

Trade and Sustainable Energy Series



Climate, Equity and Global Trade



ICTSD

International Centre for Trade
and Sustainable Development

Selected Issue Briefs No. 2

Climate, Equity and Global Trade



International Centre for Trade
and Sustainable Development

Selected Issue Briefs No. 2

Published by

International Centre for Trade and Sustainable Development (ICTSD)

International Environment House 2

7 Chemin de Balexert, 1219 Geneva, Switzerland

Tel: +41 22 917 8492

Fax: +41 22 917 8093

E-mail: ictsd@ictsd.ch

Internet: www.ictsd.org

Chief Executive: Ricardo Meléndez-Ortiz

Programmes Director: Christophe Bellmann

Senior Programme Manager: Moustapha Kamal Gueye

Programme Officers: Mahesh Sugathan and Malena Sell

Acknowledgements:

This project is made possible through the generous support of the UK Department for International Development, Oxfam Novib, DGIS (Department of Development Cooperation) of the Netherlands and the Italian Ministry for the Environment, Land and Sea and the Ministry of Foreign Affairs.

For more information about ICTSD's Programme on Trade, Environment and Natural Resources, visit our websites at www.trade-environment.org and www.ictsd.org

ICTSD welcomes feedback and comments on this document. These can be forwarded to Moustapha Kamal Gueye, gkamal@ictsd.ch.

Citation: ICTSD (2007). Climate, Equity and Global Trade: Selected Issue Briefs No. 2. ICTSD Trade and Sustainable Energy Series, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Copyright ICTSD, 2007. Readers are encouraged to quote and reproduce this material for educational, non-profit purposes, provided the source is acknowledged.

This work is licensed under the Creative Commons Attribution-Noncommercial-No-Derivative Works 3.0 License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-nd/3.0/> or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

The views expressed in this publication are those of the author(s) and do not necessarily reflect the views of ICTSD or the funding institutions.

CONTENTS

Urgent Attention Needed on the Climate and Equity Impacts of Global Trade	1
Environmental Goods: A Doha Round Deliverable for Climate Change? By Mahesh Sugathan, ICTSD	3
Talking Carbon: Implications of US–China Trade By Shui Bin, Researcher, Joint Global Change Research Institute, USA, and Robert C. Harriss, President, Houston Advanced Research Center, USA	6
The Effects of Climate Change Policies on International Trade and Competitiveness By Muthukumara Mani, Senior Environmental Economist, The World Bank	9
Border Measures to Address Climate Change–Related Competitiveness Concerns: EU and US Interests By Thomas L. Brewer, Associate Professor, Georgetown University, Washington, DC and Associate Fellow, Centre for European Policy Studies (CEPS), Brussels	11
Patenting and Access to Clean Energy Technologies in Developing Countries By John H. Barton, George E. Osborne Professor of Law, Emeritus, Stanford University	13
Food Miles, Fair Miles Debate: Global Trade Implications By Malena Sell, ICTSD	15

Urgent Attention Needed on the Climate and Equity Impacts of Global Trade

The steadily growing volume of global trade is forcing policymakers to start taking a hard look at its climate impact, while keeping equity and development issues as top priority. The climate implications of export-led growth in emerging economies, the potential barriers that intellectual property may pose for access to clean technologies in developing countries, the possibility of carbon leakage between countries with stringent versus lax climate regulations, and the carbon footprint of the emerging trade opportunities in niche markets for low income countries are at the core of the debate. In the WTO, climate change concerns have also been explicitly referred to in the context of ongoing negotiations on environmental goods and services.

As trade policies and tools are being considered to achieve climate change objectives, there is a fundamental need to ensure that countries that have least contributed to the problem of climate change are not made to pay an unfair price for its solution. Similarly, when incentive measures are being considered in the trade system, it is essential to ensure that these will be relevant to countries that are already experiencing the effects of climate change, such a flooding, droughts and declines in productivity and trading potential.

This set of issue briefs - produced by leading thinkers in research institutes, international organisations and independent non-governmental organisations - was put together by ICTSD with a view to look beyond some of the rhetoric in the debate on trade and climate change, and to identify some of the emerging issues from an equity and development perspective.

If the international community is committed to ensuring that climate change policies attend to the urgent task at hand of reducing carbon while delivering the social primary goods that societies require in a fair manner, much work remains. This presents challenges both from an analytical perspective and with respect to ensuring the adequacy of current regulatory frameworks within the increasingly complex trade regime.

Trade in environmental goods

According to many observers of the trade and climate change scene, the Doha Round negotiations could provide one concrete deliverable for climate: an agreement on eliminating trade barriers against climate-friendly technology. The EU and US tabled a proposal at a meeting at the WTO just prior to Bali, looking specifically at climate-friendly technology. Mahesh Sugathan provides a snapshot of the state of play with regard to the WTO negotiations on environmental goods and services, and gives an overview of the new proposal.

Meanwhile, there are concrete examples of existing barriers to trade that could be eliminated. The EU still levies anti-dumping duties on energy-efficient light bulbs imported from China. The US and EU also impose tariffs on land-use efficient and climate-friendly Brazilian ethanol - an industry many developing countries are hoping to replicate. Brazil has suggested including ethanol as an environmental good slated for tariff reduction or elimination. Many developing countries presently producing biofuels or hoping to attract investment in new technologies and crops, such as jathropa, find a suite of trade measures hindering the development of global markets in biofuels.

Embodied carbon in trade - and carbon accounting systems

A significant part of global carbon emissions may be a direct result of international trade. Shui Bin and Robert Harriss have studied the embodied carbon associated with trade between the US and China, noting that the US has managed to avoid a significant amount of carbon dioxide emissions due to its imports from China, and that overall emissions are higher because some of the more efficient production in the US is being substituted by less efficient processes in China.

In suggesting that consumer products imported from the emerging economies come with a significant carbon footprint, the research on embodied carbon in trade raises questions regarding current carbon accounting systems, which are based on the nation state. It also raises issues regarding the responsibilities of producer and consumer countries with regard to emissions reductions, and underlines the need for a comprehensive global regime to tackle climate change and avoid leakage of carbon emissions from countries with stringent climate policies to those without.

Carbon leakage and border adjustments

Politicians have sounded alarm bells over potential competitiveness losses in developed countries with industry relocating to developing countries with less strict climate standards - leading to carbon leakage and the same, or even larger, amounts of carbon dioxide ending up in the atmosphere. Initial empirical research into the issue by Muthukumara Mani of the World Bank does suggest that some - but not major - relocation of carbon-intensive industries to countries without climate commitments has taken place. However, he points out that the picture may change in the future when countries take on more stringent reduction targets.

In order to address such concerns, legislators in both the EU and US have suggested setting up protective measures at the border, such as border tax adjustments on energy-intensive goods. Thomas Brewer looks at activities underway on both sides of the Atlantic. The WTO-compatibility of such border tax adjustments remains untested.

Under a climate change agreement with global buy-in, such problems such problems could be prevented.

IP and access to climate friendly technology

Energy efficient goods, renewable energy technologies, biofuels and technologies such as carbon capture and storage need to be available globally at vastly increased quantities. Some have called for flexibility in the global intellectual property system to allow for more rapid engineering in all parts of the world of climate friendly technology. John Barton has looked at IP challenges in several renewables sectors, but found that IP rarely

represents the bottleneck to diffusion. Rather, trade barriers in the form of tariffs, as well as production and trade-distorting subsidies appear to be greater challenges that need to be addressed in the current context of technology development and market structures.

Air freighting and exports from vulnerable countries

While the debate on embodied carbon and leakage concerns mainly developed and emerging economies, some of the most vulnerable countries have found themselves the victims of a discussion on food miles. For example, certain developing countries in Africa have managed to capture high-value niche markets in developed countries by air freighting fresh produce during the northern winter. Some developed-country consumers are seeking to avoid such imported food products on the ground of their carbon footprint. The exporting countries want to retain their right to grow, including through trade-led growth. They argue that their overall emissions are much lower than those of the importing countries, which should start by cleaning up their own act. To regulate emissions in this area - either through compulsory measures or non-statutory standards - in the absence of sound knowledge of lifecycle carbon and energy impacts is not the way to go.



Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

Environmental Goods: A Doha Round Deliverable for Climate Change?

By Mahesh Sugathan

The Doha round negotiations are proving to be divisive, drawn-out and complicated, with trade delegations expending much of their energy on high-profile issues such as agriculture and industrial market access. However, also on the agenda is an area potentially of great interest to climate change negotiators: talks aimed at freeing up trade in environmental goods and services by cutting tariffs and non-tariff barriers.

