue that such a scheme would preserve the potentially huge benefits for the participants which trade liberalisation can bring about, where properly applied. It would be in compliance with World Trade Organisation (WTO) rules. If this were not the case, border tax adjustments could trigger countervailing measures. It would also be sufficiently clear and simple to ban the sprectres of disguised protectionist intentions and of political meddling, which would threaten the benefits from trade liberalisation. Ensuring WTO legality however comes at a price: To be on the safe side, the paper will propose a scheme, which incorporates two concessions. First, it will suggest an adjustment for the costs of certificates corresponding to production with best available technology only and not with average technology. And secondly, using the indirect method, which considers only basic materials employed in production means that subsequent energy inputs are not adjusted for.

This proposal stands in contrast to much of the existing literature. It has largely focused on adjustments for ecological taxation, i.e. adjustments for taxes rather than for other charges. Where border tax adjustments for CO_2 emissions trading schemes are discussed, they are frequently perceived as either potentially illegal[12] or as posing formidable technical difficulties. In particular, the need to identify the appropriate carbon contents embodied in traded goods where exporting countries are unwilling to cooperate in the certification of production methods has been considered to be insurmountable.[13]

It seems worthwhile mentioning that border tax adjustments are intertwined with allocation rules for the emission certificates in two significant ways. The current EU framework provides initially for partially free allocation of emission certificates, thereby reducing the average costs incurred by European producers. It is a temporary instrument mainly aimed at reducing the impact of emission trading on industry. Free allocation creates significant distortions and negative distributional effects and should therefore be totally phased out as soon as possible. Border tax adjustments firstly should allow for an accelerated phase-out schedule as they limit the negative effects of implementation CO2 emission certificates for industry in regions with emission trading. Second, if grandfathered emission certificates are perceived under WTO law as part of the emission certificates scheme and not as lump sum payments to buy of industry opposition, then grandfathered emission certificates reduce the

[12] Cf. *Daniel C. Esty*, Greening the GATT – Trade, Environment and the Future, 1994 at 168 on a proposed introduction of US border tax adjustments. However, as he points out, these adjustments would have to be seen in the context of far higher energy taxes in Japan and Europe. He proposes a system of giving credit for comparable foreign charges and taxes.

[13] *Erik Denters*, Free Riders in the Combat against Climate Change. Claims and Countermeasures, p. 15, available atwww.xs4all.nl/denters/publications; *Zhong Xiang Zhang*, Greenhouse Gas Emissions Trading and the World Trading System, JWT 32(5): 219-239 at 231.

average costs industry faces from the emission certificate scheme. Only the average costs incurred by industry can be imposed as border taxes, therefore grandfathering could reduce the level and hence the effectiveness of border taxes.

The paper contains the following section. Section two describes the productive and allocative inefficiencies of implementing emission certificates only in one region and shows how border tax adjustments can mitigate these effects. Section three analyses the restrictions on the optimal solution set by international law and in particular GATT. Section four and five addresses technical questions concerning the implementation and conclude.

2. The Economic Case for BTA

Overwhelming scientific evidence demonstrates that CO2 emissions change the global climate and lead to adverse effects for humankind as a whole.[14] Yet when making consumption or production choices agents typically do not weigh the negative effect of their decisions on other people sufficiently. They are therefore likely to cause and in turn also to suffer from the consequences of excessive CO2 emission. CO2 emissions certificates seek to provide a remedy for this problem. They are designed so as to expose producers and consumers to the costs their decision to emit CO2 has on other humans, or in other words, they seek to internalise the negative externality in their decision.

In theory, this can be achieved quite easily: If the future damage caused by climate change were known, then we would simply have to make anyone emitting CO2 to bear this cost. This would ensure optimal production and consumption decisions. However, in practice, uncertainty about future costs and political pressure by groups, which anticipate losing from the redistribution of tax burden, delay this process. This can give rise to situation where only some countries implement CO2 emission certificates. This raises the questions whether this partial implementation reduces the effectiveness of that measure and if so, whether BTA can help to restore some of the efficiency in such a case.

The first question can be answered with the assistance of a brief economic model. Assume several technologies are available to transform energy into a product. Technologies only differ in their energy efficiency, in the amount of energy required to produce one unit of the product. This is a simplified model that only looks at the first order effects of energy and assumes that production is similar with regard to all other production factors. In the dynamic analysis we will furthermore assume that different technologies differ in their investment costs. This does not affect the static analysis, because

[14] IPCC synthesis report 2001.

investment costs are sunk at the time of production decisions. Assume all technologies are present in two regions USA and Europe and the product can be traded without costs between these regions. We assume perfectly competitive demand, supply and arbitrage. We furthermore assume that the markets are in equilibrium, such that production, trade and consumption can be assumed to occur simultaneously. Without border adjustment taxes, prices are therefore equal in both regions.

Static analysis

In the first step, we present a static analysis assessing the utilisation of existing production facilities.

We first show that **global implementation** of Carbon Emission Certificates results in optimal production and consumption decisions. Production costs increase by the cost of emission certificates. Producers with the least efficient production technologies require the most emission certificates per unit of output and incur the highest cost increase. Consumers will reduce their demand if prices increase. Hence, the least efficient firm will not produce. Introduction of CO2 emission certificates therefore increases price and weakly reduces production in both regions relative to a scenario without emission certificates (Equation (3) and (4) in Appendix). The new production and allocation is efficient, because all externalities are internalised in the decision process. The analysis ignores uncertainty about future technologies and emission targets and learning externalities. If resulting dynamic effects are considered, then it is likely that under an optimal CO2 reduction policy CO2 emission certificates are complemented with other measures.

Now assume **partial implementation without border tax adjustment.** What happens relative to a scenario without emission certificates? Producers in region Europe are required to obtain emission certificates. Production costs increase in region Europe. The least efficient producers in region Europe will reduce output. A reduction in supply increases prices and results in lower consumption in both regions and higher production in region USA. In the full implementation scenario supply is also reduced in region USA, therefore the price increase is larger in the full implementation scenario (Proposition 3 in Appendix). Price increases induce consumption reductions. Partial implementation reduces consumption but not to the efficient level achieved with full implementation. Partial implementation also results in inefficient production decisions: In region Europe cost increases at the same level as under full implementation but the product price increases by less than under full implementation. Thus, production in region Europe with partial implementation is not only lower than under no implementation, but even lower than under full implementation. Partial implementation results not only in output reductions of inefficient firms but also in output reductions of some efficient firms (Proposition 1 in Appendix). This contrasts to region USA, where higher prices at constant costs result in increased output quantities and therefore imply that even technologies that are inefficient

under no-implementation will be used for production (Proposition 2 in Appendix). Production with inefficient technologies can reduce part or potentially all of the welfare gains from adjusting consumption towards the optimal level achieved under full implementation. People in both regions will suffer from the excessive emissions. Partial implementation without border tax adjustment might in some energy intensive industries with strong global competition contribute little to a reduction of global CO2 emissions.

Now assume **partial implementation with border tax adjustments** at the level of best available technology. It works as follows: Whenever a product is imported into Europe the importer has to pay a tax corresponding to the costs the most efficient producer in Europe incurs for emission certificates. BTA improve both the static and the dynamic efficiency of the emission certificates and have favourable political economy implications. The exact effect of an emission certificates scheme with BTA can again be analysed with the help of the above model. This is a special case of Grossman's analysis of BTA, which is non-distorting, if a 'stage of processing' value added tax (1980).

Partial implementation with border tax adjustment in Europe can result in an increase or decrease of production in the USA relative to no emission certificates, dependent on the demand and technology (Proposition 4 in Appendix). This is the result of two countervailing effects: Demand is reduced – therefore global production is reduced and all producers are affected. If demand is very price responsive in Europe, then the global demand reduction is the dominant effect and producers in the USA will face lower output levels.

However, producers in region Europe pay a weakly higher cost for the emission certificates than producers in region USA pay for the border adjustment tax at the level of best available technology. If dispersion of efficiencies between technologies is high then this effect dominates and producers in the USA benefit from the partial implementation with border tax adjustment and their output is increased.

As the impact on producers in the USA can be ambivalent, it is of interest to see, whether partial implementation with border tax adjustment can be seen as a means of reducing market share of US producers. This would be the case if US producers not only had to reduce their production relative to no emission certificates, but if a wider range of US production technologies would turn inefficient than European production technologies under the implementation of emission certificates with border tax adjustment. Proposition 5 in the Appendix shows, that given typical assumptions on well-behaved demand functions this is not the case. Therefore partial implementation with border tax adjustment does not "discriminate" against US producers.

Dynamic Efficiency

Under partial implementation of CO2 emission certificates without border adjustment taxes, **investment in production** in Europe is reduced in our stylised model relative to both no implementation and full implementation. Emission certificates increases the production costs by more than the rise in market price, therefore investment options which were previously profitable might no longer be profitable. In contrast, in the USA production costs stay constant but price increases. This will result in additional investment in the USA. The shift of production from Europe to the USA results in costly, and therefore inefficient re-allocation of production and labour from Europe to the USA with subsequent product flows from the USA to Europe.

Investors face a trade off between low investment costs coupled with high energy costs for inefficient machines and high investment costs for efficient technology coupled with low energy costs. CO2 emission certificates increase energy costs and therefore shift the balance towards more energy efficient technologies. However, investment in the USA is not affected by emission certificates. Investors shifting investment from Europe to the USA will invest in weakly less energy efficient technology than they would have used in Europe. Therefore lack of border adjustment taxes can eliminate a large proportion of the dynamic effect of emission certificates to ensure investment in energy efficient technologies. This effect might be compensated by technology spill over from Europe to the USA of more efficient technologies deployed under the higher energy costs.

Emission certificates with border tax adjustment retain the incentive for companies to invest in Europe, even in energy intensive sectors, and therefore ensure that energy efficient technologies are used.

One challenge of border tax adjustment is to set an appropriate level of taxes, which will be discussed in the section 4 on the implementation. To achieve dynamic efficiency it has to be ensured that individual companies do not influence the level of border adjustment taxes. If an individual company, by applying a more energy efficient technology in Europe, would define a new best available technology, then this company might be reluctant to invest in this technology. The new best available technology would reduce the level of border-tax adjustment and thereby lower the price the company would receive for its products in Europe. The issue can be avoided if best available technology requires a certain market share of the technology and covers several related products, such that any individual company decision is marginal.

Political Economy Implications

In most countries it is unclear which sectors of population and industry will directly benefit from the implementation of carbon emission certificates. Therefore we observe strong political lobbying by potential losers against the implementation. In Europe particularly energy intensive industry argues that the unilateral implementation of CO2 emission certificates will result in moves to other locations. Such arguments either result in exclusion of industry sector from the emission scheme or prevent politicians to adopt targets that would imply significant levels of CO2 emission prices. However, with border tax adjustment the competitive disadvantage of European industry is compensated for, such that more ambitious CO2 reduction targets can be realised and emission certificate schemes can be implemented with fewer loop holes and at lower transaction costs if they do not require special clauses for several industrial sectors.

In the United States the unilateral implementation of emission certificates in Europe creates benefits for industry. Therefore the lobbying efforts of special interest groups against emission certificates in the US might increase after implementation of emission certificates in Europe. If border adjustment taxes are applied in Europe, then the profits from higher prices and sales volume for US industry from Europe wide emission certificates should decrease. Lobby activities of US industry to retain these benefits will be reduced and the US will be more likely to implement policies to reduce CO2 emissions.

3. International Law as a Restriction of the Policy Space

Probably the major restriction under international law comes from WTO/GATT.[15] This treaty is binding on the members, to which group both the European Community and its individual member states belong. Any breach of the obligations can give rise to a dispute settlement procedure before the WTO panel as the first and the appellate body as the second instance.[16] While the "court" itself has no direct means of enforcing its ruling, it can ultimately grant the applicant state permission to impose trade sanctions on imports from the other state, which violated its obligations under GATT. These

[15] On this see in particular the seminal article by Demaret/Stewardsson, fn. 10. Cf. also *Ernst-Ulrich Petersmann*, International Trade Law and International Environmental Law: Environmental Taxes and Border Tax Adjustment in WTO Law and EU Law, in: Revesz/Sands/Stewart (eds.), Environmental Law, the Economy and Sustainable Development, Cambridge University Press, 2000; *Christian Pitschas*, GATT/WTO Rules for Border Tax Adjustment and the Proposed European Directive Introducing a Tax on Carbon Dioxide Emissions and Energy, Georgia Journal of International and Comparative Law 24 (1994), 479-500; *Marco Düerkopf*, Trade an Environment: International Trade Law Aspects of the Proposed EC Directive Introducing a Tax on Carbon Dioxide Emissions and Energy, Common Market Law Review 1994, 807-844.

