Fostering Low Carbon Growth: The Case for a Sustainable Energy Trade Agreement

November 2011

ICTSD Global Platform on Climate Change, Trade and Sustainable Energy

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International Centre for Trade and Sustainable Development

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The paper builds mostly on ICTSD work undertaken since 2008, including a model sustainable energy agreement discussed and presented in the contexts of the WTO, the UNFCCC, the Global Green Growth Forum in Copenhagen, October 2011, and the World Economic Forum's Global Agenda Councils initiative, in response to its proposed 2010 SEFTA.

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ICTSD welcomes feedback on this document. These can be forwarded to Mahesh Sugathan, smahesh@ictsd.ch

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List of Abbreviations and Acronyms

AFV	Alternative Fuel Vehicle
ARRA	American Recovery and Reinvestment Act of 2009
BIT	Bilateral investment treaty
BNEF	Bloomberg New Energy Finance
CCS	Carbon dioxide capture and storage
CDM	Clean Development Mechanism
CET	Clean Energy Technology
CO_2	Carbon dioxide
COP	Conference of the Parties
CSC	Committee on Specific Commitments
ECT	Energy Charter Treaty
EGs	Environmental Goods
EPA	Environmental Protection Agency
EPIA	European Photovoltaic Industry Association
EPAct	Energy Policy Act of 1992
EPO	European Patent Office
EU	European Union
Euratom	European Atomic Energy Community
EuroStat	Statistical Office of the European Community
FDI	Foreign Direct Investment
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariffs and Trade
GHG	Greenhouse Gas Emissions
GPA	Government Procurement Agreement
Gt.	Gigatonnes
HS	Harmonised System
ICE	International Electro-technical Commission
ICTSD	International Centre for Trade and Sustainable Development
IEA	International Energy Agency
ILO	International Labor Office

ILUC	Indirect Land Use Change
IPCC	Intergovernmental Panel on Climate Change
ITA	Information Technology Agreement
kW	kilowatts
LCR	Local Content Requirement
MFN	Most Favoured Nation
MW	Megawatts
NAMA	Non-agricultural Market Access
NAMAs	Nationally Appropriate Mitigation Actions
NTB	Non-tariff Barrier
OECD	Organisation for Economic Cooperation and Development
PPA	Power Purchase Agreement
PPMs	Processes and Production Methods
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
RED	Renewable Energy Directive
REN	Renewable Energy Network
RFS	Renewable Fuel Standard
RPO	Renewable Purchase Obligation
SCM	Agreement on Subsidies and Countervailing Measures
SEGS	Sustainable Energy Goods and Services
SETA	Sustainable Energy Trade Agreement
TBT	Technical Barriers to Trade Agreement
UN	United Nations
UN CPC	UN Central Product Classification
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USD	United States Dollars
VAT	Value-Added Tax
WEO	World Energy Outlook
WTO	World Trade Organization
WWF	World Wide Fund for Nature

Foreword

Climate change is an unprecedented challenge facing humanity today. Given that fossil fuel-based energy use is the biggest contributor to anthropogenic greenhouse gas emissions, a rapid scale up and deployment of renewable or sustainable energy sources could significantly reduce the emissions responsible for global warming. A switch to cleaner and low-carbon transport fuels and technologies could also make a positive contribution toward achieving this goal.

Energy efficiency measures represent a 'low hanging fruit', as far as climate mitigation potential is concerned, and will entail the rapid deployment and use of energy efficient equipment and energy management practises. These measures will also contribute to energy security for countries that rely on fossil fuel imports, the supply of which may diminish or become unreliable in the future.

Efforts to scale up sustainable energy require power producers to keep sustainable energy generation costs as low as possible. While incentives such as feed-in tariffs and tax breaks help, lowering the costs of equipment and services used to produce sustainable power could also play a critical role in facilitating the scale up process.

Trade policy can contribute in this regard by lowering barriers to market access for sustainable energy goods and services. Often, however, trade and domestic sustainable energy policies could also be designed to restrict access to competitively priced goods and services for sustainable energy producers. This is because policymakers, while striving to lower the costs of sustainable energy production, also often seek to promote the domestic manufacturing of renewable energy equipment and the provision of services. In addition, the sustainable energy sector is also seen by many policymakers as a potential engine for job creation.

Balancing these objectives may be difficult, however, especially when policymakers still need to win local support for sustainable energy policies from their constituents. Local manufacturing and employment-driven motivations may also trigger protectionist policies for goods and services connected to energy efficiency or sustainable transport.

Trade and diffusion of energy efficient products and technologies may be hampered by diverse or conflicting technical standards and lack of harmonisation or mutual recognition efforts. Trade in cleaner transport fuels and technologies could be affected by a range of domestic policy measures, such as subsidies and product standards. While addressing trade barriers and ensuring a more open and fair trade regime for sustainable energy, policymakers will also need to be mindful of developing country concerns with regard to development priorities and access to technologies.

This paper addresses some of the most critical and challenging issues in the trade and sustainable energy interface. It highlights the diversity of trade-related barriers in sustainable energy goods and services that arise as a consequence of both trade as well as domestic sustainable energy policies.

Effectively addressing these market barriers will require a holistic and integrated approach that may not be feasible within the present framework of trade, energy, and climate-related regulatory barriers and institutions. This is because of various institutional and context-specific reasons, such as the fragmented and ambiguous nature of many existing World Trade Organization (WTO) agreements and rules, lack of effective and operational provisions both within and outside the WTO in several cases, and even the non-inclusion of key countries that matter within existing regulatory frameworks on trade as well as energy.

The current stalemate in the WTO Doha negotiations, along with the 'single undertaking' approach that requires trade-offs and links among a widely divergent set of issues, may also be working against effectively addressing critical and sensitive energy-related issues and barriers as part of a formal WTO 'negotiating round'.

In such a scenario, the paper argues that it may be worth looking at the possibility of a Sustainable Energy Trade Agreement as a stand-alone initiative that could address these barriers and enable trade policy to advance climate change mitigation efforts and increase sustainable energy supply.

This agreement could be initially pursued as a plurilateral option, either within or outside the WTO framework. It could serve to catalyse trade in sustainable energy goods and services while seeking to address the needs and concerns of participating developing countries, many of which may not be in a position to immediately undertake ambitious liberalisation in sustainable energy goods and services.

This paper was conceived and written by an ICTSD team comprised of Ricardo Meléndez-Ortiz, Mahesh Sugathan, Ingrid Jegou, Christophe Bellmann, Malena Sell, and Joachim Monkelbaan. It builds on ICTSD work that has been undertaken since 2008, including the mapping of key climate-friendly goods, the identification of trade-related drivers and barriers, and the development of a model sustainable energy agreement that has already been discussed and presented in the contexts of the WTO, the United Nations Framework Convention on Climate Change (UNFCCC), and the World Economic Forum's Global Agenda Councils initiative.

This paper was produced under ICTSD's Global Platform on Climate Change, Trade and Sustainable Energy. One of the objectives of this Platform is to identify trade policies that contribute to a rapid diffusion and transfer of clean technologies around the world and provide new incentives for innovation and investment in climate-friendly technologies.

We hope that you will find the paper to be a thought-provoking, stimulating, and informative piece of reading material and that it proves useful for your work.

Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

Executive summary

The transition to a low-carbon economy will require the replacement of conventional fossil fuel-based energy sources by sustainable ones as fossil fuels are a major contributor to greenhouse gas (GHG) emissions. It will also entail the deployment of energy efficiency measures in both conventional power generation and end-use sectors, such as buildings, industry, and transport, in addition to the deployment of cleaner, low-carbon transport fuels and technologies. Such measures will also contribute to reducing countries' dependence on certain types of fossil fuels whose supplies may be unreliable or diminishing.

Globally, as the Intergovernmental Panel on Climate Change (IPCC) has noted, energy supply is the largest single source of greenhouse gas emissions. The challenge to de-carbonise production and economic activity comes at a time of rapid expansion in energy demand, and in a context in which half of the world's population currently has no access to modern forms of energy.

In 2004 conventional energy supply and its related use in the buildings, industry and transport sectors were responsible for about 70 percent of global GHG emissions. More recent estimates from the International Energy Agency (IEA) placed such emissions at a record high of 30.6 Gigatonnes (Gt.) in 2010 alone, making the targets set by the international community to limit climate temperature rise to a maximum of 2 degrees centigrade (36 degrees Fahrenheit) extremely difficult to meet.

Indeed, for the "pathway to be achieved, global energy-related emissions in 2020 must not be greater than 32 Gt. This means that over the next ten years, emissions must rise less in total than they did between 2009 and 2010," the IEA notes. Non-clean energy sources - i.e. fossil fuels - currently account for about 80 percent of emissions worldwide, and existing infrastructure and projects in construction are estimated to already lock-in to 2020 approximately 20 percent of those emissions.[2]

The geographical distribution of GHG emissions is highly heterogeneous, as is energy consumption. While they only host a fifth of the world's population, 40 percent of emissions continue to be generated in OECD countries, and 40 percent of energy demand is located there. Meanwhile, 75 percent of the growth in emissions in 2010 came from an energy-deficient developing world that is experiencing long-term economic growth trends.

The UN has declared 2012 as the International Year of Sustainable Energy for All, and its Advisory Group on Energy and Climate Change - composed of major energy companies and UN agencies - has recommended universal access and a 40 percent increase in energy efficiency in the next 20 years. If these recommendations are implemented, this could reduce global energy intensity by 2.5 per cent per year, approximately double the historical rate.

Cutting energy-related emissions in half by 2050 would require deep de-carbonisation of the power sector. To maintain the same level of output, fossil fuel use would need to be offset by sustainable energy; the largest increase, according to the World Bank's 2010 World Development Report, would have to come from renewable energy sources

The World Bank report illustrates the enormous magnitude of the effort to increase the share of low-carbon energy to 30-40 percent by 2050 from present levels of 13 percent. This would imply, over the next 40 years, deploying annually an additional: 17,000 wind-turbines (producing 4 megawatts [MW]each hence 68000 MW annually); 215 million square metres of solar photovoltaic panels, 80 concentrated solar power plants (producing 250 MW each); and 32 nuclear plants (producing 1000 MW each). As an example of comparison for wind, the biggest capacity addition in wind energy since 1995 happened during 2008-2009 when close to 40000 MW was added, according to the World Wind Energy Association.

A positive development, however, has taken place in the area of financial new investment in renewable energy, which has been growing steadily. A number of studies have also highlighted the greater job-creating potential for sustainable energy as compared to the fossil-fuel sector.

Sustainable energy, for the purposes of this paper, includes **solar, wind, small-scale hydro and biomass-related fuels, technologies and services,** but could broadly encompass any energy source that has the potential to mitigate greenhouse gas emission. Sustainable energy usually has a high relative price compared to conventional fossil fuel energy. This disparity stems partly from the fact that there is no proper pricing mechanism for carbon or the negative environmental externalities associated with fossil fuel use. A further burden on sustainable energy is imposed through subsidies provided to fossil fuels by governments worldwide.

Domestic policies aimed at encouraging the development of sustainable energy usually focus on regulatory and fiscal measures such as renewable portfolio standards or on fiscal incentives such as tax-credits. Such measures reduce both investment and production-related costs for renewable energy producers. Domestic sustainable energy promotion policies also work to increase consumer demand, either through a system of incentives such as tax reduction on solar home equipment or regulations such as mandatory purchase requirements. A similar set of policies can also influence the supply of, and demand for, sustainable transport fuels and technologies.

For a sustainable energy power plant, the upfront technology and capital equipment costs coupled with the costs associated with support services constitute a major portion of the overall expense burden. While many governments seek to bring down the costs of sustainable power, they may also simultaneously try to meet other policy objectives. These objectives include creating a manufacturing base for sustainable energy equipment and generating local jobs.

While synergies are possible, it can become difficult for policymakers to balance these often-conflicting objectives. It may be difficult, for instance, to seek sustainable power production at the lowest cost possible when power producers are facing import restrictions on technologies and equipment of the quality and prices they desire.

Global manufacturing and services companies operate through a complex network of supply chains. These chains allow companies to optimise production costs by sourcing components and services from their most efficient production/supply locations. Hence, policies that prevent or constrain supply chain optimisation increase costs, and consequently prices, for sustainable energy goods and services (SEGS).

Domestic sustainable energy policies as well as trade-policies can both create barriers for supply chain optimisation in the sustainable energy sector. Some of these measures (such as tariffs) may be de-jure trade restrictive, while others may have a de-facto trade restrictive impact in the way that they are designed or implemented. On the other hand, many broader policies supportive of sustainable energy, such as the removal of fossil-fuel subsidies, may also have a positive impact on trade in SEGS.

Non-tariff trade-related barriers to SEGS are diverse. They can range from domestic support measures for biofuels to export restrictions on critical raw materials as well as restrictions on the modes by which services are supplied across borders. Local content requirements are one policy that many countries use to create domestic jobs in sustainable energy manufacturing, specifically by mandating the use of locally-made components or technologies in sustainable energy projects. Countries may also link incentives or subsidies to power producers to the use of local equipment. Such measures have already triggered trade disputes at the World Trade Organization (WTO) and, should their use spread, may generate further trade friction. Other domestic sustainable energy policies may have no foreseeable impact on trade. A number of countries that are amongst the greatest emitters of greenhouse gases both on an absolute as well as per capita basis also figure amongst the top exporters and importers of these goods.

Other trade and market barriers could be sparked by domestic laws and measures linked to investment, government procurement, competition policy and trade facilitation, or possibly by their absence. A great diversity of product-related standards or, on the contrary, an absence of standards could also `hamper trade and diffusion of renewable energy equipment, as well as energy efficient products.

It is imperative, therefore, for countries interested in facilitating diffusion and access to SEGS to start addressing these trade-related barriers. Trade in SEGS is affected by rules and disciplines that have been developed in multilateral, plurilateral, regional, and bilateral forums. This includes the WTO as well as other regional trade agreements and bilateral investment treaties. In addition trade in SEGS is further impacted by the negotiating and rule-making fora set up to address the broader issue of climate change, such as: the United Nations Framework Convention on Climate Change (UNFCCC) and the Energy Charter Treaty which deals with issues of energy transit.

The use of certain types of barriers can be addressed through existing WTO rules or potentially as part of the Doha Round of trade negotiations. However, while WTO disciplines and rules could be invoked in certain cases, they are often ambiguous as far as the energy sector is concerned. For example, a comprehensive and universally accepted classification of energy services, including sustainable energy services, is missing in the WTO nomenclature. Liberalisation negotiations for such services will involve diverse sectors such as engineering, construction, maintenance and consultancy. This could lead to an incoherent approach within WTO negotiations and ineffective outcomes as far as meaningful market access for sustainable energy services is concerned.

Doha negotiations on environmental goods (including those relevant to trade in sustainable energy equipment) have been bogged down by differences between members over scope and coverage, as well as the modalities of liberalisation. Services negotiations too have been making extremely slow progress. Issues that were originally on the table for negotiations, such as investment, competition policy, and transparency in government procurement were dropped from the Doha negotiating agenda following the lack of an 'explicit consensus' at the WTO Ministerial Conference in Cancun in 2003. The Doha Round as a whole is presently stalled, following a lack of agreement in a number of critical areas, such as non-agricultural market access (NAMA) – i.e. manufactured goods. The 'single-undertaking' approach of the WTO, whereby 'nothing is agreed until everything is agreed', makes it very difficult in current circumstances to address energy-related issues as part of a large and comprehensive set of multilateral trade negotiations.

A major forum outside the WTO relevant to sustainable energy is the UNFCCC negotiating framework. This framework, however, faces challenges of its own and may not be the appropriate place to negotiate trade rules and to introduce operational provisions for addressing trade and market barriers to SEGS. Another Forum could be provided by the Energy Charter Treaty (ECT), especially since it covers transit and investment-related provisions on energy. However, membership in the ECT is not universal and excludes many countries that matter. Important emerging countries, including China and India, are not yet part of the ECT. Furthermore, at a substantive level the ECT addresses issues of transit and investment related to energy, but has no framework to trade-related concessions on SEGS. Individual regional or bilateral trade agreements may also be limited in terms of membership and may not include important countries that matter for SEGS trade.

All these factors indicate that it is worthwhile to consider a fresh approach that takes a holistic and integrated view of the sustainable energy sector, while simultaneously addressing a variety of market and trade-related barriers. A Sustainable Energy Trade Agreement (SETA) could be a way to bring together countries interested in addressing climate change and longer term energy security while maintaining open markets. Numerous possible pathways could be conceived for such an agreement in terms of structure, as well as the scope of issues and market barriers to be addressed.

A SETA could be a stand-alone plurilateral agreement similar to the Government Procurement Agreement (GPA) at the WTO. Alternatively, it could extend concessions on a most favoured nation MFN) basis to all WTO Members, similar to the Information Technology Agreement (ITA), with such an extension made conditional on the accession of a 'critical mass' of Members based on various trade, climate, or energy-related criteria.

A SETA could also be conceived as a stand-alone plurilateral agreement outside of the WTO, the advantage in this case being that membership would also be open to other, non-WTO Members. There could also be a possibility of eventually incorporating such an agreement into the WTO framework at some point in the future. If concluded outside the WTO, Members would need to clarify the agreement's relationship with existing WTO rules and agreements, including with regard to any dispute settlement mechanisms.

Numerous possibilities also exist with regard to the manner in which the scope of issues and market barriers could be addressed within a SETA. Issues could be addressed in two phases, with a first phase addressing clean energy supply goods and services, starting with solar, wind, small-hydro and biomass and eventually extending to marine, geothermal, clean coal, and transport-related biofuels. A second phase could address the wider scope of energy efficiency products and standards, particularly those related to the priority sectors identified by the Intergovernmental Panel on Climate Change (IPCC) for GHG mitigation: buildings and construction, transportation, and manufacturing. Negotiators could take up issues as a 'cluster' or proceed incrementally on an issue by issue agenda.

Each of these approaches has its own pros and cons. Whatever the approach adopted, negotiators should ensure that the 'development dimension' is reflected in the modalities, including special and differential treatment for developing countries as well as meaningful provisions on facilitating access to climate-related technologies, technical assistance, and capacity building.

While not a 'silver bullet' remedy for all the trade-related issues and challenges on sustainable energy, a SETA might facilitate alternative or innovative approaches to liberalising sustainable energy goods and services. It could provide an environment conducive to assessing the linkages between sustainable energy goods and energy services, and serve as an ideal 'laboratory,' where rules and disciplines pertaining to sustainable energy could be clarified and take shape.

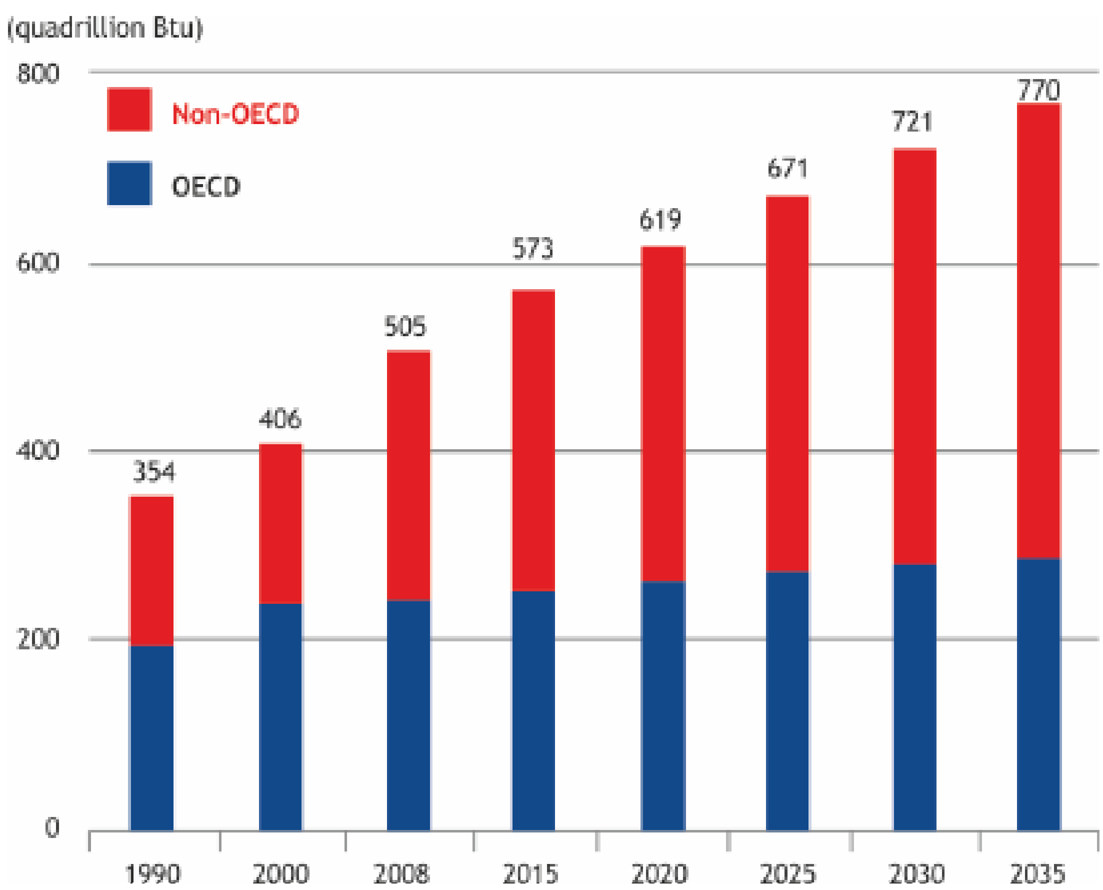
In addition to its catalysing effect on world trade in a sector of huge importance to global climate mitigation efforts, such an agreement could constructively inform, and perhaps even shape the course of future negotiations and work at the WTO as well as the UNFCCC.

Introduction

The Challenging Road Ahead

The challenge to de-carbonise our economies, especially given the rapid expansion of energy consumption (projected at 25 percent every ten years[3]) has made it imperative for countries and communities to undertake a major scale up in the use of clean energy sources and technologies. This is only set to increase as the half of the world's population that currently has no access to modern forms of energy develops. Non-clean energy sources – i.e. fossil fuels – currently account for about 80 percent of emissions worldwide. In 2004 conventional energy supply and its related use in the buildings, industry and transport sectors contributed about 70 percent of total global greenhouse gas (GHG) emissions. More recent estimates from the International Energy Agency (IEA) placed such emissions at a record high of 30.6 Gigatonnes (Gt.) in 2010. This makes the targets set by the international community to limit climate temperature rise to a maximum of 2 degrees centigrade (36 degrees Fahrenheit) extremely difficult to meet. Indeed, for the "pathway to be achieved," global emissions per annum must not exceed 32 Gt. in 2020. "This means that over the next ten years, the growth of emissions must be smaller in total than the increase in the amount of GHGs emitted between 2009 and 2010."[4] It is thought that existing infrastructure and other buildings projects have already locked-in 20 percent of those emissions before 2020.

Figure 1: World Energy Consumption (1990-2035)



Source: International Energy Outlook 2011, US Energy Information Administration (EIA), 19 September 2011.

The geographical distribution of GHG emissions is highly heterogeneous, as is energy consumption. The OECD countries only host a fifth of the world's population yet contribute 40 percent of global emissions. Meanwhile, 75 percent of the growth in emissions in 2010 came from outside the OECD. Much of the developing world has been experiencing a long-term economic growth trend which has meant that there has been consequential and significant rise in energy demand. The UN Secretary General, Ban Ki-moon, at the World Energy

Summit in January 2011 succinctly voiced these concerns when he noted that, "Our challenge is transformation. We need a global clean energy revolution – a revolution that makes energy available and affordable for all." The UN has reacted by declaring 2012 as the International Year of Sustainable Energy for All. The UN Advisory Group on Energy and Climate Change – composed of major energy companies and UN agencies – has recommended universal access and a 40 percent increase in energy efficiency over the next 20 years. Should these recommendations be implemented; this would reduce global energy intensity by 2.5 percent per year, which is approximately double the historical rate.

The recent 16th session of the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP) in Cancun agreed on a shared long-term vision, this included a goal to limit average global temperature warming below 2 degrees Celsius when compared to pre-industrial levels. The conference further recognized the need to strengthen this goal, based on scientific advancements, and to consider a 1.5 degree Celsius goal at a future date. For the moment, pledges to meet mitigation goals have been agreed on a country-by-country basis. This "bottom up" approach may eventually make monitoring and verification mandatory for developed economies. While there are no binding targets for developing countries, they have pledged to undertake nationally appropriate mitigation actions (NAMAs) as well as report on their progress in meeting national climate targets or actions. Developing countries are also encouraged to develop low-carbon strategies or plans in the context of sustainable development.

Given that conventional fossil fuel-based energy use is a major driver of GHG emissions; the transition to a lower-carbon economy will necessitate a move away from fossil fuel-based energy use to sources of sustainable energy. The future-orientated nature of this structural change, in the way that energy is generated, means that governmental policies should reflect this and attempt to anticipate the patterns of future energy demand. As this increased demand is most likely to originate in the developing world, the high relative cost of sustainable energy remains a significant barrier to enabling this shift. The price difference between sustainable energy and fossil fuels is aggravated by the current lack of a pricing mechanism to account for the negative externalities of carbon. A further burden on sustainable energy is imposed through subsidies, provided by governments worldwide, which artificially lower the cost of fossil-fuels.

The upfront technology and capital equipment costs as well as the associated support services for a sustainable energy power plant constitute a major investment with a heavy cost burden. Without any support, this would require sustainable power prices to be sufficiently high so as to recoup these costs.

Trade-related barriers can play a major role in artificially inflating costs and impeding a power firm from competitively sourcing both the equipment and capital it needs. The reality of global supply chains means that necessary equipment, their components, as well as various related services may need to be sourced from a number of different countries. This is because certain countries will be better placed to produce different types of equipment and services both in terms of quality and cost.

The strategic nature of the energy sector' could lead many countries to pursue development of domestic manufacturing capacities or to attract Foreign Direct Investment(FDI) with a view to securing long-term availability of equipment at competitive prices. This might however prompt them to pursue policies that could, at least in the short to medium-term, be trade restrictive. Consequently, such policies would have the effect of constraining market access opportunities for other states.

Possible Solutions?

There is therefore a need to tread as fine a balance as possible between these competing objectives of accessing low-cost power, creating domestic employment, and building indigenous capacities; all the while, doing so in a manner that does not constrain legitimate market opportunities for trading partners. It is crucial that the sustainable development goals and priorities of developing countries be kept in mind. This paper sets forth the case for a Sustainable Energy Trade Agreement (SETA) that can address these various issues and concerns while concurrently enabling a trade-friendly response to climate change mitigation that is focused on lowering sustainable energy-related costs. The authors will assess the existing institutions and multilateral and regional regulatory frameworks that could address this, all the while highlighting where these may not be able to respond to the urgency of the situation nor be broad enough to include key actors, issues or sectors.

Outline

The paper begins in Chapter 1 by providing the reader with a contextual background on the subject – namely the urgency of climate change mitigation and how sustainable energy measures can advance mitigation efforts. It also analyses the geography of emissions so as to underscore which countries will need to be involved in sustainable energy-related policy initiatives from a climate mitigation perspective.

Chapter 2 analyses recent trends in production and investments related to sustainable energy, including a breakdown of these trends by both sector and geography. This section also highlights the fact that, in spite of the challenges in scaling up investment flows, the investment climate in renewable energy looks increasingly bright, particularly in countries that matter for climate mitigation. Chapter 3 underscores the importance of domestic policies and regulation in promoting the uptake of both sustainable energy and sustainable transport. It draws attention to the diverse policy objectives - such as employment generation and economic recovery - that these policies are aimed toward, in addition to the primary goals of climate change mitigation and energy security.

Chapter 4 examines the interface between trade and sustainable energy policies. It draws attention to the reality of supply chains in the sustainable energy production landscape. This section also outlines the key issues and challenges posed by trade and domestic sustainable energy policies, particularly with regards to trade flows in sustainable energy goods and services. It also highlights the restrictive effects of certain policies, as well as the lack of clarity in certain existing rules and disciplines governing trade.