WTO members have on their plate a set of negotiations that could increase the global flow of clean and energy-efficient technologies and renewable energy, speeding up the diffusion of know-how critical to allowing countries to make a shift towards a sustainable energy future. The liberalisation of environmental goods and services was included in the 2001 Doha agenda.

Just prior to a meeting of trade ministers during the UNFCCC Conference of the Parties in Bali, the EU and US submitted a joint proposal at the WTO on environmental goods and services specifically relevant to climate change mitigation. This proposal could provide the basis for a deliverable from the global trading system with regard to the global quest to mitigate climate change. US Trade Representative Susan Schwab stressed that "WTO Members have an unprecedented opportunity to address in a concrete and meaningful way the global environmental challenge of climate change." Eliminating tariff and non-tariff barriers to environmental goods and services - particularly clean energy technologies - could lower their costs and increase global access to and their use.

This article provides some background on key issues and the state of the negotiations on environmental goods and services at the WTO and analyzes the EU-US submission.

The mandate

Paragraph 31 (iii) of the 2001 Doha Ministerial Declaration calls for the reduction, or as appropriate, elimination of tariff and non-tariff barriers on environmental goods and services (EGS). The mandate does not specify what environmental goods are, nor does it indicate the pace, depth or sequencing of liberalisation in this sector vis-à-vis other goods and services. Discussions on the definition and scope of environmental goods are taking place within the WTO Committee on Trade and Environment special negotiating session.

Defining environmental goods and the challenge of 'dual use' goods

The lack of a universally accepted definition of EGS has left trade delegates struggling over the scope of goods and services slated for liberalisation. Several approaches have surfaced, centred on lists, projects, or a request-offer process for bringing down trade barriers.

One bone of contention is that of so-called 'dual use' goods. While the aim of the EGS mandate is to liberalise trade, some say this applies to goods intended solely for environmental protection purposes, and oppose any consideration of dual use goods that can have both environmental and non-environmental uses.

Many of the proponents of environmental goods liberalisation - dubbed the 'Friends of Environmental Goods' and comprising Canada, the EU, Japan, Korea, New Zealand, Norway, Chinese Taipei, Switzerland and the US - have argued that the benefits of EGS liberalisation would be limited if it was restricted to the handful of products used solely for environmental purposes.

On the other hand, a number of developing countries are concerned about cutting tariffs for goods only vaguely linked to environmental protection, worrying in particular about the impacts of dual use imports on small and medium enterprises (SMEs) in the non-environmental sectors.

The 'list' approach to defining environmental goods

Over the years, WTO members have focused quite heavily on different lists of environmental goods that could be liberalised. They have considered lists compiled by the Organisation of Economic Cooperation and Development (OECD) and the Asia Pacific Economic Cooperation (APEC) forum, and the 'Friends' of environmental goods have created a consolidated list of 153 goods based on their own individual lists.

If delegates were to agree on a set list of environmental goods, these would have to be updated, as new technologies and solutions appear - a living definition reflecting the real world. The problem here would be how to treat outdated environmental goods. Tariffs lowered once cannot be hiked up again.

The 'project' approach to defining environmental goods

An alternative approach, introduced by India and Argentina as a response to the problem of dual use goods, centres on specific projects. Under the project approach, tariffs would be temporarily bound at lower levels for agreed

goods and services destined for specific environmental projects - for the duration of the project only. The criteria for the projects would be decided multilaterally by the Committee on Trade and Environment. The approach has met with criticism from many of the 'Friends,' which say it lacks predictability and would include burdensome procedures. In addition, they question its consistency with WTO rules.

The 'request-offer' approach to defining environmental goods

Brazil has informally floated a third approach under which WTO members would negotiate the goods for liberalisation based on a 'request-offer' approach. The request-offer approach is used under the General Agreement on Trade in Services (GATS), with countries requesting specific liberalisation commitments from each other, and then extending tariff cuts they deemed appropriate equally to all WTO members.

Goods of interest to developing countries

From the beginning of the negotiations, it has been clear that most industrially produced environmental goods are of interest mainly to developed countries and the most advanced developing countries. Therefore, some developing countries have proposed that agricultural environmental goods also should figure in any basket of goods slated for liberalisation. While African countries expressed some interest in organic agriculture early on in the negotiations, the issue was not taken up by developing countries owing to the fear that discrimination (albeit positive) on the basis of process and production methods (PPMs) would be introduced within the WTO. The topic has resurfaced in discussions lately.

Are biofuels environmental goods?

The WTO distinguishes between industrial and agricultural goods, with the former subject to a more stringent set of rules related to tariffs, subsidies etc. Due to historic classification reasons, as well as how they are processed, biodiesel is considered an industrial good while bioethanol is considered an agricultural good. At a recent meeting of the WTO Committee on Trade and Environment, Brazil - an efficient producer of ethanol that faces major tariff barriers in developed country markets - suggested that biofuels should be considered as environmental goods.

Environmental services

Liberalisation of environmental services has received far less attention than environmental goods since discussions started at the WTO. The environmental services discussed at the WTO refer to human-produced services, such as end-of-pipe pollution control and remediation services; they do not include ecosystem services provided by nature.

Unlike environmental goods, environmental services existed as a separate category within the WTO Services Sectoral Classification List even before the launch of the

Doha Round. Discussions have progressed slowly. A group of countries dubbed 'Friends of Environmental Services' have played an active role as demanders, both in terms of flagging conceptual issues that need to be worked out and in requests for specific countries to liberalise specific environmental services.

Some delegations have pointed out that the current WTO Services Sectoral Classification list needs to be updated to reflect current realities and the evolution of the environmental industry beyond traditional end-of-pipe/pollution control/ remediation/clean-up towards integrated pollution prevention and control, cleaner technology and resources and risk management.

A number of countries have highlighted the close linkage between environmental goods and services, noting that their separation is difficult, owing to their integrated nature. They have suggested that, where appropriate, EGS should be liberalised in parallel.

The EU-US proposal on 'climate-friendly' goods and services

On 30 November, the EU and US made a joint informal proposal at the WTO, suggesting the liberalisation of goods and services specifically relevant to climate change mitigation. They further suggested the negotiation of an innovative Environmental Goods and Services Agreement (EGSA) modelled on the existing Information Technology Agreement (ITA). The aim would be to boost market access for a wide range of EGS contributing to environmental protection objectives in addition to climate change.

The proposal was made as a contribution to the Bali trade ministers' summit on climate change. In addition to providing a concrete response to the Doha mandate on EGS, it sought to "make a substantial and concrete contribution to support global and national climate and energy security objectives, particularly in light of the ultimate objective of the UNFCCC."

Climate-friendly goods and services

The EU-US proposal identifies 43 products directly relevant to climate mitigation based on the consolidated list of 153 goods compiled by the 'Friends' of environmental goods. The proposal draws directly from a recent World Bank report on trade and climate change, suggesting that by removing tariffs and non-tariff barriers to key technologies, trade could receive an annual boost of 7-14 percent. In addition, liberalisation of climate-friendly technologies could facilitate more investment in high-end technology.

A two-tier approach

The EU-US submission introduces a two-tier approach to liberalising EGS. The 43 goods identified in the World Bank study as "directly linked to addressing climate change, and other relevant goods that enjoy consensus on the basis of their clear environmental benefit" would be included in a first tier of goods. The goods include

a wide variety of products such as solar collectors and system controllers, wind-turbine parts and components, stoves, grates and cookers and hydrogen fuel cells.

These would provide a starting point for the work rather than an exhaustive list of goods, and other relevant goods that members agree on could be added.

The first tier would also include relevant services, which “contribute to Members’ efforts to address climate change, such as: air pollution and climate control services; technical testing and analysis; energy-related services (e.g. engineering and maintenance services to optimise the environmental performance of energy facilities); and services for the design and construction of energy-efficient buildings and facilities.”

The proposal stresses the importance of liberalising environmental goods and services in parallel. Designing more energy-efficient buildings would require, for instance, consulting, design and construction services in addition to solar panels for heating.

The proposal further suggests a second tier of environmental goods liberalisation that would include a broader set of goods based on the consolidated list of 153 products compiled by the ‘Friends’ of environmental goods. These goods would address domestic and global environmental challenges beyond climate change. In terms of second tier services, the submission proposed a broad set of environmental and climate-related services, including environmental, energy, construction, architectural, engineering and integrated engineering services.

Tariff cuts, special treatment for developing countries

The EU-US submission calls for the elimination of tariffs and non-tariff barriers to climate change mitigation technologies and clean energy by the entry into force of a Doha round accord. According to trade sources, the ultimate objective of the submission is to create a ‘zero tariff world’ for climate friendly goods in the near future and no later than 2013.