[16] For this see the 1994 Understanding on Rules and Procedures Governing the Settlement of Disputes (in the following this is abbreviated as DSU).

sanctions can, without in turn triggering countermeasures, be maintained until the other state ceases its infraction.[17]

The restriction should not be brushed aside by simply arguing that border tax adjustments would be introduced so that the EU could fulfill its obligation under the Kyoto Protocol as a multilateral environmental agreement (MEA).[18] For the relationship between MEAs and GATT is far from clear.[19] In general, the implications of the MEA on the obligations under GATT depend on whether both states in question are party to the MEA. Where they both are, it can be reasonably argued that the obligations under GATT between the two states are altered by the MEA.[20] However, where one state is not a member, it seems far more difficult to reason that the obligations under GATT are changed. Just as under ordinary contract law, treaties generally apply only between the parties (res inter alios acta tertiis nec nocet nec prodest, Art. 35 of the Vienna Convention on the Law of Treaties). The case of the US as the main non-participant industrialised country refusing to sign up to the Kyoto Protocol presents additional difficulties: The US has signed and ratified the 1992 Framework Convention on Climate Change (FCCC) and also signed the Kyoto Protocol. However, the Bush administration has subsequently refused to ratify the Kyoto Protocol, but has so far not formally withdrawn from the agreement. Hence, it is obliged under Art. 18 of the 1969 Vienna Convention to refrain from acts which would defeat the object and purpose of the Kyoto-Protocol because it has signed the treaty subject to ratification. Hence, there is the possibility that the GATT obligations are altered. However, the obligation under Art.18 of the Vienna Convention ceases once the US has declared not to become a party to the treaty.[21] Such formal withdrawal would always remain open to the US, therefore it would seem wise to apply a precautionary approach to law-making. Possible incompatibilities with GATT should be avoided. In the following, we examine potential conflicts of border tax adjustments with GATT.

For legal purposes, the border tax adjustments described in the previous section amount to two different measures which follow a distinct regime: The first measure, refunds for exports, has to stand the test whether it constitutes an outlawed subsidy. The second measure, taxes charged on imports, has to fend off the suspicion that it represents an illegal discrimination. At first glance, one might think

[17] Cf. Art. 22 DSU.
[18] Both the EC and its member states are parties to the Kyoto Protocol.
[19] On this see e.g. *Gabrielle Marceau*, Conflicts of Norms and Conflicts of Jurisdictions – The Relationship between the WTO Agreement ans MEAs and other Treaties, JWT 35 (6), 1081, 1131, 2001; *Mike Meier*, GATT, WTO, and the Environment: To what extent do GATT/WTO rules permit member states to protect the environment when doing so adversely affects trade? (1997) 8 Colorado Journal of International Environmental Law & Policy 241 at 271; *Doaa Abdel Motaal*, Multilateral Environmental Agreements (MEAs) and WTO Rules – Why the "Burden of Accomodation" Should Shift to MEAs, JWT 35 (6): 1215-1233, 2001; *Ann Rutgeerts*, Trade and Environment – Reconciling the Montreal Protocol and the GATT, JWT 33 (4): 61-86, 1999.
[20] Cf. *Ann Rutgeerts* (Fn. 19), JWT 33 (4): 61-86, 1999 at 67.
[21] USCIB, WTO Rules and Procedures and Their Implication for the Kyoto Protocol – A Background Paper, 11/2002 available at www.uscib.org.

that the same criteria should be applied to both measures. However, legally this need not necessarily be the case.[22] Hence, in the following, the two measures will be analysed separately. This however should not be understood so as to preempt the answer on the question whether different standards will actually result.

3.1 Exports

Under WTO law, countries must not subsidize most form of exports (agriculture being the lamentable exception). Art. XVI:4 GATT states that contracting parties must not grant directly or indirectly any form of subsidy on the export of any product other than a primary product which results in the sale of such a product for export for a lower price than the comparable price charged for the like products to domestic buyers. If prohibited subsidies are granted, the importing state may under conditions spelt out in Art. VI:3 and 6 (a) GATT impose countervailing duties[23] on the imported good. However, Art. VI:4 GATT makes it clear that a countervailing duty must not be implemented where a product destined for export is exempted from duties or taxes borne by the like product when destined for consumption in the region of origin or exportation, or such duties or taxes are refunded on exportation. In the same vein, under the note ad Art. XVI, these exemptions or remissions do not constitute subsidies under that article.

The 1994 Agreement on Subsidies and Countervailing Measures extends the range of adjustable prior-stage cumulative taxes under GATT.[24] Annex I to the agreement contains an illustrative list of prohibited export subsidies. Litera (h) allows a region to remit taxes in respect of prior stages cumulative taxes on inputs that are consumed in the production of the exported product, making normal allowances for waste. Footnote 61 to Annex II specifies that inputs consumed are not only inputs physically incorporated, but also 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.[25]

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[22] On the similar question whether the rules guiding border tax adjustments on inports and exports should be symmetrical see e.g *Ole Kristian Fauchald*, Environmental Taxes and Trade Discrimination, 1998 at 166 with further references.

[23] A different issue is whether lax environmental standards can give rise to countermeasures. This should be denied, cf. *Düerkop* (fn. 15), at 830 f.

[24] Cf. the general interpretative note to Annex Ia of the 1994 WTO Agreement.

[25] The Assistant US Trade Representative claims that a gentleman´s agreement applies to the extension in the footnote (*Donald M. Phillips*, Letter to Abraham Katz, President of the United States Council for International Business, Reprinted in U.S. Secures Agreement not to Use GATT to Allow Energy Tax Rebate, Inside U.S.Trade, 28 January 1994. Accordingly it would only apply to the few countries that still have a cumulative indirect taxes rather than a VAT. The footnote could then not be invoked by developed countries with respect to energy taxes (*Demaret/Stewardson* (fn. 10)p. 30). However, no written proof for the agreement exists. (*Demaret/Stewardson*, ibid.). Furthermore, the agreement if it existed would not change the obligations of the parties in the sense implied as the form would be inappropriate (see *Biermann/Brohm*, Implementing the Kyoto Protocol without the United States: The Strategic Role of Energy Tax Adjustments at the Border, Working Paper of the Global Governance Project, no. 5, 2003 (downloadable at

Consequently, it appears that *tax* exemptions and remissions for energy and fuel on exported products would be admissible under WTO rules.[26] From this does not automatically follow, admittedly, that any costs for certificates should be deductible as well. One might argue that the omission of emission certificates in the text of Annex I does create obstacles insofar as it allows an e contrario argument. However, that would not seem too convincing as the list is labeled merely illustrative. The GATT, on the other hand, mentions duties alongside taxes e.g. in Art VI:4. Generally, taxes can be defined as A tax is a compulsory contribution imposed by government for which taxpayers receive nothing identifiable in return for their contribution.[27] Defining duties in the same vein would require there at least to be a compulsory payment made to the state. In order to prevent abuse, it cannot include payments to the government made in return for a more or less specific service. Also, a fee for using a motorway or, more controversially, a fee for a broadcasting licence would probably not be included. In all these cases, the service given to the individual already compensates her for the costs incurred. The same, however, is not true for the right to emit CO_2: In the case of motorways, the individual gets a service that did not exist before the government provided the infrastructure. It could equally be provided by private firms. Similarly, the necessity for a broadcasting licence simultaneously serves the interests of the applicant as she will be protected from others trying to broadcast on the same frequency, thus making hers inaudible. The necessity of a permit for emitting CO_2 almost exclusively serves the interests of the wider community. Hence, the costs of obtaining the permits should not be seen as providing such a service. Taking the component of payment to the state, the costs incurred by buying from the state and only these can be remitted.

Yet for all purposes in a decentralized economy it appears difficult to identify the inputs of a product for which certificates have been bought from the state. This presents two problems: First, what level should be used for the border-tax adjustment? Secondly, how to measure the product, e.g. based on volume, weight or value, to best relate it to the input components? On the first question, the only feasible way would be to use the *average cost* of the certificates that were either bought or allocated from the state. For example, if half of the certificates in circulation are allocated to each business free of charge and the second half had to be bought for a price of 100, the price used for adjustment purposes would be 50.[28] The average cost would then have to be multiplied by the combined quantity of emissions from all production stages. In the context of grandfathering, this severely curtails the

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www.glogov.org/workingpapers/workingpaper5.html), p. 24 who analyse the implications under Art. 31 and 32 of the 1969 Vienna Convention).

[26] Further concerns are raised by *Fauchald* (Fn. 22), 188 ff. who asks whether energy taxes really are prior-stage cumulative taxes rather than prior-stage specific stages. However, this distinction does not seem to be upheld any more.

[27] Similar definitions apply in the context of the OECD Model Tax Convention, cf. only *Ismer/Sailer*, Internationales Steuerrecht 2003, 622, 623.

[28] Under rational expectations, the market price for the certificates can be assumed to be equal to the price paid to the state in the framework of an auction.

effectiveness of BTA. From this perspective, it might appear more appropriate to simply take the market price of the certificates. The issuing of the certificates would then be considered a lump sum transfer to the firms. However, even provided these lump sum transfers would not run foul of WTO subsidy rules, the legal terminology, which speaks of duties and likens them to taxes might prevent this interpretation. On the second question, again a general solution seems to be warranted, for the quantity of emissions can hardly be ascertained and even where it could, it would imply that for all exports the incentive to produce with the least amount of greenhouse gas emissions would be eliminated. Therefore, exported products should receive the same remission irrespective of how they were actually produced. Regarding the level of tax remitted, it should be borne in mind that there is the danger of the remission turning into an illegal subsidy distorting the playing field. Hence, the amount should be fixed at a rather conservative (i.e. low) level.[29] This issue will be further discussed, in section 3.3, once the import side has been discussed.

3.2 Imports

Since border tax adjustments on imports cannot act as quantitative restrictions outlawed under Art. XI GATT, two major requirements must be met under GATT. First, WTO member states are obliged to offer every other member state most favoured nation status with respect to any border restrictions, Art. I GATT. Secondly, Art. III GATT stipulates that foreign producers be treated no less advantageous than domestic producers (national treatment clause). This applies to like products (Art. III:2 first sentence GATT) and to directly competitive and substitutable products (Art. III:2 second sentence).

3.2.1 Art. III:2 first sentence GATT: Like products

As the Appellate Body sees the first sentence of Art. III:2 GATT as a special case of the second, it construes the former narrowly.[30] According to Art. III:2 first sentence GATT, member states shall not subject imported products, 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.

This implies two criteria: Firstly, the question would have to be answered whether domestic and foreign products are like.[31] GATT does not contain a definition of that term. Consequently, it is sometimes suggested that any attempt of defining likeness would be inappropriate.[32] Rather, any

[29] The Report of the Working Party on Border Tax Adjustments, adopted on 2 December 1970, L/3464, para. 16 found it sensible to rebate some taxes for composite products by average rates for a given class of goods, where the taxes were generally eligible for adjustment, but where the calculation of the exact amount presented difficulties. This point should not be confused with the rationale for using average rates to calculate the charges borne per permit.

[31] It should be noted that the term "like" in Art. III:2 first sentence GATT has a narrower meaning than the same term under Art. III:4 GATT, cf. only European Community – Measures Affecting Asbestos and Asbestos-Containing Products, Report of the Appellate Body, WT/DS135/AB/R, adopted 5 April 2001, para. 99.

[32] See for example *Mattoo/Subramanian*, Regulatory Autonomy and Multilateral Disciplines: The Dilemma ans a Possible Solution, JIEL 1998 1 (303).

distinction made on regulatory grounds should be allowed. To determine whether an infraction of Art. III GATT has occurred, it has to be examined if protectionist intent inspired the distinction or a protectionist effect followed from it. This "aims and effects" test[33] can imply that products with different production processes are no longer like products.[34] The WTO judiciary, however, has explicitly rejected this test[35] and adopted a different stance. Likeness is assessed taking into account physical properties, the product's properties, nature and quality, its end-uses in a given market, consumers´ tastes and habits, as well as the tariff classification of the product[36]. Production processes that do not change the physical properties etc. of the product are considered to be irrelevant.[37] For both approaches, like products could probably be found in the case of border tax adjustments: Assuming that both foreign and domestic products would be manufactured with a plenitude of technologies, the first-mentioned approach would have to consider products produced with a similar technology to be like, while the judiciary would have to consider the entire group of homogeneous products to be like. Hence, one can say that the criterion of like products would under both approaches pose a surmountable hurdle.