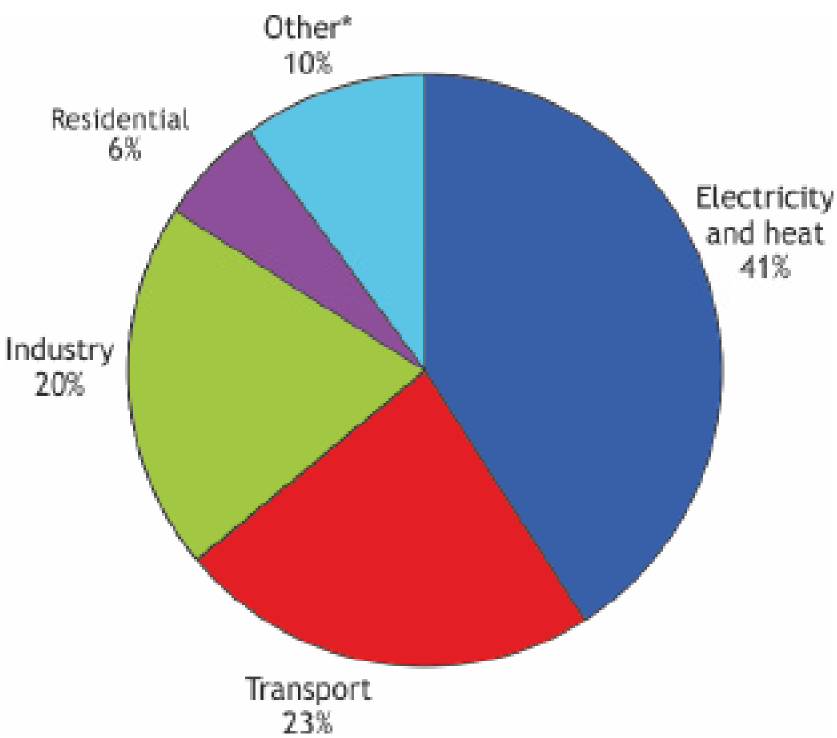
Chapter 5 examines some of the governance gaps within existing multilateral and plurilateral frameworks - gaps that, if addressed, could potentially resolve the issues and challenges posed in Section 4. It notes the deficiencies within existing regulatory frameworks and institutions, particularly in terms of addressing sustainable energy as part of a broader package of issues for trade negotiations. The paper concludes that an agreement focusing on trade in sustainable energy will provide this vital issue area the 'regulatory push' needed to address trade and related domestic policy barriers. The paper sets forth possible pathways and options that such an agreement could take with regards to structure, scope of issues, and market barriers, along with any additional considerations that are important from a trade and sustainable development perspective.

Chapter 1

The Relevance of Sustainable Energy in Climate Change Mitigation

In advancing mitigation efforts, non-fossil energy sources will play an important role, as will greater efficiency in the use of fossil fuels. A rapid scale-up and deployment of sustainable energy sources - which for the purposes of this paper will be defined as **solar, wind, small-scale hydro and biomass-related technologies and services** - can make a significant dent in the growth of GHG. As Figure 2 reveals, generation of electricity and heat was by far the largest producer of CO_2 emissions and was responsible for 41 percent of the world CO_2 emissions in 2009. This was followed by transport (at 23 percent), industry (at 20 percent) and the residential sector (at 6 percent), with other contributing around 10 percent. Thus the combined share of electricity and heat generation together with transport represented nearly two-thirds of global emissions in 2009.[5]

Figure 2: World CO_2 Emissions by Sector in 2009

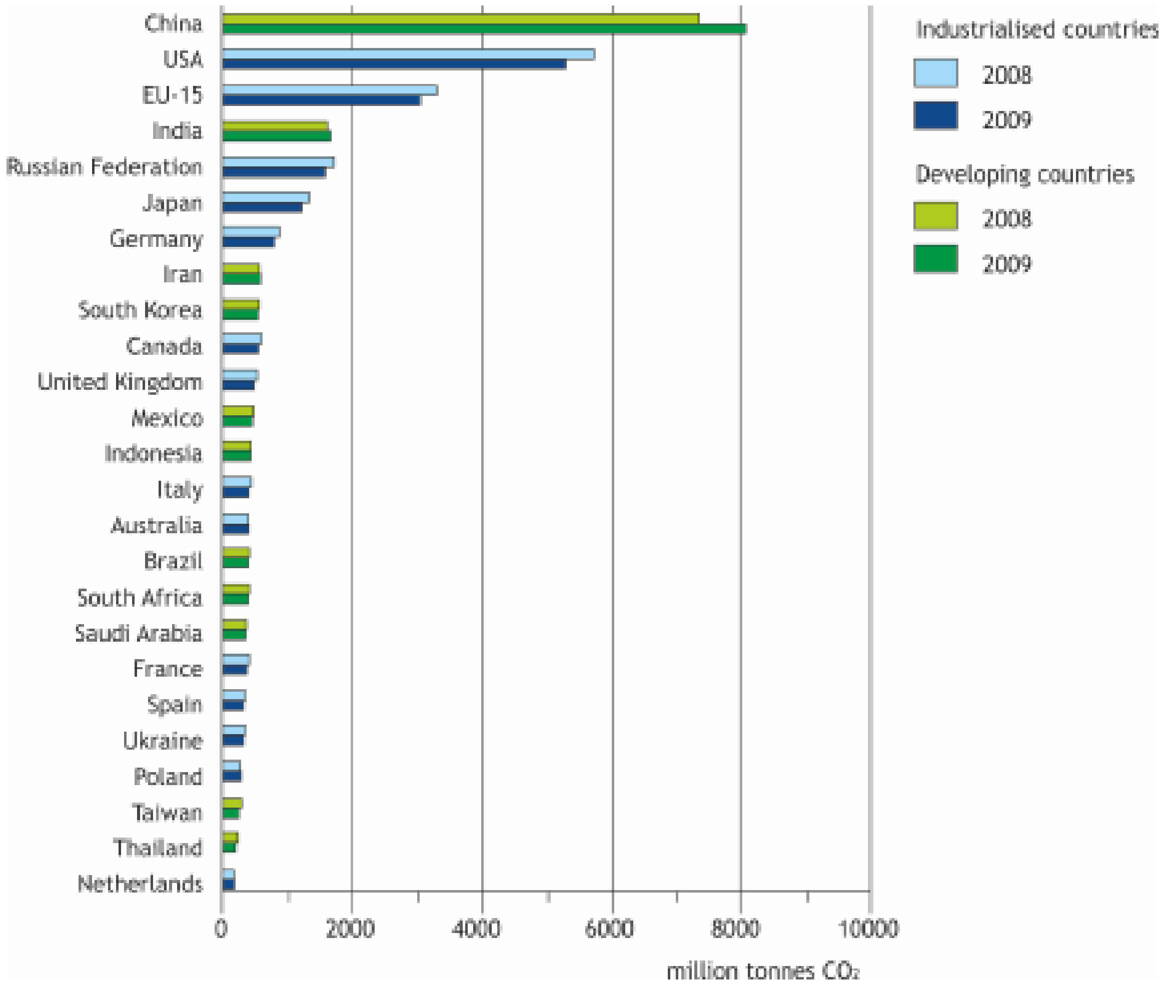


Other sectors include commercial/public services, agriculture/forestry, fishing, energy industries (other than that of electricity and heat generation) and other unspecified emissions.

Source: International Energy Agency (IEA), CO_2 Emissions from Fuel Combustion: Highlights, 2011.

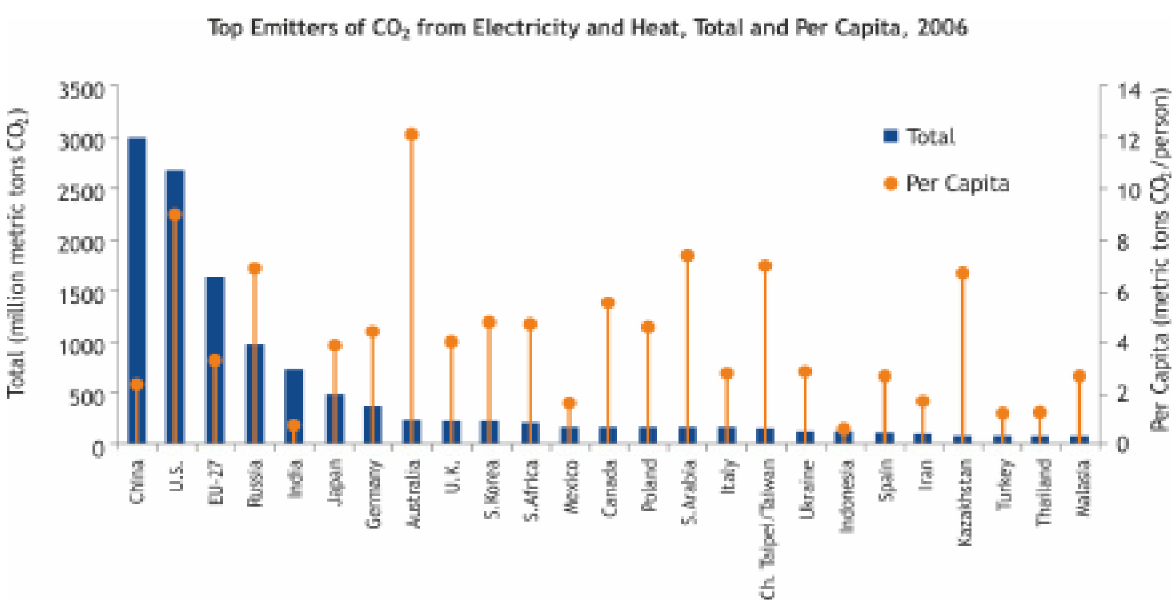
From the perspective of this paper, it is also important to understand the geography of emissions growth by source, as this gives an indication of which sectors should be addressed on a priority basis and which countries need to be involved in any agreement on sustainable energy. Figure 3 below shows the top 25 emitters of GHGs as a whole; Figure 4 shows the ranking according to electricity and heat-related emissions.

Figure 3: Top 25 of the Largest CO_2 Emitting Countries in 2008 and 2009



Source: Olivier J. G. J, Peters, A. H. W. "No growth in total global CO_2 emissions in 2009," Netherlands Environmental Assessment Agency, 2010.

Figure 4: Top Emitters of CO_2 from Electricity and Heat, Total and Per Capita in 2006



Source: World Resources Institute, 2010. Accessed via EarthTrends Delivered - http://earthtrendsdelivered.org.

Both in terms of overall CO_2 emissions and emissions from electricity and heat (that contribute the bulk of global CO_2 emissions) it is clear that the major emitters comprise the OECD, as well as fast-growing developing economies such as China and India. According to a recent IEA report, two-thirds of global emissions for 2009 originated from just ten countries, with the shares of China and the United States far surpassing those of all others. Combined, these two countries alone produced 12.0 Gt CO_2 or 41 percent of world CO_2 emissions.[6]

Developing countries certainly require greater energy in order to meet their developmental and poverty alleviation goals, but from a global environmental perspective these figures also underscore the need to enable these countries (along with the developed world) to switch to cleaner, more sustainable forms of energy, as well as to switch to energy-efficient goods.

Understanding the geography of emissions is also important from an international policy perspective. The reality is that only a small number of countries in the world account for the bulk of global GHG emissions. Identifying high-emitting countries that are members, or not, of any particular international treaty or agreement will facilitate an understanding of the way these countries may be constrained, or not, in introducing and implementing policies on energy production and use. These constraints in turn will play an important role in shaping the trajectory of global emissions at least in the near to mid-term future (allowing for the possibility of other, newer countries to emerge as major energy-consumers and emitters in the longer run).

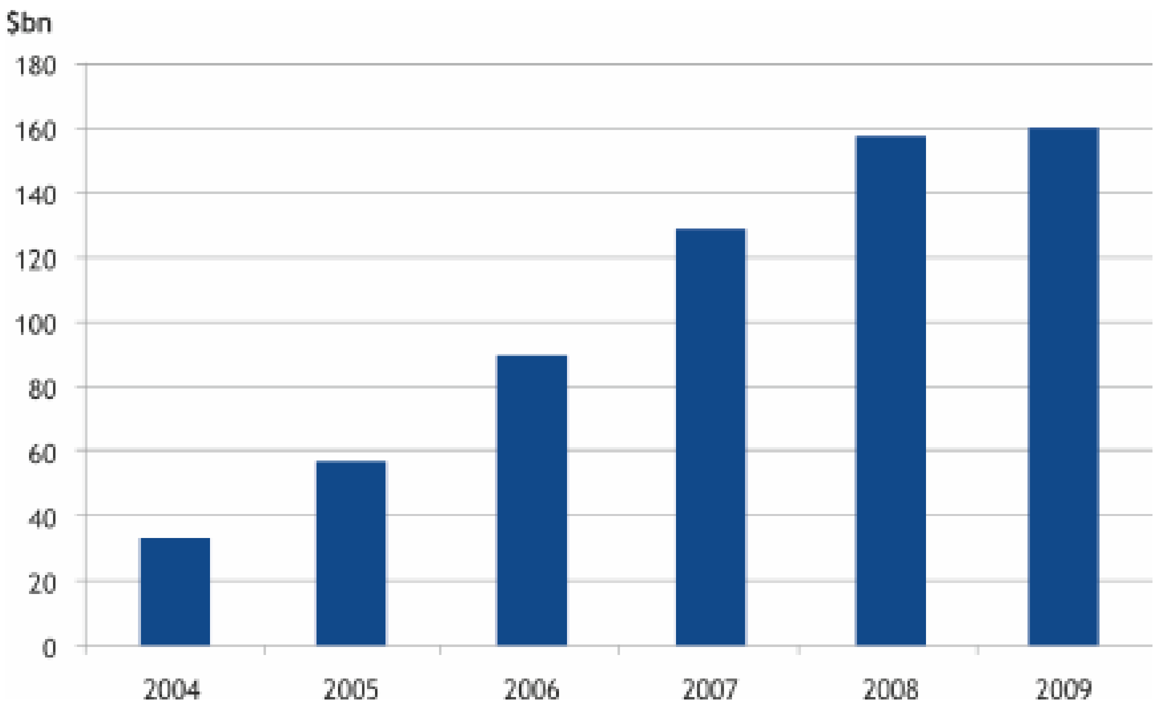
Chapter 2

Overview of the Global Market and Challenges to Scaling up Sustainable Energy

Cutting energy–related emissions in half by 2050 would require deep de-carbonisation of the power sector. This reduction in fossil fuel use would need to be offset by both sustainable and nuclear energy (which, while being low-carbon, is not considered as sustainable energy for the purposes of this paper); the largest increase, according to the World Bank's 2010 World Development Report, would have to come from renewables. To increase the share of low-carbon energy from 13 percent as of present to 30-40 percent by 2050 would imply an effort of enormous magnitude. Over the next 40 years, it would imply an addition *each year* of 17,000 wind-turbines (producing 4 megawatts [MW] each), 215 million square metres of solar photovoltaic panels, 80 concentrated solar power plants (producing 250 MW each) and 32 nuclear plants (producing 1000 MW each). De-carbonisation of the power sector will also help reduce life-cycle emissions in the case of presently available transport-related technologies that rely on electricity (such as electric locomotives), as well as future ones such as electric cars that will increasingly draw upon the electric grid for their energy needs.

All indications are that the environment for sustainable energy growth - defined for the purposes of this paper as heat and electricity produced from solar, wind, small-scale hydro, and biomass - is more favourable than it has ever been before. Renewables are witnessing rapid growth worldwide and are rising in importance relative to other forms of energy. Investment in sustainable energy grew 230 percent from 2005 to 2009 and USD 162 billion was invested globally in 2009 in sustainable energy.[7] This further increased to USD 211 billion in 2010.[8] However it must be borne in mind that a slip towards deeper recession in major world economies could dampen future investment inflows as well as government support for renewables.

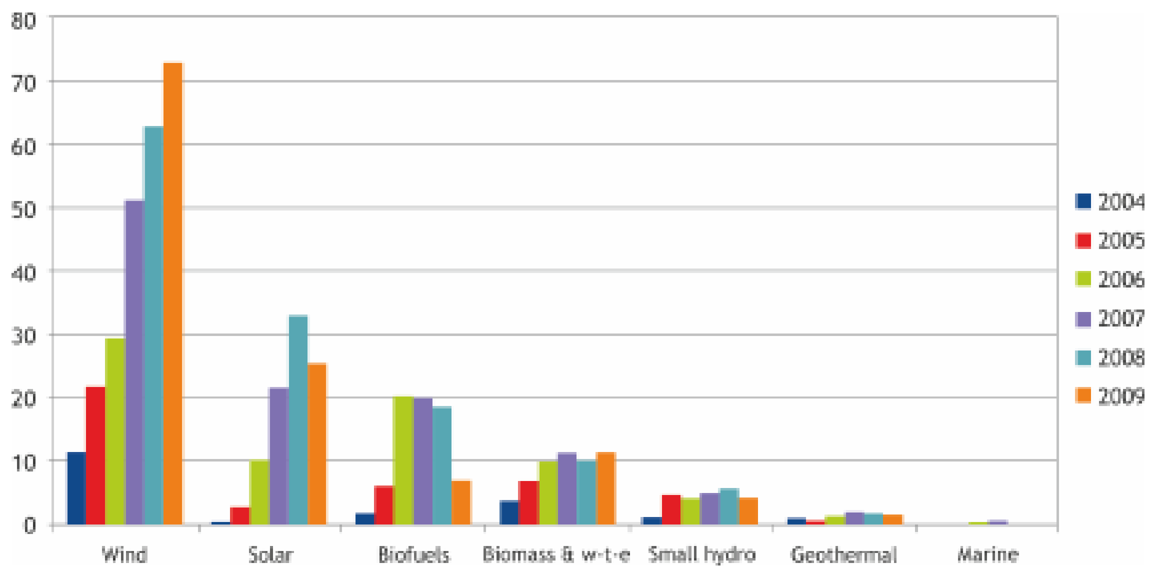
Figure 5a: Total New Investment into Renewable Energy - Global Trends (2004-2009) in USD billion



Source: ICTSD Analysis based on UNEP and Bloomberg New Energy Finance, 2011, Global Trends in Renewable Energy Investment 2011: Analysis of Trends and Issues in the Financing of Renewable Energy.

Renewables contributed about one-fourth of global power capacity from all energy sources and delivered 18 percent of global electricity supply in 2009. Investment in new sustainable energy capacity in both 2008 and 2009 represented over half of total investment in new power generation.[9] Grid-connected solar photovoltaic (PV) power, for instance, witnessed a 100-fold increase since 2000. Between 2005 and 2009, wind power grew 27 percent annually, solar hot water by 19 percent and ethanol by 20 percent. Figure 5B provides a breakdown of financial new investment by technology from 2004-2009. The landscape is clearly dominated by wind-power investments as the figure shows.

Figure 5b: Financial New Investment by Technology (2004-2009) in USD billion

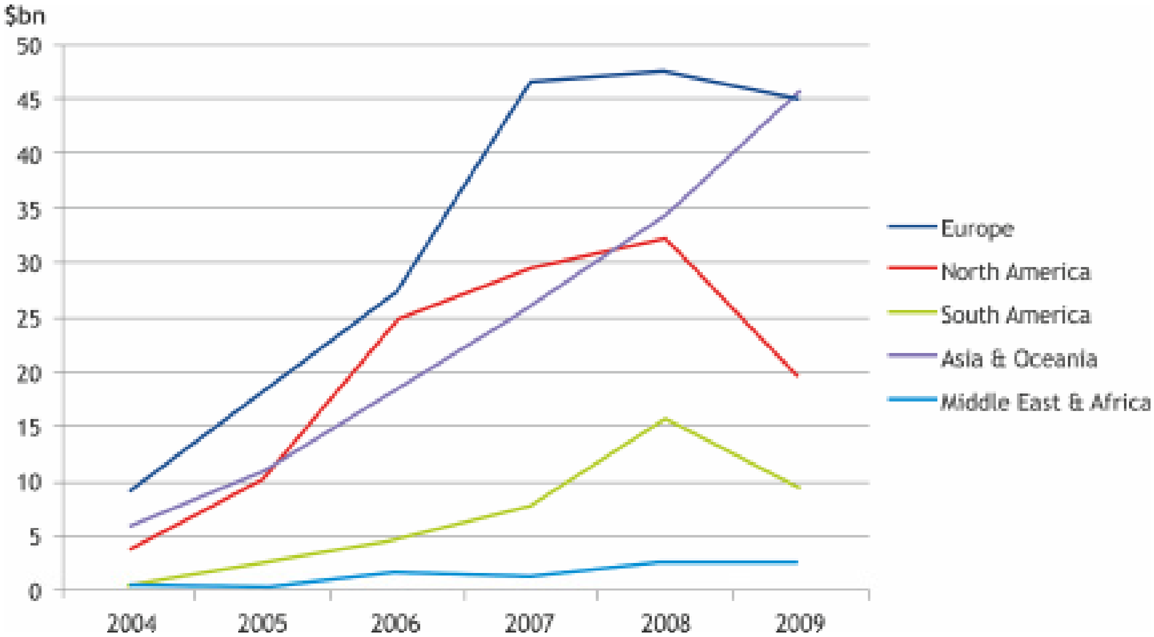


Source: ICTSD Analysis based on UNEP and Bloomberg New Energy Finance, 2011, Global Trends in Renewable Energy Investment 2011: Analysis of Trends and Issues in the Financing of Renewable Energy.

Over a quarter of greenfield investments in alternative/renewable power generation were in developing economies. While the majority of these investments flowed to developed economies, over a quarter were in developing economies. Notable recipients included Brazil, Chile, China, India, Indonesia, Morocco, Pakistan, Peru, Philippines, South Africa, Tunisia, Turkey, Viet Nam and Zambia. As compared to greenfield investments, cross-border mergers and acquisition operations in renewables, on the other hand, are concentrated in a handful of countries (primarily Brazil, China, India and Turkey). This reflects the dearth of companies with advanced renewable power generation technologies in renewable electricity generation in many developing economies.[10]

Brazil, China, and India today figure amongst the top 10 countries in the world in terms of the volume of new financing in sustainable energy. With a combined USD 44.2 billion in 2009, 37 percent of global financial investment in clean energy flowed to these countries.[11] In 2010, developing economies overtook developed ones for the first time in terms of 'financial new investment,' comprised of spending on utility-scale renewable energy projects and provision of equity capital for renewable energy companies. Figure 5C provides a regional breakdown of new investment by region. As the figure shows, Europe is clearly dominant in terms of new investment flows between 2004-2009 but with a decline in recent years and the Asian region fast catching up.

Figure 5c: Financial New Investment by Region (2004-2009) in USD billion



Source: ICTSD Analysis based on UNEP and Bloomberg New Energy Finance, 2011, Global Trends in Renewable Energy Investment 2011: Analysis of Trends and Issues in the Financing of Renewable Energy.

In 2010, USD 72 billion was invested in developing countries, compared to USD 70 billion in the developed world. China accounted for the bulk of this, attracting USD 48.9 billion worth of investment in 2010. The US came second with USD 25 billion, an increase of 58 percent over 2009. Financial new investment in South and Central America increased 39 percent from 2009 to USD 13.1 billion. In the Middle East and North Africa, investment grew by 104 per cent to USD 3.8 billion, and nearly tripled to USD 6.2 billion in Latin America, with the exclusion of Brazil. India gained 25 per cent, with investment rising to USD 3.8 billion in 2010, and Asian developing countries – excluding China and India – saw increases averaging 31 percent to USD 4 billion.[12]

Developing countries collectively account for more than half of sustainable power capacity. China leads in several indicators of market growth. India is fifth worldwide in total existing wind power capacity. Markets for sustainable energy are also growing rapidly in a number of other developing countries, such as Argentina, Costa Rica, Egypt, Indonesia, Kenya, Tanzania, Thailand, Tunisia, and Uruguay, among others.[13] Figures 5 (a-c) above and Tables 1-4 below reflect these trends and also clearly bring out the importance of the G-20 countries in terms of growth of renewable energy investment as well as installed capacity. It is heartening that many of these countries also figure amongst the top CO_2 emitters shown earlier in this paper.

Table 1: Top Ten Countries in Sustainable Energy Capacity (in Gigawatts [GW]) (2009)

United States	53.4
China	52.5
Germany	36.2
Spain	22.4
India	16.5
Japan	12.9
Rest of EU-27	12.3
Italy	9.8
France	9.4
Brazil	9.1

Source: Pew Charitable Trusts, 2010.

Table 2: Top 10 Countries in 5-year Growth in Installed Capacity (2004-2009)

South Korea	249%
China	79%
Australia	40%
France	31%
India	31%
United Kingdom	30%
Turkey	30%
United States	24%
Canada	18%
Rest of EU-27	17%

Source: Pew Charitable Trusts, 2010.

Table 3: Top 10 Countries in Sustainable Energy Investment (2009)

China	$34.6 billion
United States	$18.6 billion
United Kingdom	$11.2 billion
Rest of EU-27	$10.8 billion
Spain	$10.4 billion
Brazil	$7.4 billion
Germany	$4.3 billion
Canada	$3.3 billion
Italy	$2.6 billion
India	$2.3 billion

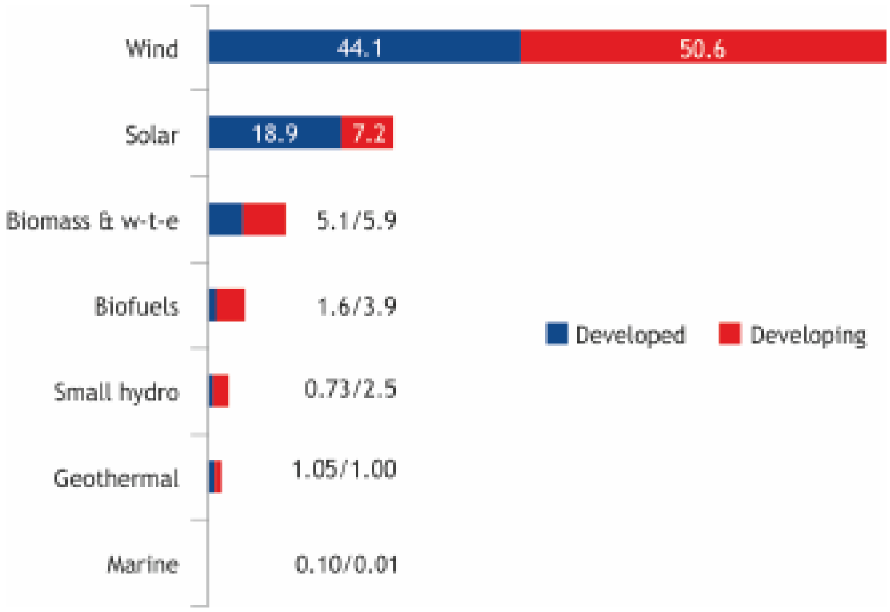
Source: Pew Charitable Trusts, 2010.

Table 4: Top Ten Countries in Five-Year Growth in Clean Energy Investment (2009)

Turkey	178%
Brazil	148%
China	148%
United Kingdom	127%
Italy	111%
United States	103%
France	98%
Indonesia	95%
Mexico	92%
Rest of EU-27	87%

Source: Pew Charitable Trusts, 2010.

Figure 6: Financial New Investment in Renewable Energy: Developed versus Developing Countries in 2010, in USD billion



Source: Bloomberg New Energy Finance, UNEP, 2011.

In addition to sustainable energy generation, relevant equipment manufacturing activity appears to be shifting from Europe to Asia, particularly China. Over 2003 to 2009, nearly half of greenfield investment projects in the manufacturing of environmental-technology products (such as wind turbines, solar panels and biodiesel plants, as well as associated parts) were in developing countries (over 85 percent of which involved developed country Transnational Corporations). Algeria, Argentina, Brazil, China, India, Indonesia, Libyan Arab Jamahiriya, Malaysia, Mexico, Mozambique, Philippines, Singapore, South Africa, United Republic of Tanzania and Viet Nam, were among the largest or key recipients.[14]

In 2009, China produced 40 percent of the world's solar PV supply, 30 percent of the world's wind turbines (up from 10 percent in 2007), and 77 percent of the world's solar hot water collectors.[15]

Despite these favourable trends, investment is still far from the levels required to bring about a major transformation of the energy sector. The IEA World Energy Outlook 2006 projects that around USD 20 trillion (of which USD 10.5 trillion will have to be for developing countries) will be required in energy infrastructure in order to bring about a low-carbon society. Of this USD 20 trillion, around USD 11 trillion will be required for the power sector alone. It is clear that the bulk of the investment will have to come from the private sector, as opposed to public finances.