In terms of special and differential treatment (S&D) for developing countries, the proposal envisages longer phase-in periods for tariff elimination for products in the first tier in these countries and the US and EU said they were willing to consider other types of S&D.

For second tier products, the proposal does not set specific deadlines and calls on countries to “eliminate tariffs and take appropriate actions to identify and address specific non-tariff barriers” within the context of the discussions on industrial goods at the WTO. Fewer countries would eliminate trade barriers to the second tier products, as least developed and other particularly disadvantaged countries would be exempt from making commitments.

On Tier 1 services, the submission calls on all WTO members involved in relevant services negotiations

to make commitments within their GATS schedules facilitating trade in the climate-related services. On Tier 2 services, WTO members were asked to bind existing levels of market access and national treatment commitments and undertake new liberalisation to remove market access barriers.

Initial developing country reactions

During an informal meeting of the Committee on Trade and Environment special session on 30 November, reactions from developing countries were mixed. Egypt, among others, noted the importance of climate change and welcomed the short Tier 1 list of goods. Developing countries asked for more clarification regarding the scope of the products and services within Tier 2.

Without questioning the relevance of EGS to climate change, many developing countries voiced specific concerns. They questioned how the goods had been selected and said the dual use problem had not been resolved even for the short list of 43 goods. They did acknowledge that the list specified the intended end-use for a number of the products. For instance, for clutches and universal joints were included as specifically for wind turbines.

Brazil and others pointed out that the development dimension was lacking in the submission, as it contained no products of export interest to developing countries. They would, for example, have liked to see biofuels and biofuel manufacturing equipment on the list. The list also lacked a technical assistance and technology transfer dimension, they said.

In terms of the approach, some countries criticised the concept of a mandatory ‘one-size fits all’ EGS Agreement, saying the objective of the proposal appeared to be market opening rather than environmental protection. Brazil suggested that its ‘request-offer’ approach to EGS liberalisation took into account developing country interests more adequately than a common list as implied by the EU-US submission. Hong Kong reportedly asked why a new agreement on EGS was needed, when countries could make commitments within existing goods and services schedules.

Some developing countries also questioned the US’ intentions in raising the issue in Bali, suggesting that the US was ‘forum-shopping’. Reportedly, the US said they aimed only to bring up the submission during informal discussions at the Bali trade ministers’ meeting, but had no intention to circulate the actual proposal.

Many countries were unprepared to comment on the new proposal at the initial meeting, and discussions will continue at future meetings of the WTO Committee on Trade and Environment special negotiating session.

Mahesh Sugathan is Programme Coordinator - Economics & Trade Policy Analysis at ICTSD

Talking Carbon: Implications of US-China Trade

By Shui Bin and Robert C. Harriss

China's trade, US trade and US-China trade

At the end of September 2007, China - the country with the largest foreign exchange reserve in the world - hit a fresh record with a US\$1.43 trillion reserve. The reserve was 45 percent higher than it was in the previous year, and 52 percent higher than that of the second runner up, Japan. A senior economist at the State Information Center of China said "The increasing trade surplus has been the main driver of the reserve expansion." (China Daily 2007)

Thanks to its ceaselessly growing economy and successful transformation into a major merchandise supplier serving consumers worldwide, China ranked third in global trade terms (the sum of the absolute values of export and import) in 2005-2006 and is expected to be number two in 2007 (WTO 2006). China also has the largest trade surplus globally. During the first nine months of 2007, China's trade surplus soared to US\$185.7 billion, which already was higher than its total 2006 surplus that amounted to US\$177.5 billion.

As the largest merchandise importer, the US has been a solid first at the opposite end, registering its largest trade deficit for decades. In 2006, the US trade deficit escalated to US\$817 billion, of which as much as 28 percent related to its trade with China (see Figure1).

Although China's currency has appreciated since last year (registering a 7.4 percent increase between 2006 and September 2007), the US-China trade deficit seems still to be growing. For example, the US monthly trade deficits with China during January and September of this year were between 3 and 34 percent higher than they were for the same months the year before.

CO₂ emissions from China and the US

Although the US and China are at the opposite ends of the spectrum with respect to trade balance, the countries converge as the top two emitters of CO₂ globally. In 2005, the US emitted 5,957 million metric tons of CO₂ (MtCO₂) followed by China's 5,323 MtCO₂. Together, their emissions make up 40 percent of the global total (see Figure 2).

As the world's largest fossil fuel producer and consumer, as well as the largest CO₂ emitter, the US has been in the spotlight as the clear frontrunner. Since 2002, China's annual growth of carbon emissions has taken off sharply, with growth rates ranging from 11 percent to 19 percent between 2002 and 2005. In June 2007, the Netherlands Environmental Assessment Agency (MNP) announced that "according to preliminary estimates for 2006, China topped the list of CO₂ emitting countries, surpassing the USA by an

estimated 8 percent." (MNP 2007). The 2007 edition of the International Energy Agency (IEA)'s Global Energy Outlook, released in November, confirmed that China will overtake the US as the world's biggest emitter of CO₂ before 2010. (IEA 2007).

The CO₂ emissions associated with US-China trade

In the age of globalisation, are there linkages between trade and CO₂ emissions? The answer is yes. Trade can include the transportation of more than one thinks: goods, services, capital, and also CO₂ emissions.

According to the existing CO₂ accounting framework, CO₂ emissions resulting from the manufacture of a product are accounted for by the manufacturer/producer (in the country of origin) - not by the consumer (in the destination country). Therefore, when a country imports a product, it also "outsources" the related CO₂ to the exporting country.

In the case of the trade between the US and China, one can ask the following questions:

- 1) How much of China's carbon is emitted to meet final consumer demand in the US?
- 2) What quantity of CO₂ emissions has the US avoided emitting by trading with China?
- 3) What are the impacts of US-China trade on global CO₂ emissions?

Shui and Harriss have tried to answer these questions. Their research is based on US-China trade data¹ from 1997 to 2003 and an input-output approach², and has produced some interesting preliminary results (Shui and Harriss, 2006). The following sections give an overview, and raises questions for the future.

Figure 1: US Trade Deficits in Goods, 1987 -2006

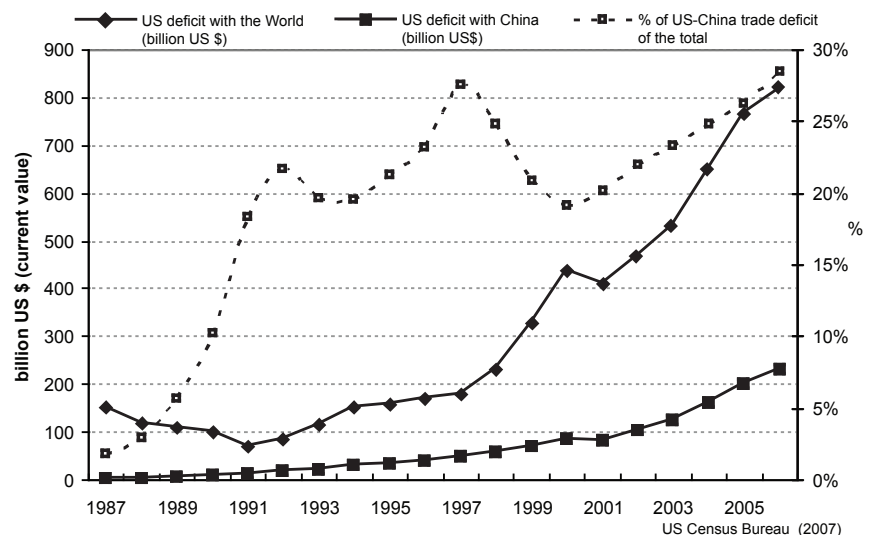


Table 1: Top 10 Exports in US-China Trade in 2003 Unit: billion US \$

Rank	Chinese Exports to the US		US Exports to China	
1	Other Computer Peripheral Equipment	11.4	Soybean	2.8
2	Audio and Video Equipment	9.9	Aircraft	2.2
3	Games, Toys, and Children's Vehicles	8.3	Semiconductor and Related Devices	2.0
4	Electronic Computers	5.6	Plastics Material and Resin	0.8
5	Institutional Furnitures	4.7	All Other Basic Organic Chemicals	0.8
6	All Other Miscellaneous	4.1	Cotton	0.7
7	Women's Footweares (except Athletic)	4.0	Other Computer Peripheral Equipment	0.7
8	Other Footweares	3.5	Meat	0.5
9	Printed Circuit Assembly (Electronic Assembly)	3.5	All Other Miscellaneous Machinery	0.5
10	Dolls and Stuffed Toys	3.3	Fertilizers	0.5
	Total of China's top 10 exports	58.4	Total of the top 10 US exports	11.6

CO₂ embodied in exports/imports

During 1997 to 2003, the top ten Chinese products exported to the US mainly comprised computers and their peripheral equipment, electronics, toys and clothing. The top ten US exports to China were more diverse, ranging from soybean, aircraft, semiconductors and computer peripheral equipment to fertilizers, as presented in Table 1. The US trade deficit with China during the study period rose from US\$49.7 billion to US\$124.0 billion, with an annual growth rate of 16.5 percent.

