Call for inputs on ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the Technology Executive Committee could possibly play in this area of work

18 June – 31 July 2012

Background

The COP, by its decision 1/CP.16, requested the Technology Executive Committee (TEC), as one of its functions, to recommend actions to address the barriers to technology development and transfer in order to enable enhanced action on mitigation and adaptation.

The rolling workplan of the TEC for 2012-2013 includes the organization of a thematic dialogue on enabling environments and barriers to technology development and transfer. This thematic dialogue was organized in conjunction with the 3rd meeting of the TEC.

Call for inputs

The TEC, at its 3rd meeting, agreed to launch a call for inputs on ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the TEC could possibly play in this area of work.

Observer organizations accredited by the UNFCCC are invited to provide inputs on ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the TEC could possibly play in this area of work and send their inputs to: tec@unfccc.int.

The call for inputs will be open from 18 June – 31 July 2012 (24:00 GMT). The inputs from this call will be considered at the 4th meeting of the TEC.

Inputs received

Inputs submitted

Date received	Submission
20 July 2012	Mary Robinson
26 June 2012	World Bank
30 July 2012	Energy Research Centre of the Netherlands
31 July 2012	Business Council for Sustainable Energy
31 July 2012	Brookings Institution
31 July 2012	Climate Action Network International
31 July 2012	Indian Institute of Technology
1 August 2012	Asian Development Bank

1 August 2012	International Centre for Trade and Sustainable Development
1 August 2012	Institute for Global Environment Strategies
1 August 2012	Third World Network
1 August 2012	United Nations Development Programme
2 August 2012	South Centre
6 August 2012	International Renewable Energy Agency
6 August 2012	Global CCS Institute
6 August 2012	World Business Council for Sustainable Development
13 August 2012	Climate Investment Funds

Meeting the energy needs of the poorest: a role for social protection

A question of scale

2012 may well prove to be a critical year in terms of international efforts to address the issue of access to energy. The United Nations has designated 2012 the *International Year of Sustainable Energy for All* and the forthcoming United Nations Conference on Sustainable Development, Rio+20, has identified energy as one of its priority areas.

Issues of sustainable development are fundamental to efforts to achieve universal access to modern energy. Development is not possible without energy and sustainable development is not possible without access to clean, affordable, and sustainable energy. While climate change is one of the greatest development challenges the world currently faces, it is also an opportunity for developing countries to 'leapfrog' fossil fuel path dependency and become low-carbon sustainable development leaders. Access to sustainable energy is fundamental to achieving development goals such as poverty reduction; improved health; increased productivity and economic growth. The poor have a right to development and it is in the interests of all if this development takes place using clean, affordable, sustainable energy.

The facts on energy access are well known:

- Approximately 1.3 billion people currently have no access to electricity
- 2.7 billion people rely on traditional biomass fuels for cooking and heating
- International Energy Agency projections based on current levels of investment will see 1 billion people still without access to electricity in 2030[1]

None of the above can be regarded as acceptable. Similarly, 2030 has been identified as a target year for achieving universal access to modern forms of energy but 2030 is too far away. If 2012 is to truly be the *International Year of Sustainable Energy **for All***, we must acknowledge both the failure

[1] IEA, 2011, *Energy for All – Financing access for the poor,* accessed online at http://www.iea.org/papers/2011/weo2011_energy_for_all.pdf 2 May 2012

of current efforts to adequately address the needs of those without access to energy and the urgent need to develop alternative solutions. These solutions must address the following:

- The critical question of scale. How do we scale up in order to meet the energy demands of those without access to energy?

Part of the solution?

While there is no silver bullet solution to meeting the requirements of those currently without energy access, the Mary Robinson Foundation - Climate Justice is of the opinion that social protection systems have the potential to deliver access to sustainable energy on a much greater scale than heretofore.

How?

- Social protection systems offer a potential model for the delivery of access to clean, affordable and sustainable energy to those at the base of the economic pyramid. Typically, the beneficiaries of social protection programmes include the chronically poor and those who are economically vulnerable. They also constitute a significant proportion of those who currently have no access to energy. By default, countries with existing social protection systems have already identified the people whose energy needs are greatest and have the infrastructure and delivery mechanisms in place to reach them in a targeted way.

Advantages to using existing social protection systems:

- The definition of social protection used internationally varies considerably. The OECD refers to social protection as 'policies and actions which enhance the capacity of poor and vulnerable people to escape from poverty and enable them to better manage risks and shocks.'[2] Incorporating an access to sustainable energy component is entirely compatible with this goal

- Social protection programmes are established by governments with funding from a variety of sources including national budgets and international aid. Once programmes have been established they are monitored and evaluated on an on-going basis and issues of accountability and transparency are paramount. International donors are experienced in supporting these programmes and in working with ministries responsible for their administration

- Social protection programmes have the potential to include a high degree of participation involving a range of stakeholders including beneficiaries, local communities and civil society organisations in addition to government ministries. The involvement of all stakeholders, in particular women, in determining the framework that informs how and what is delivered is critical to the effectiveness of both energy access and social protection programmes

[2] OECD Publication, *Promoting Pro-Poor Growth:Employment and Social Protection* accessed online at http://www.oecd.org/dataoecd/63/8/43514582.pdf 30 April 2012

- Social protection systems have the capacity to adapt to achieve specific policy objectives:

    - Ethiopia's Productive Social Safety Net Programme (PSNP) was designed as an alternative response to food aid and a deliberate attempt to shift away from short-term emergency response food distributions. The program targets transfers to poor households in two ways: through labour intensive public works and direct support. Households can choose whether to receive transfers in the form of cash or food. Over time this programme has developed to include a component to build resilience to climate change – the Climate Smart Initiative
    - The Mahatma Gandhi National Rural Employment Guarantee Act in India aims to improve the livelihood security of rural households by providing at least one hundred days of guaranteed wage employment in every financial year to a household whose adult members volunteer to do unskilled labour. Components of the work programme aim to reduce vulnerability to climate risks (water conservation, drought proofing and flood protection) as well as increasing agricultural productivity and food security levels.[3]

    Acknowledging the pressures and constraints that social protection systems sometimes operate under, there is no reason to believe that these systems are incapable of adapting to include an access to sustainable energy component.

- The full potential of social protection programmes to deliver access to energy has yet to be explored. However, there are examples of social protection systems addressing fuel poverty:

    - The *Oportunidades* programme operated by the Ministry for Social Development in Mexico responded to increasing fossil fuel prices in 2007 by incorporating an additional cash transfer for household energy expenses. 5.8 million families benefited under the scheme and the programme reached 25 per cent of the country's poorest. However, the Ministry has recognised that increasing energy prices make continued direct cash transfers impractical and is investing in sustainable energy forms including ecological cookstoves which, by the end of 2012, will have been introduced in over half a million Mexican homes over a six-year period.[4]

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[3] Details on the Mahatma Gandhi National Rural Employment Act are extracted from a presentation on *Social Protection: Social Justice and Climate Justice* delivered by a representative of the Government of Madhya Pradesh, India at MRFCJ's meeting on Social Protection and Low Carbon Technology at The Pocantico Center of the Rockefeller Brothers Fund, 30 March – 1April, 2012

[4] Details on social protection programmes in Mexico are extracted from a presentation on *The role of energy consumption in households as part of poverty measurement and the social programs in Mexico* delivered by a representative of the Ministry for Social Development, Mexico at MRFCJ's meeting on Social Protection and Low Carbon Technology, 30 March – 1April, 2012

Time for a new approach

The decision to address the energy needs of those at the base of the economic pyramid will ultimately be a political one. It is about recognising the ability of sustainable forms of energy to fundamentally alter the lives of those who receive them, at both the individual and community levels. It will require increased investment in low-carbon technologies in addition to the reallocation of existing financial resources. It will require education on the value of access to affordable forms of sustainable energy and the consequent benefits in the areas of health, education and the empowerment of women. Above all, it requires a sense of urgency and a willingness to tackle the critical issue of scale.

MRFCJ calls on governments, the UN, multilateral development banks, investors, private sector and NGOs to make the valuable links between their work on social protection and access to sustainable energy and to deliver innovative approaches that benefit the poorest.

How MRFCJ arrived at this position

MRFCJ's approach to the issue of access to sustainable energy is informed by the following:

1. MRFCJ Principles of Climate Justice

The work of MRFCJ is guided by the Principles of Climate Justice.[5] These include supporting the right to development, highlighting gender equality and equity, and the need to share the benefits and burdens associated with climate change equitably, all of which inform the need to improve access to sustainable energy for the poor.

As an organisation working on climate justice MRFCJ is concerned that many of the initiatives working to improve access to sustainable energy will not benefit the largest but poorest socioeconomic group, the so-called bottom or base of the economic pyramid. Another common failing of these initiatives is that they tend not to bring out the gender dimensions of access to energy (in particular the benefits to women), and fail to harness the power of women as local-level agents of change. Identifying specific measures to reach those least able to pay for energy and low-carbon technologies is a priority area for the Foundation.

2. The recommendations of an MRFCJ convened meeting on social protection and low-carbon technology

MRFCJ's position on social protection and access to energy was further informed by a meeting it convened at The Pocantico Center of the Rockefeller Brothers Fund in New York from 30 March to 1 April 2012. The objective of the meeting was to examine the potential linkages, opportunities and challenges in using social protection systems as a mechanism for providing access to clean, affordable, sustainable energy for the poor in developing countries.

This MRFCJ idea was explored by bringing together two groups of experts who don't usually interact directly with one another: practitioners in social protection and practitioners in energy access. The meeting was attended by twenty one experts in social protection, renewable energy, climate change, finance and sustainable development. They included representatives from governments, international organisations, research centres, civil society and the private sector.[6]

Participants at the meeting agreed that acting on the linkages between social protection and energy access can provide an effective mechanism for delivering clean, affordable, sustainable energy to the poor. The meeting concluded that in order to develop the potential of social protection programmes to provide access to energy, the following must be in place:

- High-level political will to integrate energy access into social protection

[5] MRFCJ Principles of Climate Justice can be accessed online at http://www.mrfcj.org/about

[6] See Appendix 1 for a full list of meeting participants and Appendix 2 for the agenda of the meeting.

- Integrated approaches across government ministries
- Innovative and accessible financing mechanisms
- A multi-stakeholder model in which poor people are recognised as key actors in their own development.

The meeting's recommendations for linking social protection and access to energy are outlined in Appendix 3.

Appendix 1: MRFCJ Meeting on Social Protection and Low-Carbon Technology – 30 March – 1 April 2012 - List of Participants

Surname	Name	Position	Organisation
Ballesteros	Athena	Director, International Financial Flows and Environment Objective	World Resources Institute
Banuri	Tariq	Former Director UNDSD/ Member of CSD Secretariat	United Nations
Boyer	David	Senior Programme Director, Environment	Aga Khan Foundation
Chabeda	Patrick A.	Environment & Climate Change Specialist	Office of the Prime Minister
Chingambo	Lloyd	Chairman	Africa Carbon Credit Exchange
Davies	Mark	Programme Manager, Centre for Social Protection	Institute of Development Studies
Di Perna	Paula	Member of the Advisory Board	NTR Foundation
George	Manju	Co-founder and Vice President	Intellecap
Mahlung	Clifford	Chair	Clean Development Mechanism (CDM) Executive Board
Milanello	Marcelo	Project Manager, Brasil Sem Miseria	Government of Brazil
Nguyen	Huong Thi Lan	Director General	Institute of Labour Science and Social Affairs (ILSSA), Vietnam
Ntabadde	Martha	Senior Engineering Specialist	Uganda Carbon Bureau
Ornelas Hall	Ramiro	Director-General, Priority Groups	Ministry for Social Development, Mexico
Ouma	Marion	Programme Officer	Africa Platform for Social Protection
Pearson	Kristine	CEO	Lifeline Energy
Pope	Carl	Consultant	Carbon War Room
Ramachandran	Mack	Social Entrepreneur	Offset4poor.com
Robinson	Mary	President	MRFCJ
Sharma	Amita	National Rural Employment Guarantee Programme	Department of Rural Development, India
Tsukamoto	Mito	Senior Specialist, Employment Intensive Investment Programme	International Labour Organisation
Walker	Eric	Deputy Director, Integrated Solutions, Greater China	The Climate Group

Appendix 2: Agenda - MRFCJ Meeting on Social Protection and Low-Carbon Technology

Friday 30 March 2012			
Time	**Activity**	**Person**	**Room**
18.00 – 19.00	Reception, drinks, meet and greet		Loggia
19.00 – 21.00	Dinner		Dining room
21.00	After dinner speaker	Tariq Banuri	Hayloft

Saturday 31 March 2012			
Time	**Activity**	**Person**	**Room**
Introduction and overview			
9.00 - 9.15	Introduction: background and context	Mary Robinson	Conference room
Session 1 - Understanding each other (3 hours 30 mins) **Each 20 minute presentation will be followed by a 25 minute Q&A** **Moderator: Manju George**			
9.15 – 10.00	Presentation No. 1: Social protection: an overview of the principles, modalities, policy issues and myths	Amita Sharma	Conference room
10.00 - 10.45	Presentation No. 2: Access to low-carbon energy: the challenges of reaching the poorest	Lloyd Chingambo	
10.45 - 11.15	Coffee break		Loggia
11.15 – 12.00	Presentation No. 3: Case study: Mexico	Ramiro Ornelas Hall	Conference room
12.00 - 12.45	Presentation No. 4: Adaptive social protection: developing climate resilience through social protection programmes	Mark Davies	

12.45 - 13.45	Lunch		Dining room
13.45 - 14.15	Discussion based on presentations groups		Conference room
Session 2 - Exploring opportunities and challenges (2 hours 30 mins)			
14.15-14.30	Introduce points for discussion in breakout groups	Mary Faherty	Conference room
14:30-15.30	Breakout groups 2 Groups – 1 Facilitator & 1 Rapporteur for each group	Facilitators: Clifford Mahlung & Patrick Chabeda Rapporteurs: Mary Faherty & Kristine Pearson	Group 1 in Conf. room Group 2 in Lecture room
15.30 – 16.00	Coffee		Loggia
16.00 – 17.15	Breakout groups continued		Lecture room/Conference room

Sunday 1 April 2012			
Time	**Activity**	**Person**	**Room**
Session 3 - Strategies to get sustainable energy to the poor (1 hour 45 mins) **Moderator: Carl Pope**			
9.00 – 9.30	Feedback from previous day's session (15 mins per group)	Mary Faherty & Kristine Pearson	Conference room
9.30 – 10.45	Facilitated discussion – pulling together key points and recommendations		
10.45 – 11.15	Coffee		Loggia
Session 4 - Next steps: turning key issues into firm commitments (2 hours 15 mins) Moderator: Lloyd Chingambo			
11.15 – 13.15	Next steps to act on recommendations Actions, roles, responsibilities, timelines.		Conference room
13.15 – 13.30	Wrap up and thank you	Mary Robinson	

Appendix 3: MRFCJ Meeting on Social Protection and Low-Carbon Technology - Recommendations for Linking Social Protection and Access to Energy

Secure high-level political will

- For energy access to be integrated into social protection programmes, high level political commitment is required, which must then translate to political support at a sub-national and local level.

Integrate policies

Policy integration is necessary in order to develop a holistic approach that capitalises on the linkages between inter-related initiatives.

- Secure inter-ministry cooperation and coordination to ensure the success of social protection programmes in delivering energy access. Involve a range of ministries including (but not limited to) ministries of social protection, environment, energy, forestry, finance, when exploring options for implementation.
- Use the experience of existing multi-component social protection programmes, energy access programmes and public works programmes over the last number of years as a basis for exploring policy synergies. There are many large public works programmes that have developed innovative home-grown ways of implementing at a national level. Consider synergies using the social protection graduation graph (included as Appendix 3) as a starting point. Document and share experiences for increased south-south learning.
- Explore how social protection and energy access policies can be integrated into Nationally Appropriate Mitigation Actions (NAMAs) and bring the findings to the design of the Green Climate Fund.

Develop innovative and accessible financing mechanisms

Mechanisms need to be created that assist the poor to break out of the current cycle of paying high prices for energy such as kerosene, while lacking the capital to invest in cleaner, more affordable and sustainable energy options.

- Develop new funding mechanisms such as cost blending that can be used to fund renewable energy and social protection programmes by pooling funds that include loans, grants and government funding.
- Explore how to leverage carbon finance for scaling up energy access in social protection programmes. Exploit access to funding from the Clean Development Mechanism Programme of Activities in order to aggregate carbon credits from the household level to the community level. This could be used to create community level revolving funds to finance renewable energy and energy efficiency programmes.
- Ensure a climate justice approach informs discussions on the Green Climate Fund. Amplify the voices of those who can positively influence its design so that funding is available at the local and community level.
- Create innovation funds within social protection programmes to introduce a degree of flexibility that facilitates piloting of ideas such as the introduction of a component to deliver clean, affordable, sustainable energy to the poor.
- Explore the potential of feed-in tariffs as a mechanism for incentivising private sector involvement.
- Identify the means of providing guarantees to private investors in order to de-risk their investments and provide alternative sources of private sector funding.

Develop a multi-stakeholder model in which poor people are recognised as key actors in their own development

If social protection systems are to deliver on access to energy, a range of stakeholders from the public sector, private sector and civil society must be involved in the design and implementation of policies and programmes. This includes those currently without access to energy, local and national governments, civil society, international organisations, bilateral donors, private investors, the corporate sector, microfinance institutions, research institutions and social entrepreneurs.

- At the outset, poor people must be recognised as key actors in their right to development rather than passive recipients of services. This will require the development of mechanisms that are flexible and adaptable to respond to people's and communities' needs and priorities.

- Examine incentives that encourage poor people to consider the benefits of renewable energy and energy efficiency - 'how do you support someone who thinks they are ok where they are?'
- Design policies and programmes that provide an opportunity for local people to take charge of their lives and realise behavioural transformation. Promote an environment that creates the conditions for transformation that will build people's resilience.
- Explore the potential of public private partnerships in the area of social protection.
- Examine ways to incorporate employment, specifically public works programmes, into energy access initiatives.
- Support the role of civil society, in particular local NGOs, in bridging the link between communities and the public sector.
- Encourage social development ministries to engage with social entrepreneurs and private sector investors in the delivery of access to energy initiatives.

Position initiatives within a rights based framework

Initiatives to link social protection and energy access should be framed within a rights-based approach, thus contributing to realising the human rights laid down in the Universal Declaration of Human Rights and other international human rights instruments. Positioning initiatives within a rights-based framework means that the entitlements of the rights-holders are provided by law and therefore less prone to reversal during changes in political leadership.

MRFCJ submission

Views on ways to promote enabling environments and to address barriers to technology development and transfer

MRFCJ welcomes the opportunity to submit views to the UNFCCC secretariat on the work plan of the Technology Executive Committee (TEC), specifically on ways to promote enabling environments and to address the barriers to technology development and transfer. MRFCJ is grateful to TEC member Matthew Kennedy for channelling this submission to the UNFCCC secretariat.

Introduction to the Mary Robinson Foundation – Climate Justice

The Mary Robinson Foundation – Climate Justice (MRFCJ) is a centre for thought leadership, education and advocacy on the struggle to secure global justice for the many victims of climate change who are usually forgotten - the poor, the disempowered and the marginalised across the world. The work of MRFCJ is guided and informed by the Principles of Climate Justice. These include *supporting the right to development* and *sharing benefits and burdens equitably*, both of which inform the need to improve energy access for the poor.

Linking energy access and social protection

MRFCJ is concerned that many of the initiatives working to improve access to clean, affordable, sustainable energy will not benefit the poorest and most vulnerable. MRFCJ believes it is necessary to identify specific measures to reach those least able to pay for energy and low carbon technologies.

Social protection programmes target the poorest and most vulnerable in society, those who have little or no disposable income and who may not automatically benefit from initiatives to improve access to sustainable energy. By default, countries with existing social protection systems have already identified the people whose energy needs are greatest and have the infrastructure and delivery mechanisms in place to reach them in a targeted way.

In early 2012, MRFCJ convened 21 experts from the fields of social protection, energy access and climate finance to examine the potential linkages, opportunities and challenges in using social protection systems as a mechanism for providing access to clean, affordable, sustainable energy for the poor in developing countries. The meeting concluded that in order to develop the potential of social protection programmes to provide access to energy, the following must be in place:

- High-level political will to integrate energy access into social protection
- Integrated approaches across government ministries
- Innovative and accessible financing mechanisms
- A multi-stakeholder model in which poor people are recognised as key actors in their own development.

Relevance to the TEC

Acting on the linkages between social protection and energy access can provide an effective mechanism for delivering clean, affordable, sustainable energy to the poor. The full potential of linking energy access and social protection mechanisms has yet to be explored by governments, investors and the UNFCCC process. There is also scope for public private partnerships linking innovators and investors into government programmes.

It is MRFCJ's opinion that this idea – linking social protection and energy access – can provide an enabling environment for delivering energy access at scale and transferring technology to people who may otherwise be forgotten in other initiatives, i.e. the people occupying the base of the economic pyramid in developing countries.

Further information

Further information is included in the 12 page MRFCJ position paper *Meeting the energy needs of the poorest: a role for social protection* which is included as an Annex to this document.

CLIMATE INVESTMENT READINESS INDEX (CIRI) - A Tool to Assess Investment Climate for Climate Investments

Background

Mitigating climate-change while addressing development needs will involve massive scale-up of renewable energy as well as investments in energy-efficiency ('climate investments').[1] While the private sector will be the main driver for putting economies-both developed as well as developing-onto a low-carbon growth trajectory, public policy, at least in the near to medium term will the key driver for private investments and responsible for creating a conducive 'investment climate' for climate investments. The ingredients that combine to form the right enabling environment for climate investments are diverse and quite often depend on complex factors and country-specific circumstances. They may comprise at a broader level macro-economic determinants such as a functioning bureaucracy and banking system to a narrower set of determinants that address barriers specific to clean energy and energy efficiency investments for instance, renewable energy targets, preferential power tariffs, tax and other fiscal incentives. Similarly for greater diffusion of energy-efficient products- electricity prices matter, but so will specific policies, regulations and incentives (PRIs) designed to promote greater uptake of energy-efficient products. These include, for instance energy-efficiency targets, mandatory and voluntary appliance labeling schemes and producer and consumer-oriented incentives.

While the exact policy mix and design will depend on country-specific circumstances, the presence of key sector-specific policies could send the right 'signals' to the private sector about the readiness of countries to create an 'enabling' environment to attract climate investments. These PRIs provide not only legal certainty to investors, but also make investments in renewable energy and energy efficiency worthwhile by lowering investment-related costs and risks. They help 'level' the playing field in an environment where market realities, support for fossil-fuels and the high costs of renewable energy technologies largely favors fossil-fuel deployment and consequent 'lock-in' of carbon intensive growth patterns.

Climate Investment Readiness Index (CIRI) is a tool for promoting sustainable investment climates for climate -friendly investments. The objective of the tool is two-fold: (i) A systematic and objective evaluation of the enabling environment, particularly in developing countries for supporting private sector investment in climate mitigation technologies; and (ii) Enabling an inter-country comparison of investment climates for climate investments by systematically capturing and assessing policies that multitude of incentives and barriers - ranging from technical, to financial, to markets, to regulatory barriers – from a private sector perspective into some sort of a common, normalized and composite index (or sub-indices) which could make it easy to objectively compare countries and markets in terms of their preparedness and maturity to move into the arena of climate-friendly investments.

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[1] International Energy Agency (IEA) forecasts that US$13.5 trillion (or about $500 billion annually) in clean energy investments will be needed between 2010 and 2035and mostly in developing countries. Source: *World Energy Outlook 2010*.

Approach and Methodology

Clean energy investors look for specific policies, regulations and incentives such as renewable energy targets, reliable power purchase agreements that offer attractive tariffs, access to grids, tax and other fiscal incentives based on installed capacity, capital equipment or amount of power generated. Similarly for greater diffusion of energy-efficient products- electricity prices matter, but so will specific policies, regulations and incentives designed to promote greater uptake of energy-efficient products. These range from economy-wide or sector-specific energy-efficiency targets, mandatory and voluntary appliance labeling schemes together with producer and consumer-oriented subsidies and fiscal incentives. 'Green' building codes and incentives for 'green' construction can also encourage greater energy efficiency in the design, construction and deployment of low-carbon lighting, heating and cooling appliances within buildings-a sector that accounts for almost a third of energy consumption globally and an equally important source of CO_2 emissions according to the IEA. For both renewable energy as well as energy-efficiency, the existence of an institutional framework that effectively administers and implements these PRIs contributes to a meaningful and credible enabling environment.

A recent report by the Corporate Investment Climate Department of the International Finance Corporation (IFC) while underscoring the crucial role of private investment in achieving goal of sustainable energy development, suggests that the most appropriate mechanisms for attracting private investment should be based on a country's resources, features of its electricity market and related institutions, and investment promotion policies. According to the report such an approach minimizes distortions in the power sector and the overall economy and encourages competition and efficiency.

The report also categorizes policy instruments to promote renewable energy into three groups: (i) interventions that ease entry through streamlined regulations; (ii) regulations that reduce revenue risk and facilitate investor operations; and (iii) fiscal incentives that attract investment. Figure 1 below illustrates these categories with examples of policies and measures under each category.

Figure 1: Components of an Enabling Business Environment for Renewable Energy Investments

Facilitating entry	Reducing revenue risks and facilitating operations	Providing fiscal incentives to encourage investment
Provisions that allow for independent private providers	*Price guarantees (feed-in tariffs)* Quantity guarantees	**Tax incentives**
Coordinated, streamlined licensing and permitting	**Power purchase agreements**	*Nontax incentives (such as R&D, rebates, and grants)*
Clear, transparent rules for grid access (on-grid projects)	*Other regulatory measures*	Disincentives for fossil fuels

Source: The World Bank/IFC, 2011, *Improving the Investment Climate for Renewable Energy: A Guide for Practitioners of Investment Climate Reform.*

While diagnostic country-specific studies could help in identifying the full range of policies and potential actions required to attract climate-friendly investments, investors would, at least initially, look for a set of pre-conditions or basic parameters that would signal whether a country was serious in terms of its intent to attract such investments. CIRI is a tool that would enable investors to quickly ascertain the presence of certain basic PRIs in a country as well as the enabling environment to assess country readiness to attract private investments in the clean energy space.

Countries that have attracted the most investment in low-carbon technologies, renewable energy and energy efficiency have generally been those that have provided long-term certainty around the structure and incentives associated with these investments.[2] Conversely, many countries have struggled to attract investment because they do not have appropriate policies in place, because the policies are poorly implemented or because the policies do not provide sufficient incentives for investment.[3]

Thus in addition to tracking PRIs, their implementation aspects and their *attractiveness* is very important. By gathering and analyzing comprehensive quantitative data to compare the enabling environments across economies and over time, CIRI can encourages countries to compete towards more efficient regulation; offers measurable benchmarks for reform and serve as a resource for governments, donor agencies, private sector researchers and others interested in the business climate of climate-friendly investments.

CIRI will also thus facilitate the process to assess progress made by countries in moving towards a low-energy/carbon growth path and inform needed assistance/cooperative efforts. It will be a valuable tool not only for private sector investors but also policy makers as well as the donor community in among others, understanding what PRIs may or may not work in differing country contexts, to improve transparency, address 'weak-spots', spur much-needed reform and better targeting of external assistance.

Progress so far and way forward

Development of CIRI was initially piloted as a part of a regional study, "Assessing Investment Climate for Climate Investment in South Asia." This study outlined some of the main findings from a regulatory survey of countries in the South Asian region-India, Pakistan, Bangladesh, Nepal, Sri Lanka and the Maldives and subsequently CIRI scores were constructed for South Asian countries- for the presence of important enabling policies, regulations and incentives as well as institutions thereby providing a 'snapshot' picture of how these countries fare in terms of basic preconditions necessary for attracting climate-friendly investments. It also compared scores obtained by South Asian countries with a number of other countries-both developed as well as developing to get an assessment of how the region fares overall in terms of a conducive policy environment for climate investments relative to other countries.

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[2] 2011 Global Investor Statement on Climate Change. http://www.unepfi.org/fileadmin/documents/2011InvestorStatementClimateChange.pdf

[3] According to a recent World Bank study, in spite of a reasonably stable policy regime, a large number of renewable energy projects in India are held up because of the large number of clearances that are required during the development cycle (World Bank, 2010: Unleashing the Potential of Renewable Energy in India).