Scaling up sustainable energy faces a number of challenges. From a private sector investment perspective, the fundamental problem is the higher cost of sustainable energy deployment when compared to conventional fossil fuel sources. Fossil fuel energy sources, such as coal and oil, are often subsidised by governments, depressing their prices and boosting con-sumption. Negative environmental externa-lities associated with fossil fuel use are also not reflected in the price of this energy source.

As far as most sustainable energy sources are concerned, their costs are primarily fixed, with a major share comprising initial investment and capital costs of equipment and technology; meanwhile, the fuel source itself (sun, wind, and water) is virtually free. Hence anything that contributes to lowering investment costs, including equipment costs, serves to lower sustainable energy prices.

In the absence of cost-effective storage, sustainable energy is generally intermittent in nature. Often the best sites for sustainable energy projects are located far from centres of consumption. Investments in grid capacity, grid strengthening and better grid management to cope with intermittent electricity from renewable sources also becomes necessary. The private sector seeks a price for renewable power generation that promises a stable and attractive rate of return. Anything that lowers fixed costs (technology and investment-related expenses) also increases the relative rate of return. Cost reduction also enables power producers to generate power at lower cost, while maintaining an attractive rate of return. In addition, cost declines in sustainable power generation lead to market expansion, as sustainable power becomes more affordable for consumers. Eventually, prices reach grid parity, where sustainable energy can compete with fossil fuels without the need for subsidies.

Net growth in oil demand increasingly comes from non-OECD countries, half of it exclusively from China, and is driven by the rising use of transport fuels. This underscores the need to invest in more sustainable forms of transport fuels and technologies, such as biofuels, as well as to scale up the use of alternative technologies, such as electric batteries, hybrid engines, and hydrogen fuel cell-based technologies. In addition, greater investments in expanding public transport and mass rapid-transit systems will also play a significant role in cutting down the carbon footprint associated with transportation. Natural gas is also likely to play a key role in the transition from more conventional fossil fuels in transportation to cleaner and more sustainable energy sources.

The IEA projects that biofuel usage – transport fuels derived from biomass feedstock – is likely to increase rapidly due to rising oil prices and increasing government support. Biofuels presently constitute the most important renewable fuel source used for transportation in most countries.

The United States, Brazil, and the European Union are expected to remain the world's largest producers and consumers of biofuels. Advanced biofuels, including those from ligno-cellulosic feedstocks, are assumed to enter the market by around 2020, and mostly in OECD countries. The cost of producing biofuels today is often higher than the current cost of imported oil, so strong government incentives are usually needed to make them competitive with oil-based fuels.

Such support amounted to USD 20 billion in 2009 – mainly in the US and in a number of EU member states alone – and is projected to rise to about USD 45 billion per year between 2010 and 2020, and about USD 65 billion per year between 2021 and 2035. While the report recognises the economic costs of such support, it also acknowledges the benefits – i.e. in terms of reduced GHG emissions and reduced oil imports.[16] Environmental benefits are one of the most significant reasons for subsidising biofuels; however, other experts are of the opinion that the current generation of feedstock often provides marginal benefits in the reduction of GHG emissions while carrying significant costs in terms of water, land, and inputs.[17] In fact, subsidies provided for biofuel production may also have to do with non-environmental reasons, such as energy security, agricultural income, and employment generation.

From a trade perspective it should be acknowledged that such support also denies market access opportunities for countries such as Brazil that may be able to produce biofuels in a much more efficient manner with lower costs. The same sustainability and food security-related concerns with regard to biofuels imply that producers will need to be aware of such concerns and respond accordingly, in the larger interests of sustainable development.

In 2010, world production of ethanol reached an estimated 86 billion litres, while world biodiesel production reached nearly 19 billion litres. The United States, Brazil, and France were the largest producers of ethanol. Germany, Brazil, Argentina, France, and the United States, were the largest producers of biodiesel in 2010.[18] As Figure 6 shows, investments in biofuels – though suffering a decline of 20 percent from 2009 to 2010 – still predominantly flowed to developing countries. Biofuels was the leading sector for investment – along with wind – in countries such as Brazil. Biofuels was also, after solar, the sector that attracted the most investment for research and development (R&D).

In the case of biofuels, the imperative remains to develop and improve next generation techno-logies that do not compete directly with food production. These include options such as ligno-cellulosic biofuels and biomass-to-liquid technologies using the Fischer-Tropsch process.[19]

Table 5: Bio-fuels Production in billion litres - Top 15 Countries and EU Total in 2010

Country	Fuel ethanol	Biodiesel	Total
United States	49	1.2	50.2
Brazil	28	2.3	30.3
Germany	1.5	2.9	4.4
France	1.1	2.0	3.1
China	2.1	0.2	2.3
Argentina	0.1	2.1	2.3
Spain	0.6	1.1	1.7
Canada	1.4	0.2	1.6
Thailand	0.4	0.6	1.0
Italy	0.1	0.8	0.9
Indonesia	0.1	0.7	0.8
Belgium	0.3	0.4	0.7
Poland	0.2	0.5	0.7
United Kingdom	0.3	0.4	0.7
Colombia	0.4	0.3	0.7
World Total	86	19	105
EU Total	4.5	10	14.5

Note: All figures are rounded to nearest 0.1 billion litres except world totals and U.S. and Brazil ethanol figures, which are rounded to nearest billion litres. Ethanol numbers are for fuel ethanol only. Table ranking is by total biofuels production. Figures are by volume, not energy content. Where reported in tonnes, figures were converted to litres using factors 1,260 litres/tonne ethanol and 1,130 litres/tonne biodiesel; where reported in cubic metres, ethanol data were converted to litres using 1,000 litres/cubic metre.

Source: REN 21, Renewables 2011 Global Status Report

Sustainable energy investments can also be an engine for job-creation and has other positive economic impacts. A report on Green Jobs by the UNEP, ILO, IOE and ITUC highlights research findings which indicate that renewables create more jobs per average megawatt of power manufactured and installed, per unit of energy produced, and per dollar of investment as compared to conventional energy sources. However, with the exception of biomass, more renewable energy jobs appear to be generated in the manufacturing and construction segment (as compared to coal and gas-fired plants which may employ more people in fuel-processing, operations). Solar is relatively more labour-intensive and the potential for biomass may depend on the manner in which biomass collection is organized. Overall, across a broad range of scenarios, renewables promise a net gain in employment as compared to fossilfuels. Kammen et al calculate that that deriving 20 percent of U.S. electricity supply by 2020 from renewables could generate between 164,000 and 188,000 jobs (depending on the specific mix of different renewables) whereas the same 20-percent share generated by coal and gas plants would support a mere 86,000 jobs.[20] Table 6a. provides an illustration of the estimated employment figures per megawatt for renewable and fossil-fuel power plants.[21]

Table 6a: Estimated Employment per Megawatt, Renewable and Fossil Fuel Power Plants

	Average Employment over Life of Facility (Jobs per megawatt of average capacity)		
	Manufacturing, Construction, Installation	Operations & Maintenance/ Fuel Processing	Total
Solar PV	5.76-6.21	1.20-4.80	6.96-11.01
Wind Power	0.43-2.51	0.27	0.70-2.78
Biomass	0.40	0.38-2.44	0.78-2.84
Coal-fired	0.27	0.74	1.01
Natural gas-fired	0.25	0.70	0.95

Source: Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World, UNEP/ILO/IOE/ITUC, September 2008

Worldwide jobs in the renewable energy sector is estimated to have exceeded 3.5 million in 2010. Methodology issues – such as estimation of industry scope and definition, gross vs net job-creation (owing to industry displacement elsewhere) and direct vs indirect jobs – may account for the discrepancy between various estimates.[22] China, India and Brazil accounted for a large share of renewable energy jobs worldwide.

Investment in wind power has created a large number of jobs both in wind farms as well as in turbine and component manufacturing operations. Other non-employment related economic benefits may have also been generated. According to the Canadian Wind Energy Association, every 1,000 MW of new installed wind generation capacity provides a minimum of 3 million Canadian dollars, (2.23 million euro; or 2.99 million USD) in annual lease payments for farmers and other rural landowners matched by a similar amount in new taxes for rural municipalities. The wind industry provided employment to more than 297,000 people according to the Chinese Wind Energy Association while supplying the power needs of more than 33.4 million families. The table below provides an indication of wind-power capacity in relation to estimated jobs and economic impact in member countries of the International Energy Agency.[23] The Indian firm Suzlon employs more than 13,000 people directly – 10,000 in India with the remainder in China, Belgium and the United States.

Table 6b: Wind Power Capacity in Relation to Estimated Jobs and Economic Impact

Country	Capacity (MW)	Estimated number of jobs	Economic impact (million euro)
China	44 733	279 000	-
United States	40 180	75 000	14 450
Germany	27 204	96 100	5 650
Spain	20 676	16 970	-
Italy	5 797	28 000	1 700
United Kingdom	5 270	-	-
Canada	4 124	4 124	1 500
Portugal	3 987	3 000	1 296
Denmark	3 802	24 700	12 260
Japan	2 304	3 000	2 690
Netherlands	2 245	-	38
Sweden	2 163	-	-
Australia	1 880	2 000	1 190
Ireland	1 425	1 500	60
Greece	1 210	-	-
Austria	1 011	3 300	470
Mexico	520	1 500	208
Norway	435	-	-
Korea	381	1 103	1 092
Finland	197	2 000	780
Switzerland	42	12 600	1 400
Total	169 586	553 897	44 784
(- = no data available)			

Source: International Energy Agency, IEA Wind: 2010 Annual Report, July 2011

In solar energy, a recent study by Greenpeace and EPIA estimated that, on average, the equilvalent of 30 full-time jobs are created for each MW of solar power modules produced and installed. Based on this data, employment figures in the PV sector were estimated to be well above 500,000 worldwide (with 300,000 in the European Union alone).[24] An earlier 2006 report by Greenpeace and European Photovoltaic Industry Association (EPIA) pro-jected possible PV employment by 2025 to be 80,000 to 100,000 jobs in Germany, 180,000 in the United States, 430,000 in China, and 92,000 in Japan (and 300,000 by 2030). A number of countries that currently do not play a major role in PVs could witness rapidly growing employment in coming years. The report projects a combined 60,000 jobs in 2015 in Australia, Brazil, India, and Thailand, and 250,000 to 330,000 in 2025.[25]

Chapter 3

The Importance of Sustainable Energy Policies

The lack of a level playing field for private sector investment in sustainable energy implies, in most cases, that governments will need to intervene by means of domestic sustainable energy policies, including financial incentives. Policies that help lower the cost of renewable energy – including the cost of grid-related equipment and associated technologies – and increase the costs of non-sustainable energy - will increase the possibilities for scaling up deployment of sustainable energy.

Such policies usually attempt to 'kickstart' market creation by providing an enabling environment that is conducive to attracting private sector investment. Governments, in turn, expect that the private sector, once established, will work towards reducing equipment and technology costs and thereby bring down the costs of sustainable power generation, rendering support unnecessary in the long run. In addition to specific sustainable energy policies detailed below, there are other, broader initiatives that contribute to creating an environment conducive to sustainable energy investment. These include carbon taxes and other environmental regulatory measures for pricing carbon and the negative externalities caused by GHG emissions. The removal of fossil fuel subsidies will be a major step in the right direction.

The presence of policies that are designed specifically to attract private sector investment in sustainable energy does not negate the importance of broader macroeconomic indicators that private sector investors usually look for. Good roads and ports will enable speedy, cost-effective delivery of parts, components, and equipment. The availability of a skilled and educated workforce will enable firms to set up operations fairly quickly. Clear, transparent rules and enforceability of contracts, such as power purchase agreements, are vital for sustainable power generators. Hence, private sector investors will continue to place emphasis on the availability of good infrastructure, a skilled workforce, and the rule of law, for instance. In some cases, political instability or uncertainty may deter investors from moving in, despite having good incentives to do so otherwise.

The table below illustrates commonly used policies and policy instruments to promote sustainable power generation. While some these are targeted towards producers in that they provide incentives to lower production costs, others are consumer-oriented and encourage consumers (households, firms, or government entities) to purchase renewable energy. Producer-oriented incentives, such as investment subsidies and grants, or preferential loans, could be tied to investment or installed capacity (including equipment cost), or as in the case of production-related incentives, they could be made conditional on the actual power that is generated. A further explanation of the various policy instruments is provided below.

Table 7: Typology of Sustainable Energy Policies

Producer-Oriented Policies and Incentives (Incentivising supply of sustainable energy)			Consumer-Oriented Regulatory Policies and Incentives (Creating demand for sustainable energy)
Investment-related	Production-related	Other Regulatory Policies and Incentives	
Investment Subsidies/Grants	Preferential Tariffs and Premiums (including Feed-in Tariffs)	Renewable Energy Targets	Carbon and Energy Taxes
Investment Tax-credits. E.g.: Accelerated depreciation	Production Tax-credits/ Generation-based Incentives	Binding Commitments to Reduce Greenhouse Gases	Removal/Reform of Fossil fuel-based Subsidies
Preferential Finance or Soft Loans	Power Purchase Agreements (providing stable guaranteed returns for 'X' number of years)	Carbon and Energy Taxes	Renewable Purchase Obligations
VAT and Sales Tax Reductions and Exemptions on Equipment		Removal/Reform of Fossil fuel-based Subsidies	Renewable Energy Certificates (RECs)
Income Tax Holidays		Government Assistance for Business Development	Government Procurement (including through competitive bidding)
Customs-duty Exemptions and Reduction		Renewable Portfolio Standards	VAT and Sales Tax Reductions and Exemptions on Equipment (for instance: solar water heaters or rooftop solar panels)
		Subsidies/ Grants for R&D	Financial Incentives and Soft Loans to purchase RE Equipment
			Net Metering

Source: ICTSD Analysis Based on REN21, Renewables 2011 Global Status Report

As Table 7 above shows, sustainable energy policies can be broadly classified as those that can influence both demand and supply of sustainable energy through a combination of regulations and incentives. On the supply side, they can work to reduce investment - as well as production-related costs for renewable energy producers. On the demand side, they can help generate greater demand from consumers – households, commercial enterprises, and governments – for renewable energy, either through a system of incentives or through mandatory purchase requirements.

i. **Producer-oriented supply side policies** that incentivise sustainable energy power producers commonly take the form of **investment - or production-oriented incen-tives as well as regulations and additional incentives that may either 'force'**

or 'encourage' production of sustainable energy.

a. **Investment incentives** help lower upfront costs for power producers. In the case of renewable energy, upfront installation costs are the greatest burden, given that variable operating costs – such as fuel – are virtually nil, except in the case of biomass power. These could take the form of:

- **Direct subsidies or grants** that are provided per kilowatt (Kw) of rated capacity or as a percentage of total investment cost.

- They can also take the form of **investment tax credits or tax incentives** according to levels invested, enabling producers to reduce their tax liabilities. While investment tax credits can be useful in enticing profitable enterprises or high-income individuals to enter the renewable energy market to reduce their tax liabilities, these credits can be inefficient if investors are more interested in maximising their tax shelter than in achieving actual electricity production.[26] This has happened in India, for instance, where firms with business interests across a wide variety of sectors have installed wind turbines without concern for the location of these wind turbines or actual power generation, but simply to avail of tax benefits.[27]

- **Preferential financing terms** such as lowered interest rates or longer repayment horizons can significantly reduce project costs. Many governments have created special funding agencies to provide loans for renewable energy projects at below-market interest rates. Additionally, many development organisations, including the World Bank, provide loan guarantees, which reduce risks for commercial lenders and thus lower interest rates.

- **VAT and sales tax reductions and/or exemptions, property tax reductions, as well as customs duty exemptions** can also help lower project investment costs. Governments may find it easier to provide tax incentives rather than collect taxes and then disburse them as subsidies.

- **Customs duty reductions and/or exemptions** help power producers lower the cost of imported RE equipment.

- **Income tax holidays** are an additional incentive to attract investors.

b. **Production-related incentives** help lower the cost of producing sustainable energy. However, unlike investment incentives that are paid based on initial capital costs, production-related incentives are paid per Kilowatt hour (Kwh) of electricity generated. They are superior to investment tax credits in that they are paid on the basis of actual electricity generated, so there is no incentive for investors to artificially inflate investment costs or set up installations simply to claim tax credits. On the other hand, they may be affected by future changes in policy and cutbacks, so the degree of predictability is lower and political risk higher. Production incentives commonly take the form of:

- **Preferential power tariffs** that pro-vide the producer with an incentive over and above the tariffs paid for conventional energy sources; these preferential power tariffs compensate the producer for higher costs associated with renewable energy generation. These tariffs may take the form of 'feed-in' tariffs that are paid to the power producer by an electric utility, as mandated by law, for a specific duration of time.[28]

- **Power Purchase Agreements (PPA)** are reliable power purchase contracts with the purchase guaranteed for a certain number of years. This has been cited as perhaps the single most critical requirement of a successful renewable energy project. The vast majority of renewable energy projects have been implemented by independent power producers that are not affiliated with utilities. These producers thus need to have access to the utility's transmission and distribution grid and to obtain a contract to sell the power either to the utility or to a third party by wheeling through the utility grid. Because renewable energy projects are generally considered risky by financial institutions, a reliable, stable long-term revenue stream is extremely important for obtaining financing at a reasonable cost. Creation of reliable power markets for independent power producers has thus been the cornerstone of essentially every successful renewable energy strategy. Of course, simply ensuring a PPA may not incentivise investors unless the tariff that is reflected (whether 'feed-in' or some other form of preferential tariff arrived at through negotiations or bidding) is attractive enough for the producer.

- **Production tax credits or generation-based incentives** are paid (according to per Kwh produced) over and above the guaranteed power-tariff. These may take the form of cash subsidies, which are sometimes bid for, or tax credits. These payments are dependent on the actual amount produced, so they incentivise the producer to generate more unless a production cap is set for the incentive. On the other hand, if these payments are not guaranteed for a certain time period, they may be subject to shifts in policy.[29]

Other supply-side related incentives include government **subsidies and grants** to firms for carrying out **research and development and demonstration** activities as well as **business development** activities such as export promotion, standard setting, and providing certification. They also involve regulatory measures such as **Renewable Portfolio Standards** that place an obligation on electric supply companies to produce a specified portion of their electricity from renewable sources. In addition, broader regulatory measures such as renewable energy targets, binding commitments on greenhouse gases, energy and carbon-taxes as well as removal or reform of fossil fuel subsidies can all directly or indirectly encourage production of sustainable energy through subsequent legally binding measures or through their influence on price signals.

ii. Consumer-oriented demand-side policies aim at regulating or incentivising demand for sustainable energy through laws and incentives that target consumers, thereby generating greater demand for sustainable energy. The most common demand-side measures include:

- **Renewable Purchase Obligations (RPOs)**, which are laws that require an "obligated entity" – usually electricity utilities or other entities – to purchase a certain proportion of their electricity from renewable energy sources." Often these obligations need to be backed up with penalties in order to ensure effective compliance.

- **Renewable Energy Certificates** are usually issued to eligible entities in lieu of power generated (for which there usually is no purchase agreement). These certificates are complementary to RPOs and enable entities located in areas where it may be difficult to generate renewable power to purchase an equivalent amount of certificates. Trading of these certificates is usually done through power exchanges; floor and ceiling prices may be fixed by regulators. These certificates are usually valid only for a limited period of time.

- **VAT and sales tax reductions, as well as financial incentives and soft loans** help lower the cost of equipment – such as solar water heaters and rooftop panels – to consumers.

- **Government Procurement** or purchase of renewable energy, as well as renewable energy-related equipment and services, generates additional demand. Here, the government uses its purchasing power to directly influence demand.

- **Net metering** is a scheme whereby non-utility user generators of power, such as households, can be compensated through feed-in tariffs for the 'net' difference between electricity used and fed into the grid during a set time period. Net metering schemes use special meters to measure the power generated as well as consumed. In some countries, such as Germany, consumers are compensated for all power fed into the grid and not just the 'net.'[30]

As for sustainable energy production demand can also be influenced by broader regulatory measures such as the intro-duction of energy and carbon-taxes (on fossil-fuels), as well as the reform or removal of fossil fuel-based subsidies.

One should bear in mind that the costs for producer- as well as consumer-oriented incentives are borne either by the government (through taxpayer money) or else recovered partly or fully from consumers, for instance through differential 'green' charges for electricity. Some policies, in particular energy efficiency measures may result in net benefits, i.e. producers and consumers can recoup upfront costs from future savings in energy costs.

As of 2011, at least 83 countries, of which 41 are deve-loped/transition countries and 42 developing countries, have established some type of policy to promote sustainable energy generation.[31] The Tables 8 and 9 below show both developed as well as developing countries, along with the types of sustainable energy promotion measures they use.

Table 8: Renewable Energy Support Policies: High-Income and Upper Middle-Income Countries

	Regulatory Policies					
	Feed-in tariff (incl premium payment)	Electric utility quota obligation/ RPS	Net metering	Biofuels obligation/ mandate	Heat obligation/ mandate	Tradable REC
			■ **HIGH-INCOME COUNTRIES**			
Australia	▲			▲		●
Austria	●			●		●
Belgium		▲	●	●		●
Canada	▲	▲	●	●		
Croatia	●					
Cyprus	●					
Czech Republic	●			●		●
Denmark	●		●	●		●
Estonia	●			●		
Finland	●			●		●
France	●			●		●
Germany	●			●	●	
Greece	●		●			
Hungary	●			●		
Ireland	●				▲	●
Israel	●				●	
Italy	●	●	●	●	●	●
Japan	●	●	●			●
Latvia	●			●		
Luxembourg	●					
Malta			●			
Netherlands				●		●
New Zealand						
Norway				●		●
Poland		●		●		●
Portugal	●	●	●	●	●	
Singapore						
Slovakia	●					
Slovenia	●					●
South Korea		●		●		●
Spain	●			●	●	
Sweden		●		●		●
Switzerland	●					
Trinidad & Tobago						
United Kingdom	●	●		●		●
United States	▲	▲	▲	●	▲	●

Table 8: *Continued*

	Fiscal Incentives				Public Financing	
	Capital subsidy, grant, or rebate	Invest-ment or production tax credits	Reductions in sales, energy, CO_2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants	Public competi-tive bidding
■ HIGH-INCOME COUNTRIES						
Australia	•				•	
Austria	•	•			•	
Belgium	•	•	•			
Canada	•	•	•		•	•
Croatia	•				•	
Cyprus	•					
Czech Republic	•	•	•			
Denmark	•	•	•		•	•
Estonia	•		•	•		
Finland	•		•	•		
France	•	•	•		•	•
Germany	•	•	•		•	
Greece	•	•			•	
Hungary	•		•		•	
Ireland						•
Israel			•			•
Italy	•	•	•		•	•
Japan	•				•	
Latvia			•		•	•
Luxembourg	•					
Malta	•		•			
Netherlands	•	•	•	•		
New Zealand	•					
Norway	•		•		•	
Poland	•		•		•	•
Portugal	•	•	•		•	•
Singapore					•	
Slovakia	•					
Slovenia	•	•	•		•	•
South Korea	•	•	•		•	•
Spain	▲	•	•		•	
Sweden	•	•	•	•		
Switzerland	•		•			
Trinidad & Tobago	•	•	•			
United Kingdom			•	•	•	
United States	•	•	•	•	•	•

Table 8: *Continued*

	Regulatory Policies					
	Feed-in tariff (incl premium payment)	Electric utility quota obligation/ RPS	Net metering	Biofuels obligation/ mandate	Heat obligation/ mandate	Tradable REC
■ **UPPER-MIDDLE INCOME COUNTRIES**						
Algeria	•					
Argentina	•			•		
Belarus						
Bosnia & Herzigovina	•					
Botswana						
Brazil				•		
Bulgaria	•			•		
Chile		•				
Colombia				•		
Costa Rica	•			•		
Dominican Rep.	•					
Iran						
Kazakhstan	•					•
Lithuania	•					
Macedonia	•					
Malaysia	•					
Mauritius						
Mexico			•			
Panama	•					
Peru	•			•		
Romania		•		•		•
Russia						•
Serbia	•					
South Africa	•					•
Turkey	•					
Uruguay		•		•		

Table 8: *Continued*

	Fiscal Incentives			Public Financing		
	Capital subsidy, grant, or rebate	Invest-ment or production tax credits	Reductions in sales, energy, CO_2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants	Public competi-tive bidding
■ **UPPER-MIDDLE INCOME COUNTRIES**						
Algeria						
Argentina	•	•	•	•	•	•
Belarus			•		•	
Bosnia & Herzigovina						•
Botswana			•			
Brazil			•		•	•
Bulgaria	•		•		•	
Chile	•		•		•	
Colombia	•					
Costa Rica						
Dominican Rep.	•	•	•			
Iran		•		•		
Kazakhstan						
Lithuania					•	
Macedonia					•	
Malaysia					•	
Mauritius	•					
Mexico		•			•	•
Panama				•		•
Peru		•	•	•		•
Romania			•		•	
Russia	•					
Serbia						
South Africa	•					•
Turkey						
Uruguay			•			•

Notes: Entries with an upward arrow (▲) mean that some states/provinces within these countries have state/province-level policies but there is no national-level policy. Only enacted policies are included in the table; however, for some policies shown, implementing regulations may not yet be developed or effective, leading to lack of implementation or impacts. Policies known to be discontinued have been omitted.

Countries are organized according to per capita income level as follows: "high" is $12,196 or more, "upper-middle" is $3,946 to $12,195, "lower-middle" is $996 to $3,945, and "low" is $995 or less. Per capita income levels from World Bank, 2010.

In South Korea, the current feed-in tariff will be replaced by an RPS policy in 2012. In Spain, the Value Added Tax (VAT) reduction is for the period 2010–12 as part of a stimulus package. In Mozambique, the biofuel blend mandate has been approved but not yet specified.

Source: REN 21, Renewables 2011 Global Status Report

Table 9: Renewable Energy Support Policies: Lower-Middle Income Countries and Low Income Countries

	Regulatory Policies					
	Feed-in tariff (incl premium payment)	Electric utility quota obligation/ RPS	Net metering	Biofuels obligation/ mandate	Heat obligation/ mandate	Tradable REC
■ **LOWER-MIDDLE INCOME COUNTRIES**						
Armenia	•					
Bolivia						
China	•	•		•	•	
Ecuador	•					
Egypt						
El Salvador						
Guatemala			•			
Honduras	•					
India	•	•		•		•
Indonesia	•					
Jordan			•			
Marshall Islands						
Moldova	•					
Mongolia	•					
Morocco						
Nicaragua	•					
Pakistan			•			
Palestinian Ter.						
Philippines	•	•	•	•		
Sri Lanka	•					
Thailand	•			•		
Tunisia						
Ukraine	•					
Vietnam						
■ **LOW INCOME COUNTRIES**						
Bangladesh						
Ethiopia				•		
Gambia						
Ghana						•
Kenya	•					
Kyrgyzstan		•				
Mali						
Mozambique				•		
Nepal						
Rwanda						
Tanzania	•					
Uganda	•					
Zambia						

Table 9: *Continued*

	Fiscal Incentives				Public Financing	
	Capital subsidy, grant, or rebate	Investment or production tax credits	Reductions in sales, energy, CO_2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants	Public competitive bidding
■ **LOWER-MIDDLE INCOME COUNTRIES**						
Armenia						
Bolivia			•			
China	•			•	•	•
Ecuador						
Egypt	•		•		•	•
El Salvador		•	•	•	•	•
Guatemala		•	•	•	•	•
Honduras		•	•			•
India	•	•	•		•	•
Indonesia	•	•	•		•	•
Jordan			•			
Marshall Islands			•			
Moldova			•		•	
Mongolia						•
Morocco					•	
Nicaragua		•	•			
Pakistan	▲				•	
Palestinian Ter.			•			
Philippines	•	•	•	•	•	•
Sri Lanka						
Thailand					•	
Tunisia	•		•		•	
Ukraine						
Vietnam	•	•	•			
■ **LOW INCOME COUNTRIES**						
Bangladesh	•				•	
Ethiopia			•		•	
Gambia			•			
Ghana			•			
Kenya			•			
Kyrgyzstan	•		•			
Mali			•			
Mozambique					•	
Nepal	•	•	•		•	•
Rwanda			•		•	
Tanzania	•		•			
Uganda	•		•			
Zambia			•			

Notes: Entries with an upward arrow (▲) mean that some states/provinces within these countries have state/province-level policies but there is no national-level policy. Only enacted policies are included in the table; however, for some policies shown, implementing regulations may not yet be developed or effective, leading to lack of implementation or impacts. Policies known to be discontinued have been omitted. The Palestinian Territories are not included in the World Bank country classification, they have been placed using the 2008 "Occupied Palestinian Territory" GNI per-capita provided by the UN ($1,595).

