

Realizing the Potential of the UNFCCC Technology Mechanism

Perspectives on the Way Forward

ICTSD Global Platform on Climate Change, Trade and Sustainable Energy

ICTSD

International Centre for Trade and Sustainable Development

Issue Paper No. 35

Realizing the Potential of the UNFCCC Technology Mechanism

Perspectives on the Way Forward

ICTSD Global Platform on Climate Change, Trade and Sustainable Energy

ICTSD

International Centre for Trade and Sustainable Development

Issue Paper No. 35

Published by

International Centre for Trade and Sustainable Development (ICTSD)
International Environment House 2
7 Chemin de Balexert, 1219 Geneva, Switzerland
Tel: +41 22 917 8492 Fax: +41 22 917 8093
E-mail: ictsd@ictsd.org Internet: www.ictsd.org

Chief Executive: Ricardo Meléndez-Ortiz
Core Team:
Christophe Bellmann: Programmes Director
Pedro Roffe: Senior Associate, Innovation, Technology and Intellectual Property
Ahmed Abdel Latif: Senior Programme Manager, Innovation, Technology and Intellectual Property
Daniella Allam: Junior Programme Officer, Innovation, Technology and Intellectual Property

---

Acknowledgments

This paper has been produced under the ICTSD Programme on Innovation, Technology and Intellectual Property. ICTSD wishes gratefully to acknowledge the support of its core and thematic donors, including: the UK Department for International Development (DFID), the Swedish International Development Cooperation Agency (SIDA); the Netherlands Directorate-General of Development Cooperation (DGIS); the Ministry of Foreign Affairs of Denmark, Danida; the Ministry for Foreign Affairs of Finland; the Ministry of Foreign Affairs of Norway; Australia's AusAID; the Inter American Development Bank (IADB); and Oxfam Novib.

Padmashree Gehl Sampath works at the United Nations Conference for Trade and Development (UNCTAD). She is an expert on issues of innovation, technology and development and has previously worked at the Open University (UK) and the United Nations University-MERIT. The views expressed here are the author's personal views.

John Mugabe is Professor of Science and Innovation Policy, Graduate School of Technology Management (GSTM) at the University of Pretoria, and Director of Science and innovation Policy Studies (SIPS) Corporation, Pretoria. He was Science and Technology Advisor to NEPAD (2002-2008) and Executive Director of the African Centre for Technology Studies (ACTS) 1995-2002.

John Barton † (1936-2009) was George E. Osborne Professor of Law, Emeritus at Stanford Law School.

The views expressed in this publication are those of the authors and do not necessarily reflect the views of ICTSD or its funding institutions.

ICTSD welcomes feedback and comments to this document. These can be sent to Ahmed Abdel Latif (aabdellatif@ictsd.ch).

Citation for the Issue Paper:

Gehl Sampath, Padmashree; John Mugabe and John Barton; (2012); *Realizing the potential of the UNFCCC Technology Mechanism: Perspectives on the Way Forward;* ICTSD Programme on Innovation, Technology and Intellectual Property; Issue Paper No. 35; International Centre for Trade and Sustainable Development, Geneva, Switzerland, www.ictsd.org

Citation for individual pieces:

Gehl Sampath, Padmashree; "Can the Climate Technology Mechanism Deliver its Promise? Some Issues and Considerations"; in (2012); *Realizing the potential of the UNFCCC Technology Mechanism: Perspectives on the Way Forward;* ICTSD Programme on Innovation, Technology and Intellectual Property; Issue Paper No. 35; International Centre for Trade and Sustainable Development, Geneva, Switzerland, www.ictsd.org

Mugabe, John; "African Perspectives on the UNFCCC Technology Mechanism''; in (2012); *Realizing the potential of the UNFCCC Technology Mechanism: Perspectives on the Way Forward*; ICTSD Programme on Innovation, Technology and Intellectual Property; Issue Paper No. 35; International Centre for Trade and Sustainable Development, Geneva, Switzerland, www.ictsd.org

Barton, John; "Technology Transfer: An Evaluation of Treaty-Based Mechanisms Relevant to Climate Change"; in (2012); *Realizing the potential of the UNFCCC Technology Mechanism: Perspectives on the Way Forward*; ICTSD Programme on Innovation, Technology and Intellectual Property; Issue Paper No. 35; International Centre for Trade and Sustainable Development, Geneva, Switzerland, www.ictsd.org

For more information about ICTSD's Programme on Innovation, Technology and Intellectual Property, visit our website at http://ictsd.org/programmes/ip/

Copyright © ICTSD, 2012. Readers are encouraged to quote this material for educational and nonprofit purposes, provided the source is acknowledged. This work is licensed under the Creative Commons Attribution-Non-commercial-No-Derivative Works 3.0 License. To view a copy of this license, visit http://creativecommons.org/licenses/ bync-nd/3.0/ or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

ISSN 1684-9825

TABLE OF CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS

AWG LCA	Ad Hoc Working Group on Long-term Cooperative Action
CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
CERs	Certified Emissions Reductions
CGIAR	Consultative Group on International Agricultural Research
COP	Conference of Parties
CTC	Climate Technology Centre
CTCN	Climate Technology Centre and Network
DOE	Designated Operational Entity
GEF	Global Environmental Facility
GHG	Greenhouse Gas
IP	Intellectual Property
IPRs	Intellectual Property Rights
LDC	Least Developed Country
NGO	Non-governmental Organization
NSI	National System of Innovation
OECD	Organisation for Economic Cooperation and Development
SADC	Southern African Development Community
SAIS	Southern African Innovation Support Programme
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
TEC	Technology Executive Committee
TM	Technology Mechanism
TNA	Technology Needs Assessment
TTF	Technology Transfer Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNFCCC	United Nations Framework Convention on Climate Change

LIST OF BOXES

FOREWORD

Combating climate change requires the large scale diffusion of clean energy technologies. For this reason, enhancing technology development and transfer has been a key objective of the United Nations Framework Convention on Climate Change (UNFCCC) since its inception. The Bali Action Plan (2007) reaffirmed the centrality of technology transfer as one of the priority areas to be addressed in global climate negotiations.

After three years of deliberations, the Cancun Conference of the Parties (COP) established a Technology Mechanism (TM) whose goal is to enhance action on technology development and transfer in support of climate change mitigation and adaptation. The Durban COP completed the institutional set up of the TM, deciding that its two components - the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN) - would jointly report to the COP. It also adopted the modalities and rules of procedure of the TEC and the terms of references of the CTCN. The TEC which is akin to being the policy body of the TM is already in place, has met twice and adopted its work plan for 2012-2013. The CTCN, the operational arm of the TM, has not yet come into existence. The process for selecting a host for the Climate Technology Centre (CTC) which will steer the Network is well underway and should be finalized by the next COP meeting in Qatar, next December.

Against this background, the think pieces in this issue paper seek to contribute to the process of operationalisation of the TM by providing some suggestions and inputs on the range of issues and challenges confronting it. They are premised on the belief that the TM represents a potentially important milestone and positive development in efforts to operationalise UNFCCC technology transfer provisions in a more effective manner. Its mandate emphasizes a number of important priorities such as the strengthening of national innovations systems, the elaboration of technology actions plans, the strengthening of R&D collaboration and the promotion of public-private partnerships which bring new dynamism to international cooperation in this area.

At the same time, the mandate and functions of the TM, and of its bodies, are, in many instances, worded in a general manner and leave significant latitude in terms of their implementation. The inputs of all stakeholders, particularly from developing countries, could be valuable in helping these newly or soon to be established entities work out the manner in which they should carry out their respective responsibilities. In its first two meetings, the TEC has reached out to a number of stakeholders for this purpose. This issue paper seeks to complement such efforts.

The first think piece by Padmashree Gehl Sampath reflects on how the TM can “keep its promise” and deliver a novel approach focused on technology development and innovation rather than simply transfer and “access.” The author argues that the TM is uniquely positioned to support developing countries building their capacity to develop and deploy climate change technologies. She highlights some key considerations with regards to putting the TM into practice such as: ensuring coordination between the TM’s two bodies, identifying technological needs, putting priority areas into practice, addressing the need for effective monitoring and evaluation, promoting a participatory approach, apportioning financial priorities, and coordinating with existing initiatives.

The author concludes that an approach towards technology development, as proposed by the TM, could be an important step not only within climate change, but also in broader international discussions on technology, to move beyond simply window dressing the notion of technology transfer, to effective technology diffusion and technology assimilation.

The second think piece by John Mugabe brings an African perspective on the TM. The author argues that TM should focus on addressing the needs and challenges facing African countries to access and/or use climate technologies and chiefly their weak national systems of innovation. He calls on African countries to be more actively engaged in UNFCCC processes and discussions relating to technology and the operationalisation of the TM.

The author flags a number of issues that merit closer consideration in this regard: promoting the inclusion of activities or actions for strengthening African national systems of innovation and building capacity for technology prospecting; establish a specialized African working group of experts on technology transfer to assist countries in identifying specific ways and means for enhancing Africa's engagement in the development, governance and operations of the TM; and request the African Union Commission to undertake a comprehensive survey of existing African networks and organizations that are engaged in climate change technology development and transfer activities so they can 'plug' into the future work of the CTCN.

The last contribution in this issue paper is of a very special nature. It is the draft of a paper that the late Professor John Barton was writing for ICTSD when he unexpectedly passed away in 2009. This work "in progress" looks at the implementation of technology transfer provisions in international environmental agreements and seeks to draw lessons which continue to be relevant as the TM becomes operational. We hesitated a lot in releasing this unfinished work but ultimately thought that it would be valuable to share it with a wider community of scholars and experts that could possibly build upon it. In this regard, the manuscript contains many annotations and insights by the author that point to knowledge gaps which call for further research.

Throughout the years, Professor Barton developed a close collaboration with ICTSD that we greatly valued. It resulted in a number of insightful and thoughtful publications that addressed a wide range of issues from IPRs and nutrition to technology transfer and R&D which reflected his innate curiosity, multiple centres of interest and wide ranging expertise. In the area of climate change, his 2007 paper for ICTSD, *Intellectual Property and Access to Clean Energy Technologies in Developing Countries, An Analysis of Solar Photovoltaic, Biofuel and Wind Technologies* was groundbreaking as it was one of the first studies to look at IPRs and access to clean energy using patent data. Since then, it has become a work of reference that is extensively quoted in studies and discussions on the subject.

There is an additional reason for releasing this manuscript at this point in time: this year marks the tenth anniversary of the release of the report of the Commission on Intellectual Property Rights (CIPR) which was chaired by the late Professor Barton. The report had a significant impact in global policy debates on intellectual property and the chairmanship of the Commission by John Barton had an important part to that effect. Thus, we seize this opportunity to pay a special tribute to the late Professor Barton whose scholarly contributions and policy prescriptions continue to resonate until today in many public policy debates.

A central tenet of ICTSD's Innovation, Technology and Intellectual Property programme, launched in July 2001, has been that in a knowledge-based economy, a better understanding of innovation and intellectual property related issues is imperative for informed policy making in virtually all areas of development. Our focus has been on ensuring a proper balance between the different interests at stake in designing appropriate intellectual property regimes that are supportive of sustainable development objectives and compliant with international commitments. An additional central objective has been to facilitate the emergence of a critical mass of well-informed stakeholders in developing countries – including decision-makers and negotiators as

well as actors in the private sector and civil society - able to define their own sustainable human development objectives in the field of innovation and intellectual property and effectively advance them at the national and global levels.

I sincerely hope you will find this issue paper a useful contribution to efforts aimed at ensuring an effective operationalisation of the UNFCCC Technology Mechanism.

Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

EXECUTIVE SUMMARIES

Can the Climate Technology Mechanism Deliver its Promise? Some Issues and Considerations
By Padmashree Gehl Sampath

The Technology Mechanism (TM) is a very promising initiative as it proposes a dynamic approach geared towards fostering innovation and technology development as opposed to a limited focus on technology transfer. Innovation constraints in developing countries stem from the inability to build local indigenous technological capabilities, which are not only essential for innovation of completely new products and processes, but also for greater adaptation, deployment and use of existing environmentally friendly technologies within local contexts. It is important, therefore, to address the challenges in building these capacities in developing countries.

The TM's approach, resting on technology as a means to enhance innovation capacity is also better positioned to cater to the technological capacity building needs within developing countries, which in this context, are fairly heterogeneous. Any exercise to address technology needs to be dualistic in nature, distinguishing that technology development and innovation capacity needs may differ between developing countries with some level of capacity for innovation and production and those others without such capacity. Intellectual property (IP) protection has been a polarizing topic in climate change technology discussions. For the TM to succeed, it needs to be recognised that technology development and transfer is a much wider notion than simply an issue of IPRs. At the same time, it seems difficult to envisage that the issue of IPRs is completely evaded in deliberations about technology development and transfer.

Finally, there are some key considerations with regards to putting the TM into practice that need to be addressed such as: ensuring coordination between the TM's two bodies, identifying technological needs, putting priority areas into practice, addressing the need for effective monitoring and evaluation, promoting a participatory approach, apportioning financial priorities, and coordinating with existing initiatives.

An approach towards technology development, as proposed by the TM, could be an important step not only within climate change, but also in broader international discussions on technology, to move beyond simply window dressing the notion of technology transfer, to effective technology diffusion and technology assimilation.

African Perspectives on the UNFCCCC Technology Mechanism
By John Mugabe

It is important to ensure that the Technology Mechanism (TM) is a suitable institutional arrangement for supporting developing countries, and African ones in particular, to effectively engage in the development, acquisition and use of technologies for climate change adaptation and mitigation.

Technology needs assessment (TNAs) show that African countries are already exposed to a wide range of climate change technologies but do not have endogenous capabilities to adopt, diffuse and effectively use these technologies. Most African countries, including the least developed countries (LDCs), may not be able to access and/or use these technologies because of a number of barriers. The main barriers identified can be clustered into a generic one: weak national systems of innovation.

In that regard, the TM's programmatic areas and activities need to be explicitly based on the priorities and needs of developing countries in general and LDCs in particular. Some developing countries have become exporters of both adaptation and mitigation technologies, and thus the TM should look at means towards facilitating South-South technology transfer.

With this in mind, African negotiators and stakeholders should be more actively engaged in UNFCCC processes and discussions relating to the operationalisation of the TM. A number of issues merit close consideration in this regard such as: promoting the inclusion of activities or actions for strengthening African national systems of innovation and building capacity for technology prospecting; establishing a specialized African working group of experts on technology transfer to assist countries in identifying specific ways and means for enhancing Africa's engagement in the development, governance and operations of the TM; and requesting the African Union Commission to undertake a comprehensive survey of existing African networks and organizations that are engaged in climate change technology development and transfer activities so they can 'plug' into the future work of the CTCN.

Technology Transfer: An Evaluation of Treaty-Based Mechanisms relevant to Climate change
By John H. Barton†

Evaluating the international technology transfer provisions contained in international environmental agreements can provide important insights for negotiations on the emerging new architecture on technology transfer under the UNFCCC. More specifically, it is useful to review these along with their negotiating background and their implications in regards to achieving adequate flow of technology and capital, their effect on least-developed countries, and the implications for global governance.

The mechanisms worth reviewing are: the Montreal Protocol agreed upon in 1987, the subsequent Multilateral Fund of 1990, the Global Environmental Facility (GEF), the Clean Development Mechanism (CDM), the Convention on Biological Diversity (CBD) and other international research programs in this area.

There are a number of implications. First, there will have to be special research-oriented efforts for technologies that are not yet mature, since general global mechanisms appear to be more successful with more mature technologies, but fail in the research area. Efforts will also need to be more scientific rather than political. It is clear that research – i.e. the development of new technologies to be transferred – requires significantly different arrangements than do the sectoral and project funding approaches.

In addition, GEF history shows that nations are doing inadequate technology needs assessments, and that the officials who do such assessments are often not linked with those who design programs to import the technology. This is an especially important issue since responding to climate change has to be integrated into the development process. Also, the relative magnitudes of the different approaches suggest the importance of supplementing UNFCCC funding systems with funding through other channels.

Furthermore, there should be strong capability to acquire new technology and ways to reconcile the role of the private sector in the area of technology transfer. Lastly, a global governance system that is balanced between developed and developing countries is a must.

It is almost certain that there will be a multiplicity of mechanisms to enhance the transfer and diffusion of climate change technologies to developing countries. The availability of this variety of mechanisms is a positive, particularly since different technologies are likely to be more feasibly transferred through different mechanisms. Moreover, it appears very likely that bilateral and regional mechanisms will be responsible for as much technology transfer as global multilateral mechanisms.

1. CAN THE CLIMATE TECHNOLOGY MECHANISM DELIVER ITS PROMISE? SOME ISSUES AND CONSIDERATIONS

By Padmashree Gehl Sampath

1.1 Introduction

There is little doubt that technological capacity is the missing centerpiece in global efforts to promote the faster deployment, use and innovation of climate change technologies. Efforts since the inception of the United Nations Framework Convention on Climate Change (UNFCCC) to operationalize its provisions on technology transfer culminated in the creation of the Technology Mechanism (TM), agreed upon at the 16th Conference of the Parties (COP) in Cancun (2010), building further on the earlier mandates from the Bali Action Plan (2007).[1]

The TM, one of the concrete outcomes of the UNFCCC discussions in this area, aims to enhance action for technology development and transfer in support of climate change mitigation and adaptation. The TM consists of two main bodies that should 'facilitate the effective implementation of the Technology Mechanism, under the guidance of the COP', namely:

1) The Technology Executive Committee (TEC), which is meant primarily to be the policy arm of the TM; and,

2) The Climate Technology Centre and Network (CTCN), which is the operational arm of the TM.