While benchmarking countries on the basis of existence of PRIs was a good starting point, it is now proposed that CIRI methodology be refined and extended and made a truly global index—first of its kind--capturing investment friendliness of countries towards clean energy investments covering a number of countries. It is proposed that the "enabling environment" for clean energy investments will be captured through standard questionnaires that will be administered a rolling basis initially in a number of countries.[4] The CIRI index thus created will tell us how attractive the private sector perceives the various PRIs available in a given country on paper as well as the effectiveness of implementation. Other complementary outputs could include as per demand: (i) country specific investment climate type studies; (ii) regional studies; and (iii) sector studies (e.g. solar, wind, biomass etc.). Country coverage and sector coverage could be revisited annually. It is also proposed that a web-based "Clean Energy Platform" be created that captures, in addition to country specific policies, regulations and incentives, and private perception the actual clean energy investment flows (available from Bloomberg) and the general "Doing Business" index.

A range of stakeholders will be engaged through this exercise. The private sector will be engaged actively (including business associations/chambers of commerce) which have been successful in developing and promoting locally viable renewable energy investments to assess the potential/opportunities for generating additional venture capital and/or internationally-motivated private-sector engagement to the promotion of renewable technologies. The team will also consult other experts in RE and EE along with an extensive mix of private-sector respondents including large firms and SMEs. Other relevant players included would be equipment manufacturers, energy service companies, manufacturers of EE material such as light bulbs and HVAC.

At the national level key players will include relevant government agencies including Ministries of Energy/Renewable Energy, Environment and Finance, electricity generation and distribution utilities and line agencies responsible for promoting energy efficiency. Going forward, it is important to ensure that the CIRI index:

(i) Has a wide recognition and appropriate buy-in at country level;

(ii) Uses transparent and robust methodologies;

(iii) Incorporates the needs of the key investors;

(iv) Focuses on key areas for investors e.g. infrastructure or innovation rather than trying to be all encompassing and too ambitious at early stages;

(v) Builds on and not duplicate existing investment climate/ doing business work;

(vi) Be continuing and sustainable i.e. updated each year;

(vii) Be supported by key development partners/organizations.

[4] Methodology will be designed along the lines of "Doing Business" model where standard questionnaires are administered through local experts, including lawyers, business consultants, accountants, freight forwarders, government officials and other professionals routinely administering or advising on legal and regulatory requirements.

Institutional Arrangements

The CIRI team will be housed in Global Indicators & Analysis Group of Finance and Private Sector Vice Presidency of the World Bank Group. The team will closely interact with the World Bank Group's Investment Climate Assessment and Doing Business teams, various regional division experts as well as the Energy Sector Management Assistance Program (ESMAP) teams to avoid any duplication of efforts ensure coherence as well as exploit mutual synergies. The team will be guided by a group of senior technical experts from both within and outside the Bank.

The World Bank's Investment Climate Assessments (ICAs), Investing Across Borders (IAB) and Doing Business (DB) initiatives already evaluate and compare the general business climate in a country (that also impacts investments in clean energy sectors). IAB for instance has already developed scores based on whether full-equity ownership is available to foreign investors in electricity generation, transmission and distribution including in renewable power sectors of hydro, solar, wind and biomass. CIRI will take these valuable initiatives in a new direction by looking at sector-specific determinants. Like the ICA and IAB it will also examine objective laws and regulations (in this case those which are relevant to clean electricity generation). Unlike IAB (that focuses on foreign direct investment) CIRI will target both foreign as well as domestic investors. While the cross-cutting variables measured by Doing Business (such as the number of days required to register a business) are important for clean energy investors, CIRI (unlike Doing Business) will not be limited to firms of any particular size or by geographical location within a country.

The International Finance Corporation (IFC) is also very actively involved in providing investment and advisory services to firms involved in clean energy generation and clean technologies. The IFC's Investment Climate business line's interventions are designed to complement the work of other parts of the World Bank and IFC and focuses on measures that foster competition, reduce barriers to private sector entry and operation, and develop appropriate and affordable fiscal and non-fiscal incentives to promote investments in renewable energy.

CIRI findings will be of great value to IFC teams in getting a better insight into the barriers to investment that the private sector faces in various countries. This will immensely help their advisory service activities as well as enable a strategic channeling of their lending activities. The team expects to work closely with relevant experts at the IFC and also develop collaborative work programs that will draw on expertise and networks within the Bank and IFC and exploit resulting synergies.

CIRI will seek to be a 'living' and constantly evolving (and improving) tool. It will seek to differentiate itself from similar initiatives in evaluating countries horizontally across specific policy indicators within sectors (wherever possible) and will score countries based on the presence of key PRIs as well as the perceptions of the key private sector players (in terms of global and country market presence) in clean energy and energy-efficient products rather than arbitrarily constructed numbers and weights. Based on feedback from experts and target audiences, the indices can over time ensure that the policy variable elements it captures and measures are the ones that 'truly matter' taking into account national circumstances and priorities.

Expected Outcomes and Impact

The success of every activity lies in the outcomes and long-term impact that it has. *CIRI: Assessing Investment Climates for Climate Investments* will seek to enable the following outcomes:

- *Transparency*: It will provide factual information about what clean-energy laws and regulations say and how they are implemented.
- *Identification of 'weak' spots* in a country's business climate for clean energy investments by clearly identifying areas of policy implementation where a country needs to improve.
- *Reform*: An index-based benchmarking of countries based on the perception of their investment climates amongst the private sector will be useful in spurring reform in these countries.
- *Better evaluation and understanding* of what clean-energy and energy-efficiency promotion policies may or may not work in different country-contexts both by governments as well as donor agencies.
- *Better targeting of external assistance:* The project results will be useful for tailoring country-specific technical assistance to improve investment climate in the clean-energy and energy-efficiency sectors both from various departments within the Bank group as well as other aid-agencies. Further it is also expected that the results will influence the nature and direction of assistance that is channeled under the auspices of the UNFCCC through the Green Climate Fund and Technology Mechanism.
- *Independent Verification:* The results could also be a useful way to independently verify National Appropriate Mitigation Action (NAMAs) that are related to clean-energy

In the long run, it is expected that the wider diffusion of the findings will result in greater inflows of private-sector investments into clean-energy sectors as a result of reform driven by CIRI findings. Greater coherence and synergy between public financing (domestic governments, World Bank and external aid agencies) and private-sector needs is also expected to result in better use of public funds to leverage clean energy and energy-efficiency investments.

Measuring some of these impacts will also be important to assess the overall effectiveness of the approach. For instance it may be interesting to correlate the trends in actual private-sector investment flows into a country with both for existence of policy, regulation and incentives (PRI) as well as based on private-sector perception surveys (PSPS).

One could think of this leading to a "**Clean Energy Platform**" where one will be able to track periodically the evolving PRI regime in countries, private perception, actual level of investments in clean energy and energy efficiency and broader macro variables of doing business from "Doing Business" or "Investment Across Borders" database.

This is envisaged as a multi-donor initiative. USAID has committed over a five year period.

Budget

Proposed Annual Budget[1]

Output	Costs (US$)
Framework development	500,000
Survey design	500,000
Data collection and analysis in candidate countries (e.g. 80 countries)	1,800,000
Publication/Dissemination	200,000
Total	3,000,000

1. It is anticipated that the costs for framework development and survey design are upfront costs and need not be incurred on an annual basis. There will be some costs, however, for annual updates of the survey.

Timetable and milestones

Formal CIRI launch	January 2012
Framework development	January-June 2012
Identification of partners and consultants and launch workshops	February-June 2012
Launch of Questionnaires	June-December 2012
Side Event in COP 18	December 2012
Data analysis and collation	January-June 2013
Stakeholder consultations	June-August 2013
Release of CIRI index	September 2013
Dissemination Workshops	September-December 2013

CLIMATE TECHNOLOGY AND DEVELOPMENT PROJECT

Innovation systems in developing countries

Policy Brief

July 2012

Abstract

This paper provides a review of what every developing-country policymaker should know about low-carbon innovation. It explains what is unique about low-carbon innovation, why low-carbon innovation systems matter, and in what ways they need to be strengthened. However, building low-carbon innovation systems is a resource-intensive and long term endeavour, the outcomes of which are neither guaranteed nor predictable, and no single approach fits all national contexts. To mitigate the risky nature of building innovation systems, the public sector needs to provide financial support alongside private sector investments. Innovations emerge from a system of interconnected firms, (research) organisations and users all operating within an institutional environment that supports the building and strengthening of skills, knowledge and experience, and further enhances the interconnectedness of such players. Successful development and adoption of low-carbon technologies in developing countries depends on the presence of appropriate policies and innovation systems. Appropriateness means they are responsive to their local context in terms of available resources, comparative advantages, societal characteristics and cultural practices. Innovation skills and knowledge should be built in tandem with the adoption of low-carbon technologies and practices. An advantage for poorer developing nations stems from the weaker entrenchment of vested interests and less well established energy infrastructures. These provide opportunities for more easily steering development in low-carbon directions, avoiding the high-carbon pathways that industrialised countries have taken. International initiatives could help to build low-carbon innovation systems in developing countries, but they should align with national policies of countries in order to better enable self-determined low-carbon innovation.

INTRODUCTION

Many developing countries are already implementing policies and strategies that could help them shift to a low-carbon development pathway. The development and deployment of lower-carbon fuels, technologies and infrastructures are key components of these strategies. For decades, Brazil has been investing in a biofuels industry. Its transport sector is the only one in the world that does not depend exclusively on conventional oil. Hundreds of thousands of people are employed in the biofuel sector. In India, an indigenous wind turbine industry has been developing for over a decade. Suzlon started building wind turbines on a small scale in 1995, and has since grown to become the fifth largest global wind turbine producer, employing 13,000 people globally.

The Brazilian biofuels and Indian wind energy examples illustrate the potential benefits of low-carbon innovation. These benefits do not only include emissions reductions when compared to an energy pathway powered purely by fossil fuels. They can also include the development of local capabilities within these countries to develop and deploy low-carbon technologies.

The aim of this paper is to explain what is unique about low-carbon innovation, why low-carbon innovation systems matter, and how they can be strengthened. Focussing on the information-needs of developing-country policymakers, it provides a comprehensive overview of low-carbon innovation.

WHAT IS LOW-CARBON INNOVATION?

In common with innovation in general, low-carbon innovation encompases several stages including research and development (R&D), prototyping, demonstration, market-formation, commercialisation and deployment. The links between these stages are complex and non-linear. The scale and scope of innovation varies widely. In particular, there is a fundamental difference between incremental innovations which lead to improvements in existing products, and radical innovations which yield new inventions and/or methods of production (Freeman 1992). Radical innovations in different parts of the economy can lead to more pervasive and transformational change. The main difference with low-carbon innovations is that, by lowering carbon emissions, they reduce the environmental and social costs associated with using high-carbon technologies, which do not account for such externalities. The markets for low-carbon innovations, therefore, tend to remain weak unless specifically addressed by relevant policy that can force high-carbon options to internalise these externalities.

But incremental change is also an important type of innovation, and can make an enormous difference in low-carbon development. Indeed, incremental improvements can have more economic significance over long periods of time than radical innovations by realising repeated improvements in, for example, the efficiency of production equipment (Bell 2012). In developing countries, the benefits of adopting existing cleaner technologies can be pronounced, as in the example of the Korean steel industry adopting highly-efficient electric arc furnaces (D'Costa 1994; Gallagher 2006).

WHERE DOES LOW-CARBON INNOVATION OCCUR?

Both radical and incremental innovations occur in different settings throughout the economy: from production processes to business models; from large industries to small firms to academia; and from consumer-practices to government policies (Hoogma et al 2002). Innovation does not just entail technical changes but can also be social, political or cultural. This makes the range of actors in innovation wider, and the range of activities broader. Low-carbon innovation does not necessarily involve high-tech companies or universities (and this is particularly true in poorer developing countries). Rather, there is growing evidence that successful innovations also require changes in areas other than technical hardware. Therefore, a 'socio-technical' approach to the analysis of innovation is required – where changes in technologies are linked to changes in their societal context (Geels 2002). This is important to understanding why and when certain technologies are developed and adopted and others are not – a particularly pertinent concern if low-carbon technology development and adoption is desired.

'Innovation' is also often used to refer to the *process* of innovating, not just the outcome. This is important because it helps to highlight that innovations do not simply emerge from the activities of exceptionally talented or charismatic entrepreneurs (although entrepreneurs can be critical to the success of particular innovations: e.g. see Garud and Karnøe 2001). Innovation emerges from the activities of networks of actors who combine their knowledge, skills and resources in complex ways, as they seek to achieve their various individual and/or collective goals.

Box 1 Policy innovation in Indonesia

The CASINDO programme (Capacity development and strengthening for energy policy formulation and implementation of sustainable energy projects in Indonesia) aimed to build and strengthen institutional and human capacity for energy policy formulation and development of renewable energy and energy efficiency projects in Indonesia, both at the national and regional level.

Within regional governments in Central Java, North Sumatra, West Nusa Tenggara, Yogyakarta and Papua, and as stipulated by national law, institutional structures were created to formulate regional energy policies. Regional governments or private parties developed concrete renewable energy projects, supported by the regional CASINDO technical teams. In some regions projects for micro hydropower and/or waste digesters for biogas were implemented. New education programmes on sustainable energy have been developed and introduced at technical schools and universities to create conditions for continuation of capacity building in the longer term. Under these programmes, demonstration renewable energy technologies were selected, purchased and installed at their campuses.

Figure 1 Opening of a biogas installation at the Diponegoro University in Semarang in Central Java

The programme explicitly developed human capacity at the higher education level as well as at the technical level, as there is a need for engineers skilled at installation, operation and maintenance of renewable energy technologies. The project was staffed mostly with local stakeholders. The programme ended in May 2012. The activities initiated under the CASINDO programme are now continued by the CASINDO technical teams and the Indonesian government.

INNOVATION: ALL ABOUT SYSTEMS

It is important to think of innovation taking place within an innovation system. According to Chris Freeman, this system includes the “network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies” (Freeman 1987).

One of the many consequences of this complexity is that innovation outcomes are “irreducibly uncertain” (Gallagher et al 2012). Another is that new innovation systems take time to develop and their development is resource-intensive (Watson et al 2011). It is not possible to predict what specific technology variants, production processes and user-practices will emerge from a particular innovation system and, conversely, it is non-trivial to design an innovation system for a particular outcome. It is also difficult to predict how long the process of innovation will take. The history of low-carbon technologies shows that supporting them to commercial reality can take decades.

Governments can shape the extent and direction of innovation. Experience shows that policy interventions can have a very positive effect, although success requires carefully-designed policy. However, the outcome and level of success is also influenced by factors beyond the scope of governments. Examples such as the Danish wind industry, Brazilian ethanol, and the development and deployment of renewables in Germany show the benefits of ‘systems thinking’ in action (Jacobsson and Bergek 2004). These succcess stories are not only due to the implementation of particular market-creation policies (e.g. German feed-in tariffs). They are also due to a combination of high-level political leadership and legitimacy, and complementary policies focussing on areas such as grid access, local financing and industrial development.

How can low-carbon innovation be influenced?

Research indicates that the influence over the direction of innovations is crucial. It does, however, require an understanding of the enabling and constraining levers that policymakers can bring to bear in order to support low-carbon innovation.

A challenge is that many low-carbon innovations are at a pre-commercial stage of development. Policies therefore need to focus on R&D, demonstration, pre-commercial deployment, market-creation and early commercial viability (Ockwell et al 2008).

Different developing countries will have a range of strategic needs and priorities, comparative advantages, and national socio-economic and institutional structures that influence their innovation policies and strategies (Cimoli et al 2009; Sagar 2011). Considerations could include existing capabilities and skills, natural resource endowments and the potential for particular technologies to improve energy access. This diversity of strategies, combined with the stage of development of particular technologies, will influence the choice of policy interventions and the actors who should be involved (Gallagher et al 2011).

Using social processes for low-carbon innovation

Considering the social, cultural and political dimensions of innovation, and that it is users who adopt new technologies and practices, policy should not only focus on 'supply push' measures such as funding for R&D or demonstration. As the German renewables example mentioned above illustrates, they should also be concerned with 'market pull' measures to create demand for low-carbon technologies. Market-creation is a key function of government, and it is needed to avoid the social costs of using of fossil-fuels and to level the playing field for cleaner technologies. It should also be recognised that when users adopt innovations, they embed them in their lives and may even construct cultural meaning while doing so. The car is an iconic example in many contexts, where it has come to be seen as symbolic of individual freedom.

Conversely, cultural practices and meanings may prevent some innovations from becoming adopted. In Ghana, for instance, some of the benefits of bioenergy technologies might be foregone because of the social stigma associated with using human waste (Bensah and Brew-Hammond 2010). This means that it is important to include users in innovation processes. They can articulate their concerns, needs, wants and market demands – and this could make significant differences to policy strategies. Therefore, an understanding of the social context, and thereby how to leverage social processes to advance innovation, is an important complement to the technical aspects of innovation.

It is also increasingly recognised that consumers or users innovate beyond simply adopting ready-made technologies and practices (von Hippel 2005). Technologies, therefore, can either 'fit' or not with current practices. Alternatively, they can 'stretch' practices: that is, offer opportunities to develop new ways of doing things or new things to do (Hoogma 2000; Raven 2007). Analysing these fit-stretch dynamics could be critical to effective policy interventions, but this requires an understanding of innovation that goes beyond the currently dominant view that "innovation" refers to (radically new) technical hardware (Byrne et al 2012).

Box 2 Fit-stretch dynamics and solar technologies

Solar cookers offer a variety of benefits including reduced needs for biomass collection and lower health-damaging smoke emissions in the home. However, their widespread adoption at the household level is held back because they do not 'fit' well with a number of social and cultural practices prevalent in developing countries. For example, they can only be used during daylight hours, and in the open rather than inside a kitchen. Many subsistence farmers spend daylight hours cultivating their crops, and cooking in the open rather than in an enclosed space is a "major deterrent" to the use of solar cookers for some (Sesan 2012).

Figure 2 Solar cooker

Solar home systems (SHSs), in contrast, can 'fit' easily into current practices around the use of light while offering higher quality lighting than from kerosene lanterns. But SHSs also create opportunities for 'stretching' practices. For example, the small quantities of electricity generated by SHSs can be used to power TV, radio and mobile phones, all attractive because of what Jacobson (2007) calls their "connective" quality. That is, they enable people to connect to the world beyond their household.

Figure 3 Solar home system

POWERFUL EXISTING COALITIONS AND LOCK-IN

Because of the systemic characteristics of low-carbon innovation, policymakers need to be aware of broader sources of inertia which may hamper the effectiveness of innovation policies. High-carbon technologies, fuels and practices are often deeply entrenched in energy systems. The result is that these systems include powerful vested interests, meaning that the politics of change can be far from straightforward. In many countries, developing low-carbon energy systems is not only a case of supporting new technologies. It also means dismantling and replacing old high-carbon technologies, and challenging the institutions, interests, market structures and social norms that go with them.

Moreover, there are technological lock-ins. Long life-times of existing high-carbon infrastructure, countless jobs, expectations of modern life-styles, status of consumption and favourable regulatory environments evolve interdependently, together strengthening high-carbon lock-in (Unruh 2000). This presents an immense challenge to low-carbon innovation that leads to meaningful emission reductions. The relative lack of established high-carbon infrastructure in developing countries, therefore, presents an opportunity for low-carbon innovation.

Industrialised countries are finding it difficult to overcome carbon lock-in. Middle- and low-income countries also have industrialising sectors and a rising middle class that have – to some extent – embarked on high-carbon development pathways.

LOW-CARBON INNOVATION IN DEVELOPING COUNTRIES

The transition to low-carbon energy systems is a common global challenge. However, the starting points for low-carbon innovation in lower-income countries differ from those in industrialised countries. The less developed energy-provision infrastructures in poorer developing countries offer opportunities to pre-empt technological lock-in, and to bypass the carbon-intensive pathways that some industrialised and middle-income countries have followed. Also, the innovation systems in poorer countries for low-carbon technologies are often underdeveloped. At the same time, the financial, human, and institutional resources in these countries are often limited, thereby making the process of developing and strengthening innovation systems much more difficult.

In addition, addressing the needs of the energy-poor is urgent. Essentially, there are two takes on this: some suggest that the needs of the energy-poor could be met using cheaper high-carbon energy solutions now, without compromising greenhouse gas emissions reductions (e.g. see Sanchez 2010), while others consider the socio-technical nature of innovations and raise questions about whether such high-carbon development would simply lead to high-carbon lock-in, and would therefore store up difficult problems for the future (Byrne and Watson 2012). In many countries, though, low-carbon solutions (such as micro-hydro power generation) are already being used to enhance energy access for the poor.

SPECIFIC INNOVATION NEEDS OF DEVELOPING COUNTRIES

As we have seen, the successful development and adoption of low-carbon technologies depends on the presence of an appropriate innovation system with its host of supporting policies, activities and skills. Underpinning such innovation systems is the range of relevant capabilities (i.e. skills and knowledge) of important actors such as firms, research institutes and communities – and how these are connected together through market or other relationships. Many developing countries possess these capabilities in only weak or fragmented terms, and the systems of interconnection are often undeveloped (Gallagher et al 2011).

The national contexts of developing countries often differ considerably from those of industrialised countries. The innovation needs for low-carbon pathways in those countries are therefore also different. Table 1 (adapted from Sagar 2009) explains three areas of innovation-related activities where developing countries have distinct needs.

So, given the discussion of the need for strong capabilities and interconnections, a focussed effort on building and strengthening skills, knowledge, experience and interconnectedness relevant to low-carbon development is urgently needed. The development of a skilled workforce is a key pre-condition, and international experience in education or work will facilitate technology acquisition and export. But, the precise capabilities required in any particular developing-country context will depend on many factors and must be self-determined[1].

This in itself will require capabilities for making and implementing policy (Bazilian et al 2009). But, as noted above, the legitimacy of policies is important. This can be enhanced through participative approaches that will also require capabilities amongst civil society.

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[1] This stands in contrast to an extreme example in which a developing country chooses to deploy existing technologies which are obtained from foreign manufacturers and installed and operated by foreign parties. But self-determined innovation can operate at different levels. For example, it could mean that a developing country only innovates in certain areas such as in technology installation and operation. Or, it could mean attempts to move up the value chain to become original equipment manufacturers; the kind of trajectories cultivated in parts of Asia (Hobday 1995).

Table 1 Capabilities for technology and innovation

Adaptation and modification of existing technology	capabilities to appraise, select and support technology adoption capabilities to operate, maintain and further develop technologies once they are deployed
Addressing needs ignored by markets	capabilities to identify needs, to select and implement policies to support new markets
Joint R&D for long-term innovation capabilities	innovation capabilities: what, why and how they can be enhanced

It is also important to note that low-carbon innovation and development means more than just low-carbon electricity generation, distribution and use (Watson 2008). It cuts across all sectors and development strategies: e.g. transport, energy efficiency (in industry, commerce, agriculture, households), spatial and infrastructural planning, and the technologies and practices associated with other services such as education, water, sanitation, health, communications, waste, entertainment, leisure, and so on. Therefore, capabilities are requried to analyse needs comprehensively, and to prioritise the most important sectors, technologies and institutions.

IMPLICATIONS

National and international policies and instruments can play an important role in helping to build low-carbon innovation systems in developing countries that further human development. This is intrinsically linked with capacity building and technological cooperation – which are therefore core policy areas of the international climate and energy negotiations.

The context in which innovation takes place matters and will have important implications for efforts to build particular innovation capabilities and systems. For example, the innovations appropriate to industrialisation will tend to be different to those that service the needs and address the challenges of a rising middle class. The needs of the poor require policy responses that address the urgency of their particular problems, which tend also to be different to those of industrialisation and a rising middle class. Of course, there are interdependencies across these contexts. The process of industrialisation can generate innovations that provide technologies relevant to the needs of both the middle class and the poor, and can provide jobs that help to spread the income gains of the industrialisation process. Market demand expressed by the middle class, and perhaps even by the poor, can influence directions of industrialisation. But there are likely to be important distinctions too. For example, the poor may have little option but to adopt innovations based on price, while the middle class may have options to demand innovations that provide more sophisticated functionality or are status-enhancing.

Internationally-driven policy initiatives such as the Technology Mechanism of the UN Framework Convention on Climate Change (UNFCCC), and its associated Climate Technology Centre and Network (CTC&N), open up opportunities to help build low-carbon innovation systems of the kind described here. Likewise, other multilateral or bilateral initiatives such as Climate Innovation Centres (CICs) could also contribute to innovation system building in developing countries (Sagar 2011). However, it is important to remember that these will need to be aligned and synergistic with national policy frameworks if developing countries are to realise self-determined low-carbon innovation.

Interactions of this kind can be powerful, as demonstrated by the experiences of China around, most notably, innovation in the wind power sector (Watson et al 2011). Of course, we should be careful not to generalise too freely from the Chinese context to others but useful lessons are available from such experiences, as they may be from others such as in India and Brazil.

We will explore the context issues mentioned above in three seperate briefings over the coming months. Before doing so, we will focus on the UNFCCC Technology Mechanism and CTC&N in our second briefing. This we intend to release in August.

RECOMMENDATIONS

This briefing has highlighted aspects of innovation systems for low-carbon development that will be explored in detail in our future briefings and case studies. It leads to several policy recommendations.

First, it is important to understand innovation in broader terms than the introduction to the world of radically new technical hardware. This is innovation, of course, but is at one end of a continuum that stretches all the way to incremental changes of hardware and to the first adoption of such hardware by any market actor. Furthermore, innovations can occur in processes, techniques and practices of various kinds: social, cultural, political, and so on.

Second, it is crucial to recognise that innovations emerge from systems of interconnected actors – firms, (research) organisations and users – all operating within an institutional environment. This means that there are opportunities to influence the processes of innovation. Possible levers available to achieve such influence include implementing policies, laws and regulations to support low-carbon innovation. Policies should also be designed to ensure that the different kinds of players in the system are able to coordinate and collaborate to meet their individual and collective goals.

Third, low-carbon innovation encompasses the cultivation of indigenous capabilities to develop and deploy low-carbon technologies. These capabilities for low-carbon innovation must be built in tandem with actions to support the adoption of low-carbon technologies and practices in order to facilitate their long term sustainability. Moreover, low-carbon innovation capabilities need to be built in ways that are sensitive to the local context, exploiting comparative advantages such as existing research capacity, skills and local availability of natural resources. And, of course, the local context includes social and cultural practices that could impede or facilitate the development of certain innovations, whether addressing the needs of the energy-poor or a rising middle class. A focussed effort on building and strenghtening knowledge, skills, experience and interconnectedness is much needed in developing countries.

Fourth, there are different starting points for industrialised countries and lower-income countries taking up the global challenge of building low-carbon energy systems. The weaker entrenchment of vested interests and high-carbon energy infrastructures in poorer developing countries could provide opportunities to develop self-determined low-carbon innovations and circumvent the high-carbon pathways that industrialised countries have followed.

Fifth, international initiatives such as the Technology Mechanism of the UNFCCC, CTC&N and other initiatives such as CICs could contribute to innovation system building in developing countries. However, it is important to remember that these will need to align and be synergistic with national policy frameworks if developing countries are to realise self-determined low-carbon innovation.

Finally, international assistance for building low-carbon innovation systems must recognise that such an endeavour is both resource-intensive and long term. Outcomes cannot be guaranteed or predicted with complete certainty. It is therefore a risky, systemic undertaking that cannot be carried by the private sector alone. Public sector financial support is required to complement and assist private sector innovation, and to help create markets for the low-carbon energy technologies and services that are required.

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A full overview of data and assumptions is available from the authors.

Response to Call for Stakeholder Input by the UNFCCC Technology Executive Committee
July 31, 2012

The Business Council for Sustainable Energy (BCSE) represents the broad portfolio of existing clean energy business sectors, including renewable energy, supply-side and demand-side energy efficiency, natural gas and electric utilities in North America. The Council has represented the views of clean energy industries in the United Nations Framework Convention on Climate Change (UNFCCC) process since 1992.

In response to the UNFCCC's Technology Executive Committee's request, the Council would like to offer its comments in response to the following areas:

1) On technology road maps and action plans;
2) On ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the TEC could possibly play in this area of work; and.
3) On actions undertaken by accredited observer organizations relevant to the TEC in performing its functions

The companies and trade associations within the Council's membership offer their expertise and experience developing clean energy and energy efficiency projects in countries around the world as a resource to the TEC as it moves forward with its 2012-13 work plan.

1) On technology road maps and action plans

The Council would like to offer the following publications and materials as produced by two of its members – Johnson Controls and Center for Environmental Innovation in Roofing - as a resource to inform the process of creating technology road maps for clean energy industry sectors.