Source: REN21, Renewables 2011 Global Status Report.

The recent financial downturn has prompted many countries to look at the sustainable energy sector as a source of economic growth and jobs. This has, in turn, led to a number of countries allocating 'green' stimulus funds that prioritise sustainable energy. As of 2010, stimulus plans have targeted USD 184 billion for sustainable energy. The US has taken the lead, allocating USD 67 billion, followed by China with USD 47 billion. The US plans to target energy efficiency, renewable energy deployment, transportation, and smart grid technology, while China has focused on energy efficiency, clean vehicles, grid infrastructure, and other clean energy technology. China's "Golden Sun" initiative proposes to grant up to 50 percent of the installation cost of solar photovoltaic power plants. South Korea reportedly intends to increase its share of the overseas green market by allocating stimulus funding to boost exports of LED lighting products, solar cells, hybrid cars, and other low-carbon technology products.[32] Analysis by Bloomberg New Energy Finance reveals that at present nearly half the allocated amount has been spent.[33]

The realm of alternative vehicle fuels and technologies is also replete with examples of supportive government policies and financing examples. A large number of these have been introduced recently in the context of fiscal stimulus measures to overcome recession and generate local employment in what are increasingly being considered promising new sectors for the future.

Table 10 illustrates policies commonly used by the government to promote sustainable transport. As in the case of sustainable energy production, governments can, through regulations and incentives, influence behaviour and decisions of both producers and consumers of clean transport fuels and technologies (including automobiles). Certain policies (highlighted in gray within the table) can work on both the supply- as well as demand-sides. Fuel pricing, for instance, could trigger a reduction in driving frequency amongst consumers, while also contributing to the demand for and production of fuel efficient vehicles.

Table 10: Typology of Sustainable Energy Related Transport Policies

Producer-Oriented Regulatory Policies and Incentives. (Incentivising supply of sustainable transport and cleaner transport fuels)	Consumer-Oriented Regulatory Policies and Incentives (Creating demand for sustainable transport and cleaner transport fuels)
Targets and Mandates for AFVs: *for example, in 2008 China's Ministry of Science and Technology (MOST), which oversees China's auto industry, mandated that 10 percent of new cars must run on alternative fuels by 2012*	
Regulatory measures: *for example, the mandatory conversion of urban buses to Natural Gas Vehicles with a view to reducing urban air pollution, as has been implemented in some developing countries*	
Availability of CDM financing options for investments in sustainable transport	
Fuel-pricing	Fuel-pricing
Subsidies and other incentives (including loans) for investment in AFV manufacturing capacities, in particular for electric batteries: for example, under the American Recovery and Reinvestment Act (ARRA)	Tax incentives for scrapping old cars and replacing them with more fuel-efficient cars: For example, the Car Allowance Rebate System (CARS), also known as the "cash for clunkers" programme in the US

Table 10: *Continued*

***Public Procurement** of energy-efficient vehicles*	***Obligations on government institutions to acquire AFVs as part of their purchase of vehicles.** For example, in the US the Energy Policy Act of 1992 (EPAct) requires that 75 percent of all covered light-duty vehicles (LDV) acquired for Federal fleets must be AFVs*
***Fuel economy and CO_2 emissions standards** that may be combined with long-term targets setting tighter standards to help manufacturers plan for the future and provide incentives for continuous improvements.*	
***Taxation and tax incentives:** these may be differentiated on the basis of vehicle efficiency and/or CO_2 emissions*	
***Penalties imposed on car manufacturers:** for instance, if the average CO_2 emissions of their vehicles are above a certain limit value*	
Promoting the use of fuel-efficient tyres	Promoting the use of fuel-efficient tyres
Labelling (information on fuel economy and/or the CO2 emission performances of vehicles)	Labelling (information on fuel economy and/or the CO2 emission performances of vehicles)
Restrictions on imports of second-hand vehicles (which may slow the penetration of new vehicle technologies)	Restrictions on imports of second-hand vehicles (which may slow the penetration of new vehicle technologies)
	Grants and tax-credits for the purchase of AFVs
***Incentives for investment in infrastructure and fuel-delivery systems:** for example, the US Alternative Fuel Infrastructure Tax Credit*	***Tax-incentives that reduce the operating costs of AFVs***
Government support for deployment and demonstration projects	
***Biofuel blending mandates** that can increase the shares of renewable sources of energy in the transport sector without creating a need for new investments in infrastructure and fuel delivery systems.*	
***Specific biofuel targets and plans that define future levels of biofuel use (in addition to targets for renewable fuels, see above).** For example, the US Renewable Fuels Standard (RFS) requires fuel distributors to increase the annual volume of biofuels blended to 36 billion gallons (136 billion litres) by 2022. Japan's target is to produce 6 billion litres of biofuels per year by 2030, representing 5 percent of its transport energy. China targets the equivalent of 13 billion litres of ethanol and 2.3 billion litres of biodiesel per year by 2020.*[34]	

Table 10: *Continued*

Biofuel production subsidies	
Biofuel Tax measures *such as excise tax exemptions*	***Biofuel Tax measures*** *such as excise tax exemptions*
Policies and regulations for the introduction of flex-fuel vehicles (FFV) that are able to use any mixture of gasoline and ethanol	
R&D development subsidies *including on second-generation biofuels*	
Biofuel standards and certification	***Biofuel standards and certification***

Source: Vossenaar, R. (2010b). Deploying Climate-Related Technologies in the Transport Sector: Exploring Trade Links, ICTSD Issue Paper No. 15, ICTSD Programme on Trade and Environment, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Clean Energy Generation versus Equipment Manufacturing

In assessing the implications of policies and incentives for sustainable energy, it is useful to distinguish between incentives provided for sustainable power generation versus incentives provided for equipment manufacture. While nearly every country in the world – depending to a large extent on geographical factors and resource endowment – would benefit from the deployment of sustainable energy, perhaps the same urgency or priority does not hold true for the deployment of manufacturing activity in sustainable energy equipment. Certain countries may be more suited to manufacturing sustainable energy equipment or parts for various reasons, including skills, low labour costs, or infrastructure. Yet most countries desire to attract manufacturing activity, in addition to sustainable power generation. This is due to obvious benefits related to employment generation, economic activity, technology flow and diffusion, along with the need to simply try and establish early leadership in an area that many believe will witness rapid growth in the coming years.

According to a report by World Wide Fund for Nature (WWF) and Roland Berger, the market for clean energy technology was larger than the pharmaceutical market in 2007. Sales of energy efficiency products were EUR 540 billion, and renewable energy technologies contributed EUR 91 billion. Despite the crisis, the report expects this growth to continue at five percent a year for efficiency products and 15 percent for renewables (under a conservative IEA 450 scenario). This is projected to result in a total market volume of EUR 1600 billion a year in 2020, making it one of the largest industries in the world. The report, which was the first to rank countries on the basis of sales, places Denmark, Brazil, and Germany in the lead based on their strengths in wind equipment, ethanol and renewable energy-related machinery (WWF-Netherlands and Roland Berger, 2009). Based on an assessment of these countries' policies, the report concludes that countries aiming to develop their clean energy technology sectors should emulate the leaders and:

- Launch Technology Action Programmes that develop a single technology from research to demonstration. This would make government support more consistent and bridge the gap between academia and industry.

- Central banks should encourage the integration of CO2 risk into financial models to facilitate a shift towards "clean" investments. More capital must also be raised for seed investment in clean energy technology ventures.

- Develop a strong home market for clean energy technology applications by influencing the purchasing decisions of government, business, and consumers through government procurement, greater stability in policies on sustainable energy subsidies, and tax differentiation.[35]

Interestingly, none of these recommendations imply favouring domestic industries at the expense of or by discriminating against foreign firms or imports. Rather, they emphasise supporting industries through the innovation cycle and providing market development support. The development of strong home markets in sustainable energy can also serve to provide manufacturers at home with a head start. This is particularly true in industries such as wind energy, where equipment is heavy and production may need to be much more localised and close to wind farms.

Despite this, the temptation exists to provide support to building domestic industries in ways that may discriminate against foreign suppliers and imports. The paper will now discuss why this matters and the nature of the barriers that may constrain private investors and dampen international trade in sustainable energy goods and services.

Chapter 4

The Relevance of Trade: Trade-related Barriers and the Interface with Sustainable Energy Policy

The Reality of Supply-chains for Sustainable Energy and the Dilemma of Balancing Objectives

Global manufacturing and services companies operate through a complex network of supply chains; this enables them to optimise production costs by sourcing components and services from their most efficient production/ supply locations. Hence, policies that prevent or constrain supply chain optimisation increase costs and consequently prices for sustainable energy goods and services. As sustainable energy prices are sensitive to upfront costs of capital and equipment (see for example Table 11a below which provides an indication of capital and equipment costs in a wind energy project and Table 11b that shows estimated average turbine cost/per Kw and total installed cost/per Kw in selected International Energy Agency member countries), such policies may also increase the cost of final sustainable energy supply. Government and tax payers ultimately bear such cost. Cost escalation also delays the attainment of grid parity – the point where renewables become a viable and competitive alternative to fossil fuels – and thus slow down global climate mitigation efforts.

Table 11a: Life Cycle Breakdown of a Wind-Energy Investment Project

Wind power project costs	Percent of total capital costs	Percent of total life-time project costs
Fixed upfront costs		
Capital equipment costs	75	58
Turbines (excluding blades and towers)	45	35
Blades	10	8
Towers	12	9
Equipment transportation	8	6
Other materials; land purchase, concrete, transformers, high-voltage extensions/electrical equipment, cables and road/site preparation	16	12
Construction labor subtotal	7	5
Other costs; wind mapping/site consulting, legal services/certification and financing	3	2
Total fixed upfront capital costs	100	77
Variable costs		
Wind farm annual operation and maintenance (O&M) costs		1-1.5
Total 20-year project O&M costs		~23

Note: Estimates relate to onshore medium-sized (1.5-2.0MW) turbines. Table is a rough estimate and no attempt is made to bring fixed and variable costs to a directly comparable net present value (NPV) format.

Source: WRI, 2009, It should be a Breeze: Harnessing the Potential of Open Trade and Investment Flows in the Wind-energy Industry.

Table 11b: Estimated Average Turbine Cost and Total Project Cost in IEA Member Countries for 2010

Country	Turbine cost (euro/kW*)	Total installed cost (euro/kW*)
Australia	1,100 to 1,500	1,500 to 2,500
Austria	1,400 to 1,800	1,700 to 2,000
Canada	-	1,488 to 1,860
China	720	970 to 1,020
Denmark	-	1,030 onshore 2,680 offshore
Germany	-	1,336 to 1,756 onshore 3,323 to 3,561 offshore
Greece	-	1,100 to 1,400
Ireland	1 100	1,800 onshore
Italy	1 200	1 740
Japan	1 500	2 250
Mexico	1,100 to 1,200	1 500
Netherlands	-	1,325 onshore 3,200 offshore
Portugal	900 to 1,000	1,000 to 1,400
Spain	-	1 400
Sweden	1 400	1 600
Switzerland	1 450	1 885
United States	818 to 1,042	1 603

** Applicable conversion rate to USD: 1.344*

(- = no data available)

Source: International Energy Agency, IEA Wind: 2010 Annual Report, July 2011

For instance, according to a recent report by the World Resources Institute (WRI),[36] major future cost improvements for wind industry investments would have to be concentrated in the dominant capital equipment cost segment. Historically, global integration of manufacturing sectors has led to cost reduction through facilitation of economies of scale, increased competition, technological innovation, and just-in-time production techniques with lean global supply chains. Wind industry experts have generally expressed the belief that the relative cost share of fixed upfront capital should decline as technology learning, global integration of supply chains, and increased global competition yield better turbine design and cheaper components.

In the wind sector, developing country firms from China and India have already emerged amongst the top suppliers of equipment for the domestic market as well as overseas markets. The wind energy sector, characterised by high transportation costs, will witness increasing reliance on FDI rather than trade, as, among other reasons, firms are driven by the need to establish manufacturing bases close to where wind farms are located. This, in turn, is driven by domestic sustainable energy policies and incentives. Is some instances, the manufacturing chain for wind is marked by vertical integration where firms can guarantee reliability of supply and quality components. In others, they may also rely on external supplier for components. Despite the trend in the wind industry for turbine manufacturing to be located close to wind-power markets, industry experts also opine that some turbine components that are lighter and easier to manufacture, such as gearboxes and bearings, could be increasingly outsourced from China, Japan, and Korea with forgings and cast-iron supply facilities. Thus the characteristics of the product or component may well determine the extent to which production may be 'outsourced' in the wind-turbine industry.

Wind power related services - required in the planning, construction, and operation of the power plant - as distinct from manufacturing, involve services such as site identification, construction, logistics, operation and maintenance, and sales. Experts believe that in the future, the global wind industry could provide benefits for countries with a strong presence in services, such as Denmark and Germany with their R&D services, and the US with their financial services. Supply chains will thus continue to remain relevant for wind power related services as well. Opportunities in terms of movement of skilled technicians to install turbines in foreign markets could also arise for countries such as India.

Solar PV, on the other hand, is a sector that is much more trade-intensive. The lighter solar modules and cells have seen a trend towards shifting manufacturing to Asia. This trend is likely to continue. New players from emerging economies have entered mid-stream manufacturing of wafers, cells, modules, and components, and competition has intensified. Given that these eqipments and components make up an important proportion of costs, it is desirable to have open markets and low as well as predictable trade barriers.

A good illustration of the way supply chains operate in the sustainable energy sector is provided in the UNEP-Bloomberg 2011 report on Global Trends in Renewable Energy Investment. The 212 MW Olkaria geothermal complex in Kenya involves Israeli and Kenyan plant operators. The drilling equipment comes from China, financed by Chinese and French development banks. Japanese loans pay for the transmission line and German loans for project expansion. Four engineering companies - three from Japan and one from France - have been pre-qualified as bidders for work to increase the capacity by 280 MW. Another example comes from Latin America. Two small-scale hydro projects in Rio Grande do Sol province in Brazil will use French-owned Alstom turbines. These turbines will be developed by a Canadian-owned company. The USD 1.7 billion Thornton Bank wind project off the Belgian coast will use turbines from Germany-based Repower, owned by Suzlon of India, with French and German utilities as shareholders. Some of the debt-risk is guaranteed by German and Danish export credit agencies. French, Dutch, and German commercial banks, as well as the European Investment Bank are lenders. A Danish company will supply blades for the project.[37]

These examples illustrate that in the pursuit of low-carbon development paths, trade and trade policy will play an important role in enabling countries to access climate-friendly goods and services. Depending on their manufacturing capacities and cost-conditions, this pursuit will also enable these countries to create a competitive production base in these technologies. In clean energy sectors, few countries have the domestic capacity or know-how to produce all they need. This is particularly true for developing countries, and although building domestic capacities may be their long-term goal, trade liberalisation and, where possible, foreign direct investment can provide rapid access to key technologies.

Even as trade policy can affect the free flow of sustainable energy goods and services, sustainable energy-related policies may also have implications for international trade. On the one hand, these policies have been instrumental in creating demand, including for sustainable energy goods imported from developing countries. For example, the demand for solar panels manufactured in China has mainly been driven by incentives for solar energy generation provided in Germany and other EU countries.

As opposed to sustainable energy incentives, incentives aimed at strengthening manufacturing capacities by erecting barriers to trade may affect the opportunities for manufacturers, including in developing countries, to participate in international supply chains. The latter usually happens because countries often seek to address multiple policy objectives while also attempting to bring down the costs of sustainable energy and accessing sustainable energy technologies at the lowest possible costs. These other objectives include generating domestic jobs, strengthening manufacturing capacities, and creating a manufacturing base for sustainable energy equipment and services while earning customs revenue. While synergies are possible, it often becomes difficult for policymakers to balance these objectives, with the result that one is often attained only at the expense of the other.

Many countries that figure amongst the major GHG-emitters are also active in sustainable energy investment and in initiating sustainable energy policies. Many of these countries are also important traders in sustainable energy equipment and components. A precise definition of sustainable energy equipment is elusive, as customs classifications often capture equipment used for more than one purpose, or may include several categories of unrelated equipment. Tables 12 and 13 focus on trade-related data for two categories of products for which the end-use is more or less exclusively for sustainable energy generation (also called single end-use products). These are solar PV devices and light-emitting diodes (HS-854140), and wind turbines (HS-850231).

Table 12: Top-ten Exporters of Photovoltaic cells, Modules and Panels (HS-854140) in 2008 (in USD million)

Exporters	USD m	%	Importers	USD m	%
All reporters	30513	100.0	All reporters	33138	100.0
China	11745	38.5	EU27	17075	51.5
Japan	6190	20.3	China	3744	11.3
Taiwan, China	4002	13.1	United States	2760	8.3
EU27	2027	6.6	Korea, Rep.	2144	6.5
United States	1976	6.5	Hong Kong, China	1984	6.0
Korea, Rep.	805	2.6	Japan	1412	4.3
Malaysia	749	2.5	Taiwan, China	660	2.0
Singapore	737	2.4	Singapore	559	1.7
India	529	1.7	Mexico	488	1.5
Mexico	398	1.3	India	420	1.3
Top 10	29159	95.6	Top 10	30826	93.0
Developing countries	19460	63.8	Developing countries	11068	33.4

Source: COMTRADE using WITS from Vossenaar, R. (2010). Climate-related Single-use Environmental Goods, ICTSD Issue Paper No. 13, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Table 13: Top Ten Exporters of Wind–powered Generating Sets (HS-850231) in 2008 (in USD million)

Exporters	USD m	%	Importers	USD m	%
All reporters	3335	100	All reporters	4753	0
EU27	1810	54.3	United States	2679	56.4
India	651	19.5	Canada	545	11.5
Japan	469	14.1	Turkey	285	6.0
China	211	6.3	Australia	221	4.6
Vietnam	126	3.8	China	189	4.0
United States	22	0.7	Japan	174	3.7
Australia	20	0.6	Brazil	122	2.6
Brazil	14	0.4	EU27	106	2.2
Korea, Rep.	3	0.1	Korea, Rep.	102	2.1
Canada	3	0.1	Taiwan, China	91	1.9
Top 10	3329	99.8	Top 10	4514	95.0
Developing countries	1010	30.3	Developing countries	941	19.8

Source: COMTRADE using WITS from Vossenaar, R. (2010). Climate-related Single-use Environmental Goods, ICTSD Issue Paper No. 13, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

The figures for trade in solar PV modules and wind turbines clearly show that a number of the key traders of these products also figure amongst the top GHG-emitting countries and are also represented within the G-20. Hence, many countries with the greatest stake in addressing climate change through sustainable energy deployment also have an important stake in ensuring stability and predictability of trade flows and market access. Major exporters of one sustainable energy equipment or component may well be major importers in another, sometimes in the same sector as the case of China in both solar panels as well as wind-powered generating sets show. Trade policy will therefore be an important tool among an array of policy tools for these countries in the fight against climate change.

Trade liberalisation, whether locked in through negotiations at the World Trade Organization (WTO), bilateral and regional agreements, or undertaken autonomously, can lower sustainable energy equipment costs for consumers (industries or households) by enabling them to purchase these at world market prices. Addressing trade-related barriers created by both trade and sustainable energy policies can play an important role in global climate mitigation efforts. It is therefore important to identify and address these barriers, as well as to understand existing trade rules and disciplines together with ongoing negotiations that may or may not suffice to address the barriers. At the same time, consideration also needs to be given to particular concerns, priorities, and sensitivities of developing countries that may prevent such countries from immediately going ahead with all-out liberalisation.

4.1 Trade-related Barriers

Trade-related barriers to sustainable energy goods and services are diverse. These barriers may be operationalised through 'de-jure' trade-restrictive policies, as well as other policies that may have an indirect, yet real, 'de-facto' impact, based on the way they are designed. Some policies may be both 'de-jure' and 'de-facto' trade restrictive.

Multilateral efforts to liberalise trade and maintain an open and non-discriminatory trading system are embodied in the rules and disciplines enshrined under the framework of the WTO. The WTO was created in 1995 as a result of the Uruguay Round of Trade Negotiations launched in 1986. From negotiating simple reductions on tariffs for industrial goods, trade negotiations (and disciplines) now encompass a wide and complex set of sectors, from agriculture and services to issues such as intellectual property rights, standards, and subsidies.

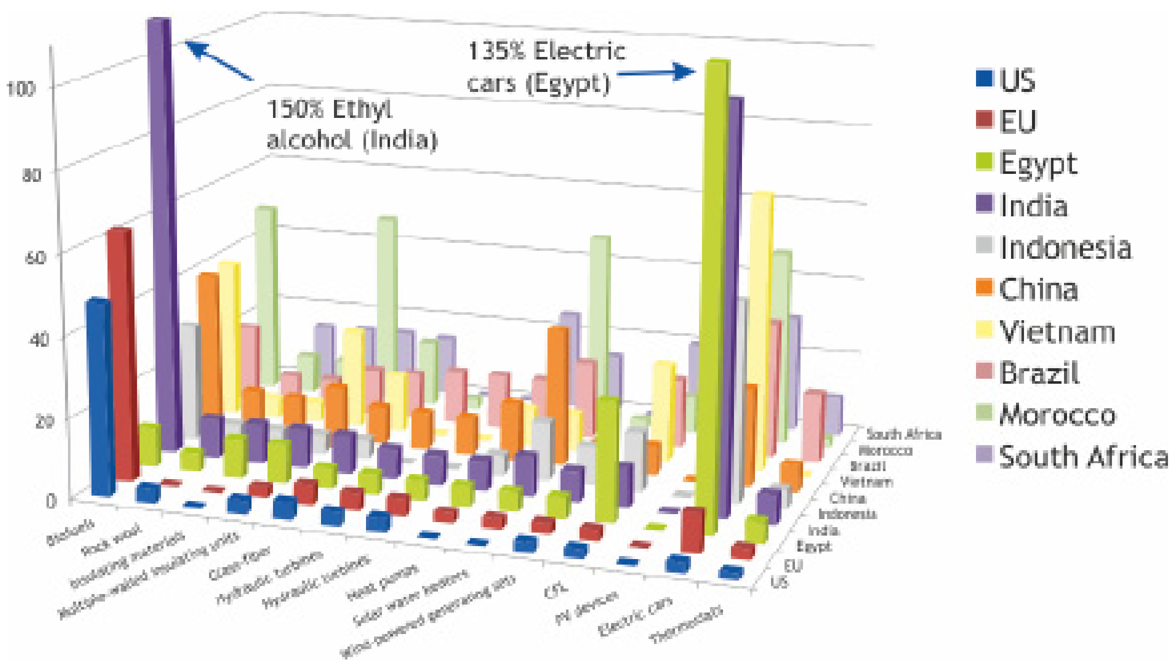
The WTO also has a dispute-settlement mechanism that is unique in its ability to enforce trade rules by means of authorising members to suspend trade-related concessions if trading partners are deemed to violate existing binding obligations. The latest round of multilateral negotiations under the WTO was launched in November 2001 at Doha in Qatar; the negotiating mandate is laid out in the Doha Ministerial Declaration. So far a successful conclusion has eluded WTO members after 10 years of negotiations. Part of the challenge in reaching an agreement lies in the fact that the WTO operates on the principle of 'unanimity,' where the consent of every member is needed to secure an outcome. Additionally, negotiated outcomes are agreed as part of a 'single undertaking' whereby 'nothing is agreed until everything is agreed.' Hence the outcomes of successful negotiations in one issue area cannot be adopted until negotiations have concluded similarly successfully in all other negotiating areas.

The GATT and WTO principles that govern international trade also apply to trade in energy and energy products.[38] As distinct from energy per se, sustainable energy goods and services (i.e. equipment and services required in the production of sustainable energy) are subject to whatever WTO rules and disciplines that may exist on goods and services in general.

Some of the key trade-related barriers are outlined below with an assessment of how they are addressed under existing WTO rules, with a quick snapshot of progress in further rule-making and liberalisation under the Doha Round of negotiations. The Doha Round represents the latest and only truly multilateral initiative to liberalise goods and services and create new trade-rules and disciplines.

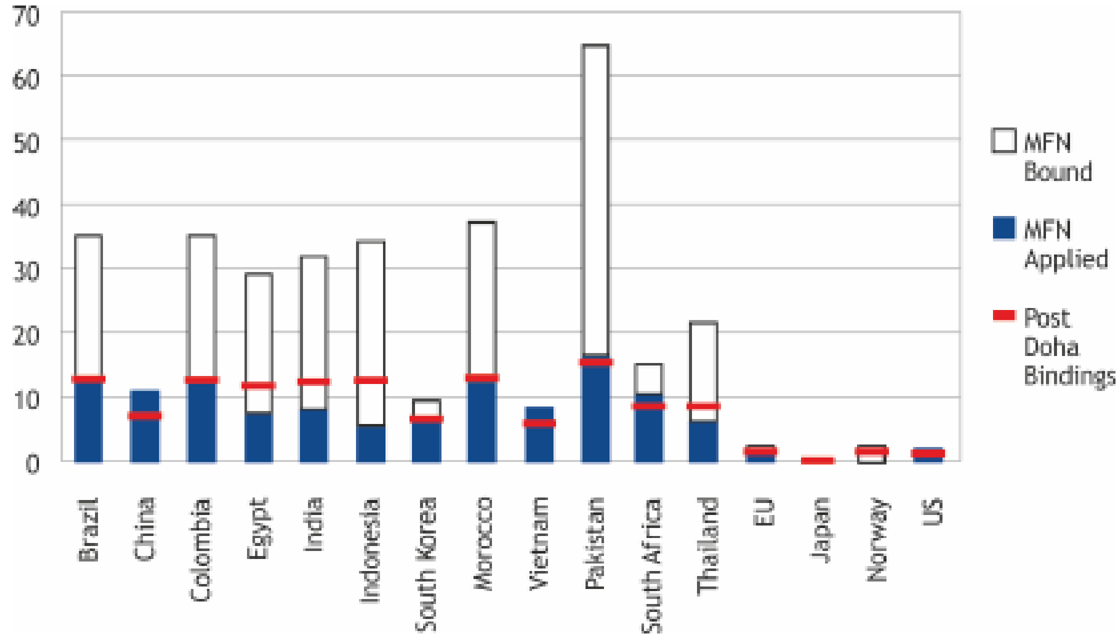
Tariffs: Tariffs are the most visible 'de-jure' barriers. However, as Figures 7 and 8 and Table 14 show, tariff levels that are actually applied by most countries for sustainable energy-related goods – such as solar panels and wind turbines – are usually in the single digits and well below 'bound' levels legally permissible under the WTO. Many countries have also autonomously lowered their tariffs as the low applied tariffs for a number of products in Figures 7 and 8 show. Table 14 shows the significant difference between bound and applied tariff rates in the case of wind turbines.

Figure 7: Applied Tariffs on Selected Climate-Friendly Products, 2008.