Mainly due to their large monetary value, the top five Chinese and US export products with the largest CO₂ embodiment pretty much fall into the same categories as when ranked by their trade value. For example, audio and video equipment (27.4 MtCO₂) and toys (25.7 MtCO₂) were the two Chinese exports with the largest CO₂ embodiment, and soybean (1.7 MtCO₂) and plastics materials (1.1 MtCO₂) were the US exports with largest associated CO₂ embodiment. Table 2 illustrates the top five Chinese and American exports with the highest associated CO₂ embodiment in 2003.

Shui and Harriss's study also revealed that the CO₂ embodiment of Chinese exports to the US has climbed from 213 MtCO₂ in 1997 to 497 MtCO₂ in 2003. This indicates that 6.8 percent and 13.3 percent of China's CO₂ in 1997 and 2003 were emitted to meet final demand in the US. The CO₂ embodiment of US exports to China was insignificant, 10 MtCO₂ in 1997 and

18 MtCO₂ in 2003, accounting for 0.2 percent of the US' annual CO₂ emissions during the same period.

"Avoided" CO₂ emissions in the US

It is well known that the US has suffered a vast trade deficit with China. The untold part of this story is that the US has avoided emitting a large amount of CO₂ within its shores because of its trade with other countries, including China. Had the US manufactured the same quantity of products domestically, its reported CO₂ emissions would be significantly higher than they are today.

The avoided CO₂ emissions due to the US-China trade (compared to US production of the same quantity of goods domestically) are significant and growing, in line with growing US imports from China. The avoided CO₂ emissions have risen from 150 MtCO₂ in 1997 to 358 MtCO₂ in 2003. The total avoided amount was 1,711 MtCO₂ during this period, about six percent higher than the emissions of the world's third largest CO₂ emitter, Russia, in 2003.

The top three Chinese exports which brought about the largest avoided CO₂ emissions for the US included audio and video equipment (21.2 MtCO₂), games and toys (19.8 MtCO₂), and computer peripheral equipment (15.0 MtCO₂).

The impact of US-China trade on global CO₂ emissions

The previous two sections have looked at the impacts of US-China trade on national emissions.

What is the impact of US-China trade at the global scale?

The CO₂ embodiment in audio and video equipment, the largest Chinese export to the US in 2003, is 27.4 MtCO₂. However, the CO₂ embodiment in the same quantity of audio and video equipment produced in the US would be 21,2 MtCO₂ - that is, 6.2 MtCO₂ lower. These figures suggest that CO₂ emissions from the manufacturing of a product in China are higher than the CO₂ emissions from producing the same product in the US, which is largely due to the relatively high use of coal and less efficient manufacturing technologies in the industrial sector in China.

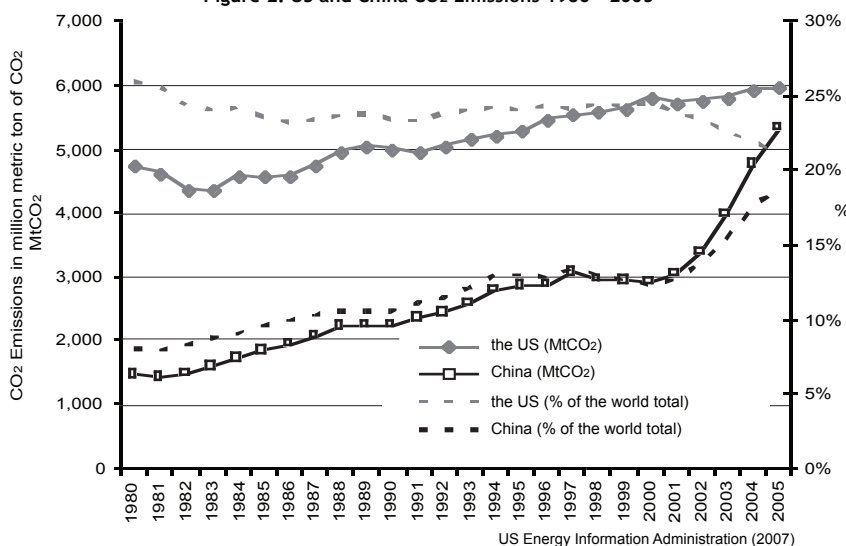
Figure 2: US and China CO₂ Emissions 1980 - 2005

Table 2: Top 5 Exports in US-China Trade, ranked by their CO₂ embodiment in 2003 Unit: MtCO₂

Rank	CO ₂ emissions embodied in Chinese exports	CO ₂ emissions embodied in US exports
1	Audio and Video Equipment 27.4	Soybean 1.7
2	Games, Toys, and Children's Vehicle 25.7	Plastics Material and Resin 1.1
3	Other Computer Peripheral Equipment 19.4	All Other Basic Organic Chemicals 1.1
4	Institutional Furniture 13.5	Fertilizers (Mixing Only) 0.8
5	Women's Footwear (except Athletic) 12.8	Aircraft 0.8
	<hr/> Total of China's top 5 exports 98.9	<hr/> Total of the top 5 US exports 5.5

Therefore, the "additional" global CO₂ emissions resulting from US-China trade during 1997-2003 would be 720 MtCO₂ in total, about 17 percent higher than Canada's total CO₂ emissions in 2003 (See Figure 3).

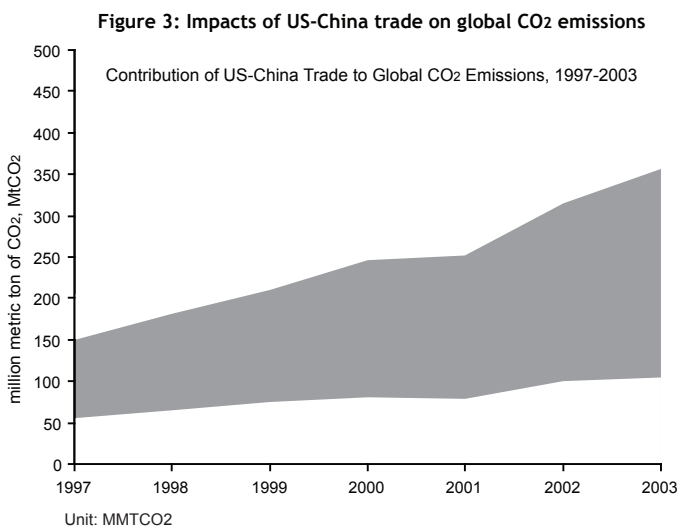
Concluding observations

Trade is a complicated and multifaceted issue. The economic, financial, political and social impacts of trade have been discussed at great length. Embodied carbon in trade is less well studied, and has remained rather "invisible" in current discussions of the linkages between trade and climate change.

In the case of the two global top traders - the US and China - the monetary imbalance has fueled political and economic arguments. The embodied carbon of their trade flows has not quite established itself as a talking point for these top two carbon emitters. The huge US trade deficit does help it reduce its domestic CO₂ emissions. For China, its rocketing trade surplus includes the cost of rising domestic and global carbon emissions.

There are now an increasing number of studies on carbon embodiment in trade. All indicate the significant role trade plays in national, regional and global CO₂ emissions (Antweiler, 1996; Wyckoff and Roop, 1994; Muradian et al., 2002; Peters and Hertwich, 2006; Weber and Matthews, 2007). Quantifying carbon and other pollutants associated with international trade will shed light on opportunities and priorities for implementing emissions mitigation programmes such as the successors to the Kyoto Protocol.

Deepening globalisation has ensured a need to address the significance of the carbon dimension of trade if we are really serious about finding a way to confront climate change.



Shui Bin is a researcher at the Joint Global Change Research Institute, USA, and Robert C. Harriss is president of the Houston Advanced Research Center, USA

Acknowledgements

The authors are grateful for the helpful reviews and comments received from Dr. Ronald D. Sands and Mr. Page G. Kyle at the Joint Global Change Research Institute.

