Trade and Climate Change

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Part IV

National Policies to Mitigate, and Adapt to, Climate Change, and their Trade Implications

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Climate change mitigation and adaptation measures and policies intersect with international trade in a number of ways. This part reviews the range of policies to mitigate, and adapt to the effects of, climate change. It provides examples of national efforts on climate change mitigation and adaptation, whether voluntary or mandatory, public or private. It is based mainly on national experiences and key literature on the topic. In broad terms, it provides an overview of the rationale behind these mitigation and adaptation policies and their potential implications for the environment and trade. The key aspects in the design of climate change related measures are presented in order to draw a clearer picture of their overall potential and effects on environmental protection, development and trade.

A number of policy measures have been used or are available at the national level to mitigate, and adapt to, climate change. They are typically distinguished as either regulatory measures (i.e. regulations and standards) or economic incentives (e.g. taxes, tradable permits, and subsidies). Climate change resulting from emissions of greenhouse gases is, in economic terms, a negative externality.[1] In order to correct such negative externalities and to "internalize" environmental costs, setting a price on carbon dioxide (CO_2) emissions is a key policy response. However, the existence of a number of market imperfections[2] means that carbon pricing alone may not be sufficient or may be difficult to implement. Therefore, apart from national efforts to internalize the environmental costs of greenhouse gas emissions (see Section IV.A below), other policies are being considered and implemented by governments, including financial measures to promote development and deployment of climate-friendly goods and technologies (see Section IV.B below), and technical requirements to promote the use of such goods and technologies (see Section IV.C below). These distinctions also provide a useful framework for considering the potential relevance of trade rules, and this is how this report is structured below.

In addition, it should be noted that a number of adaptation and mitigation measures in the area of agriculture with related impacts on forestry and biodiversity are being explored at the national level. As noted in Parts I and II of this Report, a changing climate will likely have a profound impact on current agricultural production systems and may require farmers to adapt. For some this may present new opportunities, but for others, particularly farmers in developing countries, this could present significant challenges. Adaptation in the agricultural sector has taken place throughout history and often without specific policy interventions. As farmers recognise the impact of a changing climate on agricultural yields, they alter their practices, such as the timing of operations, the choice of crops or livestock breed or the mix of their production, to account for the new situation.

However, the risk of a rapidly changing climate caused by greenhouse gas emissions may require policy interventions to ensure that farmers can respond in a timely manner and that support is available as farmers consider their options. Support for research will also become increasingly important to ensure the knowledge base required to deal with new pests and diseases and the changing climate is available. In this context, the WTO Agreement on Agriculture and the Agreement on Sanitary and Phytosanitary Measures (SPS) may play an important role. For example, the Agreement on Agriculture, in particular through its "Green Box" provisions for permissible subsidies, provides exemptions for research and development. Similarly, the SPS Agreement would help countries align their response to new types of pest and disease outbreaks as a result of climate change.

There are also opportunities within national agriculture policy to focus on mitigation. Notwithstanding the difficulties of calculating agricultural emissions, there is an expectation that emissions from agriculture should be reduced. At a practical level, a reduction in emissions can be achieved through a wide range of activities, including adopting energy saving practices, changing livestock feeding methods, reducing the application of pesticides, and improving manure and slurry storage. Moreover, enhancing carbon storage in soils and biomass by removing land from production (thereby avoiding soil disturbance) or by creating new woodlands are seen by many as providing a useful mitigation opportunity. From a trade policy perspective, the removal of trade barriers that currently encourage carbon-intensive agricultural practices may be an

option. For instance, several commentators have called for the reduction and removal of the most harmful kinds of trade-distorting agricultural subsidies; a step that is currently being addressed in the Doha Round.

Although national policies related to agriculture may offer important adaptation and mitigation opportunities, an in-depth analysis of these policy areas is beyond the scope of this Report. Additional studies are clearly required to address these and other types of national adaptation and mitigation measures currently under consideration. Rather, as previously stated, the analysis below focuses on price and market-based mechanisms to internalize the environmental costs of greenhouse gas emissions, and on financial and technical measures to encourage the development, deployment and use of climate-friendly technologies.

In this Part, the universe of relevant WTO rules is addressed in connection with the presentation of the different types of domestic policies and not in relation to specific measures. Broadly speaking, WTO rules and case law that relate generally to environmental issues are relevant to the examination of climate change measures. The general approach under WTO rules has been to acknowledge that trade measures may be used to achieve certain policy objectives as long as a number of carefully crafted conditions are respected. Moreover, WTO rules, as a whole, offer a framework for ensuring predictability, transparency and the fair implementation of such measures.

A number of WTO rules may be relevant to the examination of mitigation and adaptation measures and most of them are explained in this Part in detail. First, several provisions of the General Agreement on Tariffs and Trade (GATT) should be mentioned, including: the disciplines on tariffs, essentially prohibiting members from collecting tariffs at levels higher than that provided for in their WTO scheduled consolidation; a general prohibition against quantitative restrictions; a general non-discrimination principle, consisting of the most-favoured-nation and national treatment principles; and the general exceptions of the GATT that allows WTO members to adopt policy measures to protect the environment. Moreover, specific rules on technical regulations and standards as contained in the Agreement on Technical Barriers to Trade (TBT) may be relevant, and for instance the rules that such measures may not be more restrictive than necessary to fulfil a legitimate objective, must respect the principle of non-discrimination and be based on international standards, where they exist.

Also, rules of the Agreement on Subsidies and Countervailing Measures (SCM) may be relevant as they define the concept of "subsidy", establishe the conditions under which WTO members may or may not employ subsidies, and regulate the remedies that may be taken against subsidized imports. The disciplines of the General Agreement on Trade in Services (GATS) should also be mentioned: it imposes general obligations such as most-favoured-nation treatment, as well as further obligations in sectors where individual members have undertaken specific commitments such as environmental and energy services. The provisions of the Agreement on Trade-Related aspects of Intellectual Property Rights (TRIPS Agreement) may also be relevant, for instance in relation to the development and diffusion of climate-friendly technologies. Finally, other disciplines may be applicable, for instance those on import licensing and rules of origin and those related to the plurilateral Government Procurement Agreement.

A. Price and market mechanisms to internalize environmental costs of GHG emissions

This section discusses domestic efforts to internalize the environmental costs of greenhouse gas emissions and therefore to set a price on such emissions. The section starts by presenting two types of internalization mechanisms: internal taxes on greenhouse gas emissions, and emission trading schemes (see subsection IV.A.1 below). Generally, such domestic climate change policies alter the relative prices of traded goods covered by such schemes and taxes and may affect conditions for international trade. Therefore, a discussion of the disparities in domestic levels of carbon pricing among countries, and the risk of "carbon leakage"[3] will follow (see subsection IV.A.2 below). In this context, the options discussed in the literature on this subject and suggested by some policy makers to counterbalance these disparities (e.g. border measures) will also be addressed. Finally, the section will present WTO rules that may be relevant to domestic efforts to internalize environmental costs of greenhouse gas emissions, including related border measures (see subsection IV.A.3 below).

1. Domestic measures

a) Taxes on greenhouse gas emissions, and in particular "carbon taxes"

Of the range of measures available to reduce greenhouse gas emissions, one possibility, which is widely discussed in the relevant literature and has already been implemented by several countries, is the use of taxation to put a price on the release of CO_2 into the atmosphere. The main tax base of a "carbon tax"[4] is the combustion-related CO_2 emissions of fossil fuels (which are the key source of CO_2 emissions). Such a tax is usually calculated by measuring the carbon content of fossil fuels,[5] which is directly proportional to the amount of CO_2 that is produced during their combustion.[6] The tax base typically varies for each of the fossil fuels to reflect their varying carbon content, i.e. higher carbon-content fuels, such as coal and oil, are often taxed more, and relatively lower carbon-content fuels, such as natural gas, taxed less.[7] The CO_2 tax may also be based on measured emissions.[8] However, a review of the relevant literature and existing legislation did not identify any example of taxes on the emissions of CO_2 during production of goods (e.g. in the cement and steel sectors).

Broadly speaking, a carbon tax may be levied on two main points of taxation or application: consumers and producers. Although the revenue implications of one collection point over another are considered to be relatively minimal, whether the consumer or the producer is taxed may have an effect on the incentives for switching fuel and thus on the overall environmental impact of the tax, as well as on the costs of collection and enforcement.[9] Most countries implementing a "carbon tax" levy it directly on consumers through a tax on fuel consumption "at the pump".[10]

National carbon taxes are already in use in some countries, including Finland,[11] which was the first country to enact a carbon tax in 1990, and was later followed by seven other European countries.[12] Several other non-European countries have also envisaged the introduction of a carbon tax, but ultimately decided not to proceed with it.[13] Carbon taxes have also been discussed or introduced at the city or state level. For instance in Canada, the province of Quebec introduced a carbon tax in October 2007[14] and in July 2008 the province of British Columbia began phasing in a carbon tax on all fossil fuels;[15] and in the United States, the San Francisco Bay Area (California) adopted a greenhouse gas fee in May 2008.[16]

Often, governments use a combination of a tax on CO_2 emissions and a tax on energy use.[17] A "carbon tax" and an "energy tax" have different tax bases: an energy tax is based on the energy content of energy sources, while a carbon tax is based on their carbon content. Therefore, energy taxes can be imposed on both fossil fuels and on carbon-free energy sources.[18] Since energy taxes apply to fossil fuels, they have a *de facto* effect on CO_2 emissions and can be considered as "implicit carbon taxes".[19] An energy tax falls more heavily on oil and gas than a carbon tax, because oil and gas have a greater energy content than coal. A carbon tax, on the other hand, places a greater burden on coal than

on gas and oil, because coal releases more CO_2 during combustion than gas or oil do.[20]

For example, Finland[21] and Sweden combined a tax on CO_2 emissions and a tax on energy use.[22] Other countries have not adopted explicit carbon taxes but have introduced general energy taxes aimed at promoting energy efficiency and energy savings, thereby reducing greenhouse gas emissions. This is the case, for example,[23] in the United Kingdom with the Climate Change Levy[24] as well as in Germany,[25] in the context of a general environmental tax reform aimed at promoting energy saving and efficiency.[26]

Other greenhouse gases are also subject to taxation. For example, France introduced a tax on nitrous oxide (N_2O) emissions in its general tax on polluting activities.[27] In Norway, taxes on the import and production of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) were introduced in 2003.[28] In Denmark, imports of industrial gases, HFCs, PFCs, and sulphur hexafluoride (SF_6) have been subject to taxation since 2001.[29] In 2003, the government of New Zealand proposed a methane (CH_4) tax on sheep and cattle, which has, however, never been adopted.[30]

b) Emission trading schemes

Another way of setting a price on activities that have a negative impact on the environment is to: (i) fix a cap on total emissions, (ii) translate this cap into "allowed emissions" or allowances to cover emissions, and (iii) create a market in which these allowances can be auctioned and/or traded, at a price set by the market (i.e. a tradable allowance system).[31] In theory, the market price of these allowances should reflect the marginal cost[32] of emission reductions and thus encourage emitters to reach a specified emission reduction target. The price paid for the allowance is in effect, the carbon price.[33]

The first such emission trading scheme (ETS) was introduced in the United States following the Clean Air Act Amendments of 1977 in order to reduce emissions of air pollutants in certain regions.[34] In the following years, several other emission trading programmes were implemented in the United States,[35] including provisions for trading sulphur dioxide (SO_2) allowances among electric utilities in order to reduce the emissions that contributed to acid rain, in line with the 1990 Amendments to the Clean Air Act.[36]

A provision for international emission trading for greenhouse gases was subsequently included in Article 17 of the 1997 Kyoto Protocol to the UNFCCC, as explained in Section III.A.[37] It was intended to enable parties to Annex I of the Kyoto Protocol to reduce emissions through international emission trading. Annex I parties can acquire units from other parties and use them towards meeting their emission targets under the Kyoto Protocol. Since the conclusion of the Kyoto Protocol, the use of emission trading at the domestic level has received increased attention as an efficient and effective tool in complying with greenhouse gas emission targets under the Kyoto Protocol.

There are a limited number of mandatory emission trading schemes implemented at the national level. The European Union introduced, in January 2005, the world's largest greenhouse gases emission trading scheme (the EU-ETS), which currently covers more than 10,000 installations in the energy and industrial sectors that are collectively responsible for about half of the EU's emissions of CO_2.[38] Denmark implemented, in 2001-2004, an emission trading scheme to control CO_2 emissions from producers in the electricity sector (in 2005, the EU-ETS superseded this scheme).[39] In 2005-2007, Norway implemented an emission trading scheme on CO_2 emissions, which covered 10 per cent of the country's total greenhouse gas emissions. The scheme has now merged with the EU-ETS, although installations that were already subject to Norwegian CO_2 taxes are not included in the EU scheme.[40] In Switzerland, since 2008, companies wishing to be exempted from the CO_2 tax must undertake a legally binding commitment to reduce their energy-related CO_2 emissions and, in return, receive emission allowances that can be traded directly on the domestic and international markets.[41] New Zealand also adopted legislation on an emission trading scheme in 2008.[42]

Other proposals have been discussed, or announced for the near future. In Australia, a mandatory national

emission trading scheme is planned.[43] Since 2007, Canada has also been developing a greenhouse gas emission reduction plan, which includes the creation of a carbon emission trading market by 2010.[44] In the United States, since 2007, several climate change and energy bills are being discussed, including the possibility of introducing a mandatory cap-and-trade scheme.[45]

Voluntary national emission trading schemes have also been put in place. For instance, in 2002-2006, the United Kingdom implemented an ETS based on voluntary participation that is open to both the public and private sectors.[46] In 2005, Japan launched a voluntary ETS covering CO_2 emissions from companies that agreed to commit to reaching emission reduction targets.[47] Another example of a voluntary emission trading system is the Chicago Climate Exchange, launched in 2003 in North America.[48] Its members are business firms and governmental and non-governmental organizations that choose to make voluntary commitments to reduce emissions of all six major greenhouse gases.[49] Once these voluntary commitments are made, they become legally binding.

At the sub-national level, the state of New South Wales in Australia introduced, in 2003, the Greenhouse Gas Abatement Scheme, which is the second-largest mandatory scheme, after the EU-ETS.[50] In the United States, the Air Resources Board of the state of California recently approved a framework for implementing a cap-and-trade programme for the electricity generation sector, which will be implemented in 2012.[51] Seven western states of the United States and four Canadian provinces[52] also committed, in 2007, to the Western Climate Initiative, under which a regional cap-and-trade programme will be implemented in 2012.[53] In 2009, ten northeast states[54] of the United States, as part of the Regional Greenhouse Gas Initiative, launched the first cap-and-trade scheme for greenhouse gas emissions within the United States.[55]

Emission trading schemes share a number of design characteristics that are briefly discussed below: the scope; the allocation of emission allowances; the linkages with other existing schemes; and some other features.[56] These design characteristics are important, as they determine the cost burden for participants, and influence the overall trade implications of the schemes.

i) Scope

First, domestic trading schemes can be linked to two types of emission targets:[57] (i) an overall emission level (the cap-and-trade system); or (ii) an emission standard for each source (the rate-base system). In a cap-and-trade system, the government defines an overall maximum amount of greenhouse gases, usually set in physical units (e.g. tonnes), that regulated sources can emit over a specified time-frame.[58] To achieve the goal of decreased emissions, this maximum quantity of allowable emissions is often capped at a lower level than the amount of past emissions, and this cap typically decreases over time. The government then creates a number of "allowances" to cover emissions equal to the size of the cap.

In contrast, under a rate-based system (also called relative cap, "baseline and credit"[59] or carbon intensity-based), the government determines a standard of emissions for each source, usually expressed in either emissions allowed per unit of production, or emission-intensity.[60] For instance, the Greenhouse Gas Abatement Scheme in New South Wales (Australia) and the emission trading market currently under discussion in Canada use rate-based cap-setting.[61] In Canada, the baseline of each firm is planned to be its emission-intensity target.[62]

There are two key differences between cap-and-trade and rate-based systems.[63] A rate-based model does not set a general cap on emissions and therefore gives rise to uncertainty about the overall emission level that may be achieved. Moreover, the administrative burden involved is higher with a rate-based system than with cap-and-trade: as with an environmental tax, the regulating authorities would need to periodically recalculate and adjust rate standards to achieve a certain emission target and correct for additional emissions that may result from increased production.[64]

Second, the number of participants in an emission trading scheme is also an important element in

determining the potential impact on emission reduction of any given scheme.[65] However, the extent to which small and large emitters contribute to reaching the overall emission target is uneven, and the cost-effectiveness of including small installations in emission trading schemes has been questioned.[66] In fact, existing and proposed schemes usually provide for minimum thresholds of CO_2 emissions so as to exclude small installations. For instance, in the third phase of the EU-ETS, installations emitting under 25,000 tonnes of CO_2 per year will be allowed to opt out of the ETS, provided that alternative reduction measures are put in place.[67] The proposed Canadian,[68] Australian[69] and Californian[70] emission trading schemes also include minimum thresholds.

Third, sectoral coverage varies. Some schemes cover a wide range of sectors or allow for the gradual inclusion of more sectors. For instance, in the post-2012 period, the scope of the EU-ETS – which currently covers power generation, iron and steel, glass, cement, pottery and bricks, among others – will be extended to include new sectors, including petrochemicals, ammonia and the aluminium sector.[71] The proposed Canadian scheme is also intended to cover a wide array of sectors: electricity generation produced by combustion; oil and gas; forest products; smelting and refining; iron and steel; some mining; and cement, lime and chemicals.[72]

Finally, concerning the type of gases covered, most regimes cover only CO_2, as is the case for the EU-ETS, the United States' Regional Greenhouse Gas Initiative and Switzerland's trading scheme. In contrast, New South Wales (Australia) and the proposed Canadian scheme also cover other greenhouse gases.[73] The EU-ETS post-2012 phase foresees the inclusion of two new greenhouse gases: nitrous oxide (N_2O) and perfluorocarbons (PFCs).[74]

ii) Allocation of emission allowances

In an emission trading system, allowances are the common currency. Usually, one allowance gives the holder the right to emit one tonne of CO_2, as in the case of the EU-ETS, or the right to emit one tonne of CO_2-equivalent (CO_2-eq), as, for example, in the New South Wales scheme.[75] Companies that keep their emissions below the level of their allowances can sell their excess allowances. On the other hand, companies that emit more than the level of their allowances usually have two possibilities, which may also be combined: take measures to reduce their emissions (such as investing in more climate-friendly technologies), or buy the extra allowances they need on the market.

The method of allocating allowances may have important implications on the distribution of costs among covered companies as well as how costs are passed on to consumers, and therefore may influence the potential loss or gain in competitiveness for certain industries.[76] In this regard, both the point of application (or regulation) of the scheme and how allowances are distributed are important considerations.

Broadly speaking, there are two points of application, which may also be combined.[77] In an "upstream" design, the overall limit on emissions applies to producers and importers of fossil fuels and to producers of other energy sources. The emission costs are typically passed on to consumers in the form of higher prices. It is argued that one key advantage of an upstream system is that it involves relatively low administrative costs because it regulates the emissions of a limited number of entities. However, since there are no real options for suppliers of fossil fuels to reduce the carbon content of these fuels, it is argued that an emission cap amounts to a simple fuel cap, with the related negative impact on the profits of fossil fuel producers and importers. Moreover, an upstream design may be insufficient to encourage end-user energy efficiency and emission reductions.

In a "downstream" design, the emission limit applies to sources of emissions, e.g. to end-users of fossil fuels, who are the actual emitters of CO_2.[78] The downstream system offers the advantage of a potentially wide and efficient market for emission trading. Its main drawback lies in higher administrative costs, as it may apply to potentially large numbers of participants.[79]

Most existing schemes are designed in a downstream fashion, as for example the EU-ETS, which applies to single installations in the targeted sectors.[80] The appropriate point of application may differ from sector to sector. For instance, where emissions linked to the

transport sector are concerned, it is considered that a downstream point of application would be difficult to implement, as it would have to include all owners and operators of vehicles,[81] and therefore an upstream point of regulation is usually favoured, at the level of refiners and importers of fuels.

Currently, there are two key methods used by the regulator to distribute allowances to existing installations:[82] allocation free of charge and/or auctioning. Free allowances can be based on historical emission levels ("grandfathering"), or on projected sectoral emissions, or they can be distributed by another method, for example on the basis of emissions per unit of output ("benchmarking").[83] The advantages of the free distribution of allowances are that it reduces the risk of losing competitiveness in energy-intensive and trade-exposed sectors; and it may also be a first step in the progressive phase-in of an emission trading scheme.

With auctioning, companies are required to bid for the number of allowances they need to purchase in order to cover their emissions, as opposed to receiving an initial amount free of charge.[84] Reasons in favour of auctioning include the following: it is likely to provide an immediate price signal in the allowances market, which should increase the scheme's overall effectiveness, as the consumers of CO_2-intensive products will adjust demand accordingly; it provides higher incentives to take early action to reduce emissions; and it may attenuate the windfall benefit problem[85] and therefore be more in keeping with the "polluter pays" principle.[86]

In practice, allowances have often been distributed for free, mainly to address the competitiveness concerns of energy-intensive industries.[87] For instance, Switzerland has distributed 100 per cent of its allowances for free.[88] In the third phase of the EU-ETS, there will be a substantial increase in the amount of auctioning (from less than 4 per cent in Phase II to more than 50 per cent in Phase III).[89] Also, under Australia's emission trading scheme a high proportion of free allowances will be allocated to emission-intensive and trade-exposed industries.[90] On the other hand, under the Regional Greenhouse Gas Initiative, several participating northeast states of the United States have decided to auction 100 per cent of their annual allowances.[91]

iii) Linkages with existing schemes, including offsets

A number of emission trading schemes have already been established or are planned for the near future. Although it may be very challenging to link several schemes, as they often vary in some of their key characteristics (such as size, environmental stringency, reporting and monitoring mechanisms, or CO_2 price), there are some clear advantages in doing so. For example, linking emission trading systems could lead to the creation of a larger market, which may in turn bring down the overall cost of reducing greenhouse gas emissions, increase liquidity[92] and reduce volatility of allowance prices.[93]

Two types of links may be distinguished. First, direct links can be set up, whereby emission allowances are traded across several different emission trading schemes.[94] For instance, in the third phase of the EU-ETS, linking and mutual recognition of allowances will be allowed between the EU-ETS and the cap-and-trade systems of any country at the national or sub-national levels, as long as the design of the other emission trading schemes do not undermine the "environmental integrity" of the EU-ETS.[95]

Second, indirect links (which are quite common)[96] may also be established, whereby emission trading schemes are linked to project-based offsets.[97] "Carbon offsetting" (or "offsets") refers to the act of reducing or avoiding greenhouse gas emissions in one place in order to "offset" greenhouse gas emissions occurring somewhere else.[98] Offsets are credits typically generated from emission-reducing projects, such as tree planting, or investments in renewable energy, energy conservation or methane capture.

Credits from project-based offsets can be generated from abroad, for example through the Clean Development Mechanism (CDM).[99] For instance, under the EU-ETS, operators are allowed, within a certain limit, to cover their emission allowances by buying credits generated by emission-saving projects

undertaken in other countries.[100] These projects must be officially recognized under the Kyoto Protocol's Joint Implementation mechanism or the CDM. CDM projects are also accepted as offsets in Norway, Japan, the Chicago Climate Exchange, Switzerland[101] and in the proposed Australian emission trading scheme.[102]

Some ETSs also provide for the possibility to use domestic offsets from domestic projects that are not part of the emission trading scheme.[103] For instance, in the Regional Greenhouse Gas Initiative (United States) and the New South Wales (Australia) schemes, other types of offsets from United States[104] and New South Wales-based projects,[105] respectively, can be used. In the third phase of the EU-ETS, it will also be possible to use domestic offset credits from domestic projects that reduce greenhouse gas emissions but that are not covered by the ETS.[106]

iv) Other features

Most emission trading schemes provide for a banking mechanism in order to help stabilize the fluctuations of allowance prices and limit the risk of non-compliance.[107] Banking enables allowances to be carried over from one phase to the other, i.e. allowances not used during the trading period for which they were issued can be banked for use at a later trading period.[108] Banking typically achieves early results in emission reduction, as most firms reduce their emission levels further than required, or buy more allowances than they need, in order to be sure of avoiding non-compliance penalties.[109] The banking of allowances can help firms meet emission targets while providing flexibility to undertake large investments that are necessary to reduce emissions. Provisions allowing the banking of allowances are, for instance, incorporated in the EU-ETS (from the second period onwards),[110] in the emission trading schemes of New South Wales in Australia, in the Chicago Climate Exchange, in the United States' Regional Greenhouse Gas Initiative, in Switzerland, in the national scheme proposed in Australia, and in California's proposed scheme.[111]

Borrowing is another flexibility mechanism that allows a greenhouse gas-emitting entity to use allowances from a future time-period to cover current emissions: the entity borrows from potential reductions that have not been realized yet, but are anticipated to occur in the future, presumably at lower cost than current reductions.[112] Borrowing can constitute an insurance mechanism against price spikes in the event of sustained demand for allowances. For instance, Australia's scheme will allow a limited degree of borrowing, using allowances from the following year, in order to increase flexibility.[113] However, there are some limitations to the use of borrowing, such as the fact that the environmental objective of reduced emissions could be undermined if companies launch into borrowing against future rights and thus delay their emission reductions for several years.[114]

Emission trading schemes may also include some enforcement mechanisms, including possible sanctions.[115] The effectiveness of such mechanisms will depend on the regulator's technical ability to monitor and detect violations, and legal ability to deal with violations once detected.[116] For instance, under the EU-ETS, if an installation does not possess sufficient allowances to cover its annual emissions, it will be financially penalized, and the amount of the deficit in allowances will be carried over to the following period. The fine for non-compliance in the first phase of the EU-ETS was 40 euros/tonne CO_2, and is 100 euros/tonne CO_2 for the second phase.[117] From 1 January 2013 onwards, the fine for non-compliance will increase in accordance with the European Index of Consumer Prices.[118]

c) Environmental effectiveness

Carbon taxes and emission trading schemes may have two key environmental effects:[119] (i) a "direct effect", i.e. a reduction of greenhouse gas emissions, a stimulation of energy-efficient measures, the switching to low-carbon fuels and products, and changes in the economy's production and consumption structures; and (ii) an "indirect effect", through the "recycling" of the fiscal or auctioning revenues to fund, for instance, investment in more climate-friendly technologies, or to enhance emission-reducing changes in investment and consumption patterns.