Source: ICTSD Analysis based on Vossenaar, R.(2010). Climate-related Single-use Environmental Goods, ICTSD Issue Paper No. 13, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Figure 8: Simple Average Bound and Applied MFN Rates on Single End-Use Goods (percent) (excl. biofuels and cars)



Source: ICTSD Analysis based on Vossenaar, R.(2010). Climate-related Single-use Environmental Goods, Environmental Goods and Services Series, Issue Paper No. 13, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Table 14: Installed Wind-Energy Capacity, Wind Turbine Imports and Import Duties

	Installed capacity (MW)		Imports of wind turbines in 2008 (USD m)	Tariffs on wind turbines (HS850231)			
	Total Installed Capacity (End of 2010)	Additions in 2010		MFN Applied		Bound	
				Rate	Range*	Rate	Range*
United States	40267	5115	2679.1	2.5		2.5	
European Union	84278	9295	106.0	2.7		2.7	
Canada	4124	836	545.2	0.0		6.2	
China	44773	18928	189.3	8.0		8.0	
India	13065	2139	2.3	7.5		25.0	
Brazil**	961	326	121.7	0.0		35.0	
Chile	172	4	15.3	6.0		25.0	
Costa Rica	123	0	25.5	0.0		45.0	
Egypt, Arab Rep.	550	120	0.7	5.0		10.0	
Korea, Rep.	381	33	102.2	8.0		n/a	
Mexico	520	316	85.4	10.0	0-20	37.5	35-40
Morocco	286	33	0.2	2.5		30.0	
Taiwan, China	519	83	90.9	10.0		10.0	
Tunisia	114	60	..	30.0	17-42	30.0	17-42
Turkey	1329	528	285.0	1.4	0-2.7	13.6	12.8-14

** Where more than one national tariff position exists.*

*** In 2009, Brazil increased its MFN applied tariff on wind turbines with capacity of up to 3,300 kVA from zero to 14 percent*

Source: Global Wind Energy Council, Global Wind Report: Annual Market Update, 2010; European Wind Energy Association, Wind in Power: 2010 European Statistics, Feb 2011; International Energy Agency, IEA Wind: 2010 Annual Report, July 2011; Vossenaar, R. (2010). Climate-related Single-use Environmental Goods, ICTSD Issue Paper No. 13, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Despite this, even low tariffs may constrain firms in optimising their supply chains, particularly for equipment and components that may be produced more cheaply elsewhere. Within the context of the current global trade regime, a World Bank study has found that a removal of tariffs and non-tariff barriers (based on ad-valorem equivalents of selected measures such as quotas and technical regulations) for four basic climate-mitigation technologies (wind, solar, clean coal, and efficient lighting) in 18 developing countries with high GHG emissions would result in trade gains of up to 13 percent.[39] While tariffs may be less of a problem compared to non-tariff measures, they should not be neglected. The emphasis on tariffs also does not understate in any way the influence of other domestic demand drivers. In many cases, as ICTSD research has also shown, demand for many environmental goods may be price inelastic and dependent on variables other than tariffs including income levels and technical assistance projects. Hence these domestic variables should not be neglected. Significantly, ICTSD research did show that in two categories of products (both relevant to climate change mitigation), namely-heat and energy management, and renewable energy -imports showed a higher sensitivity to tariff reduction than other types of environmental equipment.[40]

In the context of clean energy equipment, tariffs on final equipment as well as on inputs and components used in their manufacture need to be considered. Lowering of tariffs on inputs and components is likely to facilitate optimisation of supply chains by sustainable energy equipment manufacturers. Even binding the present levels of tariffs on clean energy goods would serve to increase predictability of market access for exporters.

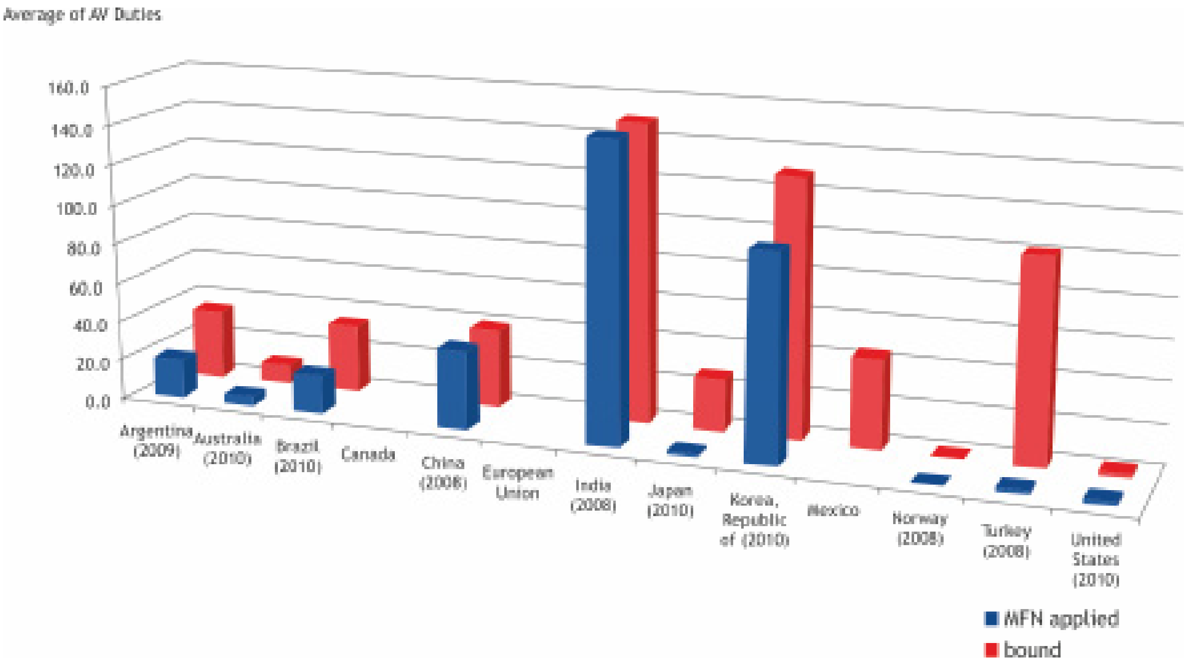
One of the greatest challenges with regard to the Doha environmental goods negotiations at the WTO – which include sustainable energy equipment – has been to define the precise scope of 'environmental goods'. Customs classification under the harmonised system (HS classifications) often groups these goods at the six-digit level with other goods, which may not have an environmental or renewable energy end use. Many countries are reluctant to reduce tariffs across the board if these would apply also to goods unrelated to sustainable energy generation. The issue is particularly sensitive if countries have domestic industries that require tariff protection for these products.

Adding to this complexity, goods that may have environmental or renewable energy applications may often also be used for non-environmental purposes. At the same time, countries have the option of fast-tracking tariff liberalisation of renewable energy-related equipment that are clearly single end-use[41] (i.e. used only for the purpose of sustainable energy generation) and by using clear product descriptions and 'ex-outs' (separating individual renewable energy-related products from others in the same category).

HS classification of biofuels has implications on how WTO disciplines apply to domestic measures aimed at these products. Until recently, both biodiesel and bioethanol used to be traded as agricultural products. In 2005, the World Customs Organization decided to put "biodiesel" in Chapter VI on "products of chemical and allied industries" (HS 382490). Bioethanol is still traded under HS 2207 in Chapter 22 on "beverages, sprits and vinegar."[42, 43] Certain countries, such as EU member states and the US, have developed their own national nomenclatures for product categories such as biodiesel and electric vehicle batteries. Such precision in classification should also be extended internationally at the World Customs Organisation (WCO). This would help to better track of trade flows and trade-related tariff concessions.

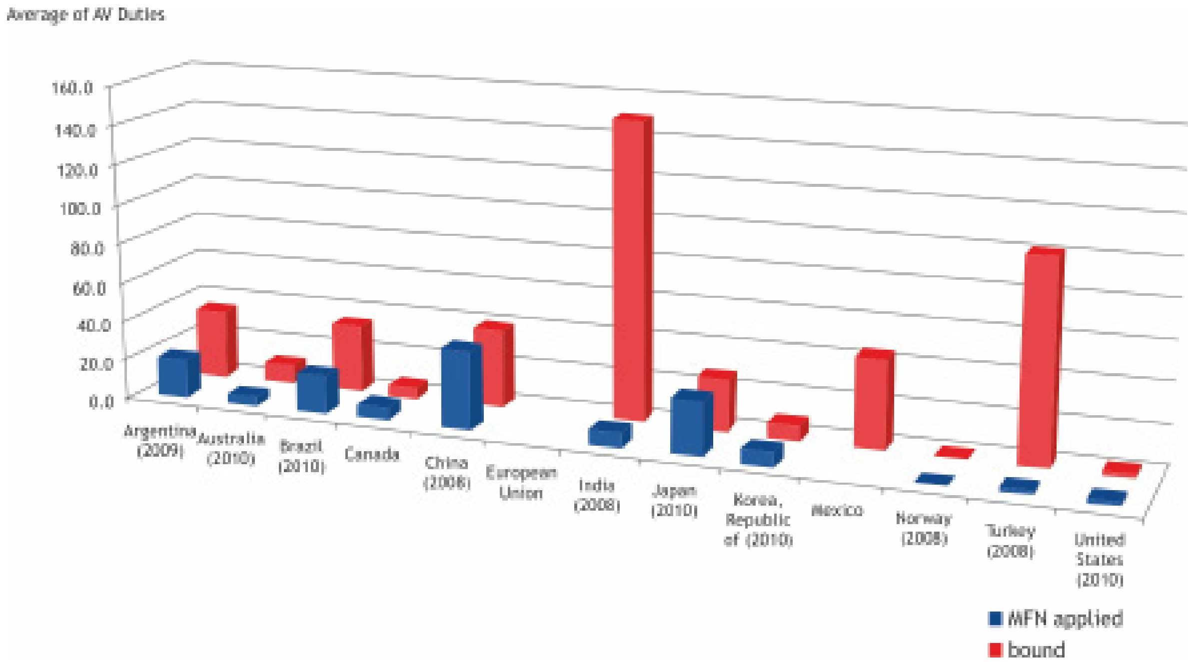
Tariff reductions for cleaner energy-related products have been proposed formally and informally as part of the WTO Doha negotiations on environmental goods by several delegations. These have included climate-friendly equipment such as solar panels and wind turbines (US, EU, and Philippines) and natural gas and related technologies (Qatar and Saud Arabia).[44] Brazil has proposed liberalising ethanol and bio-diesel which fall into the export basket for many developing countries. However owing to the deadlock in negotiations, it may be some time before these proposals are revived, if at all. In the case of ethanol, as the figures below illustrate, tariffs may not be as big a barrier to market access to the US or EU where subsidies prove the bigger obstacle. In many emerging countries, however, there appears to be scope for further reduction, particularly in bound tariffs which even though they may not increase actual trade flows could serve to enhance the predictability of actual applied protection levels.

Figure 9: Average Ad-valorem tariffs by Major Importers for Undenatured Ethyl Alcohol (HS 2207.10). MFN Applied Rates (Most Recent Year Available) and Bound Rates



Source: ICTSD Analysis based on WTO Tariff Download Facility , www.wto.org

Figure 10: Average Ad-valorem tariffs by Major Importers for Denatured Ethyl Alcohol (HS 2207.20). MFN Applied Rates (Most Recent Year Available) and Bound Rates



Source: ICTSD Analysis based on WTO Tariff Download Facility , www.wto.org

Local Content Requirements: Local content requirements (LCRs) that mandate the use of locally-made components or technologies in RE projects can induce a certain degree of investment in local manufacturing, but this is likely only in those countries which already may have fairly attractive market for sustainable energy and a decent manufacturing base. In the absence of these conditions – such as in a number of smaller countries with low manufacturing capabilities – LCRs may not result in the desired levels of investment. Local content policies have a been widely used in a number of both developed and developing countries, such as Spain, Brazil, Canada, and China.

The extent to which LCRs distort competition and affect trade may depend on the way that local content policies are designed. If policies are laid out in broad terms - such as stipulating a certain percentage or value of the investment to be sourced locally - it may offer more flexibility to the investor as opposed to LCRs that specify in detail the components and parts to be sourced locally.

Of course, the percentage of local content will also matter. LCRs may be sub-national and force firms to locate in specific geogra-phic locations. They may also be tied to government-led incentive schemes, including for procurement. Depending on the size and attractiveness of the domestic market and availability of local suppliers with the ability to manufacture the equipment and components required, LCRs will influence a firms' ability to optimise its supply chain. In many cases, as in the wind power sector in China, foreign firms will establish domestic manufacturing facilities in response to the LCRs.

In practice, LCRs are discriminatory and can, like tariffs, constrain effective organisation of sustainable energy supply chains. The Agreement on Trade-related Investment Measures (TRIMS) under the WTO as well as the organisation's Agreement on Subsidies and Countervailing Measures (SCM) both address local content measures. However, these agreements deal only with trade and investment-related local content, and not those relevant to government procurement.

Subsidies: Subsidies are an important tool used by governments worldwide to support deployment of sustainable energy and can take the form of grants, capital subsidies, soft loans and tax credits. The rapid scale up of grid-connected solar PV in recent years in countries such as Germany, Spain, the US, and Japan, even when equipment costs did not decline, can largely be attributed to government support policies for solar PV. Such support schemes appear to be needed for sustainable energy, at least until the time that it attains 'grid parity' for reasons that have been outlined in the previous chapters.

Subsidies and incentive schemes are usually granted to firms that produce sustainable energy or renewable energy equipment. In case they are provided conditional on exports, such subsidies would clearly violate WTO rules, prohibiting export subsidies. Trade impacts of other forms of sustainable energy-related subsidies may be harder to pin down and clear evidence of an adverse trade impact and 'injury' may need to be shown if a dispute does arise between WTO members. Sustainable energy production incentives by themselves need not discriminate against foreign equipment, as power producers will be able to source equipment based on competitive considerations. Feed-in tariffs provided for sustainable energy in one country often drive production and exports of equipment from another country.[45]

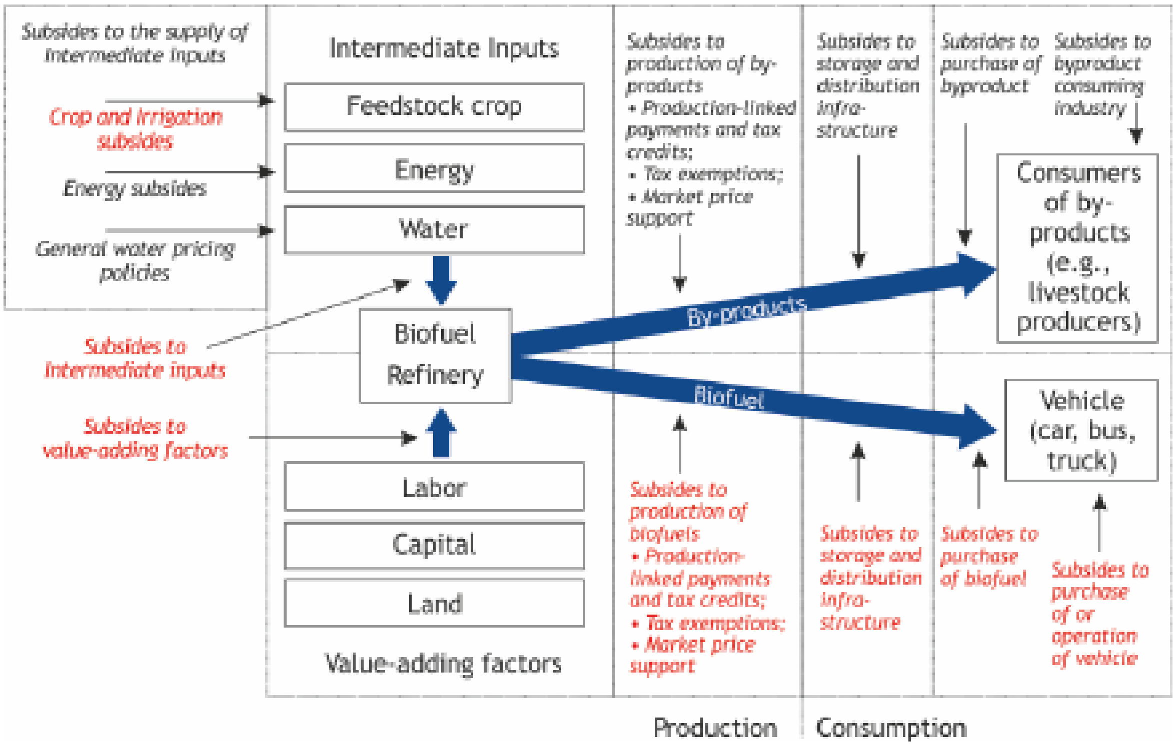
If subsidies are made contingent on the use of domestic equipment, or if subsidies are directly provided to domestic equipment manufacturers, this may affect manufacturers based abroad that previously served the market through exports.

Hence, subsidy provisions - depending on how they are designed and whether they cause adverse trade impacts or injury to foreign manufacturers - may be deemed to run afoul of WTO subsidy rules under the global trade body's Agreement on Subsidies and Countervailing Measures. Article 3.1 (b) of the SCM Agreement clearly prohibits "…subsidies contingent, whether solely or as one of several other conditions, upon the use of domestic over imported goods."

This is a consideration that WTO members need to keep in mind as they design sustainable energy incentives. As governments seek to promote domestic manufacturing and jobs in "green energy", it is likely that incentives linked with LCRs would trigger complaints and disputes at the WTO. Japan's challenge against Ontario's feed-in tariffs and a US complaint with regard to China's Wind Power Fund serve as cautious examples in this regard.[46] China has already dropped the subsidies after consultations with the US, but with increasing global green technology support and harsh competition in the sector, more cases may follow.[47]

Biofuel markets are also affected by government support measures and trade restrictions. The Global Subsidies Initiative (GSI) found that, by 2006, government support for biofuels in OECD countries (in particular for biofuel facilities, production-related payments, and exemption of biofuels from fuel excise taxes) had reached USD 11 billion a year (GSI, 2006). Eliminating distortions in biofuels trade may provide sustainable development opportunities for low-cost, developing-country producers.

Figure 11: Subsidies Provided at Different Points in the Biofuel Supply Chain



Source: Steenblik, R. Subsidies: the Distorted Economics of Biofuels, Discussion Paper. No 2007-3.OECD-International Transport Forum, 2007.

WTO rules could apply in case biofuel subsidies are found to have a trade-distorting impact. The green box provisions of the WTO Agreement on Agriculture (AoA) do not provide a broad category sheltering measures on the basis that they offer some environmental benefits. To qualify as green box support, specific requirements must be met. For instance, payments under environmental programmes must be limited to the costs of compliance with the programme. As the figure above illustrates, subsidies may be provided at different levels of the value-chain and the 'pass-on' of subsidies is particularly relevant. Ethanol is classified as an agricultural product and producers of ethanol could also benefit from subsidies provided to feedstock. But even bio-diesel, while classified as in industrial product (owing to chemical process of transformation), could also benefit from agricultural feedstock subsidies. Given the increasing trends towards subsidising new forms of biofuel sources, such as switchgrass and algae, it may be desirable to clarify how such sources would be classified and whether such subsidies would be regarded as agricultural or industrial.[48]

A number of OECD countries have also started providing grants and tax credits for the purchase of alternate fuel vehicles. Such consumer-based support, as long as it does not discriminate against imports, is compatible with WTO rules. However some governments are also providing subsidies aimed at strengthening manufacturing capacities, such as with electric vehicle batteries.

Such support may have implications for patterns of production, competitiveness and international trade flows.[49] Under the American Recovery and Reinvestment Act of 2009 (ARRA), tax credits can be awarded for qualified investments in advanced energy projects to support new, expanded, or reequipped manufacturing facilities located in the United States, including for fuel cells, advanced batteries, and electric vehicles.

China has introduced subsidies totalling up to USD 19,300 for every car sold. However, the benefits have largely been enjoyed by Chinese car manufacturers. US car-maker General Motors, for instance, was reportedly refused the subsidy for its electric car - the Volt, the first foreign commercial mass-market electric car to be imported and marketed in China, unless the company transferred some of its core technologies to a joint venture in China with a Chinese automaker. These technologies comprised electric motors, complex electronic controls, and power storage devices (whether batteries or a fuel cell). Trade experts have reportedly warned that China would risk violating WTO rules if Beijing imposed that requirement.[50]

While renewable energy subsidies need to be designed in a non-trade distorting manner, subsidies to fossil fuels, as mentioned earlier, also tilt the playing field against renewables by artificially lowering the price of competing fossil fuels. According to the International Energy Agency (IEA), as of 2009, fossil fuels had received more than USD 312 billion in subsidies, compared with USD 57 billion for renewable energy.[51] Fossil fuel subsidies may be provided to both producers and consumers. In a developing country context, where millions of people below the poverty line lack access to energy services, these subsidies may provide relief. However, they subsidies are often badly targeted and their benefits are also captured by sections of society that do not require this type of support. In any case, fossil fuel subsidy reform will need to be undertaken carefully and must accommodate the concerns of developing countries, where such policies are a politically sensitive issue. Reform of fossil fuel subsidies will help lower the subsidies' burden for renewables and enable faster attainment of 'grid parity.'

Export Restrictions, Taxes, and Dual Pricing: State energy practices affecting natural resources and energy have proven sensitive and controversial because the issue is closely linked to state sovereignty over natural resources. Notably, the issue of natural resources input pricing policy and whether such a policy can be considered a form of subsidisation of a country's exports became a subject of increasing debate and even confrontation among countries. Attempts during the GATT Uruguay Round to negotiate specific provisions regulating practices related to natural resources, including energy, did not result in an agreement.[52]

While export restrictions can have general revenue and conservation purposes, in many instances, however, their aim is to improve the competitive position of domestic processing industries vis-à-vis their foreign competitors and also attract FDI. Article XI:1 of the GATT prohibits export restrictions. Export duties are generally considered permissible, although their restrictive effects have also been pointed out. Exceptional circumstances under which countries could impose export restrictions are: (i) to relieve critical shortages of foodstuffs or other products; (ii) necessary for the marketing of commodities (Article XI: 2). The term 'marketing of commodities' has been interpreted to further the marketing of a commodity by spreading supplies of the restricted product over a longer period of time. Other permissible export restrictions relevant to energy and raw materials are related to price stabilisation (Article XX (i)), along with the conservation of natural resources (Article XX (g)) and security-related exceptions. (Article XXI).

In the absence of a general WTO ban on export restrictions in the form of duties, it is notable that some WTO Members — including China, Ukraine, and Vietnam — have made country-specific commitments to lower or eliminate certain export duties as part of their accession agreements. Within the context of the Doha negotiations on non-agricultural market access (NAMA), export duties have been notified as non-tariff barriers (NTBs).[53]

Dual pricing schemes for natural resources are another non-tariff trade barrier that has considerable trade-distorting effects. These measures are practiced in particular by Russia and Saudi Arabia with respect to natural gas. A dual pricing scheme consists of providing the natural resource cheaper internally than after export[54]: since the government has a monopoly over the natural resource, the government can fix the price. The economic effects of a dual pricing system are the same as those of an export duty. The countries practising these schemes justify them as being a WTO-compatible investment incentive.

The trade distortions caused by these schemes have been raised in the course of the WTO Doha negotiations. It is interesting to note that both the European Union and the United States consider dual pricing schemes as an issue to be dealt with in the 'rules' negotiations, rather than the NAMA talks.[55]

Legally speaking, dual pricing schemes are not specific subsidies within the meaning of the WTO Agreement, but rather confer a general benefit; therefore, they cannot be attacked under the existing WTO regime. To that effect, a possible solution would be to introduce a specific prohibition.

Given their intrusive nature and the trade distortions they create, both the European Union and the United States have suggested categorising these schemes as prohibited subsidies. This would solve the issue of specificity, since prohibited subsidies are irrefutably presumed to be specific.[56]

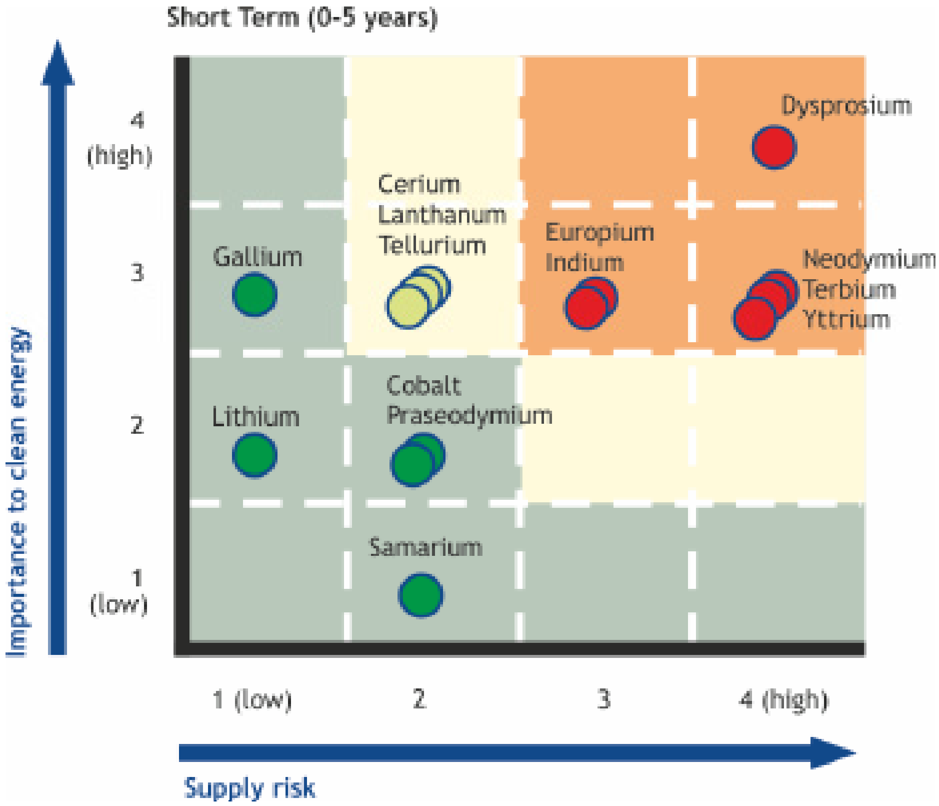
As far as sustainable energy is concerned, export restrictions could increasingly become relevant, particularly in clean-tech applications such as electric car batteries and wind turbines, given the use of certain rare earth materials such as neodymium oxide. More than 95 percent of current production of rare earth metals is currently in China. The figures below illustrate some of the key raw materials with clean energy-related applications, as well as their criticality from an importing country's (in this case US) perspective.

Figure 12: Materials in Clean Energy Technologies and Components

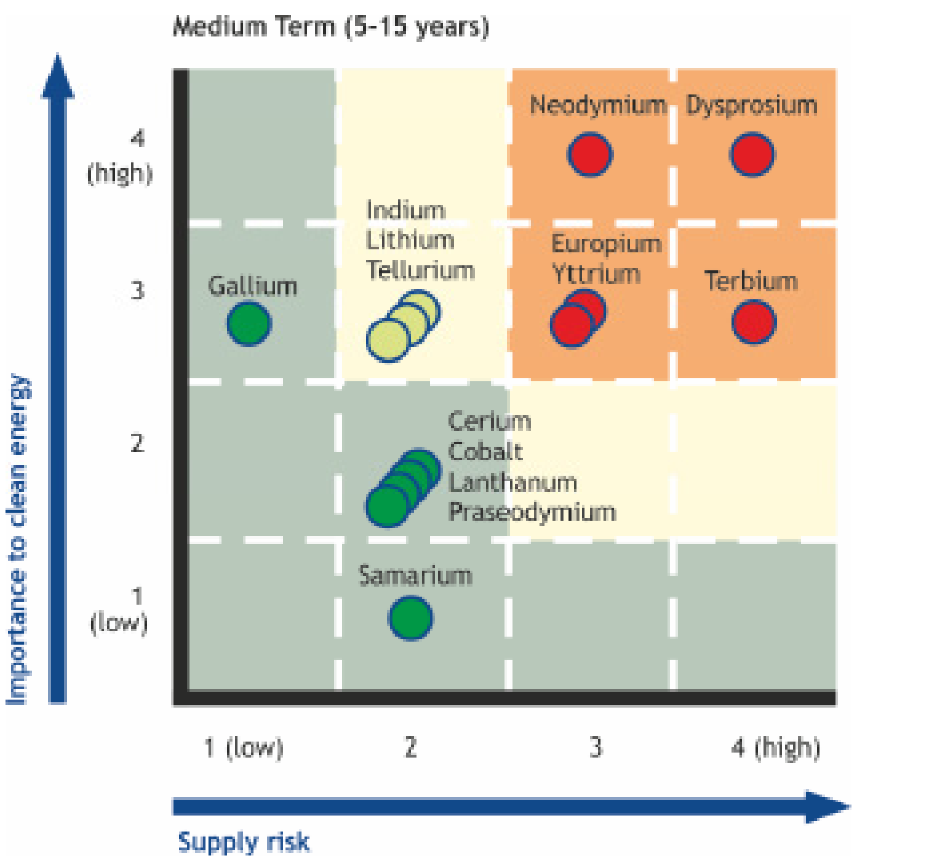
		Solar Cells	Wind Turbines	Vehicles		Lighting
	Material	PV films	Magnets	Magnets	Batteries	Phosphors
Rare Earth Elements	Lanthanum				•	•
	Cerium				•	•
	Praseodymium		•	•	•	
	Neodymium		•	•	•	
	Samarium		•	•		
	Europium					•
	Terbium					•
	Dysprosium		•	•		
	Yttrium					•
	Indium	•				
	Gallium	•				
	Tellurium	•				
	Cobalt				•	
	Lithium				•	

Source: US Department of Energy, Critical Materials Strategy, 2010.