Secondly, the taxes or charges applied to the foreign product must not be in excess of those applied to like domestic products. This in turn mainly raises two points[38]: What taxes or charges are taken into account when determining the taxes and charges on the respective products? And what is the yardstick to determine whether there is an excess – are foreign products considered individually or are they considered as a group?

While it is clear that the imported product would be subject to the (border adjustment) tax, it is less so which taxes and charges are applied to the domestic product.[39] As it has been held in the Superfund

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[33] United States – Measures Affecting Alcoholic and Malt Beverages, Report of the Panel, DS23/R- 39S/206, adopted on 19 June 1992, at 5.25; United States – Taxes on Automobiles, Report of the Panel, DS31/R, unadopted, at 5.10. The approach is however no longer adhered to in the WTO judiciary, cf. fn. 36.

[34] *Biermann/Brohm* (Fn. 25), 2003, p. 27; *Howse/Regan*, The Product/Process Distinction – An Illusory Basis for Disciplining "Unilateralism" in Trade Policy, European Journal of International Law 2000.11, 249-289. Against the "aims and effects" test *John H. Jackson*, Comments on Shrimps/Turtle and the Product/Process Distinction, 11 EJIL 303 - 308, 2000, at 304; *Quick/Lau*, Environmentally Motivated Tax Distinctions and WTO Law – The European Commission's Green Paper on Integrated Product Policy in Light of `Like Product´ and ´PPM`-Debates, JIEL 6(2), 419-458, 2003, at 452 ff.

[35] Japan – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 1 November 1996, WT/DS8/AB/R, WT/DS10/AB/R, WT/DS11/AB/R, AB, p. 20.; more explicitly confirmed in European Communities – Regime for the Importation, Sale and Distribution of Bananas, Report of the Appellate Body, WT/DS 27/AB/R, p. 100, para. 241.

[36] Japan – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 1 November 1996, WT/DS8/AB/R, WT/DS10/AB/R, WT/DS11/AB/R, AB, p. 20.

[37] In the following it will be assumed that consumers' tastes and habits do not overcome the "strong presumption of likeness [for physically identical products]" (*Quick/Lau*, (Fn. 34) at 431).

[38] This structure of Art. III:2 first sentence GATT can be explicitly found e.g. in Japan – Taxes on Alcoholic Beverages, Report of the Appelate Body, adopted on 1 November 1996, WT/DS8/AB/R, WT/DS10/AB/R, WT/DS11/AB/R , p. 18.

[39] For a discussion of the (economic) rationale behind the distiction see *Demaret/Stewardson* (Fn. 25) at pp. 14 ff.

Case[40], the reason for imposing the tax, i.e. whether the tax was levied to encourage the rational use of environmental resources or for general revenue purposes, is irrelevant. Furthermore, indirect taxes like a sales tax or a VAT are definitely taxes applied on the domestic product. Border tax adjustments for these taxes are commonplace in practice (an example would be excise taxes on the import of goods[41]), and can legally be so as they are levied on foreign and domestic products alike.[42] In contrast, there is a widespread view that direct taxes, among them in particular taxes on profits, are not levied on the product and hence do not count for the tax burden on the domestic product.[43] Thus, adjustments for direct taxes[44] would be in breach of the GATT obligations. Therefore, the question arises, on which side of the direct/indirect taxes dividing line the costs for emissions certificates would fall.

In pursuit of an answer to the question, what, if any, costs for emissions certificates are applied to the product, it might be worthwhile to first seek clarification as to how a tax on carbon emissions would be classified and then to ask whether that classification extends to the case of emissions certificates. On the first question, scholars are divided.[45] On the one hand, some argue[46] that Art. II: 2 (a) GATT[47] indicates that energy taxes should not be viewed as a tax adjustable at the border. Yet since this clause allows certain behaviour by the parties, it should be construed as widening their policy space, if it is not seen as being merely declaratory. Nothing in the wording indicates that the clause actually seeks to disallow certain behaviour. The weight of this argument therefore does not seem to be too great. On the other, as it has been shown above, a moderate adjustment for exports seems possible. Although the rules for exports and imports have evolved separately and no references in dispute settlement report on Art. III GATT make remarks on exports, quite strong arguments support a symmetrical treatment[48]: The wording in Art. I GATT uses the term "originating in or destined for" in a way that tends to support a symmetric treatment[49]. Furthermore, a symmetric treatment has the advantage of simplicity. Moreover a symmetric treatment ensures that the destination principle is applied as coherently and efficiently as possible in order to avoid excessive trade distortion. Although Member states do not

[40] United States – Taxes on Petroleum and Certain Imported Substances ("Superfund"), Report of the Panel adopted on 17 June 1987, BISD 34S/136, para 5.2.3 – 5.2.4.
[41] E.g. for the European Union Art. 2 no. 2 of the 6th Council Directive 77/388 of the 17th May 1977 on the harmonisation of the laws of the Member States relating to turnover taxes (6th VAT Directive).
[42] Note Ad Art. III explicitly states that any internal tax or other internal charge which applies to an imported product and to the like domestic product and is collected in the case of the imported product at the time or point of importation, is nevertheless to be regarded as an internal tax or other internal charge.
[43] *Demaret/Stewardson* (Fn. 25), p. 16.
[44] Report of the Working Party on Border Tax Adjustments (Fn. 29), para. 8.
[45] Cf. e.g. *Pitschas* (fn. 15), at 493; *Düerkop* (fn. 15), at 822 ff. (before the 1994 Understanding on Subsidies); Sebastian *Puth*, WTO und Umwelt – Die Produkt-Prozess-Doktrin, 2003, 268; *Biermann/Brohm*.
[46] *Pitschas* (fn. 15), at 493.
[47] Reading: „Nothing in this article shall prevent the parties from imposing on the importation of any product a charge equivalent to an internal tax imposed consistently with the provisions of paragraph 2 of Article III … in respect of an article from which the imported product has been manufactured in whole or in part." The equally valid French text, can be considered to give even more support to that view, when it speakes slightly differently of "une marchandise qui a été incorporée dans l'article importé."
[48] *Demaret/Stewardson* (Fn. 25), pp. 30 f.; *Fauchald* (Fn. 22), pp. 166 ff.; against such a symmetry in this case *Puth* (fn. 45), 268 because he considers the rule for exports as the result of a specific political compromise.
[49] *Fauchald*, (Fn. 22), p. 166.

have an obligation to make symmetric use of adjustments they are allowed to make, they should be given the possibility to avoid double taxation or double non-taxation, [50] each of which would disturb the level playing field among competitors that is vital for the welfare gains from international trade to be reaped. For an answer to the second question, the results obtained for export border tax adjustments, equally apply to imports. Hence, the average costs of emissions certificates procured from the state can be treated like a tax.

When it comes to the yardstick, the question is only whether "like" imported products are subject to higher taxes, not whether the difference leads to a significant distortion in trade flows.[51] In particular, it does not matter whether only 1.5 per cent of domestic output profited from a lower tax rate.[52]

Thus, if one followed the view that likeness must not be denied by taking into account production methods, then all products must regardless of how they were made be considered as homogeneous. The only way to introduce border tax adjustments would then be to take the lowest charges incurred by any domestic producer. To make this practically feasible, the lowest amount should be estimated by assessing the quantity of greenhouse gases that would have been emitted when all components had been manufactured with best available technology.[53] This is certainly only a second best solution. The adjustment would not completely equalise the playing field as foreign producers would regardless of their production technology be assumed to have produced with best available technology, e.g. an energy inefficient US steel producer would only pay the import taxes corresponding to CO2 costs incurred by the most efficient European producer. Yet it would constitute an improvement to the situation without any adjustment. Moreover, it would provide a viable alternative which would be legal under GATT – discrimination against domestic producers is not illegal and it does not hurt a foreign producer if it assumed that her production technology was more ecologically sound than it really was. It would also send a political signal of goodwill to other WTO parties that the measure was not about discrimination. It might be advisable to entrust the definition of the best available technology standard to an independent body. This would help to reduce the impact of the collision of interest arising from the fact that foreign industry would want the standard to be the lowest possible, whereas domestic producers would want to see it high.[54]

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[50] *Demaret /Stewardsson* (Fn. 25), p. 31.

[51] See *Simonetta Zarrilli*, Domestic Taxation of Energy Products and Multilateral Trade Rules: Is This a Case of Unlawful Discrimination? JWT 37 (2), 359-394, 2003 at 371 f. with references to the WTO/GATT judiciary.

[52] United States – Measures Affecting Alcoholic and Malt Beverages (Fn. 33), para. 5.6.

[53] This concept can e.g. be defined as the most effective and advanced stage in the development of activities and their methods of operations which indicate the practical suitability for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole, cf. European Commission Council Directive 96/61/EC of 24 September 1996 Concerning Integrated Pollution Prevention and Control.

[54] The position of domestic industry can be explained by two factors: one is the fact that a higher border tax adjustment would make the foreign products less competitive. The second is the fact that where the border tax adjsutments are applied symmetrically, domestic industry would receive a higher payback. This gives cause for

If, in contrast, one held the view that production processes are relevant for "likeness", then there would be as many different products as there were substitutable production processes. The treatment of every imported product would have to be compared to that of the respective domestic product. It would have to be taken into account that less favourable treatment to some products cannot be balanced by more favourable treatment to others. Accordingly, in the Reformulated Gasoline Case,[55] the panel did not accept as a valid defense the fact that on average the treatment of foreign and domestic firms was equivalent. This is not contradicted by the Superfund Case[56] where the GATT panel considered the method by the US, which imposed an adjusting tax amounting to what would have been payable under the predominant US production method, to be in accordance with GATT rules. For foreign producers had the possibility of establishing that less of the input in question was used and that the tax charged should thus be lower.[57] This principle implies for border tax adjustments that Art. III:2 first sentence GATT is violated where the foreign producer does not have the possibility to show that her carbon emissions were lower than the standard assumed for adjustment, while domestic producers pay according to their true emissions. Then, two approaches were feasible: on the one hand, one could adopt an approach where each business has upon importation to demonstrate how much greenhouse gas was emitted during production. This seems even less desirable for imports than for exports. While the latter are subject to the control of the exporting state, the production of the former has taken place outside its jurisdiction. Because of the territoriality principle under public international law, any controls would, unless the other state consented, have to be carried out by officials of that other state. These controls, however risk to be somewhat ineffective, as it might not be in the best interest of that other state to apply them too stringently: That state might pursue a different environmental agenda. Furthermore, a lower adjustment would imply a higher profit margin for the exporting company from the transaction, which can under certain conditions feed through to higher tax revenue of the exporting state.[58] Moreover, more production in that region generally implies more domestic employment. All these arguments would favour the second approach which would again be the best available technology approach rather than a production process specific adjustment tax..

Hence, the best technology approach would be allowed under Art. III:2 first sentence GATT. Indeed if one shared the view of the judiciary that production processes were irrelevant for likeness under that provision, it would constitute the only admissible way. If one did not, it would still be the only way

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concern as domestic lobbbying could make state officials inclined to higher standards. Therefore, procedural safeguards seem warranted.

[55] United States – Standards for Reformulated and Conventional Gasoline, Report of the Panel, WT/DS2/R, from 29 January 1996, adopted with alterations concerning other points on 20 May 1996, pp. 37 f. at 6.14.

[56] Report of the GATT Panel, United States: Taxes on Petroleum and Certain Imported Substances, 17 June 1987, BISD 34S/136. Not convincing on this point *Biermann/Brohm* (Fn. 25), 26. More generous for exports, Report of the Working Party on Border Tax Adjustments (Fn. 29), para 16.

[57] This is pointed out by *Demaret/Stewardson* (Fn. 25), p. 26.

[58] See Art. 7 of the OECD Model Tax Convention.

really feasible. Further discussion of compatibility with Art. III:2 second sentence GATT and Art. I GATT will therefore concentrate on this approach.

3.2.2 Art. III:2 GATT: Directly competitive and substitutable products

Art. III: 2, second sentence GATT in conjunction with Art. III:1 GATT and the Note Ad Article III demands that imports must not be taxed dissimilarly from directly competitive or substitutable domestic products so as to afford protection to domestic production. With respect to taxation, this raises three questions[59]: Do the foreign and domestic products compete? If so, are the imported and domestic products not similarly taxed, which requires a difference that must be more than de minimis[60]? And finally: Is the dissimilar taxation applied so as to afford protection to domestic production? This last question demands – diverging from Art. III: 2 first sentence GATT – that protective impact has to be separately ascertained.