The "direct effect" stems from the fact that a carbon tax or an emission trading scheme internalizes the environmental cost of carbon by setting a price on the carbon content of energy and on the CO_2 emissions generated in production and/or consumption. In theory, an appropriate price signal on carbon should have the following consequences: ensure that emitting entities pay the full environmental cost of their actions; encourage individuals and businesses to move away from the use of high-carbon goods and services, and to invest in low-carbon alternatives; and, in the long run, promote innovation in new production methods and products that meet consumer demand while reducing pollution.[120]

In order to be fully efficient, a carbon tax should be set at a level that internalizes the costs of environmental damage, so that prices reflect the real environmental costs (the so-called "Pigouvian tax").[121] Most of the integrated assessment models that have been employed to determine the optimal trajectory of a carbon tax show it rising over time. For example, Nordhaus's (2008) study based on his DICE (Dynamic Integrated Model of Climate and the Economy) model shows that the optimal carbon tax begins at $34 (in 2005 prices) per metric ton carbon in 2010, then rises to $42 per ton in 2015, $90 per ton in 2050, and $220 per ton carbon in 2100. The explanation for this is that the carbon tax should be set to equal the marginal damage caused by the emissions.[122] Over time, this marginal damage will increase as the stock of carbon in the atmosphere accumulates so that to fully internalize these rising costs, the carbon tax must increase accordingly. However, the literature and regulations reviewed in this section show that such optimal carbon taxes have rarely been used by policy makers, given, *inter alia*, the difficulty in estimating environmental damage cost and the fluctuations of energy prices.

It seems, however, that countries have rather followed the more pragmatic "Baumol-Oates" approach, pursuant to which the tax rate is set so as to simply influence taxpayers' behaviours to achieve a given environmental objective.[123] This more pragmatic concept is easier to implement in a context where the cost of environmental damage is difficult to evaluate.[124] In practice, the carbon tax rate used varies from country to country: for instance, in Nordic countries, the average CO_2 tax revenue ranges from 7.8 euros/tonne CO_2 in Finland to 23 euros/tonne CO_2 in Sweden.[125]

The "indirect effect" of a carbon tax or an emission trading scheme (under auctioning) may vary depending on how the public revenue which has been raised is used. The revenue can either be included in the government's general budget, or can be redistributed in order to: finance specific programmes, in particular environmental ones (this is known as "earmarking"); compensate industries that are most affected by the tax or the emission trading scheme (and hence alleviate competitiveness concerns); or reduce the burden imposed by some other taxes (such as labour and value-added taxes).[126] Moreover, it has been argued that some additional benefits may be generated by the manner in which the revenues collected with carbon taxes or pursuant to auctioning under an emission trading scheme are "recycled", i.e. reinvested in the economy (this is known as a "double dividend").[127] In addition to an "environmental double dividend" (i.e. reducing CO_2 emissions may be accompanied by a decrease in local pollution), there may also be an "economic double dividend", i.e. recycling the revenues from carbon tax or from auctioning by reducing some other taxes may have a beneficial impact on economic growth, employment or technological development.[128]

Even though recycling the collected revenue, in particular with certain earmarked programmes, might result in environmental advantages, such "fiscal cushioning" may undermine the environmental effectiveness of climate policies and therefore circumvent the intended effect of a carbon tax or emission trading scheme. A number of problems related to this practice have been underlined, among them: firms may delay giving up polluting modes of production; revenue recycling might not motivate companies to fully face up to the environmental cost of their emissions; and earmarking may create obstacles to necessary tax re-evaluations, based on economic and environmental rationales, because the use of the revenue is fixed in advance by the regulator.[129]

In practice, countries often use a mix of possibilities for redistributing the revenues generated from emission

trading schemes or carbon taxes. For instance, Finland uses carbon tax revenues both to promote renewable forms of energy and energy efficiency (earmarking), and to reinvest in the general national budget.[130] In Denmark, fiscal revenues are recycled to industry through investment grants for energy-efficient production measures, through reductions of employers' contributions to labour funds, as well as through a special fund for small and medium-sized enterprises.[131] In Sweden, tax-relief rules have been introduced for sectors "subject to competition" and a strategy was adopted in 2000 for a "green tax shift", under which increased carbon taxes are offset by reduced taxes on labour.[132] Norway uses part of the revenues from the carbon tax to reduce income tax.[133] Finally, in the third phase of the EU-ETS, a substantial portion of the revenues which will be generated by the auctioning of allowances as from 2013 will be used to reduce greenhouse gas emissions and adapt to the impacts of climate change, through contributions to certain funds for third countries, investment in renewable energies, and afforestation and reforestation measures in developing countries, among others.[134]

How successful have carbon taxes and emission trading schemes been in practice? Overall, most studies on the results of carbon taxes show relatively small but positive effects on CO_2 emissions. For instance, a 2004 survey of evaluations of CO_2-based taxes concluded that all these taxes, either on their own or as part of a wider package, had generally contributed to the reduction of emissions.[135] Also, a 2000 assessment showed that Finland's CO_2 emissions would have been 7 per cent higher in 1998 had the energy taxes been kept at the 1990 level.[136] The relatively low levels of environmental effectiveness are usually explained by the extensive tax exemptions and the relatively inelastic demand in the sectors that were taxed.[137] When looking at specific sectors, however, emission reductions seem larger. For instance, in Sweden, emissions from district heating, and from the industrial and housing sectors decreased by 19 per cent from 1987 to 1994 and 60 per cent of this reduction could be attributed to the CO_2 taxation.[138] A 1996 study in Norway also found a decrease of 21 per cent in emissions from stationary combustion plants from 1991 to 1995, due to the introduction of the carbon tax.[139]

In theory, a well-functioning emission trading scheme should limit emissions to the specified caps, and should therefore achieve a high level of environmental effectiveness.[140] However, due to the political, practical and economic reasons analysed in the previous section, most emission trading schemes until now have had limited scope and thus a limited ability to curb emissions. Moreover, assessments of the results are still at an early stage, since existing emission trading schemes have not been in operation for long.[141] For instance, the performance of the EU-ETS to date cannot be evaluated without recognizing that the first three years (2005-2007) constituted a "trial" period aimed at developing the cap-and-trade infrastructure needed to reduce greenhouse gas emissions.[142]

Both carbon taxes and emission trading schemes are mechanisms that set a price on greenhouse gas emissions and therefore aim at internalizing the environmental cost of such emissions, with a view to reducing the quantity of emissions to environmentally optimal levels, at the minimum cost.[143] In the case of a carbon tax, the price is determined directly by the regulators through the tax rate (i.e. exogenously), while the quantity of emissions that will be reduced is a result of measures adopted by the industry to reduce emissions (i.e. endogenously). On the other hand, in the case of an emission trading scheme, the quantity of emissions that will be reduced is determined by the regulators (i.e. exogenously) while the price is determined by the market (i.e. endogenously) according to the supply of and demand for emissions, and the price adjusts itself to the marginal abatement costs (i.e. the cost of reducing one additional unit of emissions).[144]

The regulator's choice of instrument is arguably dependent on the relative value assigned to price versus the need to ensure the certainty of an environmental outcome. A carbon tax may be more appropriate when the costs of achieving a desired level of emissions are uncertain. An emission trading scheme may be preferable in situations where greater environmental certainty is needed. For instance, a typical case where greater environmental certainty is relatively more important than price certainty is where there is a risk of reaching a threshold of damage. This is the case when the environmental damage is relatively limited below a

certain threshold, and potentially catastrophic above the threshold. In this situation, if a safe emission threshold can be identified, a cap is the preferable option in order to avoid severe environmental consequences.[145]

On the other hand, when there is no threshold of damage, and the marginal abatement costs are relatively sensitive to the level of pollution identified as being acceptable, a tax may be preferable. For instance, in the case of stock pollutants (defined as pollutants that accumulate over time), it is generally argued that every unit of pollution has roughly the same effect on the environment. In this situation, greater price certainty is relatively more important than environmental certainty, and therefore a tax would be preferable to an emission cap.[146]

In the case of climate change, the harmful environmental effects derive from the accumulation over time of stock pollutants such as greenhouse gases. This would make a case for the adoption of a tax. On the other hand, in the long term, the continued concentrations of greenhouse gases in the atmosphere may eventually reach a certain threshold that could give rise to catastrophic environmental consequences, as discussed in Part I of this publication. In such cases, stabilizing emissions below a threshold level would be very important, providing a rationale for setting an emission cap.[147]

2. Border measures

In the absence of an internationally agreed price on carbon[148] and since emission reduction policies, such as taxes and/or trading schemes, are not applied universally, the implementation of emission reduction policies has given rise to concerns about competitiveness as well as about environmental efficiency, i.e. "carbon leakage". Concerns about competitiveness and carbon leakage, particularly in relation to energy-intensive industries, have recently come to the forefront of climate change discussions, triggered by the consideration and implementation of emission trading schemes in several developed countries.

To reduce the cost of compliance for potentially affected industries, mechanisms such as free allowances or exemptions are used.[149] Another mechanism is to use trade measures at the border to impose a similar cost on importers. This type of trade policy is also argued to be an incentive for other countries to reduce their greenhouse gas emissions, so that the environmental objectives of domestic legislation are achieved and at the same time the global nature of climate change is taken into account.

The following sections first clarify the concepts of "competitiveness" and "carbon leakage", and then present the various types of border mechanisms that are being suggested to remedy them: border tax adjustments to carbon or energy taxes; border measures in relation to an emission trading scheme; and some other types of border measures.

a) Rationale: competitiveness effects and carbon leakage

Both unilateral carbon taxes and emission trading schemes affect relative costs of goods and hence, to a certain extent, also affect the competitiveness of firms and sectors.[150] The competitiveness of a sector may be defined as its ability to maintain profits and market shares.[151] Effects on competitiveness arise in particular if environmental policies in different countries impose different levels of costs on competing firms, thus creating a price advantage for firms located in countries with less stringent environmental policies.[152]

The effects of climate change measures on the competitiveness of sectors will depend on a number of factors that relate to: (i) the specific characteristics of the sector (e.g. its trade exposure; how energy-intensive or CO_2 emission intensive it is; its direct and indirect carbon costs;[153] its production costs; the ability to pass on cost increases through prices; the market structure; transportation costs; its capacity to reduce emissions and/or energy consumption; the possibility to evolve towards cleaner production technologies and processes); (ii) the design of the regulation (e.g. the amount of the carbon charge; the stringency of the regulation; the availability of alleviations and exemptions; and in the case of an emission trading scheme the allocation method for allowances); and (iii) other policy considerations (e.g. energy and climate policies adopted by other countries).[154] The

influence of each of these factors may be industry-specific and quite complex to determine. Two of these factors have been at the centre of discussions on the effects on competitiveness of recent emission trading schemes and of those under consideration: the "cost pass-through capability" of companies, and their trade exposure.

The "cost pass-through capability" of a company is its capacity to transfer to consumers any increases in the cost of its production processes by increasing its product prices, without losing profitability (in other words the cost recovery potential). The price increase needed to recover costs incurred due to emission reduction schemes may be determined by adding the direct costs of meeting the emission cap to the indirect carbon costs. Direct carbon costs depend on the carbon intensity and energy intensity of the production process and the availability of emission abatement techniques. In addition to direct costs, industries may also face indirect carbon costs related to increases in the cost of energy inputs in reaction to an increased "carbon constraint" (such as an increase in electricity price).[155]

The ability to "pass through" costs depends on a number of elements, including: the elasticity of demand, i.e. the price responsiveness of demand for a product; the market structure; and the trade exposure.[156] For example, electricity companies can more easily pass on their costs to consumers because electricity demand is relatively price-inelastic (i.e. demand remains nearly constant, whether prices increase or fall), the market structure is usually highly regulated, and there is very limited international competition from countries with no carbon emission reduction policies.[157] Moreover, it is argued that producers of internationally traded commodities will have far less scope to offset their carbon costs through price increase, as they fear loss of market share.[158] Exposure to international trade is seen as the main constraint to companies' ability to pass through costs to consumers.[159]

Studies done to date have generally found that the effects on competitiveness of environmental regulations, including climate change policies, are relatively small, or are likely for only a small number of sectors, because the costs of compliance with a regulation are a relatively minor component of a firm's overall costs, which also include, for example, exchange rate fluctuations, transportation costs, energy prices and differences across countries in the costs of labour.[160] For instance, a study examining the literature on competitiveness effects of a carbon price concluded that it would negatively impact the competitiveness of only a few energy-intensive manufacturing industries and would be likely to have a limited impact on output and employment levels.[161] It should be noted, however, that the carbon constraint in some emission trading schemes (e.g. in Phase III of the EU-ETS) is expected to be increasingly stringent, with fewer free allowances, which will therefore increase the potential impact on the competitiveness of a number of sectors.[162]

Related to the potential impact of climate change mitigation policies on competitiveness, the issue of "carbon leakage", or the risk of energy-intensive industries relocating to countries with weaker environmental policies, has recently received a great deal of attention. It is clear that the price of carbon will be different between countries that have implemented carbon constraining regulations such as a carbon tax or an emission trading scheme and countries that have not. Moreover, among countries that use such a pricing instrument or which have enacted different regulatory measures to mitigate climate change, the price of carbon may also vary considerably.[163]

The concerns related to carbon leakage are usually linked to two risks: a risk of creating "carbon havens", i.e. countries with less stringent carbon policies which attract carbon-intensive industries, thereby endangering the global effectiveness of carbon-constraining environmental policies, and a risk of job relocation resulting from the relocation of industries to countries where climate change mitigation policies are less costly.[164]

Some countries have proposed – or have already introduced in their legislation on emission trading schemes – criteria to identify sectors or sub-sectors that would be at risk of carbon leakage. These criteria include the following: increases in production costs induced by the introduction of the new regulation; trade exposure; emission intensity; the extent to

which it is possible to reduce emissions or electricity consumption; and the extent to which other countries are taking comparable action to reduce emissions and improve carbon efficiency.[165] Identification of the sectors that may be at risk of carbon leakage may prove to be a challenging task in practice, mainly because of the difficulties involved in collecting the data for the above-mentioned indicators.

In the context of emission trading, free allocation of emission allowances to energy-intensive industries or output-based rebates have been considered to be a means to prevent carbon leakage. For instance, in the third phase of the EU-ETS certain sectors could continue to receive all their allowances for free for the period 2013-2020 if the European Commission determines that they are "at significant risk of carbon leakage".[166]

But alleviations and exceptions may not be sufficient to prevent carbon leakage, and the question that then arises is whether the concerns over carbon leakage and competitiveness impact warrant government intervention in the form of border adjustments.[167]

b) Key characteristics

In complement to the domestic implementation of carbon taxation or of an emission trading scheme, the introduction of border measures aimed at offsetting possible asymmetries in competitiveness and preventing carbon leakage has been widely discussed in the literature on the subject, and in some countries. The following sections address border tax adjustments to carbon taxes or energy taxes, border measures in relation to emission trading schemes, and other types of border measures.

i) Border tax adjustments to carbon taxes or energy taxes

As shown in Subsection IV.A.1(a), the term "carbon tax" has been used by countries and in the related literature to refer to two broad types of climate change related taxation: (i) taxes on the consumption of fossil fuels in relation to their carbon content; and (ii) taxes on the emissions of CO_2 during the production process (e.g. in the cement and steel sectors) – although the general review of countries' taxation in the previous subsection did not identify any examples of this type. In addition, countries usually impose a number of taxes on the consumption of energy in general (i.e. taxes that are not linked to the carbon content of fossil fuels, but are aimed at reducing the consumption of all energy sources).

The 1970 report of the *GATT Working Party on Border Tax Adjustments*[168] referred to a definition of border tax adjustment used in the OECD.[169] Under this definition, a border tax adjustment (BTA) consists of two situations: (i) the imposition of a tax on imported products, corresponding to a tax borne by similar domestic products (i.e. BTA on imports); and/or (ii) the refund of domestic taxes when the products are exported (i.e. BTA on exports).

Border tax adjustments are commonly used with respect to domestic taxes on the sale or consumption of goods.[170] BTAs are considered by tax experts to be a means to implement in a government's fiscal policy the "destination principle", according to which goods are taxed in the country of consumption.[171] The overall economic objective of a BTA is to level the playing field between taxed domestic industries and untaxed foreign competitors by ensuring that internal taxes on products are "trade-neutral".[172] For example, many tax schemes adjust for taxes on products such as cigarettes or alcohol.[173] Countries also commonly adjust domestic taxes on fossil fuels when importing such fuels.[174]

However, not all internal taxes may be suitable for adjustment. The question whether domestic carbon/energy taxes are eligible for border tax adjustment pursuant to GATT and WTO rules is discussed below in Section IV.A.3(a).

ii) Border adjustments in relation to an emission trading scheme

Border adjustments in relation to an emission trading scheme (for instance in the form of an obligation on importers to hold emission allowances) have not yet been put in place. However, as part of the discussion on domestic emission trading schemes, a debate is

currently taking place in certain countries on possible means to impose border adjustments.[175]

For instance, it has been envisaged to link an emission trading scheme to certain requirements on imports from countries that do not impose similar emission reduction obligations on their industries. In such cases, importers would have to submit emission allowances or certified emission credits to cover the emissions created during the manufacturing process of the imported good; or they would be allowed to purchase allowances in the domestic emission trading markets on equal terms with domestic industries.[176]

iii) Other border measures

A number of other types of border measures have been envisaged by governments and in literature on the subject, in particular with a view to encouraging certain countries to agree to emission reduction commitments.[177] Such measures would be imposed on imported products, especially energy-intensive ones, originating from certain countries, and include for instance: an import charge or a higher tariff.[178]

Academics have also discussed the possibility of raising a countervailing duty (against "*de facto* subsidies") or an anti-dumping duty (against "environmental dumping") on imported goods produced in countries that do not impose climate change related regulations, in order to offset the emission-reduction costs those imports have avoided paying, or the *de facto*, or "hidden" subsidy that those goods are receiving.[179] It has been argued that inaction involves a benefit, and therefore the avoided cost of fighting climate change could be considered to be a hidden subsidy on emissions which could be countervailed.[180] A number of other authors, however, are of the view that it would be difficult to qualify a country's failure to adopt climate legislation as a "subsidy" or environmental "dumping" in terms of WTO law.[181]

Another type of measure that has been discussed is the possibility of imposing a tax on certain means of international transport – for example on trucks driving through a country's territory – based on their evaluated emissions of CO_2.[182] Such a measure mainly aims at internalizing the costs of means of transport to better reflect their true impact on society and the environment, and also aims at promoting a more equitable taxation for the use of road infrastructure based on principles such as "user-pays" and "polluter-pays".[183]

c) Practical challenges

There are, however, a number of practical difficulties involved in the implementation of a border tax adjustment in relation to a carbon or energy tax, and further difficulties in designing a mechanism to adjust the cost of emission allowances and calculate the proper level of border adjustment. The main challenges relate to (i) the difficulty in assessing product-specific emissions, and (ii) the fluctuations of the carbon price (or allowance price) in the context of an emission trading scheme. An additional difficulty may arise in cases where imported products are subject, in the country of origin, to other climate change regulations, such as technical regulations, rather than price mechanisms such as taxes.[184] Compliance with certain regulations, such as a fuel efficiency standard, may also involve a cost (e.g. investment in more energy-efficient technologies) that may be complex to evaluate and transform into an adjustable price or a "comparable action".

The main difficulty in assessing products' emissions comes from the fact that greenhouse gas emissions involved in the production process may vary depending on the product, the company and the country.[185] The CO_2 intensity of a product (i.e. embedded CO_2 divided by its value) depends on the quantity of fuels used, the production process of a particular good, the energy efficiency of the production process, the type of fuels or energy used, the source of the energy (i.e. the particular energy mix used in the country of production).[186] If the input is not recognizable in the final product, then it will not be possible to calculate the tax or charge from merely inspecting the product at the border, and alternative methods of assessment of the amount of border adjustment to be imposed on imported products will therefore be necessary.[187] Several methods are usually discussed. First, the country of import could require that imported products be accompanied by some sort of certification or labelling as to the relevant

aspects of the production process used.[188] The second potential method would be for the importing country to assume that the imported product has been made according to the "predominant method of production" used in the country of import or the "best available technology" currently available and to tax the product accordingly.[189]

It is generally considered that the first approach requiring that the imported products be accompanied by certification or other information documents may raise a number of practical issues, such as: (i) the difficulty of precisely assessing the actual quantity of CO_2 emitted during the production of a specific item; and (ii) the fact that producers may not be willing to share confidential information on the composition of their products.[190] Such an approach had been envisaged by the United States in relation to chemical products. In the GATT *Superfund* case, the panel found that a United States tax on certain chemicals that was imposed directly on products was eligible for border tax adjustment and consistent with GATT Article III.2.[191] Importers were required to provide sufficient information regarding the chemical inputs of taxable substances to enable the tax authorities to determine the amount of BTA to be imposed.[192]

A case that arose under European Union law is also often referred to concerning the practical difficulties involved in the estimation of the amount of border adjustment to a carbon/energy tax: the 1998 *Outokumpu Oy* case.[193] The Finnish government had imposed a tax on electricity using different rates depending on how it was generated. Finland taxed imports at a flat rate set to approximate an average of the domestic rates, because it argued that it was impossible to determine how imported electricity was produced once it had entered the distribution network. Outokumpu Oy, an electricity importer, complained that this flat rate was a violation of the European Communities Treaty, which forbids direct and indirect discrimination against imported products. The European Court of Justice agreed and explained that Finland's law did not give the importer the opportunity to demonstrate that its electricity was produced by a particular method in order to qualify for the rate applicable to domestic electricity produced by the same method.[194] However, the Court also held that, provided that a tax differential was based on objective criteria and applied to domestic and foreign products alike, it was lawful for member states to tax the same or similar products differentially.[195]

In cases where industries are not in a position to disclose any such information, the second option that has been suggested is for the country imposing the adjustment to assume that the imported products have been produced using the "best available technology" versus the average technology.[196] It has been argued that the "best available technology" chosen could be one that has a certain world market share for the production of the products concerned. The level of the tax would then correspond to the quantity of greenhouse gases that would have been emitted if all components had been manufactured with the "best available technology". It has also been suggested, for credibility reasons, that elaboration of the best available technology standards should be entrusted to an independent body that would receive all required information from the industry.[197]

Some authors argue[198] that a similar approach has been implicitly accepted by the GATT Panel in the *Superfund* case. Under the Superfund Act, if the importer failed to provide information regarding the chemical inputs of taxable substances, the United States could impose instead a rate equal to the amount that would be imposed if the substance were produced "using the predominant method of production".[199] The panel did not find that this method would constitute an infringement of the national treatment principle, as contained in Article III.2, first sentence.[200]

The fluctuations of the carbon price in an emission trading scheme is in fact one of the major differences with an adjustment on a carbon/energy tax (which establishes a fixed carbon price).[201] The actual cost of allowances varies from firm to firm due, for example, to grandfathering, different experiences in emission allowance markets, or worldwide differences in emission profiles within a given industry.[202] In fact, a single firm might also hold different types of allowances: some received free of charge, some purchased from the government in an auction, and others purchased on the open market. Therefore, it may be difficult to base a border adjustment on the current market price of

allowances, especially when some free allocations have been distributed.[203]

3. Relevant WTO rules

Several WTO disciplines may come into play if a carbon/energy tax or an emission trading scheme and/or their adjustments affect international trade.[204] The literature has been very prolific on the extent to which GATT and WTO rules would apply to border measures based on the carbon content of products or based on the adoption of "comparable" climate change mitigation measures.[205]

The discussion has been triggered by a number of factors, including: (i) the recent design by governments of new policy mechanisms to mitigate climate change; (ii) the concerns over competitiveness and carbon leakage and the related risk of protectionism; (iii) the absence of universal commitment to reduce greenhouse gas emissions and the related temptation to use trade measures to encourage reduction in emissions; and (iv) some perceived legal uncertainties in GATT and WTO provisions about measures on production processes (in particular "non-product related PPMs"), as they have not yet been clarified in the dispute settlement system of the WTO.

The following subsections first focus on GATT and WTO disciplines that deal specifically with border tax adjustments and then address more general rules that may be relevant to different types of border measures and to domestic regulations that have an effect on trade.

a) Rules specific to border tax adjustments

Generally speaking, two types of internal taxes may be distinguished: taxes on products (called indirect taxes) and taxes on producers (i.e. direct taxes).[206] In its examination of BTAs, the 1970 GATT Working Party indicated that taxes directly levied on products (i.e. so-called indirect taxes, such as excise duties, sales taxes and the tax on value added) were eligible for adjustment, while certain taxes that were not directly levied on products (i.e. direct taxes such as taxes on property or income) were normally not eligible for adjustment.[207]

In 1976, a GATT panel, in the *United States Tax Legislation (DISC)* case,[208] confirmed, for the export side and in relation to GATT rules,[209] the distinction between direct and indirect taxes and the ineligibility of direct taxes (on producers) for adjustment.[210] The question of whether domestic carbon/energy taxes are eligible for border tax adjustment pursuant to GATT and WTO rules and, if so, under which conditions, is addressed in this subsection.

i) Border tax adjustments on imported products

Pursuant to GATT Article II on tariff concessions and customs duties, for a BTA on imports to be characterized as a tax adjustment and not a customs duty,[211] the charge imposed on the imported product needs to be equivalent to the tax imposed on the "like" domestic product. In other words, there is a difference between a "border tax" and a "border tax adjustment". A "border tax" is a tax (or customs duty) imposed on imported goods, while a "border tax adjustment", is an adjustment of the taxes imposed domestically on products when the goods are imported. Therefore, GATT Article II.2(a) allows WTO members, at any time, to impose on the importation of any product a charge equivalent to an internal tax (e.g. a border tax adjustment).[212]

There is an extensive legal debate over the eligibility, for border adjustment, of domestic carbon/energy taxes. Some authors have also discussed whether the price paid by an industry to participate in an emission trading scheme (in the form of an obligation to hold emission allowances) could be qualified as an "internal tax or other internal charge of any kind" under GATT Article III.2,[213] and would therefore be comparable to a carbon/energy tax for the purpose of introducing border adjustments. According to these authors, GATT and WTO rules on border tax adjustment could then become relevant.

Two GATT provisions are at the centre of the discussion on border tax adjustments in relation to carbon/energy taxes: (i) Article II.2(a) and its phrase "articles from which the imported product has been manufactured or produced in whole or in part"; and (ii) Article III.2, first

sentence and the terms "applied, directly or indirectly, to like domestic products".