Figure 13: Distribution of Clean Energy Relevant Raw Materials by Criticality Category: Short-term Criticality Matrix



Medium-term Criticality Matrix



Source: US Department of Energy, Critical Materials Strategy, 2010

In June 2009, the issue came to the fore when the United States and the European Union (later joined by Mexico) lodged a complaint against China, claiming that export restraints (including quotas and export taxes) imposed by China on a number of raw materials violate WTO rules.

In July 2011, a WTO Panel found that China violated international trade rules by restricting the exportation of nine raw materials, refuting Beijing's claim that these restrictions were based on environmental grounds under Article XX (g), because of the lack of a clear link between the Chinese body of regulation and the attainment of an environmental objective. Furthermore, the panel also criticised China for lacking corresponding restrictions on domestic production and consumption of these materials, which is a requirement under WTO law when claiming a GATT Article XX exemption.[57]

The case could also have ramifications for a recent decision by China to halt production of minerals at three major mines in Jiangxi province and further tighten its rare earth export quotas, a move that is expected to cut global supplies and raise global prices. These quotas were first introduced in 1999.[58] Beijing has justified the move on environmental grounds. The EU, US, and Japan are expected to discuss increasing domestic production, reducing industrial demand, increasing imports from other international suppliers such as Canada and Australia, and finding new ways to substitute for the rare earth ingredients in the production of high-tech goods. The restrictions have had an impact on prices; these remain at a high level after surging in some instances by as much as 2000 percent.

Foreign companies have expressed concern that state-controlled producers, such as Baotou - also known as Bao Gang Rare Earth - might further consolidate China's control over the global rare earths industry. According to The New York Times, the Chinese government has made a concerted effort to close 31 private rare earth processing companies and force four others into mergers with Bao Gang, making it the overwhelming giant of rare earth extraction in northern China. Such moves also highlight the significance of monopolistic or oligopolistic entities in sectors critical to sustainable energy, and also illustrates an interesting of the trade-competition policy interface.

Table 15: China's Rare Earth Export Quotas and Demand from the Rest of the World

Year	Export Quotas (tonnes REO)	Change from Previous Year	ROW Demand (tonnes)	ROW Supply (tonnes)
2005	65 609	-	46 000	3 850
2006	61 821	-6%	50 000	3 850
2007	59 643	-4%	50 000	3 730
2008	56 939	-5%	50 000	3 730
2009	50 145	-12%	25 000	3 730
2010	30 258	-40%	48 000	5 700-7 700

Source: US Department of Energy, Critical Materials Strategy. 2010.

Procurement Policies: Government procurement for sustainable energy and related equipment and services can play an important role as a driver of demand. At the same time, procurement policies can also discriminate against foreign suppliers by favouring domestic suppliers in a 'de-jure' or 'de-facto' manner. Many governments prefer to use procurement policies as a tool for promoting domestic sustainable energy capacities and industries. While this is understandable, it also means that countries may not be able to choose the most competitively priced equipment and services globally available. Hence, it is desirable that local suppliers and producers not be indefinitely sheltered from competition in government procurement.

The WTO's Government Procurement Agreement (GPA) contains rules that provide for openness, non-discrimination and transparency. However, this agreement is a plurilateral one, applicable only to countries that are parties – and therefore does not extend to the WTO membership as a whole. At present it has 14 members, including the European Union as a single entity, and excludes a number of key markets and players for sustainable energy, such as China and India. As far as services are concerned, rules that would be multilaterally applicable for procurement have not yet been developed. There is, however, a mandate for doing so under the GATS rules (Article XIII: 2).

Transparency in procurement policies can also affect suppliers of sustainable energy goods and services. Even if there are preferences provided to local suppliers as a means to promote local industries, these preferences should be transparent and clear so that foreign suppliers know what to expect. Even if a country's procurement market is otherwise open to foreign bidders, lack of transparency and clarity in procedures can impose unnecessary costs upon foreign suppliers who may wish to participate in the domestic procurement market. Such lack of transparency may even operate as 'de-facto' protectionist measures.

The multilateral Working Group on Transparency in Government Procurement – established by the Singapore Ministerial Conference – was mandated to conduct a study on transparency in government procurement practices that took into account national policies. Based on this study, the Working Group should develop elements for inclusion in an 'appropriate agreement'.

Para 26 of the Doha Declaration recognises the "case for a multilateral agreement on transparency in government procurement and the need for enhanced technical assistance and capacity building," taking into account the development priorities of participants, especially least developed countries. The Declaration also clarifies that the negotiations "shall be limited to the transparency aspects and therefore will not restrict the scope for countries to give preferences to domestic supplies and suppliers." In addition, members committed themselves to "ensuring adequate technical assistance and support for capacity building both during the negotiations and after their conclusion." The declaration also provided for negotiations on the subject to be launched on the basis of an 'explicit consensus' at the Fifth Ministerial Session at Cancun.

Discussions after Doha in the Working Group have seen disagreements on the scope of WTO provisions in this area. Many members such as the US, EU and Switzerland want as broad a scope as possible and believe that greater transparency would not diminish members' ability to use procurement as a tool to meet various socio-economic objectives. Developing countries, on the other hand, have expressed concern over the 'intrusiveness' of potential rules. Some are opposed to any obligation that requires notifying members of all tenders (structured invitations by governments or government agencies to suppliers for the supply of goods and services) or translating them into the official languages of the WTO, as well as to WTO reviews or examination of domestic laws and regulations. While certain countries, such as Japan, have called for a legally binding and effective transparency agreement, many developing countries are against dispute settlement procedures applying to this area.

In the aftermath of the failure to reach an 'explicit' consensus on launching negotiations in Cancun, transparency in government procurement was finally dropped from the Doha negotiations on 1 August 2004.[59]

Standards and Certification: Technical standards and requirements are imperative for the successful performance of sustainable energy equipment, and consequently for the projects in which this equipment is being used. Technical standards are important in conveying confidence and trust between manufacturers, operators, owners, financial institutions, and government authorities. Standards can be either 'design-based' or 'performance-based'. Greater harmonisation of standards enables easier and quicker deployment of equipment across projects and countries, supporting the development of economies of scale. Minimum performance standards are also necessary for renewable energy producers to obtain project-specific financing from commercial banks, and this in turn implies that these producers use certified equipment as well.

The need to comply with different foreign technical regulations and standards involves significant costs for producers and exporters. General costs arise from the translation of foreign regulations, hiring of technical experts to explain foreign regulations, and adjustment of production facilities to comply with the regulations. Additionally, producers need to prove that the exported product meets the foreign regulations. The high costs involved may discourage manufacturers from trying to sell abroad.

In the absence of international disciplines, the risk exists that technical regulations and standards could be adopted and applied solely to protect domestic industries. The WTO's Technical Barriers to Trade (TBT) Agreement regulates the application of standards. Article 2.2 of the TBT requires that technical regulations "are not prepared, adopted or applied with a view to, or with the effect of, creating unnecessary obstacles to trade." Technical regulations in accordance with relevant international standards are presumed "not to create an unnecessary obstacle to international trade."[60]

The TBT also encourages members to base their national regulations, or parts of them, on existing international standards, unless "their use would be ineffective or inappropriate" with regard to fulfilling a given policy objective.

Standards are important when new products and innovations, such as energy storage technologies and smart-grid applications, enter the market. There is a danger that standards may be set so as to favour domestic manufacturers, particularly if international standardisation efforts do not keep up with new products and innovations that emerge. It may be in the interests of countries to move towards harmonisation, mutual recognition and equivalence, taking cognizance of work in bodies such as the International Electro-technical Commission (ICE).

Increasing energy efficiency is an important tool for mitigating climate change. According to the International Energy Agency's (IEA) World Energy Outlook, energy efficiency can contribute as much as 65 percent to GHG emission reductions in 2020. Energy efficiency policies are increasingly used to promote and accelerate the deployment of energy efficiency technologies, which include energy performance standards and energy labelling. These requirements, however, can form trade barriers if they differ by country and region and can hinder trade flows in energy efficient goods and technologies.

While efforts at harmonising these standards have been increasing, they are so far limited to a handful of industrialised countries. Many developing countries have lagged behind in developing their own energy efficiency policies, designing and implementing standards, and participating in international harmonisation efforts. For these countries, energy efficiency policies of other countries can still form important trade barriers even if harmonised. Hence it is very important that developing countries develop standards and labelling programmes for energy efficiency and that there also be greater efforts at harmonisation, mutual recognition, or equivalence between standards of various countries.

Doing so will not only facilitate trade in energy efficient products, but will also allow countries to pursue their energy efficiency goals with the least possible impact on trade. Greater involvement of developing countries in harmonisation efforts will also be important in case of any technology transfer commitments that come out of the UNFCCC/Kyoto Protocol process.[61] While energy efficiency is outside the scope of this paper, it does recognise that initiatives on energy efficiency will continue to be an important pillar of global climate change mitigation efforts and facilitating trade in energy efficient products could play a key role in such efforts.

Sustainability-related standards and certification will also increasingly play a role in the biofuels trade given that existing biofuels – ethanol and bio-diesel – can be produced in a variety of ways and from various feedstocks with varying environmental impacts. The larger life cycle-related environmental concerns associated with biofuel production will also need to be kept in mind. The US Renewable Fuel Standard (RFS), which mandates increasing amounts of "renewable" fuels in the US gasoline supply (almost entirely ethanol), includes sub-standards for cellulosic ethanol and "advanced biofuels," which are defined as those that decrease greenhouse gas emissions by at least 50 percent compared with gasoline.

In 2010, the US Environmental Protection Agency (EPA) confirmed that sugarcane ethanol from Brazil qualified as an advanced biofuel (EPA calculations showed that sugarcane ethanol from Brazil reduces GHG emissions compared to gasoline by 61 percent, using a 30-year payback for indirect land use change (ILUC) emissions). In the EU, the 2009 Renewable Energy Directive – which commits each Member State to reach the target of a 10 percent share of renewable energy in total energy consumption in the transport sector by 2020 – only permits biofuels with high GHG savings to be counted for the national targets and to benefit from lower excise tax rates. The initial threshold of 35 percent savings compared with petrol and diesel will rise to 50 percent by 2017 and to 60 percent for new facilities.[62]

The role of standards could continue to be critical for second and third-generation biofuels derived from lingo-cellulosic ethanol and algae once they enter the market. Such standards, labels, and conformity assessment procedures will need to be assessed in the context of relevant GATT/WTO provisions, particularly if they deal with process and production methods (PPMs). Similarly, standards could increasingly become important in new areas of energy generation, as well as sustainable transport-related technologies such as 'smart grids' and electric car batteries. Private sector standards and labelling will also become important and, while non-mandatory, they may affect market access opportunities for exporters. Their legality is an issue that is not completely clarified under WTO rules. On these standards, if possible for specific sectors such as biofuels. The Kimberly Process certification scheme for instance has been pointed out as a model.[63]

Services: Trade in services plays as critical a role in sustainable energy investments as trade in equipment or goods does. Sustainable energy projects often involve the use of both goods and services as inputs. As mentioned earlier, sustainable energy projects involve the construction, operation, maintenance, and financing of power projects. All this involves services often rendered by diverse firms specialising in these services. Many of these services may be provided most cost-effectively by firms based abroad. These firms might, however, face obstacles in accessing foreign markets. These obstacles are of a very different nature from the ones facing goods.

Unlike goods that have to physically cross a border to reach consumers, trade in services happens through four modes of supply. The first is Mode 1-Cross-border supply, where services are supplied across borders without dislocation of the service supplier or consumer. For example, a software programmer based in India delivers a service to a client in the US via the internet. The second, Mode 2-Consumption abroad, involves movement of consumers across borders to consume a service. For instance, when Americans travel to India for medical treatment in Indian hospitals, India is exporting medical services to the US. Thirdly, Mode 3-Commercial presence involves the establishment of a service provider in the domestic territory of a country to deliver a service. For example, when Bank of America establishes branches in India, the US is exporting banking services to India via Mode 3. Lastly, Mode 4-Movement of Natural Persons is where services are delivered by individuals that temporarily relocate to the country from abroad to provide a service, such as when technical repair personnel from Abengoa – a solar thermal firm in Spain - travel to India to fix a technical problem at their solar thermal power plant in India.

Under WTO rules, trade in goods is subject to different rules than trade in services. The former is governed by the General Agreement on Tariffs and Trade (GATT) and the latter by the General Agreement on Trade in Services (GATS). In certain cases, such as when firms are involved in both generation and transmission of electricity, it is possible that provisions of both goods and services agreements will apply. In general, the multilateral debate regarding the definition and coverage of energy leads to the tentative conclusion that, within the existing WTO framework, the generation of electricity (including renewable electricity) falls under the scope of the goods agreement, while transmission, distribution, and related services fall under the scope of the GATS. Electricity also has a specific customs code under the Harmonised System (HS 2716.00).

Sustainable energy-related services do not find explicit mention within existing classifications proposed for environmental services or under a category titled 'energy services'. As far as energy is concerned, the W/120 does not include a special section for energy services, but only three separate sub-sectors that are related to energy activities: (1) "services incidental to mining, rendered on a fee or contract basis at oil and gas fields"; (2) "services incidental to energy distribution" listed under "Business services"; and (3) "transportation via pipeline of crude or refined petroleum and petroleum products and of natural gas" listed under "Transport Services". Moreover, some energy-related activities, not exclusive to the energy sector, such as construction, consulting, business, communications, financial services, and engineering are covered by other sections.

Within the WTO, the negotiations on environmental services are facing the challenge of updating the current GATS classification, as the agreement does not reflect the evolving structure of the industry. In particular, the current classification (W/120) of environmental services largely focuses on infrastructural services, despite "non-infrastructural" services such as air pollution control or environmental consulting emerging as important activities in recent years, primarily due to increasingly demanding environmental regulations.

As far as environmental services are concerned, several proposals classification-related issues are under scrutiny of members. Some Members have based their proposals on the classification developed by the OECD/the Statistical Office of the European Community (EuroStat), which includes three categories of environmental services: pollution management, cleaner technologies, and resource management. The EU proposed seven subsectors based on the environmental media (air, water, soil, waste, noise, etc.) to comprise the classification, in order to preserve the mutually exclusive character of the W/120 list.

The WTO Services Sectoral Classification list (W/120) is based on the UN Central Product Classification (CPC).[64] However, there have been a number of proposals by Members who consider that it needs updating. Certain environmental services overlap increasingly with services classified within other services sectors. Several proposals have been being put forward to address the issue of dual use services.

In a submission as early as 1999 (S/CSC/W/25), the EU stated that the list did not, for instance, reflect changes in the environmental industry which was developing beyond traditional end-of-pipe/pollution control/remediation/cleanup towards integrated pollution prevention and control, cleaner technology and resources and risk management. The EU proposed an alternative classification comprising 'core' services which can undisputedly be classified as "purely" environmental and where the services are classified according to the environmental media (i.e. air, water, solid and hazardous waste, noise, etc.). Thus, the mutually exclusive character of the W/120 list is preserved. In addition, subsequent EU submissions in 2000 (S/CSS/W/3 and S/CSS/W/38) also propose a 'cluster' approach whereby conceptual services such as design, engineering, R&D and consulting services which have an environmental 'end-use' would be subject to a special 'cluster' or 'checklist'. The checklist would be used as an aide-memoir during the other sectoral negotiations. Thus, commitments for these 'end-uses' could be scheduled within relevant GATS sectors, other than the environment.

Canada supports the EU's 'cluster' approach, encouraging liberalisation in all Modes of delivery. In particular, Canada distinguishes between the present list of environmental services (core services) and other related services (non-core or dual-use services) and stresses the importance of liberalising both services at the sub-sectoral level. The proposals by the US and Switzerland are largely in line with the classification of 'core' versus 'non-core' services. Services related to sustainable energy could exacerbate the issue of 'dual use', since these particular services appear to spread across multiple sectors classified in W/120.

Colombia, while accepting the EU classification as a working basis, has added three more services: (i) the implementation and auditing of environmental management systems; (ii) the evaluation and mitigation of environmental impact; and (iii) advice in the design and implementation of clean technologies (S/CSS/W/121). Some delegations have cautioned against Members making unintended commitments in a number of other sectors while liberalising under the 'cluster approach'.

Presently, Members are free to make use of their own classifications. Multilaterally accepted classification issues can be worked out within the WTO Committee on Specific Commitments (CSC). Sector-specific discussions in the CSC have focused on specific questions, namely:

- Spelling out of remaining CPC categories and making them more visible in the classification;

- Restructuring of the environmental sector into seven instead of four sub-sectors (based on various environmental media, water, air, waste and noise, etc.);

- The specific relation of consultancy services related to environmental services. Many Members have proposed that environmental consultancy services be included explicitly under environmental rather than consultancy services. While no consensus has been reached, some Members such as the EU, the US, Australia and Norway are using these proposals in their offers.

These and other proposals could be worked out further in the SETA, focusing specifically on services related to sustainable energy generation and use.

Table 16 below is based on recent ICTSD analysis and shows broad services sectors as well as sub-sectors relevant to climate change mitigation. These are based on the recent (second) version of CPC classification which was completed on 31 December 2008.[65]

Table 16. Key Sectoral Mitigation Technologies, Policies, Measures, and Services that are Directly Related to the Implementation of Such Policy Measures

Sector	Key Mitigation Technologies and Practices Currently Commercially Available[66]	Related Services at UN CPC (ver.2) Class and sub-class Levels	Corresponding Division in the CPC (ver.2)
Energy supply	Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power; early applications of carbon dioxide capture and storage (CCS) (e.g. storage of removed CO_2 from natural gas)	- General construction services of power plants [54262] - Site preparation services [543] - Installation services [546]	Construction services [54]
		- Management consulting and management services; information technology services [831] - Engineering services for power projects [83324] - Surface surveying services [83421] - Composition and purity testing and analysis services [83441] - Other technical testing and analysis services; radiological inspection of welds [83449] - Other professional, technical and business services n.e.c.[839]	Other professional, technical and business services [83]
		- Private network services [8414] - Data transmission services [8415] - Internet communication services [842] - On-line content [843]	Telecommunications, broadcasting and information supply services [84]
		- Hazardous waste treatment and disposal services [9432]	Sewage and waste collection, treatment and disposal and other environmental protection services [94]

Chapter 4

Table 16. *Continued*

Sector	Key Mitigation Technologies and Practices Currently Commercially Available[66]	Related Services at UN CPC (ver.2) Class and sub-class Levels	Corresponding Division in the CPC (ver.2)
Transport	More fuel-efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning	- General construction services of railways [54212]	Construction services [54]
		- Engineering services for transportation projects [83323] - Composition and purity testing and analysis services [83441]	Other professional, technical and business services [83]
		- Interurban railway transport services of passengers [64210] - Supporting services for railway transport (6730]	Passenger transport services [64][67] Supporting transport services [67]

Table 16. *Continued*

Sector	Key Mitigation Technologies and Practices Currently Commercially Available[66]	Related Services at UN CPC (ver.2) Class and sub-class Levels	Corresponding Division in the CPC (ver.2)
Buildings	Efficient lighting and daylighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves, improved insulation; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycling of fluorinated gases	- General construction services of residential buildings [5411] - General construction services of non-residential buildings [54112] - General construction services of local pipelines and cables and related works [5425] - Installation services [546]	Construction services [54]
		- Management consulting and management services; information technology services [831] - Engineering services for building projects [83321] - Architectural services and advisory services [8321] - Surface surveying services [83421] -Composition and purity testing and analysis services [83441]	Other professional, technical and business services [83]
		- Private network services [8414] - Data transmission services [8415] - Internet communication services [842] - On-line content [843]	Telecommunications, broadcasting and information supply services [84]

Table 16. Continued

Sector	Key Mitigation Technologies and Practices Currently Commercially Available[66]	Related Services at UN CPC (ver.2) Class and sub-class Levels	Corresponding Division in the CPC (ver.2)
Industry	More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO2 gas emissions; and a wide array of process-specific technologies	- General construction services of mines and industrial plants [5426] - Installation services [546]	Construction services [54]
		- Management consulting and management services; information technology services [831] - Engineering services for industrial and manufacturing projects [83322] - Surface surveying services [83421] - Composition and purity testing and analysis services [83441]	Other professional, technical and business services [83]
		- Private network services [8414] - Data transmission services [8415] - Internet communication services [842] - On-line content [843]	Telecommunications, broadcasting and information supply services [84]

Source: Kim, Joy A. (2011); Facilitating Trade in Services Complementary to Climate-friendly Technologies; ICTSD Programme on Trade and Environment; Environmental Goods and Services Series; Issue Paper 15, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Trade in services faces a greater number of restrictions than trade in goods. Barriers to trade in services are closely linked to domestic regulatory policy objectives, such as greater employment for nationals, restricting flows of migrant labour, and protection of domestic firms. Measures that restrict access to foreign sustainable energy service providers in a country's market would constitute both an investment restriction and also a restriction on trade in services under Mode 3 (commercial presence). The schedule of WTO services commitments reflects to what extent a country has legally bound its market access. The flexible nature of GATS commitments mean that countries are not obliged to commit a particular sector for market opening. Even if they do decide to commit a sector, they can still schedule exceptions and restrictions with regard to market access. They might, for instance, provide access for foreign companies only to certain sectors and sub-sectors or certain geographical locations or in Modes of entry. They may also restrict the scope of national treatment, for instance limiting foreign equity in a certain sector.

These GATS commitments, as they apply to Mode 3, also reflect the extent of investment liberalisation that a WTO Member is legally obliged to undertake. Many countries have liberalised investments autonomously in all modes of services entry much beyond what they are legally obliged to do (autonomous liberalisation). In India's electricity sector, for instance, 100 percent FDI is allowed in generation, transmission, distribution, and electricity trading. Countries may also wish to secure access for the temporary movement of their service providers to foreign countries (Mode 4). Obstacles in this regard can hamper effective implementation of sustainable energy products. For example, Suzlon, an Indian company, faced visa problems for its engineers that were needed in Brazil to set up wind power installations.

While autonomous liberalisation in services may have improved actual conditions of access for sustainable energy service providers, liberalisation coupled with legally binding commitments would serve to increase predictability of access.

Table 17. Major Exporters and Importers of Architectural, Engineering and Other Technical Services (in USD million)

Exporters	Value	Importers	Value
European Union (27)	39,212	European Union (27)	25,169
Extra-European Union (27) exports	22,657	Extra-European Union (27) exports	10,331
India	7,360	India	2,746
United States	5,020	Canada	2,560
Canada	4,066	Brazil	1,708
Brazil	3,033	Russian Federation*	1,616
Norway	2,144	Kazakhstan*	1,289
Russian Federation*	1,571	Singapore	977
Singapore	1,398	Norway	579
Australia	955	Korea, Rep.	531
Korea, Rep.	253	Australia	370

Source: Cattaneo et al. (2010) derived from WTO (2007). *Note: * Not a WTO Member*

Research by ICTSD shows that only a handful of the countries have made full commitments in service areas related to the energy sector, such as construction and engineering. The principal Modes of supply for the complementary services for sustainable energy technologies are Mode 3 ('commercial presence') and Mode 4 ('movement of natural persons'). However, they appear to be largely limited, as the majority of countries concerned have put specific as well as horizontal limitations on Modes 3 and 4. Countries have also restricted national treatment for a number of sectors. No discernable progress seems to have been made on members' new commitments in their initial or revised offers. While it is true that many of the services relevant to sustainable energy supply, such as construction and engineering, could also apply to other sectors (housing or roads, for instance), members are always free to limit

GATS concessions made in these services solely to those related to sustainable energy supply.

A variety of domestic laws, regulatory measures, and administrative rules could also affect trade in these services. In particular, regulations concerning government procurement could have a significant impact on trade in these services given that the public sector is the largest client in this area.

Investment: Investment-related issues are crucial to the expansion of sustainable energy supply. A stable, transparent, and predictable investment framework, coupled with an attractive set of incentives and regulation, can send a positive signal to potential sustainable energy investors. Obviously, investment flows into sustainable energy will also be determined by the existence of sound macro-economic indicators, such as availability of infrastructure, skilled labour, rule of law, etc., as mentioned previously in this paper. Conditions of entry for foreign companies are usually reflected in domestic laws and provisions on FDI, as well as in particular provisions of any bilateral investment agreements (BITs) signed by member states. The WTO's Agreement on Trade-Related Investment Measures already prohibits the use of local content measures, trade-balancing requirements, and export restrictions, with certain exceptions for developing countries.

A broader agreement on a multilateral investment framework has been difficult to reach. Para 20 of the Doha Ministerial declaration provided for negotiations on trade and investment after the Fifth Session of the Ministerial Conference (held in Cancun) on the basis of a decision that would be taken by explicit consensus. This provision recognised the case for a multilateral framework to secure transparent, stable, and predictable conditions for long-term cross-border investment, particularly FDI, which would contribute to the expansion of trade. This provision also recognised the need for enhanced technical assistance and capacity-building in this area. The explicit consensus was not achieved and investment was also dropped from the Doha negotiating agenda in the aftermath of the Cancun failure.

Several of the issues that were discussed in the WTO Working Group on Trade and Investment, which was mandated by the 1996 Singapore Ministerial Declaration, are also of relevance to investments in sustainable energy. These include: **scope and definition** (for instance whether to include trade-creating investments or also portfolio investments); **transparency** (including the possibility of binding obligations or commitments on transparency); **non-discrimination**; modalities for **pre-establishment commitments** based on a GATS-type positive list approach (i.e. commitments only apply to sectors explicitly listed); **development provisions**; **exceptions and balance-of-payments safeguards and consultation**; **and the settlement of disputes between members**. During discussions in the WTO Working Group, some Members also stressed that these issues were not exhaustive and others, such as performance requirements, could also be discussed.[68]

Para 21 of the Doha Declaration also recognised the needs of developing and least developed countries for enhanced support for technical assistance and capacity building in this area. They would need support in, among other areas, policy analysis and development in order to evaluate better the implications of closer multilateral co-operation for their development policies and objectives, and human and institutional development.

All of these issues also affect the sustainable energy sector. In the interest of catalysing and providing a more stable and predictable environment for sustainable energy investors, early pioneering efforts could be undertaken to address these issues as they pertain to sustainable energy - irrespective of the stalemate on broader discussions in the WTO. Building the capacity of developing countries to absorb potential investment-driven technology flows could also be an outcome from such an agreement.

Competition Policy: Competition policy helps check abuse of monopolistic or oligopolistic power by firms and the formation of cartels. This a very real possibility in the sustainable energy sector, particularly in the case of new 'breakthrough' technologies that may be developed by one or a select number firms. In certain sectors, such as concentrated solar thermal power generation, only a handful of companies worldwide may possess the requisite capacities and technology.