References

- Antweiler, W. (1996). "The pollution terms of trade." *Econ. Syst. Res.* 8(4): pp 361-365.
- China Daily (2007). "Foreign exchange reserves swell to US\$1.43 trillion." http://www.chinadaily.com.cn/bizchina/2007-10/13/content_6171927.htm
- IEA (2007). "The World Energy Outlook 2006 Maps Out a Cleaner, Cleverer and More Competitive Energy Future." http://www.iea.org/textbase/press/pressdetail.asp?PRESS_REL_ID=187
- MNP (2007). "Chinese CO₂ emissions in perspective." Retrieved August 16, 2007, from <http://www.mnp.nl/en/service/pressreleases/2007/20070622ChineseCO2emissionsinperspective.html>.
- Muradian, R., M. O'Connor, et al. (2002). "Embodied pollution in trade: estimating the 'environmental load displacement' of industrialised countries." *Ecological Economics* 41(1): 51-67
- Peters, G. P. and E. G. Hertwich (2006). "Pollution embodied in trade: The Norwegian case." *Global Environmental Change* 16(4): 379-387.
- Shui, B. and R. C. Harriss (2006). "The Role of CO₂ Embodiment in US-China Trade." *Energy Policy* 34(18): 4063-4068.
- US Census Bureau (2007). "Foreign Trade Statistics." <http://www.census.gov/foreign-trade/www/>
- US Energy Information Administration (2007). "Total emissions from the consumption of energy." <http://www.eia.doe.gov/emeu/international/carbondioxide.html>
- Weber, C. L. and H. S. Matthews (2007). "Embodied Environmental Emissions in U.S. International Trade, 1997-2004." *Environ. Sci. Technol.* 41(14): 4875-4881.
- WTO (2006). *International Trade Statistics 2006*.
- Wyckoff, A. W. and J. M. Roop (1994). "The embodiment of carbon in imports of manufactured products: Implications for international agreements on greenhouse gas emissions." *Energy Policy* 22(3): 187-194.

Endnotes

- The data was provided by the US Department of Commerce.
- One of main models used is called the Economic Input-Output Lifecycle Assessment (<http://www.eiolca.net/about.html>).

The Effects of Climate Change Policies on International Trade and Competitiveness

By Muthukumara Mani

Efforts to reduce emissions to meet Kyoto and future climate targets have raised competitiveness concerns in countries implementing these policies, as well as fears that carbon-intensive industries will relocate to non-implementing countries.

This article examines the implications of climate change policies on competitiveness across industries, as well as issues related to leakage, if any, of carbon-intensive industries to developing countries.

Competitiveness

There is a widespread concern regarding the international competitiveness of major industries, especially in the energy-intensive sector, among countries that have undertaken measures to reduce greenhouse gas (GHG) emissions. They especially worry that higher energy costs not only burden them domestically, but also give competitors in countries without such measures (especially the US and China) an unfair advantage.

To test the hypothesis, we looked at the impacts of OECD measures to reduce GHG emissions on export competitiveness of energy-intensive sectors. The focus was on two types of instruments: (1) carbon taxes as a fiscal measure, and (2) energy efficiency standards as a regulatory measure. The reason for choosing these was that both have existed for quite some time in many countries, and hence their impacts on competitiveness are much more traceable than those of more recent emissions trading and voluntary regimes. While both carbon taxes and energy efficiency standards aim at reducing energy consumption, they use very different mechanisms to do so.

In a country that imposes a carbon tax (or a similar energy input tax), one would expect energy-intensive industries to suffer significant increases in production costs compared to those of their trading partners. Consequently, these industries would

either become less competitive internationally and lose some of their market share or, in order to avoid this loss, migrate to countries with no such taxes. In each case, exports of energy-intensive commodities hit with the carbon tax would decrease, while their imports would be expected to increase. Conversely, a carbon tax levied by an importing country would increase exports of the exporting country, thereby making it more competitive.

Similarly, the cost and time needed to comply with different energy efficiency programme requirements could add to the cost of internationally traded products. However, since such regulations in principle could be applied equally to imports and locally manufactured products, effects on trade in countries with higher energy efficiency standards could be nullified to some extent. On the other hand, it could adversely impact trade from countries with lower or no standards to countries that have higher efficiency standards.

Our results using an econometric modelling exercise show that when a carbon tax is imposed only by the importing countries, it adversely affects the competitiveness of exporting countries. This could be due to the offsetting measures applied by importing countries to mitigate and nullify the impact of such taxes on domestic industries. On the other hand, when a carbon tax is imposed by exporting countries, or by both importing and exporting countries, then the overall trade between countries increases. This suggests that subsidies and other exemptions for the energy-intensive industries may be overcompensating for the disadvantages arising from the imposition of the carbon tax. When we look at the effects of energy efficiency standards we find strong

Table: Impact of Carbon Taxes and Energy Efficiency Standards on Export Competitiveness

Measures	Carbon Tax (imposed by country)			Energy Efficiency Standards (imposed by country)		
	EXP	IMP	EXP and IMP	EXP	IMP	EXP and IMP
Carbon tax only		Marginally Significant (-)				
Energy Efficiency Standards only				Highly Significant (-)	Highly Significant (-)	Highly Significant (-)
Carbon Taxes and Energy Efficiency Standards		Marginally Significant (-)		Highly Significant (-)	Highly Significant (-)	Highly Significant (-)
Energy-Intensive Industries	Highly Significant (+)	Highly Significant (-)	Highly Significant (+)			
Industries Subject to Energy Efficiency Standards				Highly Significant (-)	Highly Significant (-)	Highly Significant (-)

negative effects on export competitiveness – irrespective of whether the standard is imposed by exporting countries, importing countries, or both.

When we examine how these policies affect specific industries that use energy intensively, the results suggest that the net effect varies considerably across industries. Trade competitiveness is adversely impacted by a carbon tax in the case of the cement industry, but the paper and steel industries actually benefit from a carbon tax. Similarly, energy efficiency standards mainly impact transport equipment and metal products industries.

The results emerging from our analysis suggest that carbon taxation policies do not impact on the competitiveness of energy-intensive industries. This suggests that complementary policies (implicit subsidies, exemptions etc.)—which are used in conjunction with carbon taxation policies levied by these countries, particularly on energy-intensive industries—could be negating any impact of carbon taxation. A more detailed study of this issue is warranted, as it will yield a greater understanding of the implicit subsidies/costs that are associated with each industry. The importance of this finding cannot be understated, as trade measures are justified based on perceptions of higher costs and associated loss of competitiveness on account of these costs on energy-intensive industries in developed countries.

Carbon Leakage

Many industrialised countries are concerned about the potential impact that mandatory carbon reduction targets would have on their economies. Among these concerns is the one that any plan that exempts developing countries from emissions limits would be ineffective because carbon-intensive industries would simply shift their operations to one of the exempt countries. A “leakage” would not only undercut the environmental benefits of the Kyoto Protocol or successor agreement; in addition, the competitiveness of industrialised-country industries could suffer.

Most emissions in industrialised countries result from inherently domestic activities such as transportation, heating, cooling and lighting, where leakage is either difficult or impossible. On the other hand, for energy-intensive industries such as cement, chemicals, and others, international competitiveness is an important concern. This leads to a debate somewhat akin to the “pollution havens” debate that dominated the environment literature in the 1990s.

Is such leakage really happening? We examined the evidence for any relocation of carbon-intensive industries due to more stringent climate policies, mostly in the OECD countries. We identified industries that would be most impacted by carbon reduction targets. These were energy-intensive industries—pulp and paper, industrial chemicals, iron and steel, nonmetallic mineral products, and nonferrous metals—that would have an incentive to relocate to avoid more stringent energy/carbon pricing policies.

When the actual data is examined on imports and exports across various income groups and regions since the 1990s, this provides some interesting results. The import-export ratio of energy-intensive production in high-income OECD countries shows an increasing trend (probably reflecting an increase in imports and decrease in exports). When the same ratio is examined for low- and middle-income developing economies, there is almost a mirror image of the OECD graph (Figure 1). This could be a reflection of some relocation of energy-intensive industries to developing economies, that did not impose any additional constraints on these industries on account of climate change.

Among the developing country regions we find an indication of some industrial relocation from the US, mainly to East Asia, and especially to China.

Our analysis suggests a gradual increase in the import-export ratio of energy-intensive industries in developed countries, and a gradual decline in the ratio in some developing regions. There is some evidence—although it is not very pronounced—of leakage of carbon/energy-intensive industries to developing economies that could be attributed to more stringent climate change policies and energy efficiency standards.