Article II.2(a) allows two types of import charges (i.e. border tax adjustments): (i) charges imposed on imported *products* that are like domestic products; and (ii) charges imposed on *articles* from which the imported product has been manufactured or produced in whole or in part. The first type could refer, for instance, to charges imposed on domestic fuels and imported "like" fuels.[214]

Concerning the second type of charges, however, extensive discussion has taken place on the extent to which the energy inputs and fossil fuels used in the production of a particular product could be considered to be "articles from which the imported product has been manufactured or produced in whole or in part".[215] It has been suggested by some that the wording of Article II.2(a) may restrict the application of Article II to inputs physically incorporated into, or part of, the final product, which would therefore exclude the possibility to adjust taxes on the energy or fossil fuels used during the production of goods (other than taxes on fuels themselves).[216]

Article II.2(a) also states that internal taxes and equivalent charges on imported products need to be imposed consistently with GATT Article III.2 and the preamble to Ad Note Article III.[217] Under Article III.2, border adjustments on imported products is only allowed in respect of taxes "applied, directly or indirectly, to like domestic products" (i.e. indirect taxes).[218] The meaning of the words "directly or indirectly" has been extensively debated in the literature related to adjustments of taxes on CO_2 emissions. In particular, the focus of the debate has been the question whether, pursuant to both Articles II.2(a) and III.2, only the environmental taxes on inputs which are physically incorporated into the final product may be eligible for adjustments when the final product is imported.[219]

It has been argued by some that the word "indirectly" contained in Article III.2 may be interpreted as allowing the use of border tax adjustments on taxes that are charged on inputs used during the production process of a particular product, i.e. applied indirectly to products.[220] According to this argument, a tax on the energy or fuels used in the production process or the CO_2 emitted during production (neither of which are physically incorporated in the final product) could therefore be considered to be applied indirectly to products.[221]

The GATT *Superfund* case[222] has been mentioned in this context. In this case, the dispute panel found that a US tax on certain substances (used as inputs in the production process of certain chemicals)[223] which was imposed directly on products was eligible for border tax adjustment.[224] It has been argued that this case confirms that the GATT allows border tax adjustments on imported products in relation to an internal tax on certain inputs used in the production process.[225]

ii) Border tax adjustments on exported products

GATT and WTO rules permit, under certain conditions, the use of border tax adjustments on exported products. Export BTAs cannot be subject to anti-dumping duties imposed on goods that are deemed to be "dumped" (i.e. exported at less than the cost price in the domestic market) nor can they be subject to countervailing duties that an importing country introduces to offset certain subsidies provided in the exporting country.[226] Export BTAs do not constitute subsidies.[227] Export BTAs are therefore neither prohibited nor "actionable" under the WTO Agreement on Subsidies and Countervailing Measures (SCM) and GATT rules. Footnote 1 of the SCM Agreement reads:

"In accordance with the provisions of Article XVI of GATT 1994 (Note to Article XVI) and the provisions of Annexes I through III of this Agreement, the exemption of an exported product from duties or taxes *borne by* the like product when destined for domestic consumption, or the remission of such duties or taxes in amounts not in excess of those which have accrued, shall not be deemed to be a subsidy." [emphasis added]

GATT Article VI:4, the Ad Note to Article XVI and footnote 1 of the SCM Agreement refer to taxes "borne by" products and not "applied to" or "subject

to" as contained in GATT Article III:3. In 1970, i.e. before the SCM Agreement came into effect, the GATT Working Party on Border Tax Adjustments took note of these differences in wording in the GATT and concluded that they had not led to any differences in interpretation of the provisions.[228] It also noted that GATT provisions on tax adjustment applied the "principle of destination" identically to imports and exports.[229]

Furthermore, Items (e) and (g) of the Illustrative List of Export Subsidies contained in Annex I of the SCM Agreement endorse the distinction between direct and indirect taxes.[230] Border tax adjustments on exports with respect to direct taxes are considered to be export subsidies (Item (e)) and are therefore prohibited under Article 3 of the SCM Agreement.[231] On the other hand, border tax adjustments on exports with respect to indirect taxes are considered an export subsidy only when the BTAs are "in excess" of taxes "levied in respect of the production and distribution of like products when sold for domestic consumption" (Item (g)). Item (g) provides that the following is an export subsidy:

"The exemption or remission, in respect of the production and distribution of exported products, of indirect taxes [footnote omitted] in excess of those levied in respect of the production and distribution of like products when sold for domestic consumption."

Item (g) therefore allows, for instance, a tax on domestically produced fossil fuels to be rebated when a product is exported, provided that the rebate is not larger than the actual tax levied on "like" products "when sold for domestic consumption".[232] Moreover, Item (g) allows border tax adjustment (if not "in excess" of taxes that are charged on like products) in relation to indirect taxes levied "in respect of the production and distribution" of like domestic products. This has been interpreted by some authors as including taxes on energy or fuel consumption, since those taxes are levied in respect of the production of the goods.[233]

It has also been argued that carbon and energy taxes are a particular type of indirect tax and would fall under the category of "taxes occultes" (literally, "hidden taxes").[234] The 1970 GATT Working Party on Border Tax Adjustments included, under this category, taxes on "advertising, *energy*, machinery and transport" (emphasis added).[235] In fact, the Working Party noted a divergence of views among delegations regarding the eligibility for adjustment of "taxes occultes" and even indicated that adjustment was not normally made for "taxes occultes" except in countries having a cascade tax.[236] However, it has been argued by some authors that certain of the "taxes occultes" that were mentioned by the GATT Working Party are now explicitly allowed by the SCM Agreement: the Working Group listed taxes on "machinery and transport" as examples of "taxes occultes", whereas the SCM Agreement allows border tax adjustments on taxes not in excess of domestic indirect taxes in respect of the "production and distribution" of like products, which potentially could include transport taxes.[237]

Finally, there has been extensive discussion on the extent to which Item (h)[238] on "prior stage cumulative indirect taxes" (PSCI taxes)[239] of the Illustrative List of Export Subsidies read together with footnote 61[240] to Annex II on "Guidelines on consumption of inputs in the production process" could be interpreted as implying that carbon and energy taxes are eligible for border tax adjustment on both the product and the related production process of the product.[241]

b) General disciplines

The following subsections will focus on one of the key disciplines of the GATT and WTO agreements: the non-discrimination principle (i.e. national treatment principle and the most-favoured nation clause). Moreover, if a trade-related climate change measure is found to be inconsistent with one of the core provisions of the GATT (e.g. Articles I, III or XI), justification could still be sought under Article XX. This will be the focus of the last subsection.

Other disciplines and WTO agreements may be also relevant to climate change related measures such as the prohibition of quantitative restrictions[242] and disciplines on technical barriers to trade.[243] Also, the provisions of the Agreement on Subsidies and Countervailing Measures (SCM) may be relevant to emission trading schemes, for instance if allowances

are allocated free of charge. Some authors[244] are of the view that free allowances could constitute actionable subsidies covered by the SCM Agreement.[245] It should be noted however that if free allowances are found to be actionable subsidies covered by the SCM Agreement, "adverse effects" would have to be demonstrated for action to be taken by another WTO member.[246]

i) Non-discrimination principle

National treatment

The national treatment principle may be particularly relevant in cases where a climate change related regulation is applied differently to domestic and foreign producers. The national treatment principle is a key discipline of the WTO and GATT. In accordance with GATT Article III, a member shall not discriminate between its own and like foreign products (giving them "national treatment").

Article III.2 deals specifically with internal taxes or other internal charges. For a tax or charge on imports to fall under this provision, it needs to apply "directly or indirectly, to like domestic products". As already briefly discussed in previous subsections, the key question is whether a potential tax on CO_2 emissions released during the production process will be considered to be a tax applied indirectly to products. For taxes or charges on imports to be consistent with Article III.2, they should not be applied "in excess" to taxes levied on like domestic products. Moreover, in accordance with GATT Article III.2, second sentence, and the Ad Note, "directly competitive or substitutable" imported and domestic products shall incur similar taxes, and these shall not be applied so as to afford protection to domestic production.

GATT Article III.4 addresses "all laws, regulations and requirements affecting the internal sale, offering for sale, purchase, transportation, distribution or use" of products. As indicated by the Appellate Body in the *US – FSC (Article 21.5, EC)* case, the word "affecting" in Article III.4 can be interpreted as having a "broad scope of application".[247] Article III.4 provides that, in respect of all such regulations and requirements, imported products shall not be accorded treatment less favourable than that accorded to like domestic products. In the *Korea – Various Measures on Beef* case, the Appellate Body found that imported products are treated less favourably than like products if a measure modifies the conditions of competition in the relevant market to the detriment of imported products.[248]

The national treatment principle is also found in several other WTO agreements, such as the Technical Barriers to Trade (TBT) Agreement (Articles 2, 5, Annex 3.D) and the Sanitary and Phytosanitary Measures Agreement (Article 2). On the other hand, it should be noted that in the GATS, Article XVII allows a WTO member to maintain discriminatory conditions on its national treatment obligations unless it commits otherwise.

Most-favoured nation clause

According to the most-favoured nation clause, a WTO member shall not discriminate between "like" products from different trading partners (giving them equally "most favoured-nation" status). GATT Article I.1 provides that "any advantage, favour, privilege or immunity" granted by any member to any product originating in or destined for any other member shall be accorded immediately and unconditionally to the like product originating in or destined for the territories of all other members. As explicitly provided in Article I.1, the scope of application of this provision also extends to all matters referred to in paragraphs 2 and 4 of Article III (see above). The most-favoured nation clause is also found in other WTO agreements, including Article II of the GATS and Article 2 of the TBT Agreement.

Definition of like products

One of the key questions discussed in relation to the application of the non-discrimination principle as contained in GATT Articles I and III relates to the "likeness" of domestic and imported products. This is an important question: when a domestic product and an imported product are found to be "like", their treatment must be consistent with the national treatment principle and the most-favoured nation clause.

The question of the definition of "likeness" has been addressed by a number of dispute settlement cases. As rephrased[249] by the Appellate Body in the *EC – Asbestos* case, the analysis of the likeness of products is based on four categories of "characteristics" that the products involved might share:[250] "(i) the physical properties of the products; (ii) the extent to which the products are capable of serving the same or similar end-uses; (iii) the extent to which consumers perceive and treat the products as alternative means of performing particular functions in order to satisfy a particular want or demand; and (iv) the international classification of the products for tariff purposes".[251]

The Appellate Body has made it clear that the concept of likeness is one that needs to be addressed on a case-by-case basis:[252] the four criteria are simply tools to assist in the task of sorting and examining the relevant evidence and not a closed list of criteria that determine the legal characterization of products.[253] An important question in relation to the application of the four above-mentioned criteria to climate change measures is whether products may be considered "unlike" because of differences in the way in which they have been produced (referred to as non-product-related processes and production methods (PPMs)), even though the production method used does not leave a trace in the final product, i.e. even if the physical characteristics of the final product remain identical.

ii) GATT exceptions

A number of authors have underlined the importance of the case law related to GATT Article XX on General Exceptions in the context of climate change related measures.[254] If a particular measure is inconsistent with one of the core provisions of the GATT (e.g. Articles I, III or XI), it could still be justified under Article XX. Article XX lays out a number of specific instances in which WTO members may be exempted from GATT rules.[255] Two exceptions are of particular relevance to the protection of the environment: paragraphs (b) and (g) of Article XX. According to these two paragraphs, WTO members may adopt policy measures that are inconsistent with GATT disciplines, but necessary to protect human, animal or plant life or health (paragraph (b)), or relating to the conservation of exhaustible natural resources (paragraph (g)).

GATT Article XX on General Exceptions consists of two cumulative requirements. For a GATT-inconsistent environmental measure to be justified under Article XX, a member must perform a two-tier analysis proving: first, that its measure falls under at least one of the exceptions (e.g. paragraphs (b) and/or (g), two of the ten exceptions under Article XX); and, second, that the measure satisfies the requirements of the introductory paragraph (the "chapeau" of Article XX), i.e. that it is not applied in a manner which would constitute "a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail", and is not "a disguised restriction on international trade".[256]

Environmental policies covered by Article XX

WTO members' autonomy to determine their own environmental objectives has been reaffirmed on a number of occasions (e.g. in *US – Gasoline*, *Brazil – Retreaded Tyres*). The Appellate Body also noted, in the *US – Shrimp* case, that conditioning market access on whether exporting members comply with a policy unilaterally prescribed by the importing member was a common aspect of measures falling within the scope of one the exceptions of Article XX.[257] In past cases, a number of policies have been found to fall within the realm of paragraphs (b) and (g) of Article XX: (i) policies aimed at reducing the consumption of cigarettes,[258] protecting dolphins,[259] reducing risks to human health posed by asbestos,[260] reducing risks to human, animal and plant life and health arising from the accumulation of waste tyres[261] (under Article XX(b)); and (ii) policies aimed at the conservation of tuna,[262] salmon and herring,[263] dolphins,[264] turtles,[265] petroleum,[266] and clean air[267] (under Article XX(g)).

Although policies aimed at climate change mitigation have not been discussed in the dispute settlement system of the WTO, the example of the *US – Gasoline* case may be relevant. In this case, the panel had agreed that a policy to reduce air pollution resulting from the consumption of gasoline was a policy concerning the protection of human, animal and plant life or health as mentioned in Article XX(b).[268] Moreover, the panel found that a policy to reduce the depletion of clean air was a policy to conserve a natural resource within the meaning of Article XX(g).[269] Against this background,

some authors have argued that policies aimed at reducing CO_2 emissions could fall under Article XX(b), as they intend to protect human beings from the negative consequences of climate change (such as flooding or sea-level rise), or under Article XX(g), as they intend to conserve not only the planet's climate but also certain plant and animal species that may disappear because of global warming.[270]

Also in the *US – Shrimp* case, the Appellate Body accepted as a policy covered by Article XX(g) one that applied not only to turtles within the United States' waters but also to those living beyond its national boundaries. The Appellate Body found that there was a sufficient nexus, or connection, between the migratory and endangered marine populations involved and the United States for purposes of Article XX(g).[271] This point is particularly important in the context of climate change mitigation policies. Some authors have indeed argued that this finding could be relevant to establishing a sufficient nexus between a member's domestic mitigation policy or a border measure and the intended objective of this policy, the protection of a global common asset, the atmosphere.[272]

Degree of connection between the means and the environmental policy objective

In order for a trade-related climate change measure to be eligible for an exception under Article XX, paragraphs (b) and (g), a connection needs to be established between its stated climate change policy goal and the measure at issue. The measure needs to be either: *necessary* for the protection of human, animal or plant life or health (paragraph (b)) or *relating to* the conservation of exhaustible natural resources (paragraph (g)).

To determine whether a measure is "necessary" to protect human, animal or plant life or health under Article XX(b), a process of weighing and balancing a series of factors has been used by the Appellate Body, including the contribution made by the environmental measure to the policy objective, the importance of the common interests or values protected by the measure and the impact of the measure on international trade. If this analysis yields a preliminary conclusion that the measure is necessary, this result must be confirmed by comparing the measure with its possible alternatives, which may be less trade-restrictive while providing an equivalent contribution to the achievement of the objective pursued.[273]

For instance, in the *Brazil – Retreaded Tyres* case, the Appellate Body found that the import ban on retreaded tyres was "apt to produce a material contribution to the achievement of its objective", i.e. the reduction in waste tyre volumes.[274] The Appellate Body also found that the proposed alternatives, which were mostly remedial in nature (i.e. waste management and disposal), were not real alternatives to the import ban, which could prevent the accumulation of tyres.[275]

In *EC – Asbestos*, the Appellate Body also found, as a result of a process of weighing and balancing a series of factors, that there was no reasonably available alternative to a trade prohibition. This was clearly designed to achieve the level of health protection chosen by France and the value pursued by the measure was found to be "both vital and important in the highest degree".[276] The Appellate Body made the point that the more vital or important the common interests or values pursued, the easier it was to accept as necessary measures designed to achieve those ends.[277]

For a measure to be "relating to" the conservation of natural resources in line with Article XX(g), a substantial relationship between the measure and the conservation of exhaustible natural resources needs to be established. In the words of the Appellate Body, a member has to establish that the means (i.e. the chosen measure) are "reasonably related" to the ends (i.e. the stated policy goal of conservation of exhaustible natural resources).[278] Moreover, in order to be justified under Article XX(g), a measure affecting imports must be applied "in conjunction with restrictions on domestic production or consumption" (the even-handedness requirement).[279]

For instance, in the context of the *US – Gasoline* case, the United States had adopted a measure regulating the composition and emission effects of gasoline in order to reduce air pollution in the United States. The Appellate Body found that the chosen measure was

"primarily aimed at" the policy goal of conservation of clean air in the United States and thus fell within the scope of paragraph (g) of Article XX.[280] As far as the second requirement of paragraph (g) is concerned, the Appellate Body ruled that the measure met the "even-handedness" requirement, as it affected both imported and domestic products.[281]

In the *US – Shrimp* case, the Appellate Body considered that the general structure and design of the measure in question were "fairly narrowly focused" and that it was not a blanket prohibition of the importation of shrimp imposed without regard to the consequences to sea turtles;[282] thus, the Appellate Body concluded that the regulation in question was a measure "relating to" the conservation of an exhaustible natural resource within the meaning of Article XX(g).[283] The Appellate Body also found that the measure in question had been made effective in conjunction with the restrictions on domestic harvesting of shrimp, as required by Article XX(g).[284]

In the context of climate change, according both to Article XX(b) and to Article XX(g), a substantial link will need to be established between the trade measure and the environmental objective. It should be noted that in *Brazil – Retreaded Tyres*, the Appellate Body recognized that certain complex environmental problems may be tackled only with a comprehensive policy comprising a multiplicity of interacting measures. The Appellate Body pointed out that the results obtained from certain actions – for instance, measures adopted in order to address global warming and climate change – can only be evaluated with the benefit of time.[285]

The importance of the manner in which trade-related environmental measures are applied

The introductory clause of Article XX (its "chapeau") emphasizes the manner in which the measure in question is applied. Specifically, the application of the measure must not constitute a "means of arbitrary or unjustifiable discrimination" or a "disguised restriction on international trade".

The chapeau requires that the measure does not constitute an abuse or misuse of the provisional justification made available under one of the paragraphs of Article XX, that is to say, is applied in good faith.[286] In *Brazil – Retreaded Tyres*, the Appellate Body recalled that the chapeau serves to ensure that WTO members' right to avail themselves of exceptions is exercised in good faith in order to protect legitimate interests, not as a means to circumvent one member's obligations towards other WTO members.[287] In other words, Article XX embodies the recognition by WTO members of the need to maintain a balance between the right of a member to invoke an exception, and the rights of the other members under the GATT.

WTO jurisprudence has highlighted some of the circumstances which may help to demonstrate that a measure is applied in accordance with the chapeau. These include relevant coordination and cooperation activities undertaken by the defendant at the international level in the trade and environment area, the design of the measure, its flexibility to take into account different situations in different countries, as well as an analysis of the rationale put forward to explain the existence of a discrimination (the rationale for the discrimination needs to have some connection to the stated objective of the measure at issue).

For instance, in the *US – Gasoline* decision, the Appellate Body considered that the United States had not sufficiently explored the possibility of entering into cooperative arrangements with affected countries in order to mitigate the administrative problems raised by the United States in their justification of the discriminatory treatment.[288] Moreover, in the *US – Shrimp* case, the fact that the United States had "treated WTO Members differently" by adopting a cooperative approach regarding the protection of sea turtles with some members but not with others also showed that the measure was applied in a manner that discriminated among WTO members in an unjustifiable manner.[289]

At the compliance stage, in *US – Shrimp (Article 21.5)*, the Appellate Body found that, in view of the serious, good faith efforts made by the United States to negotiate an international agreement on the protection of sea turtles, including with the complainant, the measure was now applied in a manner that no longer constituted

a means of unjustifiable or arbitrary discrimination.[290] The Appellate Body also acknowledged that, "'as far as possible', a multilateral approach is strongly preferred" over a unilateral approach.[291] But, it added that, although the conclusion of multilateral agreements was preferable, it was not a prerequisite to benefit from the justifications in Article XX to enforce a national environmental measure.[292]

Moreover, in the *US – Shrimp* case, the Appellate Body was of the view that rigidity and inflexibility in the application of the measure (e.g. by overlooking the conditions in other countries) constituted unjustifiable discrimination.[293] It was deemed not acceptable that a WTO member would require another member to adopt essentially the same regulatory programme, without taking into consideration that conditions in other members' territories might be different, and that the policy solutions might be ill-adapted to their particular conditions.[294]

In order to implement the panel and Appellate Body recommendations, the United States revised its measure and conditioned market access on the adoption of a programme comparable in effectiveness (and not essentially the same) to that of the United States. For the Appellate Body, in *US – Shrimp (Article 21.5)*, this allowed for sufficient flexibility in the application of the measure so as to avoid arbitrary or unjustifiable discrimination.[295] The Appellate Body pointed out, however, that Article XX does not require a WTO member to anticipate and provide explicitly for the specific conditions prevailing in every individual member.[296]

Finally, an environmental measure may not constitute a "disguised restriction on international trade", i.e. may not result in protectionism. In past cases, it was found that the protective application of a measure could most often be discerned from its "design, architecture and revealing structure". For instance, in *US – Shrimp (Article 21.5)*, the fact that the revised measure allowed exporting countries to apply programmes not based on the mandatory use of turtle excluder devices (TEDs), and offered technical assistance to develop the use of TEDs in third countries, showed that the measure was not applied so as to constitute a disguised restriction on international trade.[297]

B. Financial mechanisms to promote the development and deployment of climate-friendly goods and technologies

The previous section discussed efforts to internalize the environmental costs of greenhouse gas emissions. Through such efforts, a price signal on emissions is set and individuals and businesses are encouraged to switch away from high-carbon goods and services and to invest in low-carbon alternatives. Government funding to enhance the deployment and utilization of new climate-friendly technologies and renewable energy is another type of economic incentive commonly used in climate change mitigation policies. This section introduces and gives examples of the wide range of governmental policies that are in place, or being discussed, to facilitate the innovation process or address the additional costs related to the use of climate-friendly goods and technologies so as to encourage their development and deployment.

1. Rationale

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) underlined that many mitigation technologies are currently commercially available, and more are expected to be commercialized soon.[298] However, the development and deployment of new technologies, including technologies for the use of renewable and/or cleaner energy sources, may be occurring at a slower pace than is desirable from an environmental point of view, and may therefore need to be reinforced by national policies.

Although the private sector plays the major role in the development and diffusion of new technologies, it is generally considered that a closer collaboration between government and industry would stimulate the development of a broad range of low-carbon technologies at more affordable prices.[299]

A number of factors may hamper the development of new climate-friendly goods and technologies, and may inhibit innovation in the climate change technology sector.[300] First, there is the problem of "environmental externality": because carbon emissions do not have a

cost, firms and consumers have no direct incentive to find ways to reduce them. Second, companies' incentive to invent and develop new technologies may be reduced due to the "knowledge effect": in other words, individual companies may not always be able to profit fully from their investment in innovation because "knowledge" about such technologies (and therefore the opportunity to make a profit from them) may spread to other companies, and to other countries. Third, companies may not always be able to convince private investors of the relevance and interest of a research project in the climate change area, because they may not be in a position to demonstrate the environmental effectiveness of their product until it has been brought into use on a wide scale.

Furthermore, a number of factors may affect the cost of deployment of climate-friendly and renewable energy technologies.[301] First, the cost of energy from renewable sources – except large hydropower installations, combustible biomass (for heat) or large geothermal projects – is generally not competitive with wholesale electricity and fossil fuel prices. One of the biggest challenges facing renewable energy technologies is therefore the development of options that can generate energy at costs that are competitive with conventional energy sources. Public funding policies may be able to make the price of energy from renewable sources competitive with that of fossil fuels.

Second, it has been observed that the removal of subsidies on fossil fuels, by changing patterns of energy use and encouraging the development and widespread application of more energy-efficient technologies could be an important mechanism for reducing greenhouse gas emissions.[302] A number of studies have analysed the economic and environmental impact of removing or significantly reducing fossil fuel public subsidies.[303] Such studies usually demonstrate that there would be a substantial reduction in CO_2 emissions. The Agreement on Subsidies and Countervailing Measures (SCM) may be relevant in this regard. Also, some experts have attempted to draw a link between the current Doha Round negotiations on disciplining fisheries subsidies and future multilateral action to address fossil fuel subsidies. It should be noted that a number of countries have engaged in a policy of reduction in subsidies for fossil fuels and coal, both on the production and on the consumption side. In China, for instance, fuel prices rose substantially (over 40 per cent) between 2004 and 2006, as the country removed fuel subsidies.[304] Pre-existing fuel subsidies have also been reduced in other countries, such as Pakistan[305] and Nigeria.[306]

Third, low-emission energy technologies in sectors other than electricity generation (such as transport and industry) are also generally more expensive than conventional technologies. Here, too, governmental funding for industries and individuals using less energy-intensive or emission-intensive technologies – such as purchasing more energy-efficient products or installing meters to measure electricity use – may also help to offset the additional cost involved in the use of these cleaner technologies.

Finally, putting new renewable energy or climate-friendly technologies on the market is also associated with a "learning cost", i.e. the additional cost involved in adapting to the new technology.[307] If the learning rate is low, and/or the time before the technology becomes competitive spans decades, the learning cost will be high, and private sector firms may be unwilling to risk deploying the new technology. In fact, new technologies may not become cost-effective until significant investment has been made and experience has been accrued, and such "learning cost" may reduce the incentive to deploy climate-friendly goods and technologies.

In response to all these factors affecting the cost of climate-friendly and renewable energy goods and technologies, governmental funding may contribute to their faster deployment and increased use, and may also help reduce the gap between their cost and that of conventional technologies and sources of energy.[308] The following subsections introduce the wide range of existing or proposed governmental policies to facilitate the innovation process or to reduce the additional costs related to the use of climate-friendly goods and technologies, and thus encourage their development and deployment.

2. Scope

Policies to promote the development and deployment of goods and technologies aimed at mitigating or adapting to the effects of climate change have been established by certain national and/or sub-national bodies. A number of countries[309] have set up funding programmes at the national level to support climate change policies, such as Denmark's Energy Technology Development and Demonstration Programme[310] or Finland's BioRefine Programme on biomass.[311]

Programmes based on financial incentives (rather than direct payments) usually occur at the national level. For instance, Germany[312] and Spain[313] have both established renewable energy feed-in tariffs (i.e. this refers to a regulated minimum guaranteed price per kilowatt-hour that an electricity company must pay for renewable energy fed into the national electricity grid by a private independent producer. At the sub-national level, some bodies also provide funding.[314] For instance, some provinces in Germany, such as North Rhine-Westphalia,[315] have set up energy research programmes. Another example is Kristianstad, a Swedish municipality, which in 1999 declared its intention of becoming a "Fossil Fuel Free Municipality".[316] This programme, funded by a combination of municipal and state grants, includes promotion of the use of biomass and biogas, energy efficiency and sustainable community planning.

Depending on the type of projects being financed by national and sub-national policies, the population targeted by the policy may vary. A distinction may be made between measures targeted at consumers ("demand-pull") and measures targeted at producers ("supply-push").[317] "Demand-pull" policies are designed to increase the demand for mitigation technologies by reducing their cost for end-users, and are mainly used in the energy, transport and building sectors. "Supply-push" policies aim at providing entrepreneurs with the right incentive to invent, adopt and deploy mitigation technologies. Such production support programmes are mainly used in the energy sector (especially in renewable energy production) and in the transport sector.

Furthermore, certain industries may be specifically targeted by funding programmes, such as the "Wave and Tidal Stream Energy Demonstration scheme" in the United Kingdom, which gives support to businesses using the newly developed technologies for wave and tidal stream power generation.[318] "Energy aid" in Finland is another such programme available to enterprises: it is state aid intended to promote the development of less CO_2-intensive energy production and consumption.[319]

In Germany, since 1990, a public bank has provided private companies with low-interest loans for specified renewable energy projects.[320] Some programmes may also be addressed to a wider public, as is the case of the "Sustainable Development Technology Canada" foundation,[321] whose "SD Tech Fund" aims at stimulating research, development and demonstration of technologies related, among other things, to climate change and air quality. Eligible beneficiaries include the private sector, academic bodies and non-governmental organizations.