Driving Transformation to Energy Efficient Buildings, Version 2.0
http://www.institutebe.com/energy-policy/Driving-Transformation-Energy-Efficient-Buildings2.aspx

This policy toolkit, originally released at COP 17 in Durban, South Africa, was recently updated for the UNCSD Rio+20 Conference. This second-edition report reviews government policy options that can accelerate building energy efficiency improvements. New in this edition is a building efficiency policy assessment tool that provides a practical starting point for accelerating energy efficiency policy development. The tool offers a simple framework to help decision-makers set policy priorities with input from stakeholders. It outlines a workshop designed to support consensus-based, multi-stakeholder collaboration and uses visual tools to build consensus and prioritize building efficiency policy options and strategies.

This edition also includes new content on the private-sector's role and priorities around building energy efficiency, in particular describing how to create market conditions that support investment in energy efficient buildings and leverage private-sector capital, technology and services to scale up the market.

The publication was produced by the Institute for Building Efficiency at Johnson Controls, and in collaboration with the Business Council for Sustainable Energy, Center for Clean Air Policy, U.S. Green Building Council and World Green Building Council.

RoofPoint™ 2012
www.RoofPoint.org

RoofPoint is a voluntary, consensus-based green rating system developed by the Center for Environmental Innovation in Roofing (Center) to provide a means for policy makers, industry practitioners and building owners to select sustainable roofing strategies based on long-term energy and environmental benefits. RoofPoint outlines key, geographically appropriate strategies that address all critical environmental aspects of modern roofing systems and their impact on clean energy production and carbon reduction. Specific strategies include energy efficiency and renewable energy production, materials management, water management, and life-cycle and durability management. In addition to the continual improvement of RoofPoint, the Center is committed to making the program available to policy makers and practitioners in emerging economies.

2) On ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the TEC could possibly play in this area of work

The Council and its members believe that it is critical to invest resources and expertise into shaping enabling environments that will facilitate sustainable deployment of clean energy technologies. A suite of complementary policies and market structures, including effective and non-discriminatory financing mechanisms for technology transfer and deployment, non-discriminatory government procurement policies with respect to climate-change-related technology, and international trade regimes that promote cleaner, more energy-efficient and lower greenhouse gas emitting technologies, are necessary in order for clean energy technologies, products and services to take root. Furthermore, policies that reduce uncertainty as to potential gains that private business can anticipate from major research will enhance society's ability to achieve significant innovation in pursuit of a green economy.

As the Council represents different sectors within the clean energy industry, the Council recognizes that ultimately each technology often faces unique circumstances when trying to enter a new market. A particular industry may have different modalities for diffusion, as well as different financial needs and incentive structures, infrastructure constraints and end-user behaviors that must be addressed. At the highest level, however, an enabling environment that respects the rule of law, protects financial investments and provides a policy framework that creates an even playing field, is needed by all clean energy technologies.

Capacity building and the identification of technology needs and available solutions are other essential elements. The transition to a low carbon economy can not happen solely by government mandate; it also requires a partnership with the private sector and education of the general public. The Council is encouraged by the increased momentum to engage with the private sector, which today accounts for more than two-thirds of total investments in the research and development of adaptation and mitigation technologies, especially in regard to effective mechanisms for technology deployment, diffusion and transfer.

As the TEC examines through its work the key elements of enabling environments and barriers to technology transfer, the Council offers a fact sheet prepared for the technology discussions at the COP 17/CMP 7 in Durban. While this fact sheet references the Climate Technology Center & Network (CTC&N), its relevance to the TEC's work is that it provides a format through which the perspectives of private sector can be shared to demonstrate technology transfer in action and the necessary enabling environments required to do so.

BCSE Fact Sheet on Supporting Technology Transfer in Durban
http://www.bcse.org/images/2011International/bcse%20cop%2017%20technology%20fact%20sheet.pdf

3) On actions undertaken by accredited observer organizations relevant to the TEC in performing its functions

The Business Council for Sustainable Energy is a business coalition with twenty years of experience of coordinating industry expertise and providing policy input on behalf of the renewable energy, energy efficiency and natural gas sectors in North America. The Council's advocacy work and policy interventions have occurred at the state/regional, federal and international levels of government. As the Council is a coalition of companies and trade associations in these sectors, it can quickly disseminate information and solicit feedback from a broad network of voices from clean energy sectors. This network can also be extended internationally, as the Council is a founding member of the International Council for Sustainable Energy (ICSE), along with the Clean Energy Council of Australia and e5 of Europe. The Council offers the TEC the ability to connect to leading clean energy executives in the U.S. and abroad as needed, to review, comment and provide input on future materials produced by the TEC.

Additional information is provided in the requested templates.

Innovation and Green Growth: Enabling Environments and Role of the TEC

Nathan E. Hultman,[1] Katherine Sierra,[2] Allison Shapiro[3]
The Brookings Institution
Washington DC
July 2012

For many years, the international community has approached environment and development challenges through the lens of sustainable development—usually conceived as meeting the needs of the current generation while not sacrificing the ability of future generations to meet their own needs. While this approach has been constructive and successful in many ways, it lacks a clear pathway for how to realize those goals. As just one of many examples, addressing climate change will require fundamental transformations to the energy system that the IEA estimates could demand up to $46 trillion of additional investment by 2050;[4] in addition, more than ¾ of the total new energy investment will be directed to non-OECD economies. This capital that will come not from government development efforts but must be leveraged through new markets, new business models, and new policies.

"Green growth" seeks to establish the necessary pathway though a combination of private sector innovation and engagement within a supportive national and international policy context. It aspires to tackle three challenges simultaneously: encouraging development and poverty reduction; creating new and more vibrant economies based on clean technologies; and securing an increasingly greener world. Of course, tackling such challenges as climate change, energy access, environmental degradation, sanitation, and water availability while achieving economic and development goals will require unusually creative approaches based on new and profitable business models, novel approaches to financing, and innovation in our national and global institutions. Though not sufficient in isolation, green growth innovation will enable the advances toward goals in human health, natural resource sustainability, and social equity. Countries can also benefit from cultivating new green industries as a matter of domestic economic policy. Innovations in green technology therefore represent potentially transformational approach to some of the world's thorniest development and environment challenges—but realizing that potential will require creative approaches for vibrant private sector engagement.

What is green growth innovation?

As a result of more widespread economic development in recent decades, global capacity for research and development is evolving broadly across the developed world and emerging economies. However, building on this progress will require action to encourage new ideas across the diversity of development contexts, and to ensure that those ideas can reach and transform new markets. The challenge of transitioning onto cleaner development pathways is particularly difficult for developing countries, whose need for rapid economic growth often seems to outweigh the importance of "leapfrogging" onto cleaner development trajectories. Achieving the

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[4] International Energy Agency, "Energy Technology Perspectives 2010".

goal of sustainable economic development will require regional and international cooperation for implementation, supportive domestic policies, institutional capacity building, strong public private partnerships, long-term financing, and human capital development. In parallel, new mechanisms are needed to support the development and diffusion of intellectual property (IP) that can be shared with, and created in, developing countries along with enforcement mechanisms for its protection. Many existing initiatives have been launched to support this goal, but they have not achieved scale nor are they expanding at a rate sufficient to tackle the challenges.

Innovation for green growth can be characterized as frontier, adaptive, or absorptive (Figure 1). *Frontier innovations* are novel solutions that have not yet been introduced to the world. They are typically adopted in the research phase of the technology development cycle. *Adaptive innovations* are modifications to existing technology that make them more useful in alternative situations. They can occur across the technology development cycle. *Absorptive innovation* refers to changes to an institutional environment that make the transfer, successful implementation of, and learning from frontier and adaptive innovations easier. This applies to the final two stage of the development cycle. Examples of this type of innovation include in-country infrastructure for knowledge and device diffusion, regulations to support IP protection, and international agreements for technology transfer.

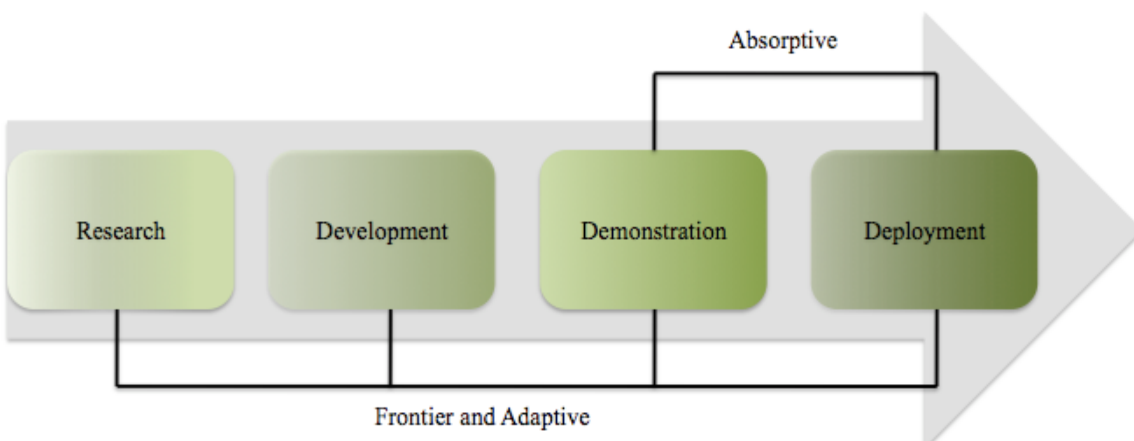

Figure 1. Types of innovation according to technology development phase.

When the term innovation is applied to technological change, it is often conceived of as a change to a product or service—e.g. a higher yielding seed, a more efficient delivery system, but it can also describe improvements in business model or process change. When applied to process change, however, innovation for technological development has perhaps its greatest potential for impact because it creates an environment supportive of continuous idea generation and R&D capacity. This in turn creates opportunities for commercialization and financial sustainability. In contrast to many preconceptions about innovation and technology, it is important to consider all types of clean technology R&D—frontier, adaptive, and adoptive—across development contexts, and, by extension to consider the approaches that might accelerate each.

Box 1. Examples of green growth initiatives in developing countries

- **Sustainable Energy For All:** an initiative launched by United Nations Secretary General Ban Ki-moon in 2012 ahead of the Rio Earth Summit, with the goal of mobilizing actors across a broad spectrum for urgent action to achieve three objectives by 2030:
    - Ensure universal action to modern energy services;
    - Double the rate of improvement in energy efficiency;
    - Double the share of renewable energy in the global energy mix.

  Although the initiative did not receive strong textual support at Rio +20, it is strongly supported by governments, the private sector, multilateral development banks (MDBs), and civil society groups. MDBs pledged over $30 billion toward the initiative's objectives, the US pledged $2 billion, and several countries pledged support for domestic action.

- **Lighting Africa Initiative:** a joint program of the World Bank and International Finance Corporation aimed at helping develop commercial off-grid lighting markets in Sub-Saharan Africa. With the objective of providing safe, affordable, and modern off-grid lighting to 2.5 million people in Africa by 2012 and to 250 million people by 2030, the program is mobilizing the private sector to build sustainable markets in Kenya, Ghana, Tanzania, Ethiopia, Senegal and Mali.

- **Green Growth Alliance (G2A2):** a G20 partnership initiative launched in 2012 with the goal of addressing the estimated $1 trillion annual shortfall in green infrastructure investment. The Alliance calls for actions to be adopted in five target priority areas over the next three years: promote free trade in green goods and services; achieve robust carbon pricing; end inefficient subsidies and other forms of fossil fuel support; accelerate low-carbon innovation; and, increase efforts to target public funding to leverage private investment.

Sources: United Nations Foundation (2012), Lighting Africa (2012), World Economic Forum (2012).

Trends in green growth innovation

To date, clean technology innovation has remained concentrated in higher income countries, though the direction of device transfer is shifting away slowly from its historic North-South directional flow. Technology innovation for the Base of the Pyramid (BOP) remains very low, regardless of country origin. With the exception of China, developing country clean technology patents have been limited to less than a dozen countries, and their share of total green technology innovation is actually on the decline. However, green patent trends indicate that a new tier of developing country innovators is emerging, joining Brazil, India, and China as frontier technology developers. This presents an opportunity for the international community to support the new tier of emerging economy innovators to develop frontier technologies for the BOP.

Several sectors have emerged in recent years as testing grounds for green growth innovation, with new technologies continually in development (see Figure 2). Technology patenting varies by sector and scale, just as it does between country income level and region. Within the sector of climate change mitigation technologies, between 2001 and 2010 the greatest share of patents in high-income countries was issued to advanced vehicle and waste-to-energy technologies. In developing countries, it was to wind and solar, which were the third and fourth most popular issued patent categories in high-income countries. Emerging economies are also beginning to pursue patents in technology sectors in which there had been no patent activity before 2001, such as advanced vehicles, biomass, and lower-carbon cement. This is a hopeful trend which suggests that the new tier of emerging economy innovators are not holding back from competing in sectors in which thay have no historical precedent as producers. However, the pace of green growth innovation in least developed countries (LDCs) remains very slow.

Sector	Example technologies
Electricity access	• Smart power grids • Indoor cooking stoves using renewable energy (i.e. solar, wind, etc.) • Off-grid technologies such as local wind turbines
Water management	• Desalinization plants • Waste-water treatment facilities
Climate change / reducing emissions	*Mitigation technologies:* • Smart power grids • Renewable energy technologies: wind, solar, geothermal, marine energy, biomass, hydro power, etc. • Electric and hybrid vehicles • Carbon capture and storage *Adaptation technologies:* • Higher yield seeds (for more arid and saline soils) • Drought resistant crops and cultivation practices • Climate resistant infrastructure: sea walls, drainage capacity, water, forest and biodiversity management, etc.
Transport	• Bus Rapid Transit (BRT) • Low emission vehicles and fuels: biogas, hybrid and plug-in electric vehicles
Building energy efficiency	• Smart power grids & smart meters • Thermal insulation • Energy efficient lighting: energy-efficient compact fluorescent lamps, electroluminescent light sources (LED) • Energy recovering stoves using Thermo Electric Generators
Agriculture	• GM crops • Mechanical irrigation and farming techniques

Figure 2. Key sectors and technologies for green growth innovation.

Example: Investment and R&D in the Global Renewable Energy Sector

In terms of the scale of technologies, we can look to renewable energy financing data for some illustrative examples. UNEP and Bloomberg New Energy Finance estimated that about $268 billion USD were transacted in the RE sector in 2010, of which $211 was new investment (Figure 3). This number is estimated to have reached $263 billion in 2011,[5] a roughly 25% increase over the 2010 global figure. Distributed energy technologies have garnered an

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[5] Alex Morales. (2012). "Renewable energy investment in quarter plunges to three year low." Published in Bloomberg BusinessWeek, April 12, 2012.

increasing share of global renewable energy investment dollars over the past several years. In 2010, just over one-quarter of total renewable energy investment went to distributed technologies. The vast majority went to developed countries. This is largely due to domestic policy investives for solar PV in Europe. (In fact, 57% of distributed energy investments in 2010 were spent in Germany alone.) The amount of investment in utility-scale energy companies and projects was roughly equal between developed and developing countries in 2010.[6]

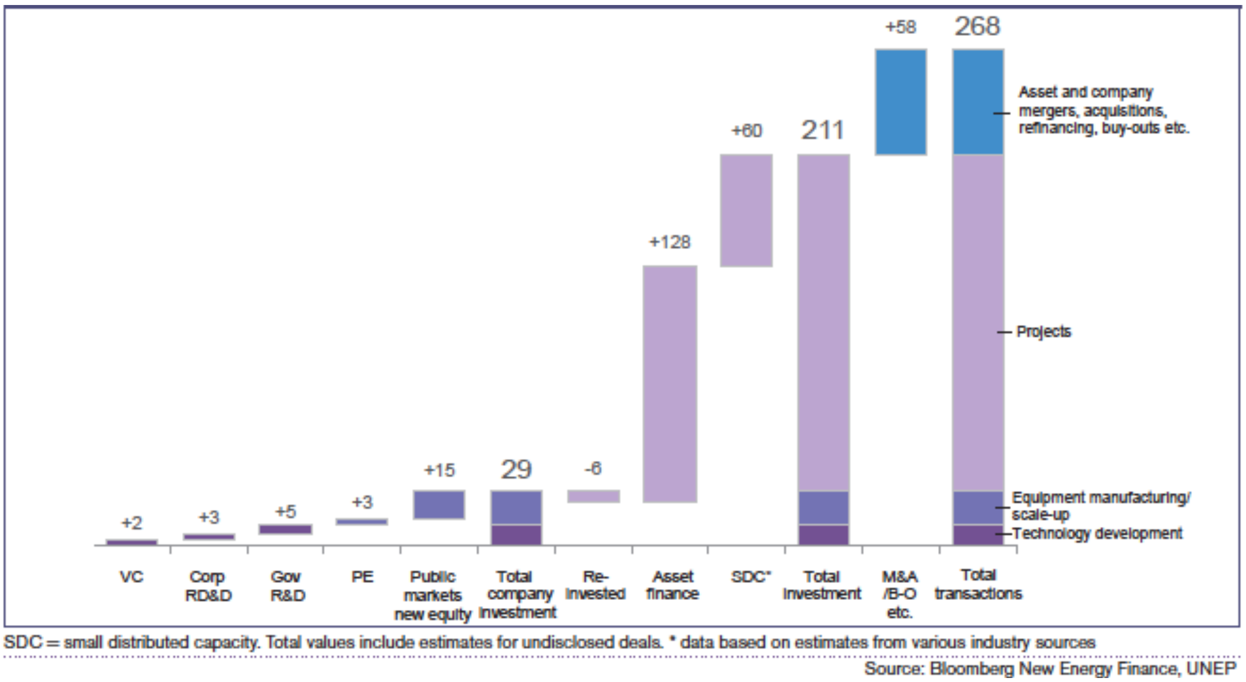


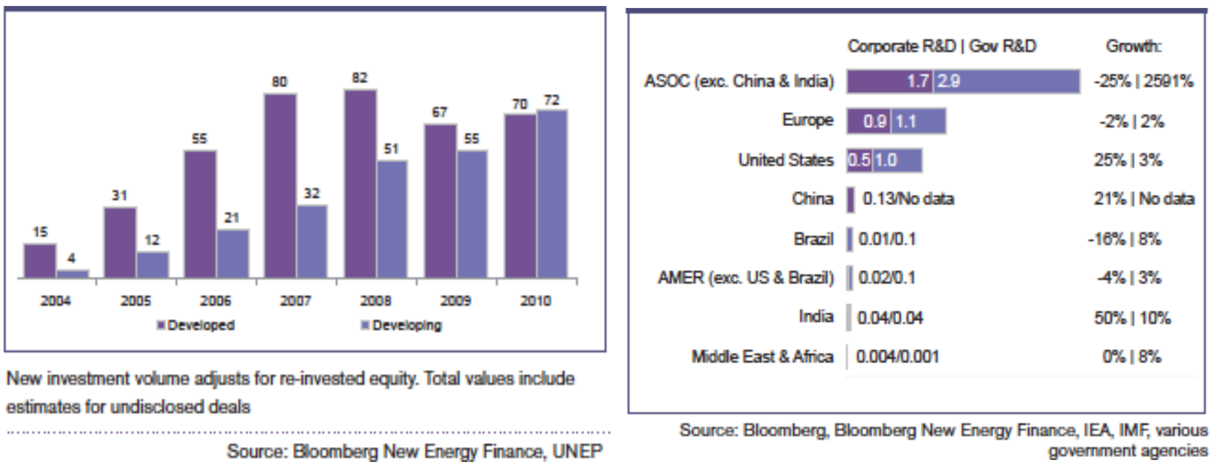
Figure 3. UNEP/BNEF Estimates for 2010 Global Renewable Energy Transactions (billion USD).

Notably, in 2010 the investment in renewable energy in non-OECD countries for the first time exceeded that of developed countries ($72 billion vs. $70 billion, see Figure 4a). Development bank finance contributed at least $13 billion in project finance, mostly in the form of concessional loans. That year, investment in Africa rose five-fold, in Latin America it rose nearly three-fold, and in Asia it rose 31%. However, 83% of developing country renewable energy investment that year went to the three largest emerging economies—China, India, and Brazil—and the vast majority was spent on asset finance, not R&D. Furthermore, despite the tremendous increase in investment in Africa, total new financial investment in renewable energy remains very low ($3.6 billion in 2010) on the continent.[7]

R&D investment across all sectors of the economy reached $1.3 trillion in 2011 across all sectors, green growth and otherwise. This is a 17% increase since 2008. Investments were led by the

[6] UNEP, Bloomberg New Energy Finance. (2011), Global Trends in Renewable Energy Investment 2011: Analysis of Trends and Issues in the Financing of Renewable Energy. p. 44
[7] BNEF, UNEP (2011), p.14.

United States (34%), China (13%), and Japan (12%).[8] All other countries outside of these three, the European Union, and India accounted for only 3% of general R&D spending in 2011. However, U.S. dominance of R&D investment spending is shifting toward the major Asian economies and Brazil. Economic and technological capacity growth in the largest emerging economies, particularly India and China, have also created a trend of reverse flow of R&D investment from emerging to developed nations. Still, R&D spending as a percentage of GDP remains in the low single digits across all countries (average: 1.9% in 2011).



(a) *(b)*

Figure 4. UNEP/BNEF Estimates for Trends in Renewable Energy Support (a) Financial New Investment in Renewable Energy (billion USD), developed vs. developing countries; (b) Corporate and Government R&D for Renewable Energy by region (billion USD), 2010, and growth on 2009. Source: UNEP/BNEF 2011.

However, renewable energy R&D investments have not been keeping pace. In 2011, only 4% ($9 billion) was spent on R&D, despite alternative energy R&D investments more than doubling between 2004 and 2010.[9] Furthermore, excluding the stimulus boosts, global investment in energy RDD&D in the OECD countries has actually only marginally increased in real terms since 1974.[10] Additionally, global renewable energy investment in the first quarter of 2012 was at its lowest level since the height of the recession in early 2009, signaling a global decline public financing of alternative energy with the expiry of stimulus programs.[11]

With regard to renewable energy R&D investment, in 2010, the largest regional investors were Asia and Oceania, which accounted for just over half of global R&D investment in renewable energy that year (Figure 4b). Most R&D financing came from the public sector, as corporate

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[8] Batelle, R&D Magazine (2010). "2011 Global R&D Funding Forecast." December 2010, p.3.
[9] UNEP, Bloomberg New Energy Finance (2011). Global Trends in Renewable Energy Investment 2011, p.13.
[10] Tom Kerr (2010). *Global Gaps in Clean Energy RD&D: Update and Recommendations for International Collaboration.* International Energy Agency report for the Clean Energy Ministerial, p.8.
[11] Morales (2012)

R&D budgets shrank in the wake of the financial crisis. Early stage-VC financing rose 41% to $930 million in 2010. By technology type, solar received the largest share of any technology type.[12] Biofuels received the next largest share, followed by wind. Though it continues to receive a tiny share of global R&D investment, marine energy saw the greatest investment growth of any clean energy technology type in 2010.

Catalyzing new approaches

As companies increasingly incorporate social equity into their sustainability agendas, and as growth opportunities in emerging markets continue to outperform those in developed countries, corporate interest in innovation for emerging economies can be expected to increase, yet investment in innovation for the BOP remains largely non-existent. Therefore, a major question for the sustainable development agenda is how to incentivize green BOP innovation from the private sector. Many policy and IP tools exist to promote behavioral change and spur technological innovation, though they vary widely across countries. In addition, dozens of financial products have also been created to diffuse and reduce risk in technology investment. Hundreds of initiatives exist to promote natural resource sustainability and poverty alleviation in developing countries. However, major gaps remain in international collaboration for poverty alleviation.

New green innovation initiatives or partnerships might hasten the pace and scale of innovation, stimulate international venture capital markets, and broaden international cooperation across public and private partnerships for R&D, demonstration, and deployment. The gaps in green growth innovation where private sector investment could have a substantial impact include:

- Facilitating South-South collaboration
- Enhancing greater North-South collaboration
- Encouraging greater frontier innovation in the new tier of emerging economy innovators
- Supporting adaptive innovation for the BOP from all countries
- Investing in support for absorptive innovation in all countries
- Providing business advisory support to developing countries
- Increasing financing for IP-sharing and financial products to de-risk entrepreneurial investments

Of these, least commonly supported areas are long-term finance, business acceleration, frontier and adaptive BOP innovations, and South-South collaboration.

New approaches to green growth innovation would both build capacity for technology development and adoption and encourage private sector engagement in developing country research and innovation for green growth. The most effective approaches should reflect all of the following factors:

- **Relevance to the challenges of green growth.** The ideal international architecture will be able to support breakthrough technology development at small, medium, and large scales.
- **Capability of stimulating frontier, adaptive, and absorptive innovation.** Adaptive innovation could be the key to meeting many LDCs' clean development needs, and

[12] BNEF, UNEP (2011), p.33.

absorptive innovation programs could be encouraged throughout the developing world. Policies to stimulate absorptive capacity must increase the quality of higher education, retain talent in-country, stimulate technology "discovery" at all levels of innovation (from household through the research laboratories), and promote economy-wide openness to new technologies.

- **Support for innovation across the technology value chain.** Technology deployment can be encouraged via financial support, logistical support for supply chain development and security, and consumer marketing to improve market penetration. This includes substantial investment in business advisory services to attract international venture capital and to take successful start-ups to full commercial scale.
- **Financial innovation to de-risk private investment.** Innovative financial products can leverage public investments by de-risking private capital. Examples include first loss funds, sovereign risk insurance, collateralized loans with flexible interest rates dependent on project outcomes. There are many funds that support this objective (i.e. the Clean Technology Fund of the Climate Investment Funds which provides project support) as well as recent initiatives that are looking to scale this up by tapping into private capital. To date, most of the funding has gone to support deployment of proven technologies in developing countries. Little focus has been on providing de-risking support for earlier stages of the RDD&D continuum.
- **Value addition to existing institutions.** Any new approaches should be complementary to existing international initiatives that aim to stimulate clean technology RDD&D such as the UNFCCC Technology Mechanism, CGIAR, Clean Energy Ministerial, the Green Climate Fund, and Infodev Climate Innovation Centers. It will be important to understand not only the gaps in services provided by these organizations but also the programs that have been most successful so they can be replicated in other countries and to other sectors.
- **Attractiveness to investors, policymakers, and developing countries.** In this era of fiscal austerity, it will be essential to create an infrastructure with sufficient incentives to leverage public financing from developed countries and have real rewards to the private investors.

While there are many concrete possibilities, jumpstarting the green innovation ecosystem in any given country context will require an approach across all aspects of the innovation spectrum. This implies a need to cultivate technical knowledge, to encourage and foster the existing entrepreneurial culture, and to connect entrepreneurs to financing. Figure 6 presents this "three part challenge" for jumpstarting the green innovation system. A system to address these three issues could work through universities, research organizations (both for-profit and and non-profit), academic institutions, and start-ups to reach individual researchers, financiers, and budding entrepreneurs. This network would be complemented by a set of funds to deploy risk capital for the diffusion of technologies that have been proven at the demonstration stage.