Sustainable energy is an area that is also characterised by requirements of networks (such as for transmission and distribution). There may be a need for rules that grant fair access for all sustainable energy producers to such networks. In the case of 'breakthrough' technologies, where one or a few companies have intellectual property rights on the technology, effective competition policy may help prevent monopolistic abuse of such technologies.

An open trade policy is sometimes regarded as the best competition policy, as it enables goods and services produced anywhere in the world to enter a domestic market on the most competitive terms and conditions. While sustainable energy also competes with conventional forms of energy, proactive government policies and incentives to encourage sustainable energy deployment make it a distinct sphere, within which rules of competition should apply so that the consumer is not exploited. In the end, societies' and governments' objective should be to ensure that sustainable energy production is competitive and that prices trend downwards. Ensuring a competitive market place for sustainable energy will speed up this process.

Like investment and transparency in government procurement, competition policy was included for possible negotiations following the Doha Ministerial declaration. As was the case with investment, there was a failure to reach consensus on launching negotiations during the Fifth Session of the WTO Ministerial Conference in Cancun.

Para 23 of the Doha Declaration recognised that a multilateral framework could enhance the contribution of competition policy to international trade and development. Para 25 provided for the Working Group on the Interaction between Trade and Competition Policy to focus on the clarification of (i) core principles, including transparency, non-discrimination, and procedural fairness, along with and provisions on hard-core cartels; (ii) modalities for voluntary co-operation and support for progressive reinforcement of competition institutions in developing countries through capacity building. All of these issues would apply to sustainable energy.

Discussions in the Working Group on Trade and Competition Policy established by the WTO saw a number of fault lines on the scope of a possible agreement. These ranged from whether certain forms of cartels could be defended on grounds of efficiency, to whether the national treatment provision should be applied unconditionally. Many developing countries called for special and differential treatment and some even called for exceptions to the national treatment provisions on the grounds of development. WTO Members generally agreed that the mandate did not imply harmonisation of national competition laws and that developing countries would require flexibility and progressive adoption of any WTO obligations resulting from negotiations.

Inclusion of provisions on technical assistance and capacity building were critical in ensuring 'buy-in' from developing countries at the time of the Doha Ministerial, although consensus to launch negotiations could not be secured.

Like investment and transparency in government procurement, competition policy has also fallen off the Doha agenda following the failure to reach an 'explicit consensus' to launch negotiations at Cancun.[69]

The GATS contains limited provisions that deal with the conduct of private entities such as monopolies and exclusive service suppliers. Restrictive business practices by incumbent operators are subject to Article VIII and Article IX. Article VIII is especially relevant to gas transportation and distribution services and requires Members to ensure that the incumbent natural monopolist in the transportation and distribution market does not act in a manner inconsistent with the most favoured nation (MFN) principle and with the Member's specific commitments. In addition, if such a monopoly supplier competes in the supply of a service outside the scope of its monopoly rights, the Member has to ensure that the incumbent monopolist does not abuse its position subject to the Member's specific commitments.

While these are commendable rules, the basic problem is that most Members undertook relatively limited commitments within energy services. The United States and Norway proposed to devise a Reference Paper for energy services, modelled on the Reference Paper to the GATS Agreement on Basic Telecommunications Services, and to develop a set of rules for cross-border energy trade but the negotiations failed to receive impetus.[70] These issues may be particularly relevant for trade in sustainable energy, particularly electricity, as it requires access to grids and facilitation by grid owners that may be state utilities or monopolistic entities.

Trade Facilitation and Transit: Cumbersome customs clearance procedures and delays at the border significantly add to the costs of doing business for any firm. This also applies to firms supplying sustainable energy equipment. The 2011 World Bank Doing Business report estimated that costs incurred by businesses as a result of documents involved in exporting and importing, as well as the number of days it took to export and import. Export-related costs per container ranged from USD 889.8 in East Asia to USD 1961.50 in Sub-Saharan Africa. Import-related costs per container ranged from USD 934.7 in East Asia to USD 2491.80 in Sub-Saharan Africa. Figures for OECD countries ranged from USD 1058.70 per container for exports and USD 1106.30 for imports. More efficient trade facilitation procedures would certainly result in cost savings per container. Over a large volume of containers, this could make a significant difference to firm operating costs.

Trade facilitation was one of the 'Singapore' issues - along with investment, competition policy, and transparency in government procurement - pinpointed for possible negotiations at the end of the Doha Round on the basis of 'explicit' consensus. Para 27 of the Doha Declaration provided that, until the Fifth WTO Ministerial Conference, the Council for Trade in Goods "shall review, and as appropriate, clarify and improve relevant aspects of Articles V (Freedom of Transit), VIII (Fees and Formalities Connected with Importation and Exportation) and X (Publication and Administration of Trade Regulations) of the GATT 1994 and identify the trade facilitation needs and priorities of members, in particular developing and least-developed countries."

Unlike the other three 'Singapore' issues, an explicit consensus was secured for launching negotiations on trade facilitation after Ministerial-level negotiations in July 2004 in Geneva. Subsequent discussions in the newly established Negotiating Group on Trade Facilitation have witnessed significant progress in comparison with a number of other issues in the Doha Round. Any WTO agreement on trade facilitation would depend either on a successful conclusion in other negotiating areas or being agreed as part of an 'early harvest' due to lack of overall agreement in the round.

Of the issues included in a trade facilitation agreement, freedom of transit would be of particular significance to cross-border sustainable energy suppliers, specifically for the cross-border export of electricity generated from renewable sources. Cross-border trade in electricity is already common within the EU and between the US and Canada. There are a number of initiatives in the pipeline involving trade in electricity and the interconnection of electricity grids across regions and even continents. These include exports of hydro-power from the Central Asian republics to India via Afghanistan and Pakistan, and solar-thermal power from the deserts of North Africa and the Middle East to Europe (under the 'Desertec' initiative). Such initiatives would be facilitated by some sort of an agreement or understanding among countries on transit access for such energy.

Chapter 5

Governance Gaps and the Need for a Sustainable Energy Trade Agreement

Trade in Sustainable Energy Goods and Services (SEGS) is affected by rules and disciplines that are developed in multilateral, plurilateral, regional, and bilateral forums. These rules and disciplines include the WTO as well as other regional trade agreements and bilateral investment treaties. In addition, trade in sustainable energy goods and services is affected by negotiating and rule-making forums set up to address broader issues of climate change, such as the UNFCCC, or issues of energy transit, such as the Energy Charter Treaty.

The WTO

A number of the barriers listed above could certainly be addressed in the context of existing WTO rules or potentially as part of the Doha Round of trade negotiations. However, while WTO disciplines and rules exist on these issues, they are often ambiguous or unclear in many aspects as far as the energy sector is concerned. For example, a comprehensive and universally accepted classification of energy services, including sustainable energy services, is missing, and instead liberalisation negotiations are scattered across sectors such as engineering, construction, maintenance, and consultancy. This could lead to an incoherent approach within WTO negotiations and ineffective outcomes as far as meaningful market access for sustainable energy services are concerned.

The Doha negotiations have also dealt with sustainable energy goods and services in a piecemeal manner and have failed to make much headway. Negotiations on issues relevant to market access for sustainable energy goods and services are scattered across various negotiating committees and bodies, such as the Committee on Trade and Environment (charged with defining the scope of environmental goods), the negotiating group on non-agricultural manufactured goods (charged with dealing with the modalities of tariff reduction on manufactures) and agriculture (for agricultural goods). The Council for Trade in Services is responsible for negotiations on liberalisation of services, as well as for developing rules for procurement in services. Rules on standards are discussed in the Committee on Technical Barriers to Trade, while the plurilateral Committee on Government Procurement administers the GPA.

Negotiations on environmental goods (relevant to trade in sustainable energy equipment) have been bogged down by issues of scope and coverage, as well as over the modalities of liberalisation. Services negotiations too have been making extremely slow progress. Issues that were originally on the table for negotiations, such as investment, competition policy, and transparency in government procurement were dropped following the lack of an 'explicit consensus' at the Cancun Ministerial conference.

Thus a 'single undertaking' approach of the WTO negotiations where 'nothing is agreed until everything is agreed' makes removing market barriers to sustainable energy goods and services conditional on progress in other areas of negotiations. This could hamper progress and lower ambitions as far as the removal of trade-related barriers to sustainable energy is concerned. The mercantilist approach characteristic of WTO negotiations also means that Members are likely to tend towards maintaining the *status quo* and adopting a cautious approach in an area where innovative and 'out of the box' thinking is required. Examples include issues such as special treatment for various forms of sustainable energy subsidies or private labelling and certification schemes for biofuels.

As far as the issue of energy transit is concerned, while Article V of the GATT provides for freedom of transit, it does not resolve the issues in cases where the countries of transit are not members of the WTO. That provision of the GATT also, arguably, does not address specific modes of transit relevant to energy, such as pipelines and electricity grids.

Regional Trade Agreements

The number of regional trade agreements involving a selected group of countries has been growing, as has the number of bilateral trade agreements. A number of these provide for market liberalisation that goes beyond WTO commitments. Many also include additional provisions on issues such as investment, competition policy, or government procurement. These agreements are, however, restricted in terms of membership, and there is no single agreement that would include all major GHG-emitting countries or all key traders of sustainable energy goods and services.

The Energy Charter Treaty

The Energy Charter Treaty, signed in December 1994 and presently made up of 51 signatory countries plus the EU and the European Atomic Energy Community (Euratom), addresses energy transit and trade. The treaty provides a set of rules that covers the entire energy chain, from investment to production and generation. It provides a multilateral framework - the only at present - for energy co-operation, and is designed to promote energy security through the operation of more open and competitive energy markets while respecting the principles of sustainable development and sovereignty over energy resources. The treaty covers all types of energy materials and products, including electricity and energy-related equipment. It has provisions on investment protection that also apply to investments in hydropower, solar, wind, and other forms of renewable energy.

The Treaty's provisions focus on four broad areas:

- The protection of foreign investments, based on the extension of national treatment or most favoured nation treatment (whichever is more favourable) and protection against key non-commercial risks.

- Non-discriminatory conditions for trade in energy materials, products, and energy-related equipment based on WTO rules and provisions to ensure reliable cross-border energy transit flows through pipeline, grids, and other means of transportation.

- The resolution of disputes between participating states and – in the case of investments – between investors and host states.

- The promotion of energy efficiency and attempts to minimise the environmental impact of energy production and use.[71]

The Energy Charter Treaty rules on trade and transit are based on WTO provisions but extended to non-WTO Member countries that are parties to the treaty. Treaty provisions also oblige participating states to take necessary measures to facilitate transit and secure established energy flows. Transit countries are under obligation not to interrupt or reduce existing transit flows, even if they have disputes with another country involved in the transit. Through its investment and transit provisions, the Treaty also supports the establishment of new transportation capacity and thereby facilitates diversification of supply and export. Treaty provisions are enforceable through a state-to-state dispute settlement mechanism. While falling short of providing legally binding tariff commitments or provisions on services and intellectually property rights, the Treaty does provide for protection of investment.

While the treaty is commendable in that it covers transit and investment-related provisions on energy, membership is still not universal. Important emerging countries such as China and India are not yet part of the treaty. Furthermore, while at a substantive level it addresses the issues of transit and investment related to energy, the treaty lacks any sort of framework to reflect trade-related concessions on energy and related goods and services.

The UNFCCC

The recent 16th session of the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP) in

Cancun outlined a shared long-term vision, including a goal to limit average global temperature warming below 2 degrees Celsius in comparison to pre-industrial levels. The COP further recognised the need to strengthen this goal, based on scientific advancements, and to consider a 1.5 degree Celsius goal at a future date. While there are no binding targets for developing countries, they have pledged to undertake nationally appropriate mitigation actions, as well as report on progress made in meeting national climate targets or actions. They are also encouraged to develop low carbon strategies or plans in the context of sustainable development.

The Cancun text dealing with Long-term Cooperative Arrangements, Para 90 (under the heading of Economic and Social Consequences of Response Measures) recognised the importance of an open and non-discriminatory trading regime by reaffirming that:

Parties should cooperate to promote a supportive and open international economic system that would lead to sustainable economic growth and development in all Parties, particularly developing country Parties, thus enabling them to better address the problems of climate change; measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade.

Whilst the text paves the way for additional market-facilitating provisions, it does not represent *concrete and operational* measures that sustainable energy goods and services producers could look forward to. It will not serve to catalyse market-expansion and address the market barriers to sustainable energy expansion. The UNFCCC may also not be an appropriate forum to develop and clarify trade-related rules and disciplines on sustainable energy.

Thus many of the existing institutions and rule-making forums are either too broad in their scope and deal exclusively with climate change related measures (UNFCCC), exclude issues of importance to sustainable energy goods such as competition policy (the WTO), or are too restricted in terms of members (the Energy Charter Treaty and regional trade agreements). The WTO and UNFCCC also grapple with an intractable set of broader negotiating challenges on trade and climate change mitigation, and as such presently do not provide an environment conducive to a focused approach for dealing with market and trade barriers to sustainable energy goods and services. Hence, it is clear that a fresh approach that takes a holistic and integrated view of the sustainable energy sector, while simultaneously addressing the diversity of market and trade-related barriers, is required.

5.1 A Sustainable Energy Trade Agreement

A Sustainable Energy Trade Agreement SETA could be a way forward from the impasse affecting the present Doha Round of negotiations. It would underscore the urgency of tackling market and trade-related barriers to sustainable energy through the actions of a small group of like-minded countries wishing to forge ahead unconstrained by the political realities of a 'single undertaking.' It would also serve to highlight the urgency of tackling the global problem of climate change and the role that trade policy can play in this regard.

Structure

The *structure* of such an agreement would require careful consideration and design. A good starting point could be an agreement amongst the members of the G-20 group of countries. The G-20 comprises not only many of the world's largest economies – including key producers, exporters, and importers of sustainable-energy related equipment[72] and services – but also countries that are leading GHG emitters both in absolute terms and on a per capita basis.

The SETA could be modelled either on the plurilateral Government Procurement Agreement (GPA) or the Information Technology Agreement (ITA), both of which are part of the WTO framework. While concessions made in the former are enjoyed only by members to the agreement, ITA concessions extend to all WTO Members on a most favoured-nation (MFN) basis. Indeed, the SETA could be designed to contain a clause automatically 'multilateralising' concessions, subject to a critical mass of WTO members becoming party to the agreement. Membership could be open, although modalities for members wishing to join at a later stage could differ from those applicable to original members.

Alternatively, the SETA could be a stand-alone agreement completely outside the WTO framework. In this case, the members would need to clarify SETA's relationship with existing WTO rules and agreements, including GATT Article XXIV that lays down conditions for the conclusion of regional trade agreements. In addition, when issues such as subsidies and standards are discussed, negotiations would need to involve officials from non-trade related ministries, such as finance and environment.

5.2 Scope of Issues and Market Barriers

The *scope of issues and market barriers* to be covered by the SETA could be closed and defined in advance, or alternatively left open-ended.

As mentioned at the outset, the agreement may be undertaken in a two-phased approach, explicitly stated:

- **Phase one** will address "clean energy" supply, i.e. goods and services relevant to sustainable energy generation in the areas of solar, wind, hydro, and biomass that would be included as a starting point. In addition, product and issue coverage could extend to biofuels used for transportation, such as ethanol and bio-diesel. A more comprehensive list of "clean energy" supply goods and services may include technologies related to marine and geothermal energy, and clean coal. The full set is what ICTSD has used in the mapping of production and trade in the energy supply sector;[73] also in the EPO-UNEP-ICTSD joint 2010 report on Clean Energy Technologies (CET).[74] The simple definition followed was that of *energy generation technologies that have the potential for reducing greenhouse gas emissions*. An illustrative list of goods can be found in Appendix A, which was developed by ICTSD for a model agreement on sustainable energy in 2010 in the context of discussions with the World Economic Forum's Global Agenda Council initiative.[75] In a recent paper by Hufbauer and Kim (2011), they point out that while including products where applied tariffs are already low may be easier to include in a SETA, the potential net increase in trade will be lower than if products with higher applied tariffs are included.[76]

- **Phase two** may address the wider scope of energy efficiency products and standards, particularly those related to the priority sectors identified by the Intergovernmental Panel on Climate Change (IPCC) for GHG mitigation: buildings and construction; transportation; and manufacturing.[77] Agri-culture would necessarily be added, as its late incorporation under UNFCCC has most recently indicated.

The agreement could initially focus on key trade-related issues as a cluster under an 'all or nothing' mini-single undertaking approach:

- Tariffs
- Non-tariff barriers (NTBs)
- Subsidies
- Procurement
- Services, including all modes of delivery: cross-border delivery/supply; consumption abroad; commercial presence (investment-relevant establishment issues); and movement of natural persons.

Alternatively, it could proceed incrementally on an issue-by-issue agenda.

If left open-ended, depending on the ambitions of the parties, the agreement could also address issues related to:

- domestic energy regulation, such as fossil fuel subsidies, investment, competition policy;
- trade facilitation
- transit issues related to sustainable energy.

Sustainable energy is a rapidly changing field, characterised by new technologies, innovation and market developments. Therefore, an open-ended SETA, where new issues could be added to, would enable the agreement to be dynamic and responsive to changing needs and circumstances. Hufbauer and Kim (2011) suggest focussing first on tariffs as they are easily quantified and less controversial than non-tariff barriers. They propose an initial elimination of tariffs followed by phasing out other barriers over a period of five or ten years. They consider on the basis of lower bound and applied tariffs that NAFTA (US, Canada and Mexico), the EU, Chile, Colombia, Peru, Australia, New Zealand, Singapore, Japan, Korea and China as likely to be potential initial members. Other promising candidates but with much higher levels of bound and applied protection on climate-friendly goods include Brazil, India, Indonesia, Turkey and South Africa.[78]

Whether closed or open-ended in terms of issues, the SETA would need to take into account the following important considerations:

- *The modalities of liberalisation,* such as phase-out periods for tariffs or sunset clauses for subsidies.

- *The development dimension and special and differential treatment* would be of utmost importance, given that issues of energy access, trade, and climate change are closely linked to development. Adequate provisions both in terms of market access opportunities and protective measures may be needed for developing countries, in order to ensure these countries' effective participation. Developing countries may require longer phase-in periods for libera-lisation and the ability to protect their sensitive sectors, at least for a certain period of time. Needless to say, meaningful technical assistance and capacity-building provisions should be an integral part of the SETA framework.

- An adequate *dispute settlement mechanism* may be required. If the SETA is concluded within a WTO framework, Members should clarify the role of the WTO's dispute settlement mechanism in adjudicating any disputes that may arise. In such cases, a mandate could be provided for members to resort to the WTO's dispute settlement mechanism. Alternatively, if non-trade issues are included, an agreement on additional independent adjudicating mechanisms may be needed.

- *The relationship of the SETA to existing trade and climate rules, agreements, and institutions* would need to be clarified. Ideally, the Agreement should not duplicate existing provisions in the WTO or the UNFCCC, but instead refer to them as required. New rules and provisions may be needed in areas where WTO rules are ambiguous or non-existent, for instance on:

  - voluntary standards;
  - classification of sustainable energy related goods and services;
  - cross-border trade in electricity.

In terms of classification of sustainable energy goods within the SETA, members should ensure that this does not change their balance of rights and obligations with respect to non-members of the SETA. Classification should also be coherent with potential classification at a multilateral level, such as the World Customs Organisation. When it comes to harmonising standards, the SETA may need to be cognisant of TBT rules and developments in the WTO's TBT Committee, as well as of work undertaken in other bodies, including international, regional, and private standardising bodies.

As assessment of the diverse options for the pathways that a SETA could take, as well the various pros and cons of some of the options, are outlined in the Table below:

Table 18: Possible Pathways for a Sustainable Energy Trade Agreement

Options	Pros	Cons
Structure		
Type of Agreement		
• Plurilateral (ITA-type) within the WTO framework	• Benefits are extended to all WTO members, provided a certain critical mass of members is reached.	• Depending on 'criteria' and level of critical mass defined (e.g.: top traders of sustainable energy goods and services or top GHG emitting countries), there may be a delay in the agreement coming into force. • May exclude non-WTO members from joining.
• Plurilateral (GPA-type) within the WTO framework	• May be easier to address contentious issues if concessions are not extended to all WTO members. • May enable agreement to come into force more quickly.	• Benefits are only enjoyed by parties to the agreement.
• Plurilateral or multilateral agreement outside the WTO framework	• Can include non-members to the WTO. • May provide useful lessons that could subsequently (when the environment is ripe) be replicated within a WTO framework.	• May lower confidence in the ability of the multilateral trading system to deliver on issues that matter for trade and sustainable development.
Membership		
• Criteria undefined to achieve 'critical' mass	• May provide greater options for 'like-minded' countries to initiate the SETA process.	• In the absence of strict criteria, an initial SETA may not include countries that matter and could result in a less than desirable outcome for trade in SEGS and climate change mitigation.
• Based on one criterion or a combination of criteria. For e.g.: top 20 GHG emitting countries, countries comprising X per cent of trade in sustainable energy goods and services.	• Provides a clear criteria and rationale for initiating the SETA and also defines objective thresholds for an agreement to come into effect or be meaningful.	• Sticking to strict criteria and 'thresholds' may prevent countries that do not meet these criteria but are interested from joining or initiating a SETA.

Table 18: *Continued*

Options	Pros	Cons
• Using an existing high-profile grouping such as the G-20 to launch initiative	• May provide a forum conducive to taking a political decision. Groupings such as G-20 automatically include both high emitters as well as key traders of SEGs.	• May become too closely linked with a certain grouping of countries. With new countries emerging as GHG emitters or traders of SEGS, there may be a need to reach out to non-members of the group.
Accession		
• Upon fulfilment of a common set of minimum conditions as to what is required from developed, developing, or LDC countries.	• Will result in an easier process to join a SETA and speedier expansion.	• May result in an initial 'wait and see' attitude on the part of many countries.
• Negotiations with each individual member, similar to the WTO accession process, that could result in SETA 'plus' obligations (more than what has been committed by already existing SETA members).	• Requirement of undertaking subsequent negotiations with each member with possible 'SETA' plus obligations will result in a greater group of countries seeking to be original parties and thereby having a say in the shape of rules and disciplines.	• May discourage subsequent expansion of SETA once it has been concluded between the original interested parties, unless the benefits outweigh the perceived costs for newer members.
Scope of Issues and Market Barriers		
• Closed: Focus on a few pre-defined sectors and/or issues/market barriers with or without a 'single-undertaking' approach. 'Single-undertaking' approach may offer greater scope for trade-offs.	• Enables tightly focused negotiations on a critical set of issues. Countries may come with a 'make-it' or 'break-it' attitude.	• Closes the possibility of dealing with certain initially sensitive issues/barriers in future rounds of negotiations. May not enable SETA to be responsive to new issues as they emerge.
• Open-ended 'cluster approach': Phases of negotiations, with each phase addressing a particular 'cluster' of issues, with or without a 'single-undertaking' approach. 'Single-undertaking' approach may offer greater possibilities for trade-offs.	• Enables countries to deal initially with a set of issues that may be less contentious and move onto more difficult or contentious issues at a later stage.	• Contentious issues may get pushed or postponed to future rounds of negotiations, which may delay outcomes desirable from a trade and sustainable development perspective.

Table 18: *Continued*

Options	Pros	Cons
• Separate negotiations for each sector/issue. Iterative process with rules/ disciplines developed issue by issue in each set of negotiations.	• Enables countries to focus on a specific issue and conclude a set of rules successfully before moving onto a new issue. • A successful round of negotiations on one issue can improve the 'atmospherics' for negotiations on future issues.	• Reduces the possibilities for trade-offs among issues within a single set of negotiations. • May delay desirable outcomes from the conclusion of new rules and disciplines.
Other Considerations for a SETA		
• Modalities of liberalisation for sustainable energy goods and services. (For e.g.: Phase out periods for tariffs, sunset clauses on subsidies, etc.)		
• Dispute Settlement Mechanism and relationship to the WTO's Dispute Settlement Mechanism if the SETA is concluded within a WTO Framework. Also, if non-trade issues are included, what sort of dispute settlement process will apply.		
• Reflecting the 'development dimension' and special and differential treatment for developing countries in terms of both rules and disciplines, as well as liberalisation modalities. This also includes provisions on facilitating access to technologies and technical assistance and capacity-building.		
• Clarifying the relationship of the SETA to existing trade and climate rules, agreements, and institutions.		

A key issue in terms of potential membership will be whether a SETA will extend MFN benefits to non-Members. While the first may enable greater support from the wider WTO membership, confining benefits only to SETA's founding members may make it more attractive to them.[79] It is important for potential members of SETA to keep in mind the legal and procedural requirements under the WTO to obtain a waiver for a plurilateral agreement that does not extend benefits on an MFN basis to non-members. This would require a waiver under Annex 4 of the Marrakesh Agreement. While it is beyond the scope of this paper to explore the legal implications of various pathways that may be followed for a SETA, it will be important issue deserving careful consideration by policy makers and negotiators.

Conclusion

Addressing market barriers related to sustainable energy goods and services will facilitate cost reductions, however small, in the provision of sustainable energy. This is a critical step in global climate change mitigation efforts, given the significant contribution of the energy sector to global carbon dioxide and other greenhouse gas emissions.

Many of the key greenhouse gas emitting countries are developing policies to promote the scaling up of sustainable energy generation. While these policies are commendable, countries should ensure that such policies do not run afoul of existing trade disciplines and that these policies enable fair competition in the growing market for sustainable energy technologies and services. Such technologies and services are most often produced and traded between the countries that are major emitters and have introduced proactive sustainable energy policies.

Given the common goals of these countries to address climate change, as well as ensure free and fair trade, it would make sense for these countries to negotiate an agreement on sustainable energy that is holistic, comprehensive, and addresses the main market barriers. Market and trade barriers are addressed within the context of WTO and regional trade negotiations; rules and disciplines regarding such barriers are also being developed in various other forums. However, these rules are scattered and diffused amongst sectors and countries and do not offer an integrated solution.

The WTO represents the most comprehensive approach, but the difficulties plaguing the Doha negotiations mean that urgent action on a trade and market-friendly response to climate change is at risk. A sustainable energy trade agreement (SETA) – independent of negotiations on other issues within the WTO – represents an alternative option. SETA could be housed within or outside the WTO Framework and could proceed independent of the ongoing Doha negotiations.

A SETA would certainly not be a 'silver bullet' for addressing all the problems plaguing negotiations in the WTO or the UNFCCC. For instance, the 'dual-use' controversy arising in the Doha environmental goods negotiations would not go away under a SETA approach, but the SETA might facilitate alternative or innovative approaches to liberalising such goods. A SETA framework would also enable WTO members to think beyond the confines of specific committees, such as the CTE, NAMA, TBT, GPA, and the Services and TRIPs Councils.

A SETA would allow for a holistic perspective on sustainable energy, whether the goods involve manufactures such as solar panels, or possibly agricultural ones, such as ethanol. The agreement could address a broader diversity of barriers that may be more difficult to take up under the WTO's 'single undertaking' approach. Because SETA would focus on a specific sector, sustainable energy, political buy-in may be easier to achieve than if these barriers were to be negotiated across a wider range of goods and services.

Furthermore, SETA could potentially bring under its ambit high GHG emitters, which are not yet members of the WTO. While these countries may not be big players as far as trade in sustainable energy goods and services are concerned, this could change with the new trade and investment opportunities that a SETA might bring.

Moreover, the SETA will provide an environment conducive to assessing the linkages between sustainable energy goods and sustainable energy services, allowing for a truly meaningful liberalisation exercise. Ultimately, the SETA could be an ideal 'laboratory', where rules and disciplines pertaining to sustainable energy could be clarified and take shape. Like the ITA for information technology products, the SETA could have a catalysing effect on world trade - this time in a sector of huge importance to global climate mitigation efforts. All of this could constructively inform, and perhaps even shape the course of future negotiations and work at the WTO as well as the UNFCCC.