3. Type of support

Usually, incentive policies related to climate change may focus on three areas: (i) increased use of renewable and/or cleaner energy sources; (ii) development and deployment of energy-efficient and/or low carbon-content goods and technologies; and (iii) development and deployment of carbon sequestration technologies.[322]

It should be noted that, in recent years, a large number of incentive policies, in particular fiscal measures, have focused on the development and deployment of liquid biofuels (fuel ethanol and biodiesel). There is an extensive body of literature, which is not reviewed here, on the contribution of different types of biofuel support measures to achieving their intended objectives, including greenhouse gas emission reduction, minimizing environmental implications, assuring food security, or contributing to the improvement of rural areas for developing countries.[323]

There are numerous stages in the technology innovation process. Subsection IV.B(a), below,

presents governmental efforts to foster research and development of climate-friendly goods and technologies. Subsection IV.B(b) focuses on policies aimed at increasing the deployment of such goods and technologies (including their commercialization and diffusion).[324]

a) Incentives to promote invention of new climate-friendly technologies and goods

Because of the deterrents to investment outlined above – including the "knowledge" and "learning" effects – basic research must often be stimulated through grants and awards to encourage innovators to invent new technologies and processes.[325] A number of governmental grants are intended to facilitate the development of greenhouse gas emission-reducing technologies or renewable energy technologies by financing the cost of research.[326] For example, in New South Wales (Australia), the Climate Change Fund provides, *inter alia*, grants aimed at supporting the demonstration and early commercialization of new renewable energy technologies.[327]

Another example is New Zealand's Plan of Action for Sustainable Land Management and Climate Change, which provides, *inter alia*, research grants for the agriculture and forestry sectors aimed at increasing their resilience and their adaptability to a changing climate.[328] In Korea, too, the Automobile Low Emission Technology Development Support funded research institutions developing, *inter alia*, hybrid vehicles for use as public shuttle buses.[329]

There is also growing interest in other means of encouraging innovation, such as awards for the development of new technologies.[330] Such awards may be provided *ex post* by recompensing existing innovations, i.e. by making a return on investments which have already been made in R&D. Grants may also be awarded *exante* to encourage new research and development projects, in which case the technological improvement to be achieved is generally specified prior to the research process. This type of award is more likely to be used when specific innovations are needed.

For instance, the Bright Tomorrow Lighting Prizes (L Prize), sponsored by the US Department of Energy under the Energy Independence and Security Act of 2007, will be awarded to participants that develop technologies for a new "21st Century Lamp" to replace 60 watt incandescent light bulbs and PAR 38 halogen lamps.[331] The competition will award significant cash prizes and offer other benefits for the winning designers (including opportunities for federal purchasing).

A number of governmental support measures for innovation are implemented on fulfilment of certain conditions, such as reaching performance targets. Performance conditions relate mainly to the achievement of a particular emission target. For instance, in Australia, to be eligible for the Low Emissions Technology Demonstration Fund, technologies had to demonstrate a potential to be commercially available by 2020 to 2030 and able to reduce the energy sector's greenhouse gas emissions by at least 2 per cent per annum from 2030.[332] Australia has also set up the Greenhouse Gas Abatement Program, which provides capital grants to projects that are expected to result in quantifiable emission abatement.[333]

b) Incentives to encourage the deployment of climate-friendly goods and technologies and the increased use of renewable sources of energy

Deployment incentives mainly take the form of financial assistance or support that concerns the cost of production or of use of climate-friendly goods and services. Governmental support measures to encourage the deployment of climate-friendly goods and technologies and the increased use of renewable sources of energy may be implemented upon the fulfilment of certain conditions and criteria.

First, governmental support may be linked to output.[334] Such output-linked support is usually provided through a feed-in tariff (i.e. a minimum guaranteed price per kilowatt-hour) or through direct payments and tax credits provided in proportion to the volume of production. Second, governmental support for climate-friendly production may target intermediate inputs in the production process, such as the energy sources that are used for heat and electricity. Finally, production

support may also focus on value-adding factors such as capital and labour. In the United Kingdom, for instance, the Offshore Wind Capital Grants Scheme provided support covering up to 40 per cent of eligible costs, for the deployment of offshore wind electricity-generating facilities with certain minimum generation levels.[335]

There may also be some conditions related to the origin of production. For instance, in some US states, tax credits are only awarded if the raw materials used during production have been produced in the same state in which the production plant is situated. This is the case in Montana, for example, where ethanol producers receive a tax credit only if their ethanol is produced from Montana agricultural products, or is produced from non-Montana agricultural products only when Montana products were unavailable.[336]

The following sections outline three types of financial incentives which are used or are being considered for use by governments to encourage the deployment of climate-friendly goods and technologies: fiscal measures, price support measures and investment support.

i) Fiscal measures

Typically, two types of fiscal measure are used to encourage participation in climate change mitigation efforts: tax reductions (i.e. tax exemptions, tax deduction and tax rebates) and tax credits (i.e. income tax credits, personal tax credits, corporate tax credits, production tax credits and investment tax credits). Such fiscal measures may be either targeted at consumption (i.e. they may reward the purchase and installation of certain technologies) or at facilitating investment in the production of climate-friendly goods and renewable energy.[337]

Fiscal measures aimed at consumption, for instance, can be illustrated by the reduction in value-added tax (VAT) for small hydroelectric, wind and biogas power generation plants in China, while measures targeting investment decisions can be seen in the Chinese government's reduction of income taxes for producers of wind and biogas power projects.[338]

Another fiscal measure, which is used mainly to encourage the use of renewable energy sources, is "accelerated depreciation", which allows investors in renewable energy technologies to depreciate the value of their plant and equipment at a faster rate than is typically allowed, thereby reducing their stated income for the purposes of income taxation.[339] Examples[340] of countries which use such policies include Mexico,[341] the Netherlands,[342] India[343] and the United States.[344]

ii) Price support measures

In the past, feed-in tariffs have been a primary price-support mechanism, used both in Europe and in the United States to encourage the generation of electricity by means of renewable energy sources. A "feed-in tariff" usually refers to a regulated minimum guaranteed price per kilowatt-hour that an electricity company must pay for renewable energy fed into the national electricity grid by a private independent producer.[345]

This type of programme was first implemented in the United States in 1978, with the Public Utilities Regulatory Policies Act (PURPA).[346] PURPA required public utilities to purchase power from renewable energy producers and to pay the utility's avoided cost. Another example is Germany's feed-in tariff, introduced in the 1991 Electricity Feed Act, and its successor, the 2000 Renewable Energy Sources Act.[347] Other countries followed these early examples, including Spain,[348] Italy,[349] France,[350] and the state of South Australia (for solar photovoltaic installations only).[351] Feed-in tariffs have also been introduced in a number of developing countries,[352] including Algeria[353] and Thailand.[354] In China, the Renewable Energy Law (2006) established feed-in tariffs for biomass and wind power.[355]

Feed-in tariffs have proved successful for a number of reasons.[356] First, feed-in tariffs for renewable energy sources usually have a long time-frame and therefore offer long-term price guarantees, providing a high level of security for investors. Moreover, feed-in tariffs are flexible in design and can be adjusted to account for advances in technology and changing market conditions, making them more effective and efficient.

It has also been argued that feed-in tariffs encourage the development of local production of renewable energy, thereby increasing price competition, and also contribute to increasing companies' profit margins, thus encouraging innovation. The literature on this topic shows that feed-in tariffs have been particularly successful when they form part of a broad package of support measures, including tax deductions, "soft" loans (i.e. at subsidized rates) as well as investment incentives (such as subsidies or partial debt relief) for selected technologies.[357]

"Net metering" is another common measure aimed at reducing costs for owners of small-scale on-site renewable energy power generation equipment.[358] If the amount of power that a consumer's renewable energy equipment (such as solar panels or wind turbines) supplies to the national electricity grid is greater than the amount the consumer takes from the grid during a certain billing period, the consumer receives a credit for that amount on future energy bills. In the United States, net metering is available in most states,[359] while in Canada it is offered in the provinces of Ontario and British Columbia.[360] Net metering has also been adopted in Thailand[361] and Mexico.[362]

iii) Investment support

Investment support policies are used to reduce the capital cost of installing and deploying renewable energy technologies:[363] a specified percentage of the costs of constructing or installing climate-friendly technologies is returned to the investor in the form of a capital grant, resulting in significant reductions in the overall cost of such technologies.[364] For instance, between 1994 and 2002, in order to stimulate the development and use of photovoltaic (i.e. solar) power systems, Japan set up a capital grant programme[365] which is considered to have been the driving force behind the rapid deployment of photovoltaic power systems in that country.

In 2006, the state of California approved the California Solar Initiative, which provides rebates to homeowners, businesses and farmers for the installation of rooftop solar systems.[366] Grants to encourage energy-efficient modernization or renovation programmes are offered in many countries, as for instance in Canada, where property owners can apply for EcoENERGY Retrofit grants for improving the energy efficiency of their home.[367]

Investment support policies may also take the form of favourable lending conditions, or low-cost financing with subsidized interest rates for investors in climate-friendly technologies or goods.[368] For instance, in Germany the "100,000 Roofs Programme", launched in 1999, offered "soft loans" (i.e. at subsidized rates) to encourage the installation of photovoltaic systems.[369] Another example is the Indian Solar Loan Programme, which provides low-cost financing for solar energy systems.[370]

In Bangladesh, the micro-financing institutions Proshika and Grameen have started to offer assistance aimed at increasing adaptability and reducing vulnerability to the effects of climate change, through the use of loans for construction of safer housing, for helping people to diversify from agriculture and for undertaking more disaster-proof activities, and through the provision of rapid credit facilities to promote fast recovery in the immediate aftermath of a disaster.[371]

4. Relevant WTO rules

Governmental funding policies to increase the development and deployment of renewable energy sources and of low-carbon goods and technologies may have an impact on the price and production of such goods. From an international trade perspective, such policies lower the costs for producers, leading to lower product prices. In turn, lower prices may reduce exporting countries' access to the market of the subsidizing country or may increase the exports of the subsidizing country.[372]

Moreover, some countries may provide domestic energy-consuming industries with subsidies to offset the cost of installing emission-reducing technologies, thus enabling them to maintain international competitiveness.[373] Since the renewable energy and low-carbon technology sectors are open to international trade, WTO disciplines on subsidies (as contained in the Agreement on Subsidies and Countervailing Measures (SCM)) may become relevant to certain

support policies. Moreover, the WTO Agreement on Agriculture may be relevant: it contains a category of permissible green subsidies, known as Green Box, which could allow countries to pursue climate adaptation and mitigation measures in the area of agriculture.

The SCM Agreement aims at striking a balance between the concern that domestic industries should not be put at an unfair disadvantage by competition from goods that benefit from government subsidies, and the concern that countervailing measures to offset those subsidies should not themselves be obstacles to fair trade.[374] The rules of the SCM Agreement define the concept of "subsidy", establish the conditions under which WTO members may or may not employ subsidies, and regulate the remedies (countervailing duties) that may be taken against subsidized imports.[375]

The SCM Agreement also contains surveillance provisions: Article 25 requires each member to notify the WTO of all the specific subsidies it provides, and Article 26 calls for the Committee on Subsidies and Countervailing Measures to review these notifications.[376]

Article 1 of the SCM Agreement defines a subsidy as having three necessary elements: (a) a financial contribution has been provided; (b) the contribution was made by a government or a public body within the territory of a WTO member; and (c) the contribution confers a benefit.[377]

A "financial contribution" is defined by an exhaustive list of measures, which include direct transfers of funds (for example grants or loans), potential direct transfers of funds (such as loan guarantees), government revenue forgone (e.g. fiscal incentives through tax credits), the provision by government of goods and services other than general infrastructure, and government purchase of goods.[378] The range of governmental measures which may be described as subsidies is broadened further by Article 1.1(a)(2), which includes any form of income or price support.[379]

The SCM Agreement does not provide guidance on how to evaluate whether or not a "financial contribution" confers a "benefit". However, the Appellate Body ruled in the *Canada – Aircraft* case that the existence of a benefit is to be determined by comparison with the market-place (i.e. on the basis of what the recipient of the benefit would have received in the market).[380] Moreover, the SCM Agreement's operative provisions only apply to subsidies that are "specific"[381] to a certain enterprise or industry or to a group of enterprises or industries, because it is assumed that non-specific subsidies will not distort the allocation of resources within the economy.[382]

The Agreement makes a distinction between two categories of subsidies:[383] (i) prohibited subsidies (i.e. subsidies contingent upon the export or use of domestic rather than imported products);[384] and (ii) actionable subsidies (i.e. subsidies that cause adverse effects to the interests of other WTO members).[385] Subsidies in the second category are open to challenge by other members only if they are believed to cause adverse effects. In either case, the complaining member may challenge the subsidizing member's subsidies in WTO dispute settlement.

Three types of adverse effect are identified in the Agreement:[386] "injury" to the domestic industry of another WTO member; nullification or impairment of benefits accruing under GATT 1994; and "serious prejudice" to the interests of another member, as defined in the SCM Agreement.[387] These adverse effects generally occur when a subsidy has a negative impact on the access to the subsidizing member's market or to a third country's market, or affects domestic producers in the home market of the complaining member.[388]

In addition to challenging subsidies through WTO dispute settlement, a member may impose countervailing measures on imported products in order to offset the benefits of specific subsidies that have been granted uponthe manufacture, production or export of those goods.[389] However, a WTO member may not impose a countervailing measure unless three specific conditions are met: (i) it must determine that there are subsidized imports; (ii) it must establish that there is injury to the domestic industry; and (iii) it must show that there is a causal link between the subsidized imports and the injury.[390] The SCM Agreement also includes rules on procedures for initiating and conducting investigations, and rules on

the implementation and duration (normally five years) of countervailing measures.[391]

Finally, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) may be relevant to the development and diffusion of climate-friendly technologies.[392] The essential objective of the grant and enforcement of intellectual property rights, as set out in the TRIPS Agreement, is to both promote necessary innovation and facilitate the diffusion of technology, balancing legitimate interests in a socially beneficial manner. Intellectual property protection should "contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations".[393]

While the TRIPS Agreement sets out general standards for the protection of intellectual property under national laws, achieving this "balance" in practice is a matter for domestic policymakers and legislators to establish, through an appropriate mix of law, regulation and administrative measures within the policy space defined by the TRIPS Agreement, including through the use of flexibilities in the application of TRIPS standards. Specifically concerning the promotion of climate-friendly innovation and the diffusion of climate friendly technology, patent-related measures that have been raised in policy discussions include promoting technology sharing and patent pooling,[394] technology brokering and clearing house initiatives, more effective use of patent information tools to locate useful technologies, and the facilitation of patent examination of green technologies,[395] as well as limitations or exceptions to patent rights such as research exceptions and specific regulatory interventions such as non-voluntary licensing,[396] government use authorizations and disciplines or guidelines on patent licensing to promote competition.[397] Beyond patent law, other areas of TRIPS standards are relevant to the protection of marks certifying environmentally friendly products and suppressing acts of unfair competition such as making misleading representations about the positive environmental qualities of products (so-called "greenwashing").[398]

C. Technical requirements to promote the use of climate-friendly goods and technologies

In addition to economic incentives such as carbon pricing and financial measures, another approach commonly taken in environment and climate strategies is to develop technical requirements – e.g. in the form of mandatory technical regulations or voluntary standards – for products and production methods, so as to bring about emission reductions and gains in energy efficiency.

In relation to climate change, such regulations and standards intend generally to: (i) improve the energy efficiency of products and processes; and (ii) reduce their energy consumption and/or the quantity of greenhouse gases emitted during the production of a product, or emitted while it is being used. Moreover, some regulations and standards are being developed to facilitate the adaptation to the consequences of climate change. However, as indicated in Part I, adaptation measures are usually undertaken in the context of larger national initiatives related mainly to urban planning, the water sector and coastal management, and few such measures have been put in place so far; this section, therefore, does not review specific examples of such policies.

Since the 1980s, countries have made increasing use of mandatory regulations and voluntary standards to promote the use of more energy-efficient equipment and electric appliances[399] thereby reducing the levels of greenhouse gas emissions associated with their usage. It is estimated that energy-efficiency improvements have resulted in savings of more than 50 per cent in energy consumption over the last 30 years.[400] Furthermore, according to the Stern Review, there is a considerable potential for increased energy efficiency in the buildings, transport, industry, agriculture and power sectors in particular.[401]

This section examines the range of technical requirements aimed at reducing greenhouse gas emission levels and promoting energy efficiency, and discusses related implementation and enforcement instruments, such as information tools, procedures for

assessing conformity to regulations, and restrictions and prohibitions. The various aspects of the design of such instruments will determine their potential for climate change mitigation. Furthermore, since the fulfilment of certain regulatory requirements may have an impact on conditions of competition, there can be implications for international trade, and thus the relevant WTO rules and work are also reviewed.

1. Key characteristics

a) Scope

Technical requirements to promote energy efficiency and reduce emissions levels are mainly developed and implemented at the national level. Standards and technical regulations, targeting energy efficiency in particular, have been adopted by most developed countries and by a growing number of developing countries.[402] Such national measures can be public (such as the minimum energy-efficiency performance standards for major domestic appliances, set by the federal government in Canada)[403] or private (such as the Leadership in Energy and Environmental Design (LEED), which is a set of standards in the building sector developed by the US Green Building Council).[404]

In addition, national measures can be either mandatory or voluntary. For instance, in Australia the Minimum Energy Performance Standards (MEPS) for appliances are mandatory regulations;[405] while in the United States, ENERGY STAR is a voluntary labelling endorsement programme.[406] Moreover, technical requirements may also be instituted at the sub-national level, as is the case in the United States, with California's appliance efficiency regulations[407] or in Italy, with Umbria's energy-efficiency building standards.[408]

Standards that aim at enhancing energy efficiency and that set targets for emission reductions are also developed internationally. Such international standards are often used as a basis for regulations at the national level.[409] Currently, examples of areas where international standards may offer practical tools for the application of climate-related regulations include: (i) measurement and methodological standards to measure energy efficiency and greenhouse gas emissions; and (ii) standards related to the use and development of new energy-efficient technologies and renewable energy sources.

Examples of the first category include standards prepared by the International Organization for Standardization (ISO) that can be used to calculate the thermal properties of a building or of individual construction materials.[410] Similarly, the International Electrotechnical Commission (IEC) has developed standards for measuring the efficiency of power conditioners because of their widespread use in solar power generation systems.[411]

Examples of international standards related to the use and development of new energy-efficient technologies and renewable energy sources include the ISO standards on solar energy, hydrogen and wind technologies, and solid and liquid biofuels.[412] In the sector of biofuels in particular, endeavours to promote collaboration are being made in order to reduce the significant differences in the specifications of biofuels between the major producers and users of biofuels (in particular with respect to biodiesel).[413] Such efforts include the Tripartite Task Force, whose members are Brazil, the European Union and the United States;[414] the Energy Working Group in the context of Asia-Pacific Economic Cooperation (APEC);[415] the International Biofuels Forum[416] (which includes Brazil, China, the European Union, India, South Africa and the United States); international efforts within the ISO;[417] as well as private sector collaboration efforts, such as the Roundtable on Sustainable Biofuels.[418]

b) Key specifications

Regulators may establish measures that specify requirements on products and/or processes and production methods in order to achieve reductions in emission levels or other energy-efficiency objectives.

Product-related requirements may achieve indirect results, depending on consumers' purchasing choices and after-sale consumption behaviour. In the context of climate change, such product-related requirements mainly address the energy efficiency and the greenhouse gas emissions related to the use of the product. On

the other hand, requirements targeting production methods may result in direct environmental outcomes during production processes, as they improve energy efficiency or limit greenhouse gas emissions to a certain level.

Moreover, standards and regulations, whether related to products or to processes, can be based either on design or descriptive characteristics, or in terms of performance.[419] These different characteristics are outlined in the following subsections.

i) Design-based requirements

Technical requirements for energy efficiency or emission reduction that are based on design or descriptive characteristics specify the particular features a product must have, or the specific actions to be undertaken during production, and determine which goods to use, or which technologies to install. For instance, several governments have developed technical measures with respect to the quality and specifications of biofuels[420] (e.g. Brazil,[421] India,[422] the European Union,[423] and the United States).[424] Japan's standards for business owners concerning the rational use of energy in factories are an example of descriptive requirements for a production process, as they specify, *inter alia*, that combustion facilities must use a certain type of energy-efficient equipment.[425]

Regulations such as design standards (also called technology standards) that are based on descriptive characteristics are best used when there are few options to the polluter for controlling emissions; in this case, the regulator is able to specify the technological steps that a firm should take to control pollution.[426] Moreover, when emissions cannot be measured, or when concerns exist about the feasibility of other policy options, design standards related to existing technologies may provide a practical way to reduce pollution by helping eliminate the least efficient technologies from the market and promoting the use of more efficient ones.[427]

ii) Performance-based requirements

Performance-based requirements for emission reduction or energy efficiency (also known as performance standards) dictate the standards of performance to be achieved for products or processes, or mandate specific environmental outcomes per unit of production (e.g. they may limit emissions to a certain number of grams of CO_2 per kilowatt-hour of electricity generated). In other words, they stipulate environmental outcomes to be delivered by products or production methods, without pronouncing how the outcomes should be achieved. Such requirements are especially prevalent in efforts to improve energy efficiency in such areas as appliances, buildings and transport.

Often, performance requirements are established to encourage the removal of cost-ineffective, energy-inefficient products from the marketplace, and to stimulate the development of more efficient alternatives and processes. Performance-based requirements generally provide more flexibility than design-based requirements, and costs may be lower because firms can choose how they will meet the stipulated environmental target. Indeed, performance standards increase the number of ways that compliance can be achieved, by offering more than a single mandated technology. These compliance options may include finding solutions through changes in the production process, reduction in output, switching to different fuels or other inputs, and alternative technologies.[428] Costs can be further reduced in performance standard implementation by the introduction of additional flexibility, for example through the use of averages.

The performance of a product or process may be set in various ways. Standards may be established, for instance, in terms of maximum CO_2 emissions levels, maximum energy consumption levels, minimum energy performance levels, or minimum fuel economy. For instance, in the European Union, a directive provides that the electricity consumption of domestic refrigeration appliances must be lower than or equal to a specific maximum allowable value;[429] in Australia, all inefficient incandescent light bulbs are to be phased out through the introduction of minimum energy performance standards for lighting products;[430] and in the United States, the US Corporate Average Fuel Economy (CAFE) Standard sets a target in terms of minimum fuel efficiency.[431]

The calculation of the level of performance to be achieved by a standard may be based on different factors. It may be based, for example, on the most efficient product in its category, or on the average energy consumption or emissions of all products in a particular category.[432] Japan's Top Runner Program is an example of the first type of performance calculation: the most efficient model on the market is identified, and the energy performance of this "top runner" is used to set a target for all manufacturers.[433] An example of the second approach may be found in the new US CAFE standard, which is based on the combined average fuel economy of all passenger cars and light trucks sold in a given year in the United States.[434]

Measures may also set out performance standards which apply uniformly across an entire product line (e.g. all light vehicles must achieve the same minimum fuel economy level), or may provide for variation depending on categories within the product line (e.g. based on aspects such as vehicle weight or engine size). For instance, an EU regulation on emission performance standards for new passenger cars defines a "limit value curve" of permitted emissions of CO_2 for new vehicles, depending on the mass of the vehicle: producers will therefore be required to ensure that the average emissions of all new cars which they manufacture are below the average of the permitted emissions for cars of that mass, as given by the curve.[435]

2. Key compliance tools

a) Information tools

Labelling schemes are intended to provide information to consumers, allowing them to make rational decisions which take into account the environmental consequences of specific products, and thus to stimulate manufacturers to design products that achieve higher ratings than the minimum standard.[436] In other words, labelling schemes also aim to stimulate market innovation in energy-efficient products.

Labels, displayed on products at the time of purchase, encourage responsible action with regard to energy use by providing consumers with information on the environmental consequences of the use of specific products and/or the environmental impact of their production process. Labels are often based on, and/or are used in conjunction with, standards. For example, the Seasonal Energy Efficiency Ratio label in the United States, which displays the efficiency of central air-conditioning units, is used in conjunction with a minimum energy performance standard.[437]

One of the main objectives of energy labelling is to encourage manufacturers to develop and market the most efficient products, by ensuring that the benefits of such products can be recognized by the customer. By increasing the visibility of energy costs and providing an energy benchmark (i.e. a reference point to compare the energy performance of one product against that of another), labelling schemes also aim to stimulate market innovation in energy-efficient products, transforming the suppliers of such energy-efficient products from "niche markets" to market leaders.[438]

i) Scope

Labelling schemes have been adopted in many countries across different sectors.[439] While most OECD countries have used energy-efficiency labelling for a number of years, a growing number of non-OECD countries are now also using such measures.[440] For instance, South Africa,[441] Argentina,[442] Ghana,[443] Sri Lanka[444] and Tunisia[445] have adopted energy-efficiency labelling schemes.[446] However, a study done by the World Energy Council (WEC) (2008) finds that labels, despite their recent proliferation, are not as widespread in Africa, the Middle East, or non-OECD Asia: for example, less than 20 per cent of the countries in these regions have refrigerator labels (a common energy-efficiency label in other regions).[447]

In addition, labelling schemes can be either mandatory or voluntary. Examples of mandatory labels include the energy rating labelling programmes for household appliances in Australia;[448] the CO_2 emission labels for new cars in Switzerland;[449] or the fuel consumption labels of new cars in Canada.[450] There are examples of voluntary comparative labelling programmes in several countries,[451] including several developing economies, such as Thailand,[452] India,[453] Brazil[454] and Hong Kong, China.[455]

ii) Type of information covered

Most labelling schemes provide information on the energy efficiency of products or production processes. Energy-efficiency labels are informative labels that are affixed to a product and that describe its energy performance (such as its energy use, efficiency or energy cost), thereby providing consumers with the data necessary for making informed decisions.[456] Many countries have introduced energy-efficiency labels for electrical appliances.[457] Energy-efficiency labels are also present in the building sector. For instance, Denmark requires large and small buildings to display labels that evaluate the building's consumption of heat, electricity, and water.[458] Also, general ecolabels such as the Nordic Swan, and the German Blue Angel, use energy efficiency as one of the many criteria used to award the label to a product.[459]

Moreover, several countries have implemented labels showing the levels of CO_2 emitted by new products. For instance, at the point of sale, new vehicles in Australia must carry a label on the windscreen giving information on the vehicle's fuel consumption and CO_2 emissions.[460] In the European Union, new cars are also required to display labels showing levels of CO_2 emissions in units of grams per kilometre.[461]

In the same way as standards and regulations, on which they are very often based, labelling schemes can be directed at products' characteristics and/or production processes. However, most environmental labels use a criterion that focuses on a product's performance while in operation, such as its energy-efficiency or CO_2 emissions. Such labels mainly concern household appliances and cars. For example, Australia,[463] the European Union,[462] Canada[464] and the United States[465] all require energy-efficiency labels for several household appliances.