The mandate on the establishment of the TM, as contained in the Cancun decisions,[2] sets out the key policy functions of the TEC and the CTCN. The 17th COP, held in Durban last December, finalized the institutional set up of the TM. It was agreed that the TEC and the CTCN will function autonomously from each other, although they will jointly report to the COP on progress in their activities. The terms of reference for the CTCN and the modalities and rules of procedure of the TEC were also adopted in Durban.

These outcomes are important as they lay the foundations how and in what ways the TM can perform its mandate. This think piece seeks to analyze and point to some of the promises and perils that lie ahead in implementing the operational details of the TM.

1.2 The Promise of the TM–Based Approach: Innovation and Technology Collaboration

The TM's key point of departure is that it proposes a dynamic approach geared towards fostering innovation and technology development as opposed to a limited focus on technology transfer. The focus of the TM (see Box 1) is on simultaneously promoting technology transfer and technology flows with two slightly differentiated aims: first, promoting innovation of environmentally sound technologies and their diffusion through R&D cooperation, international partnerships, among others, and second, promoting the ability of developing countries to maintain, operate and adapt such technologies, by enhancing their technology absorptive capacity.[3]

Box 1: Technology development and transfer within the TEC and the CTCN

As laid out by paragraph 121 of Decision 1/CP 16, the Technology Executive Committee is expected to perform key policy functions such as:[4]

(a) Providing an overview of technological needs along with an analysis of technical issues relevant for the development and transfer of technology in climate change mitigation and adaptation;

(b) Assisting in the creation of international, regional and national technology action plans to promote cooperation in technology, and

(c) Promoting the *collaboration* on the development and transfer of technology related to mitigation and adaptation between governments, private sector actors, non-profit organizations and research and academic communities.

The functions of the CTCN are complementary to those of the TEC. The CTCN is expected to facilitate a network of national, regional, sectoral and international technology networks, organizations and initiatives. Its core functions include:

(a) Identifying technology needs for the implementation of environmentally sound technologies, practices and processes in developing countries and facilitate the prompt deployment of existing technologies;

(b) Promoting their ability to maintain, operate and adapt technology;

(c) Promoting R&D cooperation including through south-south and trilateral channels;

(d) Facilitating international partnerships among public and private stakeholders to accelerate the *innovation* and diffusion of environmentally sound technologies to developing country Parties.

Source: UNFCCC Decision 1/CP 16

As a result, the TM-based approach, while acknowledging the importance of technology exchange through well-established means - including imports of machinery and equipment (UNCTAD, 2007 and 2010), trade in goods, licensing and scientific collaboration such as joint research and research partnerships – aims to support national innovation systems in developing countries. Supporting innovation systems in developing countries through means identified in the TM, such as "international partnerships among public and private stakeholders to accelerate the innovation and diffusion of environmentally sound technologies to developing country Parties" (see functions of CTCN in Box 1 above), implies that the emphasis of the TM is on addressing innovation constraints in developing countries. Such innovation constraints stem *inter alia* from the inability of countries to build local indigenous technological capabilities, which are not only essential for innovation of completely new products and processes, but also for greater adaptation, deployment and use of existing environmentally friendly technologies within local contexts.

The challenges of building indigenous climate-related technological capacities in developing countries

In climate change, it has been emphasized that most climate change mitigation technologies are off patent and 'available' to developing countries at their disposal (IPCC, 2007). However, what is becoming increasingly clear through empirical work and studies on technological development and change across sectors, including climate change, is that it is often not an easy task to access even

technologies that are off patent and in the public domain. Developing countries that have been able to access such technologies for reverse engineering and new product development are those that demonstrate some level of indigenous technological capacity. The lack of technological capacity or limitations therein, in many developing countries and least developed countries (LDCs), explains to a large extent the inability to tap into existing channels of technology.

This brings us to a fundamental point, namely that, whatever the channel through which an existing technology is acquired, the acquisition of information concerning the technology is only one part of the process. The ability to learn, use and adapt the acquired technology is just as important, if not more. Such adaptation may ultimately lead to the ability of making minor technical improvements that are more suited to the local context or the development of new applications of the transferred technology; each of which signifies an important step in the growth of innovation capacity (see economic historical studies on this point, for example, Amsden, 1989).

Successful technology transfer is therefore deeply embedded in the ability of recipients to diffuse and use the technologies in question which is shaped by what is known as the 'innovation system' of the country/sector in question. The term innovation system, used now in the TM is a milestone in itself, and denotes the network of institutions, organizations and actors, which permeate the development of knowledge locally leading to the development of new products, processes and applications. This concept acknowledges that technology development per se through all means, including technology transfer, is a collective exercise in any sector, and serves as a heuristic tool to guide policy makers on how to promote interactive learning and technological change.

Learning from other initiatives in structuring the TM-based approach

It has been often the failing of technology transfer approaches in the past that the focus has been on simply providing 'access' to technologies without facilitating aspects of such improved access, namely, promoting know-how exchange and the development of indigenous technological capabilities. The success of the technology transfer processes lies not in how many international obligations exist for the purpose - binding and non-binding - but rather on how the international obligations are structured around ground realities of technology acquisition and use processes. This is an important point that is also demonstrated in previous efforts to promote technology transfer such as the CDM, which have not sufficed to produce sustainable results because they have not succeeded in promoting learning in a systemic approach, across public research institutions and the private sector.[5]

In order to structure a new TM-based approach to technology transfer that would overcome these difficulties, two critical departures seem to be urgently needed. First, the substantive focus of technology transfer needs to move away from a simple emphasis on transfer of machinery and equipment (through imports, joint production, FDI and other means) to an active focus on know-how and building of technological capacity. Within this change in focus, aspects of scientific collaboration (such as training, joint research and facilitation of academic exchange in tertiary disciplines) will play an important role but it needs to be clearly augmented by aspects of technological collaboration *that build capacity* for firm-level/organization level design and production activities. These forms of activities are the backbone of innovation capacity, which is measured by the number of useful commercial products that local agents are able to adapt

and produce as opposed to how much research is ongoing in any local context. This is not to undermine the importance of research, but to clearly accentuate the importance of technological collaboration to build innovation capacity as opposed to research capacity.

Second, our understanding of the range of actors involved in technology transfer needs to be expanded to critically focus on the local public and private sector simultaneously. Local public sector institutions have a critical role in a range of activities in the climate change area, particularly in developing countries, including:[6]

(i) *Energy efficiency,* including better conversion efficiency, performance, reliability and durability;

(ii) *Material efficiency,* including advanced manufacturing techniques for components that substitute expensive with cheaper and reliable material inputs and reduce the use of toxic materials;

(iii) *Sustainable management,* including sustainable production processes that can reduce environmental impacts of manufacturing, use and final disposal;

(iv) *Storage efficiency,* including better methods for storage and integration of environmentally sound technologies into existing distribution systems;

(v) *Technological change and development,* including new mitigation and adaptation technologies (UN/DESA, 2009); and

(vi) *New R&D* into state-of-the-art climate change mitigation technologies.

Similarly, private sector actors, in developing and developed countries, play a very important role in technological processes, and are the key actors in technology exchange processes. Technology acquisition and exchange amongst private sector actors are influenced by factors that are firm-based and profit-oriented. From a survey of existing trends globally in other sectors, the following factors seem to be very important:

(i) Emerging competition trends in the sector from firms in developing countries;[7]

(ii) Quid-pro-quo in sense of the ability of the developing country firms' to strategically offer services/ product partnerships in return over a longer term;[8]

(iii) Ability on part of the developing country firms' to search efficiently for alternate technologies and pay their market price;[9] and,

(iv) Existence of a wide range of public-private initiatives aiming at creating technological exchange in the sector more widely given its public importance.[10]

While the first factor, namely, the capacity of firms in developing countries to compete with incremental technologies is often associated with a negative impact on the propensity of international firms to engage in technology transfer, all the other three aspects have potential positive implications for technology transfer between private sector actors. Developing countries that lack innovation capacity, in the climate change area, often lack factors (i) to (iii) listed above and therefore call for a more holistic range of engagement (see next section on heterogeneous capacity of countries). Providing appropriate incentives to the international private sector (which may not accrue on their own, given the inability of the firms in these countries to offer quid pro quo services or pay the market price) and assisting local firms in acquiring technology therefore remains a very important and effective means to promote technology exchange.

The TM-based approach takes on board many of the above-mentioned considerations. For the first time, it seeks to address and incorporate some of these important realities of technology development, chiefly the importance of know-how for development of endogenous capabilities to promote diffusion, adaptation and innovation in climate change technologies. Some of the key terms in this undertaking are

'technological needs', 'transfer of technology', 'diffusion', 'technology action plans', 'development of endogenous capacities', 'know-how', 'collaboration', 'network', 'adaptation' and 'innovation'.[11] The notion of technology development and transfer enshrined in the TM spans 'different phases of the technology cycle' from the key phases of acquiring information, assimilation and absorption of technological knowledge, to adaptation to local conditions, to absorption of subsequent improvements and the dissemination of the transferred knowledge, thereby jointly account for the complex process of technology transfer.

Such a systemic approach is highly relevant in the case of climate change mitigation technologies. It allows for an appropriate consideration of other obstacles to technology transfer in order to find comprehensive solutions, including the issues of finance, inadequate laws and regulations in supplier and recipient contexts, asymmetries in the abilities to search and bargain for appropriate technologies and the shortage of qualified know-how. It also helps to take into account several unique features of technology and innovation in this area. As opposed to other sectors, where technological capacity is triggered off by a large unmet need, there is already a well-established energy system globally, and such technologies primarily seek to provide alternative solutions to achieve the same result either by using natural resources of a different kind or by promoting the energy efficiency of current solutions to adapt and mitigate climate change (UNCTAD, 2011). Their unique selling point is that they offer environmentally friendly solutions to needs that are already being met by other technological advances. This calls for a very different form of support especially to developing countries, where local firms and research institutes are faced with different kinds of constraints in innovating and catering to local needs, often in the most price competitive means.

Addressing heterogeneous technological needs and capabilities

The TM's approach, thus resting on technology as a means to build innovation capacity is also better positioned to cater to the technological capacity building needs within developing countries, which in this context, are fairly heterogeneous. Some emerging economies have significantly advanced capabilities to engage in innovation in the area of climate change. For example, Chinese firms such as Suntech, Yingli Green Energy and Motech Solar, are rapidly expanding their market shares globally at the expense of already well-established German and Japanese firms (Hader et al, 2011). Similarly, India has several large solar manufacturers such as Moser Baer Photovoltaic Ltd, Tata BP Solar, Central Electronics Ltd and Reliance Industries. Indian firms are also focusing on smaller products and onshore installations in wind energy, and accounting for an increasing share of exports in this field. Three Chinese companies now rank among the top 10 in terms of market shares for wind power (Bouée, Liu and Xu, 2011), though they focus almost exclusively on meeting domestic demand. Goldwind, another large Chinese wind turbine company, has recently acquired a majority stake in Germany's Vensys in an effort to expand its know-how. Brazilian firms are increasingly successful in niche areas including biofuels.

At the same time, however, a large number of other developing countries are faced with institutional constraints in promoting innovation that are quite similar. As noted by Mugabe (2012), most African countries' technological needs assessments in this area shows that there is a need to build general innovation capacity in the system to promote the absorption and use of climate change technologies. Therefore any exercise to address technology needs to be dualistic in nature, distinguishing that technology development

and innovation capacity needs may differ between developing countries with some level of capacity for innovation and production and those others without such capacity. The TM, by offering more support for technological learning through technology transfer for both the public and private sectors as discussed here, can address the more fundamental issue of how the adaptation and use of climate change mitigation technologies can be better promoted in the developing countries, by building their capabilities for developing and deploying these technologies. It can also support developing countries in dealing with the emerging market-based standards (such as carbon footprinting and border carbon adjustments) without more adverse impacts on their nascent, emerging productive sectors (UNCTAD, 2011).

The TM and intellectual property rights issues

Intellectual property (IP) protection has been a polarizing item between developed countries and developing countries in UNFCCC discussions since Bali. While there are several dimensions to this complex interplay between IP protection and the demand for technology transfer, stronger protection of IP has been a cause for concern as to whether and how it will affect access to proprietary technologies across sectors.

In the context of climate change, while several technologies that are needed are in the public domain, there has been an increasing trend towards the patenting of clean technologies (termed the so-called Kyoto Effect) in the past few years (UNEP/EPO/ICTSD, 2010). This increasing tendency towards patenting is confirmed by other independent analyses of patent trends relating to climate change mitigation technologies.[12] Analysis conducted using patent data suggest that while energy prices drove innovation in clean and renewable energy technologies until the 1990, the spike in innovation and related patenting in these sectors since 2000 is more attributable to policy changes in the climate change arena (Dechezlepretre et al, 2010).

The jury is still out on this issue. While there seems to be an increasing trend towards patenting, what impact this will have on market concentration and how it will affect the development of technologies in some of the more technologically advanced developing countries remains unclear. The increased patenting is important and relevant from the perspective that it confers market power (and thereby, potentially, the ability to exclude competition) in different climate change technologies, and makes it harder for firms in developing countries to access knowledge. In a recent study, Haščič et al. (2010) conclude that in some segments, such as those related to wind power and carbon storage, patents seem to confer a large share of the market, indicating a positive relationship between patenting and market access, whereas in some other technologies, such as solar PV, this is not the case.[13]

Technologically advanced developing countries have expressed some concerns as to how increased patenting and licensing practices of global firms will impact upon enterprise activity of their own firms in this area (see, for example, Barton, 2007 and Lewis, 2008). This is also an issue for the international community to the extent that growing patenting activity in this area, may have an adverse impact upon the potential amount of new, cost reducing innovations available in the future, and possibly hinder market competition by increasing barriers to enter for firms from developing countries.

Despite these concerns on how intellectual property protection will impact upon access to technologies or global market concentration, up until now, there has been no agreement on any reference to intellectual property rights (IPRs) in the Cancun and Durban outcomes, and thus they are not explicitly included in the mandate of the TM. However, the issue has already been raised in the first two meetings of the TEC (September 2011 and February 2012). For the TM to succeed, it needs to be recognised that technology development and transfer is a much wider notion than simply

an issue of IPRs. At the same time, it seems difficult to envisage that the issue of IPRs is completely evaded in deliberations about technology development and transfer (See Abdel Latif et al, 2011).

1.3 Putting the TM Into Practice: Some Considerations and Challenges

Based on the terms of reference that were agreed upon in Durban, the UNFCCC has issued a call for proposals for hosting the Climate Technology Centre in January 2012.[14] The mission of the CTCN is to "stimulate technology cooperation and to enhance the development and transfer of technologies…"[15] The CTCN is expected to be composed of a Climate Technology Centre, to be assisted by a Network with the participation of institutions that are capable to responding to requests from developing country Parties in relation to technology development and transfer. It is also expected that institutions in the Network will be national, regional, sectoral, international or intergovernmental organisations.

What is evident from the agreed outcomes in Durban is that there is still a tendency to lapse into the international bureaucratic language of the kind that has been the hallmark of technology transfer-related provisions in the last four decades (Gehl Sampath and Roffe, 2012 forthcoming). Despite this tendency, the TM carries with it the potential of moving the technology transfer discourse into a much needed direction as previously mentioned.

Building further on the Durban results, the following issues seem to be relevant to achieve traction in the positive direction.

Ensuring coordination and coherence between the TEC and CTCN

For the purpose of achieving the goals of the TM, it seems absolutely imperative that the TEC and CTCN are well synchronized and work in tandem. Most of their functions are complementary in nature – for instance, while the TEC is mandated with the task of creating technology action plans at the international, regional and national levels, the CTCN is expected to foster alliances and collaborations to achieve the targets set out by the plans. Recognising this, the arrangements to make the TM fully operational in 2012 clearly recognise that the CTCN and the TEC *shall* relate so as to promote coherence and synergy in the functioning of the TM. Under the current arrangement, the CTCN, once operational, is expected to elaborate its modalities and procedures according to its terms of reference. Greater coherence between the CTCN and TEC, during the course of the coming years, can also be achieved by setting common goals and common outcomes.

Identifying technology areas and technological needs

The TM's task of creating international, regional and national technology plans that match the technological needs of countries has now been allocated to the TEC. Taking into account the decision that created the TM, these technology needs "…must be nationally determined according to local circumstances and priorities." Putting this into practice calls for (a) garnering the support and participation of individual countries to take into account their technological needs in this area; and (b) identifying and reaching agreement on what sectors are covered by the technologies that fall under the purview of the TEC. These technology areas have not been clearly listed out in the modalities and procedures set out for the TEC.[16] The second task is easier to achieve than the first. Garnering participation and clarity on the individual technological needs of countries in this area could prove to be a very difficult exercise. As a first step in this process, a means by which this could be achieved is by promoting coalitions or groups of like-minded countries (regionally or otherwise) with the intention of formulating joint technology needs. This could fit very well into the CTCN's mandate of facilitating regional collaboration on innovation issues. Such regional collaboration will have to distinguish between least developed countries'

(LDCs) needs to acquire and develop capacity in climate change adaptation technologies, as opposed to climate change mitigation technologies that are in greater need in the more technologically advanced developing countries.

Putting the priority areas into practice

The seven priority areas identified in the TM's mandate are very pertinent to the new idea of technology development and innovation. Ideally, these needed to be reorganized on a practical priority basis for policy formulation purposes. The seven priority areas are highly interlinked and include cooperative research, development and deployment programmes, diffusion of environmentally sound technologies and know-how, increasing public and private investment in technology deployment, diffusion and transfer activities, the strengthening of national systems of innovation and the development and implementation of national technology plans. From a practical policy implementation perspective, all other priority areas are specific actions within the umbrella of strengthening innovation systems, and are dependent on how innovation system related actions are accomplished – for example, technology plans directly depend on the countries' innovation system constraints and how they can be addressed. Similarly, mobilizing public and private investment for technology diffusion and deployment is also innovation system dependent. It would have been useful to operationalize these priority areas under the broader heading of strengthening of national innovation systems.