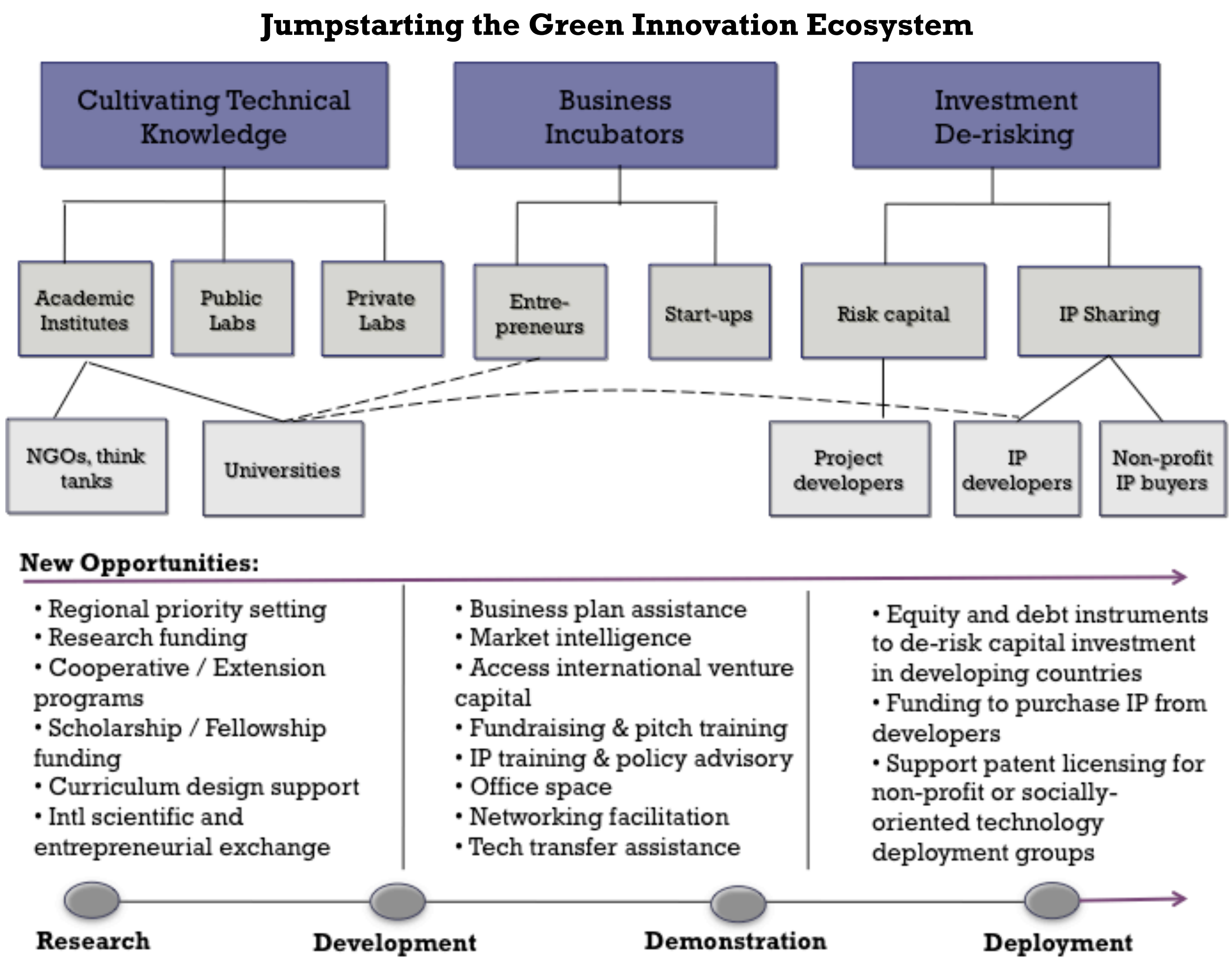

Figure 5. A Three Part Challenge for Jumpstarting Green Innovation

Role of the New Technology Institutions under the UN Climate Agreements

The UN climate change negotiation process has long recognized the fundamental importance of technology and innovation, and now has an opportunity to contribute to the wider goals of supporting innovation capacity. While "technology" has historically been construed within the framework of technology transfer, new technology policies and institutions initiated in Cancun provide an opportunity to bolster the innovative systems in emerging and, particularly, developing economies. These new approaches are embedded in the Technology Mechanism and the Technology Executive Committee. In building out the new institutional architecture for the Technology Mechanism, the TEC can be particularly helpful in providing an overview of the areas most likely to benefit from policy intervention and to set the strategic direction for supporting the innovation ecosystem across diverse development contexts. Specific approaches to this agenda could include but are not limited to:

- Conducting a systematic and comprehensive survey of institutions to support innovation and identifying existing programs that could become partners or affiliates;

- Identifying, through both consultation and independent analysis, gaps in the existing international architecture to support the innovation ecosystem as well as examples of success in supporting innovation in diverse development contexts;
- Holding workshops at regional levels to catalyze discussion and action in at least the three areas identified above: cultivating technical knowledge; supporting business and entrepreneurship in low-carbon and adaptation technologies; and strategies for IP management and investment de-risking.
- Establishing a solid, regular, and reliable data and reporting system for funding, programs, and national policy goals to support climate and energy innovation.

Conclusion

Green growth provides a route for realizing the economic, environmental, and development goals. It offers an opportunity to make existing heavy industries more sustainable while simultaneously encouraging new industries and economic diversification. Central to this green growth strategy is technological innovation and the establishment of of creative, integrated, private and public sector approaches to support innovation in developing countries. It is therefore necessary to:

1. Expand the scope of innovation support to BOP and low-margin innovations
2. Work creatively to better understand and address the challenges of IP sharing
3. Pioneer new business models and financing structures
4. Cultivate a broad-based technical knowledge in both emerging economies and LDCs
5. Create a support structure to enable entrepreneurs to expand their own expertise and access to networks

Indeed, without these creative approaches and the new technologies and market transformations they entrain, we almost certainly will not be able to realize the goals of universal access to clean energy, water, and sanitation, or broader environmental goals for climate stabilization and biodiversity protection, while encouraging economic growth and vitality across the spectrum of development contexts.

Appendix: Developing country green growth gaps and options to alleviate them, based on Brookings Institution analysis.

Gap	Geography	Options
North-South collaboration	All countries	• *Stronger IP regimes to support strategic research partnerships, joint ventures, cross-border enterprise development* • *Dedicated funds, challenge programs requiring North-South collaboration* • *Opportunities for international study – grants, scholarships, etc.* • *Financial de-risking instruments to encourage foreign investment*
South-South collaboration	Developing, emerging countries	• *Regional science foundations to identify common needs, pool funding, and avoid research overlaps* • *Strengthen top-performing university networks* • *Scientific and entrepreneur study abroad programs, dedicated ODA* grants*
Frontier innovation for the BOP	New tier of emerging economy innovators	• *Dedicated international VC funding and risk capital for developing country start-ups, challenge/prize programs* • *Training for developed country firms in understanding BOP needs, conducting demonstration tests, and developing supply chains* • *Formal extension/ cooperative/ internship programs for university students*
Adaptive innovation for the BOP	All countries	• *To encourage BOP innovation from developed countries: Govt.-funded R&D, subsidies, advanced market commitments, compulsory licensing, open-source innovation, patent pools bilateral and multilateral market access agreements, applied research networks* • To encourage BOP innovation in developing countries*: Dedicated ODA funding to LDCs, national and community-level technology "discovery" programs, higher-education networks, strengthened IPRs, challenge programs, advanced market commitments, applied research networks*
Adoptive innovation	All countries	• *Financial support for early adopters, enterprise training programs* • *Adoption incentives: subsidies, tax credits, feed-in tariffs*
Business advisory support	Developing, emerging countries	• *Business services: Incubation centers, business education at technical universities, business plan competitions, deployment-focused "study abroad" programs for professors and university students, community demonstration competitions, networking events and online collaboration tools*
IP sharing and implementation assistance	Developing countries	• *Financial incentives to encourage sharing of patent information and provision of implementation assistance* • *Non-financial incentives to do the same (patent commons, patent pools, professional "exchange" programs for implementation advisory)*
Long-term financial support	Developing countries	• *Financial products to de-risk investments in technology development in developing countries (e.g. first loss fund, sovereign risk insurance, concessional loans, etc.)*

CAN Submission to the Technology Executive Committee Meeting Bangkok, Thailand 6-8 September 2012

28 July 2012

Tackling the Intellectual Property Elements of an Enabling Environment for Technology Transfer

Climate Action Network-International (CAN-International) is the world's largest network of civil society organizations, with more than 700 members in over 90 countries, working together to promote government action to address the climate crisis.

Executive Summary

Climate Action Network International (CAN) concurs with the apparent consensus at the third Technology Executive Committee (TEC) meeting (held on the 28th and 29th of May in Bonn) that intellectual property rights (IPR) is an issue in the transfer of climate technologies that could be an incentive, a barrier, neither or both. Furthermore, the determination of which role it plays can only be made at the national/sectoral level on a case-by-case basis. There are cases where IPR has been and *can* be a barrier and some parties are concerned that it will be a barrier to the transfer of key climate technologies to help mitigate their emissions and enhance their adaptive capacities. On the other hand, technology developers are concerned with the intellectual property enforcement risk in developing economies and potential negative impacts on innovation. In the absence of some guidance on key issues related to IPR from the Technology Mechanism (TM), countries and providers would be left to deal with each IPR issue that arises from scratch, stalling and even derailing much-needed technology deployment.

But the UNFCCC can play a critical role here to ensure that countries have the tools they need to find resolution in a case where IPR issues threaten to pose a barrier to the transfer of a key climate technology while ensuring that appropriate incentives for technology innovation are maintained. By providing appropriate guidelines on the use of existing tools and a platform to facilitate various forms of information sharing on IPR solutions among other initiatives, the UNFCCC has the opportunity to proactively prevent IPR from becoming a widespread barrier while building confidence in the TM among both demanders and suppliers of climate technologies.

CAN recommend:

1. *The adoption of a COP Decision for a declaration on climate change and intellectual property that existing international flexibilities on patents, plant varieties, and copyrights especially relating to competition law, compulsory licensing, exceptions and limitations must be interpreted in ways conducive to enabling rapid and efficient uptake of technologies to address mitigation and adaptation. In addition support for public-private partnerships and bilateral or multilateral research initiatives, such as joint R&D projects without patents, can also enable the development and diffusion of technologies.*

2. A COP mandate to the TEC to provide clear rules and regulations that will ensure that UNFCCC support for 'incremental costs' includes those associated with purchase of IP protected products and IP licenses embodying best available technologies;

3. A COP mandate to the TEC to establish a Consultative Group on IPR (CGIPR) in conjunction with the Climate Technology Center and Network (CTCN) that would help countries and private sector stakeholders evaluate whether IPR barriers to the transfer of their desired technologies exist and, if so, to help them to find resolution.

4. A COP mandate to the TEC to establish a set of criteria for technology prioritization based on Technology Needs Assessments, patent status, and a set of objective criteria for greenhouse (GHG) mitigation potential and effectiveness at building adaptive capacity.

In addition to these general recommendations CAN also makes the following specific recommendations on the distribution of products and knowledge:

A. Distribution of Products:

In accordance with a COP mandate the TEC should

1. Develop and make available through the CTCN and Regional networks ***Model Licenses for Least Developed Country (LDC) Market Segmentation*** *that would allow LDCs to access technologies at a lower cost but also set limits on the export of goods produced under such licenses to non-LDC parties so that the benefits are well-targeted**;***

2. Design or designate a ***business-to-business (B2B) platform for commercial transactions related to climate change mitigation and adaptation products and goods, especially for public domain products;***

B. Distribution of Knowledge:

1. In accordance with a COP mandate the TEC should develop and distribute through the CTCN and Regional networks ***Model Licenses for LDC Market Segmentation*** *to ensure affordable access to technologies and knowledge for LDCs;*

2. The UNFCCC should require that R&D funding by any UNFCCC financial mechanism establishes joint intellectual property rights for the UNFCCC, through the TEC and/or CTCN as its authorized representative.

3. The TEC should design, or designate an ***Intellectual Property Exchange*** *specifically for climate change mitigation and adaptation technologies. Such an exchange would enable secure, efficient and transparent arms-length transactions for intellectual property licensing at a one-stop shop, with a range of standard licenses that can be pre-designated by rightholders.*

CAN concludes that these actions are both urgent and necessary to ensuring the successful operationalisation of the TM and to transform the patterns of technology deployment required to shift markets from niche providers and consumers, to mass providers and mass consumers, across borders which action represents our best hope for meeting the agreed 2°C goal, and for keeping the door to 1.5°C open.

CAN hopes that consideration of these actions is undertaken at COP 18.

I. Introduction

We thank the TEC for the opportunity to provide input on the important topic of enabling environments for the transfer of environmentally sound technologies. We look forward to continuing openness and inclusion of the contributions of civil society to the work of the TEC. We fully support the TEC in its endeavor to provide concrete and achievable recommendations to COP18 on what the COP can do to nurture such environments.

Due to the limited time available before the COP18 deadline, this CAN submission focuses on the issue of IPR. We have chosen this focus because it is has been highlighted by some countries as a possible barrier to the transfer of mitigation and adaptation technologies and because action on IP offers the UNFCCC an opportunity to make quick strides to improve country trust in the TM and to re-balance the discussion towards supply-side measures ('push' policy measures that can be taken by countries to encourage their rightholders to export technological products and license technologies).

The TEC should not interpret from our choice that we have no interest in other matters related to enabling environments. We look forward to further engaging with the TEC on other topics in the broader discussion of enabling environments, including demand-side measures, within the framework of UNFCCC Articles 4.1c, 4.3, 4.5 and 4.7.

Our approach: Addressing both demand-side and supply-side constraints

This submission aims to focus on achievable, near term solutions with concrete timelines rather than to rehash old debates. While important longer term action may require re-structuring and renegotiating international treaties, the near term recommendations from CAN will focus on solutions that do not require complex and distant time-horizon processes for treaty negotiations.

CAN believes that it is important that the "enabling environments" discussion is an opportunity to promote positive action on core issues relating to technology transfer such as IPR. We must address not only demand-side constraints (on the ground conditions in countries that make rightholders reluctant or unlikely to export technological products or license technologies into a specific domestic market) but also those on the supply-side (largely in developed countries). We must also acknowledge that IPR policy measures on both the supply-side and demand-side take place in the broader context of ongoing dynamic shifts in the location and the flows of technology; and in an existing governance framework established by the UNFCCC. This requires a recognition that:

- Technology product and knowledge flows increasingly move South-to-North and South-South even while these remain a small part of overall global flows. For example, South-South flows of renewable energy technology are at a very low level, the lowest among the four South-to-North vectors of flows.[1] However, these have been increasing since 2002 and are likely to grow as more developing countries put in place policies that create demand for such technologies;
- Actions to enable demand-side measures (see below for the types of measure) may bear costs, costs which may need to be offset within the framework of UNFCCC Articles 4.1c, 4.3, 4.5 and 4.7, and especially on the basis of poverty and vulnerability with the poorest and most vulnerable populations and their public or private sector actors receiving full amelioration of those costs.

While this document will focus on supply-side measures (specifically, intellectual property-related supply-side measures), we note that demand-side measures are also a necessary, though not sufficient, part of a portfolio of

[1] p573, IEA, *Energy Technology Perspectives 2010: Scenarios and Strategies to 2050*, (Paris: IEA/OECD, 2010) – Figure 15.3. However, in specific markets such as solar panels, countries such as China are now the major products exporters both to developed and developing countries.

policies and measures that must be put in place to enable technology transfer. Strongly linked to making intellectual property-related interventions most effective are demand-side measures such as:

- The creation of predictable, stable and transparent environments for financial transactions, contracting, licensing, and dispute settlement. This is necessary to reduce both the perception and the reality of sovereign risk. However, it may be inappropriate to ask countries to reduce policies aimed at enabling technology spill overs and learning as these are a main goal of technology transfer policies. Without these, learning in the broader economy may not take place at a pace sufficient to build endogenous capacity into adaptable, GHG reducing patterns.
- Assurance of predictable, stable and transparent protection of intellectual property consistent with national policy needs and international obligations;
- Implementation of market creation measures that establish some form of carbon price and stimulate demand for GHG reduction technologies;
- Implementation of market support measures to reduce the costs of adopting GHG emissions reduction technologies and invest in climate resilience for the long term; this may involve subsidization for purchase of technologies and technological goods, either through direct cash transfers or through after-purchase tax mechanisms; as well as support for research and development of locally appropriate technologies;
- Immediate reduction of fossil fuel production subsidies and more gradual reduction of fossil fuel consumption subsidies commensurate with ensuring energy access for the most vulnerable;

Implementing such demand-side measures clearly bears a cost either directly financial or through imposing regulatory burdens on domestic actors. The success of these demand-side measures also requires the existence of willing providers of both technological products and knowledge, willing to sell at a price significantly above marginal cost of production or investment but not so high as to make rapid adoption of technologies economically unviable. It is this supply-side element that we plan to focus on in this submission driven by one key question:

What can the UNFCCC do to help each country achieve greater market penetration and adoption of climate mitigation and adaptation technological products and knowledge at a price that makes technology adoption economically viable and at a speed that will meet the climate challenge of peaking before 2015.

II. Understanding the role of Intellectual Property

In order to properly frame the solutions that CAN will put forward, it is important to clarify a significant range of rights that are implicated, including: Patents, Utility models (sometime called petty patents); Trade secrets; Industrial design protection; Plant breeders rights or Plant variety protection; and Copyright – for software protection especially as related to efficiency in appliances as well as smart metering. The existence or use of IPR may reduce competition (at both the product and the knowledge level), maintaining high prices for a product above marginal cost of production as the IP owner has no incentive to lower the price of the product or knowledge, make it more competitive or allow others to reproduce or use it. Thus, intellectual property is a trade-off between present (static efficiency) anti-competitive costs and the generation of future technologies (dynamic efficiency).

Governments are constantly assessing the appropriate balance between static and dynamic efficiency and use several tools to shift the balance in one direction or another depending on specific policy goals and needs at a particular time. The tools that they use to do so include compulsory licensing, working requirements, patent exceptions, patent exclusions and the broad application of competition law to restructure markets in technological knowledge and technological products. However, the appropriateness and effectiveness of these tools to address technology transfer is conditioned on an understanding that:

- The market for technological products is markedly different from the market for the technology/knowledge embedded in products.
- The key problem related to distribution of goods is that prices of products (e.g. household appliances; software programs; seeds) may be set so high that they make it uneconomical to adopt climate mitigation and adaptation technologies.
- The key problem related to distribution of the technology/knowledge is: refusals to allow others to reproduce or use the knowledge; or setting the price of accessing the knowledge at such a high price as to make it uneconomical for others to participate in the market.

Certain types of behaviour (such as anti-competitive tactics, refusals to deal, exercising monopoly pricing, abusive litigation, patent trolling, undue claims etc.) of individual IPR holders can pose a barrier to technology transfer but the existence of such barriers can only be truly determined at the national level in the specific market sector. Thus the key question in determining whether the international intellectual property framework poses a barrier is:

Do countries have the requisite tools to address situations where the acquisition and use of IP by an individual or group of intellectual property holders poses a barrier to transfer of a key climate change mitigation or adaptation technology in their domestic market?

This question is applicable across all types of IPR but the issue is clearest in relation to: the TRIPS Agreement, especially for patents, copyright for software/databases and protection of plant and plant varieties; the International Convention for the Protection of New Varieties of Plants (UPOV 1991) in relation to farmers rights to save, re-sow and re-sell seeds; the WIPO Copyright Treaty, for software and databases.

Countries have historically used variations of tools to correct the market imbalances caused by the behaviour of individual rightholders, or to remove the ability of such actors to prohibit certain kinds of actions in areas of core public interest or vulnerability. Such tools have historically included:

- Compulsory licenses;
- Working requirements;
- Parallel imports;
- Research and other exceptions; e.g. humanitarian use exemptions particularly for adaptation-related technologies/know-how
- Technology transfer and other performance requirements to qualify for foreign direct investment; and
- Application of competition law.

This submission concludes that while some of these tools remain available, the international system of rules on intellectual property (the TRIPS Agreement; UPOV 1991; the WIPO Copyright Treaty) place such limits on their exercise that they are unable to be used to effect the kind of sectoral and economy-wide market restructuring required to enable countries to access technology at a sufficiently rapid pace to ensure peaking of emissions before 2015 and to enable the building of sufficient adaptive capacity by the 2025 horizon for vulnerable countries who are already experiencing and will continue to bear the brunt of the effects of increasingly extreme climate variability. In addition, unilateral actions and threats by some countries have had a significant chilling effect on countries' ability to use the existing flexibilities freely as part of industrial policy.

At the general level for example, while TRIPS has many existing flexibilities, both individually, and in the aggregate, they are limited in what they can address especially to manage broad issues such as market structure in IP licensing of technologies. At best, they are capable of dealing with the distribution of goods/ products problem, but remain largely unavailable to address issues relating to market structure and distribution of knowledge. The main flexibility and option that appears most available under the TRIPS Agreement is to apply the rules of competition law to the market behavior of rightholders since TRIPS does not restrict the use of competition law to structure knowledge and product markets.

As such, the UNFCCC should take action to:

- reduce transaction costs, transaction risks and price barriers for technology providers and technology adopters;
- mitigate the lack of flexibilities in the international IP system by encouraging the use of mechanisms to:
    - Enable specific forms of licensing with favourable terms for LDCs and other developing countries;
    - Enable measures to de-link innovation and distribution of technologies from pricing mechanisms, such as prizes, advanced market commitments, and public funding of research and development; and
    - Provide purchasing power where it is missing.

III. What solutions from the UNFCCC?

In suggesting actions that the TEC should recommend to the COP, CAN have taken into account that:

- Solutions must encompass technologies not just to address mitigation, but adaptation. In particular, adaptation must be addressed in its two core dimensions:
    - Increasing adaptive capacity, through poverty reduction and economic development;
    - Providing measures to adapt to specific climate challenges, such as floods and droughts.
- Technology transfer for adaptation must address itself to the broad range of technologies necessary to ensure rapid but sustainable development in the near term.
- The near term peaking requirements (before 2015) for emissions as well as the requirement for rapid increases in adaptive capacity suggests the need for a radical transformation in the existing structure of technology markets in the period to 2020. The patterns of deployment required suggest that markets in technology will have to shift from niche providers and consumers, to mass providers and mass consumers, across borders. This will require predictable, stable and transparent markets with simple rules, pricing and valuations, at a cost closer to marginal price of production than now exists, at least for existing and near term technologies. For technologies that will need to be developed, the route from research and development to mass market will have to be sped up, and rewards for innovation may need to be somewhat de-linked from pricing mechanisms in order to achieve rapid uptake of technologies that may still need to compete against existing lower cost but GHG intensive or maladaptive alternatives. For rightholders, this may entail lower profits per unit of technology, but higher profits overall due to increase in volumes sold.
- Solutions should prioritize the special needs of LDCs (article 4.9 of the Convention) and ensure special consideration for "enhancements of endogenous capacities and technologies" (1/CP16 paragraph 120). Any solution that is predicated on limiting the amount of spill over and absorption of technology into the economies of vulnerable countries does not meet this standard.
- Fairness and equity should be the driving principles behind any solutions in line with UNFCCC Article 4.1(c), 4.3, 4.5 and Kyoto protocol Article 10(c).

With this framework in mind, CAN suggests that the Technology Executive Committee recommend the following actions to COP 18, for implementation as suggested in each proposal. These are divided into three groups: Broad Institutional recommendations; recommendations to address distribution of products; and recommendations to address distribution of knowledge.

Broad Institutional Recommendations

CAN Recommendation 1

1. ***CAN recommend the adoption of a COP Decision for a Declaration on Climate Change and Intellectual Property.***

Generally, there is a clear need for a statement that existing international flexibilities on intellectual property, in particular patents, plant varieties, and copyright especially relating to competition law, compulsory licensing, exceptions and limitations should be interpreted in ways conducive to enabling rapid and efficient uptake of technologies to address mitigation and adaptation. CAN recommend the adoption of a COP decision on a Declaration on Climate Change and Intellectual Property that at a minimum, states that:

- All possible policy avenues to accelerate research, development, demonstration and diffusion of climate-friendly technology, should be explored, including the use of all flexibilities, exceptions and limitations in international and national patent and related intellectual property rules, as well as innovative uses of intellectual property mechanisms, licensing practices, and alternative modes of innovation such as open source approaches.
- UNFCCC parties agree that the TRIPS Agreement, the International Convention for the Protection of New Varieties of Plants, the International Treaty on Plant Genetic Resources for Agriculture, and the WIPO Copyright Treaty ("the international IP treaties') do not and should not prevent UNFCCC parties from taking measures to address climate change mitigation and adaptation. Accordingly, while reiterating their commitment to the international IP treaties, they should affirm that these agreements can and should be interpreted and implemented in a manner supportive of UNFCCC members obligations to adopt measures necessary to address climate change mitigation, to enable their citizens to adapt to the effects of climate change and to promote the public interest in sectors of vital importance to their socio-economic and technological development. They should reaffirm the right of UNFCCC parties to use, to the full, the provisions in these international treaties, which provide flexibility for this purpose.

CAN Recommendation 2

2. CAN recommend that the TEC make clear in its rules and regulations, including for those that establish the relationship between the TEC and the CTCN, and the TEC and the Green Climate Fund (GCF), that the effect of the provisions of Article 4.1c, 4.3, 4.5, and 4.7 requires the UNFCCC to provide support for, and include within the definition of 'incremental costs':

- Purchases of products embodying the best available technologies in the context of projects and programmes funded by all recognized financial mechanisms of the UNFCCC;
- Purchases of licenses (at full cost, or concessional rates) for best available technologies in the context of projects and programmes funded by all recognized financial mechanisms of the UNFCCC, especially in the context of activities undertaken by the CTCN.

CAN suggests that this recommendation be implemented in the finalization of the rules for operationalization of the CTCN and the GCF , and be included as an implementation mandate for the GEF, in its role as a financial mechanism of the Convention. Preferably this would take place at COP 18.

CAN Recommendation 3

3. The TEC should recommend that the CTCN establish ***a Consultative Group on IPR*** (CGIPR) at COP18 (as a function of the CTCN itself, composed of appropriate and experienced expert advisors) that provides a platform for research, analysis, discussion and consultations on IP in international climate change mitigation and adaptation technology markets. The CGIPR should;

- Cooperate with existing bodies such as WIPO and the IEA to actively gather data, information and analyses from all sources and stakeholders and publish a bi- annual ***Climate Technology Perspectives*** report focusing on the progress of technology development and deployment in key mitigation and adaptation sectors, as well as the latest data on patent landscapes, licensing surveys, and barriers. The aim would be to provide an evidentiary and empirical basis for action by UNFCCC parties and the UNFCCC itself. The first such report should be published at COP20.

- Create a website with an ***IP Reporting Mechanism*** for all stakeholders to report problems and issues relating to intellectual property and technology transfer, especially on issues such as:
    - Public domain and anti-commons problems relating to research and development;
    - Refusals to deal;
    - Restrictive licensing practices;
    - Restrictive covenants;
    - Anti-competitive pooling arrangements;
    - Unreasonable, unfair and discriminatory pricing;
    - Inability to enforce IP rights or licensing contracts;
    - Undue or unfair government appropriation of IPR;

  CAN suggests that this be established and running within 6 months of COP18.

    - Establish a ***Multi-Stakeholder Platform*** which will operate as a TRIPS Article 40.3 consultative mechanism on information sharing and enforcement on anti-competitive practices in climate mitigation and adaptation technology markets. This platform will work to bring relevant stakeholders together to voluntarily work out, agree and implement market-based and sector-wide solutions, such as:

    - Patent pools, patent commons, and related concepts such as patent libraries;
    - Joint research and development initiatives;
    - Compulsory or non-voluntary licensing ;
    - Patent buy-outs;
    - Geographically segmented licensing;
    - Parallel imports;
    - Patent exclusions;
    - Open-source and/or general public licensing
    - Prize funds; open access to publicly funded technologies

  CAN suggests that this be established by a decision at COP18 and operationalized by COP19.

- Authorize, designate or create an ***Arbitration Mechanism*** to address intellectual property licensing problems that arise in the context of any legal dispute related to projects or programmes funded by any UNFCCC Financial Mechanism. This will reassure rightholders that they will have a reliable, secure, predictable way of managing disputes related to IP that they provide through UNFCCC processes. In this way fears of sovereign risk and uncertainty of IP enforcement can be mitigated, especially for small and medium enterprises. Receipt of funds from any UNFCCC financial mechanism and use of such in any contract using, accepting or in any way transferring intellectual property, should be contingent on acceptance of a mandatory arbitration clause in the funding contract and in the contract between the funding recipient and the technology provider (subject to the participants' choice of law in each contract and the designated countries system for recognition of mandatory arbitration terms).
    - It may be appropriate to designate existing mechanisms with sufficient expertise on arbitration issues related to cross border transaction on intellectual property (e.g. the WIPO Arbitration and

Mediation Center). Such mechanisms should meet minimum criteria for transparency, and expertise in environmental.

CAN suggests that this be established by a decision at COP18 and selection could be finalized and the mechanism authorized to begin operation by COP19.

CAN Recommendation 4

4. CAN recommend that the TEC establish a set of criteria for technology prioritization based on Technology Needs Assessments, whether the technology is in the public domain, and objective criteria such as, environmental impact, GHG mitigation potential and effectiveness at building adaptive capacity. Such prioritization should exclude from consideration technologies that have unacceptable and harmful consequences, or that may be maladaptive and should be done on an urgent basis.