Labels may, however, also use broader criteria, such as a product's entire life-cycle, including its production, use and disposal. Such labels focus on ways of reducing the overall environmental impact of a product, including improved energy efficiency. Examples of eco-labels, which include energy-efficiency criteria and life-cycle analysis, are the Nordic Swan,[466] the German Blue Angel[467] and the EU's eco-label Flower.[468] The Carbon Reduction Label in the United Kingdom is another example of a label that focuses on the whole life-cycle of the products it labels.[469] Some companies have also introduced their own labels to indicate the energy used in the production process of their products.[470]

Labelling schemes have also been used by companies to show the origin of products, how far they have travelled in order to reach the consumer, and the emissions generated during their transport.[471] In particular, the term "food mile" is used to refer to the distance food travels from the location where it is grown to where it is consumed. There is some debate, however, over the validity of food miles as an accurate indication of the energy use and greenhouse gas emissions associated with agricultural products. More specifically, it has not only been argued that high food mile ratings do not necessarily mean that more greenhouse gas emissions were produced during the life cycle of a product, but it has also been suggested that airfreight is not a useful indicator of environmental damage.[472]

Instead of simply focusing on airfreight of food products, a number of authors argue that emissions from the entire transport chain need to be considered.[473] Others call for the total energy used from "production to plate" to be examined.[474]

iii) Type of instrument

It is possible to distinguish between two main types of energy-efficiency labels: comparative labels and endorsement labels. Comparative labels provide consumers with information enabling them to compare performance among similar models using categories of performance (such as a rating of 1 to 5 stars) or a continuous scale (showing where the product stands in energy consumption in relation to the amount used by the most and least energy-efficient models in that category).[475]

Comparative labels do not explicitly rank different products or brands; they simply provide the information necessary for consumers to make the comparison. Most comparative labels are of a mandatory nature to ensure that the least-performing products will also be

labelled.[476] Comparative energy labels for household appliances are in place, for instance, in Australia,[477] the European Union,[478] Canada[479] and the United States.[480] Comparative labels have also been introduced in some developing countries, for instance in Brazil,[481] Tunisia,[482] China,[483] Iran,[484] Thailand[485] and Korea,[486] and are often modelled on successful developed country labels.[487]

Finally, endorsement labels are also used in some cases: these are essentially seals of approval given by an independant party, assuring consumers that a product meets certain criteria. Endorsement labelling programmes are usually voluntary.[488] An example of an endorsement label is the voluntary Energy Star label in the United States, which is now used for over 60 product categories.[489] The Energy Star label has also been adopted by a number of other countries over the years, in an effort to provide a single set of energy-efficiency qualifications.[490]

A number of developing countries have implemented their own voluntary endorsement labelling programmes, similar to the Energy Star: for instance Brazil,[491] Thailand,[492] and China, whose "China Certificate for Energy Conservation Product" labelling scheme has been run by the China Standards Certification Center (CSC) since 1998.[493] Endorsement labels can also been used in conjunction with comparative labels, as, for example, in the United States, where the Energy Star and EnergyGuide labels may be used together.[494] Finally, there are examples of labels which are used to endorse production methods, as is the case of the Carbon Reduction Label in the United Kingdom.[495]

b) Conformity assessment tools

A conformity assessment procedure is used to determine whether the mandatory and/or voluntary requirements have been fulfilled. Conformity assessments give consumers confidence in the integrity of products, and add value to manufacturers' marketing claims. This section presents the key conformity assessment procedures (testing, inspection, certification, accreditation and metrology) and provides examples in relation to climate change mitigation efforts.

The first of these procedures involves testing a product against specific standards, and is the most common form of conformity assessment, providing the basis for other types of procedures, such as inspection and certification. A test is a technical operation carried out according to a specified procedure, in order to verify one or more characteristics of the product undergoing conformity assessment.[496]

Products can be tested at different stages of their life. For example, the Electricity Generating Authority of Thailand (EGAT) conducts "*ex post* testing" on labelled appliances to ensure their compliance with efficiency standards. Failure to meet the previously awarded efficiency rating results in a downgrading on the efficiency rating scale or complete removal of the label.[497] Similarly, in Hong Kong, China, the authorities monitor the accuracy of energy-efficiency claims on energy labels through sampling and *ex post* testing.[498]

A second procedure – inspection – is the examination of a product design, a product, or a process or installation, and determination of its conformity with specific requirements or, on the basis of professional judgement, with general requirements.[499]

Examples of inspection in relation to climate change related requirements are mainly found in the building sector. For instance, the Leadership in Energy and Environmental Design (LEED) standards, administered by the US Green Building Council, are voluntary environmental standards for commercial buildings. Conformity with these standards is assessed through on-site inspection of five key criteria: sustainable site development, water savings, energy efficiency, selection of materials and indoor environmental quality.[500] Similarly, in order for homes in the United States to qualify for the Energy Star label, they must be inspected by an Independent Home Energy Rater.[501] Another example, in the European Union, is the requirement for regular inspection of boilers and air conditioning systems in buildings in order to ensure compliance with minimum energy performance requirements.[502]

A third type of conformity assessment tool, certification, involves written assurance (the certificate)

issued by an independent external body, stating that a product, building or company conforms to specific energy-efficiency or emission standards.[503] Carried out by an independent certification body, certification programmes help create transparency in markets, where energy costs are not always visible. Certification gives confidence to consumers and helps suppliers build their reputation, expand their market and promote new products.[504] Testing and inspection are often integral steps in certification being awarded. For example, all regulated energy-using products (such as domestic electrical appliances) sold in Canada must carry a mark indicating that the energy performance of the product has been verified. The mark must be that of an accredited independent certification body or a provincial authority.[505]

Accreditation is another conformity assessment tool, and is the procedure by which an authority gives formal recognition that a particular person or organization is competent to carry out specific conformity assessment tasks.[506] This can apply to testing laboratories, inspection bodies or certification bodies. Accreditation bodies do not deal directly with the verification of product specifications themselves; instead they assess the bodies carrying out such functions.[507] For example, under the Hong Kong Mandatory Energy Efficiency Scheme, energy test reports must be issued by a laboratory that has been assessed and evaluated by a recognized independent certification body, or that has been accredited by the competent bodies of Hong Kong, China, or their counterparts in other countries, according to mutual recognition agreements.[508] Also, in the United States, the Department of Energy requires accreditation of the laboratories that perform energy-efficiency testing on lighting and electric motors.[509]

A final example of a conformity assessment tool is metrology, which involves ensuring that the measuring equipment used in conformity assessments complies with the requirements for such use.[510] For example, in order to facilitate its compliance assessments on minimum-efficiency standards developed by the US Department of Energy, the National Institute of Standards and Technology developed a specialized power-loss measurement system for testing the power transformers used in the transmission and distribution of electrical power.[511]

c) Restrictions and prohibitions

Measures have been taken by governments to restrict the sale or prohibit the import of certain energy-inefficient products or to ban the use of certain greenhouse gases in the composition of products. It is common for governments to restrict the use of certain substances for environmental reasons.[512] However, since bans and prohibitions have a direct impact on trade (by removing or reducing trade opportunities), governments commonly try to take account of factors such as availability of viable alternatives, technical feasibility and cost-effectiveness, when applying such measures.

Such quantitative restrictions include, for example, bans to prevent and minimize emissions of fluorinated greenhouse gases (such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)). A number of governments have set up regulatory measures to phase out the use of such gases, in particular pursuant to the Montreal Protocol.[513] For instance, national legislation is in place in Austria,[514] Denmark,[515] Switzerland[516] and the European Union[517] to limit and control the use of HFCs, for example in refrigeration equipment, foams and solvents.

In addition, some other regulations and standards may also effectively ban certain less energy-efficient products from the market. For example, several countries are beginning, or planning, to prohibit the sale of inefficient lighting products, such as incandescent light bulbs, as, for instance, in Australia,[518] the European Union,[519] Canada,[520] Chinese Taipei[521] and Argentina.[522]

3. Environmental effectiveness

The extent to which energy-efficiency and emission-reduction regulations and standards actually contribute to achieving their environmental objectives can be estimated by comparing measurements of the average annual energy efficiency and energy consumption achieved for a given product when regulations are in place with a baseline scenario that assumes no regulations

were implemented.[523] In addition, some other means of measurement may be used, in particular to evaluate the environmental effectiveness of a labelling scheme: such measurements may include consumer awareness and acceptance of labels (credibility and understanding) and changes in consumer and manufacturer behaviour.[524]

A number of studies have shown the potential of regulations and standards for increasing the energy efficiency of specific products, particularly electrical equipment.[525] For instance, it has been shown that, in California, the energy-efficiency standards implemented and regularly updated since the late 1970s have significantly contributed to the reduction of energy consumption of major household appliances, such as refrigerators: the energy use of refrigerators in 2000 was more than two-thirds lower than it had been in 1974.[526] Some other studies have calculated the amount of emission reductions resulting from energy-efficiency policies. For instance, in the United States, it was calculated that, if the energy-efficiency standards for household appliances had not been put in place, the total projected CO_2 emissions from the residential sector would have been 8 per cent higher by 2020.[527]

The environmental effectiveness of labelling schemes aimed at promoting energy efficiency and reducing emission levels can be evaluated through examination of the behavioural changes of consumers and manufacturers.[528] Studies show that consumer awareness of environmental labels varies from country to country.[529] For instance, mandatory energy-efficiency rating labels in Australia are recognized by more than 95 per cent of consumers.[530] In Nordic countries, the Nordic Swan label, which covers a wide range of environmental criteria, including energy efficiency, is recognized by 90 per cent of consumers.[531] In the United States, several surveys have been conducted to assess consumer awareness and understanding of the mandatory Energy Guide label. Although recognition of the label was found to be quite good, understanding was limited, with respondents unable to accurately describe the information provided on the label or to determine which appliance was more energy-efficient, based on the labels.[532]

A number of factors may affect the recognition and understanding of labels, which, in turn, influence the market penetration of labelled products and the overall environmental effectiveness of the scheme. These factors include: (i) the size and diversity of the market (i.e. where there is a wide array of brands, models, sizes, designs and features, the purchasing decisions of consumers may be more complex); (ii) the credibility of the labelling programme sponsor (i.e. some studies show that government-run labels tend to be more credible, better recognized and more financially stable); (iii) their clarity and consumer friendliness; and (iv) the link to a certification programme.[533]

Finally, the environmental effectiveness of energy-efficiency conformity assessment may depend on a number of other factors, including: (i) the accuracy of testing results; (ii) the competence of testing laboratories; (iii) the capacity of testing laboratories to keep up to date with changes in technology in order to be more effective; and (iv) the existence of compliance monitoring.[534]

Certain conformity assessment procedures, such as certification and testing, may have a positive environmental effect by ensuring the introduction of more efficient technologies. For instance, in the US automobile sector, *ex post* testing and potential recalls of vehicles have been an effective way of influencing manufacturer behaviour: the expense and consumer dissatisfaction related to "emission recalls", when vehicles fail to meet emission limits, has encouraged many manufacturers to implement standards that are stricter than the existing legal standards, and to design more effective and durable emission-control systems.[535]

4. Relevant WTO rules and work

As outlined in the previous sections, countries have developed a number of climate change related standards and regulations, including procedures to assess conformity. The key WTO instrument governing these measures is the Agreement on Technical Barriers to Trade (TBT). In addition, certain rules of the General Agreement on Tariffs and Trade (GATT) may be relevant, such as GATT Article I (the "Most-Favoured

Nation" clause), Article III (National Treatment principle) and more specifically, Article III:4.[536]

Other provisions of the GATT 1994 may also be relevant. For instance, Article XI requires the general elimination of quantitative restrictions on the importation or exportation of products. Article XI 2(b) introduces an exception to the general rule contained in Article XI and allows import and export prohibitions or restrictions "necessary to the application of standards or regulations for the classification, grading or marketing of commodities in international trade". Furthermore, Article XX establishes exceptions to GATT obligations which may be applicable to certain technical measures.[537]

a) Coverage of the TBT Agreement

The TBT Agreement covers three sets of activities: (i) the preparation, adoption and application of technical regulations by governments;[538] (ii) the preparation, adoption and application of standards[539] by standardizing bodies; and (iii) the conformity assessment procedures used to determine whether the relevant requirements in technical regulations or standards are fulfilled.[540]

The scope of the TBT Agreement extends to all technical regulations, standards and conformity assessment procedures that apply to trade in goods, i.e. to all agricultural and industrial products.[541] However, two areas of trade in goods are excluded from the TBT Agreement:[542] sanitary and phytosanitary measures, which instead are subject to the provisions of the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS); and government procurement specifications, which are addressed in the plurilateral Agreement on Government Procurement (GPA). Technical measures which relate to services are dealt with under Article VI.4 of the General Agreement on Trade in Services (GATS).

i) Mandatory regulations, voluntary standards and conformity assessment procedures

The TBT Agreement makes a distinction between technical regulations (with which compliance is mandatory), and standards (which are voluntary). A fair number of climate-related requirements are voluntary standards and labelling schemes, including some adopted by private entities.[543]

Although the key legal principles are broadly similar for regulations, standards and conformity assessment procedures, there are some differences among each set of provisions, as well as important differences in the level of obligation of members with regard to mandatory regulations and voluntary standards. Indeed, as regards mandatory regulations, members have an obligation to ensure that these regulations are consistent the provisions of the TBT Agreement. On the other hand, with regard to voluntary standards, members are only required to take "reasonable measures" to ensure, for example, that standardization bodies within their territories respect certain disciplines of the TBT Agreement.[544]

An annex to the TBT Agreement contains the Code of Good Practice for the Preparation, Adoption and Application of Standards. This Code of Good Practice includes all the key legal principles of the TBT Agreement (e.g. non discrimination, avoidance of unnecessary obstacles to trade and harmonization). The Code can be accepted, and its provisions followed, by any standardizing body within a WTO member's territory; by any governmental regional standardizing body of which one or more members are also WTO members; and by any non-governmental regional standardizing body which has one or more members situated within the territory of a WTO member.[545] Given the recent proliferation of private carbon labelling (in particular, "food miles" schemes), some authors have also discussed the potential relevance of the TBT Agreement to requirements of this type, which are developed and adopted by private entities (e.g. food supply chains).[546]

Finally, given the number of energy-efficiency and emission-reduction standards that are based on performance requirements, TBT Article 2.8 is an important element. This provision states a preference for regulations based on performance – which may also be seen as less trade-restrictive measures to regulate – rather than for regulations based on design. Indeed, the

idea of this provision is to allow producers to find the most cost-effective way of fulfilling the requirements of a technical regulation. What counts is the result, i.e. the performance of a product, rather than the way in which this outcome is achieved.

ii) Products, processes and production methods

A technical regulation is defined under the TBT Agreement as a document which lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory.[547]

The Appellate Body, in the *EC – Asbestos* and the *EC – Sardines* cases, has set forth three criteria in order to identify a technical regulation: (i) the document must apply to an identifiable product or group of products. A product does not necessarily have to be mentioned explicitly in a document for that product to be an identifiable product, as "identifiable" does not mean "expressly identified";[548] (ii) the document must lay down one or more characteristics of the product. This has been interpreted as meaning that the term "product characteristics" includes not only features and qualities intrinsic to the product itself, but also related "characteristics", such as the means of identification, the presentation and the appearance of a product;[549] and (iii) compliance with the product characteristics must be mandatory.

As outlined in the definitions of technical regulations and standards contained in the TBT Agreement,[550] such requirements include documents which specify requirements relative to "processes and production methods" (PPMs) that are *related* to the product characteristics. However, the second sentence of the definition of technical regulations and standards states that they "may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method".[551]

The fact that the second sentence of both definitions leaves out the term "related" when "labelling" (among others) is mentioned, has been interpreted by some as providing some scope for the labelling of a non-product related process or production method (i.e. that does not leave a trace in the final product, so-called "unincorporated PPMs") to be covered by the TBT Agreement.[552] As has been seen in the previous Subsection IV.C.1, a number of energy-efficiency and emission-reduction standards and labelling schemes are based on non-product related PPMs (i.e. the emissions involved in the production of a product do not leave a trace in the characteristics of the final product).

b) Non-discrimination and the avoidance of unnecessary barriers to trade

The TBT Agreement applies the core GATT principle of non-discrimination to each set of activities described above. Technical regulations, standards and conformity assessment procedures are to be applied to products imported from other WTO members in a manner no less favourable than that accorded to "like" (i.e. similar) products of national origin (national treatment principle) and to like products originating in any other WTO member (most-favoured nation treatment).[553] A key question in this context is whether goods produced with a different emission intensity or energy intensity may be considered "unlike" pursuant to the TBT Agreement.[554]

Moreover, technical regulations, standards and conformity procedures must also not be prepared, adopted or applied with the intention or effect of creating unnecessary obstacles to trade.[555] It is important to note, however, that the TBT Agreement recognizes the right of members to take regulatory measures to achieve their legitimate objectives, including: national security; the prevention of deceptive practices; protection of human health or safety, animal or plant life or health, or the environment.[556] Thus, the protection of human, animal or plant life or health and of the environment could be relevant to an energy-efficiency or emission-reduction regulation.

The TBT Agreement also provides a number of guidelines and tests to avoid unnecessary obstacles to trade. For instance, a technical regulation would be considered an "unnecessary" obstacle to trade if it was found to be more trade-restrictive than necessary

to fulfil a legitimate objective.[557] Similarly, conformity assessment procedures should not be stricter than is necessary to give confidence that products conform with technical regulations and standards.[558] Although the provisions of the TBT Agreement mentioned in this subsection have never been tested in the Dispute Settlement Body, it may be relevant to refer to the panels' and the Appellate Body's interpretation of the word "necessary" in the context of GATT Article XX.[559]

The non-discrimination principle has also not been tested in the context of the TBT Agreement. However, it may be interesting to note an unadopted GATT panel report; the *United States – Automobiles* case. In this case, the panel examined three US measures on automobiles: the luxury tax on automobiles, the "gas guzzler" tax on automobiles, and the Corporate Average Fuel Economy regulation (CAFE). The luxury tax of 10 per cent was imposed on the first retail sale of vehicles over US$ 30,000 (a tax paid by customers).[560] The gas guzzler tax was an excise tax on the sale of automobiles within "model types" whose fuel economy failed to meet certain fuel-economy requirements (a tax imposed on manufacturers).[561] The CAFE regulation required a minimum average fuel economy for passenger automobiles (or light trucks) manufactured in the United States, or sold by any importer.[562] For companies that were both importers and domestic manufacturers, the average fuel economy was calculated separately for imported passenger automobiles and for those manufactured domestically.

The GATT panel found that both the luxury tax and the gas guzzler tax were consistent with the national treatment principle.[563] However, it found the CAFE regulation to be inconsistent with this principle,[564] because the separate calculations of fuel economy for the foreign vehicles discriminated against foreign cars, and because the fleet averaging requirement differentiated between imported and domestic cars on the basis of factors relating to control or ownership of producers or importers (i.e. based on origin), rather than on the basis of factors directly related to the products themselves.[565]

c) Harmonization

Energy-efficiency standards and regulations and their related conformity assessment procedures may act as a barrier to trade, in particular when they differ from country to country.[566] Differing requirements raise the cost of information, and make exporting to other markets more difficult. A solution to this obstacle is the harmonization of norms, which may be described as the adoption by several countries of common norms on the same subject, where previously each might have had its own set of requirements.[567] Harmonization is a core principle of the TBT Agreement, and the importance of international standards is enshrined in its Preamble. The TBT Agreement strongly encourages efforts by WTO members to harmonize technical regulations, standards and conformity assessment procedures.

The TBT Agreement provides for three approaches to harmonization. First, WTO members are to give positive consideration to accepting the technical regulations of other members as being equivalent to their own.[568] The TBT Agreement urges countries to recognize the equivalence of the norms set by their trading partners, even when they differ from their own, provided they achieve the same final objective. Second, the Agreement encourages mutual recognition of conformity assessment results.[569] Countries are encouraged to recognize the procedures that their trading partners use to assess compliance with regulations if they are convinced of the reliability and competence of their conformity assessment institutions.

Third, and most importantly, WTO members are urged to use international standards as a basis for their own technical regulations, standards and conformity assessment procedures,[570] except when such international standards would be an ineffective or inappropriate means for the fulfilment of the legitimate objectives pursued.[571] Moreover, in order to encourage members to base their regulations on international standards, the Agreement contains a "rebuttable presumption" that any technical regulation which is prepared in accordance with (and not only "based on") relevant international standards will not be considered an unnecessary obstacle to trade.[572] In this context, the TBT Agreement also provides that members, within

the limits of their resources, must play a full part in the preparation of international standards, with a view to harmonizing technical regulations.[573]

Although a list of international standardizing bodies for the purposes of the TBT Agreement does not exist, guidance on the identification of these bodies may be found in a decision adopted in 2000 at the Second Triennial Review by the TBT Committee on principles for the development of international standards, guides and recommendations.[574]

d) The TBT Committee and transparency requirements

Transparency is a core principle of the WTO and features in many WTO agreements, including the TBT Agreement. It is an important tool to ensure that trade flows as smoothly, predictably and openly as possible. In the TBT Agreement, WTO members are required to share information on any draft technical regulations and conformity assessment procedures that may have an impact on trade: such measures must be notified to other members.[575] Notifications can make an important contribution towards avoiding unnecessary obstacles to trade and can provide members with the opportunity to influence proposed regulations of other members.[576]

Moreover, a Committee on Technical Barriers to Trade,[577] composed of representatives from each WTO member, meets three to four times a year. An official record of the discussions held during formal meetings is prepared, and is made available to the public. About half of each meeting of the TBT Committee is dedicated to the discussion of specific trade concerns that members may have in relation to technical regulations or conformity assessment procedures which have been proposed or adopted by other members. The Committee therefore provides an important forum to discuss technical requirements to mitigate climate change. Such concerns are often based on a notification of a technical regulation or conformity assessment. Usually, before raising a specific trade concern in the TBT Committee, members go through several stages of information exchange and consultation.

Most trade concerns are in relation to the implementation of transparency procedures and claims that certain measures adopted by WTO members are more trade-restrictive than necessary. In recent years, a number of measures related to the reduction of emissions of certain equipment or the improvement of energy efficiency of electrical appliances have been discussed in the TBT Committee and/or notified to other members.

For instance, in 2007 Brazil notified a draft technical regulation which sets down minimum energy performance standards for non-electric water heaters;[578] in 2008, the European Communities notified a draft regulation that established CO_2 emission performance standards for new passenger cars;[579] Singapore notified a regulation that stipulates that motor vehicles must be registered and labelled to provide information on their levels of fuel consumption and CO_2 emissions;[580] and China notified several technical regulations related to the energy efficiency and energy conservation of electrical storage water heaters, copy machines and computer monitors.[581]

e) Technical assistance provisions

The TBT Agreement contains detailed provisions on technical assistance to developing countries and least-developed countries.[582] These provisions are mandatory but most of them are accompanied by one or more qualifications, such as "take such reasonable measures as may be available to them" or "on mutually agreed terms and conditions". These provisions combine two sorts of obligations: obligations to advise other members, especially developing-country members, on certain issues, and obligations to provide them with technical assistance.

Members have an obligation, if so requested, to advise developing-country members and provide them with technical assistance, on mutually agreed terms and conditions, regarding the establishment of national standardizing bodies, and participation in international standardizing bodies; the establishment of conformity assessment bodies; the steps that should be taken by developing countries' producers if they wish to have access to systems for conformity assessment operated

by governmental or non-governmental bodies within the territory of a developed-country member; and the establishment of the institutions and legal framework which would enable developing-country members to fulfil the obligations of membership or participation in international or regional systems for conformity assessment.[583] Some members regularly inform the Committee of their technical assistance programmes in the TBT field.[584]

Moreover, WTO members have, in relation to the activities of bodies within their territories, the obligation to encourage their national standardizing bodies to advise developing-country members and provide them with technical assistance regarding the establishment of national standardizing bodies, and participation in international standardizing bodies. WTO members are also obliged to arrange for the regulatory bodies within their territories to advise developing-country members and to grant them technical assistance regarding the establishment of regulatory bodies, or conformity assessment bodies, and regarding the methods by which their technical regulations can best be met. Another obligation of WTO members is to encourage bodies within their territories which are members or participants of international or regional systems for conformity assessment to advise developing-country members, and to consider requests for technical assistance from them regarding the establishment of the institutions which would enable the relevant bodies within their territories to fulfil the obligations of membership or participation.

Endnotes

1 Charles D. Kolstad defines an externality as follows: "An *externality* exists when the consumption or production choices of one person or firm enters the utility or production function of another entity without that entity's permission or compensation". Kolstad (2000), p. 91. In other words, negative externalities arise when an action by an individual or group produces harmful effects on others.

2 According to Alan V. Deardorff, a market imperfection is "[a]ny departure from the ideal benchmark of perfect competition, due to externalities, taxes, market power, etc." Deardorff (2006), p. 172.

3 See Section IV.A.2.

4 Carbon tax is shorthand for carbon dioxide tax or CO_2 tax.

5 See United Nations (1997); Zhang and Baranzini (2004), p. 508.

6 Fossil fuels contain carbon atoms, which are converted to CO_2 when they are burned. Burning 1 tonne of carbon creates 3.67 tonnes of CO_2.

7 The United States Environmental Protection Agency (EPA) reports the following carbon content coefficients (in Tera Grams Carbon/Quadrillion British thermal units) for 2005: coal (26), natural gas (14), crude oil (20). For more details see US Environmental Protection Agency (2007), Table A-23.

8 See for instance, Estonia's CO_2 levy. European Environment Agency (2005), p. 54 and Estonia (2005), *Fourth National Communication under the UNFCCC*, 156 p., at pp. 86-87.

9 Baron (1997), p. 28; OECD (2001c), p. 25.

10 OECD (2001c), p. 72.

11 In Finland, the carbon tax is levied on the carbon content of fuels used for heating and transportation. See the website of Finland's Ministry of the Environment on *Environmentally related energy taxation in Finland* available at www.ymparisto.fi/default.asp?node=11865&lan=en.

12 Since 1991, in Sweden, the CO_2 tax is levied on petrol, oil, liquefied petroleum gas, natural gas, coal and coke, and in fossil carbon in household refuse; see Swedish Tax Agency (2007), *Facts about Swedish Excise duties*, 7 p. Since 1991 in Norway, the CO_2 tax is levied on mineral oil, petrol and production of oil and natural gas on the continental shelf; see website of Norway's Ministry of Finance on *Existing green taxes*, at www.regjeringen.no. Since 1992, in Denmark, the CO_2 tax is levied on coal, oil, natural gas and electricity. See Skatteministeriet (2007), *Tax in Denmark 2007*. Slovenia has had a carbon tax since 1997. See Slovenia (2006), *Fourth National Communication under UNFCCC*, 149 p., at p. 73. Since 1999, in Italy, the CO_2 tax is imposed on coal, petroleum coke and "Orimulsion" used in combustion plants, as well as on coal and mineral oils used for electricity production. See Newman (2005), p. 13. See Article 8.7 of the Italian regulation of 23 December 1998. Since 2000 in Estonia, the CO_2 levy is imposed only on the emissions of large combustion plants (thermal input exceeding 50 MW) and is based on measured emissions. See European Environment Agency (2005), p. 54 and Estonia (2005), *Fourth National Communication under the UNFCCC*, 156 p., pp. 86-87. Since 2008, Switzerland has had a tax on CO_2 emissions from imported heating fossil fuels (e.g. heating oil, natural gas, coal, petroleum coke). See Swiss Federal Customs Administration (2007), *Taxe sur le CO_2 sur les combustibles. Que faut-il savoir à ce sujet?*

13 For instance, in New Zealand an extensive discussion of the potential contribution of a carbon tax to climate change mitigation took place in 2002-2005. See e.g. "New Zealand Announces Trading Scheme For Carbon Emissions; Abandons Carbon Tax" (2007), *International Environment Reporter, BNA* 30:20, p. 769. A proposal for a carbon tax has also been discussed in Japan since 2003 but has not yet been adopted. See e.g. "Japan's Ruling Party to Discuss Carbon Tax" (2006), *International Environment Reporter, BNA* 29:7, p. 247.