A closer reading of the modalities and procedures of the TEC as agreed upon in Durban reveals that these priority areas may even have been substantially watered down. As one example, para 121 (g) of the Cancun Agreement of 2010 states that the TEC should "Catalyze the development and use of technology road maps or action plans at the international, regional and national levels". This priority area, which has been elaborated upon in Section D of the Modalities and Procedures on "Facilitating and Catalyzing" simply suggests "Making recommendations on concrete actions, such as an international process for the development of technology road maps and action plans…"[17] This appears to be much weaker than the original intent of actively engaging in helping countries to make context-specific technology action plans.

As part of its initial mandate, the TM recognizes that the innovation systems constraints in developing countries are wide ranging and encompass different kinds of challenges depending on the level of development of the country in question. Building innovation capacity and addressing the impediments to technological learning and diffusion calls for policy action at various levels – from improving education and human resource endowments to promoting enterprise development and collaborative learning – many of which will take decades. Not only are some of these hard to monitor from an international perspective, they also entail policy and institutional issues that go beyond the climate change area. On a positive note, however, the past decade has seen an increasing emphasis across the developing world on innovation, and the role of domestic policy frameworks to promote it. Against this background, the TM's role would be most useful if its identified priority areas would work hand in hand to complement domestic efforts in innovation capacity strengthening that are already in motion in developing countries. These need to be further coordinated with the activities of the CTCN, with clearly articulated milestones that can monitor progress (see next point).

In this context, currently, some of the important functions for the CTCN that have been proposed, which will be discussed and decided upon during the 18th session of the COP will be:

(a) identifying currently available climate-friendly technologies for mitigation and adaptation that meet their key low-carbon and climate-resilient development needs;

(b) Facilitating the preparation of project proposals for the deployment, utilization and financing of existing technologies for mitigation and adaptation;

(c) Facilitating adaptation and the deployment of currently available technologies to meet local needs and circumstances;

(d) Facilitating research, development and demonstration of new climate-friendly technologies for mitigation and adaptation, which are required to meet the key objectives of sustainable development;

(e) Enhancing national and regional human institutional capacity to manage the technology cycle and to support the challenges for activities listed above.

Decision on these functions needs to be made bearing in mind that the CTCN's role would be best served to complement national efforts to build innovation capacity from within the area of climate-friendly technologies. The roles identified for the CTCN will need to be well aligned with the priority areas identified for the TM and at the same time, encapsulated into the operational details of the TEC.

Addressing the need for effective monitoring and evaluation systems

The most staggering problem currently in the implementation of the TM is that critical terms such as "technology transfer", "challenges and opportunities for technology transfer", and "building capacity" have all not been defined and agreed upon. The call for proposals for the CTCN sets out the criteria for evaluating the prospective host's technical capabilities, among which the host's "comprehensive understanding of the development and transfer of technologies including in the context of the Convention" is one. Given that the international community has been grappling with the issue of what exactly constitutes technology transfer and how best to measure it in various forums, it is unclear as to how such comprehensive understanding can be demonstrated and understood.

Even beyond choosing the host of the CTCN, clearly agreeing on these definitional parameters will be important to realize the TM's core promise of moving beyond the rhetoric of technology transfer to an approach to technology development.

In order to effectively address these definitional issues and to promote consensus amongst countries on the TM's activities, one step ahead could be to embark upon the process of identifying a set of indicators for technology transfer. At a broad level, these indicators for technology transfer could be structured on the broad lines of:

(a) Distinguishing between technology needs of different kinds of countries, or more specifically targeting technology exchange on the basis of regional technological needs.

(b) Segmenting the technology development activities into independent initiatives with clear parameters of success. This is critical to have results that can be monitored with ease. The technology development activities could be split up into programmes and projects that have clear technology components aimed at each one of the priority areas for strengthening innovation systems. The programmes and projects should be accompanied by identifiable monitoring and evaluation milestones from the outset, which are not currently evident.

(c) Identifying measures to conceptualize technological collaboration as a separate issue from scientific collaboration cooperation.

Promoting a participatory approach to technological change

To benefit from the technology development approach a more participatory process is required. In this approach, developing countries are not simply the 'recipients' of technology, but active participants in setting the agenda for technology transfer according to needs, on the one hand, and working domestically to promote the capacity to use technological opportunities on the other. The more technologically advanced developing countries in the emerging South are also well-positioned to help promote technological development and deployment of climate change technologies across the developing world. Currently, the terms of reference for the CTCN do not specify how such a participatory approach is to be set out. In fact, from the current terms of reference on the CTCN it is not clear how the participatory institutions that will form part of this Network are to be selected, coordinated and what binding roles can be assigned to them. The functioning and effectiveness of the CTC will largely depend on the Network since the members of the Network are to undertake the substantive work to address requests made to the CTC by developing country Parties.[18] These issues need to be addressed constructively also bearing in mind the important contribution of the emerging Southern countries in promoting technological development in this area.

Apportioning financial priorities

Given that the existing climate change financing architecture is fragmented (UNCTAD, 2011; Tan, 2010), the CTCN has an indisputable role to play in promoting all aspects of climate change technology adaptation as opposed to just mitigation, development and innovation. Learning from other existing mechanisms, especially the Global Environmental Facility's experience, it is evident that such funding should include finance for technology transfer itself failing which technology transfer will lack necessary incentives (see for example, Pueyo et al, 2011). Such funding will also be needed to promote, for instance, subsidies for innovation related to adaptation (as opposed to a narrower focus on mitigation) and use in developing countries. This will be an important component of the CTCN if it is to promote the prompt deployment and use of climate change technologies, and at the same time cater to technological development in this terrain These aspects of the budget still remain to be fleshed out, and some more detailing on these issues will be very important to ensure effective arrangements on finance.

Coordinating with existing initiatives

Whereas Para 121 of the Cancun Agreement of 2010 stressed upon the need to coordinate the TM with other existing arrangements and initiatives, this still remains an outstanding task. The CTCN and the TEC would both benefit from being able to work in collaboration with existing regional hubs, new international initiatives on the issue, and the newly created International Agency on Renewable Energy (IRENA). The IRENA is a dedicated international agency established in 2010 with the specific purpose of promoting the widespread use and adaptation of RETs, as well as for dealing with issues of renewable energy-related innovation. One of the initiatives with whom coordination could be envisaged is the science, technology and innovation centre (an International Innovation Network), which was proposed at the UN LDC IV Conference in Istanbul in May 2011. The Centre, a signature initiative of the UN LDC IV Conference, seeks to address some of the shortcomings of existing initiatives on technology transfer. It is intended to serve as a real and virtual hub for, among others: "Facilitating joint learning – through exchange of information and experiences as well as establishment of a shared knowledge base of analytically rigorous, shared case studies – to enable peer-to-peer learning between experts, organizations and agencies from LDCs and other countries with recent and ongoing development experiences."[19]

The knowledge-sharing activities of the Network are intended to focus on four key areas, one of which would promote technological leapfrogging for facilitating access to energy by building combined clean energy and ICT-networked infrastructures (UNCTAD, 2011). The TEC and CTCN, in collaboration with such initiatives could also promote regional efforts for strengthening innovation and technological capabilities.

1.4 Some Thoughts on the Way Ahead

The traction towards a more comprehensive approach to bridging the technological divide in climate change technologies has been furthered in Durban and beyond. The past few months have seen very promising developments indeed in the move towards making the TM fully operational. The TM, as highlighted by this think piece, is a very promising initiative that seeks to address some of the key problems that the international community has been facing in promoting technology transfer. This think piece has tried to list out the strengths of the TM and also point out to some of the aspects that need further attention. Such action is immediate and urgent, and will be important to ensure that the TM performs effectively. An approach towards technology development as proposed by the TM could be an important step not only within climate change, but also in the international discussions on technology, by paving the way to move beyond simply window dressing the notion of technology transfer, to effective technology diffusion and technology assimilation.

REFERENCES

Abdel Latif, A., Maskus, K., Okediji, R., Reichman, J. & Roffe, P. et al. (2011). *Overcoming the Impasse on Intellectual Property and Climate Change at the UNFCCC: A Way Forward*, ICTSD Policy Brief No. 11, available at: http://ictsd.org/i/publications/120254

Abdel Latif., A. (2011). *The Climate Technology Mechanism: Issues and Challenges*, ICTSD Information Note 18, available at: http://ictsd.org/i/publications/103789

Amsden A. (1989). *Asia's next giant: South Korea and Late Industrialization*. New York and Oxford, Oxford University Press.

Barton, J (2007). *Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuels and Wind Technologies*. ICTSD Trade and Sustainable Energy Issue Paper No. 2, ICTSD, Geneva, Switzerland.

Bouée C-E, Liu W and Xu A (2011). *"China-Green on an unimaginable scale," in Green Growth, Green Profit: How Green Transformation Boots Business*, edited by Roland Berger Strategy Consultants GmbH, Palgrave Macmillan.

Dechezleprêtre, A., Glachant, M., Hascic, I., Johnstone, N., Ménière, Y. (2011) Invention and Transfer of Climate Change Mitigation Technologies: A Global Analysis, Review of Environmental Economics and Policy 5 (1), 109 – 130, London.

Gehl Sampath P and Roffe P (2012). Unpacking the International Technology Transfer Controversy: Fifty Years and Beyond, ICTSD Policy Series, Geneva.

Gruebler, A. et al (1999). "Dynamics of Energy Technology and Climate Change". Energy Policy 27, 247-280.

Hader M, Hertel G, Körfer-Schün M and Stoppacher J (2011). *"Renewable energy advancing fast," in Green Growth, Green Profit: How Green Transformation Boots Business*, edited by Roland Berger Strategy Consultants GmbH, Palgrave Macmillan.

Haščič I, Johnstone N, Watson F and Kaminker C (2010). Climate policy and technological innovation and transfer. An overview of trends and recent empirical results. OECD *Environment Working Papers*, No. 30, OECD, Paris. Available at: http://www.oecd-ilibrary.org/docserver/download/fulltext/5km33bnggcd0.pdf?expires=1313138057&id=id&accname=guest&checksum=5F9A4AE055F43297CA7AEFFF51EB78BE

Henzelmann T and Grünenwald S (2011). *"Green services are the unsung heroes," in Green Growth, Green Profit: How Green Transformation Boots Business*, edited by Roland Berger Strategy Consultants GmbH, Palgrave Macmillan.

IPCC (2007). *Climate Change 2007: Mitigation of Climate Change*. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge and New York, Cambridge University Press.

ISPRE (2009). *Research and Development on Renewable Energies: A Global Report on Photovoltaic and Wind Energy,* Paris, International Science Panel on Renewabe Energies.

Lewis, J (2008). *Leapfrogging In India and China*, available at: http://www.chinadialogue.net/article/shw/single/en/1874.

Ockwell, D., Haum, R., Mallett, A., & Watson, J. (2010) "Intellectual property rights and low carbon technology transfer: Conflicting discourses of diffusion and development". Global Environmental Change, 20 (4). pp. 729-738.

Tan C (2010). Confronting climate change: Towards a new international agenda for meeting the financial challenges of the climate crisis in least developed countries. Background paper for UNCTAD's *Least Developed Countries Report 2010*. Geneva, UNCTAD.

UNCTAD (2007). *The Least Developed Country Report: Knowledge, Technological Learning and Innovation for Development*. United Nations publication, sales No. E.07.II.D.8. New York and Geneva, United Nations.

UNCTAD (2010). *The Least Developed Countries Report 2010: Towards a New International Development Architecture for LDCs*. United Nations publication, sales No. E.10.II.D.5. New York and Geneva, United Nations.

UNCTAD (2011). *Technology and Innovation Report 2011: Powering Development with Renewable Energy Technologies*. United Nations publication, sales No. E.11.II.D.20. New York and Geneva, United Nations.

UN/DESA (2009). *A Global Green New Deal for Climate, Energy, and Development*. New York, United Nations.

UNEP, EPO and ICTSD (2010). *Patents and Clean Energy: Bridging the Gap between Evidence and Policy*. Final report. Available at www.epo.org/clean-energy

Urpelainen, J (2011). "The Strategic Design of Technology Funds for Climate Cooperation: Generating Joint Gains." *Environmental Science and Policy*, doi: 10/1016/j.envsci.2011.08.007

ENDNOTES

1 At the thirteenth session of the COP to the UNFCCC in 2007, a clear consensus emerged that technology transfer is central to the implementation of the Convention beyond 2012 (see UNFCCC 2007, Bali Action Plan, Document FCCC/CP/2007/L.7/Rev.1).

2 Section IV B of Decision 1/CP.16 of COP 16 on the Outcome of the work of the Ad Hoc Working Group on long-term Cooperative Action (AWG LCA).

3 This approach has been advocated for in several studies on the issue, see for example, UNCTAD (2011), Gruebler et al (1999), Ockwell (2010) and Urpelainen (2011) who all call for such a dual approach in various facets of the climate change technology discourse.

4 See para 121, Decision 1/CP.16 of COP 16 on the Outcome of the work of the Ad Hoc Working Group on long-term Cooperative Action.

5 The few studies that have sought to study the impact of the mechanism on technology transfer by studying the project design documents have not been able to derive specific results on how and to what extent the CDM has contributed to increasing technology transfer of environmentally sustainable technologies. Consensus points towards the fact that such a market-based approach to technology transfer seems to be of limited impact since the CDM institutions do not fundamentally alter the country's trade, investment, technology or innovation capacities.

6 See for example, ISPRE (2009); see also Henzelmann and Grünenwald (2011).

7 When firms in developing countries are quite versatile in their ability to reverse engineer the technologies and products and are adept at incremental innovation, the possibility of easy replication and capture of rents by local firms is often stated by companies as a reason to not engage in technology exchange or to even aggressively protect technologies.

8 In some emerging sectors, technological alliances are often boosted by the fact that the international firms lack some of the service/ distribution/ efficient product development capacity that the local firm offers that is often relevant to gain a foothold in the local/ regional market.

9 This is often observed in the case of agricultural technologies and now more recently, in a range of health technologies in order to ensure that public needs are met.

10 This is often observed in the case of agricultural technologies and now more recently, in a range of health technologies in order to ensure that public needs are met.

11 Paragraphs 113 to 121 of Decision 1/CP.16 of COP 16 on the Outcome of the work of the Ad Hoc Working Group on long-term Cooperative Action.

12 For instance, a recent study found that between 1988 and 2007, Japan had the highest number of claimed priorities for patents in all kinds of climate change mitigating technologies considered in the analysis (Haščič et al., 2010). Japan was followed by the United States, Germany, the Republic of Korea and France.

13 The data used in this study only includes patented products in solar thermal and PV, biofuels, geothermal, hydropower, carbon capture, wind, selected other climate change mitigation technologies, fossil fuels and nuclear. When these markets are considered in their totality (i.e. including inventions that are off-patent), individual firms may have smaller market

shares (denoting the absence of an oligopolistic market structure). Although the data for conducting such an analysis are currently unavailable, this needs to be borne in mind.

14 Terms of reference of the CTCN, UNFCCC 2012.

15 Para 1, Terms of reference of the CTCN, UNFCCC 2012.

16 Para 10 only mentions the term “each one of the technology area”.

17 See Part D, para (f).

18 Paragraph 120, Cancun Agreements, UNFCCC (2010).

19 For a greater discussion on this and other such initiatives, see UNCTAD (2011).

2. AFRICAN PERSPECTIVES ON THE UNFCCC TECHNOLOGY MECHANISM

By John Mugabe

2.1 Introduction

The 16th Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Cancun, Mexico in 2010 decided to establish a Technology Mechanism (TM) to facilitate the implementation of the Convention's provisions on technology development and transfer. The decision to establish a TM was the outcome of at least three years of negotiations on ways and means of ensuring that the UNFCCC's provisions on access to and transfer of technology are implemented.

The Bali Action Plan adopted by the 13th COP in 2007 called for "consideration of effective mechanisms and enhanced means for the removal of obstacles to, and provision of financial and other incentives for, scaling up of the development and transfer of technology to developing country Parties in order to promote access to affordable environmentally sound technologies".[20]

The 17th COP in Durban, South Africa (28 November - 9 December 2011) made decisions regarding the operationalization of the TM. Durban clarified the relationship between the TM's two bodies – the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN) – by establishing joint reporting to the Conference of the Parties. The terms of reference for the CTCN were adopted as well as the procedures and modalities of the TEC.

This think piece seeks to contribute to efforts at the operationalisation of the TM from an African perspective. It is about ways and means of ensuring that the TM is a suitable or appropriate institutional arrangement for supporting developing countries in general, and African ones in particular, to effectively engage in the development, acquisition and use of technologies for climate change adaptation and mitigation. It starts by providing an overview of the UNFCCC's provisions on technology development and transfer and then discusses efforts by some African countries to identify and assess their technology needs. It shows that (a) African countries are already exposed to a wide range of technologies for adaptation but do not have endogenous capabilities to adopt, diffuse and effectively use these technologies; and (b) some developing countries are exporters of both adaptation and mitigation technologies, and thus there is a need for institutional arrangements that will facilitate South-South technology transfer.

2.2 Technology Development and Transfer Issues in the UNFCCC

That technology and technological change are critical in climate change adaptation and mitigation cannot be disputed. It is widely recognized that for both developed and developing countries to reduce global greenhouse gas emissions and effectively respond to the impacts of climate change they must invest in the development, diffusion, adaptation and use of a wide range of environmentally sound technologies. This recognition is explicitly embedded in provisions of the UNFCCC and its Kyoto Protocol, as well as many other international agreements on sustainable development, the environment and trade.

Technology development and transfer provisions are contained in Articles 4 and 5 of the UNFCCC and Article 10 of the Kyoto Protocol. Article 4 paragraph1(c) of the UNFCCC states that all Parties to the Convention shall:

> Promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that

> control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors.