CAN Recommendations on Distribution of Products

CAN Recommendation 5

5. Can recommend that the TEC develop (through consultation with all relevant stakeholders) and distribute through the CTCN and Regional networks ***Model Licenses for LDC Market Segmentation***, aimed at addressing the needs of LDCs in particular, for use by private sector actors in their private contracts and transactions. One example of a model license could address the issue of lack of production capacity in LDCs (and other countries with insufficient domestic manufacturing and knowledge capacity) that makes compulsory licensing an unusable option for them:

- A model license, (designed by the TEC but used on a voluntary basis by private sector actors) to be offered for use by enterprises in UNFCCC parties to produce technologies primarily for their domestic markets and for export to LDC (or other countries with insufficient technological and manufacturing capacity) markets. The license would explicitly exclude the export of patented products (or products produced by a patented process) into other (non-LDC) UNFCCC country markets. Recipients of funds from any UNFCCC financial mechanism who used such a license would be prioritized for receipt of funds and would be guaranteed 100% support of licensing costs, even at full commercial rates.
    - It may be appropriate to require that funds for licensing of such technologies covered by such a license meet criteria, such as:
        - they would be effective at increasing energy access for the most vulnerable;
        - they would be effective at enabling specific adaptation to a climate change risk or effect to which LDCs are particularly vulnerable; or
        - they would be effective at increasing the adaptive capacity of vulnerable populations in all developing countries.
- Such licenses have already been somewhat explored in recent collaborations such as GreenXchange (http://www.greenxchange.cc/), Creative Commons (http://wiki.creativecommons.org/CC_Public_Patent_License and http://sciencecommons.org/projects/patent-licenses/) and in the development of Humanitarian Use licenses for agricultural and health-related technologies (see the Humanitarian Licensing Working Group of the American Association for the Advancement of Science Program on Science in the Public Interest http://sippi.aaas.org/hue.shtml).

CAN suggests that the license be developed and made available for use within about 6 months after COP 18.

CAN Recommendation 6

6. CAN recommend that the TEC design, designate or authorise (in conjunction with the CTCN), a ***B2B platform for commercial transactions related to climate change mitigation and adaptation products and goods,*** specifically targeted at projects and programmes funded by UNFCCC financial mechanisms, that leverages the information and categorization achieved by TT:CLEAR and its affiliated databases, to allow easy access to publicly available technologies. Such a platform would enable global, transparent offers for sale and offers for purchase on a web-based platform and enable secure, efficient arms-length transactions without long protracted negotiating and contracting processes. Registration requirements and placing of financial bonds for participation would reduce transaction risks for sellers and buyers, as would processes for reputational ranking. Such a platform could:

- Offer standard terms, possibly based on CISG[2] and INCOTERMS.[3]
- Enable optimal searching; input window self-selection (based on the products meeting minimum qualification conditions for effectiveness, reliability perhaps by adopting existing industry certifications and standards) and reliable and secure financial transactions, especially suited to government procurement departments in developing countries;
- Enable simple, standard contracting terms, billing, purchase orders, sales and delivery tracking, and expedited dispute resolution through a mandatory arbitration process provided by the platform.

Preferably a COP 18 decision would mandate the TEC to carry out an open tender process for implementing and operating such a platform leading to authorization and piloting of the system over the following year with full implementation in the subsequent year.

CAN Recommendations on Distribution of Knowledge

CAN Recommendation 7

7. Can recommend that the TEC develop and distribute through the CTCN and Regional networks ***Model Licenses for LDC Market Segmentation***, aimed at addressing the needs of LDCs in particular. To ensure distribution of knowledge into LDCs, two interventions in particular may be appropriate:

- A model license to allow enterprises from any UNFCCC party to export technological goods produced in any LDC (or other country with insufficient technological and manufacturing capacity) into any other UNFCCC party (including other developing countries) where the products or process producing such products is IP protected. The terms of such a license could include, for example, that:
    - Production of the technology and/or application of the process for production is carried out in facilities located within the territory of an LDC and is committed to do so for at least, say, 10 years;
    - At least, say, 30% of personnel involved each year in production are local citizens;
    - Production involves capacity building, education, information transfer, training of local personnel, and use of local content.
    - At least one sub-license is granted (at grant or concessional rates) for use of the technology for production and/or adaptation primarily for the domestic market of the LDC (or other country with insufficient technological and manufacturing capacity);

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[2] United Nations Convention on Contracts for the International Sale of Goods (CISG)

[3] This is a set of international agreed terms developed by the International Chamber of Commerce (in cooperation with UNCITRAL) that defines and governs the interpretation of key contract terms relating to international purchase and sale of goods. (http://www.iccwbo.org/products-and-services/trade-facilitation/incoterms-2010/)

    - Recipients of any UNFCCC Financial mechanism who used such a license would be prioritized for receipt of funds and would be guaranteed 100% support of licensing costs, even at full commercial rates. Technologies covered by such a license could be required to meet one of the following criteria:
        - They would be effective at increasing energy access for the most vulnerable;
        - They would be effective at enabling specific adaptation to a climate change risk or effect to which LDCs are particularly vulnerable; or
        - They would be effective at increasing the adaptive capacity of vulnerable populations in all developing countries.

  To maximize the impact of these licenses it would be best if they were developed and distributed at the latest 6 months after COP 18.

- For those LDCs (or other country with insufficient technological and manufacturing capacity) where a specific technology product or process is not IP protected, UNFCCC parties should commit to allow import into other UNFCCC countries of that technological product (or product produced by that process) made in LDCs (or other countries with insufficient technological and manufacturing capacity). The terms of the commitment could include, for example, that:
    - Production of the technology and/or application of the process for production is carried out in facilities located within the territory of an LDC (or other countries with insufficient technological and manufacturing capacity), and is committed to do so for at least, say, 5 years;
    - At least, say, 30% of personnel involved each year in production are local citizens;
    - Production involves capacity building, education, information transfer, training of local personnel, and use of local content.
    - Recipients of any UNFCCC Financial mechanism who carried out such production would be prioritized for receipt of funds. Technologies covered by such a license could be required to meet one of the following criteria:
        - They would be effective at increasing energy access for the most vulnerable;
        - They would be effective at enabling specific adaptation to a climate change risk or effect to which LDCs are particularly vulnerable; or
        - They would be effective at increasing the adaptive capacity of vulnerable populations in all developing countries.

    CAN suggests that this be implemented through a Decision at COP18.

<u>CAN Recommendation 8</u>

8. CAN recommend that the TEC require that all R&D projects funded by any UNFCCC financial mechanism establishes joint intellectual property rights for the UNFCCC, through the TEC and/or CTCN as its authorized representative (or through a specialized TT entity independent of the TEC but directed and mandated by it to carry out such functions on its behalf), and that the TEC and/or CTCN or specialized TT entity shall not require permission from other joint rightholders to license the technology (non-exclusively, at grant or concessional rates and terms, with proceeds shared jointly with other rightholders) to enterprises and institutions located in LDCs (or other countries with insufficient technological and manufacturing capacity) provided that:

- The enterprise or institution is located within the territory of an LDC (or other country with insufficient technological and manufacturing capacity), and is committed to carry out research and development activities related to the technology in the country for at least, say, 5 years;

- Research and development activities relating to the licensed technology, involve capacity building, education, information transfer, training of local personnel.

CAN suggests that this recommendation be adopted through a Decision at COP18 and implemented by all UNFCCC Financial Mechanisms.

CAN Recommendation 9

9. CAN recommend that as a condition of receiving funds, all R&D projects with a funding component from any UNFCCC Financial Mechanism, involve at least one public research institution from an LDC (or other country without sufficient technological or manufacturing capacity) and, at the very least, IPR in technologies and knowledge developed under the research project or programme so funded be vested jointly in that public institution and entitle it to royalty proceeds. A condition of participation for the public institution could be that it establishes a technology transfer office to ensure further development and licensing of the technologies so developed into the domestic market.

CAN suggests that this recommendation be adopted through a Decision at COP18 and implemented by all UNFCCC Financial mechanisms.

CAN Recommendation 10

10. CAN recommend that technology transfer, specifically transfer of know-how, skills, information and licenses, becomes a requirement for:

- Validation/Verification of projects for the CDM or whatever future CDM-like market mechanism exists in the post-Kyoto framework;
- Registration/Issuance of credits under the CDM or whatever future CDM-like market mechanism exists in the post-Kyoto framework, requiring best available technologies.

The aim would be to extend the benefits of hardware and product transfer that embody the majority of technology transfer under the CDM to include the much more important elements that enable building endogenous technological capacity.

CAN suggests that this recommendation be adopted through a Decision at COP18 and through amendments to the existing forms and regulations of the CDM by COP19.

CAN Recommendation 11

11. CAN recommend that the TEC design, designate or authorize an ***Intellectual Property Exchange*** specifically for climate change mitigation and adaptation technologies. Such an exchange would enable secure, efficient and transparent arms-length transactions for intellectual property licensing at a one-stop shop, with a range of standard licenses that can be pre-designated by rightholders. A pilot version of such an exchange, for example, is Green Xchange (http://www.greenxchange.cc/), although the concept has been implemented more successfully in other environments. Such exchanges make the process of identifying licensees, identifying technologies on offer and carrying out negotiations and pricing much easier and simpler, including standard licensing. It may be appropriate for the TEC and/or CTCN to select one or more existing exchanges in an open and competitive process provided that the exchange that is finally selected meets basic criteria such as:

- Ensuring the inclusion of appropriate technologies that meet basic certification criteria or standards for environmental impact, GHG mitigation potential and/or adaptation capacity;
- Providing a low flat nominal fee per transaction for those posting assets or seeking to access licenses;

- Providing security and reliability for financial transactions;
- Providing secure, speedy and predictable dispute settlement, internally or through an arbitration mechanism as in General Recommendation 3 above;
- Enabling special licensing arrangements for LDCs, based on the model licenses above.

CAN suggests that the designation/creation of an IP exchange be approved by a decision at COP18 and the process for selection carried out by the TEC in the period up to the end of 2013 when the exchange will be authorized to begin operating in the pilot phase, to be evaluated and fully implemented by 2014.

IV. Conclusion

Attempts at addressing the intellectual property issue in the UNFCCC have suffered from a lack of specificity and perhaps undue focus on legal changes or barriers. This submission aims to show that there are significant facilitative measures that the UNFCCC can, and should, take to use the international intellectual property system and existing global markets to increase the rate and scope of technology research, development, deployment and diffusion, especially into LDCs and other countries with insufficient technological or manufacturing capacity. The proposals made here should be viewed as a suite of policies that together may create critical mass that can restructure and leverage private sector activity in global markets for climate change mitigation and adaptation technology. They provide opportunities for participation and action rather than prescribe specific actions by private sector actors, and use the financial power of UNFCCC financial mechanism to put a thumb on the scale in the direction of greater distribution of climate technologies. In particular, by providing security, predictability and funding, these recommendations are aimed at the heart of the enabling environments dilemna: how to create a framework of trust that will allow rightholders to more freely engage in transactions, while ensuring that technology consumers have access to the widest and most competitive range of technologies possible. We look forward to further engaging with the TEC on ensuring enabling environments on both the supply and demand-side of the technology research and development, deployment, and diffusion markets framework.

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Inputs for TEC
Ambuj D Sagar
to: TEC
31/07/2012 20:12
Cc: Xiaohua Zhang, Ambuj Sagar
Please respond to asagar
Show Details

Re: *Call for inputs on ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the Technology Executive Committee could possibly play in this area of work*

While the Science, Technology, and Innovation (STI) enterprise has made major positive contributions to many aspects of the human condition over the past decades, it has not been sufficient to fully address a number of developmental and other challenges in all parts of the world. This is due, in large part, to the fact that the STI enterprise is organized is a way that the overwhelming majority of the development of technologies and their deployment in the real world is mediated by markets and carried out by private firms since they are better placed to carry out these activities. However, such a market-driven process, while providing abundant incentives for technological innovation, does not necessarily address the needs of those who do not have sufficient market power or the provision of pubic goods and services. Furthermore, much of the STI capabilities and resources are concentrated in industrialized countries while the most daunting climate and related challenges lie in developing countries.

This has several implications for arena of climate technology, including: (a) what would global and national climate innovation systems need to look like in order to be adequate (in scale, portfolio, and effectiveness) to meet the climate challenge, (b) what kind of capabilities are needed in developing countries, whose technological transition is key to meeting the goals of the Climate Convention, to support and advance technological change of a manner appropriate and needed for them, and how can these capabilities be developed? (c) how can one strengthen the global and national climate innovation systems so that different countries can respond to their climate and related challenges in a manners commensurate with their national context and needs? I believe the TEC needs to explore questions such as these as a way to develop activities that, complementing the CTC&N, can help us leverage technology to reshape the trajectory of national economies, especially those in developing countries, towards a low-GHG pathway.

Prof. Ambuj Sagar

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Submission by Asian Development Bank on ways to promote enabling environments

30 July 2012

Technology Executive Committee (TEC) at it third Session made a decision to call for accredited Observer Organizations to provide their inputs on ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the TEC could possibly play in this area of work, Asian Development Bank (ADB) welcomes this opportunity and is pleased to submit its inputs as following.

ADB is exploring and practicing to accelerate climate technology development and transfer through the newly established pilot Climate Technology Finance Centre (CTFC). The CTFC, which is part of a broader project entitled “Pilot Asia-Pacific Climate Technology Network and Finance Center”, a GEF-supported project jointly implemented by the ADB and the United Nations Environment Programme (UNEP), will facilitate innovation and diffusion of climate technologies by addressing several barriers and create enabling environment at different levels, using a variety of complementary tools and approaches.

ADB, will help integrate climate technology financing needs into national development strategies, plans and priorities,, and advise governments of its developing member countries (DMCs) on creating business-friendly environments, including reliable rules, regulations, and policies that favorite climate technology development and transfer, which will create an enabling environment for climate technology development and transfer, and will address the policy barrier for technology transfer.

ADB will help develop technology road maps and action plans, analyze and assess technologies and identify suitable technologies for investment and financing, and advise governments of DMCs and private sectors for investment, which will address the knowledge and information gap, a popular enabling environment barrier for technology development and transfer.

ADB will establish an innovative pilot technology marketplace to spur transactions in climate-friendly technologies, which will bring together commercial buyers and sellers of low carbon technologies (LCT) and assist them with executing transactions. Technology marketplace will provide a pragmatic solutions-oriented approach to address information barrier of technology transfer.

ADB will help mobilize financial resources, including public and private financial resources, to scale up the investment in climate technology, which will promote the technology development and transfer and will address the financial barrier.

Based on its experiences and practice, ADB recommends TEC to consider the following:

1 The TEC could synthesize existing experiences, studies and empirical researches to give new insights in addressing technology development and transfer barriers, and to provide advice on possible options for solutions.

2 The TEC could conduct, and update periodically thereafter, technology assessment for investment, so as to provide rich information for those who need for decision making on climate technology investment.

3. The TEC could work together with financial mechanism, for instance, Green Climate Fund, to develop modalities and procedures to provide financial resources for climate technology development and transfer, which will create favorite financial enabling environment for technology development and transfer.

4. The TEC could facilitate the sharing of knowledge, experience and information on technology development and transfer among stakeholders, through a forum or other platform.

Ways to promote enabling environments and to address barriers to technology development and transfer

Submission by

the International Centre

for Trade and Sustainable Development

(ICTSD)

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I- Promoting enabling environments and addressing barriers to technology development and transfer

Examining means to promote technology development and transfer to developing countries has been one of the important priority research areas of the ICTSD Programme on Innovation, Technology and Intellectual Property over the past decade. A number of ICTSD publications address this issue including:

- Unpacking the International Technology Transfer Debate: Fifty Years and Beyond by Pedro Roffe and Padmashree Gehl Sampath, (2012).
- Fostering Low Carbon Growth: The Case for a Sustainable Energy Trade Agreement by ICTSD, 2012.
- Realizing the Potential of the UNFCCC Technology Mechanism: Perspectives on the Way Forward, by Padmashree Gehl Sampath, John Mugabe and John Barton, (2012).
- Meaningful Technology Transfer to LDCs: A Proposal for a Monitoring Mechanism for TRIPS Article 66.2, by Suerie Moon (2011)
- Technology Transfer in the TRIPS Age: The Need for New Types of Partnerships between the Least Developed and Most Advanced Economies, by Domnique Foray (2009).
- Fostering the Development and Diffusion of Technologies for Climate Change: Lessons from the CGIAR Model by Carlos Correa, (2009).
- Does TRIPS Art. 66.2 Encourage Technology Transfer To The LDC's?: An Analysis Of Country Submissions To The TRIPS Council (1999-2007) by Suerie Moon (2008).
- New Trends in Technology Transfer: Implications for National and International Policy**,** by John H. Barton, (2007).
- Encouraging International Technology**,** by Keith E. Maskus (2004).

The body of knowledge and analysis generated by ICTSD in this area provides a comprehensive overview of challenges facing technology transfer to developing countries. It also includes a number of suggestions and recommendations on how to address some of these challenges that could be useful for the work of the TEC in this area.

A number of elements to be highlighted for consideration by the TEC include:

- Enhancing technology transfer requires actions both at the level of technology suppliers (through adequate incentives, effective implementation of technology transfer provisions in international instruments, developing collaborative R&D partnerships and arrangements with the participation of developing countries, finance technology transfer) and at the level of technology recipients (through the strengthening of national innovation systems and absorptive capacities).
- Public research institutions and R&D centres are willing to provide more favourable terms for the transfer of technologies and should be actively involved in the TEC's activities in addition to the private sector and other stakeholders. Lessons should be drawn from initiatives and arrangements where such

institutions and centres play a key role in technology diffusion (the case of the CGIAR system for instance).

- The weakness of technological capabilities in Least-Developed Countries (LDCs) presents important and unique challenges for successful development and transfer of climate change technologies. New partnerships and innovative solutions should be considered to overcome them. In addition, the experience gained in the implementation of initiatives and provisions relating to technology transfer to LDCs in other areas should be also considered. In this regard, the implementation of TRIPS Article 66.2, which requires developed countries to provide incentives for enterprises and institutions in their territories to promote and encourage technology transfer to LDCs, is particularly relevant to the TEC as a case study on how to best encourage technology transfer to LDCs.
- Intellectual property rights (IPRs) play an important role in technology development and transfer and thus should be addressed (see following section).
- Addressing barriers to trade in sustainable energy goods and services could facilitate the freer flow of technologies and associated service-related skills across borders. It could also contribute improve the 'enabling environment' in developing countries for the private sector to promote technology diffusion as well as enhance the readiness and absorptive capacities of developing countries in this area. One way to achieve this objective could be through a Sustainable Energy Trade Agreement (SETA).[1]

The TEC's work in looking at means to promote enabling environments and address barriers to technology development and transfer should fully take into account the diversity of technological needs of countries and the their levels of development and technological advancement and avoid 'one size fits all' prescriptions.

II- The role of intellectual property rights in technology development and transfer

Intellectual property rights (IPRs) play an important role as an incentive to technology development and innovation. They also impact on the transfer and diffusion of technologies. This duality is reflected in article 7 of the TRIPS Agreement according to which: "the protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations."

a) ICTSD's work on IPRs and climate change technologies

ICTSD has extensively examined the role of intellectual property rights in the development transfer and diffusion of climate change technologies. Its policy oriented

[1]See http://ictsd.org/programmes/climate-change/a-sustainable-energy-trade-initiative/

research has provided ground breaking analysis and empirical evidence in this area that is widely recognized and referred to in discussions and relevant publications.

Some of the highlights of its policy research in recent years include:

- Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuel and Wind Technologies, by John H. Barton (ICTSD, 2007) was among the first studies to use patent data to examine the role of intellectual property rights in access to clean energy technologies in a number of developing countries. The paper looks into the technology and industrial structure of three clean energy sectors: solar photo-voltaic (PV), bio-mass for fuel and wind energy technologies and concentrates on three technologically advanced developing countries including Brazil, China and India.
- Intellectual Property Rights and International Technology Transfer to Address Climate Change: Risks, Opportunities, and Policy Options, by Keith Maskus and Ruth Okedij, (ICTSD, 2010) combines legal and economic analysis to provide a comprehensive overview of the issues and challenges facing the role of intellectual property rights in relation to both the development and dissemination of climate change technologies.
- Patents and Clean Energy: Bridging the Gap between Evidence and Policy by the United Nations Environment Program (UNEP), the European Patent Office (EPO) and the International Centre for Trade and Sustainable Development (ICTSD) (2010) presents the findings from a comprehensive mapping of clean energy technologies, a patent landscape for clean energy generation technologies and the first global survey of clean energy licensing practices. A groundbreaking outcome of the study has been the creation by EPO of a new patent classification scheme for clean energies and a searchable database now available on the EPO's patent information service (esp@cenet).

In addition, other publications by ICTSD have looked at lessons from the global debate on intellectual property and public health[2] for efforts to foster innovation and technology transfer to address climate change as well as challenges facing small developing countries in this area.[3]

Finally, in Overcoming the Impasse on Intellectual Property and Climate Change at the UNFCCC: A Way Forward by A. Abdel Latif, K. Maskus, R. Okediji, J. Reichman and P. Roffe (ICTSD, 2011), a number of principles and parameters are suggested for addressing the issue of intellectual property rights under the UNFCCC framework taking into account of their role in technology development and transfer.

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[2] Innovation and Technology Transfer to Address Climate Change: Lessons from the Global Debate on Intellectual Property and Public Health, by Frederick M. Abbott, ICTSD Programme on Intellectual Property Rights and Sustainable Development, Intellectual Property and Sustainable Development Series, Issue Paper No. 24, June 2009.

[3] Technologies for Climate Change and Intellectual Property: Issues for Small Developing Countries, ICTSD Programme on Intellectual Property Rights and Sustainable Development, Information Note No. 12, October 2009.

b) *Key findings*

ICTSD's policy oriented research includes extensive data and findings on trends in patenting and licensing in a number of climate change technologies, including in relation to developing countries. It also identifies challenges, knowledge gaps in this area and provides a number of recommendations on how to address them.

This body of knowledge points to the following:

- Patenting in clean energy generation technologies has increased at a rate of 20 percent annually since the adoption of the Kyoto Protocol (1997), outpacing traditional energy sources of fossil fuels.
- Patenting is dominated by a handful of OECD countries (Japan, the United States, Germany, the Republic of Korea, the United Kingdom, and France) which account for almost 80 percent of patent filings with a number of emerging economies showing increasing specialization in some individual sectors.
- There is an untapped licensing potential towards developing countries.
- While the role of intellectual property rights in incentivizing innovation in a climate change technologies, particularly important mitigation technologies is well established, their impact on technology diffusion and transfer is more complex because it varies from one technology/sector/developing country to another, and is often difficult to isolate from a variety of other economic and institutional factors.
- A number of IPRs related initiatives and measures have been launched by a variety of stakeholders, including governments and the private sector, to accelerate clean energy innovation and diffusion and include: new search and classification tools to facilitate access to information on IPRs and clean energy technologies, schemes for fast tracking 'green' patent applications, initiatives for facilitating technology licensing, the creation of patent commons and IP exchanges and open innovation.[4]
- There is a pressing need for increased availability of reliable and objective information on IPR aspects of climate change technologies particularly with regard to climate change adaptation and at the country/sector level in developing countries.

c) The role of the Technology Executive Committee (TEC)

The creation of the Technology Mechanism, along with the Green Climate Fund, makes the UNFCCC the appropriate forum to address all issues impacting the development, transfer and diffusion of climate change technologies, including intellectual property rights, from a holistic perspective.

It is difficult to envisage a credible approach to work on technology development and transfer without considering the role of intellectual property rights.

[4] A, Abdel-Latif, *Intellectual Property Rights and Green Technologies from Rio to Rio: An Impossible Dialogue?* Policy Brief No. 14, ICTSD, 2012.

As the policy body of the Technology Mechanism, the TEC could contribute to a better understanding of the impact of intellectual property rights on development and transfer of climate change technologies without prejudice to the positions of countries on this issue in broader discussions under UNFCCC.

This could be achieved through technical discussions that are informed by empirical evidence and concrete examples. The outcome of such discussions should not be prejudged in advance. At a first stage, the TEC could undertake the two following tasks:

i. *Reviewing empirical evidence regarding the effects of IPRs on the transfer of climate technologies and addressing knowledge gaps*

As a first step, the TEC could begin by reviewing the existing empirical evidence regarding the effects of IPRs on the transfer of climate technologies and then endeavor to address some of the knowledge gaps in this regard, such as with regard to climate adaptation technologies and in relation to the country/sector level in developing countries. Such task would fall under function a) of the TEC's mandate in accordance with COP decision 1/CP.16: "Provide analysis of policy and technical issues related to the development and transfer of technologies for mitigation and adaptation."

ii. *Facilitating collaboration with a view to increasing availability of reliable and objective information on IPR aspects of climate change technologies* technology

One of the key findings of the UNEP-EPO-ICTSD study on Patents and Clean Energy was that gathering, analysing and providing access to information on clean energy technologies, including IPRs and licensing aspects, is a costly and complex task. It "involves a wide and diverse set of actors such as governments, IP authorities, the private sector, international and regional organisations, academic experts and non-governmental organisations." The study thus identified "a need to foster partnerships and collaboration between such actors in order to combine their different skills and expertise."[5]

In February 2011, ICTSD made a submission to the UNFCCC regarding the need for greater availability of technological information to promote cost effective mitigation actions. The submission underlined that rapid and affordable access to information on patenting of technologies for addressing climate change can significantly enhance the cost-effectiveness of mitigation actions. It argued that more tools and mechanisms in this area are urgently needed to enable further deployment and diffusion of existing technologies as well as to spur new technological innovation world-wide.[6]

The TEC with its comprehensive approach to development and transfer of climate change technologies is uniquely positioned to foster and facilitate partnerships and collaboration to address the need for greater technological information mentioned above. Such action would fall under functions d) and f) of the TEC's mandate in accordance with COP decision 1/CP.16.[7]

[5] UNEP, EPO and ICTSD, (2012) *Patents and Clean Energy,* p.68

[6] The submission is available at: http://ictsd.org/i/publications/105628/.

[7] d) promote and facilitate collaboration on the development and transfer of technologies for mitigation and adaptation between governments, the private sector, non-profit organizations and academic and

After having completed these tasks, and on the basis of the analysis and empirical evidence undertaken and the information retrieved, the TEC could possibly discuss policies and actions under its other functions.[8]

—

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

[8] In particular functions: b) Consider and recommend actions to promote technology development and transfer, in order to accelerate action on mitigation and adaptation; d) Recommend guidance on policies and programme priorities related to technology development and transfer with special consideration given to the least developed country Parties and e) Recommend actions to address the barriers to technology development and transfer in order to enable enhanced action on mitigation and adaptation;

July 31, 2012

The Chair and Members of the Technology Executive Committee
c/o the UNFCCC Secretariat
P.O. Box 260124
D-53153 Bonn
Germany

Re: Call for inputs on ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the Technology Executive Committee could possibly play in this area of work

The Institute for Global Environmental Strategies (IGES) welcomes the Technology Executive Committee's call for public inputs on ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the Technology Executive Committee could possibly play in this area of work.

In responding to the call, we would like to submit our suggestions and inputs on the following two issues: 1) Which technologies to be transferred; 2) through which mechanisms. The proposal is based on IGES research and activities and it has been discussed in chapter 6 of IGES white paper IV, titled: Green Governance in Asia-Pacific, published on Jul.2012[1].

Followings are our suggestions and inputs. We are more than happy to further engage and involve in addressing the barriers to technology development and transfer.

1) Regarding which technology to be transferred?

The focus should be on:

- Promoting the transfer of proven and commercially available technologies which are at their deployment and diffusion stage of maturity. These technologies are associated with fewer barriers, especially those which continue to be controversial under the UNFCCC process (IPR, MRV, and finance). Deployment and diffusion are urgently required actions given the risk associated with current global environmental and economic crisis.
- R&D and demonstration of new technologies are likewise important.
- Low carbon technologies which match the needs of recipients and which have large local spillovers. This should be based on conducting a proactive comprehensive technology need assessment (at and by the recipient country) and a comprehensive technology availability assessment (at the supplying country). It should involve a process of *technology customization* and *application* not only a process of technology transfer.
- Transferring combined packages of hard technologies, technical knowledge and skills. Brokerage services need to be elaborated and promoted.
- Cobenefit technologies, which simultaneously enable GHG emission reduction as well as other benefits such as improvement of water quality, air quality, waste management, health, etc.

2) Regarding through which mechanism?

Promoting low carbon technology transfer could be through the following:

- Generating financial incentives by rewarding low carbon technology transfer with credits (TTC) and facilitative arrangements such as export/import insurance. Projects which result in low carbon technology transfer should receive such credits (which could be used for payment of IPR holders). This rewarding scheme can be conducted at national

[1] Link to Chapter 6in IGES white paper IV:
http://enviroscope.iges.or.jp/modules/envirolib/upload/4015/attach/Chapter_6_E.pdf

level (such as PAT program in India), or at bilateral level (such as BOCM in Japan). It can be also conducted at global level through a mechanism similar to the CDM process. The start should be with rewarding hard technologies which are at their deployment and diffusion stage rather than soft technologies or those which are at their early stage of development (to overcome MRV issue). The TTC value should vary according to the transferred low carbon technology, and according to recipient country. Doing this may help the transfer of a larger number of technologies, and to wider set of countries; hence overcoming some of the criticisms to CDM projects.