Again, problems with this provision can be avoided when a best available technology border tax adjustment is applied priced at the average price per permit paid to the state. On the second question, it would however not be sufficient to argue that domestic products in the same fiscal class would be taxed or charged at a higher rate. Rather, a comprehensive approach has to look at all the directly competitive or substitutable domestic and imported goods. [61] One might conceive a situation where mainly foreign highly energy intensive goods directly compete with ("unlike" in the sense of Art. III:2 first sentence GATT) products made mainly domestically and with little energy input. Consider the following hypothetical example: Aluminium cars compete directly with steel cars. The former consume far more energy in production than the latter. Most imported cars are aluminium cars. Of the steel cars only a tiny number is imported. Then imported cars are generally taxed at a higher rate. The third question of whether the measure affords protection would thus become pertinent for border tax adjustments, where the tax difference is less than de minimis. In view of the fact that Members of the WTO have sovereign authority to determine the basis on which they will tax goods and to classify goods accordingly, provided they respect their WTO commitments[62], this could be safely denied: A dispute resolution board, which would in the framework of a comprehensive and objective[63] analysis

[59] Japan – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 1 November 1996, WT/DS8/AB/R,WT/DS10/AB/R, WT/DS11/AB/R, p. 24; confirmed in Chile – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 12 January 2000, WT/DS87/AB/R, WT/DS/110/AB/R, para. 47.

[60] Japan – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 1 November 1996, WT/DS8/AB/R,WT/DS10/AB/R, WT/DS11/AB/R, p. 27; confirmed in Chile – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 12 January 2000, WT/DS87/AB/R, WT/DS/110/AB/R, para. 49.

[61] Chile – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 12 January 2000, WT/DS87/AB/R, WT/DS/110/AB/R, para. 53.

[62] Chile – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 12 January 2000, WT/DS87/AB/R, WT/DS/110/AB/R, para. 60.

[63] Since the subjective intentions of the individual legislators or regulators are not to be considered because they are accessible to treaty interpreters, Chile – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 12 January 2000, WT/DS87/AB/R, WT/DS/110/AB/R, para. 62. In a similar vein see Japan – Taxes on

have to look at the design, the architecture and the revealing structure of the measure, would find a linear tax-scheme.[64] This linearity would moreover be in harmony with the objective[65] of CO_2 abatement and with the (community-wide) emissions trading scheme. And finally even though it appears possible that some mainly imported goods fell into a class viewed as high energy intensive even at best available technology, it would seem a rather contrived example and not the norm like in the Alcohol Cases[66], where almost all imported products fell in the higher tax groups, this cannot be expected for the border tax adjustment scheme.

3.2.3 Art. I GATT: Most Favoured Nation Principle

The system of border tax adjustment with best available technology would not violate the most favoured nation principle of Art. I GATT, as the system would apply to any imports regardless of whether the product is imported from a Kyoto member country or not. Also, just as under VAT, imports followed by exports of the products would in the end result in no net taxes to be borne by the products as the remission of taxes would follow the same standard.[67]

3.3 Interim Conclusion

It has been demonstrated that a system of border tax adjustments for imports with best available technology standards priced at average costs would not fall foul of GATT. It has further been shown that subsidies ought to follow a general standard of best available technology. It would therefore seem logical to extend the proposal from imports to exports as well. Again, this would never be a subsidy, as it would only remit the minimum of internal charges incurred by domestic producers. This would result in the symmetrical system, which has been advocated before to be made complete.

3.4 Auxiliary Point: Justification under Art. XX GATT

If a scheme other than the best available technology approach were implemented that was not in compliance with Art. III or I GATT or if one did not share the conviction expressed in this paper that

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Alcoholic Beverages, Report of the Appellate Body, adopted 1 November 1996, WT/DS8/AB/R,WT/DS10/AB/R, WT/DS11/AB/R. pp. 27 ff.

[64] This is a significant contrast to the Chilean Alcohol Case where due to their alcohol contents most imported products fell into a progressive zone. The point was stressed by the Appelate Body, cf. Chile – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 12 January 2000, WT/DS87/AB/R, WT/DS/110/AB/R, para. 63.

[65] Objectives have to be taken into account as was confirmed by the Chile – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 12 January 2000, WT/DS87/AB/R, WT/DS/110/AB/R, para. 71, though this is not a test of whether the measures are necessary (ibid., para. 72).

[66] Japan – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 1 November 1996, WT/DS8/AB/R,WT/DS10/AB/R, WT/DS11/AB/R; Korea – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 17 February 1999, WT/DS75/AB/R,WT/DS84/AB/R; Chile – Taxes on Alcoholic Beverages, Report of the Appellate Body, adopted 12 January 2000, WT/DS87/AB/R, WT/DS/110/AB/R.

[67] There might however be intertemporal effects where a product is exported after an improvement in best available technology has resulted in a lowering of the border tax adjustment. Then the product would, if no exceptional clause were to be provided, in effect bear taxes.

the said scheme would be consistent with Art. III: 2 GATT, Art. XX GATT might provide a justification.[68] The judiciary on world trade has evolved so as to construe a two-tier structure of justification under the article. First, it has to be examined whether the requirements of any of the eight headings are fulfilled. Of these, Art. XX (b) and (g) GATT appear pertinent. Second, the chapeau, which aims at preventing abuse of the exceptions of Art. XX,[69] basically demands that the measures must not be applied in a discriminatory way. Before going into the details of Art. XX GATT, it should be stressed that although the Kyoto Protocol aims at the protection of a global common, there is not really a question of extraterritoriality to be answered: Though border tax adjustments partly aim at changing behaviour in other states, the consequences of global warming should establish a sufficient nexus to the territory.[70]

3.4.1 Art. XX (b) GATT

Art. XX (b) GATT allows measures necessary to protect human, animal or plant life or health.[71] This again implies a two-tier structure. First, the policy of reducing CO_2 emissions must be designed to protect human, animal or plant life or health. This can be easily ascertained for the import border tax adjustment, as the clause should not only allow measures to reduce immediately harmful emissions but also those of greenhouse gases which cause a global problem in the longer run[72] and since WTO Members have the right to determine the level of protection they consider appropriate in a given situation.[73] Problems arise however with respect to exports. Border tax adjustments for these serve mainly the purpose of removing competitive disadvantages for domestic industry. As has been shown in the previous section, prices might be lower implying more consumption. As a countervailing effect, existing demand can be satisfied by domestic producers that are more efficient than foreign ones. Hence, the overall effect on greenhouse gas emissions is ambiguous. Therefore the rather difficult question arises what exactly constitutes the measure in question: Do the import and export measures have to be considered in isolation. Does the set of border tax adjustments form the measure? Or should one go even further and bundle all provisions on emissions trading into one measure? Seeing the passage of the directive without the adjustments and remembering the panel-report on the Superfund

[68] On this provision, cf. eg. *Weiß/Herrmann*, Welthandelsrecht, 2003, 208 ff.
[69] United States – Standards for Reformulated and Conventional Gasoline, adopted on 20 May 1996, WT/DS2/AB/R, DSR 1996:I, p. 21; United States – Import Prohibition of Certain Shrimp and Shrimp Products, Report of the Appelate Body, adopted on 6 November 1998, WT/DS58/AB/R, DSR 1998:VII, p. 2803.
[70] For details on this point see *Bernhard Kluttig*, Welthandelsrecht und Umweltschutz – Kohärenz statt Konkurrenz, Arbeitspapiere aus dem Institut für Wirtschaftsrecht der Martin-Luther-Universität Halle-Wittenberg, Heft 12, 2003, p. 25 ff.; *Jochem Wieters*, Trade and Environment in the EC and the WTO – A Legal Analysis, 2002, p. 273 ff. with further references.
[71] On this exception, see e.g. United States – Standards for Reformulated and Conventional Gasoline, Report of the Panel, WT/D52/R, from 29 January 1996, adopted with alterations concerning other points on 20 May 1996 at para 6.20.
[72] Cf. *Zarrilli* (Fn. 51), JWT 2003, 359-394 at 384.
[73] European Community – Measures Affecting Asbestos and Asbestos-Containing Products, Report of the Appellate Body, WT/DS135/AB/R, adopted 5 April 2001, para 168.

Case[74] and in particular the explanations of the Appellate Body in the US Gasoline report[75], one would be inclined to reject the third proposal. But also the second proposal is subject to doubts: In theory, the two directions of border tax adjustments appear separable. The arguments advanced in favor of a symmetric treatment of exports and imports come into play here as well. Their weight should be sufficient so that the measure in question should indeed be the border tax adjustments in both directions.

Second, the measure must be "necessary" in the sense that it has to be the least trade-restrictive. An alternative measure, which is consistent or less inconsistent with GATT must be used where that can be reasonably expected.[76] This demands a process of weighing and balancing a series of factors, including the importance of the common interests protected by the measure, the contribution of the trade-restriction for the success of the protection of the interests and the impact on trade flows.[77] The more vital or important the common interests or values pursued, the easier it is to establish that the measures in question are necessary to achieve those ends.[78] Concerning the standards necessary to show that common interests are at risk and that the measure can help to disperse that risk, a member is not obliged to automatically follow what at a given time constitutes a majority scientific opinion. Hence, it can rely in good faith on a respected minority opinion.[79] Accordingly, given the threat posed by global warming and considering the negligible negative impact on trade flows – the measures even if it comes in a different guise than the best available technology adjustment would still aim to level the playing field – border tax adjustments for imports should meet the second test as well. Because of the symmetry argument, this extends to border tax adjustments in general. Hence, Art. XX (b) GATT is fulfilled.

3.4.2 Art. XX (g) GATT

Art. XX (g) GATT demands that the measure be related to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption. In the Reformulated Gasoline Case[80], the panel construed the heading as requiring three criteria: First, the policy in respect of the measure for which the provision is invoked must be

[74] United States – Taxes on Petroleum and Certain Imported Substances ("Superfund"), Report of the Panel adopted on 17 June 1987, BISD 34S/136.
[75] United States – Standards for Reformulated and Conventional Gasoline, Report of the Appellate Body, adopted on 20 May 1996, WT/DS2/AB/R, pp. 13 f. (on Art. XX (g) GATT).
[76] Korea – Measures Affecting Imports of Fresh, Chilled and Frozen Beef, Report of the Appellate Body, WT/DS161/AB/R, 11 December 2000, para 163 and 166.
[77] Korea – Measures Affecting Imports of Fresh, Chilled and Frozen Beef, Report of the Appellate Body, WT/DS161/AB/R, 11 December 2000, para 164.
[78] Korea – Measures Affecting Imports of Fresh, Chilled and Frozen Beef, Report of the Appellate Body, WT/DS161/AB/R, 11 December 2000, para 162.
[79] European Community – Asbestos, para 178.
[80] United States – Standards for Reformulated and Conventional Gasoline, Report of the Panel (Fn. 71), para. 6.35.

related to the conservation of a natural resource. This can easily be ascertained as the aim of a reduction in greenhouse gas emissions at the same time contributes to the preservation of natural fossil fuel resources. Furthermore, one could probably argue that a preservation of the atmospheric CO_2 concentration constitute a natural resource as well, considering the wide interpretation given to this term in the Shrimp Turtle Case.[81]

Second, the measure itself must be related to the conservation of natural resources. For a while, the GATT and WTO panels held that "related to" should be interpreted as "primarily aimed at".However, this rather narrow interpretation seems to have been replaced in the Shrimp/Turtles Case by a wider one, which only demanded that the measure be "directly connected" to the conservation policy.[82] As demonstrated above, border tax adjustments for imports would serve the environmental purpose of helping to ensure that the most efficient producers worldwide carry the day. Again taking symmetry as given, the direct connection would be fulfilled for border tax adjustments for imports and exports.

Third, the requirement that such measures must be made effective in conjunction with restrictions on domestic production or consumption. The clause demands even-handedness in the imposition of restrictions in the name of conservation.[83] The requirement that measures concerned must impose restrictions not only on imported, but also on domestic products is clearly satisfied when one takes into account the fact that domestic products have been hit by a domestic[84] tax at least as high as imported ones.