Article 4 paragraph 5 of the UNFCCC is about the transfer of and access to technologies as well as the development of technological capacities of developing country Parties. It states:

> The developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies.

Since the UNFCCC came into force in 1994, its Contracting Parties have been exploring ways and making decisions to implement technology development and transfer provisions. The Subsidiary Body for Implementation (SBI) and the Subsidiary Body for Scientific and Technological Advice (SBSTA) have over the past decade or so also been engaged in exploring mechanisms or institutional arrangements for implementing them.

Key milestones in the search for mechanisms to implement these provisions are the adoption of the Technology Transfer Framework (TTF) (Marrakech Accords) at COP7 in Marrakech. The TTF is comprised of technology assessment, technology information, enabling or conducive policy environment, capacity building, and mechanisms for financing and promotion of technologies for adaptation.

Intellectual Property protection and the evolution of the technology transfer debate

The impact of intellectual property (IP) protection on the development and transfer of technologies for climate change adaptation and mitigation has been the subject of intense debate in the climate change negotiations for decades. The debate oscillates between two positions. Developing countries have always held the position that IP protection is a barrier to technology transfer from the developed countries. They have called for the removal of protection and more specifically patent rights on technologies. On the other side, developed countries have argued that IP protection is an incentive for technological innovation, and that the relaxation of protection through patents will deter private sector investment in research and development (R&D) and technological innovation. They have called on developing countries to strengthen their IP legislation.

Since the negotiation in the 1980s and adoption of the UNFCCC in 1992, the positions of developing and developed countries have not really changed. Agenda 21, adopted at the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil in 1992, called for consideration and examination of the impact of IP protection in general, and patents in particular, on the access to and transfer of environmentally sound technologies (See Box 2).

Box 2: Agenda 21 Chapter 34

34.10. Consideration must be given to the role of patent protection and intellectual property rights along with an examination of their impact on the access to and transfer of environmentally sound technology, in particular to developing countries, as well as to further exploring efficiently the concept of assured access for developing countries to environmentally sound technology in its relation to proprietary rights with a view to developing effective responses to the needs of developing countries in this area.

34.11. Proprietary technology is available through commercial channels, and international business is an important vehicle for technology transfer. Tapping this pool of knowledge and recombining it with local innovations to generate alternative technologies should be pursued. At the same time that concepts and modalities for assured access to environmentally sound technologies, including state-of-the-art technologies, in particular by developing countries, continued to be explored, enhanced access to environmentally sound technologies should be promoted, facilitated and financed as appropriate, while providing fair incentives to innovators that promote research and development of new environmentally sound technologies.

Source: www.un.org/esa/dsd/agenda21/res_agenda21_34.shtml (accessed 29 November 2011).

However, not much progress has been made on resolving the debate on the impact of IP on technology transfer. The lack of consensus on the issue shone through at COP17 when Parties left IP issues as they relate to technology transfer in the backburner.

For a long time, there was a pervasive perception of developed countries as the only sources of technologies for climate change adaptation and mitigation. This perception is manifest in many of the decisions of the UNFCCC Conference of Parties, as well as the positions that developing countries have adopted over the past three decades or so. It is informed by old and outdated views that (a) the North (developed countries) is the source of technological innovation and the South (developing countries) are mere recipients of technology; and (b) that technology transfer takes place from the North to the South, with only IP protection acting as a barrier to the transfer of technology. These perceptions are based on the old paradigm of technology transfer as essentially North-South, which is now rather outdated (See Box 3). This changing perception is reflected in the mandate of the TM agreed at Cancun, which makes repeated references to South-South technology cooperation.

Box 3: New paradigm: South-North and South-South technology transfer

"The traditional North-South paradigm of technology transfer ignores the increasing importance of developing countries as source of advanced climate-friendly technologies, and therefore ignores South-North and South-South transfers. Further, whereas the North-South paradigm has emphasized developing countries' intellectual property rights policies as barriers to technology transfers, the 'global' paradigm focuses attention on trade and investment policy barriers, including developed countries' policies that inhibit technology transfer from developing countries."[21]

Some developing countries are sources of new climate change mitigation and adaptation technologies. For example, Brazil is the world's leader in biofuel R&D and related technological innovation activities; South Africa is one of the leaders in coal-to-synfuels technology development. As Brewer (2008) notes, "in short, developing countries in Asia, South Africa and Africa are among the world leaders in the production of a wide range of climate-friendly technologies".[22]

Patent data show that there is increasing innovation generating new climate change technologies.[23] Most of the technologies are being developed and commercialized by private companies in the industrialized and some developing countries.

There is now a growing body of empirical studies on the relationship between IP and technology transfer.[24] They show that the IP-technology development and transfer nexus is not linear, i.e. that IP is either a barrier to technology transfer or the main incentive for technological innovation. Rather, the relationship is non-linear and more complex than it is often portrayed in international negotiations. The protection of IP *on its own* does not promote technological innovation and *on its own is not* a barrier to the transfer of technologies for climate change adaptation and mitigation. The development and transfer of climate change technologies depends, to a large extent, on the dynamism of national systems of innovation (NSI) – the capacities of countries to leverage public and private sector innovation using their policies and institutions. Indeed, whether IP is a barrier to or incentive for technology development and transfer depends on the specific conditions of each country, and in fact on specific firms in each country.

2.3 Africa's Participation in the Implementation of the UNFCCC Technology Transfer Framework

Thirty-one African countries (see Box 4) have prepared technology needs assessment (TNA) reports. There are many similarities in the technology needs of African countries. The reports focus mostly on mitigation technologies, although adaptation technologies are also addressed. Specific technologies, practices and technological applications that were identified as needs include: solar and wind power, clean coal technologies, integrated gasification combined cycle systems, fluidised-bed combustion, waste management practices, electric and hybrid-electric vehicles, geological carbon sequestration, control of biomass burning in wildfires, animal breeding for methane abatement, crop rotation and inter-cropping, information and communication technologies, using genetic modification to develop new crops and cultivars that are heat and drought tolerant, improvement in irrigation efficiency, desalination, and promotion of mass public transportation.

Box 4: African countries that have prepared and adopted TNAs

Benin, Botswana, Burkina Faso, Burundi, Cape Verde, Chad, Comoros, Congo, Côte D'Ivoire, Democratic Republic of Congo, Egypt, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Namibia, Niger, Senegal, Seychelles, South Africa, Togo, Tunisia, Uganda, United Republic of Tanzania and Zimbabwe.

Source: http://unfccc.int/ttclear/jsp/TNAReports.jsp (accessed 29 November 2011).

Barriers to Technology Development, Access and Transfer

At least 75 per cent of the technologies identified are on the international technology market, in both developing and developed countries. In fact most African countries, including the least developed countries (LDCs), are exposed to these technologies but may not be able to access and/or use them because of a number of barriers. The TNA reports were prepared between 2002 and 2009. They identified the following as the main barriers to technology development and transfer:

- Lack of financial resources (identified by 26 African countries);
- Inadequate skills in science, technology and engineering fields (27 countries);
- Lack of information on the technologies (28 countries);
- Lack of information on sources of the technologies (17 countries);
- Absence of policies and institutions to promote technology development and procurement (13 countries);
- Lack of incentives for the private sector to invest in climate change mitigation technologies (11 countries);
- IP protection (2 countries);
- Low public awareness of environmentally sound practices (23 countries); and
- Poor institutional linkages, particularly between the public and private sectors (21 countries).

Most of these barriers were identified in the energy, agriculture, forestry and water sectors.

Kenya's report treats IPRs and more specifically patents as incentives for technology development. It states: "Patents provide incentives to individuals by offering them recognition for their creativity and material reward for their marketable inventions and investment. These incentives encourage innovations in all fields of the technology including those that are environmentally friendly".[25]

Box 5: Key messages for policymakers

> The main barriers identified in TNAs of African countries can be clustered into a generic one: weak national systems of innovation. IPRs are not identified as a barrier by most countries that have prepared such reports.

As a follow-up to the TNAs, the countries are expected to develop specific plans or strategies for implementing other components of the TTF. Almost all the 28 African countries with TNA reports identified the development of technology implementation plans as one of the next steps. However, few of the countries have been able to design plans that would enable them to effectively engage in climate change technology development, acquisition and transfer.

In order to support developing countries in implementing the TTF, the Global Environment Facility (GEF) designed the Poznan programme on technology transfer in 2008. Few African countries have been able to access financial and technical support from the programme to invest in technology projects. Only three – Côte d'Ivoire, Kenya and Senegal – of the 28 African countries with TNA reports have received support from the programme. The low participation of African countries in the

GEF Poznan programme may be due to limited national capacity for project preparation.

The Africa Group – essentially members of the African Union – has expressed concerns regarding the low level of support to implement the TTF. In 2009 the Africa Group convened a Special Session of the Africa Partnership Forum on Climate Change in Addis Ababa, Ethiopia to discuss 'Enhanced Action on Technology Development and Transfer.' At this meeting the Group endorsed the proposal by G77 and China for the establishment of TM under the UNFCCC (See Box 6).

Box 6: Recommendations of the Africa Partnership Forum, September 2009

The Africa Group submissions for the negotiating text (for Copenhagen COP15) included:

- Developed countries commit to the full cost for the deployment, diffusion and transfer of technology to developing countries, together with finance and capacity building for urgent and immediate adaptation actions in developing countries;
- Use the performance indicators for technology transfer developed by the Expert Group on Technology Transfer to further enhance the measurement, reporting and verification of technology transfer;
- Address more directly the barriers to technology transfer; and
- Establish a new technology mechanism coherent with the G77 approach.

Source: www.africapartnershipforum.org

2.4 Making the UNFCCC Technology Mechanism Work for Africa

The adoption of the decision (Decision 1/CP.16) to establish the UNFCCC Technology Mechanism in Cancun in 2010 is the outcome of at least two years of negotiations. In June 2008, at a UNFCCC roundtable in Bonn Germany, the G77 and China called for the creation of an international technology mechanism to enhance technology development and transfer. This proposal was based on the premise that the implementation of the TTF was slow and was not helping much to fast track the implementation of the technology transfer provisions of the Convention and the Bali Action Plan.

Box 7: Article 1(d) of the Bali Action Plan

"Enhanced action on technology development and transfer to support action on mitigation and adaptation, including, *inter alia*, consideration of: (i) effective mechanisms and enhanced means for the removal of obstacles to, and provision of financial and other incentives for, scaling up the development and transfer of technology to developing country Parties in order to promote access to affordable environmentally sound technologies."

The main function of the TM is "to facilitate the implementation of actions for achieving enhanced action on technology development and transfer… to support action on mitigation and adaptation in order to achieve the full implementation of the Convention".[26] The TM consists of two components: a Technology Executive Committee (TEC) and a Climate Technology Centre and Network. The functions of the TEC and CTCN are outlined in paragraphs 121 and 123 of Decision 1/CP.16 (Cancun Agreements) respectively (see Box 8).

Box 8: Functions of the TEC

a) Provide an overview of technological needs and analysis of policy and technical issues related to the development and transfer of technology for mitigation and adaptation;

b) Consider and recommend actions to promote technology development and transfer in order to accelerate action on mitigation and adaptation;

c) Recommend guidance on policies and programme priorities related to technology development and transfer with special consideration given to the least developed country Parties;

d) Promote and facilitate collaboration on the development and transfer of technology for mitigation and adaptation between governments, the private sector, non-profit organizations and academic and research communities;

e) Recommend actions to address the barriers to technology development in order to enable enhanced action on mitigation and adaptation;

f) Seek cooperation with relevant international technology initiatives, stakeholders and organizations, promote coherence and cooperation across technology activities, including activities under and outside of the Convention;

g) Catalyse the development and use of technology road maps or action plans at international, regional and national levels through cooperation between relevant stakeholders, particularly governments and relevant organizations or bodies, including the development of best practice guidelines as facilitative tools for action on mitigation and adaptation.

Source: Paragraph 121 of UNFCCC Decision 1/CP.16

The Climate Technology Centre facilitates the establishment and operations of the CTN. It will be expected to engage the Network's participants (national, regional, sectoral and international technology networks, organizations and initiatives) to, *inter alia:*

(a) Advise and support developing countries (at their request) to identify their technology needs and implement environmentally sound technologies, practices and processes;

(b) Facilitate the provision of information and training for programmes to build developing countries' capacities to identify technology options, make technology choices and operate, maintain and adapt technology;

(c) Stimulate and encourage the development and transfer of existing and emerging environmentally sound technologies, through collaboration among the private sector, academia and research institutions; and

(d) Identify, disseminate and assist with developing analytical tools, policies and best practices for country-driven planning to support the dissemination of environmentally sound technologies.

2.5 Operationalization of the TM

Guiding Principles

The extent to which the TM will be successfully operationalized to evolve into an effective and efficient institutional arrangement for the implementation of technology development and transfer provisions under the UNFCCC largely depends on the following factors:

1. *Clarity of purpose and functions of the TM*. While Durban clarified the specific roles of the TM's components, the TEC and the CTCN, the language (in Decision 1/CP.16) on the functions of the TM is general and creates room for different interpretations. Wording such as "facilitate", "enhanced action" and "stimulate" need careful and agreed interpretation.

2. *Collective ownership of the TM*. Active participation of both developed and developing country parties, non-governmental organizations (NGOs) and the private sector in the design, governance and operations of the TM is critical for its success. The TM should not be controlled or perceived to be controlled by any one particular group of countries or stakeholders. Stakeholders need to be more actively engaged in discussions and decision-making on the TM. In most countries, particularly African ones, there have not been any national consultations on the TM.

3. *Institutional flexibility and integration*. The TM as a whole and the CTCN in particular should be a relatively small and flexible institution that is embedded in existing organizations. Its operations should be integrated into carefully selected existing organizations, including regional and international development bodies such as the African Development Bank and the Asian Development Bank, some of the UN agencies and the Consultative Group on International Agricultural Research (CGIAR).

4. *Experimentation and institutional learning*. The creation of the TM should be evolutionary to allow for experimentation with different organizational models, and adjusting both institutional functions and form based on lessons and experiences from its operations. This means that a phased approach should be considered in creating the TM. The first phase may focus on the design of an overall coherent TM strategic plan. Without an overall coherent strategic plan, the TM may evolve into an incoherent institutional arrangement with different components that fail to articulate.

Comparative Institutional Mechanisms

The creation and governance of the TM should be informed by experiences and lessons from a number of international and regional initiatives that have sought to establish mechanisms for technology development and transfer. There are many such initiatives, including the CGIAR, the Global Health Research Forum, and the African Union/New Partnership for Africa's Development (NEPAD) networks of centres of excellence in biosciences and water sciences.[27] Of these, the CGIAR offers many lessons since it has been in existence for at least four decades (See Box 9).

Box 9: The CGIAR: Lessons for the TM

The CGIAR comprises 15 agricultural research institutes or centres (located in both developed and developing countries), a Consortium of the centres/institutes, the CGIAR Fund and the Independent Science and Partnerships Council. The 15 centres are independent institutions conducting research and technology development on various aspects of agriculture. Each has legal status and a governance structure as well as a programme of work. The CGIAR Fund is the mechanism for financing the CGIAR, particularly the 15 centres. It is hosted and administered by the World Bank. The Consortium is the focal point or hub of the 15 centres. It promotes networking of the centres through common programmes and sharing of resources. The Council is responsible for monitoring and evaluating the quality of the CGIAR science programmes and partnerships between the CGIAR and other stakeholders.

Box 9: *Continued*

Key aspects of the CGIAR that should be noted are: (a) shared principles, programmes and facilities; (b) common dedicated fund with diversity of public and private funders; (c) a common adopted Monitoring and Evaluation Framework; and (d) simplified and flexible governance structures at the centre, Consortium, Council and Fund levels.

Source: www.cgiar.org; also see Correa, C. (2009), Fostering the Development and Diffusion of Technologies for Climate Change: Lessons from the CGIAR Model, ICTSD.

Programmatic Priorities

The TM will need to focus on specific priority activities to demonstrate its value and justify its creation. The programmatic areas and activities will need to be explicitly based on the priorities and needs of developing countries in general and LDCs in particular. It is thus instructive that the TEC, in collaboration with the UNFCCC secretariat, should provide leadership for identifying and setting priority areas of the TM based on clear principles, including:

(a) *Build on prior progress*. The identification and setting of priorities should build on efforts and results of previous and ongoing TNAs and other assessments.[28] It is important that a synthesis of the various relevant assessments be undertaken to tease out specific priorities that have been identified; and

(b) *Focus on value-addition*. The TM priority areas should be value adding. The Mechanism should not focus on those issues, areas and activities that can and should be undertaken by national governments using their own domestic financial, institutional and technical resources.

In terms of specific support for African countries, the TM should focus on those activities and processes that will *strengthen national systems of innovation*. These systems are about linkages and articulation of policies, institutions (both public and private) for research, financing, education, technology development, technology commercialization, intellectual property protection, standards management, etc. The quality and dynamism of a country's NSI determines its ability to engage in climate change mitigation and adaptation through effective technology procurement, adaptation and deployment. Specific priority actions for the TM in support for Africa should include:

1. Supporting African countries to undertake comprehensive assessments of their NSI using coherent approaches drawn from the Organisation for Economic Cooperation and Development (OECD) and other regions that have instituted NSI assessment methodologies and practices;[29]

2. Documenting and disseminating best practices for building and nurturing NSI for sustainable development; and

3. Providing technical and financial resources to countries to formulate and adopt NSI plans and strategies.

Another priority area for the TM is the provision of technical support to developing countries in general and African ones in particular to *build capacity for technology prospecting*. Technology prospecting is a non-linear process of searching, identifying, choosing and acquiring specific technologies or components of a technology. It is usually based on or informed by a TNA. Prospecting is also guided by a specific technology roadmap or several roadmaps. The challenge for many African countries pertains to the preparation of technology roadmaps or plans. Most countries have not developed specific plans to guide their

investments in technological development. Only South Africa has a ten-year technology plan. The plan has climate change covered as one of the grand challenges for the country. It identifies specific technological areas (e.g. hydrogen cells and nanotechnology) for R&D and innovation between 2008 and 2018.