14 "Climate Change: Canada's Quebec Province Plans Carbon Tax" (2007), *International Environment Reporter, BNA* 30:12, p. 470.

15 Ministry of Small Business and Revenue (2008), *British Columbia Carbon Tax Update, Carbon Tax Act*, Notice 2008-023, 11 p.

16 See Engineering Division Bay Area Air Quality Management District (2008), *Proposed Amendments to BAAQMD Regulation 3: Fees*, Staff Report. Bay Area Air Quality Management District (2008), "Air District Implements Greenhouse Gas Fee", *News*.

17 Bundesamt für Energie Schweiz (2007), pp. 39-41.

18 Usually, renewable sources of energy are exempted. See Zhang and Baranzini (2004), p. 508.

19 OECD (2001c), pp. 116-117.

20 Zhang and Baranzini (2004), p. 508.

21 See the website of Finland's Ministry of the Environment on *Environmentally related energy taxation in Finland* at www.ymparisto.fi.

22 Swedish Tax Agency (2007), *Facts about Swedish Excise duties*, 7 p.

23 See also The Netherlands' Regulatory Energy Tax that applies on fossil energy (gas, electricity and certain mineral oils) and was introduced in 1996 for households and medium-small enterprises. This is a tax on energy, not based on carbon content, but renewable energy is exempted. See IEA Climate Change database (2008, last update).

24 Department for Environment, Food and Rural Affairs (DEFRA) (2001), *United Kingdom's Third National Communication under the UNFCCC*, 121 p., at pp. 29-30, and DEFRA website at www.defra.gov.uk.

25 On the website of the German Finance Ministry on *Oekologische Steuerreform* at www.bundesfinanzministerium.de. See also Bundesamt für Energie Schweiz (2007), pp. 39, 65-66, 94.

26 Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2004), *The ecological tax reform: introduction, continuation and development into an ecological fiscal reform*, 20 p., at pp. 1, 3.

27 Ministère français de l'écologie et du développement durable (2006), *Quatrième communication nationale à la Convention cadre des Nations unies sur les changements climatiques*, 71 p., at p. 14.

28 Norwegian Ministry of the Environment (2005), *Norway's fourth national communication under the Framework Convention on Climate Change*, 92 p., at p. 33.

29 Danish Ministry of the Environment (2005), *Denmark's Fourth National Communication on Climate Change under the United Nations Framework Convention on Climate Change*, 404 p., at p. 108.

30 "New Zealand to Tax Livestock Farmers To Fund Greenhouse Gas Emissions Research" (2003), *International Environment Reporter, BNA* 26, p. 699.

31 See e.g. IEA (2001), p. 25; OECD-IEA (1997), p. 3; UNEP-UNCTAD (2002), p. 5; and IMF (2008), p. 11.

32 The marginal cost can be defined as the "increase in cost that accompanies a unit increase in output". See Deardorff (2006), p. 169.

33 This alternative to the tax approach finds its origins in the Coase Theorem suggested in 1960 by Ronald Coase, and has been applied specifically to pollution control in 1968 by John Dales in the context of waste disposal. The scheme suggested by Dales was based on the sale of property rights: the government would decide what level of pollution society was prepared to tolerate and would then offer for sale "rights to pollute". See Coase (1960), p. 42; Tietenberg (2006), p. 3; Dales (1968); and Sewell (1969), p. 386.

34 See e.g. Meidinger (1985), pp. 457-489; Tietenberg (1998), pp. 2-4; Tietenberg (2006), p. 7; UNEP-UNCTAD (2002), p. 4.

35 Emission trading schemes have also been applied to control lead in gasoline and ozone-depleting chemicals, in accordance with the Montreal Protocol. See Tietenberg (1998), pp. 15-20. Tietenberg (2002), p. 275.

36 Fossil fuel-burning utilities are endowed with a certain number of allowances each giving the right to emit 1 tonne of SO_2. In Phase I (1995-1999) of the programme, the 261 most polluting electric power-generating units were covered by this system. In Phase II (starting in 2000) most fossil fuel-fired electric generating units with a minimum capacity were covered by the system. See e.g. Tietenberg (1998) pp. 7-8; See also *Acid Rain program SO_2 allowances fact sheet* on the website of the Environmental Protection Agency at www.epa.gov; Arimura (2002), p. 271.

37 See UNFCCC website at http://unfccc.int.

38 European Commission (2008), Question 1.

39 See Sigurd Lauge Pedersen (2006), *Danish Domestic CO_2 Cap & Trade Scheme*, 7 p., at pp. 1 and 7.

40 For the period 2008-2012, the scope of the scheme has been widened in order to adapt it to the EU-ETS. See e.g. Norwegian Ministry of the Environment (2008), *Norwegian National Allocation Plan for the Emissions Trading System in 2008-2012*, 34 p.

41 See the website of Switzerland's emission trading at www.bafu.admin.ch.

42 New Zealand's scheme is currently under parliamentary review. See Goldb, E. (2009), "New Zealand: Government to Review Emissions Trading, Streamline Law on Resource Management", *International Environmental Reporter* 32:45.

43 See website of the Australian Department of Climate Change at www.climatechange.gov.au. See also Griffin, M. (2009), "Climate Change: Australian Lower House Passes Legislation For Cap-and-Trade; Senate Showdown Looms", *International Environmental Reporter* 32:516.

44 Canada (2008), 8 p. However, since the plan was announced, some Canadian provinces have introduced their own carbon taxes or have joined United States emission trading schemes (British Columbia, Ontario, Manitoba and Quebec have joined the Western Climate Initiative). See Szabo, M. (2008), "Problems plague Canada's emissions trading plans", *Reuters*, 8 May 2008.

45 See US Committee on Energy and Commerce (2007). See also Office of Management and Budget (2009), *A New Era of Responsibility. Renewing America's Promise*, 134 p., at p. 100, available at www.whitehouse.gov.

46 Eligible installations joined the EU-ETS in 2007. ENVIROS Consulting Limited (2006), *Appraisal of Years 1-4 of UK Emissions Trading Scheme*, Department for Environment, Food and Rural Affairs, p. 4.

47 See "Subsidies-Driven Voluntary Emissions Trading Scheme, Japan" in IEA Climate Change database (2008, last update). See also Reinaud and Philibert (2007), p. 11.

48 See the website of the Chicago Climate Exchange at www.chicagoclimatex.com. See also Capoor and Ambrosi (2007), pp. 18-19.

49 See www.chicagoclimatex.com.

50 At the end of 2005, the scheme was extended to 2020 and beyond. See the website of the Greenhouse Gas Abatement Scheme at www.greenhousegas.nsw.gov.au.

51 Young, S. (2008), "ARB says yes to climate action plan. Plan will slash greenhouse gases, fight global warming and provide economic stimulus for jobs and clean energy future", *News Release*, 08-102, 11 December 2008.

52 The seven states of the United States are the following: Arizona, California, Montana, New Mexico, Oregon, Utah and Washington. The four Canadian provinces are British Columbia, Manitoba, Ontario and Quebec.

53 See the website of the Western Climate Initiative at www.westernclimateinitiative.org.

54 Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, Rhode Island, Vermont, Maryland and Pennsylvania.

55 This is a mandatory programme that covers CO_2 emissions from fossil fuel-fired electricity generating units. See the website of the Regional Greenhouse Gas Initiative at www.rggi.org.

56 See in particular Reinaud and Philibert (2007). See also Kollmuss, Zink and Polycarp (2008); Boom and Nentjes (2003), pp. 45-67.

57 Reinaud and Philibert (2007), p. 21.

58 Aulisi et al. (2005), p. 4.

59 European Environment Agency (2005), pp. 16-17.

60 US Environmental Protection Agency (2003), p. 2.9.

61 See the website of the New South Wales Greenhouse Gas Abatement Scheme at www.greenhousegas.nsw.gov.au.

62 Canada (2007), p. 14.

63 Convery (2003), p. 7; US Environmental Protection Agency (2003), p. 2.9. European Environment Agency (2005), p. 19.

64 Fischer (2003), p. 2.

65 See e.g. European Environment Agency (2005), p. 20. Baron and Bygrave (2002), p. 21.

66 European Commission (2008), Question 19. US Committee on Energy and Commerce (2007), at p. 9.

67 European Parliament (2008a), Paragraph 27 concerning Articles 27 and 28. European Commission (2008), Question 7.

68 Canada (2008), p. 8.

69 Australia (2008), Vol. I, p. 6.8.

70 See California Energy Commission & California Public Utilities Commission (2008), *Final Opinion and Recommendations on Greenhouse Gas Regulatory Strategies*, 297 p., pp. 225-226.

71 European Commission (2008), Question 18. Road transport and shipping remain excluded, although the latter is likely to be included at a later stage. Agriculture and forestry are also left out due to the difficulties related to measuring emissions from these sectors with accuracy. European Parliament (2008a), Recital 3.

72 Canada (2007), p. iv.

73 For a list of the six main greenhouse gases, see Part I.

74 European Parliament (2008a), Annex 1.

75 A certificate represents one tonne of carbon dioxide equivalent (tCO_2-eq) of greenhouse gas emissions. See GGAS (2007), *Scheme Glossary*, 5 p., at p. 1. In the Chicago Climate Exchange, each Carbon Financial Instrument contract represents 100 metric tonnes of CO_2 equivalent. See website of the Chicago Climate Exchange at www.chicagoclimateexchange.com.

76 Reinaud and Philibert (2007), pp. 21-27. Boom and Nentjes (2003), pp. 45-67.

77 See Peterson (2003), p. 9; Reinaud and Philibert (2007); Pizer (2007), p. 73; and Boom and Nentjes (2003), p. 48.

78 Reinaud and Philibert (2007), p. 22.

79 Boom and Nentjes (2003), pp. 50-55.

80 Reinaud and Philibert (2007).

81 US Committee on Energy and Commerce (2007), p. 13.

82 New entrants and closure provisions are also important elements of the distribution of allowances. See Reinaud and Philibert (2007), p. 27.

83 European Environment Agency (2005), pp. 21-22. Reinaud and Philibert (2007), pp. 24-25. Hourcade et al. (2007), p. 15.

84 United States Environmental Protection Agency (2003), p. 3.16.

85 I.e. unexpected gain for high emitters, see Section IV.A.1.b) (iii).

86 United States Environmental Protection Agency (2003), p. 3.17. European Environment Agency (2005), p. 21. See also European Commission (2008), p. 4.

87 For more information on competitiveness concerns, see Section IV.A.2.a).

88 See the website of the Swiss Federal Office of the Environment at http://www.bafu.admin.ch/.

89 European Parliament (2008a), Paragraph 10 concerning Article 10. European Commission (2008), Question 5.

90 Australia (2008), Vol. II, pp. 12.44.

91 Holt et al. (2007), p. 5.

92 Liquidity may be defined as "[t]he capacity to turn assets into cash, or the amount of assets in a portfolio that have that capacity". Deardorff (2006), p. 164.

93 See e.g. Stern (2006), p. 480. European Commission (2008), Question 24. Volatility may be defined as "[t]he extent to which an economic variable, such as a price or an exchange rate, moves up and down over time". Deardorff (2006), p. 289.

94 Ellis and Tirpak (2006), p. 8.

95 See European Parliament (2008a), Paragraph 26 concerning Article 25.

96 Reinaud and Philibert (2007), p. 29.

97 Ellis and Tirpak (2006), p. 8.

98 Clean Air-Cool Planet (2006), *A Consumers' Guide to Retail Carbon Offset Providers*, 26 p., at p. VII. See also UNEP (2002), p. 10.

99 For a detailed explanation of Kyoto's flexibility mechanisms, see Section III.1.

100 European Commission (2008), Question 20.

101 See the website of Switzerland's emission trading at www.bafu.admin.ch.

102 See Australia (2008), Vol. I, pp. 11.10-11.15.

103 Reinaud and Philibert (2007), p. 29.

104 Regional Greenhouse Gas Initiative (2007), *Overview of RGGI CO_2 Budget Trading Program*, 12 p., at p. 9.

105 See Greenhouse Gas Reduction Scheme (2008), *Introduction to the Greenhouse Gas Reduction Scheme*, 20 p., at p. 7.

106 European Commission (2008), Question 22.

107 Reinaud and Philibert (2007), p. 31. Philibert and Reinaud (2004), p. 34.

108 Philibert and Reinaud (2004), p. 26. European Environment Agency (2005), p. 20.

109 Convery (2003), p. 8.

110 European Commission (2008), Question 23.

111 Ellis and Tirpak (2006), pp. 11-13, Tables 1 and 2.

112 Baron and Bygrave (2002), p. 29. Philibert and Reinaud (2004), p. 26. European Environment Agency (2005), p. 20.

113 Australia (2008), Vol. I, pp. 8.16-8.17.

114 Philibert and Reinaud (2004), p. 26.

115 See e.g. Peterson (2003), p. 10.

116 Boemare and Quirion (2002), p. 13.

117 See *Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003, establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC*, Article 16 on Penalties.

118 See European Parliament (2008a), Paragraph 19 concerning Article 16, paragraph 4.

119 Baranzini, Goldemberg and Speck (2000), p. 396. See also Rich (2004), p. 3; and Stern (2006), pp. 318-319.

120 Zhang and Baranzini (2004), p. 508. OECD (2001c), p. 25. Stern (2006), p. 308. OECD (2008b), p. 434.

121 European Environment Agency (2005), p. 45 and OECD (2001c), p. 22.

122 The marginal damage cost is the amount of harm done by adding one more unit of emissions to the current stock of greenhouse gases in the atmosphere (see Nordhaus (1993)).

123 European Environment Agency (2005), p. 46.

124 See Baumol (1972), pp. 307-322; and Baumol and Oates (1971), pp. 42-54.

125 Eurostat (2003), p. 24.

126 On recycling of carbon tax revenues, see Baranzini, Goldemberg and Speck (2000), pp. 399-400, 404 and OECD (2001c), pp. 25-27. On recycling of auctioning revenues, see European Environment Agency (2005), p. 21; Dinan (2007), p. 4; and Bohm (2003), p. 3.

127 Baranzini, Goldemberg and Speck (2000), at p. 400. Stern (2006), p. 319. IPCC (2007e), p. 756. For empirical evidence on the double dividend, see for example OECD (2001c), pp. 37-39.

128 See Stern (2006), p. 319.

129 Aldy, Baron and Tubiana (2003), p. 100. OECD (2001c), p. 26; Stern (2006), p. 319.

130 Bundesamt für Energie Schweiz (2007), pp. 39-40. Baranzini, Goldemberg and Speck (2000), p. 399. Alakangas, E. (2002), *Renewable Energy Source in Finland*, OPET Report 9.

131 Baranzini, Goldemberg and Speck (2000), p. 399. World Bank (2008b), Annex 2 at p. 110.

132 Ministry of Sustainable Development (2005), *Sweden's Fourth National Communication under the UNFCCC*, 149 p., at p. 39.

133 Bundesamt für Energie Schweiz (2007), pp. 39-40.

134 European Parliament (2008a), Article 10, p. 95.

135 Agnolucci (2004), p. 50.

136 Marjukka Hiltunen (2004), *Economic environmental policy instruments in Finland*, Helsinki, Finnish environment institute, 35 p., at p. 24. See also OECD (2001c), p. 105.

137 See e.g. OECD (2001c), p. 105.

138 Naturvårdsverket (1995), Utvärdering av koldioxidskatten – har utsläppen av koldioxid minskat? Papport number 4512, Stockholm, in Swedish, quoted in OECD (2001c), p. 105.

139 Larsen and Nesbakken (1997), *Environmental and Resource Economics*, Vol. 9(3), pp. 275-290, quoted in OECD (2001c), p. 105.

140 United States Environmental Protection Agency (2003), p. 1.2.

141 Betz and Stato (2006), p. 354. See also, Ellerman and Joskow (2008); Åhman (2007); Stefano (2008).

142 Ellerman and Joskow (2008), pp. iii, 35.

143 See for example Missfeldt and Hauff (2004), pp. 115-146.

144 United States Environmental Protection Agency (2003), p. 2.5.

145 Pizer (1999), p. 6. United States Environmental Protection Agency (2003), pp. 2.5-2.6.

146 Pizer (1999), p. 6. Philibert (2006b), pp. 8, 16. Kolstad (2000), p. 164.

147 See Philibert (2006b), pp. 21-22.

148 Stern (2006), pp. 470-471.

149 Houser et al. (2008), p. 29.

150 It is more meaningful to use a definition of competitiveness that applies to firms or sectors rather than countries. See *inter alia* Cosbey and Tarasosfky (2007), pp. 3-4; Krugman (1994); Sinner (2002), pp. 3-8; Baron and ECON-Energy (1997), p. 15; and Reinaud (2008b), p. 17.

151 Klepper and Peterson (2003), p. 3. Reinaud (2008b), p. 17.

152 Ekins and Barker (2002), p. 99. Hourcade et al. (2007), p. 13.

153 The direct carbon costs of an emissions trading scheme may be defined as the sum of abatement costs and CO_2 allowance costs. Indirect carbon costs include: increase in the price of other products covered by the carbon constraint; additional costs following higher risks perceived by investors; increase in the value of low-carbon energy sources. See Reinaud (2008b), pp. 19-21.

154 See e.g. OECD (2006b), p. 69. Baron, with Reinaud, Genasci and Philibert (2007), p. 17. Reinaud (2008a), p. 9. Reinaud (2005), p. 81. Sinner (2002), p. 10. Zhang and Baranzini (2004), p. 513. Morgenstern et al. (2007), p. 97. Parker (2008), pp. 5-16. Carbon Trust (2004), p. 6. Demailly and Quirion (2006), p. 111. Hourcade et al. (2007), p. 16.

155 Reinaud (2008b), pp. 19-21, 43-54.

156 Parker (2008), p. 10. Carbon Trust (2004), p. 6.

157 Parker (2008), p. 10.

158 Carbon Trust (2004), p. 6. Reinaud (2008b), p. 46.

159 Reinaud (2008b), p. 46.

160 See for example: Jaffe et al. (1995), p. 158; Harris, Kónya and Mátyás (2002); Xu (2000); Cole and Elliott (2003b), pp. 1167-1168; Hoerner and Müller (1996), p. 14; and OECD (2006b), pp. 10-11. Reinaud (2008b), pp. 6, 29, 56. Reinaud (2005). Some other studies have found however significant effects of environmental regulation on trade flows. See for instance Ederington and Minier (2003).

161 Reinaud (2008b), p. 39. See also Reinaud (2005).

162 Reinaud (2008b), p. 67. European Commission (2008).

163 Carbon leakage is calculated by dividing the increase in CO_2 emissions outside the region affected by the climate protection policy by the reduction in emissions inside that region. See IPCC (2007e), p. 665.

164 Reinaud (2008b), p. 27.

165 European Parliament (2008a), Article 10, pp. 100-101. Australia (2008),Vol. II, p. 12-2.

166 European Parliament (2008a), Paragraph 11 concerning Articles 10a, 10b and 10c.

167 Sinner (2002), pp. 9, 15.

168 The Working Party was established by the Council on 28 March 1968 to examine the provisions of the GATT relevant to border tax adjustments, the practices of contracting parties in relation to such adjustments and the possible effects of such adjustments on international trade. In light of this examination, the Working Party had to consider any proposals and suggestions that had been put forward and report its findings and conclusions on these matters to the Council or to the CONTRACTING PARTIES. See GATT Working Party (1970), para. 1.

169 It reads as follows: "Any fiscal measures which put into effect, in whole or in part, the destination principle (i.e. which enable exported products to be relieved of some or all of the tax charged in the exporting country in respect of similar domestic products sold to consumers on the home market and which enable imports sold to consumers to be charged with some or all of the tax charged in the importing country in respect of similar domestic products)". GATT Working Party (1970), para. 4.

170 Demaret and Stewardson date the use of BTAs back to the 18th century. Demaret and Stewardson (1994), p. 7. Hoerner and Müller (1996), p. 20. Goh (2004), p. 399.

171 See Demaret and Stewardson (1994), p. 6. The destination principle, according to which goods are taxed in the country of consumption, is to be distinguished from the origin principle, whereby the products are taxed in the country of production. Under the origin principle, there would be no need for border tax adjustment, since all products would be taxed at their point of origin. WTO (1997), para. 28.

172 Kraemer, Hinterberger and Tarasofsky (2007), p. 42. Bierman et al. (2003), pp. 30-31. Dröge et al. (2004), p. 175. Zhang and Baranzini (2004), p. 514. Goh (2004), p. 398.

173 Biermann and Brohm (2005b), p. 292.

174 Baron (1997), p. 83. OECD (2006b), p. 92.

175 For instance, in the context of the discussion of future climate change legislation in the United States, a White Paper prepared by the Committee on Energy and Commerce has mentioned such possible approaches. US Committee on Energy and Commerce (2008).

176 US Committee on Energy and Commerce (2008), p. 9. Janzen (2008), p. 23. Genasci (2008), p. 41. Saddler, Muller and Cuevas (2006), p. 46. Pauwelyn (2007), p. 22.

177 Charnovitz (2003), p. 157.

178 See for instance, Bhagwati and Mavroidis (2007), p. 301. Stiglitz (2007); Stiglitz (2006), p. 2.

179 Stiglitz (2006), p. 2. Zhang (1998), pp. 233-234. Doelle (2004), p. 101. Pauwelyn (2007), pp. 13-16.

180 Stiglitz (2007), pp. 177, 185.

181 Pauwelyn (2007), pp. 13-16; Bhagwati and Mavroidis (2007), p. 302.

182 Reuters (2007), *France's Sarkozy seeks EU carbon tax, truck tax*, 25 October 2007. Sarkozy, N. (2007), *Presentation of the Grenelle Environment Forum conclusions speech by M. Nicolas Sarkozy, President of the Republic*, 2 November 2007.

183 *Le Grenelle de l'Environnement. Promouvoir des modes de développement écologiques favorables à la compétitivité. Synthèse Rapport Groupe 6*, 2007, 43 p., at p. 8.

184 Demaret and Stewardson (1994), p. 63. Cosbey (2007), p. 16.

185 Demaret and Stewardson (1994), p. 32. Zhang (1998), pp. 231-232. Houser et al. (2008), p. 32.

186 Demaret and Stewardson (1994), p. 32. Voigt (2008), pp. 57-58. Reinaud (2008b), p. 92. Houser et. al. (2008), pp. 33-34.

187 Demaret and Stewardson (1994), pp. 32-33. Genasci (2008), p. 35.

188 Demaret and Stewardson (1994), p. 33. Zhang and Assunção (2004), p. 380. Ismer and Neuhoff (2007), p. 14.

189 Demaret and Stewardson (1994), p. 33. Zhang (1998), p. 232. See also *Superfund* case, paras. 2.4-2.6. 5.2.9. Ismer and Neuhoff (2007).

190 Ismer and Neuhoff (2007), p. 14.

191 *Superfund* case, paras. 5.2.4, 5.2.7 and 5.2.10.

192 *Superfund* case, paras. 2.6 and 5.2.9. See also Cendra (2006), p. 143.

193 *Excise duty on electricity - Rates of duty varying according to the method of producing electricity of domestic origin - Flat rate for imported electricity*, Judgment of the Court of 2 April 1998, Case C-213/96.

194 Krämer (2002), pp. 146-147. Snape and de Souza (2006), p. 297.

195 Snape and de Souza (2006), p. 297.

196 Ismer and Neuhoff (2007), pp. 4 and 16. Cendra (2006), p. 143.

197 Ismer and Neuhoff (2007), pp. 10, 16.

198 Demaret and Stewardson (1994), p. 33; Biermann and Brohm (2005a), p. 255.

199 *Superfund* case, para. 2.6.

200 *Superfund* case, paras. 5.2.9-10.

201 Saddler, Muller and Cuevas (2006), p. 45.

202 Genasci (2008), pp. 33, 39.

203 Pauwelyn (2007), p. 22; Muller and Hoerner (1997), pp. 5-6.

204 Charnovitz (2003), p. 152. Werksman (1999), p. 257.

205 See e.g. Cosbey (2008); Genasci (2008); Goh (2004); Ismer and Neuhoff (2007); Meyer-Ohlendorf and Gerstetter (2009); Pauwelyn (2007); Sindico (2008); Werksman (1999).

206 Footnote 58 to Annex I, "Illustrative List of Export Subsidies" to the SCM Agreement provides useful definitions that apply in the context of this agreement: "direct taxes" are "taxes on wages, profits, interests, rents, royalties, and all other forms of income, and taxes on the ownership of real property"; and "indirect taxes" are "sales, excise, turnover, value added, franchise, stamp, transfer, inventory and equipment taxes, border taxes and all taxes other than direct taxes and import charges".

207 "[T]here was convergence of views to the effect that taxes directly levied on products [i.e. indirect taxes] were eligible for tax adjustment. Examples of such taxes comprised specific excise duties, sales taxes and cascade taxes and the tax on value added. It was agreed that the TVA, regardless of its technical construction (fractioned collection), was equivalent in this respect to a tax levied directly – a retail or sales tax. Furthermore, the Working Party concluded that there was convergence of views to the effect that certain taxes that were not directly levied on products [i.e. direct taxes] were not eligible for tax adjustment. Examples of such taxes comprised social security charges whether on employers or employees and payroll taxes." GATT Working Party (1970), para. 14. See also WTO (1997), paras. 31 and 33.

208 The United States Domestic International Sales Corporation (DISC) legislation allowed certain types of corporations to be partially exempt from federal income tax on their export earnings. The panel considered that the DISC legislation should be regarded as an export subsidy and therefore not as a BTA on exports. The GATT Panel thereby confirmed that direct taxes such as income tax could not be adjusted. GATT Panel, *US – DISC*, paras. 12, 69.

209 In relation to GATT Article XVI:4 and the Declaration of 19 November 1960 giving effect to the provisions of that paragraph.

210 See e.g. Demaret and Stewardson (1994), p. 12; WTO (1997), para. 35; Cendra (2006), p. 138; Biermann and Brohm (2005b), p. 293.

211 On the difference between a customs duty (pursuant to Article II.1.b) and an internal charge (pursuant to Article III.2) see *China – Measures affecting imports of automobile parts*. The Panel, upheld by the Appellate Body, found that "if the obligation to pay a charge does not accrue based on the product at the moment of its importation, it cannot be an "ordinary customs duty" within the meaning of Article II:1(b), first sentence of the GATT 1994: it is, instead, an "internal charge" under Article III:2 of the GATT 1994, which obligation to pay accrues based on internal factors". Appellate Body, *China – Auto Parts*, para. 131.

212 Article II.2(a) should be read together with the preamble to Ad Note Article III, which reads as follows: "Any internal tax (...) which applies to an imported product and to the like domestic product and is collected or enforced in the case of the imported product at the time or point of importation, is nevertheless to be regarded as an internal tax (...) and is accordingly subject to the provisions of Article III".