- Enhancing the proactive involvement of the private sector in bilateral and multilateral initiatives regarding technology transfer. To this end, a stable framework of incentives should be provided by governments, as well as from regional and international organizations, to leading companies willing to play a more proactive role in transferring low carbon technology. These incentives should include material incentives (financial, IPR protection, public procurement, etc.) as well as non-material incentives (honorariums, public awards, etc.).
- Accelerating the low carbon FDI (LCFDI). LCFDI is already soaring, and the potential for further acceleration is huge. The effectiveness of this decentralized mechanism largely depends on the willingness and commitment of various stakeholders to shift from current governance mechanisms toward green governance. Green governance should be streamlined at company level and at government level. Regional and international organizations should provide the necessary support and advice to private companies and governments in the region to make this transition.
- Promoting not only information sharing regarding technologies transfer, but also knowledge building and capacity development, through a bottom up approach as indicated in the diagram below. Further explanation are as follow:

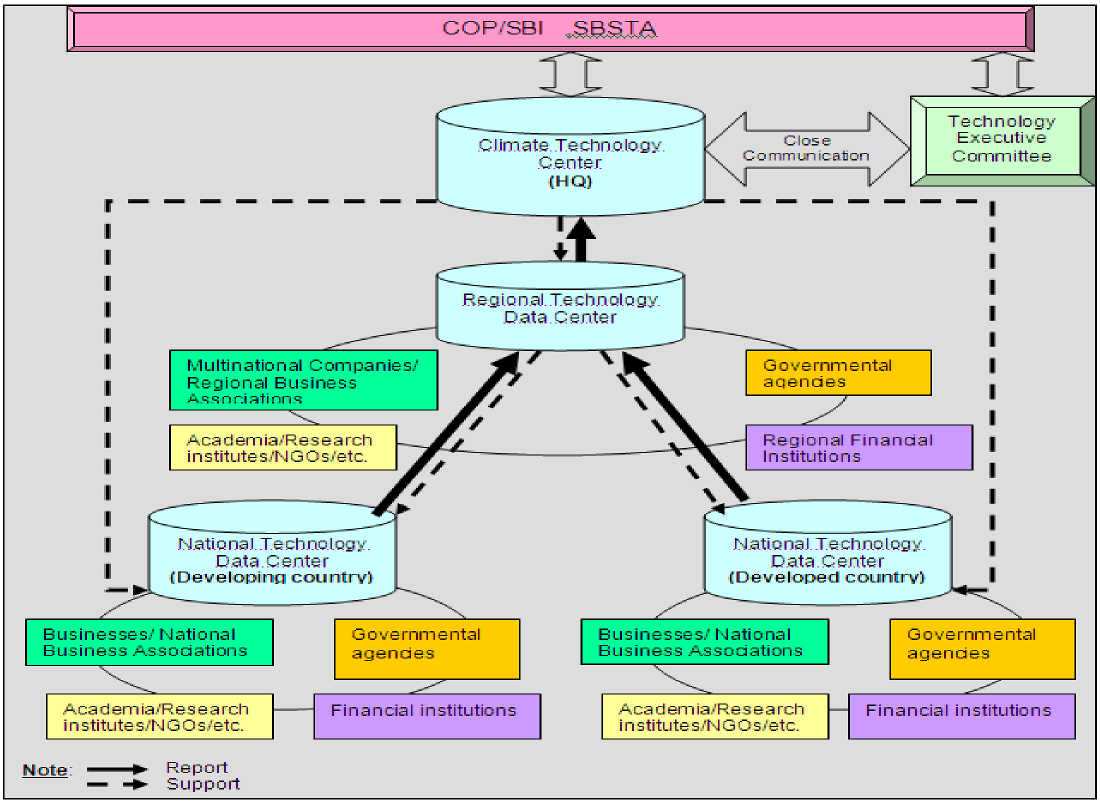
-As for information sharing, first, there is a need to establish a National Technology Data Center in each country (if it is not established yet); to this center all stakeholders within a country have to provide their information and contribution relevant to technology transfer. For example, Governmental agencies disseminate their regulations and legislations regarding technology transfer. Businesses list up their available technologies (or their needs); Financial institutions provide their funding initiatives and programs, research institute provide their findings regarding technology need assessment (or availability assessment), etc. The information collected within each National Technology Data Center should be reported to a Regional Technology Data Center (which also has to be established if is not yet there), as well as to the Climate Technology Center under UNFCCC.

Currently, there are a plenty of technology centers (national and regional); however, they are focusing more, or solely, on information sharing rather than on knowledge building and capacity development. Low carbon technology transfer can be better leveraged through the engagements of these regional technology centers, the climate technology center and the Technology Executive Committee in knowledge building as well. In this regards, organizations belonging to a regional technology center or to the climate technology center as well as the Technology Executive Committee should:

-Support each national technology data centers to develop a comprehensive technology need assessments and/or technology availability assessments. Contribution by private sectors would be useful.

-Based on the information collected from national technology data centers, develop a matrix that shows best opportunities for cooperation between two or multiple countries (through matching seeds with needs). Sharing, and facilitating the access to this map will help

efficient allocation of low carbon foreign direct investment (LCFDI), which is a tools to promote technology transfer.
-Design, or support in designing, rewarding scheme for technology transfer (or for LCFDI) in unilateral level, bilateral level, or multilateral level.
-Implement, or support in implementing, pilot projects of technology transfer as show cases. These pilot projects should be implemented at clusters, for easy replication.
-Not only disseminate the collected information, but play a consultancy role on how to effectively use it, by whom, where, etc.



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CLIMATE CHANGE & TECHNOLOGY TRANSFER: ADDRESSING INTELLECTUAL PROPERTY ISSUES

Submission by Third World Network

This contribution has been prepared by the Third World Network in response to the call by the Technology Executive Committee (TEC) for inputs on ways to promote enabling environments and to address barriers to technology development and transfer, including the role that the TEC could possibly play in this area of work.

I. INTRODUCTION

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) concluded that for the rise in average global temperatures to keep within 2°C above pre-industrial levels, global emissions must peak before 2020 and be reduced to 50-85% below 2000 levels by 2050. The task at hand is massive and it is widely acknowledged that to achieve stabilization targets of GHG there needs to be urgent worldwide deployment of climate friendly technologies in very short-time frames. Unfortunately evidence suggests a mismatch between the urgency of climate challenges as set out by the IPCC and the time taken historically for technology systems to evolve under business-as-usual practices.[1] Thus continuing to promote and advocate such approaches to facilitate technology development and transfer is essentially a recipe for a worldwide climate disaster.

According to Article 4.5 of the UNFCCC, developed countries have undertaken a commitment to "take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to environmentally sound technologies and knowledge to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention" and "In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties".

Clearly under the UNFCCC legal framework, transfer of technology does not refer merely to transactions involving the mere sale or mere lease of goods but requires the transfer of know-how and the right to use and further develop these technologies in support of the development and enhancement of endogenous capacities and technologies of developing countries.

Thus a comprehensive definition of technology transfer involves not only the purchase and acquisition of equipment but also the transfer of skills and know- how to use, operate, maintain as well as to understand the technology hardware so that further independent innovation is possible by recipient firms. It also includes the ability to make the technology through "imitation" or reverse engineering; to adapt it to local conditions; and eventually to design and manufacture original products.[2] The process of technology transfer involves progressively climbing through all these aspects.

[1] Lee *et al* (2009)
[2] The Intergovernmental Panel on Climate Change (IPCC) (2000) defines "technology transfer" as a broad set of processes covering the flows of know- how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs [non-governmental organizations] and research/education institutions It comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose it and adapt it to local conditions and integrate it with indigenous technologies." The UNCTAD draft International Code on the Transfer of technology defines transfer

Further according to Article 4.7 of the UNFCCC, the extent to which developing countries effectively implement their commitments under the Convention depends on the extent of the fulfillment by developed country Parties of their commitments on finance and transfer of technology.

Thus the Technology Executive Committee (TEC) has a critical role to play in particular to explore and recommend bold solutions that depart from "business as usual" approaches to accelerate technology development and transfer. The challenge is massive particularly in view of the fact that the technologies are developed and owned by developed countries using intellectual property but widespread diffusion of ESTs is urgently required worldwide to accelerate mitigation. In this context it is imperative for the TEC to emerge with measures and mechanisms to address barriers to effective technology development and transfer and to facilitate full implementation of the UNFCCC commitments, particularly to accelerate technology transfer so that developing countries can migrate to lower carbon pathways without compromising on their socio-economic development.

There are many barriers to technology development and effective transfer of technology to developing countries. This submission focuses on the issue intellectual property rights (IP), particularly patents and trade secrets.

In Part II, the submission highlights patenting and ownership trends in climate technologies. In Part III, the submission examines the impact of IP on the transfer of climate technologies and know-how to developing countries, in particular highlighting that IP has been and can be a barrier to the rapid development and diffusion of climate technologies. Finally in Part IV, the submission suggests several initiatives that should be pursued at the international level to promote an enabling environment for the development and transfer of technology and the role of the Technology Executive Committee (TEC) to address intellectual property issues.

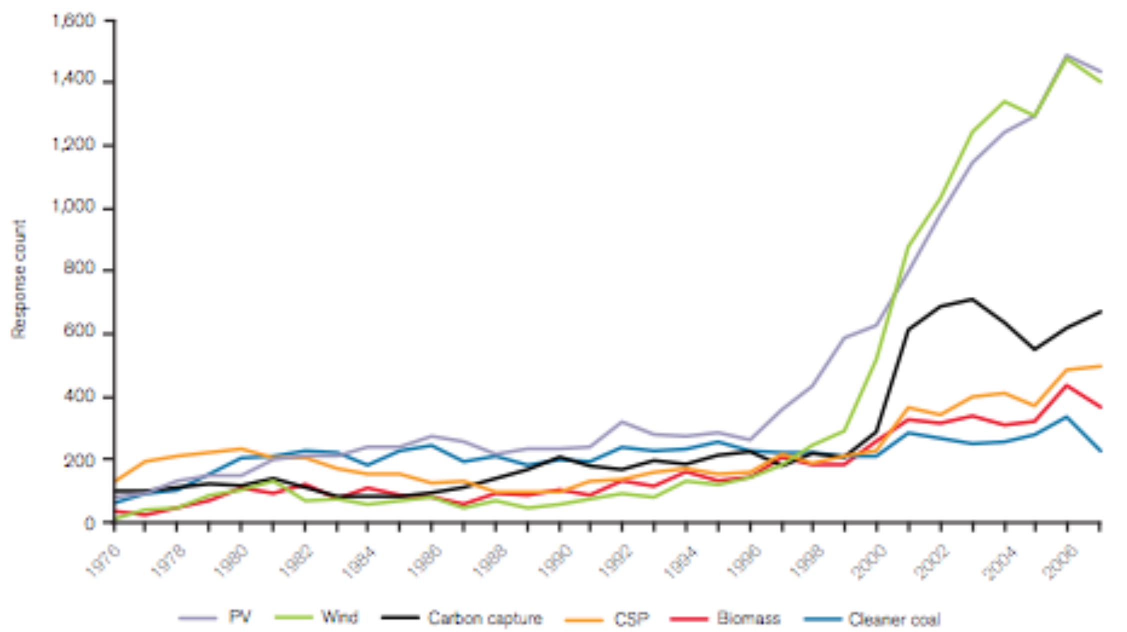
of technology as the "systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service and does not extend to the transactions involving the mere sale or mere lease of goods." (Draft International Code of Conduct on the Transfer of Technology, 1985)

II. PATENTING TRENDS IN CLIMATE RELATED TECHNOLOGIES

Patenting of climate technologies has grown significantly since the mid-1990s and OECD countries largely dominate ownership of these technologies. Table 1 sourced from Lee *et al* (2009) shows steep increases in patenting from the mid-1990s.

Table 1

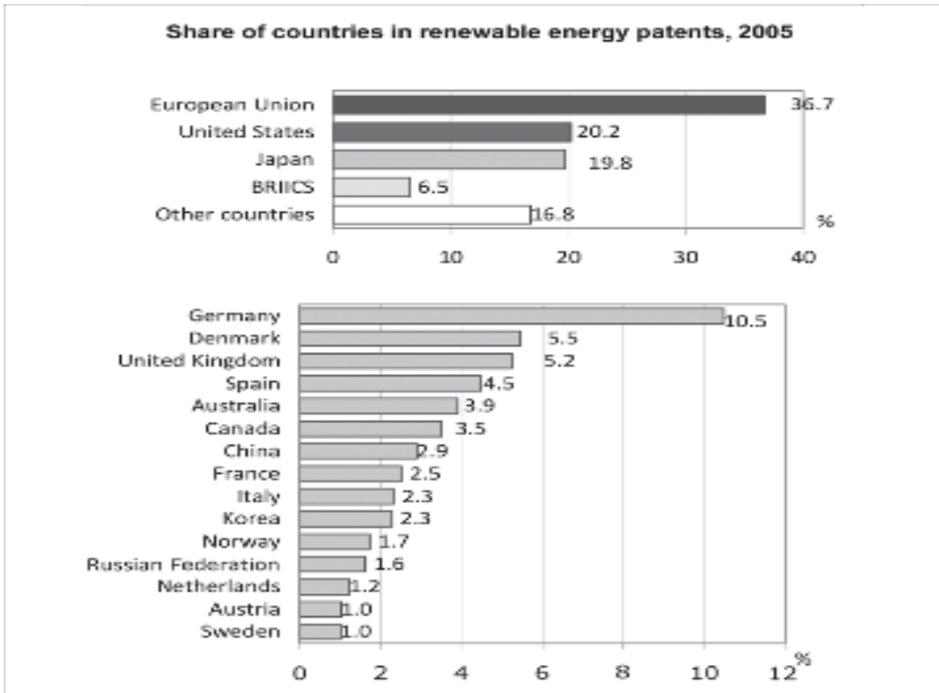
Figure 2.1: Patenting trends for six sectors (1976–2007)



Lee *et al* (2009) also notes that across the six sectors featured in Table 1, the patent owners are primarily from OECD economies, with US, Japan, Germany leading the way. The study adds that much has been made of the fast growth in innovation capacities in emerging economies such as Brazil, China and India, but these countries have no companies or organizations in the top 10 positions in any of the sectors analysed.

Data in the area of renewable energy patents show that the EU, US and Japan hold the highest number of patents. Within the EU, Germany, Denmark, UK and Spain have the highest share of patents in renewable energy. Denmark had 161 patents taken between 2003 and 2005, focusing on wind energy (OECD 2008). See Table 2.

Table 2

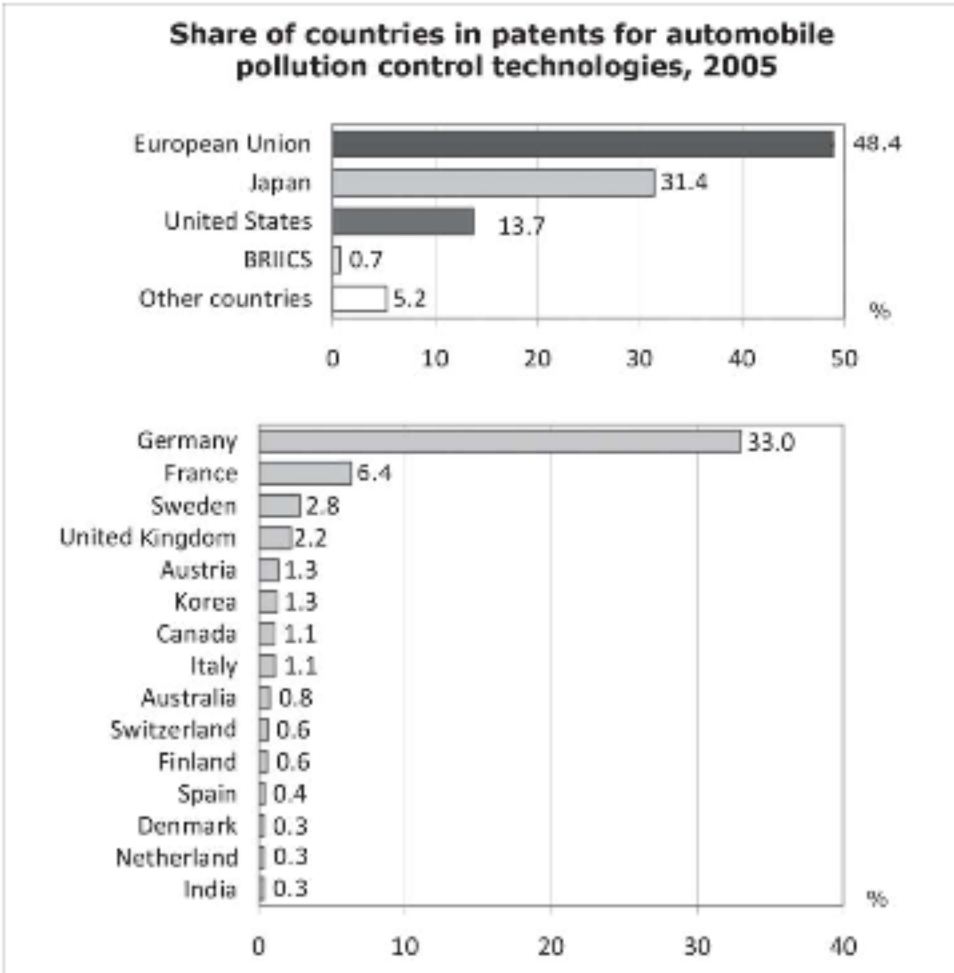


Source: OECD (2008)

Another sector dominated by major developed countries is automobile pollution control technologies, which comprise technologies used to reduce pollutants produced and released into the atmosphere by automobiles. In 2005, the EU (49% with Germany having 33%), Japan (31%) and the US (14%) held the highest share in patents for these technologies. Brazil, Russian Federation, India, Indonesia, China, and South Africa (BRIICS) held only 0.7% of the patents while other countries held 5.2% of the share of patents.[3] See Table 3.

[3] OECD (2008)

Table 3



In the field of agriculture, ETC (2010)[4] found that 6 largest agrochemical and seed corporations based in US, Germany and Switzerland are filing sweeping, multi-genome patents in pursuit of exclusive monopoly over plant gene sequences that could lead to control of most of the world's plant biomass – whether it is used for food, feed, fiber, fuel or plastics. 262 patent families (subsuming 1663 patent documents worldwide) published between June 2008 - June 2010 make specific claims to abiotic stress tolerance (such as drought, heat, flood, cold and salt-tolerance) in plants. The claims extend in many cases to multiple traits in scores of genetically modified crops and even to the harvested food and feed products. Just six corporations (DuPont (USA), BASF (Germany), Monsanto (USA), Syngenta (Switzerland), Bayer (Germany) and Dow (US) and their biotech partners (Mendel Biotechnology and Evogene) control 201 or 77% of the 262 patent families (both issued patents and applications). Three companies – DuPont, BASF, Monsanto – account for 173 or 66%. The public sector has only 9%.

[4] ETC group (2010).

III. EFFECTS OF INTELLECTUAL PROPERTY ON THE DEVELOPMENT AND TRANSFER OF CLIMATE TECHNOLOGIES

It is apparent from Part II that there is an increasing number of patents on climate related technologies. This trend is likely to continue even more robustly as climate change concerns further heighten, funding for R&D increases, and governments adopt legislative and regulatory frameworks for a greener economy. In addition, it is clear that the distribution of patent ownership is very heavily skewed in favour of developed countries.

Such a trend raises fundamental questions for developing countries, in particular, (i) whether developing countries will be hampered in their ability to gain, on reasonable terms, timely access to mitigation and adaptation technologies as well as associated know-how for purposes of R&D, especially to adapt these technologies to suit local conditions and for production; (ii) whether developing countries will have access to affordable climate technologies.

Where technologies are not patent protected, the key supply side issues are the costs of technology and the transfer of know-how to use, maintain and adapt to local conditions for developing countries. In such a scenario it is important to facilitate mechanisms to enable cheapest prices being offered to developing countries, as well as to finance the purchase of technology or the R&D that is needed to adapt and manufacture the technology. It is also important to consider mechanisms to make available the know-how (which may in some circumstances be protected as trade secrets) that is needed.

The situation is more complex when technologies are patented. Patents grant exclusive rights, which enable the patent holder, to prohibit third parties from utilizing the protected invention in countries where the invention is patented, to dictate licensing terms and to charge monopoly prices. The patent holder may also impose unreasonable conditions for use of the protected technologies or simply refuse to license the product to any other entity for fear of competition from the licensee.[5]

The Intergovernmental Panel on Climate Change (IPCC) (2000) itself notes that: "Several studies have been done that verify this strategy of using intellectual property rights as a market advantage and as a strategy to control markets as well as dominate innovation within industrial sectors." The same report elaborates on how scholars had noted problems at company level, and how companies have prevented the introduction of new technologies in the marketplace in order to advance and retain their own technological advantages. For example, in 1994 when Korea was in the process of industrialization, technologies introduced by the Japanese and the US came with a variety of restrictions, such as prohibition of consignment to a third party and sharing of improved technologies, as well as export prohibition and denial of permission to the licensee to deal in competitive products or technologies.[6]

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[5] Khor (2008a).
[6] IPCC (2000)

This and other examples (literature is rife with problems of "access" as a result of patent thickets[7], patent trolls[8], high royalty fees, licensing restrictions, onerous conditions and other anti-competitive behavior), seen against the backdrop of an increasing number of patents does raise in the context of developing countries the concern of intellectual property barriers to the development and transfer of climate-friendly technologies to developing countries.

Evidence of intellectual property as a barrier to the development and transfer of climate technologies & related know-how.

Several cases concretely identify IP as an obstacle to accessing climate technologies, while studies on this matter raise IP not only as a possible barrier to transfer of technology but also as a concern that needs action on the part of UNFCCC.

Watal (1998) provides two specific cases in the context of the Montreal Protocol of the acute problems faced by Indian firms in their attempts to access technology from suppliers holding patents[9].

One case concerned an Indian company seeking access to HFC 134a (a substitute for chlorofluorocarbon (CFC), an ozone-depleting substance used in refrigerators and air-conditioners). The patent holder, a transnational company producing HFC 134a quoted US$25 million for allowing access to the technology and proposed that the Indian firm either allow the supplier to take majority ownership in a joint venture that would be set up, or that the Indian firm agrees to export restrictions on HFC 134a produced in India. Both options were unacceptable to the Indian firm. The price was also unrealistically high as the technology fee was estimated to be between US$2 and $8 million.

In another case Indian firms that tried to acquire technology to substitute ozone-depleting substance halon (used in fire extinguishers and other products) found that the patent owner was not interested in licensing the technology to wholly owned companies. The patent holder was interested only in joint ventures where it could hold a majority share.

Watal (1998) concluded that "Efforts at acquiring substitute technology have not been successful as the technologies are covered by IPRs and are inaccessible either on account of the high price quoted by the technology suppliers and/or due to the conditions laid down by the suppliers. This would require domestically owned firms to give up their majority equity holding through joint ventures or to agree to export restrictions in order to gain access to the alternative technology."

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[7] A patent thicket is a dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology.
[8] Patent troll is a pejorative term used for a person or company that enforces its patents against one or more alleged infringers in a manner considered unduly aggressive or opportunistic, often with no intention to manufacture or market the patented invention.
[9] Watal, Jayashree, (1998), "The issue of technology transfer in the context of the Montreal Protocol: Case Study of India.", as reproduced in Khor (2002).

IPCC (2000) in its analysis on IP and restrictive business practices found that various types of restrictive business practices are used ranging from refusal to license to attaching restrictive or even prohibitive conditions for royalty and equipment sales to maximise the monopolistic rent. IPCC (2000) also noted that according to Korean firms and R&D institutions, there were cases where the private firms and even public institutions of industrialised countries refused to license climate technologies such as HFC-134a, fuel cell and IGCC (Integrated Gasification Combined Cycle), adding that some private firms sell their equipment under the condition that the buyer cannot disassemble the equipment.

IPCC (2000) also documents the experience of Korean firms that faced difficulties when they wanted to replace CFCs with acceptable substitutes HFC-134a and which were patented by foreign companies in Korea. It further found that the experience was not confined to CFC technology and that many of the technology agreements between Korean firms and their partners in Japan and the US contained restrictions such as not being allowed to consign to a third party, or to export, and that the improved technologies should be shared.

Andersen et. al. also points out in their study that: "South Korean firms are of the opinion that the concession fees demanded by technology owners represent a lack of intention to transfer the alternative technology."[10]

The IPCC (2000) report notes that the case of Korea is "only one among many".

Zhuang (2011) in its study highlights some of the IP related problems that were faced by wind companies in China. The study makes the following findings:

- There has been a major boom in China in companies that manufacture wind power equipment. However, to produce a piece of complete wind power equipment, China has to buy foreign design and technologies related to core components, such as gear boxes, which generally contribute to the largest part of the price.

- The requirements for China to access patented wind-energy technologies are also very strict. Zhuang (2011) cites a survey by Zhou et al. (2010)[11] that on average Chinese companies have to pay high licensing fees for the technology and 5 per cent royalties per piece of equipment when the final product is sold domestically; however, higher royalty fees usually apply when the final product incorporating foreign patent(s) is exported. Most importantly, Chinese innovation is discouraged because R&D activities relating to the patent are commonly only possible after the agreement of the licensor.

- Technologies transferred are not the most advanced. Because the 'unlikeliness" of leading manufactures in the industry to license to potential competitors, studies show

[10] Anderson, S.O., K.M. Sarma, et al., 2007. Technology transfer for the ozone layer – lessons for climate change. Earthscan, London, as reproduced in Khor (2008b)
[11] Zhou, Yuanchuan, Zou, Ji and Wang, Ke (2010). How to conquer the IPR barriers in the low carbon technologies?. Environmental Protection, Vol 2 (in Chinese) reproduced in Zhuang, (2011).

that developing countries manufacturers in China and India often have to obtain technology from second or third tier wind power companies who had less to lose in terms of international competition, and more to gain with regard to license fees.[12]

- China has not acquired the corresponding technological capacities. Much wind power equipment is produced by Chinese enterprises, however, the real owners of the technologies are foreign companies and China has not acquired corresponding technological capabilities.[13] Most applicants for renewable energy-related patents have been foreign enterprise subsidiaries in China; China's top three applicants for wind power patents are all developed country enterprises. During the past twenty years, the gap in wind turbine technology between China and developed countries has not been narrowed.

- To sum up, in the wind energy sector, the innovation is still concentrated in a few developed countries and the technologies have been generally transferred to other industrialized countries. Such technologies are rarely licensed to developing nations, and then mainly to emerging countries like China. The licensees do not have the freedom to use and improve the technologies acquired. Developed country companies often refuse to transfer the advanced or key technologies. The technologies from industrialized countries are strongly protected and it is difficult for developing countries to build their own technological base.

TERI (2009) that looked at technology transfer issue pertaining to climate change in 5 Asian countries, namely China, India, Indonesia, Malaysia and Thailand concluded that where important patents are in the hands of a few dominant players, this creates a monopolistic situation where dissemination of knowledge is restricted on account of limited access and higher prices of climate friendly technologies. TERI (2009) mentions the case of Chinese Yantai IGCC demonstration power plants, where Chinese companies failed to get technology from foreign companies "due to high cost and reluctances to transfer the key technologies on the part of patent holders". After prolonged negotiations, the project had to be finally stopped.

TERI (2009) also points out that the IP create a barrier not only in terms of direct costs (i.e. royalties or license fees) but also increased spending by the recipient company, either due to refusal of technology transfer or unreasonable conditions put in the technology transfer agreements. For instance a Malaysian company Solartif managed to get access to foreign technology only on condition of buying machines from the technology holder. The costs of acquiring technology through imports as a result of conditions in technology transfer agreements, according to TERI (2009) "do not get reflected as a part of IPR costs, since these are not royalties or licence fees, but are nevertheless associated with them".

[12] Lewis, J., (2008), "Leapfrogging in China and India". China Dialogue. Available at http://www.chinadialogue.net/article/show/single/en/1784, reproduced in Zhuang (2011)
[13] UNDP China (2010). China Human Development Report 2009/10: China and a Sustainable Future: Towards a Low Carbon Economy and Society, p.41., reproduced in Zhuang (2011)

Several other recent studies that have analysed specific climate technology sectors have also pointed out that IPRs can be a barrier to transfer of technology.

Ockwell *et al* (2007) looked at Light Emitting Diode (LED) lighting[14] technology and the main barriers that India faced in the transfer of such technology. On IPRs, the study concludes: "Another barrier relates to the IPR issue associated with LED manufacturing. It is a highly protected technology. As there are various processes involved in manufacturing LED chips, each process is patented and requires huge investment. At present, the cost of investing in both chip manufacturing and resolving IPR issues is substantially high compared to importing the chips."