3.4.3 Chapeau of Art. XX GATT

As the second step, the chapeau[85] requires that the measure in its application must neither constitute an arbitrary or unjustifiable discrimination between countries where the same conditions prevail, nor a disguised restriction on international trade.[86] All three criteria have to be met: there must neither be an

[81] United States – Import Prohibition of Certain Shrimp and Shrimp Products, Report of the Appellate Body WT/DS58/AB/R, adopted 6 November 1998, pp. 46 ff., para. 127 ff. Cf. also United States – Standards for Reformulated and Conventional Gasoline, Report of the Panel (Fn. 71), para. 6.37, where it was held that clean air was a natural resource.

[82] Cf. *Geert van Calster*, The WTO Appellate Body in Shrimp/Turtle: Picking up the Pieces, European Environmental Law Review 8 (4): 111-119, 1999, at 114 f.

[83] United States – Standards for Reformulated and Conventional Gasoline, Report of the Appellate Body, adopted on 20 May 1996, WT/DS2/AB/R, DSR 1996:I, p. 19.

[84] Whether or not the imported product has been hit by a tax in the state where the production took place, should not matter, as that state had the possibility of remitting the taxes up to the standard of best available technology as well. This result is supported by the fact that otherwise verification problems arise.

[85] Cf. e.g. *Quick/Lau* (Fn. 34) at 440 ff.

[86] The same obligation follows from Art. 3 para 5 second sentence FCCC: "Measures taken to combat climate change, including unilateral ones should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade."

arbitrary nor an unjustifiable discrimination[87] nor a disguised restriction on international trade.[88] They have to be read side by side, imparting meaning on each other.[89] The fundamental theme lies in the purpose of avoiding abuse or illegitimate use of the exceptions in Art. XX GATT.[90] This implies that the considerations pertinent in deciding whether the application of a particular measure amounts to arbitrary or unjustifiable discrimination can be taken into account when determining the presence of a disguised restriction.[91] The standard has generally to be lower than the one under Art. III GATT, as otherwise there could never be a justification for violations of that provision.[92] When interpreting the provisions, the context of the norm and in particular the preamble to the WTO agreement as well as the preamble to the Decision on Trade and Environment, all of which confirm the WTO´s undertaking to pursue the aim of sustainable development, need to be respected.[93] A balance has to be struck between the right of a Member to invoke an exception under Art. XX GATT and the duty of that same Member to respect the treaty rights of the other Members.[94] Factors taken into account have included the following. First, the fact that other countries would be forced to adopt virtually the same approach as the state taking the measure. Second, the failure to engage in serious negotiations[95] with the other Members before taking the measure.[96] Third, a differential treatment among various countries.[97] The second factor can hardly be said to be the case for emissions trading schemes, in particular seeing the history of the negotiations for the Kyoto Protocol. The first and the third factor would have to be observed when implementing a border tax adjustment. In particular, it would appear necessary, if a

[87] It would be a fallacy to argue that since all foreign countries would be treated alike under the proposed system, the criterion is irrelevant: Not only can there be the same conditions in all foreign countries, but also between the importing and the exporting state, United States – Standards for Reformulated and Conventional Gasoline, Report of the Appellate Body, adopted on 20 May 1996, WT/DS2/AB/R, DSR 1996:I, p. 23 f.

[88] Previously in United States – Prohibition of Imports of Tuna and Tuna Products from Canada, adopted on 22 February 1982, BISD 29S/91-09, the criterion has been interpreted as requiring formal transparency.

[89] United States – Standards for Reformulated and Conventional Gasoline, Report of the Appellate Body, adopted on 20 May 1996, WT/DS2/AB/R, DSR 1996:I, p. 25. Very critical of this approach *Fiona Macmillan*, WTO and the Environment, 2001, 88 f. More in the direction of a separate application of the requirements United States – Import Prohibition of Certain Shrimp and Shrimp Products, Report to the Appelate Body, adopted on 6 November 1998, WT/DS58/AB/R, DSR 1998:VII, para 150.

[90] United States – Standards for Reformulated and Conventional Gasoline, Report of the Appellate Body, adopted on 20 May 1996, WT/DS2/AB/R, DSR 1996:I, p. 25.

[91] Ibid.

[92] Cf. United States – Standards for Reformulated and Conventional Gasoline, Report of the Appellate Body, adopted on 20 May 1996, WT/DS2/AB/R, DSR 1996:I, p. 28 f.: "In our view these two omissions go well beyond what was necessary for the Panel to determine that a violation of Art. III:4 GATT had occurred in the first place."

[93] United States – Import Prohibition of Certain Shrimp and Shrimp Products, Report to the Appelate Body, adopted on 6 November 1998, WT/DS58/AB/R, DSR 1998:VII, p. 2803 ff.

[94] United States – Import Prohibition of Certain Shrimp and Shrimp Products, Report to the Appelate Body, adopted on 6 November 1998, WT/DS58/AB/R, DSR 1998:VII, p. 2805 f. Critical of the discretion on the part of the WTO Panel and Appellate Board, *Fiona Macmillan*, WTO and the Environment, 2001, p.103.

[95] There is no obligation to actually conclude an international agreement, as has been made clear by the follow-on case brought by Malaysia: United States – Import Prohibition of Certain Shrimp and Shrimp Products – Recourse to Art. 21.5 of the DSU by Malaysia, Report to the Appelate Body, adopted on 21 November 2001, WT/DS58/AB/RW, para. 122: there must only be comparable efforts made to secure an agreement.

[96] On this cf. already United States – Standards for Reformulated and Conventional Gasoline, adopted on 20 May 1996, WT/DS2/AB/R, DSR 1996:I, p. 28.

[97] United States – Import Prohibition of Certain Shrimp and Shrimp Products, Report to the Appelate Body, adopted on 6 November 1998, WT/DS58/AB/R, DSR 1998:VII, p. 2810.

scheme were to be implemented that was not in accordance with Art. III or I GATT, to take Members' efforts at CO_2 abatement and their respective obligations under the Kyoto Protocol, provided they are members, into account. Hence, border tax adjustments for trade with ratifying Kyoto signatories would meet difficulties when these states chose a regulatory approach.[98] This in turn threatens to introduce "Trojan horse regions" into the Kyoto system that envisage trade with non-Kyoto regions without any border tax adjustments. These regions might then be able to export goods imported from non-Kyoto regions without border tax adjustments, if only after they have sufficiently modified them to fulfil the rules of origin.[99] Anti-abuse provisions against such a behaviour could result in tremendous uncertainty.

Hence, it can be said that if the first line of defense, i.e. that Art. III GATT is not violated, were to break down, the proposed scheme could still be maintained, as there is the possibility of a justification under Art. XX (b) and (g) GATT. However, the scheme would have to be carefully designed in particular with respect to other Kyoto regions that pursue a different abatement regime. Therefore, it would seem wise to attempt to meet the standards of Art. I and III GATT.

3.5 Conclusion

It can therefore be claimed with a reasonable degree of certainty that the introduction of the border tax adjustment scheme would indeed be admissible under WTO-rules. It therefore seems worthwhile pursuing the path by examining some aspects of the practical implementation.

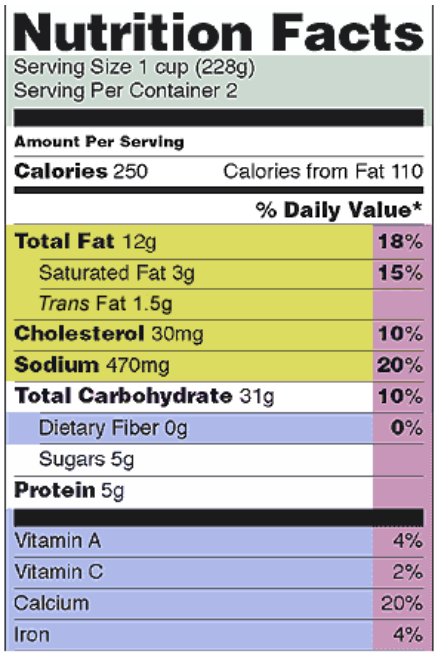
[98] This argument cannot be used to establish a violation of Art. III:2, first sentence GATT. For in that situation it could be argued that a certificates trading scheme created two kinds of costs: costs for buying the certificates and abatement costs for avoiding the necessity of their purchas, whereas a regulatory approach created only the latter. Hence a border adjustment tax would put both industries on an equal footing.

[99] These countries might specialise in modifications that require only limited CO_2 emissions.

4. Implementation

In theory, border tax adjustments could be determined for every single product according to the quantity of CO_2 emissions producing this very product with best available technology. However, the huge number of products creates information problems. Therefore, this is not possible in practice: For example, it would be very hard to determine what exactly constitutes a homogeneous product and what the best available technology was for every single product.

Hence, only an indirect way is possible. We must thus be looking for a measure that is highly correlated with the quantity of CO2 emissions during production, which avoids the aforementioned problems. Starting point for such an indirect scheme should be the fact that a large fraction of CO2 emissions can be attributed to the production of basic materials. Therefore we have to identify the quantity of different materials utilized in the production process. The border tax is calculated by multiplying the quantities of different processed materials a product consists of with the specific energy composition of the respective material. For each process material the non electric energy input and the electric energy input are treated separately as explained in section 4.5. The resulting number will be a lower bound to total energy consumed, because additional energy required for the refinement process is not included.



Nutrition Facts

Serving Size 1 cup (228g)
Serving Per Container 2

Amount Per Serving	
Calories 250	Calories from Fat 110
	% Daily Value*
Total Fat 12g	**18%**
Saturated Fat 3g	**15%**
Trans Fat 1.5g	
Cholesterol 30mg	**10%**
Sodium 470mg	**20%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	
Vitamin A	4%
Vitamin C	2%
Calcium	20%
Iron	4%

To obtain the quantities of processed materials, we suggest to apply a methodology well established in the food industry. In many countries, food products have to exhibit the content of the major components included in the product.[100] Similar to these labels, producers of goods would have to specify which quantities of different processed materials are included in their product. However, the benefit is, that the labeling is easily verifiable, e.g. by critical competitors questioning the composition of the product. At the same time, similar to the food sector, the categories will be wide enough to ensure that no critical information is revealed to competitors.

The following sections will explain in some detail how the emissions quantities for each unit of processed good can be obtained, whether these quantities should be product or production specific, what criteria determine a best available technology, and what size for the processed materials classes

[100] http://www.cfsan.fda.gov/~dms/foodlab.html#see2

should be adopted. Then the special treatment of the input factor electricity is discussed. Some remarks on grandfathering conclude the section.

4.1 Calculation of CO2 emissions associated with the production of a processed material

Two basic approaches are established to determine the emissions associated with the production of a good. The top down approach uses aggregate information on the energy consumption by different sectors, e.g. in Carnegie Mellon (2003) classified by 485 SIC groups. The economic input output model is then used to determine how many inputs from other sectors are directly or indirectly required to supply one unit of output of the assessed sector. This allows capturing the entire supply chain underlying the production of one unit of output in one technology sector. Finally the emissions of all sectors are calculated and the proportions of the emission that contributes to the output of the sector we are assessing are added. This provides for a top down determination of the CO2 (equivalent) emissions of one unit of output in any one sector. One database we used for the analysis is SimaPro[101] – a Life Cycle Assessment (LCA) software package. It enables calculating the environmental impact of a product during the entire life-cycle based on a top-down database EPS 2000 used for companies' internal product development.

The second approach is a bottom up approach. The production processes are individually examined and registered in a data-base, starting with the basic production steps. Current data sets, like Probas or GEMIS,[102] cover basic commodities as well as energy specific flow patterns.[103] Global Emission Model for Integrated Systems (GEMIS) is designed to compute a variety of emissions occurring over the complete life-cycle of products. The core database covers more than 4,400 processes in over 20 countries. The data is assembled from secondary (i.e., literature, averaged data etc.) as well as primary sources (i.e., reports from onsite inspectors). These data sets provide a good understanding of the CO2 emission pattern corresponding to basic commodities.

[101] SimaPro http://www.pre.nl.
[102] Probas: Prozessorientierte Basisdaten fuer Umweltmanagement-Instrumente, www.umweltbundesamt.de/uba-info-daten/daten/baum/, GEMIS http://www.oeko.de/service/gemis/.
[103] Some of the data basis cover the value including production and transport of fossil fuels. If the corresponding energy consumption or CO2 emissions occur outside the territory for which the border tax adjustment is to be applied, then they are not covered by CO2 emission certificate obligations. The corresponding emissions should therefore not be corrected for as part of the border tax adjustment.