The CTC will need to work with or through the World Bank's Climate Technology Programme,[30] which is supporting some developing countries to establish a centres for climate innovation. The Programme has supported Kenya and India in designing business plans for climate innovation centres. Plans for establishing Climate Innovation Centres are also being pursued in Ethiopia, Rwanda and South Africa. The processes of designing the plans have focused on reviewing aspects of NSI.

Another related initiative is the Southern African Innovation Support Programme (SAIS) funded by the government of Finland. The SAIS is supporting countries of the Southern African Development Community (SADC) to strengthen their national systems of innovation. It has commissioned a review of NSI for Botswana, Mozambique, Namibia and Zambia. Other NSI review will be undertaken in the next year or so. SAIS will also support SADC to build a regional system of innovation. The CTC and the TM as a whole should build on these ongoing initiatives.

The TM should also support: (a) more African countries to undertake TNAs and/or update their TNA reports (b) African countries to formulate and adopt technology roadmaps (c) support training workshops on climate change technology prospecting and (d) document and disseminate best practices and guidelines for climate change technology prospecting.

2.6 Recommendations and Issues for Consideration by African Negotiators

If well designed, governed and adequately funded, the proposed TM can support African countries and LDCs to effectively engage in the development, acquisition and use of technologies for climate change adaptation and mitigation. It is recommended that African negotiators should:

(a) be more actively engaged UNFCCC technology discussions, including at COP 18, and in the process of operationalisation of the TM;

(b) Advocate a gradual or evolutionary approach to the creation of the TM to ensure that it involves cost effective institutional experimentation and learning;

(c) Promote the inclusion of activities or actions for strengthening their national systems of innovation and building capacity for technology prospecting;

(d) Establish a specialized African working group of experts on technology transfer to assist them to explore specific ways and means for enhancing Africa's in the development, governance and operations of the TM;

(e) Request the African Union Commission to collaborate with component institutions to undertake a comprehensive survey of existing African networks, organizations, research institutes and universities that are engaged in climate change technology development and transfer activities. The survey will inform policymakers about the African institutions that should be promoted to engage in and/or form part of the future Climate Technology Network (CTN).

REFERENCES

Brewer, T. (2008), "Climate Change Technology Transfer: A New Paradigm and Policy Agenda". Climate Policy 8(2008) 516-526. Doi: 10.3763/cpol.2007.0451.

Correa, C. (2009), *Fostering the Development and Diffusion of Technologies for Climate Change: Lessons from the CGIAR Model*, ICTSD.

Dechezleprêtre, A., Glachant, M., Hascic, I., Johnstone, N., Ménière, Y. (2009), "Invention and Transfer of Climate Change Mitigation Technologies on a Global Scale: A Study Drawing on Patent Data", Report for AFD (French Development Agency)

Republic of Kenya (2005), "Kenya's Climate Change Technology Needs and Needs Assessment", p.191. Report under the UNFCCC.

Srinivas, K. R. (2009), "Climate Change, Technology Transfer and Intellectual Property Rights". RIS-DP #153 Research and Information System for Developing Countries, India.

ENDNOTES

20 UNFCCC (2007), Bali Action Plan, Article 1 paragraph 1(d).

21 Brewer, T. (2008), "Climate Change Technology Transfer: A New Paradigm and Policy Agenda". Climate Policy 8(2008) 516-526. Doi: 10.3763/cpol.2007.0451.

22 Ibid., p. 518.

23 Srinivas, K. R. (2009), "Climate Change, Technology Transfer and Intellectual Property Rights". RIS-DP #153 Research and Information System for Developing Countries, India.

24 See, for example Dechezlepretre, A., et al. (2008), "Invention and Transfer of Climate Change Mitigation Technologies on a Global Scale: A Study Drawing on Patent Data". Available at: http://www.nccr-climate.unibe.ch/conferences/climate_policies/working_papers/Dechezlepretre.pdf. (accessed 29 November 2011).

25 Republic of Kenya (2005), "Kenya's Climate Change Technology Needs and Needs Assessment", p.191. Report under the UNFCCC.

26 Paragraphs 117 and 113 of Decision 1/CP.16: Cancun Agreements.

27 See: www.nepadst.org

28 Such assessments include the Millennium Ecosystem Assessment, IPCC assessments, and the Global Environment Assessment by UNEP.

29 South Africa is the only African country that has undertaken an NSI assessment or survey using OECD methodology. Other African countries have tended to conduct surveys of their R&D policies and institutions with limited focus on innovation aspects of their economic systems.

30 See www.infodev.org/en/Project.127.html and www.saisprogramme.com (accessed 29 November 2011).

3. TECHNOLOGY TRANSFER: AN EVALUATION OF TREATY-BASED MECHANISMS RELEVANT TO CLIMATE CHANGE

John H. Barton †

June 2009

As explained in the foreword, this is the draft of a paper that the late Professor John Barton was writing for ICTSD when he unexpectedly passed away in 2009. This work "in progress" looks at the implementation of technology transfer provisions in international environmental agreements and seeks to draw lessons which continue to be relevant as the TM becomes operational. The manuscript contains many annotations and insights by the author that point to knowledge gaps which call for further research. Although this is an unfinished work, it could be valuable for a wider community of scholars and experts to build upon.

3.1 Introduction

Technology transfer will be one of the central areas at issue in the efforts of the 2009 Copenhagen meeting of the United Nations Framework Convention on Climate Change (UNFCCC) to strengthen the commitments made in the 1997 Kyoto Protocol and the 2007 Bali Action Plan. Arrangements for significant technology transfer to developing nations will be both part of the overall political balance of any agreement and essential to actually slowing climate change.

This paper attempts to assist the negotiators by reviewing and evaluating the international technology transfer arrangements contained in prior international environmental agreements. The central focus will be on the funds created under the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and the 1991 Global Environmental Facility (GEF), and on the 1997 Kyoto Protocol Clean Development Mechanism (CDM). Less detailed consideration will be given to the other technology transfer provisions of these agreements and to technology transfer arrangements in a variety of other contexts including the 1982 Law of the Sea Convention and the 1992 Convention on Biological Diversity.

The first part of this paper reviews the technology transfer provisions of these agreements along with their negotiating background and then considers the success and limitations of the mechanisms in operation. It is able to build on a large number of previous studies in each case. This paper therefore assembles and analyze the results of those studies, and, in some cases, explores specific transactions in more detail. The later part of the paper summarizes the lessons in a form usable by current negotiators.

Five fundamentally different technology transfer mechanisms are likely to be considered in the Copenhagen negotiations:

- First is the possibility of a fund to assist developing nations in acquiring technologies for mitigation and adaptation. Such a fund may be modeled on the Montreal Protocol Multilateral Fund of Global Environmental Facility but will, almost certainly be structured differently. In general, for climate change technologies, the cost of actually implementing the technology – purchasing and installing the wind turbine or the special equipment to increase efficiency and decrease emissions, for example – is likely to dominate any research and development costs or fees for the technology itself.[31] Hence, it will be difficult to distinguish funds designed to support investment in climate change mitigating institutions from funds designed to support technology transfer more specifically.

- Second, there may be funds or mechanisms designed to support research and development in new technologies, particularly in those especially useful for developing nations. Clear examples are concentrated solar power and carbon capture and sequestration (CCS), neither of which are mature technologies anywhere in the world.

- Third, there may be investment mechanisms based on or analogous to the Kyoto Protocol's CDM, in which Annex I (i.e. developed world) entities (which may be private sector entities) are provided an incentive to invest in projects in non-Annex I parties in a way that may provide technology transfer.

- Fourth, there may be private sector investment, flowing at least in part from Annex I to non-Annex I parties. Here there may be discussion of ways to encourage such investment. Such ways have been very difficult to find in previous negotiations, although there may be co-investment associated with some of the forms of funds just described, and there may be investment deriving from economic incentives, which may or may not be based in part on regulatory structures in the non-Annex I nations.

- Finally, there may be technology transfer deriving from international public or even private investment associated with bilateral or regional international arrangements outside the UNFCCC. It is certainly plausible, for example, that there will be European Union, Japanese, or U.S. arrangements with particular nations. And there are already World Bank Funds.

REVIEW OF CURRENT NEGOTIATING SITUATION (BONN DRAFT, China/G77 paper?)

3.2 Experience with Technology Transfer Under Previous Environmental Treaties

3.2.1 The Montreal Protocol

Negotiation and design: The Montreal Protocol was agreed upon in 1987 to restrict the introduction into the atmosphere of substances that destroy the ozone layer.[32] (Some of these substances also contribute to climate change). This agreement included restrictions on production and transfer of a number of ozone depleting substances (ODS's). It also included a vague technology transfer provision, under which the Parties undertook "to facilitate access to environmentally safe alternative substances and technology for Parties that are developing countries and assist them to make expeditious use of such alternatives," (Art. 5.2) and agreed "to facilitate bilaterally or multilaterally the provision of subsidies, aid, credits, guarantees or insurance programmes to Parties that are developing countries for the use of alternative technology and for substitute products." (Art. 5.3).

This was not enough, however to induce the membership of any developing countries other than Mexico. A debate over assistance ensured, and ultimately a Multilateral Fund (MLF) was negotiated and accepted at London in 1990. Shortly thereafter, important developing nations, including China and India, accepted the agreement. This, of course, reflected a tension between developing nations, concerned that they would be placed at a disadvantage by complying with the agreement, which would ultimately require substitutes for a number of important chemicals, and developed nations, concerned that they would be setting a precedent for financial transfers for future environmental agreements.[33] It was also facilitated by studies that evaluated the costs of compliance and found that these would

be relatively moderate – USD 1.5 to 5 billion over 10 to 18 years.[34] And its additional to the Protocol was accompanied by a significant strengthening of the Protocol's technology transfer provisions, calling on the Parties to "take every practicable step... to ensure... [t]hat the best available, environmentally safe substitutes and related technologies are expeditiously transferred" to developing countries. (Art. 10A).

The management of the Multilateral Fund is confided to a rotating Executive Committee of 14 members that includes equal number of "Article 5" (developing) and "non-Article 5" countries, and makes decisions by a two-thirds vote. The Chair and vice-Chair are chosen to be one each Article 5 and non-Article 5 members, alternating annually. As of an early study, all actions had been by consensus.[35]

The Parties to the Protocol have also created a variety of specialized technical entities, such as the Methyl Bromide Technical Options Committee and the Refrigeration Technical Options Committee. CHECK DATA AND POWER AND NEUTRALITY

Success of governance system and establishment of financial levels affecting technology transfer: The fund is required to cover the "agreed incremental costs" of complying with the treaty, as by shifting to products that do not deplete the ozone layer, and there have been decisions by the Parties spelling out the meaning of "incremental cost."

The MLF was created with an initial endowment of USD 200 million for the 1991-93 period and replenished in three year increments. The magnitude of the replenishment is determined by the Parties, based on a recommendation by the Technology and Economic Assessment Panel (TEAP), of the amount needed for developing nations to comply with the agreement. This is a panel of qualified experts, convened by the Parties. So far, the Parties have provided resources generally consistent with these recommendations, pledging a total of nearly USD 2.9 with actual disbursements of USD 2.4 billion.[36] For 2009-2011, for example, the TEAP determined that between USD 342.8 and USD 639.8 million would be needed, and the parties actually committed themselves to a USD 400 million replenishment.[37] There have, however, been delays in making the payments.)[38] The amounts are allocated according to the United Nations scale of assessments. The totals amount to about USD 140 million per year.

The mechanisms of technology transfer and their success: The MLF works through implementing agencies – the United Nations Development Programme (UNDP), the United Nations Environment Program (UNEP), the United Nations Industrial Development Organization (UNIDO), and the World Bank. (Separate arrangements were made to assist the countries of Eastern Europe and the former Soviet Union, in collaboration with the GEF – these will be discussed below.) In addition, donor nations can implement a portion (20%) of their commitment bilaterally.

Clearly, the details of technology transfer will differ from sector to sector. For example, early manufacture of foam for packaging and insulation relied upon ozone-depleting gases to make the bubbles in the foam. Under the pressure of the Montreal Protocol, technologies to use different gases were developed. Apparently these were then licensed throughout the world.[39] An example of such a license indicates a relatively standard license form, with the fee to be paid directly by UNIDO to the developed world licensor. It is significant that the agreement has a strong liability disclaimer clause (which may be quite appropriate for some technologies and not for others) and that it calls for dispute resolution in English courts. (England is the home of the licensor.)[40]

The refrigeration area is also quite significant, because it is so important to the developing world. Again, new refrigerants were developed in the developed world (and it is probable that the Protocol would not have been signed by the United States unless the domestic industry was about to come up with such products – CHECK).

WHICH WERE THEY? And many but not all of the technologies were apparently quite readily licensed to the developing world. The meaning of this should be made clear. In general, the technology for using the particular refrigerant was licensed to refrigerator manufacturers in the developed world. In only some cases, however, were developing world firms able to manufacture the refrigerant itself locally. Thus, "HCFC-123" was used in India, but the nation had to import the product. And in both this case, and the important case of "HCFC-22" in China, the most advanced refrigeration designs were not provided. A progress report on the China example states:

> The most advanced HCFC-22 compressor designs at that time were not introduced into the Zhejiang Commercial Machinery Factory, either because it was too expensive to purchase the best technology with MLF approved funds for technology transfer, or because foreign enterprises were reluctant to transfer their latest technology to the enterprise.[41]

The issue of licenses for manufacture in competition with existing developed world firms is obviously a sensitive one. At least early on, there have been no guidelines on this issue.[42] CAN I GET MORE DATA? =-- THE HFC-23, CRUCIAL IN CHINA CDM, IS A BYPRODUCT OF MAKING HCFC-22 – TRACK ALL THIS DOWN!

Lessons: The substantial success of the MLF is associated with the fact that it involved a relatively small and predictable amount of money. It was possible to anticipate relatively well the total amount needed, because the funding was needed only to phase out a relatively well-defined list of products. The commitment did not need to be open-ended. Moreover, there was relatively little industry opposition – particularly as some of the industries involved were necessarily phasing out.[43]

A leading study of the transfer of technology under the Montreal Protocol finds two kinds of barriers to the transfer of technology. One is the classical list of barriers to any type of investment or technology transfer – poor infrastructure, inadequate law, inadequate technical and administrative capability etc. The other relates more directly to intellectual property (IP). It was clear that most technologies were in the public domain. But there were a few exceptions, exemplified by "HFC-134A," where the technology was controlled by just a few firms. Licenses were offered on terms that were unacceptable to the developing nation firms. India then developed its own process, but had not commercialized it as of 2007. And China successfully developed a process under MLF funding.[44] This fact suggests that the system was willing to fund the transfer of research and production technologies rather than of simply specific products such as refrigerants, in spite of the fact that this might harm developed-world commercial interests. SORT THIS OUT!

Andersen CITE also presents a discussion of technology transfer problems in Korea. The source for this information is somewhat old – about 2000 CHECK – but the data shows difficulty for Korean firms in the terms of various international technology licenses. The key implication is almost certainly that developing world firms seeking to benefit from technology transfer need to have solid legal advice in negotiating the terms of technology licenses. WHAT ABOUT KOREA DISCUSSION IN ANDERSEN?; IS THERE AN UPDATE?

WHAT ABOUT GOVERNANCE LESSONS? CHECK FOR TECH TRANS PROVISIONS IN MONTREAL AND IN DOCS ON THE FINANCE PROCESS

It should also be noted that this area benefited from a variety of technology-specific international working groups. GET THE ORGANIZATION. Such groups are likely to be useful in each of the specific areas in which technology might be transferred for climate change. GET MORE DATA ON THESE -- CRUCIAL

3.2.2 The Global Environmental Facility

Financially, the GEF is the most important of the existing multilateral environmental technology transfer mechanisms. It was

created in 1991 by the World Bank to assist developing nations in financing the incremental costs of a number of forms of environmental improvement. It was then reorganized in 1994 to become more independent of the Bank, and serves as a financial implementing agency for a variety of international agreements including the Convention on Biological Diversity (CBD) and the UNFCCC, and also provides a parallel to the Montreal Protocol's MLF for the transitional economies.

It, however, has been much more politically controversial than the MLF. It was initially established in 1990, relatively informally, as a pilot project by the World Bank, collaborating with the UNDP and UNEP. It was to provide grants for projects that would bring benefits to the global environment beyond those provided to individual nations. During the 1992 meeting of the United Nations Conference on Environment and Development at Rio de Janeiro, it became clear that this arrangement would not be acceptable to developing nations. A deal was negotiated under which the GEF would become the "interim financial mechanism" for the conventions on climate change and biodiversity that were being negotiated at that meeting, the GEF would become more "democratic" and "transparent," and the president of the World Bank promised to seek a USD 5 billion increment for the replenishment of the International Development Association.[45]

The negotiation led to a structure, agreed in 1994, in which the Parties to the conventions would set priorities and eligibility criteria for the particular categories of expenditure. The Fund would be managed by a Participant's Assembly through a council in which developed and developing countries were to have "balanced and equitable representation," with a co-chair procedure. The council was finally established at 14 developed country members, 16 developing country members, and two transitional country members (i.e. those from the former Soviet bloc). Approval was to require a 60 % majority of both donation-weighted votes and countries represented.[46]

Governance and mechanisms: It is clear that this system has not been entirely successful. In fact, currently, the 4th replenishment negotiation was quite difficult, because of a U.S. desire (reflecting the concerns of the Bush administration? CHECK) to minimize its contribution.[47] And, although that replenishment was ultimately negotiated and a new one is underway CHECK, the GEF does not currently have adequate funds to make grants.