Endnotes

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54 See for example WTO/WT/ACC/SAU/61 of 1 November 2005, Report of the Working Party on the Accession of the Kingdom of Saudi Arabia to the World Trade Organization, p. 12-13. See also Ulrich Klaus, *Russlands Erdöl und Erdgas im Kontext der WTO Rechtsordnung*, in Der Beitritt Russlands zur Welthandelsorganisation, Chritian Tietje (Ed.);2005; Beiträge zum Transnationalen Wirtschaftsrecht, Heft 44, Martin-Luther-Universität, Halle-Wittenberg, p. 48.

55 WTO/TN/RL/W/78 of 19 March 2003, Subsidies Discipline Requiring Clarification and Improvement, Communication from the United States, p. 3; see also WTO/RL/GEN/94 of 16 January 2006, Expanding the Prohibited 'Red Light' Subsidy Category, Paper from the United States; or the Submission of the European Communities on Subsidies, WTO/TN/RL/GEN/135 of 24 April 2006.

56 On the specificity requirement of the Subsidies Code, see Christian Pitschas;2003; Das *Übereinkommen über Subventionen und Ausgleichsmaßnahmen*, in WTO Handbuch, Hans-Joachim Priess, Georg Berrisch (Eds), München, pp. 457 et seq.; see also Marc Benitah;2001; *The Law of Subsidies under the GATT/WTO System,* The Hague, London, New York, pp. 87 et seq., p. 88 footnote 191.

57 *WTO Panel Rules against China's Export Restrictions on Raw Materials*, Bridges Weekly Trade News Digest, Volume 15, Number 25, 6th July 2011. and *Tensions Build between EU, China over Rare Earths in Aftermath of Raw Materials Decision*, Bridges Weekly Trade News Digest, Volume 15, Number 27, 20th July 2011

58 China began stockpiling rare earths in 2010 and reduced global exports by 40 percent by June 2011. Two-thirds of China's production of rare earths originates in Inner Mongolia, where in February the state-controlled Baotou Steel Rare-Earth (Group) Hi-Tech Co. began building ten warehouses to store the minerals in response to government stockpiling initiatives.

59 ICTSD-IISD Doha Round Briefing Series; 2003-08; www.ictsd.org

60 www.wto.org

61 Janssen, R.; 2010; *Harmonising Energy-Efficiency Requirements-building Foundations for Co-operative Action;* ICTSD Programme on Trade and Environment; Environmental Goods and Services Series; Issue Paper No.14;International Centre for Trade and Sustainable Development, Geneva, Switzerland, www.ictsd.org

62 The European Commission encourages industry, governments, and NGOs to set up voluntary certification schemes to guarantee that biofuels sold under a label are sustainable and produced under the criteria set by the Renewable Energy Directive (European Commission, 2010). This certificate will apply to biofuels produced in the EU and imported biofuels. Biofuels

can still be imported without a certificate, but these biofuels cannot receive national public support such as tax relief. (Vossenaar, Rene; 2010; *Deploying Climate-Related Technologies in the Transport Sector: Exploring Trade Links*, ICTSD Programme on Trade and Environment; Environmental Goods and Services; Issue Paper No. 15, International Centre for Trade and Sustainable Development; Geneva, Switzerland.)

63 Echols, Marsha.A.; 2009; *Biofuels Certification and the Law of the World Trade Organization;* ICTSD Programme on Agricultural Trade and Sustainable Development; Issue Paper No.19; International Centre for Trade and Sustainable Development; Geneva, Switzerland.

64 The main purposes of CPC are to provide a framework for international comparison of statistics dealing with goods, services and assets and to serve as a guide for developing or revising existing classification schemes of products in order to make them compatible with international standards. It was developed primarily to enhance harmonization among various fields of economic and related statistics and to strengthen the role of national accounts as an instrument for coordination of economic statistics. It provides a basis for recompiling basic statistics from their original classifications into a standard classification for analytical use. The CPC constitutes a comprehensive classification of all goods and services. With regard to services, no international classification covering the whole spectrum of outputs of the various service industries and serving the different analytical needs of statistical and other users has been available before the development of CPC. As a general-purpose classification, CPC provides less detail than other specific classification systems in areas or applications for which such systems are available, for example the HS for international commodity trade statistics. (Source: Introduction to the Central Product Classification accessible at UN Central Product Classification, DRAFT ESA/STAT/SER.M/77/Ver.1.1 accessible at http://unstats.un.org/unsd/statcom/doc02/cpc.pdf

65 United Nations Statistics Division, http://unstats.un.org/unsd/cr/registry/cpc-2.asp

66 Although the IPCC report includes key mitigation technologies and practices projected to be commercialised before 2030, they are excluded from this table on purpose, given that such technologies are unlikely to be subject to immediate trade liberalisation. 'Research and experimental development services in natural sciences and engineering' [CPC 811] are largely related to mitigation technologies that are not yet commercialised. Hence, they are excluded from the scope of services in this study.

67 Inclusion of other passenger transport, as well as supporting transport services, depends on the source and type of vehicles used.

68 ICTSD-IISD Doha Round Briefing Series; 2003-08; www.ictsd.org

69 Ibid.

70 Selivanova, J.; 2007; op.cit

71 The Energy Charter Treaty, http://www.encharter.org/index.php?id=28

72 Jha, V. ;2009; *Trade Flows, Barriers and Market Drivers in Sustainable energy Supply Goods: The Need to Level the Playing Field,* ICTSD Trade and Environment Issue Paper 10, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

73 Lako, Paul; 2008; *Mapping Climate Mitigation Technologies and Associated Goods within the Renewable Energy Supply Sector;* ICTSD Programme on Trade and Environment; International Centre for Trade and Sustainable Energy ; Geneva, Switzerland.; Wind, Izaak ; HS Codes and the Renewable Energy Sector ; ICTSD Programme on Trade and Environment; International Centre for Trade and SUstainable Development ; Genva, Switzerland.

74 www.epo.org/news-issues/issues/clean-energy/study.html (See in this document Appendix D for a sample of classification and breakdown of CETs for purposes of patent landscaping; the basis for EPO's public database which effectively serves as "clearinghouse" of existing technologies in the sector.)

75 See Vossenaar, Rene; 2010a; *Climate-related Single-use Environmental Goods;* ICTSD Programme on Trade and Environment; Environmental Goods and Service Series; Issue Paper No. 13; International Centre for Trade and Sustainable Development; Geneva, Switzerland.

76 Hufbauer,Gary; Kim,Jisun;2011; *Sustainable Energy Trade Agreement: A Look at the Details,* Peterson and POSCO Research Institute.

77 Wind, Izaak; 2009; *HS Codes and the Residential and Commercial Buildings Sector* ; ICTSD Programme on Trade and Environment ; International Centre for Trade and Sustainable Development ; Geneva, Switzerland.; Goswami, Anandajit ; Mitali Dasgupta and Nitya Nanda; *Mapping Climate Mitigation Technologies and Associated Goods within the Buildings Sector*; ICTSD Programme on Trade and Environment.; Wind, Izaak; 2010; *HS Codes and the Transport Sector*; ICTSD Programme on Trade and Environment; Kejun, Jiang; 2010; *Mapping Climate Mitigation Technologies and Associated Goods within the Transport Sector*; ICTSD Programme on Trade and Environment Vossenaar, Rene; 2010; *Climate-related Single-use Environmental Goods*; ICTSD Programme on Trade and Environment; Environmental Goods and Services Series ; Issue Paper No. 13 ;International Centre For Trade and Sustainable Development; Geneva, Switzerland.

78 Hufbauer,Gary; Kim,Jisun;2011; op.cit.

79 Ibid.

80 Jha, V; 2009; *Trade Flows, Barriers and Market Drivers in Sustainable energy Supply Goods: The Need to Level the Playing Field,* ICTSD Trade and Environment Issue Paper 10, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

81 Lako, Paul; (2010); *Mapping Climate Mitigation Technologies and Associated Goods Within the Renewable Energy Supply Sector*, ICTSD Programme on Trade and Environment. Accessible at http://ictsd.org/climate-change/accelerating-trade-and-diffusion-of-climate-friendly-goods-and-services/

82 From: The European Patents Office website, Access to Patents in Clean Energy Technologies, http://www.epo.org/news-issues/issues/classification/classification.html

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Appendix A

Selected Single-use EGs and Other Sets of (Possible) Climate-related EGs

This table is based on an-ICTSD commissioned mapping study of various technologies in the energy supply sector. Experts from the Intergovernmental Panel on Climate Change (IPCC) validated the mapping study, which is available on the ICTSD website. The key areas of clean energy technology targeted were wind energy, hydro/ marine energy, solar energy, geothermal energy, biofuels, and clean coal.

Once peer-reviewed by IPCC lead experts, these mapping studies set the stage for customs classification and a subsequent detailed analysis of these technologies' market drivers, trade-flows, and trade barriers.

This table shows some trade information for the single-use environmental goods (EGs) defined by ICTSD research as a group (and listed under the column marked 'S'). "Single-use" climate-related EGs are loosely defined here as goods that are used predominantly for climate-related purposes. It is not the intention to propose a specific subset of climate-related EGs for negotiations, but rather to facilitate a more reliable and transparent analysis. The table also shows which of the products identified by ICTSD also appear as climate-related EGs in proposals by WTO Members (and listed under the column marked 'WTO') and a list of 43 climate-friendly goods published by the World Bank. It subsequently shows the export and import figures (in USD millions) for these goods.

The number of single-use EGs analysed in this table is smaller than the number of 6-digit HS codes for the climate-related EGs included in proposals by WTO Members and the list of 43 climate-friendly goods published by the World Bank. This is because the latter included multiple-use products and some other goods, including several ex-out items that were not included in the analysis of single-use EGS (because it was difficult to make a reasonable assessment of the extent to which trade might be driven by the deployment of climate-related technologies).

The table compares the set of selected single-use EGs (marked 'S') with a broader (100) set of 6-digit HS codes, which together represented over USD 300 billion of world exports (excluding intra-EU trade) in 2008. The broader set captures much more than actual trade in relevant products and components.

First, most 6-digit HS codes include unrelated products. Second, in the case of components, total trade under the provisions of a particular 6-digit HS code is included; however, only a small part, if any, may be related to the deployment of renewable energy technologies and products[80] (see Jha, 2009). Whereas trade in single-use EGs is also overestimated, the margin of error is much smaller. This is precisely why the trade analysis focuses on single-use EGs. In 2008, world exports (excluding intra-EU trade) of the set of single-use EGs analysed in this note represented 16 percent of world exports of all products listed in the Annex; for developing countries as a group it was 23 percent.

A large part of trade in products included in the HS codes listed in the Table corresponds to components that may be used for in the supply of renewable energy. Since the same components may be used for other purposes, the trade figures shown may be heavily overestimated.

The Tables in Appendix B and C illustrate the top exporters as well importers in these categories of products. As is clear they are not very different from the top exporters and importers of manufactured goods in general and include both developed as well as emerging developing countries.

Illustrative List of Harmonised System (HS) Headings to Be Covered.

HS code	Description	Set of EGs / products				Trade in 2008, USD million			
		S	ICTSD	WTO	WB (43)	World (excl. intra-EU trade)		Developing countries	
						Exports	Imports	Exports	Imports
220710	Undenatured ethyl alcohol	X	X			3603	3425	3372	929
220720	Ethyl alcohol, denatured	X	X			672	833	272	281
380210	Activated carbon		X			330	297	46	67
382450	Non-refractory mortars and concretes		X			330	297	46	67
382490	Chem. preparations (incl. biodiesel)		X			24005	23272	5372	12348
390210	Polypropylene				X	10298	13814	5094	11502
560314	Nonwovens, weighing>150 g/m2				X	870	753	204	339
680610	Slag wool, rock wool	X	X			908	878	268	272
680690	Insulating materials and articles	X	X			822	808	68	344
681091	Prefabricated structural components		X			653	633	200	166
700800	Multiple-walled insulating units	X	X			593	618	213	116
700991	Glass mirrors, unframed		X			521	530	336	172
700992	Glass mirrors, framed		X			599	999	480	133
701931	Mats			X	X	409	493	94	200
701939	Other glass-fibre insulation products	X	X			1213	805	375	241
711590	Other articles of precious metal		X			2156	2616	430	929
730431	Pipes and tubes		X			1228	1035	449	442
730441	Pipes and tubes		X			2381	2010	864	1,009

HS code	Description	Set of EGs / products				Trade in 2008, USD million			
		S	ICTSD	WTO	WB (43)	World (excl. intra-EU trade)		Developing countries	
						Exports	Imports	Exports	Imports
730451	Pipes and tubes		X			547	494	252	263
730820	Towers and lattice masts		X	X		2380	3048	1647	1491
730900	Reservoirs and similar				X	3235	2378	1297	1142
732111	Solar cooking stoves		X		X	2797	3450	1535	750
732183	Wood-pellet burning stoves		X		X	526	658	211	21
732190	Stoves, parts				X	852	898	456	267
732290	Radiators, solar air heaters		X			718	789	151	72
732490	Water-saving showers				X	811	958	553	310
741121	Tubes/pipes, copper-zinc base alloys		X			682	595	424	268
741122	Tubes/pipes, copper-nickel base		X			424	310	240	155
741129	Tubes/pipes, other		X			388	593	196	398
761100	Aluminium reservoirs, tanks		X	X	X	144	73	20	38
761290	Aluminium containers, other			X	X	2176	2076	808	991
830630	Photograph frames, mirrors		X			213	537	162	154
840219	Vapour generating boilers, other				X	517	901	189	703
840290	Steam or other boilers, parts				X	4108	2061	2358	1140
840410	Auxiliary plant for use with boiler			X	X	750	664	560	453
840490	Parts for steam boilers				X	669	634	371	319

HS code	Description	Set of EGs / products				Trade in 2008, USD million			
		S	ICTSD	WTO	WB (43)	World (excl. intra-EU trade)		Developing countries	
						Exports	Imports	Exports	Imports
840510	Gas generator			X	X	566	995	95	869
840681	Steam turbines > 40 MW		X	X	X	707	579	200	464
840682	Steam turbines < 40 MW		X	X		796	545	164	366
840690	Parts of steam turbines			X		3934	3130	1148	1455
841011	Hydraulic turbines, micro (<1 MW)	X	X	X	X	50	46	8	27
841012	Hydraulic turbines, small (1-10 MW)	X	X	X		58	62	27	46
841013	Hydraulic turbines, large (> MW)		X			99	275	28	252
841090	Parts for hydraulic turbines		X	X	X	942	710	377	472
841181	Gas turbines, of a power < 5,000 kW		X	X	X	1332	1124	58	303
841182	Gas turbines, of a power > 5,000 kW		X	X	X	7032	4186	408	2521
841280	Other engines and motors		X			561	459	114	295
841290	Other engines/ motors (blades)		X			3110	4494	656	898
841581	Air conditioner with heat pump			X	X	1655	2790	731	729
841620	Other furnace burners		X			751	988	104	709
841861	Heat pumps	X	X	X	X	1916	1531	358	716
841869	Absorption chillers/heat pumps		X	X	X	4382	4710	2046	2527
841919	Solar water heater		X	X	X	969	1013	504	224
841931	Dryers, for agricultural products		X			378	382	68	154

HS code	Description	Set of EGs / products				Trade in 2008, USD million			
		S	ICTSD	WTO	WB (43)	World (excl. intra-EU trade)		Developing countries	
						Exports	Imports	Exports	Imports
841940	Distilling or rectifying plant		X	X	X	1780	2127	275	1479
841950	Heat exchange units		X	X	X	6889	6450	1845	3119
841989	Machinery, other		X	X	X	6545	7005	1984	4746
841990	Parts of machinery, plant, equipment		X	X	X	5198	4443	1494	2050
847920	Machinery extraction veg. fats/oils		X			580	437	239	216
848210	Ball bearings		X			7129	8110	2946	4471
848220	Tapered roller bearings		X			2519	2578	741	1150
848230	Spherical roller bearings		X			1562	1581	507	1036
848240	Needle roller bearings		X			653	676	166	394
848250	Other cylindrical roller bearings		X			1536	1955	370	1085
848280	Other ball or roller bearings		X			989	1562	468	1045
848340	Gears		X	X	X	10266	10621	1993	5150
848360	Clutches				X	1643	1988	273	1032
850161	AC generators <75kVA		X	X	X	634	769	275	301
850162	AC generators 75 - 375kVA		X	X	X	434	411	159	215
850163	AC generators 375 - 750 kVA		X	X	X	306	269	152	131
850164	AC generators 750 kVA		X	X	X	3099	2511	496	1011
850231	Wind-powered generation sets	X	X	X	X	3335	4753	1010	941
850239	Other generation sets		X	X		3290	5407	392	3236
850300	Parts of motors, generators		X	X		13154	10942	4291	5479

HS code	Description	Set of EGs / products				Trade in 2008, USD million			
		S	ICTSD	WTO	WB (43)	World (excl. intra-EU trade)		Developing countries	
						Exports	Imports	Exports	Imports
850421	Liquid dielectric transformers		X			1317	1070	597	556
850422	Liquid dielectric transformers		X			1222	1032	567	444
850423	Liquid dielectric transformers		X			5612	3701	3172	1614
850431	Electric transformers		X			3235	4185	2234	2350
850432	Electric transformers		X			429	671	197	349
850433	Electric transformers		X			934	1203	476	630
850434	Electric transformers		X			1507	1726	529	1047
850440	Static converters		X	X		25541	32037	15901	14701
850680	Primary cells			X	X	449	966	237	657
850720	Lead acid accumulators	X		X	X	3751	3420	2420	1306
850740	Nickel-iron storage batteries			X		21	75	2	49
850780	Other accumulators		X	X		11274	11888	7068	7642
853710	Control boards			X	X	20155	21624	7316	9836
853931	Fluorescent, hot cathode lamps	X	X			3625	3822	3091	1216
854140	PV semiconductor devices	X	X	X	X	30513	33135	19460	11064
854449	Other electric conductors		X			462	1230	456	1042
854460	Other electric conductors		X			5734	4714	2370	2671
870390	Other (including electric) cars	X	X	X		1138	1033	71	626
900190	Mirrors (for solar energy)		X	X	X	5509	6961	1757	4936

HS code	Description	Set of EGs / products				Trade in 2008, USD million			
		S	ICTSD	WTO	WB (43)	World (excl. intra-EU trade)		Developing countries	
						Exports	Imports	Exports	Imports
900290	Glass mirrors (for solar energy)		X	X	X	1103	1167	516	688
902830	Electricity meters			X		1242	1240	753	517
903020	Cathode-ray oscilloscopes		X			437	623	244	247
903031	Multi-meters		X			326	377	148	138
903210	Thermostats	X	X	X	X	1528	2125	721	845
903220	Manostats		X	X	X	655	402	89	140
903289	Other control instruments			X		10573	13736	3263	6869
Total						312599	332010	130438	161986

ICTSD: Products (and their relevant customs codes) identified by ICTSD studies on the renewable energy; residential and commercial buildings; and transport sectors (includes a large number of multiple-use products that may be used as components in any of these sectors)

S: Single-use EGs selected for analysis

WB: 43 climate-related EGs identified by the WB

WTO: based on proposals listed in TN/TE/19, 22 March 2010, excluding vehicles (other than HS 870390) and goods proposed on the basis of energy-efficiency criteria only (see footnote 14).

Source: based on COMTRADE (using WITS, May 2010)

Appendix B

Top Exporters of Single-use Environmental Goods and Other Product Groups, 2008 (Excluding intra-EU Trade)

Single-use EGs			Climate-friendly products and components (ICTSD studies)		
	USDm	%		USDm	%
All	50986	100	All	236792	100
China	16204	31.8	EU27	59960	25.3
Japan	7923	15.5	China	48851	20.6
EU27	7043	13.8	Japan	31053	13.1
United States	4234	8.3	United States	27303	11.5
Taiwan	4038	7.9	Korea, Rep.	9827	4.2
Brazil	2449	4.8	Taiwan	7396	3.1
India	1256	2.5	Singapore	5633	2.4
Mexico	1152	2.3	Mexico	5013	2.1
Korea, Rep.	902	1.8	Switzerland	4756	2.0
Malaysia	888	1.7	Brazil	4635	2.0
Singapore	793	1.6	Canada	4261	1.8
Canada	560	1.1	India	3872	1.6
Norway	390	0.8	Malaysia	3292	1.4
Thailand	357	0.7	Israel	3011	1.3
South Africa	315	0.6	Thailand	2571	1.1
Pakistan	226	0.4	Turkey	2101	0.9
Developing countries					
	29861	58.6		99778	42.1

43 climate-friendly EG (World Bank)			All manufactured products, non-mineral (HS 28-97)		
	USDm	%		USDm	%
All	153354	100	All	7518538	100
EU27	40734	26.6	EU27	1629069	21.7
China	26954	17.6	China	1353673	18.0
United States	19739	12.9	United States	935450	12.4
Japan	19649	12.8	Japan	720500	9.6
Korea, Rep.	7232	4.7	Korea, Rep.	378667	5.0
Taiwan	6254	4.1	Canada	247088	3.3
Mexico	5008	3.3	Singapore	243685	3.2
Singapore	3262	2.1	Mexico	221450	2.9
Canada	3133	2.0	Taiwan	211702	2.8
Malaysia	2897	1.9	Switzerland	187462	2.5
India	2759	1.8	Thailand	139693	1.9
Switzerland	2617	1.7	Malaysia	138893	1.8
Thailand	2225	1.5	India	120589	1.6
Turkey	1261	0.8	Russian Fed.	109306	1.5
Norway	1213	0.8	Turkey	109150	1.5
Brazil	1129	0.7	Brazil	97661	1.3
Developing countries					
	62433	40.7			45.5

Source: COMTRADE using World Integrated Trade Solution (WITS)-March 2010 from Vossenaar, R. (2010a). Climate-related Single-use Environmental Goods, ICTSD Issue Paper No. 13, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Appendix C

Top Importers of Single-use Environmental Goods and Other Product Groups, 2008 (Excluding intra-EU Trade)

Single-use EGs			Climate-friendly products and components (ICTSD studies)		
	USDm	%		USDm	%
All	54916	100	All	248651	100
EU27	20345	37.0	EU27	49418	19.9
United States	9465	17.2	United States	41065	16.5
China	4539	8.3	China	28177	11.3
Korea, Rep.	2627	4.8	Hong Kong, China	11267	4.5
Hong Kong, China	2365	4.3	Korea, Rep.	11148	4.5
Japan	2302	4.2	Japan	10468	4.2
Canada	2059	3.7	Canada	8241	3.3
Mexico	941	1.7	Mexico	6778	2.7
Taiwan, China	901	1.6	Taiwan, China	6491	2.6
Singapore	717	1.3	Russian Federation	6315	2.5
India	653	1.2	Singapore	5844	2.4
Turkey	640	1.2	India	5022	2.0
Switzerland	630	1.1	Thailand	4130	1.7
Australia	588	1.1	Switzerland	3871	1.6
Malaysia	450	0.8	United Arab Emirates	3858	1.6
Brazil	431	0.8	Brazil	3753	1.5
Russian Federation	407	0.7	Australia	3574	1.4
South Africa	330	0.6	Turkey	3333	1.3
Philippines	316	0.6	Malaysia	3112	1.3
Norway	309	0.6	Norway	2506	1.0
Thailand	303	0.6	Vietnam	2306	0.9
Ukraine	262	0.5	South Africa	2150	0.9
Developing countries					
	17909	32.6			47.5

43 climate-friendly EG (World Bank)			All manufactured products, non-mineral (HS 28-97)		
	USDm	%		USDm	%
All	160779	100	All	8060124	18.7
EU27	31959	19.9	EU27	1504068	18.5
United States	25285	15.7	United States	1488691	9.0
China	20503	12.8	China	724045	4.8
Korea, Rep.	6354	4.0	Japan	383841	4.5
Canada	5667	3.5	Hong Kong, China	363664	3.9
Japan	5588	3.5	Canada	316826	3.2
Hong Kong, China	4851	3.0	Korea, Rep.	260402	3.1
Mexico	4685	2.9	Mexico	250166	2.6
Turkey	3649	2.6	Singapore	212900	2.6
Taiwan, China	3444	2.3	Russian Federation	212108	2.2
India	3190	2.1	India	180448	1.9
Singapore	3081	2.0	Taiwan, China	156332	1.9
Switzerland	2667	1.9	Switzerland	155432	1.8
Thailand	2644	1.7	Australia	148063	1.8
Australia	2530	1.6	Turkey	142598	1.7
United Arab Emirates	2499	1.6	United Arab Emirates	140114	1.6
Brazil	2247	1.6	Thailand	129955	1.6
Malaysia	2099	1.4	Brazil	127767	1.6
Vietnam	1670	1.3	Malaysia	125550	1.0
Norway	1581	1.0	Norway	80776	0.8
South Africa	1434	1.0	Vietnam	61849	0.7
Qatar	1264	0.9	South Africa	55900	18.7
Developing countries					
	77859	48.4		3556620	44.1

Source: COMTRADE using World Integrated Trade Solution (WITS)-March 2010 from Vossenaar, R. (2010a). Climate-related Single-use Environmental Goods, ICTSD Issue Paper No. 13, International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Appendix D

Y02 subclasses for Specific Clean Energy Technologies

In order to identify the technologies relevant for the patent landscaping analysis with the European Patent Office (EPO) and the United Nations Environment Programme (UNEP), ICTSD commissioned a mapping study of various technologies in the energy supply sector. Experts from the Intergovernmental Panel on Climate Change (IPCC) validated the study. The published mapping study is available on the ICTSD website.[81] The key areas of clean energy technology targeted were wind energy, hydro/marine energy, solar energy, geothermal energy, biofuels, and clean coal.

Classification of «clean energy» technologies as established in the EPO-UNEP-ICTSD Analysis:[82]

The categories below were defined with the help of experts in the field, both from within the EPO and with the help of external partners, including the Intergovernmental Panel on Climate Change (IPCC).

The so-called **Y02** subclasses relate to specific clean energy technologies, namely Y02C (greenhouse gases – capture and storage/sequestration or disposal) and Y02E (greenhouse gases – emissions reduction technologies related to energy generation, transmission, or distribution).

YO2E Greenhouse Gases (GHG), Reduction of Emissions Related to Energy Generation, Transmission or Distribution

ECLA code	Description
10/00	Energy generation through renewable energy sources (Geothermal, hydro, oceanic, solar (PV and thermal),wind)
20/00	Combustion technologies with mitigation potential (CHP, CCPP, IGCC, synair, cold flam, etc.)
30/00	Energy generation of nuclear origin (Fusion and fission)
40/00	Technologies for efficient electrical power generation, transmission or distribution (Reactive power compensation, efficient operation of networks, etc.)
50/00	Technologies for the production of non-fossil origin (Biofuels, from waste)
60/00	Technologies with potential or indirect contribution to GHG emissions mitigation (Energy storage(batteries, ultracapacitors, flywheels…), hydrogen technology, fuel cells, etc.)
70/00	Other energy conversion or management systems reducing GHG emissions (Synergies among renewable energies, fuel cells and energy storage)

Taking solar energy as an example, this is what a specific energy type looks like in the new scheme:

YO2E10 Energy Generation Through Renewable Energy Sources

ECLA code	Description
10/40	Solar thermal energy
10/41	Tower concentrators
10/42	Dish collectors
10/43	Fresnel lenses
10/44	Heat exchange systems
10/45	Trough concentrators
10/46	Solar-thermal plants for electricity generation, e.g. Rankine, Stirling solar-thermal generators
10/47	Mountings or tracking
10/48	Mechanical power, e.g. thermal updraft
10/50	Photovoltaic (PV) energy
10/52	PV systems with concentrators
10/54	Material technologies
10/54B	CuInSe2 material PV cells
10/54D	Dye-sensitised solar cells
10/54F	Solar cell from Group II-VI materials
10/54H	Solar cell from Group III-V materials
10/54J	Microcrystalline silicon PV cells
10/54L	Polycrystalline silicon PV cells
10/54N	Amorphous silicon PV cells
10/56	Power conversion electrical/electronic aspects
10/56B	for grid-connected applications
10/56D	Concerning power management inside the plant, e.g. battery charging/discharging, economical operation, hybridization with other energy sources
10/58	MPPT systems (maximum power point tracking)
10/60	TPV hybrids