	Top Down Eilco CO2/Kg	Top Down SimaPro CO2/Kg	Bottom Up GEMIS CO2/Kg	Bottom Up GEMIS CO2/Kg no Electric	Bottom Up GEMIS only electric KWh / Kg
Steel	0.56	1.19	1.86	1.68	0.26
Aluminum	3.97	8.45	17.33	9.68	13.40
Rubber	3.50	1.23	3.28	1.84	2.33

Figure 1: Energy intensity of three basic commodities

Figure 1 illustrates the large discrepancy of results derived from a bottom up and a top down analysis. Some of the differences can be attributed to poor data quality of top down analysis. To access Eilco the measurements, which are based on money, had to be translated into quantities using prices.[104] The biggest difficulty we were facing in several product groups was to obtain accurate commodity wholesale prices. Some of the discrepancies can be explained by errors on this level. The data set used in SimaPro is already translated into CO2 emissions per Kg product output, therefore the discrepancies to the bottom up approach represented by GEMIS are smaller. However, we assume that a main reason for the understatement of emissions in the top down analysis relative to the bottom up analysis remains. The sector does not only provide the basic commodity but also products which require additional, labor intensive input. This pushes up prices without influencing the energy input required in the sector significantly. This seems to be the case both with steel and aluminum but not with rubber. The result indicates, that a top down analysis requires a more detailed representation of the sectors than provided by 485 SIC groups. This does not allow conclusions on the bottom up analysis, because the additional refinement, which has little impact on the energy intensity per weight of the product such that the products still can be treated with the same tax level.

[104] Aluminum price 1.4$/kg from London Metal Exchange, Iron and Steel foundries 0.45 $/kg from www.citaec.info/steeltaskforce, www.cruspifutires.com, Press release of Oregon Steel Mills, 30.4. 2003, Rubber TSR20 0.80$/t, averaged, www.rubberstudy.com/statistics.aspx. The prices were on 2002/2003 price levels, while the IO tables were based on the 1992 statistics. Department of Commerce indices suggest that for iron products the appropriate deflator changes prices by 10%, not sufficient to bridge the gap www.bea.doc.gov/bea/dn2/gpo.htm.

Weber, Jenseits and Fritsche (1999)[105] compare bottom up and top down analysis at the example of non ferro metals and calculate approximately 50% higher emissions using the bottom up approach GEMIS then the top down approach based on the German input output table. Discrepancies are attributed to different assumptions about electricity generation mix, heat production and possible differences in the definitions of which products to attributed to the class

4.2 Border-tax level production or product specific?

Typically several production processes and technologies are available to produce identical final products. For production within the region that applies border adjustment taxes in theory labeling could be applied to determine which processes and therefore which quantity of CO2 emissions to reimburse. Apart from the large administrative burden both within the firm and with the controlling agency, such an approach would not have the required incentive properties. Products associated with high CO2 emission levels would be exported, because they receive higher border-tax adjustment. This is likely to result in additional transport requirements within the region. Usually transport costs serve as an incentive for companies to buy their product from a nearby plant if two plants offer identical products. If border tax adjustment levels differ for two identical products because of the different underlying production process, then the company might buy the product from the distant plant if the nearby plant has higher CO2 emissions and therefore benefits more from exporting its product. Furthermore, production process specific adjustment levels would remove the incentive for companies to improve or shift the process towards more energy efficiency, because after adjusting the process companies would receive less border-tax adjustment when exporting their product.

To use production process specific tax levels for imports into the area with border-tax adjustment seems also difficult. It would require monitoring of production processes outside of the jurisdiction and it might be more difficult to defend in the context of WTO law, because it builds on a more narrow definition of 'like products'. Production processes specific adjustment levels on imports would seem to provide appropriate economic signals. A company deciding to use a lower CO2 intensive production process will benefit from lower border tax adjustment levels when exporting to the area, which applies border-tax adjustments.

To illustrate these difficulties, we assess the situation of aluminum trade between a region A, which applies CO2 emission certificate requirements and corresponding border tax adjustments and the rest of the world B. Aluminum produced with old, CO2 intensive processes, in region A will be exported

[105] Weber, F., Jenseits W. and Fritsch, U. „Bestimmung des Kummulierten Energieaufwands (KEA) durch Input-Output- und Prozessketten-Analyse am Beispiel des Sektors NE-Metalle", Working Paper, Oeko-Institut, Mai 1999

to the world market such that the high expenditures on CO2 emissions are reimbursed. Only aluminum produced with new, CO2 efficient, processes would be sold within region A. To satisfy aluminum demand in region A, aluminum produced in the world market with CO2 efficient processes would be transported to region A and only face the low border tax adjustment rate. Companies are willing to incur the costs for the additional transport, as long as they do not exceed the difference between the border tax adjustment level for production processes with low CO2 and high CO2 emissions. Effectively region A will import from the world market aluminum produced with low CO2 emissions and export aluminum produced with high CO2 emissions. If aluminum production with low CO2 emissions in region A and B (the world) suffices to satisfy demand in region A, then aluminum prices will stay identical for both types. The only impact of the policy will be additional aluminum transports. The only financial incentive in A to shift from high to low CO2 intensive production is due to the price differentials caused by costs of exporting high CO2 intensive aluminum and importing low CO2 intensive CO2. This policy however only impacts prices in A, in B the policy provides for incentive to shift production processes.

The policy would have an impact, if region A is so large that its demand for low CO2 intensive aluminum production exceeds world production. In this case then prices for low and high CO2 intensive aluminum will differ on the world market and induce companies outside of region A to shift from high to low CO2 intensive production processes. But as soon as the world production capacity for energy efficient aluminum production reaches the demand of region A the prices would equalize. The approach does therefore not reach far.

A second problem of the approach of production process specific adjustment levels is, that it encourages double accounting. Imagine that region A is very big such that its demand for low CO2 intensive aluminum would create a price difference on the world market between low and high CO2 intensive aluminum. If a region B uses a tax break scheme to induce its aluminum industry to produce low CO2 intensive aluminum, then the industry in region B will benefit from both schemes. Such a scenario seems likely, as policy development within a region is a lengthy process and coordination between countries difficult.[106] This would benefit individual industries at the expense of public expenditure and public acceptance.

The economic and legal arguments suggest setting the border-tax adjustment rate independent of the production process. Hence, it should be made product specific.

[106] For example, even within a region like Australia, parallel evolution of support schemes for renewable energy in different states and at the federal level allows companies to claim benefits for their reneable energy from several different institutions (Iain MacGill, Hugh Outhred and Karel Nolles1, National Emissions Trading for Australia: key design issues and complementary policies for promoting energy efficiency, infrastructure investment and innovation, ERGO draft discussion paper 0303, 2003).

Production processes not only differ in the amount of energy required, but also in the fuel type used. The largest variations are in the sector of electric energy, which can be produced at zero emissions from renewables or nuclear and with very high CO2 emissions from brown coal. For this reason we suggest to address electric energy input separately. This still leaves us with the question of which fuel is used to produce process heat. In some chemical processes, specific fuels types are required, e.g. iron production is a coal-based process. In such processes the calculation of CO2 emissions is rather straightforward. More controversial could be processes, which are not fuel specific, e.g. provision of heat for drying chambers. Coal fired heat production results in about twice the CO2 emissions per unit heat produced than gas fired heat production. If both types of fuels are used in a certain process, then non-discrimination might require that the lower CO2 emission fuel types serve as reference. However, this should not imply that fuels like biomass are suggested as reference for heat production. Biomass produces close to zero emissions over the life cycle. However, currently biomass is not competitive in large-scale appliances, as can be seen by subsidies paid to plants producing electricity from biomass. The subsidies will be targeted such that the price of biomass equals the price of fossil fuels plus emission certificates. Therefore biomass producers incur the same cost increase irrespective of whether they use biomass or fossil fuels and should therefore be compensated for the higher costs when exporting. Likewise, renewable energy inputs into large scale industrial production processes is currently not typical. If it would occur in developing countries / non Annex-I countries, then it could receive financial support from Kyoto mechanisms. To avoid double accounting it should therefore not be considered for exemption from border adjustment mechanisms.

4.3 Technology level

A best available technology approach is not only legally warranted, it also makes economic sense. Domestic industry generally has an incentive to push the reference level towards a technology level with high emissions such that their competitiveness on the world market improves while industries outside the tax region will insist that border tax adjustments are not used as a means to discriminate against their access to the market. Hence, the process of determining the appropriate reference technology or technology mix can be subject to intensive lobbying and distortions of information supplied to the institution determining the reference level. Therefore a clearly defined process is crucial to allow for effective implementation. Best available technology – in contrast to the average technology mix – has the advantage that only one technological process has to be evaluated. In contrast, using a technology mix would be more complicated. In the bottom up approach all currently used production processes would have to be evaluated and then weighted with their contribution to total production. The top down approach in contrast could be easily applied, but as illustrated in 4.2,

seems to be rather inaccurate. The corrections necessary to improve the results would require that the body setting the rates receives large discretion and will therefore be subject to intensive lobbying.

Apart from the economic reasons against using an average technology mix section 3.2 already suggested that such an approach can discriminate against some of the producers outside the area which applies border tax adjustment. All foreign producers with production technologies that are more CO2 efficient than the average technology will incur higher costs than local producers with the same technology will incur for their CO2 emissions. If we assume that 50% of production is more and 50% is less efficient than the average technology, then the policy would discriminate, at varying levels, against up to 50% of the foreign producers. At the same time the border-tax adjustment policy in combination with the CO2 emission certificate costs imply that high CO2 intensive production processes are more expensive within the area with border tax adjustment than outside that area. This might be difficult to defend. The main arguments to defend the policy would be, that at the aggregated industry level the disadvantages for local and foreign producers are balanced.

In contrast, border tax adjustment levels related to best available technology will not incur these difficulties. Producers using best available technology will compete on equal footing inside and outside the border-tax adjusted area. Foreign producers using less efficient technologies will continue to be better off after the application of the border-tax adjustment than local producers. Therefore, the policy does at this aggregate level not contain discrimination against foreign producers irrespective of their production process.
However, we are still left with the question of which technology should be labeled best available technology. It should be a technology that is commercially viable. Otherwise foreign producers will cross-subsidize a super low CO2 emission plant with the sole purpose of reducing the import tax levels. This could be ensured by requiring a certain market share on the world markets of the products build with the best available technology production process.

The big advantage of setting border tax adjustment levels relative to any other tax level is, that local and foreign industry has opposing interests in setting the level higher or lower. This contrasts with usual industry interactions, during which all of industry provide information with the same bias to reduce the tax burden. The aim of the institution setting the border-tax adjustment level is therefore to create a transparent process such that industry cannot block the process by disputing the final border tax adjustment level. Instead industry can dispute and discuss the individual components. Industry at the other side of the border will balance any distortions with its expertise.

Basing the border-tax adjustment level on the best available technology on the world market rather than the home market has a second advantage. It limits the distortions on technology choice in the

home market. If the best available technology applied in the home market would be used as reference to set the border-tax adjustment level, then incumbents would delay using the new technology in order to keep the border-tax adjustment they receive at a high level.

An issue we still have not addressed so far is, how to treat new production processes that are more, rather than less, energy intensive. The additional energy intensity could be caused by higher environmental standards, which reduce non-CO2 emissions, but require additional energy and cause additional CO2 emissions. If the shifts are between different gases that contribute to climate change the issue can and will be easily addressed by using CO2 equivalent emissions rather than CO2 emissions as basis for the border-tax adjustment.[107] If the higher energy requirements are due to e.g. lower operation temperatures required to reduce NOx, then they will disadvantage producers that are exposed to the emission restrictions. This implies that best available technology reference production process should achieve the environmental standards required within the area in which the border tax adjustment is applied. Such a measure could induce the industry of the region that applies border tax adjustment to require higher environmental standards on a specific emission group to exclude a low CO2 intensive production process. However, such behavior is typically identified, if the purpose of excluding foreign products is apparent.