Implications

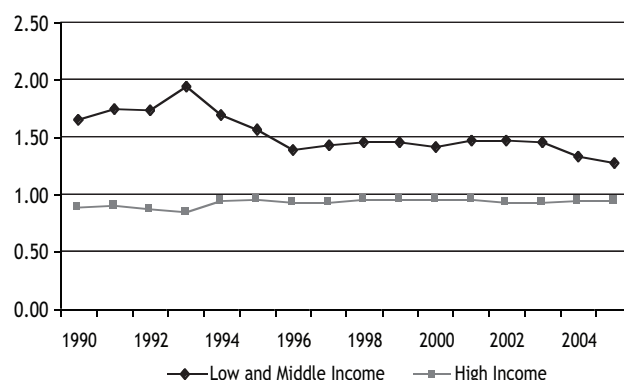
There is no conclusive evidence to suggest a loss in competitiveness from climate change measures adopted in OECD countries or of leakage or an exodus of carbon/energy intensive industries to developing countries. Developed countries have implemented various policies and measures to achieve their targets and showed some progress in mitigating climate change. However, in a number of cases economic considerations far outweighed climate considerations. Many of the incentives, especially for energy-intensive industries to reduce their emissions, have been nullified through special tax concessions, rebates, exemptions, and other such measures.

However, in the medium-to-long run, the increasingly stringent climate policies in some industrial countries and increased economic growth in some developing countries could accentuate the existing trends. The increased concentration of energy-intensive sectors in some developing countries, such as China and India, could signal not only for their greater future involvement in any global post-Kyoto scheme, but could also subject them to punitive trade sanctions for not participating in global efforts to address climate change.

While the implementation of the Kyoto Protocol may have brought to light some inherent conflicts between economic growth and environmental protection, the objectives of Kyoto also provide an opportunity for aligning development and energy policies in such a way that they could stimulate production, trade, and investment in cleaner technology options. Similarly, the WTO negotiations on environmental goods and services could potentially be used as a vehicle for broadening trade in cleaner technology options and thereby help developing countries to reduce their greenhouse gas emissions and adapt to climate change.

Muthukumara Mani is Senior Environmental Economist, The World Bank.

Figure 1. Import-Export Ratio of Energy-Intensive Products in High-Income OECD Countries and Low- and Middle-Income Economies



Border Measures to Address Climate Change-Related Competitiveness Concerns: EU and US Interests

By Thomas L. Brewer

This article describes developments in the EU and US concerning border measures, which could be imposed on imports from countries with policies that are considered insufficiently responsive to the need for climate change mitigation.

Abstractly, the underlying problem - in the terminology of political economy - is that there can be "free riders" on international agreements, including, as in this case, multilateral climate change agreements. The problem, in short, is that any given country can benefit from such an agreement without incurring the costs of participating in it. In particular, countries, industries and firms may fear that their international competitive position would be undermined by lower energy prices in non-participating countries. In the EU, these issues have arisen from time to time during the past several years with regard to US non-participation in the Kyoto Protocol. In the US, they have become salient during the past year with regard to emerging economy countries (especially Brazil, China and India).

This article considers these issues in three sections: activities in the EU, activities in the US, and scenarios for the future.

European Union

The European Parliament has passed resolutions calling upon the European Commission to consider the possibility of imposing offsetting tariffs on imports from countries that are not parties to the Kyoto Protocol.

The Commission's reaction has been to oppose such measures on the grounds that they risked exacerbating tensions in trade relations with the US, particularly at a time when trade relations were already strained and trans-Atlantic relations more generally were unusually conflicted over a broad range of issues. In addition, there were concerns that such measures would undermine support in the US for increased EU-US cooperation on climate change issues. Finally, there were concerns that such a tariff might be challenged in a WTO dispute settlement case, and the outcome of such a case would inevitably be uncertain.

However, before leaving office in 2007, French President Chirac and Prime Minister de Villepin suggested again that such measures be undertaken. European Trade Commissioner Mandelson responded, however, that this

would not be helpful. For now, the issue is quiescent at least in public. However, since it is of continuing concern to the European cement industry and other greenhouse gas-intensive industries, the issue is not likely to go away.

United States

Similar issues appeared in 2007 on the agenda in the US in the context of the introduction of climate change bills in the Congress. As in the EU, it is a combination of international competitiveness and climate change free-rider concerns that have put the issue on the active agenda in the US Congress.

As of the beginning of September 2007, the prospects for the many climate bills under consideration in the House and Senate were uncertain. However, whatever the outcome of votes in the two houses on these bills and any Presidential action that might ensue, it is clear that there is much political support for some kind of border measure provision in climate legislation that includes a mandatory cap-and-trade system.

There is a key difference in the form of the measure that is on the agenda in the US, as compared with the tariff proposal in Europe. In particular, the proposal in the US is to require US importers in some circumstances to purchase GHG emission allowances. Such a measure could be less vulnerable than a tariff to challenge in the WTO, because it could more clearly be considered an environmental measure that would qualify as an exception under GATT Article XX(g), which allows measures "relating to the conservation of exhaustible natural resources."¹

One US legislative proposal of special interest that was under consideration in September 2007 was Senate Bill S. 1766, which is commonly known as the Bingaman Bill or Bingaman-Specter bill after its sponsors. It includes Title V, "Periodic Review and International Leadership," which requires reviews every five years of "whether each of the five largest trading partners"² of the US has taken "comparable action" to limit GHG emissions (section 501(2)(B)(i)). "Comparable action" is defined

as “greenhouse gas regulatory programs, requirements, and other measures adopted by a foreign country that are determined by the President to be, in combination, comparable in effect to the action taken by the United States to limit greenhouse gas emissions pursuant to this Act, after taking into account the level of economic development of the foreign country” (section 502(a)(2)). US importers of “covered” GHG-intensive goods from countries that have been found not to have taken comparable actions must purchase “international reserve allowances” (i.e. GHG emission credits) to be issued by the US government. A “covered good” is one “that the President identifies, by rule, as a greenhouse gas intensive good that is closely related to goods, the cost of production of which in the United States is affected by this Act” (section 502(a)(5)).³

These and many other technicalities of the bill are of course subject to revision in Congressional deliberations and in any negotiations that may occur between members of Congress and the President. However, it is significant that quite specific and extensive language already has been formulated and is under active consideration in the Congress. It is also noteworthy that there would be much flexibility in how the provisions of the bill would be applied to particular circumstances. Further, the bill would require negotiations with countries before the import measures were implemented.

Perhaps more important than the legal technicalities or procedural issues at this point, is the political support already expressed for the concept of border measures on imports from countries deemed by the US government to be deficient in terms of actions to mitigate climate change in the future. Indeed, the proposal was first vetted jointly by one of the country’s largest electricity producers, American Electric Power, and one of the largest labor unions, The International Brotherhood of Electrical Workers. It has subsequently been endorsed by other major business and labour organisations. In short, the issue is now a significant item on the climate policy agenda in the US, and with much domestic political appeal.

Scenarios for the Future

As this article was being finalised in early September 2007, the US Congress was returning from a late summer recess, with a widespread expectation that at least some of the proposed climate legislation would progress to votes by the end of the year. Though not entirely out of question, the prospects were not promising for passage of such measures and acceptance by the President by the end of 2007. A more likely scenario is that there will be such legislation passed, signed and entering into effect in 2009 or 2010.

It is also likely that pressures to put in place some kind of import measures in the EU will grow as the debate and legislative process in the US progress. Ironically, the debate in the US will tend to legitimise any similar measures by the EU. Furthermore, the international competitiveness concerns in the EU are more advanced than in the US because the EU’s Emission Trading Scheme is already in operation, while any US national cap-and-trade system is still years from being operational. The precise form that such a measure would take in the EU, however, is uncertain. On the one hand, as noted above, there has already been movement towards the establishment of offsetting tariffs; on the other hand, certain features of the possible US measures, particularly in regard to challenges in the WTO, may make it more appealing to require GHG allowance purchases rather than to impose a tariff.

A third possibility that could emerge from present circumstances is that the EU and US would join together in an effort to develop border-measure provisions to be included in the post-2012 climate regime. Now that the concept has become part of the climate change dialogue in Washington as well as in Brussels, it would be natural for a trans-Atlantic dialogue, whether explicitly and officially endorsed or not, to expand as ideas for the post-2012 agenda become increasingly tangible and detailed.

Finally, the emergence of these issues makes abundantly clear that climate change issues and international trade issues have intersected. They will have to be addressed in a variety of climate and trade forums. One hopes they would be addressed in a way that is constructive for both climate change mitigation and international trade relations.

Thomas L. Brewer is Associate Professor, Georgetown University, Washington, DC and Associate Fellow, Centre for European Policy Studies (CEPS), Brussels.

¹ There are a variety of technical legal issues, which are beyond the scope of this short article, but which have been the subject of extensive analysis.

² In 2006, the top five US trade partners, *as measured by total trade (imports plus exports) of goods*, were: Canada, China, Mexico, Japan and Germany (“US Foreign Trade Statistics” of the US Census Bureau, accessed at www.census.gov/foreign-trade/statistics/highlights/top/top0706.html on 31 August 2007). In its present form, the bill provides for the first such review to be completed by January 1, 2016, from an inter-agency group to be established by January 1, 2013, by which time the trade partner rankings may obviously be different.