This reflects a process in which the funding level is basically set by political negotiation among donors. Indeed, part of what was happening in the replenishment just described is that the United States was insisting that the GEF establish a "resource allocation framework, which amounted to a form of conditionality based not only on the environmental performance of the various projects but on broader national policies.[48] Moreover, many of the donor nations are represented by their finance ministers, and developing country nations by UN or World Bank officials.[49]

Nevertheless, the mechanism has transferred more money than any other: USD 8.26 billion from 1991 through 2007, or over USD 500 million per year. This is described as having leveraged an additional USD 37.3 billion (~2.2 billion/year) in co-financing.[50] It should be noted, however, that more than half of this co-financing is funding from recipient governments and from development banks[51] – it does not, therefore, represent the private investment that could be viewed as full leverage.

The system works on a project by project basis, with implementing agencies, the UNDP, expected to contribute to capacity building and technical assistance, the UNEP, working on scientific and technical issues, and the World Bank, in management.[52] The projects are expected to be sustainable after the financing ceases, which clearly will not always be the case for climate change mitigation projects. FORM OF REVIEW? A project may involve co-financing, with the GEF picking up a portion of the cost and other investors picking up

the rest. This can be because of the GEF's limitations that it funds only the incremental portion of the cost of a project that does not benefit the developing nation – CHECK; it can also be seen as a mechanism of stretching resources. CHECK ALL OF THIS.

In spite of the fact that the system works on a project-by-project basis, the Council does develop overall strategies. Thus, it began in the climate change area with an initial strategy focused on demonstration projects. Over the years, it focused on more specific areas, some with relatively mature technologies and some with less developed technologies.[53]

Technology transfer: The GEF works on a project-by-project basis and covers a number of environmental areas – some, such as certain mechanisms of supporting biodiversity conservation regions, are unlikely to involve technology transfer. Others, however, do, and, according to a recent GEF study, nearly all involve technology transfer.[54] Examples include PV systems, wind turbines, and biomass boilers. In some cases, however, these "projects" can be sectoral as viewed from the perspective of the developing nation. For example, a Thai biomass project includes building capacity to provide information to investors, improving a regulatory framework, facilitating commercial financing, and supporting commercial guarantees.[55]

Several specifics are important. First, the GEF is able to work effectively with cofinancing. This means that the public sector funds are leveraged. Provisions for such leveraging will almost certainly be essential – although it will be crucial for the leveraging to reach private funds and not just recipient government or development bank funds.

Second, the GEF has not been a significant mechanism for scientific or technological research – it has concentrated on the diffusion of existing technologies.[56] In fact, a program on Concentrating Solar Power, where the technology is still in the development phase in developed countries, was apparently relatively unsuccessful – costs were apparently higher than expected, and ending up having to be covered by the countries themselves.[57] A critical analysis suggests, ever, that the GEF has been most effective in energy efficiency and conservation, and least effective in promoting renewable and cost-reducing energy technologies.[58] The successful areas certainly do transfer technology but only in a limited way; the less successful areas are the ones where technology transfer is more important.

There has been significant criticism related to the technology transfer component of at least one GEF project – this is the China Efficient Industrial Boilers Project, a USD 32.8 million grant completed in 2004. It was designed to provide advanced boiler technologies to a number of manufacturers in China, but there was dispute as to the terms of acquisition of the technology. GET THE DATA FROM MY OTHER STUDY

A leading GEF effort to define an expanded program of technology transfer has recently reviewed the performance of the GEF and found several issues. The most important of these is weak linkage between the GEF activity and national technology needs assessments. In addition, it was reported that there was an "uneven engagement" with the private sector, and "limited synergy" with the carbon market.[59] TNAS ARE SUPPOSED TO BE AVAILABEL ON THE UNFCCC WEBSITE; GEF/C.28/14 ON PRIVATE SECTOR – APPARENTLY BETTER WITH SMALL FIRMS THAN WITH GLOBAL ONES; The last of these points is presumably based on the possibility of providing infrastructure, technical assistance, and regulatory capability to better participate in an international carbon market.

Judging from the programs of the GEF, it appears to be more successful in reaching the poorer developing nations than is the CDM. This is extremely significant for those nations. MORE DETAIL – CONFIRMATION?

CHECK THE GEF SUSTAINABLE URBAN TRANSPORT PORGRAM? MORE ON CRESP – ELABORTION AT 29?

WHAT IS THE SCCF AND WHAT DO I SAY ABOUT IT? – IT'S UNDER KYOTO? – SEE 5/CP.9; 7/CP.7 AND LEARN!

Implications: Several general implications can be drawn here. First, it is clear – and important – that a project-based mechanism is not well adapted to immature technologies. Support of research and technology development will require different kinds of institutions.

Second, there is clear need for a solid linkage with the technology need assessment process. The problems identified in the GEF's recent study appear to be based on the fact that a number of nations have not yet completed such studies, as well as lack of bureaucratic linkage between those agencies that do the needs assessments and those that write project proposals.[60]

Third, there needs to be a well-thought expectation as to how to coordinate with the private sector. As will be seen (MOVE THIS TO LATER?), private sector funding likely to outweigh public sector funding; it will be important to find ways to mobilize those funds as through real cofinancing. THINK THIS OUT IN THE CONTEXT OF NEW GLOBAL ECONOMY!

Finally, there must be rethinking about the governance system for a fund. The GEF Council does allows rethinking and reshaping of programs in a relatively straightforward way. One may agree or disagree with particular choices, but it is important to be able to move relatively quickly and to respond to technological breakthroughs or failures and to revise future programs based on the success or failure of early programs. This means that any new technology transfer mechanisms should have a similar, relatively small, governing group, which would, of course, be subject to supervision by the entire membership.

But the overall management will be crucial. The GEF was viewed as a donor nation response to the threat of proliferation of environmental funds. And it has been effectively run by finance ministers. CHECK WHO RUNS MEF. This will not work for large-scale climate change funding – there will have to be a shared sense of the goals of the funds, which will necessarily involve both environment and economics; representation of these interests will be essential in terms of who represents nations.

And there will certainly have to be conditionality – both to ensure environmental effectiveness and to avoid misuse of fund. But the kind of conditionality added on in the "resources allocation framework" was a mistake. CHECK THE LANGUAGE. – rather the goals of the conditionality will need to be negotiated in advance or in a more balanced negotiating situation.

3.2.3 Kyoto Protocol[61]

Technology transfer requirements: The Kyoto protocol includes a number of direct technology transfer provisions. CITE AND GET FROM ARTICLE AND RECONSIDER SIGNIFICANCE -- DISCUSS THE OBLIGATIONS??? ARE THINGS LIKE APCC; AND EU-CHINA EFFECTIVELY PART OF THIS PROCESS

The CDM.? In addition, it created two mechanisms, the CDM and Joint Implementation, which can be vehicles for technology transfer. The CDM is a mechanism by which firms in Annex I (CHECK) countries (those that are subject to limits – basically the developed nations) that need carbon credits to comply with a national or regional "cap and trade" system can "buy" those carbon credits by sponsoring the establishment of a greenhouse gas (GHG) reducing project in non Annex I countries, i.e. the developing world. CHECK The result is that a developing-world entity receives money in return for reducing GHG emissions Joint Implementation is a way by which the same result can be accomplished by a trade among developed world countries and is therefore not considered further here. DISCUSS ADDITIIONALITY?

CDM governance and "financing": The process is relatively complicated. A project, often

organized by one of several firms that specialize in assembling CDM opportunities, is organized and submitted to national authorities in the host country fro review. After approval is achieved at that level, the project is submitted to a "Designated Operational Entity (DOE)," DETAIL? To ensure that it meets all the requirements. DISCUSS, ALONG WITH ADDITIONALITY ETC? This is a third party approved by the CDM Executive Board. COMPOSITION AND DETAILS? It is then submitted to the Board itself. If approved there, it returns to the host nation authorities for final approval. A different DOE then reviews the actual performance of the project before any carbon credits can be issued.[62] This is an expensive process, ranging from USD US 100,000 to 365,000 for approval and a first year's work, with an additional USD 15,000 to 25,000 per year needed for subsequent years.[63]

There is no guarantee that there will be a particular level of financing or of technology transfer. The level of activity in this area is defined by the need of firms in Annex I countries to purchase carbon credits. This depends on the severity of the regulatory ceilings affecting these firms and on the way that carbon credits are distributed by developed nations. Thus, if, as can be expected on political grounds, credits are distributed relatively freely, the firms can satisfy their obligations with national credits rather than having to purchase reductions through CDM activity in developing nations. And, the formal measure of activity in the international CDM market will be in terms of carbon, not in terms of dollars or other currency. There will, of course, be an effective price for carbon credits; this will determine the level of finance that a nation receives when it sponsors a CDM project that results in a particular level of GHG emissions reductions. Finally, not all CDM projects will involve technology transfer – some may involve financing of the implementation of technologies already available to a nation.

INCLUDE NUMBERS ON EFFECTIVE FInanCIAL FLOW – IF NECESSARY DERIVE FROM CARBON FLOW AND PRICE; CONSIDER CATALYST STUDY IMPLICATIONS? – CRUCIAL – WHAT'S PUBLIC?

Experience: The CDM process has revealed a number of specific difficulties, which derive in part from its project-based approach. Transaction costs – document preparation, administration fees, and the like – are high, so small projects are economically unfeasible.[64] Perhaps as a result, most of the projects are in the larger developing nations and few are in the poorest nations.[65] And the development benefit of the process has been skewed by a high emphasis on a few projects based on removing certain GHGs from industrial emissions in China. CITE MIKE

There have been a number of studies of technology transfer associated with the CDM. One of the most recent statistical studies, a study based on project documents, summarized its conclusions:

> Approximately 36 % of the 3296 registered and proposed CDM projects claim some technology transfer. But these projects account for about 59 % of the annual emission reductions, so technology transfer is more common for larger projects....
>
> Technology transfer is very heterogenous across project types. Technology transfer is claimed for a higher share of Agriculture, EE [Electrical Engineering Energy Efficiency?????] Own generation, Landfill gas, N20, HFC, and Wind projects, and for a lower share of Biomass energy, Cement, Fugitive, Hydro, and Transportation projects. Technology transfer is more common for projects that involve foreign participants than for unilateral projects.
>
> National rules on technology transfer may help – thus South Korea did particularly well – and this may have been in part because of a national provision that required that "environmentally sound technologies and know how shall be transferred."[66]

A comparable study reported quite similar results, and also offered somewhat more data on the implications of different national situations.

Again the bigger projects were more likely to provide technology transfer.

Second, although this effect was weak, a project was more likely to involve technology transfer if it included a credit buyer, i.e., an entity actually interested in obtaining carbon credits. Likewise, but with great impact, a project was much more likely to involve the transfer of technology if it was to a host nation firm that was a subsidiary of an Annex-I nation firm..

Again, the technology matters. Among the most important areas, technology was transferred in programs for end-of-pipe destruction of GHG's and in wind energy programs; in contrast, little was transferred in the biomass area or energy efficiency, where nations presumably already had substantial technology capabilities.

Further, the technological capability of the host nation was extremely important. Effects based on the ability to absorb technology greatly outweighed effects based on the possibility that the nation already had the technology.[67]

And in a companion study based on the same data set, the authors found that nations growing rapidly were more likely to import technology. This strengthens the arguments favoring the need to combine development with management of climate change. But they also found that different nations do well or not for reasons that were not explored – after taking into account the factors considered in their regression, China and India did less well than expected and Brazil and Mexico did better.[68]

MIKE WARA CRITIQUES ETC; CAN I LOOK AT THE MORE AND LESS TECHNOLOGICALLY-ORIENTED AREAS AND DRAW LESSONS?

Proposed CDM reforms: Many reforms have been proposed for the CDM, and some will almost certainly be implemented in a Copenhagen agreement. Some of the proposed reforms would expand the operation of the scheme to areas it does not now cover, e.g. to nuclear energy or to carbon capture and sequestration. Some would attempt to allow approval of a category of projects rather than of individual projects, in order to decrease the administrative costs of a project-by-project approach. And some would deal with administrative and procedural issues.[69] WHAT ABOUT ADDITIONALITY?

But at least one set of reform proposals would directly impact technology transfer – this is to make technology transfer one of the criteria to be considered in connection with the approval of a project, possibly for all nations, possibly for the poorest. This is obviously a potential positive for technology transfer; if implemented, however, it must be done in a way that recognizes that different kinds of projects will have significantly different technology transfer potentials

Lessons: Six points are particularly important here. First, a mechanism like the CDM involving some form of carbon trading is almost certain to be included in a Copenhagen agreement and will in fact encourage technology transfer in a number of sectors. But, as just pointed out, WHERE the economically sound GHG emission reductions that will be sought from developing nations will almost certainly exceed what is likely to be available through a CDM. Moreover, the technology transfer levels will be dependent on the political implementation of cap and trade systems around the world. Hence, a CDM-like system cannot be the exclusive means of technology transfer – more will be needed.

Second, the technology transfer process will vary from sector to sector – CDM can help more in some sectors than in others. It is likely that the same will be true for any other form of transfer.

Third, because large projects are favorable to technology transfer and because project approval and management costs are high, the CDM is almost automatically most favorable

to the larger developed nations. Specialized mechanisms must be developed to benefit the poorer nations, as by design of a category of projects or development of sectoral arrangements to encourage programs in smaller and poorer nations.

Fourth, it is clear that a nation's technological capability facilitates its acquisition of new technologies through the CDM. Ideally, the global economic and environmental move that leads to a Copenhagen agreement should also include support for developing nations in building underlying technological capabilities.

Fifth, the CDM fills in more of the puzzle on the way that the private and public sectors must be integrated. Parent-subsidiary relations were favorable to technology transfer – Copenhagen will be most successful if it allows for such transfers.

Finally, the concept of additionality is again difficult. There will almost certainly be an effort to limit the global mechanisms of Copenhagen to situations in which they are incremental or additional – the definition is not easy! MORE DETAIL ON SPECIFIC ISSUES?

3.2.4 Other treaties and organizations

The programs described above are the "classical" international funding mechanisms associated with multilateral environmental agreements. All have been studied with a view to the lessons they present for climate change; these studies, as well as the author's additional case studies, are presented above. But their lessons should be supplemented by those that can be drawn from other international programs. These are presented below, more briefly than those presented above. GO BACK TO AGENDA 21!

Other environmental treaties: At least three other international environmental agreements have called for technology transfer. CHECK THE LANGUAGE The earliest is the Law of the Sea Agreement, DATE which envisioned extensive technology transfer to facilitate developing-nation access to the profits envisioned as available from deep seabed mining. NEED LANGUAGE AND CHECK FOR OTHER OBLIGATIONS This technology transfer has not happened. One obvious reason is that deep seabed mining has not become economically feasible. However, the technology transfer provisions were also the subject of sharp international political debate. They were one of the bases for strong U.S. Senate opposition, which ultimately led a renegotiation of the treaty in XXXXX, in which the technology transfer provisions were greatly weakened. NEED DETAIL

The Convention on Biodiversity CHECK TITLE AND ADD DATE has also brought an important international debate on technology transfer. Here the issue – and, to a great extent, the central issue in negotiating of the treaty – was the terms of developed world access to the genetic resources of the developing world and, in turn, of developing world access to technologies derived from those genetic resources. CHECK FOR DETAILS OF THE AGREEMENT ETC. As for the deep seabed mining parallel, economic expectations may have been overly high. And the difficulties of resolving the conflicts, together with the slow development of developing world genetic resource regimes CITE AND CONFIRM have led to a slowing of the international flow of genetic resources and, probably, of the science based on those resources. DEVELOP -- CITE SABRINA AND ENSURE THAT I'M ACCURATE. It derives in significant part from the fact that developed nations increased the patentabily of those resources – interestingly, that trend is now weakening. And there have been important efforts toward benefit sharing with respect to genetic resources in the agricultural area. GET TREATY TITLE AND DETAIL.

WHICH OTHER TREATY – IUCN?

International research programs: As noted above, the elaborate project-funding programs have not been particularly successful in developing new technologies. Here, there are two groups of example, neither set up by treaty in the sense of the technology transfer mechanisms discussed above. These include the various agricultural research programs of the Consultative Group on International Agricultural Research (CGIAR), and a quite different group of programs in the medical sector. CHECK MY PAPER WITH DIRK

The CGIAR programs, such as the International Rice Research Center in the Philippines and the Centro International por la Mejoramiento de Maiz y Triga CHECK SPELLING for corn and wheat in Mexico, have been enormously successful in developing new crop varieties and in transferring these to the developing world. IS THERE A RECENT EVALUATION/SUMMARY – WBANK ETC/ CHECK – AND CHECK EARLIER WORK FOT ICTSD. The individual research centers have their own boards and are typically organized under the law of a particular nation. CHECK The CGIAR itself is more informal, and fundamentally provides a forum in which the centers and a variety of public and private donors can interact. In general, the institutions have faced difficulties in the sustainability of their funding, and they have had difficulty in adapting to a world in which intellectual property and the private sector have become more important. But they also demonstrate the value of a relatively informal structure – and the fact of scientific dominance on the boards is almost certainly essential to the technical success of the institutions.

The medical sector has organized its research quite differently. The initial leading institution was the Tropical Disease Research program CHECK under the World Health Organization. This has, not, however, been as successful in attracting funding as one might hope. CHECK AND VERIFY. What has attracted funding instead are "public-private partnerships,' which are typically, like the CGIAR centers, organized as non-profit entities under national law, and governed by boards that emphasize scientific capability. In this case, the funding is heavily from foundations, with less role for government funding than in the CGIAR institutions; the emergence of the Gates Foundation as an important donor is obviously crucial. And the medical institutions tend, in general, to be "virtual" research centers rather than physical centers. In other words, the medical institutions organize a variety of private-sector, university, and government activities to create new medical products; the agricultural centers bring together scientists and research facilities themselves on one site.