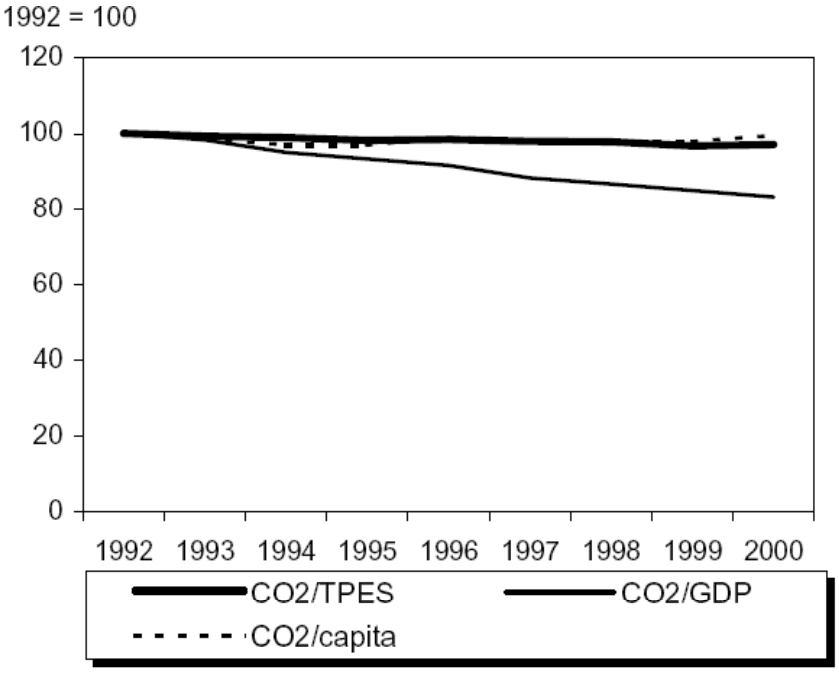


Figure 2 Energy intensity of Developed Countries (Source OECD 2002)[108]

[107] The CO2 equivalent emissions for the non-electric input in the cases presented in a study are between 7% (rubber) and 22% (aluminum) higher than CO2 emission. These differences imply, that a consistent treatment is required and has to be decided on ex-ante. (Probas, Prognos/EWI 1999, Oeko-Institute, ETH 1995)

[108] Statistic for Annex 1 Countries, TPES = Total Primary Energy Supply, Source: CO2 emissions from Fuel Combustion 1971-2000, International Energy Agency 2002

The second reason why a new production process could be more CO2 intensive, is that it resulted in the shift of the input factors, e.g. from labor to energy. Fortunately production of basic materials, which constitutes the high-energy intensive aspects, is increasingly energy efficient with the scale of the production process. Figure 2 shows that energy intensity of GDP is decreasing in Annex I countries.[109]

Summarising, we would suggest using best available technology to determine the border tax adjustment levels, because it seems easiest to implement and compliance with WTO rules seems certain. Because of opposing interests of home and foreign industries the institution setting the level border-tax adjustment should have access to all required information such that a high level of accuracy of the decisions can be expected.

The level has to be set ex-ante, because otherwise trade will be severely damaged if traders face uncertainty about the border adjustment taxes. This is particularly the case, because commodity traders between stable economies typically operate on small margins, such that already small changes of the border adjustment tax can exceed this margin and ruin the traders.

4.4 Size of processed materials class

The question not addressed so far is, how far the component materials have to be differentiated when border-tax adjustment is applied. At the outset we described that each product would be delivered with a label, which specifies the processed materials that entered into the product. However, as discussed in 4.3, the energy level would not be the energy level of the used production process but of the reference process using best available technology. How many product categories and therefore reference processes do we need to define?

Product	Probas CO2/Kg
Al99 I	8,45
AlCuMg1	8,36
AlCuMgPb	8,45
AlCuSiMg	8,35
AlMg	8,54
AlMgSi	9,55
AlMn	8,4
AlZnCuMg	8,28
AlSiMgMn	8,43

Figure 3 CO2 Intensity of production of variations of Aluminum Aloids

The following three reasons are in favor of large processed materials classes. First, the more processed materials classes we define, the larger will be the administrative burden both for industry and state to define the energy intensity of the reference processed materials and the smaller will be the incentive for industry to support the process with information. Second, the more processed materials classes we define, the more difficult will it be for companies to classify a product they export correctly and for the

[109] The aggregated graph could also represent shifts between sectors, therefore a more accurate representation should consider the evolution of energy intensity of specific industry sectors.

customs authority to verify the classification. Given that customs authorities rely on the self-declaration of companies, which can only occasionally be verified, the companies only face a sufficient incentive to truthfully classify their product, if misspecifications can be punished. However, if the specification is too difficult, then the company can dispute intentional misspecification, punishment is not possible and therefore enforcement fails. Third, the bigger a processed good class, the more companies will be competing in the class and the more likely it is that any one company will use a new, less CO2 intensive, technology. Given that others are likely to use a new, less CO2 intensive, technology, any one firm has less incentive to postpone applying a new technology. Figure 3 illustrates that for aluminum aloids a subdivision seems can be avoided, as they exhibit similar energy intensities.

Plastics	Probas CO2/Kg
EPS	3,94
HDPE	2,51
HDPE-APME 99	1,88
LDPE	2,76
LDPE-APME 99	2,08
PP	3,67
PS	3,12
PS-APME 99	2,77
PS-ISI	2,75
PET	3,43
PVC	2,41
PVC-APME-99	2,12
PVC-ISI	2,56
PUR rigid expanded	5,38
PUR flexible foam	6,40
epoxy resin	6,33
waterproof layer HDPE	2,34
damp-proof layer HDPE	3,20
damp-proof layer LDPE - flame retarded	3,96
plastic generic	1,72

Figure 4 CO2 Intensity of production of different plastics

On the other hand, the disadvantage of large product classes is, that CO2 intensity of the production can vary largely, as within the class of plastics (Figure 4). Within the class we will face the difficulty to determine which product to use to determine the CO2 (equivalent) emission per unit (weight) produced. The choice should be such, that no one has reason to suspect the intention of the project is a discriminate against foreign producer. The chosen product should therefore be among the products with the lowest CO2 (equivalent) emission in the class. This implies that the more divergent the CO2 intensity of the production of different products within a class, the lower the proportion of CO2 emission certificate costs that can be adjusted for at the border. This is the main driver for subdividing classes with inhomogeneous energy intensity of materials and increasing the number of product classes.

4.5 Electric Energy input

Certainly the most difficult energy input factor is electric energy. Electric energy is a freely tradable and homogeneous commodity. In integrated electricity systems it is technically impossible to identify the origin of an electric energy delivery. Therefore we propose a distinct treatment for electricity inputs. For electric energy input, we suggest to directly compensate for the price change of electricity rather than for the emission certificates required to match the average fuel

mix. All databases used for our analysis allow to segregate between electric energy input and other input, as illustrated for GEMIS in Figure 1.

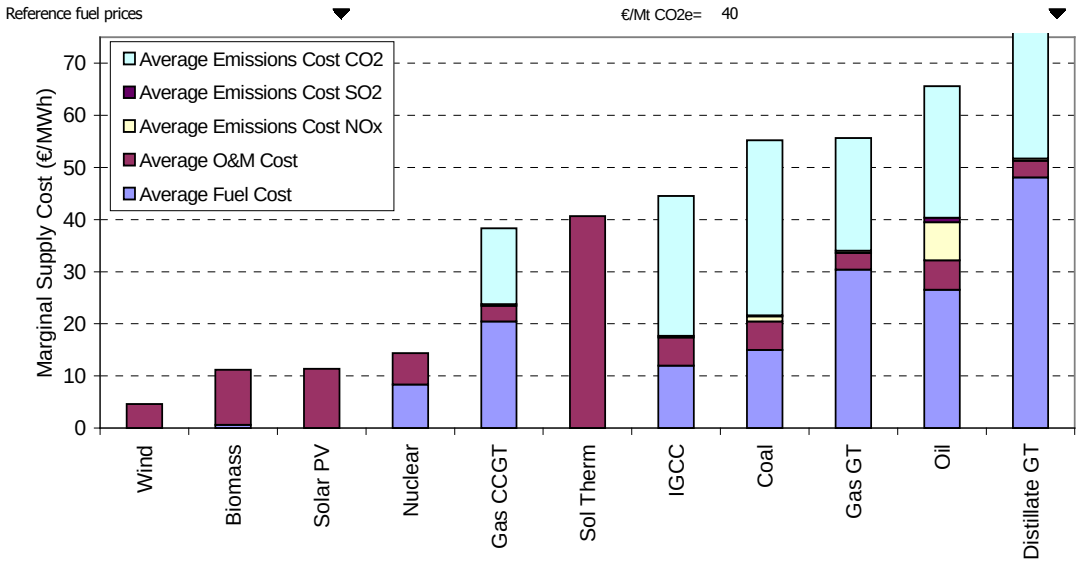


Figure 5 Change of marginal generation costs after introduction of CO2 emission certificates.[110]

Calculation of the price change requires a dispatch model, which is a standard and transparent tool. In this model generators are represented with their marginal cost curve. For a given demand curve the intercept with the marginal cost curve determines the competitive electricity price. In Figure 5 the marginal costs are depicted for different generation technologies. Because different technologies face different cost increases due to CO2 emission certificates the ranking in which they are operated can shift due to CO2 emission certificates. For example, gas combined cycle turbines are in the example more expensive to operate than coal stations in a situation without CO2 emission certificates. Therefore in a world without CO2 emission certificates coal would be at the margin in times with low demand and set electricity prices in these periods. If CO2 emission certificates are introduced, they increase the coal generation costs more than gas generation costs such that gas generation is now cheaper and can end up at the margin, setting the electricity price. If this is the case, then the price difference between coal without CO2 emission certificates and gas with CO2 emission certificates would be the price increase of electricity which will be used to set the level of border taxes. As electricity demand and generation varies throughout the year the average over several periods has to be calculated to obtain the correct value.

The observed price will always differ a little from such model approaches, mainly because of the exercise of market power which induces generators to bid their generators at higher costs into the market. However, the size of the margin is not expected to vary systematically between cases with and

[110] Source: ICF Consulting estimation for Europe, 2002, assuming a price of 40 Euro/t CO2.

without CO2 emission certificates and therefore can be ignored.[111] More interesting are inter-temporal constraints – most generators cannot alter their generation output rapidly. These ramping constraints can be included in the models and might influence the results, because CO2 emission certificates can alter which generation technology is at the margin and for example shift gas powered station to become base load providers and shift coal stations towards the margin. Coal fired power stations are less flexible to adapt to varying electricity demand than gas turbines and therefore adjustment to varying demand can be more costly with CO2 emission certificates, a systematic bias which should potentially be considered by appropriate modeling techniques.

An alternative approach would be to make an assumption about the energy mix used for the produced electricity, translate the energy input from fossil fuels into CO2 emissions, and add these to the total emissions per kg final product. However, this approach crucially depends on the generation mix. If products are produces in Norway one could argue that most power is hydro power, and therefore products should not receive border tax adjustment for their electric energy input. However, due to international electricity trade and due to limited Norwegian hydro resources CO2 emission certificates will also increase the Norwegian electricity price, even so most of the base load still faces the same marginal generation costs. This is a problem to be addressed in the context of allocation of emission certificates, but does not involve industry that buys the final product, electricity, at an increased price. Likewise, the approach to translate the fuel mix used for electricity to include the CO2 emissions into the CO2 balance of the product faces difficulties when used to calculate the import tariff. Countries like Canada or Argentina with large components of hydro could claim, that their products are produced environmentally friendly and should therefore not be exposed to the import tariff, However, even in those countries the marginal electric energy is produced with fossil generation. Therefore any change in industry output will first result in a change of power production from fossil fuels. Nevertheless, if financial incentives are strong enough, industrial plants could build a dedicated power line to a non-fossil generation plant to claim that they only use and are the only user of this energy. Hence it could be difficult to defend any fuel mix for electricity with positive contributions of fossil fuels when determining the border adjustment tariff for products. In contrast, by interpreting electricity generation as an aggregate input into the industrial production process, the CO2 emission certificates can be interpreted as a tax on electric energy. This tax will be compensated for, irrespective of the underlying evolution in the electricity industry.

4.6 Implications of grandfathering

We hold the view that border tax adjustment may only be applied so far as CO2 emission certificates are sold/auctioned rather than allocated for free. In contrast to this, free allocation in the form of pure

[111] Analysis of California experience showed, that high scarcity of NOx emission certificates created high prices and possibly reduced output from controlled generation. However, the larger area affected by CO2 emission certificates plus banking options should reduce the risk of large price spikes on CO2 emission certificates which could affect the impacts on the exercise of market power.

grandfathering could also be seen as an isolated lump sum transfer independent of the subsequent emission schemes, aimed at compensating industry for the changes in their home market. As such it could then be complemented with border tax adjustment. However, it seems more likely that the free allocation of emission certificates is perceived as an integrated component of the overall emission trading and border tax adjustment scheme. As such it would reduce the average costs industry incurs due to the overall scheme. Industry is only exposed to a limited cost component, which would greatly reduce the scope for border tax adjustment.