213 Pauwelyn (2007), p. 21. Cendra (2006), pp. 135-136.

214 For a discussion on "likeness", see Subsection IV.A.3(a).

215 See WTO (1997). Pitschas (1995), p. 493. Dröge et al. (2004), p. 177. Biermann and Brohm (2005b), p. 293.

216 Cendra (2006), p. 141.

217 The drafters of the GATT explained the word "equivalent" used in this provision with the following example: "If a charge is imposed on perfume because it contains alcohol, the charge to be imposed must take into consideration the value of the alcohol and not the value of the perfume, that is to say the value of the content and not the value of the whole". E/PC/T/TAC/PV/26, page 21, quoted in the *Superfund* case, para. 5.2.7. In the *India – Additional Duties* case, the Appellate Body found that the term "equivalent" calls for a comparative assessment that is both qualitative and quantitative in nature; it also found that the requirement of consistency with Article III:2 must be read together with, and imparts meaning to, the requirement that a charge and internal tax be "equivalent" and that whether a charge is imposed "in excess of" a corresponding internal tax (pursuant to Article III:2) is an integral part of the analysis in determining whether the charge is justified under Article II:2(a). Appellate Body, *India – Additional Import Duties*, paras. 175 and 180.

218 Demaret and Stewardson (1994), pp. 8, 16. Biermann and Brohm (2005b), p. 293. In *Canada – Periodicals*, the Appellate Body confirmed that Article III.2 uses the words "directly or indirectly" in relation to the application of a tax to both imported and like domestic products. Appellate Body, *Canada – Periodicals*, p. 464.

219 Demaret and Stewardson (1994), p. 59.

220 Demaret and Stewardson (1994), p. 18. Pauwelyn (2007), p. 20. Biermann and Brohm (2005b), p. 293.

221 Pursuant to the same line of argument, "directly or indirectly" would relate more to the *manner of application of the tax* to the like imported and domestic products (either directly or indirectly), as opposed to the nature of the tax itself. The Report of the Panel in the GATT case on *Japan – Alcoholic Beverages I* has also been referred to in this respect. The GATT Panel found that the wording "directly or indirectly" implied that, in assessing whether there is tax discrimination, account is to be taken not only of the tax rate "but also of the *taxation methods* (e.g. different kinds of internal taxes, direct taxation of the finished product or indirect taxation by taxing the raw materials used in the product during the various stages of its production) and of the rules for the tax collection (e.g. basis of assessment)" (emphasis added). GATT Panel, *Japan – Alcoholic Beverages I*, para. 5.8. See also Panel Report, *Argentina – Hides and Leather*, para. 11.183. See also Goh (2004), pp. 410, 422.

222 The Superfund Act of 1986, aimed at financing domestic programmes to clean up hazardous waste sites, imposed taxes on petroleum and on chemicals.

223 Hoerner (1998).

224 *Superfund* case, paras. 5.2.4, 5.2.7 and 5.2.10.

225 Goh (2004), pp. 412-413. Pitschas (1995), p. 491. It should be noted, however, that the issue of whether the chemical inputs were physically incorporated into the final product was not examined by the GATT Panel in this case.

226 See GATT Article VI:4. The fact that border tax adjustment on exported products is not countervailable was confirmed by the GATT Panel on *Swedish Anti-Dumping Duties*, which examined the application of Article VI:4 where an anti-dumping scheme applied to products benefiting from an export rebate of duties and charges. The GATT Panel noted that "there was no disagreement between the parties concerned regarding the obligation to take account of legitimate refund of duties and taxes". GATT Panel, *Sweden – AD Duties*, para. 16. See also WTO (1997), para. 62.

227 See GATT Interpretative Ad Note Article XVI and, since 1994, footnote 1 of the SCM Agreement.

228 GATT Working Party (1970), para. 10. It has been argued, however, that the term "applied to" has in its ordinary meaning a narrower scope of operation than the term "borne by". According to this argument, taxes "borne by" would imply that taxes on any inputs or processes on export of the final product could be adjusted. Whereas taxes "applied to" involved a more direct relationship between the tax at issue and the like imported and domestic products being compared. It should also be noted that unlike GATT Article III:2, export-related provisions do not provide for the explicit possibility of taxes being applied "directly or indirectly". See Goh (2004), p. 409; WTO (1997), para. 71; and Chaytor and Cameron (1995), p. 4.

229 GATT Working Party (1970), para. 10.

230 WTO (1997), para. 65.

231 Item (e) reads: "The full or partial exemption remission, or deferral specifically related to exports, of direct taxes [footnote omitted] or social welfare charges paid or payable by industrial or commercial enterprises. [footnote omitted]"

232 Lodefalk and Storey (2005), p. 37.

233 See e.g. Hoerner and Müller (1996), p. 33. More generally see Chaytor and Cameron (1995), p. 6.

234 See e.g. Hoerner and Müller (1996), p. 31. Lodefalk and Storey (2005), p. 38.

235 GATT Working Party (1970), para. 15.

236 However, the Working Party decided not to investigate this matter further, given the scarcity of complaints over the issue at the time of the report. GATT Working Party (1970), para. 15.

237 Hoerner and Müller (1996), p. 33. More generally see Chaytor and Cameron (1995), p. 6.

238 Item (h) reads as follows: "The exemption, remission or deferral of prior-stage cumulative indirect taxes [footnote omitted] on goods and services used in the production of exported products in excess of the exemption, remission or deferral of like prior-stage cumulative indirect taxes on goods or services used in the production of like products when sold for domestic consumption; provided, however, that prior-stage

cumulative indirect taxes may be exempted, remitted or deferred on exported products even when not exempted, remitted or deferred on like products when sold for domestic consumption, if the prior-stage cumulative indirect taxes are levied on inputs that are consumed in the production of the exported product (making normal allowance for waste) [footnote omitted] (...)."

239 PSCI taxes are multi-stage taxes levied each time goods or their components are sold (versus single-stage goods that are levied at one of the stages of supply, i.e. from manufacturing to wholesalers, from wholesalers to retailers or from retailers to consumers). Except if credit is given for the tax paid at each earlier stages, such multi-stage taxes generate multiple taxation, hence their label as "cascade taxes". On the other hand, the value-added tax (VAT) provides for a system of credits, so that at each stage, wholesalers or retailers pay tax on only the increment to value which has taken place since the last transfer and only the final consumer pays tax on the entire value of the good. See Snape and de Souza (2006), p. 11; Hoerner and Müller (1996), pp. 31, 33. Lodefalk and Storey (2005), p. 38.

240 Footnote 61 reads: "Inputs consumed in the production process are inputs physically incorporated, energy, fuels and oil used in the production process and catalysts which are consumed in the course of their use to obtain the exported product."

241 Chaytor and Cameron (1995), p. 6.

242 Pursuant to GATT Article XI, restrictions on the importation or sale of products from other WTO members are prohibited.

243 The main provisions of the Agreement on Technical Barriers to Trade are discussed in Section IV.C.

244 Hufbauer, Charnovitz and Kim (2009), p. 61. Lodefalk and Storey (2005), pp. 41-44; Petsonk (1999), p. 208.

245 Article 1.1 of the SCM Agreement defines a subsidy as a "financial contribution" by a government or public body that confers a "benefit". Article 1.2 of the SCM Agreement provides that only "specific" subsidies fall within the scope of that Agreement.

246 For more information on the key provisions of the SCM Agreement, see below Section IV.B.4.

247 Appellate Body, *US – FSC (Article 21.5 – EC)*, para. 210.

248 Appellate Body, *Korea – Various Measures on Beef*, para. 137.

249 In the GATT context, the 1970 *Working Party on Border Tax Adjustments* suggested some criteria for determining whether products are "like": "the product's end-uses in a given market; consumers' tastes and habits, which change from country to country; the product's properties, nature and quality". GATT Working Party (1970), para. 18. Tariff classification was added as a supplementary element to these criteria by the Appellate Body in Appellate Body Report, *Japan – Alcoholic Beverages II*, p. 114.

250 Appellate Body, *EC – Asbestos*, para. 101.

251 Concerning the likeness analysis in relation to internal *taxes*, the GATT Panel in the *Superfund* case noted that 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, was irrelevant. See GATT Panel Report, *US – Superfund*, paras. 5.2.3-5.2.4. Furthermore, in *Japan – Alcoholic Beverages II*, the Appellate Body also found that the policy purpose of a tax measure (the "aim" of a measure) was not relevant for the purpose of Article III:2, first sentence. See Appellate Body, *Japan – Alcoholic Beverages II*, pp. 18-19.

252 See Appellate Body, *EC – Asbestos*, para. 102; Appellate Body, *Japan – Alcoholic Beverages II*, p. 21.

253 Appellate Body, *EC – Asbestos*, para. 102.

254 See e.g. Pauwelyn (2007), at pp. 33-41; Voigt (2008), pp. 61-65; Cendra (2006), pp. 143-145; Werksman (1999), pp. 260-261.

255 See for more details on the case law related to GATT Article XX, WTO (2002).

256 Appellate Body, *US – Gasoline*, p. 22.

257 Appellate Body, *US – Shrimp*, para. 15.

258 GATT Panel, *Thailand – Cigarettes*.

259 Unadopted GATT Panel, *US – Tuna (Mexico)*; unadopted GATT Panel, *US – Tuna (EEC)*.

260 Appellate Body, *EC – Asbestos*.

261 Appellate Body, *Brazil – Retreaded Tyres*.

262 GATT Panel, *US – Canadian Tuna*.

263 GATT Panel, *Canada – Herring and Salmon*.

264 *US – Tuna (Mexico)* and *US – Tuna (EEC)*.

265 Appellate Body, *US – Shrimp* and Appellate Body, *US – Shrimp (Article 21.5 – Malaysia)*.

266 Unadopted GATT Panel, *US – Taxes on Automobiles*.

267 Appellate Body, *US – Gasoline*.

268 Panel, *US – Gasoline,* para. 6.21.

269 Panel, *US – Gasoline,* para. 6.37.

270 See e.g. Meyer-Ohlendorf and Gerstetter (2009), p. 36. Pauwelyn (2007), p. 35.

271 Appellate Body, *US – Shrimp*, para. 133.

272 Pauwelyn (2007), p. 35.

273 Appellate Body, *Brazil – Retreaded Tyres*, para. 178.

274 Appellate Body, *Brazil – Retreaded Tyres*, para. 155.

275 Appellate Body, *Brazil – Retreaded Tyres*, paras. 156-175.

276 Appellate Body, *EC – Asbestos*, para. 172.

277 Appellate Body, *EC – Asbestos*, para. 172.

278 Appellate Body, *US – Shrimp*, para. 141.

279 Appellate Body, *US – Gasoline,* pp. 20-21.

280 Appellate Body, *US – Gasoline*, p. 18.

281 Appellate Body, *US – Gasoline*, p. 19

282 Appellate Body, *US – Shrimp*, para. 138.

283 Appellate Body, *US – Shrimp*, para. 142.

284 Appellate Body, *US – Shrimp*, para. 145.

285 Appellate Body, *Brazil – Retreaded Tyres*, para. 151.

286 Appellate Body, *US – Shrimp*, para. 158.

287 Appellate Body, *Brazil – Retreaded Tyres*, para. 215.

288 Appellate Body, *US – Gasoline*, p. 26.

289 Appellate Body, *US – Shrimp*, para. 166.

290 Appellate Body, *US – Shrimp (Article 21.5 – Malaysia)*, para. 134.

291 Appellate Body, *US – Shrimp (Article 21.5 – Malaysia)*, para. 124.

292 Appellate Body, *US – Shrimp (Article 21.5 – Malaysia)*, para. 134.

293 Appellate Body, *US – Shrimp*, paras. 161-164.

294 Appellate Body, *US – Shrimp*, para. 164.

295 Appellate Body, *US – Shrimp (Article 21.5 – Malaysia)*, para. 144.

296 Appellate Body, *US – Shrimp (Article 21.5 – Malaysia)*, para. 149.

297 Panel, *US – Shrimp (Article 21.5 – Malaysia)*, para. 5.142.

298 IPCC (2007a), Table 4.2, p. 60.

299 Stern (2006), p. 347.

300 See e.g. Stern (2006), pp. 348, 351. Fischer and G. Newell (2007), p. 2. Popp (2006), pp. 311-341. Brewer (2007), p. 3. Wellington et al. (2007), p. 10. IEA (2008a), p. 171.

301 See e.g. IEA (2007b), p. 6. Green (2006), pp. 383-384. Stern (2006), pp. 221-229. Anderson (2006), p. 8.

302 Buck and Verheyen (2001), p. 20.

303 See IEA (1999), p. 10; Saunders and Schneider (2000); Anderson and McKibbin (2000); OECD (2001a), p. 16; Morgan (2007); GTZ (2007); Moltke and McKee eds. (2004); UNEP (2008).

304 GTZ (2007), p. 3. Most recent data indicates that this trend has continued. See GTZ (2009), p. 8.

305 See Government of Pakistan (2006), *Letter of Intent, Memorandum of Economic and Financial Policies, and Technical Memorandum of Understanding*, 20 November 2008, paras. 8 and 9 of Memorandum of Economic and Financial Policies 2008/09-2009/10, at p. 5, at www.finance.gov.pk. Also see Khan, M.Z. (2008), "All fuel subsidies withdrawn", *DAWN*, 20 September 2008.

306 See GTZ (2007), p. 3. See also Nuhu-Koko, A.A. (2008), "Addicted to Fuel and Electricity Subsidies: Getting the Reform Strategies Right", *Nigerian Muse*, 19 July 2008.

307 Stern (2006), p. 350.

308 Fischer and Newell (2007), pp. 2, 21. Stern (2006), p. 365.

309 See OECD/IEA (2004).

310 See Danish Energy Agency at www.energistyrelsen.dk.

311 See the website of the Finnish Funding Agency for Technology and Innovation (Tekes), at www.tekes.fi.

312 See Renewable Energy Sources Act of 25 October 2008, BGBl I S. 2074. For an English translation of the Act, see www.bmu.de. Feed-in tariff legislation has been in place in Germany since the 1991 Electricity Feed-in Act, see IEA (2006b), p. 127.

313 Ministerio de Industria, Turismo y Comercio (2007), "Real Decreto 661/2007, de 25 de mayo, por el que se regula la actividad de producción de energía eléctrica en régimen especial", *Spanish Official Gazette*. For the photovoltaic feed-in tariff, see Ministerio de Industria, Turismo y Comercio (2008), "Real Decreto 1578/2008, de 26 de septiembre, de retribución de la actividad de producción de energía eléctrica mediante tecnología solar fotovoltaica para instalaciones posteriores a la fecha límite de mantenimiento de la retribución del Real Decreto 661/2007, de 25 de mayo, para dicha tecnología", *Spanish Official Gazette*. For a

short description in English, see the IEA Climate Change database (2008, last update).

314 See The Climate Group (2007), *Low Carbon Leaders: States and Regions*, 19 p.

315 See Ministry of Innovation, Science, Research and Technology of the German State of North Rhine-Westphalia (2007), *Driving our future. Energy research in North Rhine-Westphalia*, MIWFT, 18 p., at pp. 4-5.

316 The overall objective is a 50 per cent reduction of carbon dioxide by 2050. European Commission (2007), *Fossil Fuel Free Kristianstad, Municipality of Kristianstad, Sweden*, Directorate-General for Energy and Transport, Case Study 254, 5 p.

317 IEA (2008a), p. 184. Gurney et al. (2007), pp. 44-45.

318 See Department for Environment, Food and Rural Affairs (DEFRA) (2006), *United Kingdom's Fourth National Communication under the UNFCCC*, 132 p., at p. 28.

319 See *Valtioneuvoston asetus energiatuen myöntämisen yleisistä ehdoista* (Government Decree on the General Conditions of Granting Energy Aid) of 20 December 2007, at www.finlex.fi. For an overview in English, see the IEA Climate Change database (2008, last update). See also IEA (2004), p. 260.

320 See IEA (2004), p. 309. See also www.kfw-foerderbank.de.

321 See www.sdtc.ca. See also Sustainable Development Technology Canada (2008), *SDTC 2009 Corporate Plan – Executive Summary*, 11 p., at pp. 2, 4.

322 See e.g. Green (2006), pp. 382-384. Zhang and Assunção (2004), p. 362.

323 See e.g. Steenblik (2007).

324 Following Schumpeter's definition of the three stages of technological development, such policies may also be broken down as follows: invention, innovation and diffusion. Invention involves the research and first demonstration of the physical feasibility of a proposed new technology (called research, development and demonstration (R&DD)). Innovation is the stage of first developing and bringing new products or processes to the market, in other words to help them move from the laboratory to commercialization (as many would otherwise end up in the so-called "Valley of Death" due, *inter alia*, to the difficulty of preparing technologies for the market place). And finally, diffusion is the stage of replication and standardization of a technology, and its successful widespread adoption. See Schumpeter (1934). See also Gross and Foxon (2003), p. 119; Brewer (2007), p. 4; Stern (2006), p. 349; Brown et al. (2008).

325 Maurer and Scotchmer (2003), p. 2. Davis, L. and Davis, J. (2004), *How effective are Prizes as incentives to Innovation? Evidence from three 20th century Contests*, Paper presented at DRUID Summer Conference, June 2004, Denmark, 29 p.

326 Newell and Wilson (2005), p. 3.

327 See the website of the Department of Environment and Climate Change of the New South Wales Government at www.environment.nsw.gov.au/grants/ccfund.htm and in particular the Renewable Energy Development Program of the Climate Change Fund.

328 See New Zealand Ministry of Agriculture and Forestry (2008), *Climate Change Research Grants 2007/2008*, available at www.maf.govt.nz/climatechange/slm/grants/research/2007-08/index.htm.

329 See G/SCM/N/95/Kor, 5 May 2004, p. 24.

330 See Newell and Wilson (2005), pp. 3-4; Kalil (2006); Gillingham, Newell and Palmer (2004).

331 See website of the L Prize at www.lightingprize.org.

332 See Australia's Senate (2008), *Answers to Questions on Notice*, Standing Committee on Economics, Resources, Energy and Tourism Portfolio, Additional Estimates 2007-08, 21 February 2008, 4 p., at p. 3. See also IEA Climate Change database (2008, last update).

333 See Australian Government, Department of the Environment, Water, Heritage and the Arts, Greenhouse Gas Abatement Program (GGAP), at www.environment.gov.au. OECD/IEA (2004), p. 125.

334 See e.g. Kutas, Lindberg and Steenblik (2007).

335 A description is available on the website of the Department for Business Enterprise and Regulatory Reform, at www.berr.gov.uk. See also OECD/IEA (2004), p. 637.

336 See US Department of Energy, Energy Efficiency and Renewable Energy, *Montana E85 Laws and Incentives*, at www.eere.energy.gov.

337 See e.g. Gouchoe, Everette and Haynes (2002), p. 3. Clement et al. (2005), p. 4.

338 See "The Renewable Energy Law of the People's Republic of China, adopted at the 14th Session of the Standing Committee of the 10th National People's Congress on 28 February 2005", *Beijing Review* No. 29, 21 July 2005. See also Martinot and Junfeng (2007), p. 15; US National Renewable Energy Laboratory (2004), *Renewable Energy Policy in China: Financial Incentives*, NREL/FS-710-36045, at www.nrel.gov.

339 See Clement et al. (2005), p. 13.

340 Clement et al. (2005), table 7 on p. 13.

341 See the IEA Climate Change database (2008, last update).

342 See the website of SenterNovem, an agency of the Dutch Ministry of Economic Affairs, at www.senternovem.nl. For a description of the VAMIL scheme for accelerated depreciation in English, see also *Case 6: VAMIL and MIA, The Netherlands*, at http://ec.europa.eu/environment/sme.

343 Ringwald (2008), *India Renewable Energy Trends*, Centre for Social Markets Discussion Paper, p. 18.

344 See the website of the United States Database of State Incentives for Renewables & Efficiency (2009) at www.dsireusa.org.

345 See e.g. Ragwitz et al. (2005); Sijm (2002), p. 6; OECD/IEA (2004), p. 87; Ragwitz and Huber (2005).

346 PURPA was amended in 2005 by the Energy Policy Act of 2005, sections 1251 through 1254. See the website of the US Office of Electricity Delivery and Energy Reliability at www.oe.energy.gov. See also OECD/IEA (2004), p. 87. Martinot, Wiser and Hamrin (2005).

347 For the latest version of the Act, see *Renewable Energy Sources Act* of 25 October 2008, BGBl I S. 2074. For an English translation, see www.bmu.de. According to Article 1(2) of the Act, the overall objective is to increase the share of renewable energies in the total electricity supply to at least 30 per cent by the year 2020. See also Butler and Neuhoff (2004), p. 4. Dröge *et al.* (2004), p. 179.

348 Ministerio de Industria, Turismo y Comercio (2007), "Real Decreto 661/2007, de 25 de mayo, por el que se regula la actividad de producción de energía eléctrica en régimen especial", *Spanish Official Gazette*. For the photovoltaic feed-in tariff, see Ministerio de Industria, Turismo y Comercio (2008), "Real Decreto 1578/2008, de 26 de septiembre, de retribución de la actividad de producción de energía eléctrica mediante tecnología solar fotovoltaica para instalaciones posteriores a la fecha límite de mantenimiento de la retribución del Real Decreto 661/2007, de 25 de mayo, para dicha tecnología", *Spanish Official Gazette*. For a short description in English, see the IEA Climate Change database (2008, last update).

349 In Italy, renewable energies are promoted through different price regulation mechanisms, including feed-in tariffs, depending on the source of energy, size of installation, etc. For an overview, see http://res-legal.de/en. See also Castello, S., De Lillo, A. and Guastella, S. (2007), *National Survey Report on PV Power Applications in Italy*, IEA Co-operative Programme on Photovoltaic Power Systems, 19 p., at p. 7; and Tilli, F. et al. (2008), *The Feed in Tariff Scheme in the Italian Case. An Attempt of Removing Barriers for PV Architectural Integration and for Increasing Building Energy Efficiency*, 12 p.

350 The feed-in scheme was created by Article 10 of the Law No. 2000-108 *(Loi No. 2000-108 du 10 février 2000 relative à la modernisation et au développement du service public de l'électricité*, published in the Journal Officiel de la République Française No. 35 of 11 February 2000, p. 2143). For an English translation of the original version of the law, see www.industrie.gouv.fr. For the latest version of the law (in French), see www.legifrance.gouv.fr. For a description of the scheme, see also the website of the Ministry of Ecology, Energy, Sustainable Development and Territorial Planning (in French), at www.industrie.gouv.fr. A description in English is available from http://res-legal.eu/en.

351 See *The Electricity (Feed-In Scheme-Solar Systems) Amendment Act 2008*, available at www.legislation.sa.gov.au. More information on the scheme is available on the website of the Government of South Australia: www.climatechange.sa.gov.au.

352 A list of countries using feed-in tariffs can be found at Renewable Energy Policy Network for the 21st Century (2007), *Renewables 2007: Global Status Report*, 51 p., Table 2 on pp. 23-24.

353 See Ministry of Energy and Mines (2007), *Guidelines to Renewable Energies*, MEM, 92 p. at p. 36 at www.mem-algeria.org. For a summary of the scheme (in French), also see the website of the Electricity and Gas Regulatory Commission: www.creg.gov.dz.

354 Ruangrong, P. (2008), *Thailand's Approach to Promoting Clean Energy in the Electricity Sector*, 5 p., available at http://electricitygovernance.wri.org/files/egi/Thailand.pdf.

355 See "The Renewable Energy Law of the People's Republic of China, adopted at the 14th Session of the Standing Committee of the 10th National People's Congress on 28 February 2005", *Beijing Review* 29, 21 July 2005. Martinot and Junfeng (2007), pp. 14-15.

356 See e.g. Stern (2006), p. 366; Ragwitz et al. (2005), p. 11; IEA (2007b), p. 7; Butler and Neuhoff (2004), p. 24; and Fouquet et al. (2005), pp. 18, 24.

357 See e.g. Ragwitz and Huber (2005), p. 20. Fouquet et al. (2005), p. 26.

358 See e.g. Martinot, Wiser and Hamrin (2005), pp. 12-14.

359 See Database of State Incentives for Renewables and Efficiency, available at www.dsireusa.org.

360 Ontario Ministry of Energy and Infrastructure, *Net Metering in Ontario,* 5 p. at www.energy.gov.on.ca. See the website of BC Hydro, an electricity utility, at www.bchydro.com.

361 See website of the Thai Net Metering Project at http://netmeter.org.

362 See Agredano, J. and Huacuz, J.M. (2007), *PV Technology Status and Prospects in Mexico*, IEA – PVPS Annual Report 2007.

363 OECD/IEA (2004), p. 86.

364 Foxon (2003), p. 41.

365 See New Energy Foundation, "Subsidy Program for Residential PV Systems", available at www.nef.or.jp and OECD/IEA (2004), p. 86.

366 See the website of California Energy Commission, www.energy.ca.gov and Environment California (2006), "The California Solar Initiative: A monumental step to a million solar roofs", *Energy Program News*, 7 March 2006.

367 See ecoACTION, *ecoENERGY Retrofit-Homes*, at www.ecoaction.gc.ca.

368 OECD/IEA (2004), p. 86. World Energy Council (2008), p. 50.

369 See Kreditanstalt für Wiederaufbau (2003), *Das 100.000 Dächer-Solarstrom-Programm: Abschlußbericht,* KfW, at www.kfw.de. See also Agnolucci (2006), p. 3539. The last loan was granted at the end of June 2003. Even though the 100,000 Roofs Programme has ended, KfW, a public bank, still offers loans at preferential conditions for renewable energy projects. Additionally, photovoltaic installations are supported through the feed-in tariff.

370 This is a programme provided by two Indian banking groups in cooperation with UNEP. See UNEP's website at www.unep.fr.

371 UNFCCC (2007a), p. 40.

372 See e.g. Green (2006), p. 385.

373 See e.g. Green (2006), p. 385.

374 WTO (1999), p. 90.

375 Appellate Body Report, *US – Carbon Steel*, para. 73.

376 For a review of environment-related subsidies notifications, see WTO (2008a), pp. 28-56.

377 WTO (1999), p. 92.

378 SCM Article 1. WTO (1999), p. 92.

379 Article 1.1(a)(2) includes any form of income or price support in the sense of Article XVI of GATT 1994, i.e. support which operates directly or indirectly to increase exports of any product from, or reduce imports into, a member's territory.

380 Appellate Body Report, *Canada – Aircraft*, para. 157.

381 SCM Article 2.

382 WTO (1999), p. 93.

383 The SCM Agreement originally contained a third category: non-actionable subsidies. This category existed for five years, ending on 31 December 1999, and was not extended. See SCM Articles 8-9 and 31.

384 See SCM Articles 3-4.

385 See SCM Articles 5-7.

386 SCM Article 5.

387 SCM Article 6.

388 See e.g. Green (2006), at p. 399.

389 Appellate Body Report, *US – Carbon Steel*, para. 73.

390 Appellate Body Report, *US – Carbon Steel*, para. 73. See Part V of the SCM Agreement.

391 See WTO website at www.wto.org.

392 For a discussion of the issue of transfer of technology, see Section I.B.4.

393 TRIPS Article 7.

394 E.g. the Eco-Patent Commons initiative, World Business Council for Sustainable Development (WBCSD), at www.wbcsd.org. See also Taubman, A.S. (2009), "Sharing technology to meet a common challenge, Navigating proposals for patent pools, patent commons and open innovation", *WIPO Magazine* March 2009.