³ A second Senate bill, the Lieberman-Warner “America’s Climate Security Act” - as described by an “Annotated Table of Contents” released by the Senators on August 2, 2007 - was also expected to contain a border measure that would require US importers to purchase GHG allowances in some circumstances. However, because the bill had not yet been formally introduced as this article was being written, the details of the proposal were not yet known.

Patenting and Access to Clean Energy Technologies in Developing Countries

By John H. Barton

For the world to make the transition to a low-carbon economy, renewable energy technologies have to be made available globally at an unprecedented scale. One option often flagged is here allowing flexibilities in the intellectual property (IP) system to facilitate the spread of renewable technologies in developing countries. This article explores whether IP is the bottleneck.

This article focuses on three renewable energy sectors: solar photo-voltaic (PV), biofuels and wind energy. It concentrates on more advanced developing countries, such as Brazil, China, and India.

In the politically-sensitive pharmaceutical sector, patents often have a substantial impact on price, as there may be no substitutes for a new product. In contrast, in the renewable energy sectors considered in this article, the basic technological solutions have long been off-patent. Usually, only specific improvements or features are patented. Thus, a number of competing patented products exist - and as a result of the competition, prices are usually brought down as compared to the royalties and the price increases that would be charged under a monopoly. In addition, there is competition not only between firms within a specific renewables sector, but also between the sectors and alternate sources of fuel or electricity. As a result, much of the benefit of the technologies is shared with the ultimate customers.

Another characteristic of the PV, biomass and wind sectors is that some of the renewable energy technologies, particularly PV technologies, are not yet inexpensive enough to compete without some form of subsidy or regulation (such as a feed-in law requiring that a portion of the electricity on a grid be supplied from renewable sources). Moreover, firms have been hesitant to invest in substantial research on their own, except in areas with significant subsidies - as seen in the current ethanol boom in the US. Hence, much of the research in these areas is funded by the government. At least in the US, the subsidised research will almost certainly end up protected by patent rights. When the research is licensed, a certain amount of favouritism is, by law, to be shown to US manufacturers.

Renewable energy markets

There are three types of markets for renewable energy capabilities for developing nations. The most obvious one is the market for enabling the nation itself to reduce its CO₂ emissions (not currently required by international law, but possibly required in the future). The second is the market for providing carbon offsets under the clean development mechanism (CDM) under the Kyoto

Protocol. Both these markets can be served by importing products incorporating the technology, e.g. photovoltaic panels for off-grid electrical supply.

The third type of market is for renewable products, such as biofuel (or conceivably electricity), and equipment, such as wind turbines, in which the developing country industry can become integrated into the global industry as a supplier. For this type of market, the nation must license the capability to produce such products, perhaps in an indigenous firm or in a joint venture between a local firm and a developed country firm. Alternatively, it can develop the national capacity to research and produce the products independent of a foreign licensor.

The photo-voltaic sector

Basic PV technology involves manufacture and treatment of a silicon slice used to create electricity when illuminated by the sun. There are a number of PV firms, organised in a loose oligopoly; the leading 5 firms make up about 60 percent of the market. Hence, the benefits of the basic (silicon-slice) technology are likely to be available to developing countries even in the face of patents. If developing country firms wish to enter the field as producers, they are likely to obtain licenses on reasonable terms because of the large number of firms in the sector. The possibility of entry is demonstrated by Tata-BP Solar, an Indian firm based on a joint venture, and Suntech, a Chinese firm. Suntech has not only been able to develop its own technologies but has also purchased developed country firms.

Biofuel technology

Typical biofuel technology is based on the conversion of sugar or maize into ethanol, but there are many other ways to convert biomass into fuels. In this context, again, developing countries have reasonably good access to current technologies. Indeed, Brazil has long been a leader. The questions become more challenging with regard to future biofuel technologies. There are government and venture-capital funded efforts underway to develop new processes, enzymes, or microorganisms for producing biofuel - particularly by breaking down lignin, an important component of many plants that is not now readily available for fuel use. There will be many patents

in these areas. Nevertheless, production is necessarily decentralised and there is competition among biofuel manufacturing methods and between alternative fuels. Hence, it again seems likely that the holders of patents in this area will be willing to license their technology, and the licensing fees for these technologies are unlikely to remain high for very long. The key barriers encountered by developing countries will probably not be related to IP, but to the tariffs and other trade barriers against the international sugar and ethanol markets. For example, the US has a tariff in place on Brazilian ethanol - which is cheaper, both economically and environmentally - than US maize-based ethanol.

The wind sector

The wind sector is more concentrated than the PV sector - here 4 firms make up roughly 75 percent of the industry. The sector is, however, competitive enough to allow developing nations to build wind farms incorporating equipment from the global market without enormous IP costs. It could be more difficult for developing nations to enter the global market for wind turbines, however. The current industrial leaders are strong, and are hesitant to share their technology out of fear of creating new competitors. There have been significant patent battles in this sector in the US. In addition, the engineering aspects of technology transfer have sometimes proven difficult. Nevertheless, both China and India have succeeded in building major firms over the last 10 years. The leading Indian firm has been buying developed country competitors.

Exports, firm purchases and IP

There do not seem to be significant IP barriers hindering the world from the benefiting from reduced CO₂ emissions in developing countries. When it comes to developing country opportunities to enter the export markets for PV cells, ethanol (or other renewable fuel) and wind engines, the picture is slightly more mixed. Certainly, for ethanol, the key concerns would relate to tariff and similar barriers, not IP barriers. For PV, the IP system is unlikely to be a significant barrier. For wind energy, there is some ground for concern, but again, IP problems would probably be minor.

The world is also seeing a new technology transfer mechanism in the form of developing countries purchasing developed country firms. However, there is a simultaneous risk of global concentration, particularly in the wind sector, so the world should be alert to the risks of cartel behaviour.

The three renewable energy sectors discussed above serve as examples of other important questions developing countries are facing. Should they strengthen their IP protection in order to make foreign investors more willing to transfer technology? The evidence from these sectors suggests a possibility that stronger IP would help in the more scientifically advanced developing nations,

and offers little indication of risks associated with such strengthening. (The answer may be different in poorer nations.)

The role of subsidies

The three sectors examined also underline the importance of public support for new technologies. The economics of renewable energy often requires support if the technology is to be developed. Developed country governments are likely to seek to ensure that national firms are favoured in the process of licensing technology that has benefited from support at the development stage. Part of the political basis for the support is the hope of helping national manufacturers. This builds a bias against developing nations.

It is possible to eliminate this bias by asking developed countries to agree to forego their national favouritism by licensing publicly funded inventions, at least with respect to technologies of global environmental importance. This would be quite similar to the "humanitarian clauses" being considered in the medical and nutritional areas. It would be far better to go even further - for developed countries to commit themselves to devote a portion of their technology development to the special needs of developing countries and to ensure that developing country firms have the opportunity to participate in the efforts.

Such arrangements could be negotiated in either of two ways. The first would entail commitment to make technology more readily available within the climate change negotiations. This could take the form of a quid-pro-quo for stronger environmental constraints upon developing nations. Making this work would require a stronger technology transfer commitment than has been typical for global environmental agreements. The other approach would be to create a stand-alone technology arrangement, with the quid-pro-quo based on reciprocity among research funders.

Removing trade barriers

Finally, the most important task would be to remove unnecessary barriers to trade in renewably sourced fuels, and perhaps in the future in renewably sourced electricity. Unless the world moves to a global carbon tax, renewable energy subsidies are essential. However, current subsidies are often designed in response to domestic concerns, particularly domestic agricultural concerns, and may end up discriminating against developing countries. Subsidies should ideally be redesigned so as not to distort trade or discriminate against developing country firms. A more equitable structuring of environmental market intervention would itself create stronger incentives for technology transfer to developing nations.

John H. Barton is George E. Osborne Professor of Law, Emeritus, at Stanford University

Food Miles, Fair Miles Debate: Global Trade Implications

By Malena Sell, ICTSD

Certain African developing countries have captured high-value niche markets in developed countries by air freighting fresh produce during the northern winter. They want to retain their right to grow, including trade-led growth.

The bulk of internationally traded goods are transported by water, roads and rail - aviation, however, also plays an important and growing role. As consumers have become increasingly concerned about the 'carbon footprint' of the food they eat, this has sparked debate about 'food miles' - i.e. the impact of transporting food from the producer to the consumer. The issue has prompted campaigns for buying local and leaving fresh produce or cut flowers flown in from developing countries out of the shopping bag.