Therefore, the period after 2012, when the obligation to allocate at least 90% of all allowances free of charge[112] expires, seems more promising. For two reasons, the discussion of this period should start much earlier though. First, investment in low carbon technology is facilitated when more information about future policy tools reduces uncertainty. Second, most currently discussed allocation mechanisms are not purely grandfathering based on past emission levels, but also contain some relation to current emission levels to reduce anticipated discrimination against new entrants. If however current or future emission levels influence the future allocation quota, then allocation of emission certificates distorts production decisions. This can only be avoided by eliminating such updating procedures from future policies and from the anticipation of industry decision makers.

Border tax adjustment can play a crucial role in this process. Given that industry benefits from lump sum transfers implied by free allocation of emission certificates, industry uses strong lobbying against any auction mechanism for emission certificates. The main economic argument against auctions of emission certificates is the potential reduction of international competitiveness and the implied job losses. This argument can be eliminated if border tax adjustment is implemented. It is likely that higher CO2 emission certificate prices will materialize if growing scientific evidence about climate change requires further reduction of CO2 emissions. These high prices are less damaging both for economic and social reasons, if the corresponding revenue is recovered by the state in auctions and can be used to compensate for the higher costs by reductions in other tax components. If emission certificates will continue to be allocated for free, then the resulting lump sum transfer to owners of large CO2 emitters will severely reduce competitiveness of European economy with bad social implications (for further discussion see Zhang and Baranzini 2003). Furthermore, economic efficiency is increased and transaction costs will be drastically reduced if CO2 emission certificates are required further upstream – at the fuel import level rather than at the different facility level. Such an approach is currently avoided, because it does not allow exemptions for energy intensive sectors that should not be exposed to undue disadvantage in the international competition. If such exemptions are no longer

[112] Art. 10 Directive 2003/83/EC. For the period before that, the directive even stipulates a quota of 95 percent.

required because border adjustment taxes create a levy playing field, then CO2 emission certificates can be applied upstream.

We therefore have a mutual reinforcing policy mix of auctioning of emission certificates and border tax adjustment.

5. Conclusion

This paper has demonstrated that border tax adjustments for the emissions trading scheme makes economic sense. They are in conformity with WTO law where the adjustment level does not exceed the upper bound of the amount payable for production in the European Union with best available technology. To be implementable, the scheme needs to be sufficiently practicable. To achieve this, we propose a processed-materials approach where these are in turn evaluated at best available technology. Electricity, being a homogeneous commodity, should receive a different treatment. Adjustment in that case should follow the price increase induced by Carbon Emission Certificates relative to a situation without such emission certificates.

Appendix

In the following calculations we assume that demand in two regions A, E is described by differentiable demand functions $D_A(P), D_E(P)$. Several technologies are available to produce the same product. The technologies differ in the amount of energy $\tau + \alpha$ that is required for the production of one unit of output, with τ fixed and $\alpha \geq 0$ technology specific. The quantity of installed production capacity $(\alpha \leq \alpha')$ with energy efficiency equal to or higher than α' in each region is characterized by the supply functions $Q_A(\alpha'), Q_E(\alpha')$. To simplify the subsequent calculations we assume Q is differentiable. This can be either interpreted as an approximation in the limit of many firms or as any one production plant being represented by an interval of different αs, e.g. increasing output changes energy input. The marginal costs C of technology α are composed of the basic energy costs C_0 and the additional costs for emission certificates or carbon tax C_C:[113]

$$C(\alpha) = (\tau + \alpha)(C_0 + C_C) \qquad (1)$$

As a reference case we first assume global implementation of CO2 emission certificates. Global demand equals global supply, and the global marginal technology α_G is defined such that global price P_G equals marginal costs (*1):*

$$Q_A(\alpha_G) + Q_E(\alpha_G) = D_A((\tau + \alpha_G)(C_0 + C_C)) + D_E((\tau + \alpha_G)(C_0 + C_C)) \qquad (2)$$

To determine the change of the marginal technology with changes of emission costs we differentiate *(2)* with respect to C_C with $Q' > 0,\ D' < 0$:

$$\frac{\partial \alpha_G}{\partial C_c} = \frac{\tau + \alpha_G}{\frac{Q'_A + Q'_E}{D'_A + D'_E} - (C_O + C_C)} < 0. \qquad (3)$$

With increasing costs of emission certificates a smaller set of technologies is applied, and therefore the global price is increasing (using *(3)*):

$$\frac{\partial P_G}{\partial C_c} = \frac{\partial C(\alpha)}{\partial C_c} = \frac{Q'_A + Q'_E}{D'_A + D'_E} \frac{\tau + \alpha_G}{\frac{Q'_A + Q'_E}{D'_A + D'_E} - (C_O + C_C)} > 0. \qquad (4)$$

In a second step we assume that emission certificates are only implemented in region E while costless global arbitrage in the product market continues. Therefore marginal technologies α_P^A and α_P^E differ in both regions to ensure the competitive price stays uniform:

[113] *Note that we assume that all energy input will correspond to the same amount of carbon emissions. First, this requires a separate treatment of electric energy input (as suggested in the paper) to take into account the different generation mix of coal, gas, nuclear and renewable plants, which corresponds to different CO2 emissions. Secondly, some production processes can be operated with different energy inputs (e.g. steel production with coal or electricity), and therefore additional (discrete) shifting would have to be represented, but should not affect the final outcome significantly.*

$$P = (\tau + \alpha_P^E)(C_0 + C_C) = (\tau + \alpha_P^A)C_0 . \qquad (5)$$

Expressing α_P^A as function of α_P^E the equality of supply and demand implies:

$$Q_A(\alpha_P^E \frac{C_0 + C_C}{C_0} + \tau \frac{C_C}{C_0}) + Q_E(\alpha_P^E) = D_A((\tau + \alpha_P^E)(C_0 + C_C)) + D_E((\tau + \alpha_P^E)(C_0 + C_C)) \qquad (6)$$

In this case the change of α_P^E with C_C is given by:

$$\frac{\partial \alpha_P^E}{\partial C_c} = \frac{(\tau + \alpha_P^E)\left(1 - \frac{Q'_A}{D'_A + D'_E}\frac{1}{C_0}\right)}{\frac{Q'_A + Q'_E}{D'_A + D'_E} - (C_0 + C_c) + \frac{Q'_A}{D'_A + D'_E}\frac{C_C}{C_0}} . \qquad (7)$$

Comparing the change of the marginal technology *(3)* with *(7)* shows that $0 > \frac{\partial \alpha_G}{\partial C_C} > \frac{\partial \alpha_P^E}{\partial C_C}$ if $Q'_A + Q'_E > C_0(D'_A + D'_E)$.The condition is always satisfied as $Q' > 0$ and $D' < 0$, therefore we can conclude:

Proposition 1: *With partial implementation, production in region E is weakly more reduced than with full implementation of CO2 emission certificates.*

To assess the impact of partial implementation on output in region A we differentiate we use *(5)* to express α_P^A as function of α_P^E and differentiate with respect to C_C and substitute *(7):*

$$\frac{\partial \alpha_P^A}{\partial C_c} = \frac{(\tau + \alpha_P^E)}{C_0} \frac{\frac{Q'_E}{D'_A + D'_E}}{\frac{Q'_A + Q'_E}{D'_A + D'_E} - (C_0 + C_c) + \frac{Q'_A}{D'_A + D'_E}\frac{C_C}{C_0}} > 0 .$$

The result can be summarised:

Proposition 2: *With partial implementation output in region A increases relative to no implementation.*

Finally we want to assess the impact on prices. Differentiating *(5)* with respect to C_C, gives:

$$\frac{\partial P_P}{\partial C_c} = \frac{\partial \alpha_P^A}{\partial C_c} C_0 = \frac{(\tau + \alpha_P^E)\frac{Q'_E}{D'_A + D'_E}}{\frac{Q'_A + Q'_E}{D'_A + D'_E} - (C_O + C_C)\frac{Q'_A}{D'_A + D'_E}\frac{C_C}{C_0}} > 0 . \qquad (8)$$

Comparing with *(4)* shows $\frac{\partial P_G}{\partial C_C} > \frac{\partial P_P}{\partial C_C}$:

Proposition 3: *With partial implementation the global product price increases, but by less than with full implementation.*

Now we assume border taxes t are set at the level of the best available technology: $t = \tau C_C$. Importers into region E have to pay t per unit of good, and exporters receive a reimbursement for the

higher energy costs of t. Therefore the product price levels will be $P_T^E = P_T^A + t$. This defines the relationship between the equilibrium technologies α_T^E and α_T^A in both regions:

$$\alpha_T^E\left(1+\tfrac{C_C}{C_0}\right)=\alpha_T^A. \qquad (9)$$

Using again the market clearing condition that demand equals supply:

$$Q_A(\alpha_T^E\left(1+\tfrac{C_C}{C_0}\right)-\tau)+Q_E(\alpha_T^E)=D_A(\alpha_T^E(C_0+C_C))+D_E((\tau+\alpha_T^E)(C_0+C_C)),$$

and differentiating with respect to C_C gives:

$$\frac{\partial\alpha_T^E}{\partial C_c}=\frac{(\tau+\alpha_T^E)\left(1-\frac{Q'_A}{D'_A+D'_E}\frac{1}{C_0}\right)-\tau\left(\frac{D'_A-\frac{Q'_A}{C_0}}{D'_A+D'_E}\right)}{\frac{Q'_A+Q'_E}{D'_A+D'_E}-(C_O+C_C)+\frac{Q'_A}{D'_A+D'_E}\frac{C_C}{C_0}}. \qquad (10)$$

Comparing *(10)* with *(3)* and *(7)* we obtain $\frac{\partial\alpha_P^E}{\partial C_C}<\frac{\partial\alpha_T^E}{\partial C_C}<0$. This implies that producers in region E are better of with border tax adjustment. The effect on producers in region A can be determined by differentiating *(9)* with respect to C_C and substituting from *(10)*:

$$\frac{\partial\alpha_T^A}{\partial C_C}=\frac{\tau\frac{D'_E}{D'_A+D'_E}\frac{C_0+C_C}{C_0}+\frac{Q'_E}{D'_A+D'_E}\alpha_T^E\frac{1}{C_0}}{\frac{Q'_A+Q'_E}{D'_A+D'_E}-(C_0+C_C)+\frac{Q'_A}{D'_A+D'_E}\frac{C_C}{C_0}}. \qquad (11)$$

If $\frac{\partial\alpha_T^A}{\partial C_C}>0$, then implementation of CO2 emission certificates with border adjustment taxes in region E will increase production in region A.

Proposition 4: *Producers in region A will benefit from the introduction of CO2 emission certificates with border adjustment taxes in region E if:*

$$-\frac{\partial Q_E}{\partial P_T^E}\frac{\alpha_G}{\tau}>\frac{\partial D_E}{\partial P_T^E}. \qquad (12)$$

This is the case if the supply is more responsive to price changes than demand or if the dispersion of energy efficiency of different technologies α_G is big, relative to the basic energy demand τ.

If technologies are not uniformly distributed and Q'_E is not constant or demand is not linear and D'_E not constant, then (12) is a sufficient, but not a necessary condition. The necessary condition is $t<\int_0^{C_C}\frac{\partial P_T^E}{\partial C_C}dC_C$. If the necessary condition is not satisfied, then partial implementation of CO2 emission certificates with border-tax adjustment at the level of best available technology will result in a reduction of production in region A.

The interesting question then is, whether CO2 emission certificates with border tax adjustment affects production in region A more than production in region E. This is usually not the case. Comparing the output change in region E *(10)* with the output change in region A *(11)* it can be easily shown that:

Proposition 5: *Implementation of CO2 emission certificates with border adjustment taxes affects home producers more than foreign producers* $\frac{\partial \alpha_T^E}{\partial C_C} < \frac{\partial \alpha_T^A}{\partial C_C} (< 0)$ *if*

$$\alpha_T^E (Q'_A + Q'_E) + \alpha_T^E C_0 (-D'_A - D'_E) > \tau C_C (-D'_E).$$

This condition is certainly satisfied. It requires that (in linear approximation) global production $\alpha_T^E (Q'_A + Q'_E)$ after introduction of the CO2 emission certificates plus demand increase $(-D'_A - D'_E)$ from a price reduction by energy cost difference between efficient and inefficient producers $\alpha_T^E C_0$ exceeds the reduction of demand $(-D'_E)$ from a price increase τC_C by the border adjustment tax.

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