395 UK Intellectual Property Office (2009), "UK 'Green' inventions to get fast-tracked through patent system", Press Release, May 12, 2009.

396 Third World Network (2008), *Brief Note on Technology, IPR and Climate Change*, Bangkok Climate Change Talks Briefing Paper 2.

397 Given the great range of technologies relevant to adaptation and mitigation, the diversity of innovation technology diffusion structures required to meet expected needs, and the emergence of new technologies and new sources of innovation and industrial capacity, including in the developing world, the discussion on the nature, scope and precise costs and benefits of each of these measures is not yet settled.

398 WIPO (2008), *Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions?*, Version 5.0.

399 Ellis (2007), p. 13.

400 IEA (2008a), p. 73. IEA (2007a), p. 17. See also IEA (2007c). Boot (2009).

401 Stern (2006), p. 378.

402 See the monthly lists of TBT Notifications prepared by WTO, WTO, *Notifications issued during the month of …*, G/TBT/GEN/N/…. See also Wiel and McMahon (2005). See also the Collaborative Labelling and Appliance Standards Program (CLASP) website, which provides a summary of standards and labelling programmes at www.clasponline.org.

403 Canada's 1992 Energy Efficiency Act, see the website of Natural Resources Canada at www.nrcan.gc.ca.

404 See the website of the US Green Building Council at www.usgbc.org.

405 See www.energyrating.gov.au.

406 See www.energystar.gov.

407 See California's Appliance Efficiency Program, at www.energy.ca.gov.

408 "Agevolazioni nel calcolo dei parametri urbanistici per il miglioramento del comfort ambientale e del risparmio energetico negli edifici", Regione Umbria, Legge Regionale N. 38 Del 20-12-2000, available (in Italian) at www.anit.it.

409 See Section IV.C.4(c) on WTO rules concerning harmonization.

410 See e.g. ISO 13790:2004, Thermal performance of buildings – Calculation of energy use for space heating.

411 See International Standard IEC 61683:1999 on Photovoltaic systems – Power conditioners – Procedure for measuring efficiency.

412 See for instance ISO 9459 on solar heating – domestic water heating systems; ISO 81400-4:2005 on Wind turbines, Part 4: Design and specification of gearboxes.

413 For instance, biodiesel standards in Brazil (ANP No. 42/04) and the United States (ASTM D6751) are applicable for both Fatty Acid Methyl Esters (FAME) and Fatty Acid Ethyl Ester (FAEE), whereas the current European biodiesel standard (EN 14214:2003) is only applicable to FAME. See Tripartite Task Force (2007), *White paper on internationally compatible biofuel standards*, 93 p., at p. 8.

414 Members of the Tripartite Task Force (Brazil, European Union and United States) are experts in the field of biofuels from each region, nominated by the regional standardization institutions and government bodies.

415 Milbrandt, A. and Overend, R.P., (2008), *The Future of Liquid Biofuels for APEC Economies*, APEC Energy Working Group, 102 p., at p. 6.

416 The International Biofuels Forum was launched in March 2007. See UN Department of Public Information (2007), *Press Conference Launching International Biofuels Forum*, New York.

417 For example, ISO Technical Committee TC28/SC7 on liquid biofuels.

418 The Roundtable is an initiative of the Swiss EPFL (École Polytechnique Fédérale de Lausanne) Energy Centre. See http://cgse.epfl.ch.

419 Article 2.8 of the TBT Agreement requires that, wherever appropriate, members shall specify technical regulations based on product requirements in terms of performance, rather than design or descriptive characteristics.

420 For example, under the WTO TBT Agreement, between 2000 and 2008, more than 30 notifications were submitted by WTO members on their draft regulations regarding biofuels. Most proposals were to establish product characteristics – in particular, physical and chemical specifications for biodiesel or ethanol to be used and marketed as fuels. Other proposals had to do with quality requirements for biofuels, definitions and minimum or maximum volumes of biodiesel or ethanol allowed in fuels (e.g. notifications G/TBT/N/THA/179 and 181-2005 from Thailand, G/TBT/N/CRI/57-2006 and 66-2007 from Costa Rica, G/TBT/N/HND/40-2006 and 45-2007 from Honduras, G/TBT/N/GTM 52-2006 and 57-2007 from Guatemala, G/TBT/N/SLV/101-2006 and 107-2007 from El Salvador, G/TBT/N/NIC/82-2006 and 85-2007 from Nicaragua, G/TBT/N/JPN/186-2006 from Japan, and G/TBT/N/NZL/41-2008 from New Zealand).

421 See ANP Act 36/2005 on ethanol and ANP Act 05/2005 on biodiesel.

422 See IS 15464:2004 on anhydrous ethanol for use in the automotive sector, and IS 15607:2005 on biodiesel.

423 See CEN standard prEN 14214 on biodiesel – fatty acid methyl esters (FAME).

424 See e.g. ASTM D6751 for biodiesel.

425 See The Energy Conservation Centre (2008), *Japan Energy Conservation Handbook 2008*, Japan, 134 p., at p. 18. See also Tanaka (2008), p. 11.

426 IPCC (2007e), p. 754.

427 US Environmental Protection Agency (2001), p. 16. Philibert (2003), p. 21; Stern (2006), p. 382.

428 IPCC (2007e), p. 754.

429 The category is determined by the relationship between volume and energy consumption. See Directive 96/57/EC of the European Parliament and of the European Council of 3 September 1996 on energy efficiency requirements for household electric refrigerators, freezers and combinations thereof and Framework Directive 2005/32/EC on the setting of ecodesign requirements amending Directive 96/57/EC. The latter now falls under the Framework Directive, of which it has become an implementing measure. The Framework Directive applies to all energy-consuming appliances except vehicles.

430 See www.energyrating.gov.au.

431 See Title 49, United States Code, Subtitle VI. Motor Vehicle and Driver Programs Part C. Information, Standards, and Requirements Chapters 321, 323, 325, 327, 329, and 331 (2006). See website of the National Highway Traffic Safety Administration at www.nhtsa.gov.

432 Stern (2006), p. 382; Wiel and McMahon (2003), p. 1404.

433 The Top Runner Program is prescribed under the "Law Concerning the Rational Use of Energy" (Energy Conservation Law). The types of equipment designated under the Top Runner Program are: passenger vehicles, freight vehicles, air conditioners, electric refrigerators, electric freezers, electric rice cookers, microwave ovens, fluorescent lights, electric toilet seats, TV sets, video cassette recorders, DVD recorders, computers, magnetic disk units, copying machines, space heaters, gas cooking appliances, gas water heaters, oil water heaters, vending machines, transformers. See Ministry of Economy, Trade and Industry (METI), Agency for Natural Resources and Energy, The Energy Conservation Centre (2008), *Top Runner Program: Developing the World's best Energy-Efficient Appliances*, 66 p.

434 Title 49 Code of Federal Regulations (CFR) Parts 523, 531, 533, 534, 536 and 537 (Proposed Rules) published in Federal Register 73:86, May 2008 notified to the WTO in document G/TBT/N/USA/392. See also National Highway Traffic Safety Administration (2008), *Final Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011-2015*.

435 European Parliament (2008b).

436 Wiel and McMahon (2003), pp. 1404-1405. Stern (2006), p. 386.

437 "Energy Conservation Program for Consumer Products Other Than Automobiles" (42 U.S.C. 62916309). See http://apps1.eere.energy.gov/consumer/ and United States Department of Energy (2008), *Rulemaking Framework for Residential Central Air Conditioners and Heat Pumps*, RIN: 1904AB47, 64 p.

438 Stern (2006), p. 386.

439 Energy-efficiency labels are most commonly found on household appliances, cars, and building. For one survey of the status of energy-efficiency labels and standards in different countries as of September 2004, see Wiel and McMahon (2005), pp. 19-20.

440 Wiel and McMahon (2005), pp. 19-20; See Clasponline for an updated list of the status of energy-efficiency labels and standards across countries: www.clasponline.org.

441 See the Frequently Asked Questions on Appliance Labelling on the website of the Department of Minerals and Energy of the Republic of South Africa at www.dme.gov.za.

442 See G/TBT/Notif.99/498 and G/TBT/Notif.99/498/Add.1 through Add.5. Regulations related to energy-efficiency labelling are available in Spanish at www.puntofocal.gov.ar. An overview in English is available at www.clasponline.org.

443 See G/TBT/N/GHA/2. The Energy Efficiency Standards and Labelling Regulations are available at www.ghanaef.org.

444 More information on the voluntary Energy Efficiency Labelling Scheme is available from the websites of the Sri Lanka Standards Institution at www.slsi.lk and of the Ceylon Electricity Board at www.ceb.lk.

445 See website of the National Agency for Energy Conservation at www.anme.nat.tn. For a more detailed description, see Lihidheb and Waide (2005), *The Tunisian standards and labelling programme*, 16 p.

446 Wiel and McMahon (2005). See also www.clasponline.org.

447 World Energy Council (2008), p. 44.

448 See Australia's Energy Label at www.energyrating.gov.au.

449 See Switzerland's energiEtikette at www.bfe.admin.ch.

450 Canada's EnerGuide Car Labels, see http://oee.nrcan.gc.ca.

451 Wiel and McMahon (2005), pp. 19-20 and p. 58.

452 Soksod, S. and Suwicharcherdchoo, P. (2006), *Rescaling the Energy Label No. 5: 2006 version in Thailand, Appliances Efficiency Improvement Project, Demand Side Implementation Division*, EGAT, 5 p., at p. 2. For an overview of different voluntary labels in Thailand, see www.apec-esis.org.

453 See Indian Bureau of Energy Efficiency (2006), *Energy Efficiency Labels. Details of Scheme for Energy Efficiency Labeling*, Ministry of Power, 15 p., at p. 2. See also the Energy Manager Training website of the Indian Bureau for Energy Efficiency of the Ministry of Power at www.energymanagertraining.com. The programme now covers 11 categories of products on a voluntary basis. For four categories amongst them, the scheme is set to become mandatory, see notifications G/TBT/N/IND/36 and 37 regarding refrigerators and fluorescent lamps, as well as draft regulations published in the Gazette of India of 12 January 2009.

454 The Brazilian Labelling Programme PBE includes both mandatory and voluntary labels, depending on the product. For detailed information including the relevant regulations (in Portuguese), see www.inmetro.gov.br. For an overview in English, see Ministry of Mines and Energy, *Brazilian Labeling Program*, at www.conpet.gov.br. See also G/TBT/N/BRA/197, 256.

455 For more information on the Hong Kong Voluntary Energy Efficiency Labelling Scheme, see the website of the Electrical and Mechanical Services Department at www.emsd.gov.hk. As an example, see the Labelling Scheme for Fax Machines, G/TBT/N/HKG/25.

456 Wiel and McMahon (2003), p. 1403.

457 World Energy Council (2008), p. 43. Wiel and McMahon (2005), pp. 19-20. See also the monthly lists of TBT Notifications prepared by the WTO Secretariat, WTO, *Notifications issued during the month of …*, G/TBT/GEN/N/....

458 See Danish Energy Agency at www.ens.dk.

459 See for the Nordic Swan www.svanen.nu and for the German Blue Angel www.blauer-engel.de.

460 See www.environment.gov.au.

461 Directive 1999/94/EC of the European Parliament and of the European Council of 13 December 1999 relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars. This Directive is currently under revision.

462 See Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information on the consumption of energy and other resources by household appliances.

463 See www.energyrating.gov.au.

464 See EnerGuide Appliance Label at oee.nrcan.gc.ca.

465 See US Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE) at http://apps1.eere.energy.gov.

466 See for the Nordic Swan http://www.svanen.nu/.

467 See www.blauer-engel.de.

468 See http://ec.europa.eu/environment/ecolabel.

469 See www.carbon-label.co.uk.

470 For instance, the Timberland Company has introduced energy labelling for its footwear, highlighting the energy used in the production process and the proportion of that energy that comes from renewable sources. See www.timberland.com. See also Cortese, A. (2007), "Friend of Nature? Let's see those shoes", *New York Times*, 7 March 2007.

471 For example, Wal-Mart has introduced a "Food Miles Calculator" which allows consumers to calculate the total distance their product has travelled. See http://instoresnow.walmart.com/food-article_ektid44214.aspx.

472 See ITC, UNCTAD, UNEP (2007), *Statement on Soil Association Air Freight Consultation*, 17 September 2007, UNCTAD/DITC/TED/MISC/2007/4.

473 Smith, A. et al. (2005), *The Validity of Food Miles as an Indicator of Sustainable Development*, Department for Environment, Food and Rural Affairs, London, 103 p.

474 See for instance Brodt, S. (2007), *Assessment of Energy Use and Greenhouse Gas Emissions in the Food System: A Literature Review*, Agricultural Sustainability Institute, University of California Davis; Annelies Van Hauwermeiren et al. (2007), "Energy Lifecycle Inputs in Food Systems: A Comparison of Local versus Mainstream Cases", Journal of Environmental Policy and Planning, Volume 9:1, pp. 31-51. Saunders, C., Barber, A. and Taylor, G. (2006), *Food Miles – Comparative Energy/Emissions Performance of New Zealand's Agriculture Industry*, Research Report 285, Agribusiness and Economics Research Uni, Lincoln University, 105 p.

475 See Ellis (2007), p. 19. See also CLASP, "Definition of Energy-Efficiency Labels and Standards", *General Information on Standards and Labelling*, at www.clasponline.org. Wiel and McMahon (2005), p. 9.

476 Ellis (2007), p. 19.

477 The Energy Rating Label was first introduced in 1986 in New South Wales and Victoria, and is now mandatory in all states and territories in Australia and in New Zealand. Further details on the Australian Energy Rating labels can be found at www.energyrating.gov.au.

478 See Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances.

479 See EnerGuide Appliance Label at http://oee.nrcan.gc.ca.

480 See the Energy Guide Program at www1.eere.energy.gov.

481 For an overview in English, see www.conpet.gov.br.

482 See website of the National Agency for Energy Conservation at www.anme.nat.tn. See also Lihidheb, K. and Waide, P. (2005), *The Tunisian standards and labelling programme*, 16 p.

483 See G/TBT/N/CHN/59. For the text of the China Energy Label regulation in English, see www.energylabel.gov.cn. See also Nan Zhou (2008), *Status of China's Energy Efficiency Standards and Labels for Appliances and International Collaboration*, Ernest Orlando Lawrence Berkeley National Laboratory, 14 p., at p. 11.

484 Soksod and Suwicharcherdchoo (2006), p. 2. Also see http://www.clasponline.org/.

485 Singh, J. and Mulholland, C. (2000), *DSM (demand-side management) in Thailand: A Case Study*, Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP), 15 p., at pp. 3-4. For an overview of different labels in Thailand, see www.apec-esis.org.

486 For more information on Korea's Energy Efficiency Standards & Labeling Program, see www.kemco.or.kr.

487 World Energy Council (2008), p.45.

488 Wiel and McMahon (2005), p. 10.

489 Energy Star, History of Energy Star, www.energystar.gov.

490 International Energy Star partners include: Australia, Canada, the European Union, the European Free Trade Association, Japan, New Zealand, Switzerland and Chinese Taipei. See www.energystar.gov.

491 For more information on the PROCEL label see www.eletrobras.com.

492 For information on the Thai Green Label scheme, see www.tei.or.th/greenlabel.

493 See "China speeds up energy-efficient products certification", *Xinhua News Agency*, 7 August 2008. For an overview of the different Chinese labelling schemes in English, see www.apec-esis.org.

494 Energy Star, www.energystar.gov.

495 Carbon Trust, Carbon Label Footprint, www.carbon-label.co.uk.

496 See ISO/IEC 17000: 2004, para. 4.2.

497 Soksod and Suwicharcherdchoo (2006), p. 2.

498 See e.g. Electrical and Mechanical Services Department (2009), "The Hong Kong Voluntary Energy Efficiency Labelling Scheme for Washing Machines", Hong Kong, 62 p., at p. 16, at www.emsd.gov.hk. The schemes for other products contain similar provisions.

499 ISO/IEC 17000: 2004, para. 4.3.

500 US Green Building Council, LEED, www.usgbc.org.

501 See Energy Star, *Independent Inspection and Testing Helps Make Sure a Home is Energy Efficient*, at www.energystar.gov/.

502 *Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings*.

503 For a definition of certification see ISO/IEC 17000: 2004, para. 5.5.

504 WTO (2006), p. 54.

505 See Natural Resources Canada at www.oee.nrcan.gc.ca.

506 See ISO/IEC 17000: 2004, para. 5.6.

507 WTO (2006), p. 55.

508 See Hong Kong Electrical and Mechanical Services Department (2008), *Code of Practice on Energy Labelling of Products*, at p. 4, www.emsd.gov.hk.

509 See "Energy Conservation Program for Consumer Products; Fluorescent and Incandescent Lamp Test Procedures; Laboratory Accreditation Program" 10 CFR 430.25, *Federal Register*, 29 May 1997, at p. 29223, at www1.eere.energy.gov.

510 WTO (2006), p. 55.

511 See www1.eere.energy.gov. See in particular Petersons, O., Stricklett, K.L. and Hagwood C.R. (2004), "Operating Characteristics of the Proposed Sampling Plans for Testing Distribution Transformers", NIST Technical Note 1456, 25 p. and "Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards", 10 CFR 431, *Federal Register*, 12 October 2007.

512 For example, under the Montreal Protocol, numerous governments have bans to phase out the use of chlorofluorocarbons (CFCs).

513 See Section III.A.4 on the Montreal Protocol.

514 *Ordinance by the Federal Minister for Agriculture, Forestry, Environment and Water: Management on Bans and Restrictions for Partly Fluorinated and Fully Fluorinated Hydrocarbons and Sulphur Hexafluoride*, BGBl. II Nr. 447/2002. The English version is available at www.bmlfuw.gv.at.

515 See Danish Environmental Protection Agency, *Fact sheet No. 46: Industrial greenhouse gases: HFCs, PFCs and SF_6*, at www.mst.dk. Full text of the *Statutory Order No. 552 of 2 July 2002 on regulations for certain industrial greenhouse gases* (in Danish) is available at www.retsinformation.dk.

516 See Federal Department of the Environment, Transport, Energy and Communications (2003), "Synthetic greenhouse gases under control and better protection of ozone layer", Press Release, 30 April 2003 at www.uvek.admin.ch.

517 See Regulation (EC) No. 842/2006 of 17 May 2006 on certain fluorinated greenhouse gases.

518 Australian Government, Department of the Environment, Water, Heritage and the Arts, *Phase out of incandescent lightbulbs*, at www.environment.gov.au.

519 European Commission (2009), *Commission adopts two regulations to progressively remove from the market non-efficient light bulbs*, Press Release, IP/ 09/411, 18 March 2009.

520 Canada put in place high minimum performance standards for lamps, see Natural Resources Canada, Office of Energy Efficiency (2008), "Canada's Energy Efficiency Regulations. General Service Lamps – New Regulations. Final Bulletin – December 2008", OEE, http://oee.nrcan.gc.ca. For the full text of the regulation, see "Regulations Amending the Energy Efficiency Regulations", SOR/2008-323, *Canada Gazette*, Part II, 142:26, 24 December 2008, p. 2512.

521 The proposed regulation will set high minimum efficiency standards on incandescent lamps, see G/TBT/N/TPKM/64. For the text of the "Proposed draft of the minimum energy efficiency requirements of Incandescent lamps for general service", see www.bsmi.gov.tw. Also see "Taiwan Switches On 5-year Green Plan to Ban Incandescent Lights", CENS, 7 November 2008, www.cens.com.

522 See G/TBT/N/ARG/246. The full text of Ley No 26.473 is available at www.puntofocal.gov.ar. See also Greenpeace, *Argentina to Ban the Bulb*, 14 March 2008.

523 Meyers, McMahon and McNeil (2005), p. 2.

524 Winters Lynch (1994), p. 5.

525 See e.g. Geller *et al*. (2006).

526 Wiel and McMahon (2003), p. 1408. Geller *et al*. (2006), pp. 563, 568-570. IEA (2000), p. 107. Colombier and Menanteau (1997). See also the California Energy Commission's website at www.energy.ca.gov.

527 Meyers, McMahon and McNeil (2005), p. 33.

528 Winters Lynch (1994), p. 5.

529 OECD (1997), p. 70.

530 OECD (2008c), p. 11.

531 See OECD (2008c), p. 29. OECD (1997), p. 48. See also www.svanen.nu.

532 Banerjee and Solomon (2003), p. 115.

533 Huh (1999). Banerjee and Solomon (2003), p. 119. Wiel and McMahon (2003), p. 1403.

534 Wiel and McMahon (2005).

535 Faiz, Weaver and Walsh (1996), p. 22.

536 In the *EC – Asbestos* case, the Appellate Body indicated that not all internal measures covered by Article III:4 of the GATT 1994 "affecting" the "sale, offering for sale, purchase, transportation, distribution or use" of a product are necessarily "technical regulations" under the TBT Agreement. Appellate Body Report, *EC – Asbestos*, para. 77.

537 For a detailed explanation of Article XX, see WTO (2002).

538 A technical regulation is defined in TBT Annex 1, Paragraph 1 as a: "Document which lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method". In addition, Annex 1, Paragraph 1 provides the following examples of requirements which can be included in a technical regulation: terminology requirements; symbol requirements; packaging requirements; marking requirements; and labelling requirements.

539 A standard is defined in TBT Annex 1, Paragraph 2 as a: "Document approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes

and production methods, with which compliance is not mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method".

540 A conformity assessment procedure is defined in TBT Annex 1, Paragraph 3 as: "Any procedure used, directly or indirectly, to determine that relevant requirements in technical regulations or standards are fulfilled". The Explanatory note of Annex 1, Paragraph 3 provides a non-exhaustive list of conformity assessment procedures which include: procedures for sampling, testing and inspection; evaluation, verification and assurance of conformity; and registration, accreditation and approval.

541 TBT Article 1.3.

542 Pursuant to the General interpretative note to Annex 1A, if there is conflict between a provision of the GATT 1994 and a provision of another agreement contained in Annex 1A of the WTO Agreement, e.g. the TBT Agreement, the provision of the other agreement shall prevail to the extent of the conflict. See Appellate Body, *Brazil – Desiccated Coconut*, p. 16.

543 The relevant provisions for mandatory requirements are Articles 2 and 3 while Article 4 and Annex 3 are relevant to voluntary standards. For conformity assessment procedures, key provisions are Articles 5 to 9.

544 See Article 4 and Annex 3 of the TBT Agreement.

545 TBT Annex 3, Paragraph B.

546 Pursuant to TBT Annex 1, Paragraph 8, a non-governmental body is a "[b]ody other than a central government body or a local government body, including a non-governmental body which has legal power to enforce a technical regulation". See e.g. Appleton (2009), p. 13.

547 In addition, TBT Annex 1.1 provides the following examples of requirements which can be included in a technical regulation: terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method.

548 Appellate Body, *EC – Sardines*, para. 180.

549 Appellate Body, *EC – Asbestos*, para. 67.

550 Annex 1, paras. 1 and 2. Pursuant to Annex 1.2, a standard is a "[d]ocument approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method".

551 In response to a request of the Committee on Trade and Environment in 1995, the WTO prepared a note on the negotiating history – covering both the Tokyo and the Uruguay Round negotiations – which included a discussion on the coverage of the TBT Agreement relating to processes and production methods unrelated to product characteristics. See WTO (1995), pp. 37-54.

552 For a discussion of the non-product related PPM issue, see e.g. Waide and Bernasconi-Osterwalder (2008), p. 8. Appleton (2009), pp. 6-7. Verrill (2008), p. 47.

553 See TBT Articles 2.1 (for technical regulations), 5.1.1 (for conformity assessment procedures) and Annex 3.D (for standards).

554 The non-discrimination principle and the related terms "like products" and "no less favourable treatment than" have not been tested in dispute settlement proceedings in the TBT context. For more information on the like product concept under the GATT, see Section IV.I.A.

555 See TBT Articles 2.2 (for technical regulations), 5.1.2 (for conformity assessment procedures) and Annex 3.E (for standards).

556 See TBT Article 2.2.

557 TBT Article 2.2.

558 TBT Article 5.1.2.

559 See Section IV.A.3(b)(ii) on the necessity test with Article XX.

560 Unadopted GATT panel, *US – Automobiles*, para. 2.2.

561 Unadopted GATT panel, *US – Automobiles*, para. 2.5.

562 Unadopted GATT panel, *US – Automobiles*, paras. 2.15-2.16.

563 The national treatment principle as contained in GATT Article III:2. See unadopted GATT panel, *US – Automobiles*, paras. 5.16, 5.37.

564 As contained in GATT Article III:4.

565 Unadopted GATT panel, *US – Automobiles*, para. 5.55.

566 For a discussion on this see Assunção and Zhang (2002).

567 In the SPS Agreement, harmonization is defined as "The establishment, recognition and application of common sanitary and phytosanitary measures by different Members" (Annex A.2).

568 TBT Article 2.7.

569 TBT Article 6.3.

570 TBT Article 2.4 (for technical regulations), 5.4 (for conformity assessment procedures) and Annex 3.F (for standards). Concerning conformity assessment procedures, Article 5.4 reads "In cases where a positive assurance is required that products conform with technical regulations or standards, and relevant guides or recommendations issued by international standardizing bodies exist or their completion is imminent, Members shall ensure that central government bodies use them, or the relevant parts of them, as a basis for their conformity assessment procedures, except where, as duly explained upon request, such guides or recommendations or relevant parts are inappropriate for the Members concerned, for, *inter alia*, such reasons as: national security requirements; the prevention of deceptive practices; protection of human health or safety, animal or plant life or health, or the environment; fundamental climatic or other geographical factors; fundamental technological or infrastructural problems."

571 The *EC – Sardines* case is very informative concerning the interpretation of this requirement. *EC – Sardines*, Panel and Appellate Body Reports.

572 TBT Article 2.5.

573 TBT Article 2.6.

574 See "Decision of the Committee on principles for the development of international standards, guides and recommendations with relation to Articles 2, 5 and Annex 3 of the Agreement" contained in G/TBT/9.

575 See TBT Articles 2 and 5.

576 G/TBT/13, para. 16.

577 TBT Article 13.1.

578 G/TBT/N/BRA/240, 17 April 2007

579 G/TBT/N/EEC/194, 30 April 2008.

580 G/TBT/N/SGP/5, 15 August 2008. See also European Parliament (2008b).

581 G/TBT/N/CHN/330,G/TBT/N/CHN/331,G/TBT/N/CHN/332, 29 January 2008.

582 See TBT Article 11.

583 This last obligation is only relevant to WTO members which are members or participants of international or regional systems for conformity assessment. See Articles 11.2, 4, 5 and 6.

584 See e.g. European Communities (2008), *Technical Assistance Activities in the TBT Field (European Commission and EU Member States funded. Active Projects in 2006-2007)*, G/TBT/W/303.