While it is true that the climate impact of aviation is massive as compared to other modes of transport, the source of air-freighted products makes a difference.

What are fair miles?

In addition to food miles, one could think of 'fair miles.' Developing countries argue that their overall emissions are much lower than those of the importing countries, which should start by cleaning up their own act. In addition, these vulnerable countries are already experiencing the impacts of climate change and have limited capacities to adapt.

The Kenya High Commission in London has been highly critical of the food miles concept. Directly and indirectly, its emergent perishable goods industry supports one million Kenyans. Therefore, the country has launched a campaign dubbed 'Grown under the Sun' to inform British consumers about the development benefits associated with sourcing fresh produce from Kenya. Speaking out in support of the campaign, UK Trade and Development minister Gareth Thomas noted that "driving around six miles to a supermarket to buy some Kenyan green beans emits the same amount of carbon as air-freighting that pack of green beans."

An International Institute for Environment and Development (IIED) commentator suggested that developed-country consumers "should focus their behaviour change on the remaining 99.9 percent of their climate-change footprint, by reducing things such as energy use and leisure flights."

Organic goods and air freight

The organic goods industry has been scrutinising the food miles and fair miles issue in detail. The Soil Association, a leading certifier of organic products in the UK, recently said it would continue to certify air freighted fresh produce from developing countries. The decision came with strings attached - the agricultural products would also have to adhere to strict ethical standards.

According to the Soil Association, emissions of greenhouse gases related to air freighted goods are 177 times greater than those associated with marine transport, and the group had been considering whether to stop labelling products based on their carbon footprint.

The organisation had been conducting a four-month consultative process, with participants stressing the need to consider the wider emissions context, including the full supply chain for both imported and local organic products in any comparison.

The Soil Association is pushing exporters to seek alternatives to air freighting whenever possible, its chairwoman, Anna Bradley, said. She noted that "It is neither sustainable nor responsible to encourage poorer farmers to be reliant on air freight, but we recognise that building alternative markets that offer the same social and economic benefits as organic exports take time."

The Soil Association will be working on the standards over 2008, so they can come into effect in 2009. The exporters would be obliged to comply with the additional ethical standards by 2011.

Exporters weary of additional hurdles

Reactions to the Soil Association announcement were mixed. Development charity Oxfam welcomed the decision, noting the benefits of applying fair trade standards. Duncan Green, head of research at Oxfam, stressed that "curbing greenhouse gas emissions is an urgent and vital task, but rich countries should start by putting their own houses in order, not by effectively boycotting poor ones."

Alexander Kasterine, an expert on trade and development at the International Trade Centre (ITC) said, however, that the Soil Association was missing the point. He said "Food transport has nothing to do with working conditions of farm workers, and only a small proportion of these exporters are currently using fair trade or ethical trade standards." Meeting additional standards would imply additional costs in the future.

The aviation sector

The aviation sector contributes around two percent of global carbon dioxide emissions. However, when indirect effects from other pollutants as well as cloud formation are added, aviation contributes up to nine percent of radiative forcing, or global warming effect. Aviation is also one of the fastest-growing sectors. Emissions have doubled since 1990 and are projected to further grow by 3.5 percent annually.

The aviation industry is heavily subsidised, starting with development and manufacture. Major disputes at the WTO have involved such subsidies, pitting Brazil and Canada against each other over support to Embraer and Bombardier, and the US currently challenging subsidies paid to Europe's Airbus, and Europe simultaneously going after subsidies paid to US manufacturer Boeing. Airports are also subsidised, while international tickets and jet fuel are exempt from taxes.

SELECTED ICTSD ISSUE PAPERS

Trade and Environment

Goods and Services and Sustainable Development: Domestic Considerations and Strategies for WTO Negotiations. Policy Discussion Paper, 2007.

Technology Transfer Issues in Environmental Goods and Services: An Illustrative Analysis of Sectors Relevant to Air-pollution and Renewable Energy. Issue Paper No. 6 by Lynn Mytelka, 2007.

Building Supply Capacity for Environmental Services in Asia: The Role of Domestic and Trade Policies. Issue Paper No. 5 by Aparna Sawhney, 2007.

An Overview of Key Markets, Tariffs and Non-tariff Measures on Asian Exports of Selected Environmental Goods. Issue Paper No. 4 by Rokiah Alavi, 2007.

Trade in Environmental Services: Assessing the Implications for Developing Countries in the GATS. Issue Paper No. 3 by Colin Kirkpatrick, 2006.

Options for Liberalising Trade in Environmental Goods in the Doha Round. Issue Paper No. 2 by Robert Howse and Petrus von Bork, 2006.

Dispute Settlement and Legal Aspects of International Trade

Compliance and Remedies against Non-Compliance under the WTO System: Towards A More Balanced Regime for All Members. Issue Paper No. 3 by Virachai Plasai, 2007.

Access to Justice in the WTO: The Case for a Small Claims Procedure, A Preliminary Analysis. Issue Paper No. 2 by Håkan Nordström and Gregory Shaffer, 2007.

Appeal Without Remand: A Design Flaw in the WTO Dispute Settlement System. Issue Paper No. 1 by Joost Pauwelyn, 2007.

Trade in Services and Sustainable Development

Opportunities and Risks of Liberalising Trade in Services: Case Study on Bangladesh. Issue Paper No. 3 by Ananya Raihan and Mabroor Mahmood, 2007.

Opportunities and Risks of Liberalising Trade in Services: Case Study on South Africa. Issue Paper No. 2 by Ian Steuart and Rashad Cassim, 2005.

Subsidies, Services and Sustainable Development. Issue Paper No. 1 by Marc Benitah, with David Vivas-Eugui, Alexander Werth and Mahesh Sugathan, 2005.

Intellectual Property Rights and Sustainable Development

Intellectual Property and Competition Law: Exploration of Some Issues of Relevance to Developing Countries. Issue Paper No. 21 by Carlos Correa, 2007.

Intellectual Property Provisions in European Union Trade Agreements: Implications for Developing Countries. Issue Paper No. 20 by Maximiliano Santa Cruz S., 2007.

Maintaining Policy Space for Development: A Case Study on IP Technical Assistance in FTAs. Issue Paper No. 19 by Pedro Roffe and David Vivas with Gina Vea, 2007.

New Trends in Technology Transfer: Implications for National and International Policy. Issue Paper No. 18 by John H. Barton, 2007.

Fisheries, International Trade and Sustainable Development

Fisheries, International Trade and Sustainable Development. Policy Discussion Paper, by ICTSD, 2006.

Aquaculture: Issues and Opportunities for Sustainable Production and Trade. Issue Paper No. 5 by Frank Asche and Fahmida Khatun, 2006.

Market Access and Trade Liberalisation in Fisheries. Issue Paper No. 4 by Mahfuz Ahmed, 2006.

Trade and Marketplace Measures to Promote Sustainable Fishing Practices. Issue Paper No. 3 by Cathy Roheim and Jon G. Sutinen, 2006.

Fisheries Access Agreements: Trade and Development Issues. Issue Paper No. 2 by Stephen Mbithi Mwikya, 2006.

Trade and Sustainable Energy

The WTO and Energy: WTO Rules and Agreements of Relevance to the Energy Sector. Issue Paper No. 1 by Julia Selivanova

Linking Trade, Climate and Sustainable Energy. Selected Issue Briefs, 2006.

These and other ICTSD resources are available at <http://www.ictsd.org/pubs/series.htm>.

ICTSD's project on Trade and Sustainable Energy aims to promote pro-sustainable development perspectives for a transition to sustainable energy production and consumption by brokering new and innovative knowledge on trade-related opportunities and challenges. The project aims to:

- Support the transition to a sustainable energy future by providing relevant stakeholders in different policy processes with innovative analysis regarding opportunities and challenges in the trade and sustainable energy nexus;
- Generate policy-oriented and solutions-focused knowledge on the interface between the multilateral trading system and various regimes and initiatives promoting the transition to a sustainable energy future;
- Expand the knowledge community on trade and sustainable energy by including non-traditional actors and view-points in the debate, including oil producers, climate scientists, agricultural economists, specialists in services trade, labour and consumer organisations; and
- Support existing capacity-building efforts through knowledge outputs and dialogues, particularly for poor countries and disadvantaged communities.

For further information, visit www.trade-environment.org

ABOUT ICTSD

Founded in 1996, the International Centre for Trade and Sustainable Development (ICTSD) is an independent non-profit and non-governmental organisation based in Geneva. By empowering stakeholders in trade policy through information, networking, dialogue, well-targeted research and capacity building, the Centre aims to influence the international trade system so that it advances the goal of sustainable development.