GET DATA ON INTERNATIONAL AGENCY FOR RENEWABLE ENERGY – IRENA; AND LOOK AT CCS DATA

Bilateral and regional programs: There have also emerged a number of bilateral and regional programs oriented to development and transfer of technologies, including, in particular, for climate change. For example, there is a major cooperative program between the European Union and China, and there is the Asia Pacific Partnership on Clean Development and Climate. And Japan has created a "Cool Earth Partnership." Although these are not global, they may end up actually transferring more funds than do the treaty-based operations. The Japanese program, for example, is funded at USD 10 billion for five years, or about USD 2 billion per year.

Other financing and technology transfer programs: There are still more. The World Bank has created a number of Climate Investment Funds, including a Clean Technology Fund. NEED DATA The European Development Bank and the Asian Development Bank have both created carbon-oriented funds, including a Multilateral Carbon Credit Fund in the first case and the Asia-Pacific Carbon Fund and a Climate Change Fund in the second case ANYTHING HAPPENNING WITH ANY OF THESE? These are obviously significant in light of the fact that much of the technology transfer will take place through capital investment in products that embody relevant technologies. ANYTHING ON PRIVATE SECTOR HERE? TOTAL DOLLAR VALUE

Lessons: There are several key implications here. First, there will have to be special research-oriented efforts for technologies that are not yet mature, as for CCS, some biomass technologies, and concentrated solar power. The general global mechanisms appear to be more successful with more mature technologies, but fail in the research area. Based on the experience of the CGIAR and like institutions, the international leadership of these efforts will need to be heavily scientific rather than political.

Second, the relative magnitudes of the different programs suggest the importance of supplementing UNFCCC funding systems with funding through other channels. The bilateral and similar programs may transfer nearly as much funding to o developing nations as do the global funds. This suggests that one part of the Copenhagen package should be designed to facilitate such arrangements. WHAT ABOUT SECTOR PROGRAMS; UMBRELLA ARRANGMENTS.

WHAT ABOUT FAO or WHO? WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT; IEA;

Third, the CBD and LOS experiences show the importance of getting the economics right. Obviously, it is impossible to be certain how technological feasibilities will trend in the future. But it is certainly wise to avoid potentially exaggerated expectations or fears about the values or costs of particular technologies.

3.3 Implications

3.3.1 Negotiation context and method

It is significant that the MLF and GEF negotiations both involved significant side-deals, e.g. the second-generation negotiation of the Montreal Protocol in which commitments were made to create the MLF at a particular level and developing nations then entered the agreement, and the commitments about the magnitude of the expenditures to be made through the GEF. The complexity of the Copenhagen task, and the presence of interplays with a variety of other contexts including the Doha Round, and a variety of global, regional, and bilateral funding mechanism contribute to the relevance of such side deals and the possibility that they can increase the feasibility of agreement. This is particularly true if there are likely to be sectoral arrangements. And it is shaped as well by the fact that the Copenhagen negotiation is unavoidably both an environmental and an economic negotiation.

3.3.2 Research and the public sector

It is clear that research – i.e. the development of new technologies to be transferred – requires significantly different arrangements than do the sectoral and project funding approaches. The GEF has admitted its limitations in this area. And governance is likely to be wisely very different – groups such as the CGIAR have worked best with heavy scientific input into governance – the same is almost certainly true for new climate change technologies, whether they be in the biomass area (as might be appropriate for a new CGIAR-type center) or in areas such as Carbon Capture and Sequestration. CHECK LATTER AND THINK ABOUT GOVERNMENT ISSUES

Many of the research programs are likely to involve heavy reliance on the public sector – this is exemplified by CCS. It will be important to enable the programs of different nations to collaborate. MORE HERE – CONSIDER MY TREATY PROPOSAL? EVIDENCE ON CCS; IS THERE MORE DATA?

3.3.3 Multiplicity of mechanisms

It is almost certain that there will be a multiplicity of mechanisms. Efforts to bring everything under one roof are unlikely to be wise. Moreover, it appears very likely that bilateral and regional mechanisms will be responsible for as much technology transfer as global multilateral mechanisms. CONFIRM – AND TECHNOLOGY V 444 Consider the following chart of the annual funding available through different mechanisms

FUNDING MECHANISMS

MECHANISM	PUBLIC FLOW (ANNUAL)	PRIVATE FLOW
(ANNUAL)		
MLF		
GEF		
CDM		
JAPAN PARTNERSHIP	USD 2 B	
EU-CHINA		

Among the numbers here are the following => RABLE OF GEF, MLF; CDM; BILATERAL ETC

Numbers from 41 of GEF Elaboration:

OVERALL INVESTMENT IN PHYSICAL ASSETS IN DEVELOPING 1.7 t (2000); FDI IS 10 5 OF THIS;

ON ENERGY -- USD 3 b IN NON-ANNEX 1 – OF WHICH GET THE ORIGINAL – HAITES FOR UNFCCC 2007

The availability of this variety of mechanisms is a positive, particularly since different technologies are likely to be more feasibly transferred through different mechanisms. Hence, it will be good if Copenhagen can find ways to facilitate these other mechanisms, to ensure that there are not unnecessary holes in between the various mechanisms, and to ensure that there is a reasonable balance between the different areas of need and the resources available for the needs.

3.3.4 Achieving an adequate flow of technology and capital

The magnitude of technology transfer and investment will be a major point of contention. Developing nations understandably fear that they will not receive the technology and investment they hope for – and this reflects years of very limited developed-nation respect for broad promises to transfer technology. Developed nations understandably fear making an open-ended commitment.

Independent funds, such as the Montreal Protocol's MLF or the GEF, can be defined in terms of a particular level of commitment. Clearly there is some risk that a commitment will be lived up to for only a limited number of years, but the commitment can still be reasonably strong. The smaller, more precisely-defined MLF has been more successful than the GEF. CHECK ON REPLENISHMENTS AND EXPERIENCE. – HOW MUCH IS THE ISSUE THE BUSH ADMINISTRATION'S OPPOSITION TO THE CONCEPT?

On the other hand, a mechanism tied to a carbon market, such as the CDM, is defined by a different set of limitations. Here the question is what level of carbon market transactions will be demanded, a number determined by a variety of factors including the design of developed-world carbon markets, the prices that emerge on those markets, and the general economy.

Relationship to financing – technology transfer will be heavily a matter of funding the construction of new facilities and upgrades or modification of existing facilities. How should this relation be considered – it's certainly posed by the GEF and CDM, and, of course, by the World Bank's new funds.

3.3.5 Smaller and least developed countries

It seems clear that programs such as the CDM have been more beneficial to the larger developing nations than to the smaller ones. Issues of technical capacity to participate in the programs are extremely important. This suggests need for a number of kinds of response. There might be technical assistance, there might be standardized programs designed for specific sectors common to a number of poorer nations, and there might be use of

regional or global sectoral approaches. This will be extremely important, especially there is no environmental special agency, parallel to FAO or WHO, dedicated to transferring the necessary expertise. IS THIS TRUE – AM I MALIGNING UNEP?

3.3.6 Private sector technology transfer

The private sector has always been the most important one, because it provides the context within which most technology is transferred. IS THIS TRUE? WHAT ABOUT THE PROBLEMS GENERALLY IN ENERGY TECHNOLOGIES? CHECK FOR DATA! At the same time, it is a politically difficult area, because of the tension between the normal private sector technology transfer which is likely to occur, and the expectation of treaty drafters that there should be some way to define incentives to enable the private sector to do more. And this, of course, is the focus of the IP debate.

The evidence under the CDM is that technology is most readily transferred in a private sector corporate context. WHERE DO I GO WITH THIS? And the evidence under the MLF and the CDM is that the strongest way to encourage private sector transfer is through creating a combination of (a) a regulatory regime that creates incentives for technology transfer and (b) an investment regime that encourages investment (as through legal stability, avoidance of political interference etc). GET A GOOD STATEMENT plus language about absorb and use technology.

The experience under MEA's confirms writing elsewhere[70] that IP is rarely but sometimes an issue. There is an obvious tension between the interest of developed world firms to preserve and protect their core technologies and the interest of potential developing world competitors to enter into the global competition. Moreover, for a variety of technologies, the developing world will be the key market, so that IP may be beneficial.

Several responses appear appropriate – SHOWN IN THE CASES? First, the most beneficial step for the developing nations is to encourage competition, so that prices will be low. Second, there should be mechanisms to ensure that developing nations and their firms have adequate legal advice in order to negotiate as advantageously as possible. And, finally, in rare cases, some form of compulsory license or similar approach may be reasonable, but it is wise that this be rare. One possible compromise on this very difficult issue may be to recognize the existence of the compulsory license provisions of TRIPS. CITE AND CONSIDER DOHA? SECTORAL APPROACHES?

For private sector technology transfer. Are there any ways to strengthen incentives to make these provisions more realistic? And were patent issues or the like faced in any previous context in a way that might serve as a model? STANDARD AND CENTRAL ISSUE OF PRICE AND WILLINGNESS TO TRANSFER – DISCUSS!; COMPULSORY LICENSE? COMPETITION!; NEED LEGAL ADVICE; ASLSO SECTORAL APPROACHES

3.3.7 Developing nations themselves

The CBD history shows the difficulty of translating international negotiating positions into actual nation legislation and administrative capability. That translation may be crucial in the climate change area, particularly since so much technology transfer will depend on the creation of effective regulatory incentives. Technical assistance to achieve such regulation seems likely to be essential. CITEABLE IN ANDERSEN *ET AL* -- TRACK THIS DOWN

It is clear from the GEF history, moreover, that nations are doing inadequate technology needs assessments, and that the officials who do such assessments are often not linked with those who design programs to import the technology. This will be an especially important issue – responding to climate change will almost certainly have to be deeply integrated into the development process. It is therefore crucial that the relevant development and environmental communities and bureaucracies be in close contact with each other. This is

especially important since it is generally essential to link the environmental and the economic development goals in the climate change context.

In addition, there should be strong capability to acquire new technology – this was extremely significant in the case of China and the CDM. CITE AND CHECK The contest is clearly very different from that of many years ago when developing nations were much weaker technologically. What kinds of domestic training and the like are most likely to be helpful? [Also, possible consideration of ways to encourage the national regulation, e.g. of electric utilities, that facilitates and encourages technology transfer.].; WHAT DO I MEAN HERE – CHECK THE KEY CDM STUDIES

For developing nations themselves. What kinds of domestic training and the like are most likely to be helpful? [Also, possible consideration of ways to encourage the national regulation, e.g. of electric utilities, that facilitates and encourages technology transfer.] LESSONS OF NEED TO HAVE DOMESTIC REGULATION – CITEABLE IN ANDERSEN ET AL.; ALSO L;EGAL ADVICE IN NEGOTIATING T2 AGREEMENTS; SPECIAL ISSUES FOR THE POOREST NATIONS – SECTORAL AND REGIONAL PROJECTS? TECHNICAL ADVICE?; NEED ASSESSMENTS ETC.; DO THE NEEDED BUREAUCRATIC THINGS – CF CBD

3.3.8 Terms of projects and programs

It is inconceivable that there will not be limitations on the types and details of projects to be supported by any new international program. This is reflected in the concepts of additionality and of incremental costs, as well as in broader conditionality. Nevertheless, definitions of “additional” in the CDM and of “incremental” in the MLF and GEF CHECK have been a source of enormous difficulty. Clearly, this is unavoidable, and arises from the difficulty of any precise accounting in these areas and the difficulty of defining a business as usual baseline. But the difficulty is so great that there should be some form of response, perhaps based on a reviewed expert process SENSIBLE WORD? like that of the IPCC. Treaties may reasonably contain definitions, but it’ll be essential to go further. Other forms of condition present more serious problems – there is no sense in funding a project that will be managed corruptly or whose benefits will be eliminated by ineffective regulatory structures. Here, it’ll be crucial to develop initial understandings as to the reasonable goals of contitionality.

3.3.9 Liability

The deployment of new technologies involves new risks – this will in turn call for some mechanism to manage liabilities. DO I HAVE EXAMPLES/ OTHERWISE GO TO KEOHANE AND THE EUROPEAN NUCLEAR EXAMPLE. The use of CCS poses the most interesting issues here – it is essential that there be a balance of liability arrangements so that the technology is encouraged without placing undue risk on developing nations. CHECK MY ARTICLE?

3.3.10 Governance

Certainly the establishment of a governance system balanced between developed and developing nations was relatively straightforward in the case of the MLF, but extremely contentious in the case of the GEF. Nevertheless, both systems seem to have worked. CHECK – IS THIS TRUE? – INTEGRATE WITH THE FUNDING DISCUSSION? Moreover, it seems to have allowed the flexibility to respond to changing needs – it is important that any governing body for a technology fund be small enough to have this flexibility. An executive committee type approach is essential.

It is also clear that some aspects of the governance should be committed to highly scientific groups. This has already been achieved, in effect, with the IPCC. But much more detail is needed. The highly technical working groups of the Montreal Protocol structure were crucial – clearly the same kinds of groups will be needed for climate change. And it will have to be detailed – not just groups

on PV, but groups on on- and off-grid PV, on PV cell production, and on PV cell research, etc.

But not all should be done by experts. Some will need to be political – and not to be left to finance ministers as has been the case with the GEF. Rather it'll be essential to bring both environmental and economic perspectives to the table. And because the issues are so important to people, the governance of new funds and the like should be quite transparent. It should be possible, for example, for a developing nation legislator to provoke discussion over why one technology is being favored over another.

Finally, the CDM decision-making mechanism has come under fire for a variety of reasons. Any new version of the CDM will require strong consideration of the details of the mechanism.

CHECK THE DATA FROM MY DISCUSSION W/ OPPENHEIMER

Tensions between the FAO world and the CGIAR world. And there are important issues over how any new arrangement should fit in with existing UNFCCC institutions such as the SBSTA, the EGTT, and the CDM (and, at least for evaluating specific technologies and their effectiveness, with the IPCC).] –

JHA AND HOFFMAN (2000) – ACHIEVING OBJECTIVES OF MULTILATERAL ENVIRONMENTAL AGREEMENTS – UNCTAD – WITH A JAYASHREE ARTICLE.; ENOUGH ON SECTORAL APPROACH?

PUT EVERYTHING IN KYOTO LANGUAGE – ANNEX XX ETC.

[Relationship to financing – technology transfer will be heavily a matter of funding the construction of new facilities and upgrades or modification of existing facilities. Should this relation be considered – it's certainly posed by the GEF and CDM, and, of course, by the World Bank's new funds.].

I MUST INCLUDE SOMETHING ON ECONOMIC EFFICIENCY! AND PERHAPS BUILD ON CDM TO INCLUDE MORE ON ENVIFRONMENT/ DEVELOPMENT INTERACTION – THERE ARE TWO THINKING ISSUES FOR ME: CLIMATE/ DEVELOPMENT INTERACTION AND PUBLIC/ PRIVATE INTERACTION.

REFERENCES

Andresen, S., Heggelund, G., & Ying, S. (2005) *Performance of the Global Environmental Facility (GEF) in China: Achievements and Challenges as Seen by the Chinese,* in I*nternational Environmental Agreements: Politics, Law and Economics,* 5: 323-348 November 2005.

Andersen, S. O., Sarma, K. M., & Taddonio, K. N. (2007) *Technology Transfer for the Ozone Layer,* Earthscan , London.

Barton, J. (2007) *Intellectual Property and Access to Clean Energy Technologies in Developing Countries,* ICTSD Programme on Trade and Environment, Issue Paper No. 2, December 2007.

Barton, J. (2008) *Mitigating Climate Change Through Technology Transfer: Addressing the needs of Developing Countries*, Chatham House, Energy, Environment and Development Progamme, Programme Paper 08/02, October 2008.

Clémençon, R. (2006) What Future for the Global Environment Facility?, *The Journal of Environment & Development,* 15:50-74.

Dechezleprêtre, A., Glachant, M., & Ménier, Y. (2008) The Clean Development Mechanism and the international diffusion of technologies: An empirical study, *Energy Policy,* 36: 1273-1283.

Dechezleprêtre, A., Glachant, M., & Ménier, Y. (2009) Technology transfer bu CDM projects: A comparison of Brazil, China, India, and Mexico *Energy Policy,* 37: 703-711.

De Sombre, E. (2000) The Experience of the Montreal Protocol: Particularly Remarkable and Remarkably Particular, *UCLA Journal of International Environmental Law and Policy,* 19: 49-81.

De Sombre, W. & Kauffman, J. (1996) The Montreal Protocol Fund: Partial Success Story, in R. Keohane & M. Levy (eds.) *Institutions for Environmental Aid; Pitfalls and Promises,* MIT Press.

Fairman, D. (1996) *The Global Environment Facility: Haunted by the Shadow of the Future,* in Keohane O., Levy, M. (eds) *Institutions dor Environmental Aid: Pitfalls and Promise,* Cambridge, Mass., and London: The MIT Press.

Gechlik, M. (2009) *Making Transfer of Clean Technology Work: Lessons of the Clean Development Mechanism,* San Diego International Law Journal, 2: 227-285, July 2009.

GEF Council. (2008) *Elaboration of a Strategic Program to Scale up the Level of Investment in the Transfer of Environmentally Sound Technologies,* GEF/C.34/5.rev.1, November 13, 2008.

Michaelowa, A. (2005) *CDM: current status and possibilities for reform,* Hamburg Institute of International Economics, Paper No. 3, HWWI Research Programme International Climate Policy.