On "biomass technology" the study found that IP, though it is "not a very important issue" in this sector in the context of India, has created "some friction between the European and Indian manufacturers of briquetting[15] machines" as "small-scale industries such as briquetting machine manufacturers are typically 'copycat' businesses based on reverse engineering…". The study also recognises that Europe is dominant in biomass fuel of pellets[16] and not briquettes, thus it concludes that "The growth of the pellet market in Europe has some implications for technology transfer to developing countries like India".[17]

On hybrid vehicles[18], Ockwell et. al (2007), found that commercially viable technologies for hybrid vehicles are held by companies in developed countries[19]. The study also found that "there may be IPR issues associated with imitating patented hybrid drive-trains" since companies such as Toyota, GM and BAE have strict patents relating to their hybrid drive-trains".

Ockwell (2008) also reviewed 3 studies on the issue of IPRs in the context of low carbon technology transfer and concluded: "Developing country firms were generally not observed to have access to the most cutting edge technologies within the sectors examined".

Barton (2007) looked at 3 sectors i.e. solar photovoltaic, biofuels and wind, largely in the context of bigger emerging economies of Brazil, China and India. Despite the overall optimistic tone of Barton's analysis, the study did not rule out the possibility of IPRs being a barrier for developing countries in the sectors examined. In fact, Barton raised

[14] LED is a semiconductor diode that emits light when an electric current is applied in the forward direction of the device. LEDs are widely used as indicator lights on electronic devices and increasingly in higher power applications such as flashlights and area lighting

[15] A briquette is a block of flammable matter which is used as fuel to start and maintain a fire. Biomass briquettes are made from agricultural waste and are a replacement for fossil fuels such as oil or coal, and can be used to heat boilers in manufacturing plants, and also have applications in developing countries. Biomass briquettes are a renewable source of energy and avoid adding fossil carbon to the atmosphere.

[16] Pellets are shorter and narrower compared to briquettes. Pellets can be made from various biomass materials like sawdust, wood, crop residues, or straw.

[17] Ockwell, et al (2007), pp. 82

[18] Hybrid vehicles are viewed by many as having a significant role to play in reduction of carbon emissions related to transport, for example buses and private vehicles. These vehicles combine a conventional internal combustion engine with battery-driven electric motors to achieve a significant reduction in fuel consumption and thus carbon emissions.

[19] Ockwell, et al (2007), pp. 90

concerns of “serious plausible patent issues…likely to arise from the new technologies”; the “risk of broad patents” which may complicate the development of new more efficient or less expensive technologies” and the issue of anti-competitive practices if the “relative small number of suppliers cooperate in a way to violate competition-law principles”.[20]

Barton also pointed out other technologies that may be needed to effectively operationalise climate technologies. For example in the photovoltaic and wind sector, “inverters”[21] would be needed to connect to the electricity grid but such technology is continuously evolving, pertains to a more concentrated industry and is an important area of patent activity.[22]

On Barton’s study, Ockwell (2008) states: “It is notable that for all of the case studies he examines, uncertainty is expressed as to the likelihood of developing country firms gaining access to the most advanced technologies in these industries”.

In the case of photovoltaic[23] technology, Barton suggests that access to the newer thin-film technologies (which is subject to much more extensive patenting than the older silicon-slice technology) is likely to be difficult. Similarly patent holders of new methods, enzymes or micro-organisms important in the case of biofuels may be hesitant to make these technologies available to developing country firms.[24] Barton also identifies wind technologies as an area where existing industrial leaders are hesitant to share their leading technology for fear of creating competitors.

On wind technologies, Ockwell (2008) argues that only smaller companies, which are likely to gain more from licensing and lose less from competition, are willing to sell licenses for use of their technologies. In support, Ockwell refers to a study by Lewis on how leading wind technology manufacturers in India (Suzlon) and China (Goldwind) acquired access to wind technology by license purchases from second tier developed country firms. Lewis argued that it was a disincentive for leading companies to license to potential developing country competitors that have cheaper labour and materials available and while the technology received was not necessarily inferior, it had less operational experience.[25]

Opportunistic & Anti-competitive lawsuits: Hampering access to climate technologies

IP holders are known to use legal suits to preserve their market monopoly, or to place themselves in a position to be able to extract significant royalties from the opposing entity that has used or intends to use the protected technology.

[20] Barton (2007) pp. 20
[21] For converting direct current to alternating current and could also include mechanisms to ensure that solar panels operate under efficient conditions and satisfy the requirements for connecting to the grid
[22] Barton (2007), pp. 11 & 15
[23] A panel that produces electricity when exposed to sunlight
[24] Ockwell (2008)
[25] Lewis, J., (2007), reproduced in Ockwell (2008)

For example, GE successfully used litigation over patent infringement to block foreign access to the US market, thus some firms have had to design around the patent in order to market in the US.[26] In June 2009, GE called on the US International Trade Commission (ITC) (a procedure under which a firm's imports to the US can be barred if it is shown that the firm's product violates a US patent) to block Mitsubishi turbine imports. The ITC ruled in favor of GE in August 2009.[27]

Toyota, well-known for its successful hybrid vehicle Toyota Prius was also engaged in a patent infringement battle related to their Hybrid Synergy Drive brought by Paice LLC in 2004. The trial court found that Toyota's hybrid vehicles infringed Paice's patents, and awarded Paice to be paid $25 per vehicle. In its appeal to the Supreme Court, Toyota said Paice was a "patent litigation company" attempting to "impose a royalty toll on the Prius and similar Toyota hybrid vehicles based on an obscure patent".[28] However the U.S. Supreme Court let stand a $4.3 million award against Toyota Motor Corp. for using another company's patented technology in gasoline-electric hybrid vehicles, including the top-selling Prius. What is interesting in this case is that Paice extended Toyota an offer to license its technology throughout its motion for a permanent injunction, which in itself became one of the grounds for the court rejecting a request for injunction.

The above examples show how litigation or the threat of litigation is used to engage in anti-competitive behavior, in an attempt either to preserve their market share or opportunistically in an attempt to extract benefits such as high royalties.

In the context of developing countries that are likely to be a focus of such litigation in the future, patent litigation or the threat of litigation may result in deterring developing country firms from investing in mitigation and adaptation technologies. Protracted lawsuits can slow the diffusion of technologies by decades.[29]

Ockwell et al., (2007) refers to a discussion with Prof. N Narendran, Director of Research, Lighting research center in New York, which highlighted that "As there are a number of patents associated with each process and almost all manufacturers sue each other over patents it is really difficult to resolve IPR issues".[30] Thus, an outcome of extensive litigation could be a disincentive to invest in innovation.

[26] Ockwell (2008); Barton (2007) pp. 16.
[27] Lee, et al (2009), pp 54-55
[28] Rizo (2008),
[29] Lee, et al (2009)
[30] See Ockwell et al (2007), pp. 69

PART IV: WAYS TO PROMOTE ENABLING ENVIRONMENTS AND TO ADDRESS BARRIERS TO TECHNOLOGY DEVELOPMENT AND TRANSFER

This part proposes several initiatives that can be pursued at the international level to create an enabling environment and to address intellectual property barrier to technology development and transfer. It also outlines the role of the Technology Executive Committee in addressing this issue.

A. SUGGESTIONS FOR INTERNATIONAL COOPERATION

1. Technology pooling through a collective global approach

Parties to the UNFCCC should consider a collective or global approach to enhance access to and affordability of climate technologies. In this context, it is proposed that a "Global Technology Pool for Climate Change", be developed in which intellectual property owners of climate technologies are required to place their intellectual property as well as know-how (e.g. patents and associated trade secrets) in a pool and make them available to developing country firms. Access to the technologies and associated trade secrets and know-how would be conditioned on payment of a low compensation (in some circumstances royalty free) and on standard terms (that are to be negotiated)[31]. This approach has the potential to manage the intellectual property system (if fair and reasonable terms that take into account development needs are negotiated), prevent abusive practices by the IP holder that prevents access to developing countries and make it administratively and financially easier for access to take place.

Various prominent experts and academics have also advocated similar approaches.[32] One proposal is a compulsory licensing framework that could ensure that licenses to patent are available as a matter of right to third parties[33]. Kingston on a similar license of right model states: "Of all types of industry and business which use intellectual property rights, the proposed change (to a license of rights regime) would be most beneficial in complex technologies which are rapidly increasing in importance"[34]

Another proposal by Reichman (2005) has promoted the idea of a "compensatory liability regime", i.e. a liability rule which is an option for one to use another party's innovation, under specified conditions which include (i) how the innovation may be employed; (ii) the period for which it may be employed; (iii) the compensation the innovator should receive (or at least a method for determining it); (iv) provisions for revising the terms of use upon mutual agreement.

In all the above ideas, the basic theme is to allow a third party access and use of the protected subject matter for specified purposes, without permission but subject to

[31] TWN, (2008)
[32] European Patent Office, (2007), p. 95
[33] European Patent Office, (2007), p. 95
[34] Prof William Kingston from the School of Business Studies at Trinity College in Dublin, quoted in European Patent Office (2007), p. 95

payment of some compensation to the IP holder for these uses. Payment of remuneration for patent infringement is found even in the US law[35].

US courts have also commonly applied a similar principle in court decisions. For example in the Paice LLC vs Toyota case mentioned above, injunctive relief was denied to Paice LLC and instead the court allowed Toyota to continue patent infringement, although subject to payment of royalties[36]. The main case in the US on the issue of payment of compensation in lieu of granting injunctive relief is eBay v. MercExchange[37]. The TRIPS Agreement also recognizes the possibility of WTO member states limiting remedies for infringement to payment of compensation.[38]

From the above it is apparent that the idea of allowing the use of a patent for payment of compensation is a concept that has been around for a while. The nature of the pool should be mandatory in that developed and developing countries both have to ensure, either through law or policy (e.g. a condition for receiving public funding for R&D), that the protected subject matter is given to the global technology pool for climate change for licensing to developing country firms as envisaged above.

2. International cooperation to regulate restrictive practices in licensing agreements and anti-competitive uses of intellectual property

There is little in terms of international rules to regulate restrictive practices in licensing agreements and anti-competitive uses of intellectual property.[39]

Noting the need to prevent restrictive and anti-competitive practices that can have an adverse impact on the development and diffusion of technologies, it is proposed that parties to the UNFCCC cooperate to develop norms/standards to regulate restrictive practices in licensing agreements and anti-competitive uses of intellectual property. The issues to be addressed could include a limit to the patent holders' refusal to grant a license, a reasonable rate of royalty payment (or possible exemption for developing country firms), conditions on other costs imposed on the licensee, and regulation on other conditions to be imposed on the licensee (such as limitations on the licensee's market including exports, and the ownership or rights over the innovations or modifications made by the licensee on the licensed technology).[40]

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[35] Reichman (2005), pp. 350

[36] CAFC: 2006-1610-1631; See also www.ipfrontline.com/printtemplate.asp?id=16410

[37] Love (2007): "In May 2006, the US Supreme Court issued an opinion in eBay v. MercExchange which set the standard under which a court should evaluate requests for injunctions to enforce a patent owners' exclusive right to authorize the use of a patented invention. To get an injunction, a patent owner must show the court: (1) that is has suffered irreparable injury; (2) that other possible legal remedies, including the payment of royalties, are inadequate to compensate for that injury; (3) that considering the balance of hardships between the plaintiff and defendant a remedy in equity is warranted; and (4) that the public interest would not be disserved by a permanent injunction. Under this standard, a court can choose to issue a compulsory license to use the patent rather than enforce the exclusive right, a path that has been taken several times since May 2006".

[38] Article 44.2 of the TRIPS Agreement.

[39] See Article 40 and 31 of the TRIPS Agreement.

[40] Khor, M., (2012)

3. Financing R&D and Promoting Access to Climate Friendly Technologies

The Group of 77 (G77) and China put forward a proposal for the establishment of a Multilateral Climate Technology Fund, with the expectation that the fund will finance enhanced action on technology development and transfer.[41] More specifically, it is proposed that the fund will finance *inter alia* support for research, development, manufacture, commercialization, deployment and diffusion of technologies for adaptation and mitigation and the creation of manufacturing facilities for climate friendly technologies.

However financing of R&D by any future fund should be subject to conditions concerning IP.[42] The IP on any technology resulting from R&D financed from the fund should belong to the fund under the UNFCCC. The technology with its associated know-how should be made available royalty-free and on fair and reasonable terms to firms in developing countries that would like to produce or do further R&D (e.g., to adapt the technology to local conditions). Where countries are more interested in purchasing the technology (that has been developed through financing under the fund), rather than manufacturing or conducting R&D, the technology should be made available at prices affordable to the population of the said developing country. In short, provision of financing for R&D of new technologies should be subject to certain conditions that ensure there is no impediment to equitable and affordable access to the products of the research or follow-on research by others.

4. International Declaration on IP and Climate Technologies.

Developing countries have the right to use flexibilities available in the TRIPS Agreement to facilitate access to climate friendly technologies. However whenever developing countries have used or attempted to use flexibilities available in the TRIPS Agreement, (e.g. compulsory licenses, parallel importation), patent holders and the developed countries have used various tactics to intimidate those countries. Several such incidents have been noted in the context of access to medicines, thus leading to the Doha Declaration on TRIPS and Public Health in 2001.

It is proposed that that a similar declaration be adopted on IP and Climate technologies. The idea of a Declaration on IP and climate change technologies similar to the one on public health was proposed by the Brazilian Foreign Minister in his speech to the UNFCCC Conference of the Parties in Bali. Strictly speaking, such a declaration is not required for a country to exercise rights that are already provided for in the TRIPS Agreement, (e.g. the right to issue compulsory licenses for climate-related technologies). However with an international declaration, developing countries may be more confident to make full use of the flexibilities available.

Such a declaration could also address the issue of export to countries with inadequate manufacturing capacity. The issue of export to countries with inadequate manufacturing

[41] Stilwell (2008)
[42] Shashikant, S., et al (2010)

capacity in the pharmaceutical sector was an important point raised in the Doha Declaration on TRIPS and Public Health and resolved through subsequent decisions of the WTO.[43] This issue arose as a result of restrictions placed on compulsory licenses. Under Article 31 (f) of the TRIPS Agreement a compulsory license shall be predominantly for the supply of the domestic market of the Member authorizing such use. This means that the amount that can be exported to another country is limited.

B. ROLE OF THE TECHNOLOGY EXECUTIVE COMMITTEE

1. Promote the use of TRIPS flexibilities to facilitate access to climate related technologies.

There are several options within the framework of the TRIPS Agreements that could assist in facilitating access to climate related technologies. This includes exceptions to patent rights[44], strict application of patentability criteria[45] and compulsory licensing[46]. Thus TEC should promote the use of these flexibilities.

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[43] Following the Doha Declaration a solution was eventually found in the form of a temporary solution in a WTO General Council Decision of 30 August 2003. On 6 December 2005, WTO Members agreed to convert this temporary solution into an amendment of the TRIPS Agreement. As yet, however, the amendment has not entered into force. It is also worth noting that both these decisions have been criticized for failing to facilitate access to medicines to countries with inadequate or no manufacturing capacity.

[44] Article 30 of the TRIPS Agreement allows "limited exceptions" to exclusive patent rights provided that the exceptions satisfy the three-fold test of: (1) not unreasonably conflicting with the normal exploitation of the patent; (2) not unreasonably prejudicing the legitimate interests of the patent owner; and (3) taking into account the legitimate interests of third parties. Thus, under Article 30 countries may, under certain circumstances, automatically allow the use of the patented invention by a third party without the consent of the patent holder. The TRIPS Agreement does not define these circumstances. It is up to each country to define these circumstances depending on national policies as long as the three-fold test can be satisfied. Some exceptions to patent rights that should be provided in national patent laws as they could be relevant to dealing with climate technologies, are: (1) acts done privately and on a non-commercial scale or for a non-commercial purpose; (2) uses for scientific research; (3) uses for teaching purposes; and (4) experimentation on the invention for commercial purposes, for instance to test it or improve on it.

[45] The TRIPS Agreement allows WTO Members to determine on a case-by-case basis whether to grant a patent for an invention. An invention needs to fulfill three criteria for it to be granted patent protection. The TRIPS Agreement refers to these criteria in Article 27.1, i.e., novelty, inventive step and industrial application, but does not define them. Thus, countries have the right to define the criteria in any manner they deem fit. The flexibility provided by the TRIPS Agreement allows developing countries to adopt a much stricter approach to the definition and application of the patentability criteria, thus limiting the number of patents granted on climate technologies. Without a patent, a country with some technological capacity would be able to innovate on the basis of climate technology (which is not patented) through reverse engineering. However, patent issues would still arise in the case of exports where the technology is patent-protected in the importing country.

[46] Compulsory licences are licences that are granted by a government to use patents, other types of intellectual property without the consent of the IP holder. In the context of patents, Article 31 of the TRIPS Agreement provides WTO Member states the right to grant compulsory licences, although no specific reference to the term compulsory licence is made in the said Article. The TRIPS Agreement gives examples of some grounds for granting compulsory licences but does not restrict the possible grounds to those actually cited. Thus WTO Members have not only the right to issue compulsory licences but also the freedom to determine the grounds upon which such licences are to be granted. Grounds for issuing compulsory licences could include: refusal to deal (when the patent holder refuses to grant a voluntary licence which was requested on reasonable commercial terms and conditions within a reasonable period of time); national emergency or other circumstances of extreme urgency; to remedy against anti-competitive practices; lack or insufficiency of local working of the patent; public interest; public non-commercial use (also known as government-use licence); public health; security reasons; environmental reasons; interdependent patents. The TRIPS Agreement also lists a number of conditions for issuing compulsory licences.

For example, to further facilitate compulsory licensing of climate technology, developing countries can be encouraged to introduce legislation that makes it easier to obtain compulsory licenses for certain purposes or category of products. On this it is worth noting that the US in its Clean Air Act provides for compulsory licensing when the patented innovation is necessary to comply with emission requirements, no reasonable alternative is available, and where non-use of the patented innovation would lead to a "lessening of competition or a tendency to create a monopoly". A district court can, with the Attorney General's assistance, determine whether a compulsory patent licence should be granted and set the reasonable terms.[47]

2. **Compile information on government/public spending on R&D of climate technologies and identify technologies that are publicly owned (wholly or partially). Further promote measures/mechanisms to make publicly funded R&D and technologies accessible to developing countries.**

The public sector plays a critical role in the provision of R&D funding and the amounts spent are significant. For example, in 2001 EU governments spent more than half of the total expenditure for R&D in renewable energy. The public sector spent 349.3 million euros while other sectors spent 340 million euros.[48] Public sector spending is equally important in the US. For example for the wind, biofuels and photovoltaic sectors, the US Department of Energy spent approximately 356 USD million.[49]

However governments particularly in OECD countries allow the inventor (usually public research institutions, universities and other governmental bodies) to claim patents over publicly funded technologies and to license them to the private sector. As a result, even technologies, which are wholly or partially funded by the public sector, are not easily available to firms in developing countries.

It is thus proposed that the TEC promotes measures and mechanisms to make publicly funded R&D, accessible to developing countries. For example, fully owned government technologies should be transferred at no cost. Where governments partially fund R&D, they should have partial ownership of any resulting patent. When a licence is issued to a developing-country firm, a corresponding proportion of the cost of the licence should be waived, thus reducing the overall cost to developing countries. Incentives can also be given to entities (that are publicly funded) to make the patented technology, with its know-how, available to developing countries. It has also been proposed that to support no- and low-cost transfer, a "Publicly Owned Technology Inventory" should be compiled.[50] Governments can also use their leverage as a funder of R&D to place conditions on recipients of the grants as to licensing to firms in developing countries.

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[47] 42 USC Sec 7608. See also http://www.law.cornell.edu/uscode/text/42/7608
[48] European Commission (2004)
[49] Barton (2007), pp. 8
[50] TWN (2008)

One example of publicly funded research being made available to the public is the mandatory Public Access Policy of the US National Institutes of Health (NIH). According to the law[51], the Director of NIH shall require all investigators funded by the NIH to submit, or have submitted for them, to the National Library of Medicines's PubMed Central upon acceptance for publication, to be made publicly available no later than 12 months after the official date of publication.[52] Compliance with this Policy is a statutory requirement and a term and condition of the grant award and cooperative agreement, in accordance with the NIH Grants Policy Statement.[53]

More recently the European Commission announced that it would make open access to scientific publications a general principle of Horizon 2020, the EU's Research & Innovation funding programme for 2014-2020.[54] The Commission has also recommended that its Member States take a similar approach to the results of research funded under their own domestic programmes with the goal that 60% of European publicly-funded research articles be available under open access by 2016.

Clearly open access is rapidly becoming the default mode to translate ideas into products and services, thus the TEC must consider application of a similar concept to address prompt availability of publicly funded technologies to developing countries.

3. **Compile and maintain updated information on intellectual property and restrictive business practices (e.g. refusal to deal, restrictive licensing practices) and promote measures/mechanisms to regulate/prevent restrictive practices in licensing agreements and anti-competitive uses of intellectual property, for example through the development of norms/standards.** [See also above Part IV, paragraph A2].

4. **Promote R&D incentive models and funding mechanisms including under the UNFCCC that ensure that R&D outcomes including products/technologies emerging from R&D are not monopolised, but are available to others to engage in follow-on R&D and that such outcomes are affordable.** [See also above Part IV, paragraph A3].

5. **Identify technologies relevant to mitigation of and adaptation to climate change. Conduct a mapping of intellectual property (patents, designs, know-how) in relation to these technologies and the ownership of the intellectual property, and identify aspects which may block innovation and technology transfer.**

6. **Compile and maintain updated information on legal disputes pertaining to intellectual property and climate related technologies.**

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[51] Consolidated Appropriations Act of 2007 (H.R. 2764)
[52] See http://publicaccess.nih.gov/policy.htm
[53] See http://grants.nih.gov/grants/guide/notice-files/NOT-OD-08-033.html
[54] See http://europa.eu/rapid/pressReleasesAction.do?reference=IP/12/790

7. **Promote and implement suggestions for international cooperation described above in Part IV, Section A.**

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July 31, 2012

An Innovative Public-Private Approach for a Technology Facilitation Mechanism (TFM)

Summary

In response to paragraph 265-276 of the Rio+20 Outcome Document, this paper outlines an innovative public-private approach to support the development, adoption, and deployment of environmentally-sound technologies. The approach can provide options for a facilitation mechanism as requested in paragraph 273 of the Outcome Document to help countries drive technology transfer[1], spur innovation, and attract investment. The approach also helps to strengthen capacities for countries so they have ownership of the process and can move away from a project-based, top-down system toward strategically using technology transfer as means of implementing development that is sustainable, country-driven and achieves poverty reduction.

An Innovative Approach to Technology

To address climate change and other development challenges, countries can no longer only rely on traditional methods of technology transfer. With the fast pace of technological change seen today, countries must adopt a new paradigm in order to plan for, access, finance, and deploy environmentally-sound technologies. Countries must be in the driver's seat with the capacities, tools, and networks to identify and utilize technologies based on their own goals and circumstances. Utilising the process of determining domestic current technology capacities, as well as future technology needs, facilitates a country's transition toward sustainable development.

For such a transition to occur, countries will require a TFM that can contribute to establishing appropriate enabling environments that incentivise technology innovation, sustainable investment, and codification and dissemination of best practices, including through South-South, North-South and triangular cooperation. Technology transfer that is supported by a set of institutional, policy and financial structures can lead to long-term investment in, and promotion of, solutions that are embedded in national plans and objectives. Technology transfer should be mainstreamed into the national development process. By doing so countries will build capacity from the bottom up instead of further depending on outside sources for technology innovation and financing.

A critical component of instilling the right enabling environment includes strengthening indigenous research and development (R&D) capacity to drive innovation. To realize success, countries need to

[1] For the purposes of this paper, the term "technology transfer" refers to the entire technology process, including the identification, assessment, research and development, adoption, deployment and dissemination of environmentally-sound technologies.

create national and sub-national systems that support R&D and strengthen capacities to drive innovation and investment, including the creation of local employment and entrepreneurship. As a result, countries will be able to make dramatic advances (or leapfrogging outdated technologies altogether) and build entire industries that did not exist a decade ago.

Currently there are major inequalities among countries in accessing technologies and finance. For example, 2011 witnessed a record $263 billion global investment in clean energy. However, only 5% of these investments occurred outside of the G20[2]. The distribution of CDM projects shows similar geographical inequities, as Brazil, China, India and Mexico have accounted for as many as 85% of all projects as recently as 2011[3]. Many developing countries have yet to attract the appropriate technologies and finance because they are still creating a suitable mix of policies, regulations, fiduciary capabilities, and institutions to achieve their goals. The lack of this infrastructure can compromise the abilities of governments (national and local), communities, and households to take advantage of opportunities to transition toward sustainable development.

A New Paradigm for Technology Transfer

The TFM should provide a worldwide network that will "stimulate technology cooperation and enhance the development and transfer of technologies and assist developing country parties… to build or strengthen their capacity to identify technology needs, facilitate the preparation and implementation of technology projects and strategies..." The TFM should manage the process of receiving and responding to requests from developing countries and work with the established mechanism to respond to those requests. The TFM will serve as an important hub that ensures that developing countries receive the support and technical assistance they need to achieve their goals.

Therefore in order for the TFM to be effective, its services should not only be designed to deliver specific project results, but also contribute to the creation of a national and sub-national foundation of capacities for country-driven technology development and transfer. In this way, the services do not deliver results in isolation. Rather they each support a larger national and sub-national system that promotes innovation, breaks down silos, drives investment, and delivers technology in an integrated and sustained manner.

Readiness for Technology Transfer

The services of the TFM should maintain a two-track, parallel focus on building capacities of local and national stakeholders to ensure that countries are 1) ready for technology transfer and 2) able to access and deploy technology according to their specific needs. The first track, which we can call "Readiness for Technology Transfer" might contain the following pillars:

- **Building strong local research and development.** With strong R&D capacities to develop, finance, and disseminate technology, countries can spur innovation and attract investment. Local experts and centres of excellence, such as universities, research and policy institutions,

[2] Pew Charitable Trusts (2012) "Who's Winning the Clean Energy Race? 2011 Edition" p. 2.
[3] http://www.cdmpipeline.org/cdm-projects-region.htm#1

formal and informal education settings and private organizations, can provide the needed "laboratories" to develop new technologies or modify existing technologies to better meet local needs. These institutions can serve as an innovation engine that drives new technology, enabling countries to be technology transferors in the first place. They are also critical in enabling countries to access, finance, and deploy technology.

- **Identifying technology needs and options.** Countries must have the capacities to select technologies to fit their long-term sustainability objectives. This means creating an enabling environment where individuals and institutions have the capacities to identify and assess both technology and finance options through technology needs assessments as well as financial and policy gap analysis.

- **Integrating technology with sustainable development plans.** Technology transfer does not occur in isolation. Technology plans, strategies, projects and financing must be tailored to the country context. The needs of developing countries vary widely and the technology solutions for emerging economies are very different from those of Least Developed Countries. In this way, the TFM must assist in embedding technology into national and sub-national policies and plans. Ideally, countries can mainstream their technology plan into their national climate change and green growth strategies to ensure institutional integration and technology dissemination.

- **Monitoring, Reporting and Verification (MRV).** The TFM should assist countries to put in place the systems needed to collect data on technology transfer and its impact on sustainable development. Developing indicators for and tracking information regarding the research, development, identification, deployment, and dissemination of environmentally-sound technologies can provide a vivid picture of the results achieved. This data can also be collected by the TFM for a more accurate global outlook on technology. The TFM is therefore well-placed to facilitate knowledge sharing between and among institutions and networks, both public and private.

  In this context it is easy to see how MRV systems would help to create a feedback loop for constant learning and improvement to ensure that results are achieved in the most efficient and effective way possible. This feedback loop also ensures developing countries will continue to access and finance new technology by creating a track record of success in implementing sustainable technology.

Scaling-Up National Technology Transfer

In parallel with building countries' readiness for locally appropriate technology transfer, the TFM should assist in the development and maturation of capacities to finance and deploy both new and existing technology. UNDP envisions this process to involve connecting complementary institutions and networks to catalyse technology adoption, dissemination, and significantly, local technology innovation. Taken together, these pillars are the “means” to the intended “end”: a country experienced in the transfer, local generation, and deployment of environmentally-sound technology.

- **Engaging local, national, regional and global networks, including South-South, South-North, and triangular cooperation (Figure 1).** Networks play a critical role in technology transfer. Technical networks can provide the right data, information, analyses and tools to help countries identify the right technologies for their needs. Financial networks can assist countries to catalyze and increase public and private investment. Networks can also provide peer-to-peer advice, assistance and capacity building that strengthens individual entities within the networks, making the entire system stronger.