Sarma, K.M. & Taddonio, K.N. (2009)The Role of Financial Assistance by the Multilateral Fund in Technology Change to Protect the Ozone Layer, in C. Zerefos et al (eds), *Twenty Years of Ozone Decline,* Springer.

Seres, S. (2008) *Analysis of Technology Transfer in CDM Projects*, Prepared for the UNFCCC Registration & Issuance Unit; CDM/SDM, December 2008.

United States Government Accountability Office. (2008) *Lessons Learned from the European Union's Emissions Trading Scheme and the Kyoto Protocol's Clean Development Mechanism,*

International Climate Change Programs Report to Congressional Requesters, GAO-09-151, November 2008.

World Bank-GEF. (2006) *Assessment of the World bank/GEF Strategy for the Market Development of Concentrating Solar Thermal Power,* 2006.

ENDNOTES

31 See J. Barton, *Mitigating Climate Change Through Technology Transfer: Addressing the needs of Developing Countries,* Chatham House, Energy, Environment and Development Progamme, Programme Paper 08/02, October 2008; J. Barton, *Intellectual Property and Access to Clean Energy Technologies in Developing Countries*, ICTSD Programme on Trade and Environment, Issue Paper No. 2, December 2007.

32 See S. O. Andersen, K. M. Sarma, & K. N. Taddonio, *Technology Transfer for the Ozone Layer,* (Earthscan , London 2007).

33 E. De Sombre, The Experience of the Montreal Protocol: Particularly Remarkable and Remarkably Particular, *UCLA Journal of International Environmental Law and Policy*, 19: 49-81, 2000/2001.

34 UNEP/Ozl.Pro WGII(2)/7:6, as cited in W. De Sombre & J. Kauffman, The Montreal Protocol Fund: Partial Success Story, in R. Keohane & M. Levy (eds.) *Institutions for Environmental Aid; Pitfalls and Promises* (MIT Press 1996).

35 De Sombre & Kauffman, *supra*.

36 K.M. Sarma & K N Taddonio, The Role of Financial Assistance by the Multilateral Fund in Technology Change to Protect the Ozone Layer, in C. Zerefos *et al* (eds), *Twenty Years of Ozone Decline* (Springer, 2009).

37 Recommendations from May 2008 Report of the Technology and Economic Assessment Panel; replenishment amount from Sarma & Taddonio.

38 De Sombre & Kauffman.

39 Andersen *et al, supra*.

40 *Ibid*.

41 "Conversion of CFC-12 small and medium open-type refrigerating compressors at Zhejiang Commercial Machinery Factory," MLF project CPR/REF/28/INV/300; as quoted in Andersen *et al, supra*.

42 De Sombre & Kauffman.

43 De Sombre & Kauffman.

44 www.multilateral fund.org/files/evaluation/4212.pdf, as cited in Andersen *et al*, *supra*.

45 D. Fairman, The Global Environment Facility: Haunted by the Shadow of the Future, in Keohane & Levy.

46 *Ibid*.

47 R. Clémençon, What Future for the Global Environment Facility?, *The Journal of Environment & Development,* 15:50-74 (2006).

48 Clémençon, *supra*.

49 Clémençon, *supra*.

50 http://thegef.org/interior_right.aspx?id=50#GEF%20Funding

51 Clémençon, *supra*.

52 G. Heggelund, S. Andresen, & S. Ying. Performance of the Global Environmental Facility (GEF) in China: Achievements and Challenges as Seen by the Chinese, *International Environmental Agreements,* 5: 323-348 (200%).

53 GEF Council, *Elaboration of a Strategic Program to Scale up the Level of Investment in the Transfer of Environmentally Sound Technologies*, GEF/C.34/5.rev.1, November 13, 2008.

54 *Ibid*.

55 *Ibid*.

56 *Ibid*.

57 *Ibid*. And see World Bank-GEF, *Assessment of the World bank/GEF Strategy for the Market Development of Concentrating Solar Thermal Power*, 2006. GET THIS AND ANALYZE

58 Clémençon, *supra*.

59 GEF Council, *Elaboration, supra*.

60 *Ibid*.

61 In this section, I have relied particularly on a paper by Mei Gechlik, a Lecturer and Fellow at Stanford,, on the implementation of the CDM. The piece is forthcoming in the San Diego International Law Journal.

62 See Gechlik, *supra*.

63 GAO -09-151 (Nov 18, 2008) – CHECK! – TEXT IS BASED ON MEI'S REVIEW

64 Axel Michaelowa, *CDM: current status and possibilities for reform,* Hamburg Institute of International Economics 2005./

65 *Ibid*.

66 Stephen Seres, *Analysis of Technology Transfer in CDM Projects,* Prepared for the UNFCCC Registration & Issuance Unit; CDM/SDM, December 2008. BASED IN PART ON MEI - CHECK

67 A. Dechezleprêtre, M. Glachant, & Y. Ménier, The Clean Development Mechanism and the international diffusion of technologies: An empirical study, *Energy Policy*, 36: 1273-1283 (2008).

68 A. Dechezleprêtre, M. Glachant, & Y. Ménier, Technology transfer bu CDM projects: A comparison of Brazil, China, India, and Mexico *Energy Policy,* 37: 703-711 (2009).

69 See, e.g., Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol, *Elaboration of possible improvements to emissions trading and the project-based mechanism under the Kyoto Protocol,* FCCC/KP/AWG/2008/INF.3, 24 November 2008.

70 Barton, *Intellectual Property and Access to Clean Energy Technologies in Developing Countries*.

SELECTED ICTSD ISSUE PAPERS

ICTSD Programme on Agriculture Trade and Sustainable Development
Trade Policy Options for Enhancing Food Aid Effectiveness. By Edward Clay. Issue Paper No.41, 2012.
Possible Effects of Russia's WTO Accession on Agricultural Trade and Production. By Sergey Kiselev and Roman Romashkin. Issue Paper No.40, 2012.
Post-2013 EU Common Agricultural Policy, Trade and Development: A Review of Legislative Proposals. By Alan Matthews. Issue Paper No. 39, 2011.
Improving the International Governance of Food Security and Trade. By Ahmad Manzoor. Issue Paper No. 38, 2011.
Food Reserves in Developing Countries: Trade Policy Options for Improved Food Security. By Chris Gilbert. Issue Paper No. 37, 2011.
Global Food Stamps: An Idea Worth Considering? By Tim Josling. Issue Paper No. 36, 2011.
The Impact of US Biofuel Policies on Agricultural Price Levels and Volatility. By Bruce Babcock. Issue Paper No. 35, 2011.
Risk Management in Agriculture and the Future of the EU's Common Agricultural Policy. By Stefan Tangermann. Issue Paper No. 34, 2011.
Policy Solutions To Agricultural Market Volatility: A Synthesis. By Stefan Tangermann. Issue Paper No. 33, 2011.
Composite Index of Market Access for the Export of Rice from the United States. By Eric Wailes. Issue Paper No. 32, 2011.
Composite Index of Market Access for the Export of Rice from Thailand. By T. Dechachete. Issue Paper No. 31, 2011.

ICTSD Programme on Competitiveness and Sustainable Development
Evaluating Aid for Trade on the Ground: Lessons from Nepal. By Ratnakar Adhikari, Paras Kharel and Chandan Sapkota. Issue Paper No. 23, 2011.
Evaluating Aid for Trade on the Ground: Lessons from Cambodia. By Sok Siphana, Cambodochine Dao, Chandarot Kang and Dannet Liv. Issue Paper No. 22, 2011.
Evaluating Aid for Trade on the Ground: Lessons from Malawi. By Said, Jonathan; John McGrath; Catherine Grant and Geoffrey Chapman. Issue Paper No. 21, 2011.
Evaluating Aid for Trade Effectiveness on the Ground: A Methodological Framework. By Ratnakar Adhikari. Issue Paper No.20, 2011.
EU Climate Policies and Developing Country Trade Vulnerability: An Overview of Carbon Leakage-Sensitive Trade Flows. By ICTSD. Issue Paper No. 19, 2011.
The Allocation of Emission Allowances Free of Charge: Legal and Economic Considerations. By Ingrid Jegou and Luca Rubini. Issue Paper No. 18, 2011.
The Role of International Trade, Technology and Structural Change in Shifting Labour Demands in South Africa. By H. Bhorat, C. van der Westhuizen and S.Goga. Issue Paper No. 17, 2010.
Trade Integration and Labour Market Trends in India: an Unresolved Unemployment Problem. By C.P. Chandrasekhar. Issue Paper No. 16, 2010.
The Impact of Trade Liberalization and the Global Economic Crisis on the Productive Sectors, Employment and Incomes in Mexico. By A. Puyana. Issue Paper No. 15, 2010.

ICTSD Programme on Dispute Settlement and Legal Aspects of International Trade
Conflicting Rules and Clashing Courts. The Case of Multilateral Environmental Agreements, Free Trade Agreements and the WTO. By Pieter Jan Kuijper. Issue Paper No.10, 2010.
Burden of Proof in WTO Dispute Settlement: Contemplating Preponderance of the Evidence. By James Headen Pfitzer and Sheila Sabune. Issue Paper No. 9, 2009.
Suspension of Concessions in the Services Sector: Legal, Technical and Economic Problems. By Arthur E. Appleton. Issue Paper No. 7, 2009.
Trading Profiles and Developing Country Participation in the WTO Dispute Settlement System. By Henrik Horn, Joseph Francois and Niklas Kaunitz. Issue Paper No. 6, 2009.

Fisheries, International Trade and Sustainable Development Series
The Importance of Sanitary and Phytosanitary Measures to Fisheries Negotiations in Economic Partnership Agreements. By Martin Doherty. Issue Paper No. 7, 2008.
Fisheries, Aspects of ACP-EU Interim Economic Partnership Agreements: Trade and Sustainable Development Implications. By Liam Campling. Issue Paper No. 6, 2008.
Fisheries, International Trade and Sustainable Development. By ICTSD. Policy Discussion Paper, 2006.

ICTSD Programme on Innovation, Technology and Intellectual Property
Bridging the Gap on Intellectual Property and Genetic Resources in WIPO's Intergovernmental Committee (IGC). By David Vivas-Eugui. Issue Paper No.34, 2012.
The Influence of Preferential Trade Agreements on the Implementation of Intellectual Property Rights in Developing Countries. By Ermias Tekeste Biadgleng and Jean-Christophe Maur. Issue Paper No. 33, 2011.
Intellectual Property Rights and International Technology Transfer to Address Climate Change: Risks, Opportunities and Policy Options. By K. E. Maskus and R. L. Okediji. Issue Paper No. 32, 2010.
Intellectual Property Training and Education: A Development Perspective. By Jeremy de Beer and Chidi Oguamanam. Issue Paper No. 31, 2010.
An International Legal Framework for the Sharing of Pathogens: Issues and Challenges. By Frederick M. Abbott. Issue Paper No. 30, 2010.
Sustainable Development In International Intellectual Property Law – New Approaches From EU Economic Partnership Agreements? By Henning Grosse Ruse – Khan. Issue Paper No. 29, 2010.

Trade in Services and Sustainable Development Series
Facilitating Temporary Labour Mobility in African Least-Developed Countries: Addressing Mode 4 Supply-Side Constraints. By Sabrina Varma. Issue Paper No.10, 2009.
Advancing Services Export Interests of Least-Developed Countries: Towards GATS Commitments on the Temporary Movement of natural Persons for the Supply of Low-Skilled and Semi-Skilled Services. By Daniel Crosby, Issue Paper No. 9, 2009.
Maritime Transport and Related Logistics Services in Egypt. By Ahmed F. Ghoneim, and Omneia A. Helmy. Issue Paper No. 8, 2007.

Environmental Goods and Services Series
Market Access Opportunities for ACP Countries in Environmental Goods. By David Laborde and Csilla Lakatos. Issue Paper No. 17, 2012.
Facilitating Trade in Services Complementary to Climate-friendly Technologies. By Joy Aeree Kim. Issue Paper No. 16, 2011.
Deploying Climate-Related Technologies in the Transport Sector: Exploring Trade Links. By Rene Vossenaar. Issue Paper No. 15, 2010.
Harmonising Energy Efficiency Requirements – Building Foundations for Co-operative Action. By Rod Janssen. Issue Paper No. 14, 2010.

Trade and Sustainable Energy Series
Issues and Considerations for Negotiating a Sustainable Energy Trade Agreement. Gary Hufbauer and Jisun Kim. May, 2012.
The Inclusion of Aviation in the EU ETS.WTO law considerations. By Dr Lorand Bartels. Issue Paper No. 6, 2012.
International Transport, Climate Change and Trade: What are the Options for Regulating Emissions from Aviation and Shipping and what will be their Impact on Trade? By Joachim Monkelbaan. Background Paper, 2010.
Climate Change and Trade on the Road to Copenhagen. Policy Discussion Paper, 2009.
Trade, Climate Change and Global Competitiveness: Opportunities and Challenge for Sustainable Development in China and Beyond. By ICTSD. Selected Issue Briefs No. 3, 2008.
Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuel and Wind Technologies. By John H. Barton. Issue Paper No. 2, 2007.

ICTSD EPAs and Regionalism Programme
Implications of Trade Policy Changes for the Competitiveness of Ecuadorian Banana Exports to the EU Market. By Giovanni Anania. Issue Paper No. 10, 2011 (Spanish and English).
Questions Juridiques et Systémiques Dans les Accords de Partenariat économique : Quelle Voie Suivre à Présent ? By Cosmas Milton Obote Ochieng. Issue Paper No. 8, 2010.
Rules of Origin in EU-ACP Economic Partnership Agreements. By Eckart Naumann. Issue Paper No. 7, 2010.
SPS and TBT in the EPAs between the EU and the ACP Countries. By Denise Prévost. Issue Paper No. 6, 2010.
Los acuerdos comerciales y su relación con las normas laborales: Estado actual del arte. By Pablo Lazo Grandi. Issue Paper No. 5, 2010.
Revisiting Regional Trade Agreements and their Impact on Services and Trade. By Mario Marconini. Issue Paper No. 4, 2010.
Trade Agreements and their Relation to Labour Standards: The Current Situation. By Pablo Lazo Grandi. Issue Paper No. 3, 2009.

ICTSD Programme on Global Economic Policy and Institutions
Multilateral Negotiations at the Intersection of Trade and Climate Change. By Manuel A.J. Teehankee, Ingrid Jegou and Rafael Jaques Rodrigues. Issue Paper No.2, 2012.
A decade in the WTO: Implications for China and Global Trade Governance. Edited by, Ricardo Melendez-Ortiz, Christophe Bellmann and Shuaihua Cheng. December, 2011.
The Microcosm of Climate Change Negotiations: What Can the World Learn from the European Union? By Håkan Nordström, Issue Paper No. 1, 2009.

These and other ICTSD resources are available at http://www.ictsd.org

ICTSD has been active in the field of intellectual property since 1997, among other things through its programme on on Innovation, Technology and Intellectual Property (IP), which since 2001 has been implemented jointly with UNCTAD. One central objective of the programme has been to facilitate the emergence of a critical mass of well-informed stakeholders in developing countries that includes decision-makers and negotiators, as well as representatives from the private sector and civil society, who will be able to define their own sustainable human development objectives in the field of IP and advance these effectively at the national and international level. The programme has generated an issue paper series on Intellectual Property Rights and Sustainable Development with the intention of offering a clear, jargon-free synthesis of the main issues to help policy makers, stakeholders and the public in developing and developed countries to understand the varying perspectives surrounding different IPRs, their known or possible impact on sustainable livelihoods and development, and different policy positions over the TRIPS Agreement and other relevant international intellectual property arrangements. This issue paper series is the consequence of a participatory process involving trade negotiators, national policy makers, as well as eminent experts in the field, the media, NGOs, international organizations, and institutions in the North and the South dealing with IPRs and development.
Previous publications under this Series include:

- Bridging the Gap on Intellectual Property and Genetic Resources in WIPO's Intergovernmental Committee (IGC). Issue Paper No.34 by David Vivas-Eugui, 2012.
- The Influence of Preferential Trade Agreements on the Implementation of Intellectual Property Rights in Developing Countries. Issue Paper No. 33 by Ermias Tekeste Biadgleng and Jean-Christophe Maur, 2011.
- Intellectual Property Rights and International Technology Transfer to Address Climate Change: Risks, Opportunities and Policy Options. Issue Paper No. 32 by Keith E. Maskus and Ruth L. Okediji, 2010.
- Intellectual Property Training and Education: A Development Perspective. Issue Paper No. 31 by Jeremy de Beer and Chidi Oguamanam, 2010.
- An International Legal Framework for the Sharing of Pathogens: Issues and Challenges. Issue Paper No. 30 by Frederick M. Abbott, 2010.
- Sustainable Development in International Intellectual Property Law – New Approaches From EU Economic Partnership Agreements? Issue Paper No. 29 by Henning Grosse Ruse – Khan, 2010.
- The Technical Assistance Principles of the WIPO Development Agenda and their Practical Implementation. Issue Paper No. 28 by C. Deere-Birkbeck and R. Marchant, 2010.
- Free Trade of Pharmaceutical Products: The Limits of Intellectual Property Enforcement at the Border. Issue Paper No. 27 by Xavier Seuba, 2010.

For further information, visit www.ictsd.org

About the International Centre for Trade and Sustainable Development, www.ictsd.org

Founded in 1996, the International Centre for Trade and Sustainable Development (ICTSD) is an independent think-and-do-tank based in Geneva, Switzerland and with operations throughout the world. Out-posted staff in Brazil, Mexico, Costa Rica, Senegal, Canada, Russia, and China. By enabling stakeholders in trade policy through information, networking, dialogue, well-targeted research and capacity-building, ICTSD aims to influence the international trade system so that it advances the goal of sustainable development. ICTSD co-implements all of its programme through partners and a global network of hundreds of scholars, researchers, NGOs, policymakers and think-tanks around the world.