Figure 1 – TFM engagement in local, national, regional and global networks

  Networks can also facilitate capacity building through South-South, North-South and triangular cooperation. By connecting institutions that specialize in areas related to technology transfer (e.g. energy, finance, agriculture, transport), countries have access to a specialised system of experts. In particular, experts at the local level that have intimate knowledge of the cultural, social, and economic priorities are in the best position to ensure that technology is applied appropriately, efficiently, and equitably.

- **Focussing on building partnerships.** The TFM should tailor technology solutions to the appropriate country context. Furthermore, countries must have the ability to identify and assess domestic and international stakeholders to build a cooperative system that can address unique country needs. This system would build on inherent strengths and expertise of diverse individuals and groups, including non-traditional actors in technology such as communities.

- **Mobilising the private sector.** One such critical partner is the private sector, both foreign and domestic, and the TFM should build the capacities of countries to mobilize these actors. Given that many technologies will be sustained by private investment, close partnerships with industry actors can ensure that technologies are developed and deployed strategically within the context of the market. In other words, partnerships with industry can help guide the creation and installation of the appropriate mix of incentives, regulations and frameworks to access, sequence, and combine private finance.

  Mobilising the private sector can also support local entrepreneurship. The TFM should help countries to install the institutional and regulatory frameworks to support local innovators and entrepreneurs. This will help the country to depend less on the import of technologies that are not as well tailored to a country's development needs and will make a long-term and sustainable impact.

- **Maintaining strong local research and development.** The R&D component of building capacity for technology cannot be underestimated, nor can it be cleanly contained in either the "Readiness" or "Scaling-Up" tracks. This native skill set and knowledge base is essential in maintaining the momentum a TFM would catalyse in a given country. Therefore the cultivation of local R&D expertise is essential to both being ready for technology transfer and being able to scale-up technology in-country.

Outline for a Potential TFM Structure

In line with the above, UNDP maintains that the TFM should incorporate an innovative public-private approach for technology transfer, one that is owned by the countries it serves. This necessarily involves a wide range of stakeholders including private sector actors. UNDP envisions a hub of inter-connected institutions (Level 1) that represent a region (Level 2) supported by centres of excellence. The TFM hub and the regionally-represented network should be backstopped by a presence in each country (Level 3) that can provide targeted technical assistance, policy, and finance services. Additionally, this third level should include an effective dissemination mechanism at the national level in order to connect and mobilise the best local scientific and technical expertise (Level 4). As such, the TFM can leverage the experiences of all countries that are innovating, adopting, and deploying environmentally-sound technologies.

The graphic below (Figure 2) demonstrates how a TFM can be designed to operate as an inter-connected web of national, sub-national, regional, and global partners. At the middle of the graphic is a major hub in a developing country that takes on the coordination role. It is surrounded by a supporting structure of regional centres of excellence that connect directly to the TFM and to each other. The third ring represents the presence at the national-level; for example, the UN could leverage is presence in 177 countries and territories for this purpose. The fourth ring represents research institutions at the national and sub-national levels where countries can build and exploit local capacity in R&D, in cooperation with the private sector. When taken together, the web brings together the comparative advantages of these organisations at all levels to help countries address their specific technology circumstances and needs. The various entities share information with each other and through networks for the mobilisation of skills, policies, and finance to support effective technology transfer. If requested the UN can assist to develop this structure further based on its experience.

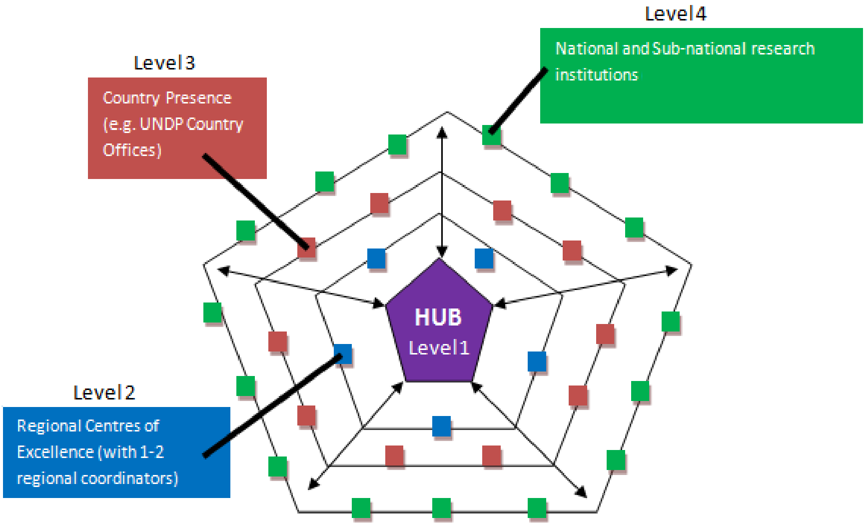

Figure 2 – A vision of the TFM as a hub for technology transfer

Such a structure necessarily means that the TFM will be at the heart of some of the world's best centres of excellence for technology transfer and innovation. Given that technology transfer can create markets for new products that may affect a country's imports and exports, it is essential to secure the neutrality of the TFM. Rather than "picking winners and losers", the TFM should ensure that countries operate on a level playing field, have the support necessary to achieve their goals, and are encouraged to pursue the appropriate technology mix that meets national needs. For this reason it is critical that the TFM operates at high levels of impartiality and transparency when it provides advice and support to countries.

The functions of the TFM will need support to provide services for accessing finance. Attracting the right investments is critical for the successful adoption and dissemination of environmentally-sound technologies. The TFM will need to enhance a country's ability to connect stakeholders to the appropriate types of financing sources.

UN Support for the Innovative Approach to Technology

The UN maintains a portfolio of thousands of technology and energy projects that support countries to combine and sequence different types of financing to enable a transition to sustainable development. Collectively, the UN can bring its expertise in areas such as capacity building, governance, and poverty reduction to facilitate technology transfer in an integrated, sustainable, and cross-sectoral manner. The UN stands ready to provide support to address the gaps described above and to assist the TFM to not only fulfill the services outlined by the Outcome Document, but also create the right foundation of technology needs identification and assessment and strong local R&D. On top of this robust base, the UN can assist countries with the integration of technology with low-emission and climate-resilient development plans, engagement with networks, mobilisation of the private sector, MRV and other functions.

Specifically, the UN can:

1. **Support a neutral approach by the TFM that supports all countries to build strong indigenous R&D capacities.** As a key service provider on technology, the UN has decades of experience in providing neutral support for R&D of technologies through programming under the Global Environment Facility, the Multilateral Fund for the Implementation of the Montreal Protocol, and other national, bilateral and multilateral sources. UNDP has piloted technology projects around the world and codified best practices and lessons learned. These experiences, can serve as important guides for countries as they undertake research, development, and demonstration of new technologies.

   Furthermore, the UN works to ensure that all countries have access to information from technology R&D efforts around the world. For example, UNDP created a ClimateTech Wiki online platform in partnership with UNEP, REEP, UNEP-Risoe, NL Agency in the Ministry of Economic Affairs of the Netherlands, Joint Implementation Network, and the Energy Research Centre of the Netherlands. The platform offers a knowledge sharing forum for a wide range of stakeholders in developed and developing countries who are involved in technology transfer. ClimateTechWiki offers detailed information on a broad set of mitigation and adaptation technologies.

2. **Connect the TFM to technical, policy and finance networks at the sub-national, national, regional and global levels.** Because the UN has a global presence, it could be requested to support the creation of this inter-connected web structure. For example, UNDP is an active convener of hundreds of networks that support countries to access the knowledge and information they need to achieve their development goals. UNDP's support to all levels of the layers mentioned above includes a vast organisational network of Country Offices, Regional Service Centres in Bangkok, Bratislava, Dakar, Pretoria, and Panama, and a global support team of technical advisors. This network provides advice and expertise on financial, scientific, institutional, regulatory, and policy issues. This structure helps achieve results effectively and efficiently, as it provides support countries as they identify, plan, deploy and finance environmentally-sound technologies.

3. **Transfer knowledge and expertise in implementing technology solutions.** The UN's decades of experience in delivering results can help ensure that countries have the capacities to succeed, including the abilities to identify needs, integrate technology with sustainable development strategies, and establish robust MRV systems. The UN's expertise from serving as an implementing entity can help to inform the on-the-ground functions of the TFM. The UN's lessons learned can be instilled in the TFM so it can begin effectively supporting countries to develop country-driven regulatory and financial systems can help to achieve their goals.

   For example, UNDP has assisted over 75 countries in the Technology Needs Assessment process and developed a guidebook on this topic in 2010. It also has provided services to help countries design inclusive green, development strategies that include the integration of technology transfer into national development planning. UNDP also has provided support throughout its portfolio for Monitoring and Evaluation of all environment and energy projects.

4. **Provide services for countries to access financing for technology, including from the private sector.** The international community has created numerous financing instruments aimed at supporting technology transfer. The UN provides extensive support to countries to strengthen their capacities to address the informational, behavioral, regulatory, technical, and financial barriers to accessing finance. In this way, countries can more effectively catalyze finance to support the identification, adoption, and dissemination of environmentally-sound technologies.

   Moreover, UNDP helps countries to create the right enabling environment that can leverage public resources to attract private investment. This can also be used to promote local entrepreneurship and new employment opportunities at the national and sub-national levels.

Immediate Next Steps

To move forward, UNDP proposes that a two-step approach is taken to design a TFM that puts countries in the driving seat to spur innovation and achieve sustainable development that is pro-poor and pro-MDGs. In this UNDP model, countries lead the process. They can rely on technical and financial networks as they identify, develop, adopt, and disseminate technology but have ultimate ownership over the network, information exchange and project cycles.

UN Global Programme for Technology

As a first step, a US$10 million global programme should be created to enable the TFM to provide country-driven support. The programme will provide an integrated approach to technology where counties have what they need to identify and prioritize technologies according to their needs and circumstances. For example, the global programme should provide a framework for how the TFM will link technical and finance networks, serve as a hub to codify knowledge and lessons learned, and help countries to plan technology projects supported by assessing gaps and opportunities.

The global programme should also outline the capacity building needs of the TFM itself. By identifying gaps in knowledge, expertise and functions, the TFM can work more efficiently to address and resolve potential barriers.

Nationally-specific Technology Transfer Projects

Thereafter the TFM should support countries to create national technology transfer projects within this framework. Countries can use the national projects to identify and assess their technology needs and options within the framework of inclusive development strategies. These strategies promote the adoption of environmentally-sound technologies, drive investment, and build capacities of institutions, individuals and systems. Throughout the process, local skills are enhanced to ensure that technology choices respond to specific local needs and the development and installation of technology emerges from a knowledgeable and skilled domestic workforce.

It will be critical for countries to utilize South-South, North-South and triangular collaboration through the TFM. By learning from the experiences of other countries with similar challenges, developing countries can approach technology transfer more strategically. They can build on this knowledge to identify and install the appropriate place-based incentives and frameworks to access, sequence and combine different sources of finance toward environmentally-sound technologies.

By using this approach to design and shape the innovative public-private partnership for technology transfer, the TFM can provide effective support to countries. If designed well, the TFM will no doubt play an important role in strengthening national and local infrastructures and capacities of countries to develop, adopt and deploy sustainable technologies that will drive long-term development.

UNDP Environment and Energy Group, 30 July 2012

SUBMISSION BY THE SOUTH CENTRE TO THE TECHNOLOGY EXECUTIVE COMMITTEE (TEC) ON WAYS TO PROMOTE ENABLING ENVIRONMENTS AND ADDRESS BARRIERS TO TECHNOLOGY DEVELOPMENT AND TRANSFER AND THE ROLE OF THE TEC

Contents

SUBMISSION BY THE SOUTH CENTRE TO THE TECHNOLOGY EXECUTIVE COMMITTEE (TEC) ON WAYS TO PROMOTE ENABLING ENVIRONMENTS AND ADDRESS BARRIERS TO TECHNOLOGY DEVELOPMENT AND TRANSFER AND THE ROLE OF THE TEC*[*]

A. INTRODUCTION

This contribution has been prepared by the South Centre in response to the call by the TEC for inputs on ways to promote enabling environments and to address barriers to technology development and transfer, including on the role that the TEC could possibly play in this area of work.

This submission focuses on three areas: (1) Barriers to technology development, diffusion and transfer, in particular, the role of intellectual property rights (IPRs) in those processes in the context of developing countries; (2) International cooperation in research and development as a component in promoting an enabling environment and addressing barriers to technology development and transfer; and (3) The role of TEC.

B. BARRIERS TO TECHNOLOGY TRANSFER, WITH PARTICULAR REFERENCE TO IPRS

B1. Technology development

In the developed world, IPRs are generally regarded by the private sector as important incentives to innovate. The exclusive rights that they confer allow title-holders to prevent competition and thereby charge prices above marginal costs. This, in turn, may allow them to recoup research and development (R&D) investment and obtain extraordinary profits. While the availability and enforcement of IPRs, particularly patents, may foster innovation, this will strongly depend on the context where such rights apply. In countries with low R&D capabilities, limited access to capital markets and considerable asymmetries in income distribution, high levels of IPRs protection may have significant negative allocative consequences, without contributing –or even impeding- their technological development[1].

There is a widespread view that the role of the patent system in promoting innovation is less substantial than usually claimed, even in developed countries. Patents may even stifle the very innovation they are supposed to foster.[2] A study, for instance, found that patents do provide profits for their owners, but taking the effect of other owners´ patents

[*] This submission is substantially based on Correa, Carlos (2011), Pharmaceutical Innovation, Incremental Patenting And Compulsory Licensing, Research Paper 41, South Centre, Geneva; and Correa, Carlos (2012), Mechanisms for International Cooperation in Research and Development: Lessons for the Context of Climate Change, Research Paper 43, South Centre, March 2012; Khor, Martin (2012), Climate Change, Technology And Intellectual Property Rights: Context And Recent Negotiations, Research Paper 45, South Centre, Geneva

[1] See, e.g. Stiglitz, Joseph, (1999), "Knowledge as a global public good", in Kaul, Inged; Grunberg, Isabelle and Stern, Marc, (Eds.), <u>Global public Goods. International Cooperation in the 21 ST Century</u>, New York, p.315.

[2] Jaffe, Adam B. and Lerner, Josh (2004), <u>Innovation and Its Discontents : How Our Broken Patent System is Endangering Innovation and Progress, and What to Do About It</u>, Princeton University Press.

into account, including the risk of litigation, companies in most sectors 'would be better off if patents did not exist'[3].

'Collective invention' based on sharing innovations may be more efficient than patenting them. Competition can be a powerful incentive to introduce product, process or organizational innovations. Many important innovations are the result of stiff competition, particularly when different technological options may be pursued. Some studies suggest that innovation not only thrives in a competitive environment, but that more profit can be generated by inventors in a system based on the broad diffusion and common use and improvement on innovations.[4]

Incremental innovations prevail in most sectors, including those relevant for the mitigation of and adaptation to climate change. When incremental innovations prevail, the exclusionary rights conferred by IPRs can lead to underutilization of knowledge, especially for the generation of subsequent innovation. A conflict arises between first and subsequent generation innovators, since knowledge is both an *output* and an *input* in its production process. Hence, the greater the rights conferred to the first generation, the greater the limitations on and the costs for the second generation of innovators. As a result, in cumulative systems of technology, patents may deter rather than promote follow-on innovations.

Mapping the patent situation of particular technologies has become extremely complex and costly. With the reinforcement and expansion of measures for the enforcement of IPRs (such as broadly applicable border measures, expansive doctrines of infringement by equivalence), potential users face the risk of high litigation costs and damages if an infringement is found. Inventing around existing technologies has become increasingly difficult and risky.

In particular, patents can discourage research and innovation by locals in a developing country. When most patents in the country are held by foreign inventors or corporations, local R&D can be stifled. In the case of climate change technologies, patents are highly concentrated in three countries—Japan, Germany and the USA—which account for two thirds of total innovations in thirteen technologies with significant global GHG emission abatement potential[5]. The monopoly rights conferred by patents can restrict local research activities, as the use of patented technologies may be prohibited or expensive. This is particularly the case when patents are granted without a rigorous assessment of novelty and inventive step, leading to the proliferation of patents around a single technology.

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[3] Bessen, James and Michael Meurer (2008), Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators at Risk, Princeton and Oxford: Princeton University Press, p. 16.

[4] See, e.g., Torrance, Andrew and Bill Tomlinson (2009), 'Patents and the Regress of Useful Arts', 10 *Colum. Sci. & Tech. L. Rev*. 130.

[5] Antoine Dechezleprêtre, Matthieu Glachant, Ivan Hascic, Nick Johnstone, Yann Ménière (2008), Invention and Transfer of Climate Change Mitigation Technologies on a Global Scale: A Study Drawing on Patent Data. Final Report, MINES,CERNA, AFD, Paris, p. 4. The referred to technologies include wind, solar, geothermal, ocean energy, biomass, waste-to-energy, hydropower, methane destruction, climate-friendly cement, energy conservation in buildings, motor vehicle fuel injection, energy-efficient lighting and Carbon Capture & Storage (CCS).

Strategic patenting and lax patentability standards, explain the surge in patent applications and grants in many countries. A large number of patents that would not be granted if the novelty, inventive step (or non-obviousness) and industrial applicability standards were rigorously applied are approved every year in various fields of technology.

Patent proliferation is a direct consequence, on the one hand, of strategic patenting approaches and, on the other, of the relaxation of the standards applied for the examination of patent applications, rather than of robust rates of innovation or the need of protection against imitation.[6] As a US federal appeals court judge recently stated,

> "In most [industries], the cost of invention is low; or just being first confers a durable competitive advantage because consumers associate the inventing company's brand name with the product itself; or just being first gives the first company in the market a head start in reducing its costs as it becomes more experienced at producing and marketing the product; or the product will be superseded soon anyway, so there's no point to a patent monopoly that will last 20 years; or some or all of these factors are present. Most industries could get along fine without patent protection".[7]

The steady increase in the number of patent applications and grants is largely explained by firms' strategies aimed at creating large portfolios of patents ('patent tickets') in order to prevent competitors from entering into a particular field, acquiring bargaining chips to get access to others' technologies or be better positioned as a defendant in eventual litigation. A report by the World Intellectual Property Organization (WIPO) described 'strategic patenting behaviours' as those:

> "practices aimed at blocking other firms from patenting, creating a thicket of defensive patents around a valuable invention to prevent competitive encroachment and litigation, and to enhance patent portfolios for cross-licensing negotiations … Some firms also use patents to block fellow competitors or to extract rents from other firms; non-practicing entities in particular have emerged which are said to litigate against other firms based on their patent portfolios"[8].

Although 'patent thickets' are well known in some sectors, such as information and telecommunication technologies[9] and pharmaceuticals,[10] they can arise in any sector where innovation-based competition is strong, including many areas of ESTs.

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[6] See, e.g., Jaffe, Adam B. and Lerner, Josh (2004), Innovation and Its Discontents : How Our Broken Patent System is Endangering Innovation and Progress, and What to Do About It, Princeton University Press;

[7] Richard A. Posner (2012), Why There Are Too Many Patents in America, available at http://www.theatlantic.com/business/archive/2012/07/why-there-are-too-many-patents-in-america/259725/.

[8] WIPO (2011), 2011 World Intellectual Property Report. The changing phase of innovation, Geneva.

[9] For instance, Google was reported to pay U$S 12,5 billion to get access to 17.000 patents held by Motorola in relation to mobile phone technologies.

[10] For instance, one single anti-retroviral, ritonavir, is protected by up to 800 patents. See WIPO (2011), Patent Landscape Report on Ritonavir, available at http://www.wipo.int/freepublications/en/patents/946/wipo_pub_946.pdf.

B2. Technology transfer and diffusion

The concept of transfer of technology has been ambiguously used in climate change and other debates, as well as in the academic literature. Sometimes, the sales of equipment embodying particular technologies are deemed to constitute a form of 'transfer'. But, unless there is local technical capacity and legal space for reverse engineering, sales do not lead to learning and the creation of a viable technological base. A recent study noted that although 'the deployment of technological goods is what matters to address climate change, the transfer of technological capabilities is indeed the key to developing countries…'[11] Such transfer, however, is not only important to open new business opportunities, but to accelerate the deployment of technologies to address climate change through local production. As noted in the same study, '[F]rom a general interest point of view, it also reduces costs through increased competition'[12].

Hence, actions on transfer of technology to be taken in the context of the UNFCCC need to aim at the actual *transmission of knowledge*. 'Technology' should be defined for this purpose –as proposed in the UNCTAD draft International Code on the Transfer of Technology- as 'systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service'[13]. This concept does not extend to the transactions involving the mere sale or mere lease of goods[14]

Opinions on the role of IPRs in the process of transfer of environmentally sound technologies (ESTs) to developing countries significantly diverge. Developed countries have generally held the view that they provide an effective platform for the transfer of protected technologies. The recognition of IPRs would, in accordance with this view, reduce the risk of imitation and create incentives for right-holders to license-out their technologies.

However, developing countries have repeatedly expressed their concerns about the impact of IPRs, particularly patents, on technology transfer. IPRs normally provide for exclusive rights that can be used to prevent access to the needed technologies or subject their transfer to high prices or other restrictive conditions. These concerns have been recognized in various international instruments and fora. Thus, para. 34.10 of Agenda 21 stated that

> "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 counties, 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."

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[11] Arnaud de la Tour, Matthieu Glachant et Yann Ménière (2010), Innovation and international technology transfer: The case of the Chinese photovoltaic industry, Working Paper 2010-12, CERNA, Paris, p. 2.

[12] Id.

[13] See United Nations Conference on Trade and Development (UNCTAD) (1985). "Draft International Code of Conduct on the Transfer of Technology, as at the close of the sixth session of Conference on 5 June 1985", TD/CODE TOT/47, Geneva.

[14] Id.

Further, para. 34.18 (d) of Agenda 21 explicitly recognized the existence of barriers for the transfer of 'privately owned technologies'. It indicated the need to adopt 'appropriate general measures to reduce such barriers while creating specific incentives, fiscal or otherwise, for the transfer of such technologies.'

The idea that IPRs may undermine access to technology and the development of a local technological base also underpins article 66.1 of the TRIPS Agreement. This provision exempted least developed countries (LDCs) from the implementation of the TRIPS Agreement's obligations during a transitional period that was already extended once, in 2005, until 2013. Article 66.2 of the same Agreement established an obligation for developed countries to provide incentives for to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to LDCs in order to enable them to create a sound and viable technological base. This obligation remains largely unfulfilled[15].

The stated concerns on the impact of IPRs have led to proposals to amend the TRIPS Agreement,[16] or to otherwise exclude or limit the applicability of IPRs in the field of ESTs[17].

It is sometimes argued that there is a lack of evidence on the blocking impact of IPR on access to ESTs and that such evidence should be produced and supplied by those holding this view. This unduly reverses the burden of proof. While there is increasing evidence on the impact of IPRs in the field of ESTs,[18] it would be up to those arguing that IPRs are conducive to transfer of technology to developing countries to show that this is actually the case. By their very nature, IPRs, notably patents, do create *barriers* to the use of the covered technologies in the countries where protection was acquired. Their main legal effect is to establish a *ius prohibendi* that can be exercised against any third party with a potential interest in using the protected technology.

The impact of the right to prohibit is particularly severe in a context of proliferation of patent grants, including in the area of ESTs, and of strengthening and expansion of enforcement measures. This context accentuates the asymmetric bargaining position of technology owners and would-be licensees who, if able to obtain the required technology, must generally pay a high price therefor via the tied purchase of inputs or spare parts, royalties and other forms of remuneration.

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[15] See, e.g. Correa, Carlos (2007), Intellectual property in LDCs: strategies for enhancing technology transfer and dissemination, study prepared for UNCTAD, 2007, available at www.unctad.org/Templates/Page.asp?intItemID=4316&lang=1; Moon, Suerie (2008), Does TRIPS Art. 66.2 Encourage Technology Transfer To The LDC's?: An Analysis Of Country Submissions To The TRIPS Council (1999-2007), ICTSD, available at http://ictsd.org/downloads/2009/03/final-suerie-moon-version.pdf.

[16] An early expression of such concerns can be found in the submission made by India to the Committee on Trade and Environment (1996) where it proposed to amend a number of provisions of the TRIPS Agreement, including the patent term and compulsory licenses.

[17] See, e.g., the debates and proposals by some developing countries submitted during the UNFCCC Conference held in Cancun, Mexico, from 29 November to 10 December 2010.

[18] See, e.g. UNEP, EPO, ICTSD, *Patents and clean energy: bridging the gap between evidence and policy. Final report*, 2010. Available from http://ictsd.org/downloads/2010/09/study-patents-and-clean-energy_159101.pdf.

Patents may also prevent technology diffusion, as they allow right-holders to control when, to whom and at what price a technology could be made available. High products prices may delay adoption of technologies relevant for climate change mitigation or adaptation. The entry of Chinese producers in the solar photovoltaic market, for instance, has shown how competition can lead to price reductions that improve the rate of diffusion of an important component of ESTs.

Finally, technical standards can reduce the cost of production and benefit consumers. However, technology diffusion may be slowed down or prevented when patents become part of technical standards. Innovation may be equally stifled. Right holders of patented technologies necessary to implement a specific standard may charge high royalties or impose other licensing terms, thereby negatively affecting competitors and users, and slowing down the diffusion of technologies needed to address climate change. Users may need to pay higher prices and become locked-in by high switching costs. If licenses are not readily available under reasonable and non-discriminatory terms, or the permitted users of the standard collude to set prices of standard- compliant goods, competition authorities can intervene to protect competition.

C. INTERNATIONAL COOPERATION IN RESEARCH AND DEVELOPMENT AS A COMPONENT IN PROMOTING AN ENABLING ENVIRONMENT AND ADDRESSING BARRIERS TO TECHNOLOGY DEVELOPMENT AND TRANSFER

C1. Introduction

The 16th Conference of the Parties of the UNFCCC created a 'Technology Mechanism' and defined a number of priority areas for enhanced action on technology development and transfer.[19] Paragraph 10 of the Decisions adopted on the Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action defined as one of such actions:

> "(a) [the] [D]evelopment and enhancement of endogenous capacities and technologies of developing country Parties, *including cooperative research, development and demonstration programmes*;" (emphasis added).

In addition, one of the functions of the established 'Climate Technology Network' is to

> "(b) Stimulate and encourage, through collaboration with the private sector, public institutions, academia and research institutions, the development and transfer of existing and emerging environmentally sound technologies, as well as opportunities for North/South, South/South and triangular technology cooperation;"

These elements in the Cancun negotiated text reflect the importance attributed by the Parties to the UNFCCC, particularly by developing countries, to the implementation of effective cooperative mechanisms to develop and transfer environmentally sound technologies (ESTs).

[19] Decisions adopted by the Conference of the Parties on the Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action, FCCC/CP/2010/7/Add.1. Available from http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2.

Although the issue of technological cooperation in the area of ESTs was raised on several occasions by developing countries[20], little has been achieved so far. A report by the Expert Group on Technology Transfer (EGTT) established in the context of the UNFCCC in 2001[21], observed in this regard:

> "While there are a large number of climate-related international collaborative activities, a preliminary survey of the landscape indicates a number of large gaps. First, most existing initiatives are focused on enabling frameworks and facilitating deployment. Second, mitigation technologies (and within that, energy technologies) dominate; there is relatively limited focus on adaptation. Third, most of the collaborations between developed and developing countries are targeted at or take place with the major developing economies…
>
> "One particular observation relating to technologies for both mitigation and adaptation is that, while there are many international collaborative initiatives around technologies to address climate change, many of these involve processes for identifying needs and facilitating the sharing of knowledge and experiences rather than actually undertaking collaborative R&D."[22]

This section examines possible modalities of collaboration for *research and development* (R&D). It briefly discusses, first, the various sources of technology for adaptation to and mitigation of climate change. Second, the paper examines different elements relevant for fostering cooperation in R&D and the modalities that such cooperation may adopt, having in view experiences made in other areas of science and technology. Finally, an analysis of the cooperative model used to promote the development and diffusion of seeds in the 'green revolution' is presented, with the aim of exploring its possible applicability to the case of environmentally sound technologies.

C2. Problems facing developing countries in accessing technology

Countries may ensure the diffusion of technologies needed for adaptation to and mitigation of climate change through a combination of various sources: the application of technologies in the public domain (including by reverse engineering[23]), access - under licensing or other agreements - to foreign-owned technologies, and research and development (R&D) leading to the implementation of new technologies.

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[20] See, e.g., Decision 4/CP.7, 2001, paragraph 14(c), which urged all the Parties 'to promote joint research and development programmes, as appropriate, both bilaterally and multilaterally".

[21] The Conference of the Parties (COP) decided to terminate the mandate of the Expert Group on Technology Transfer (EGTT) at the conclusion of its sixteenth session.

[22] Report on Options to Facilitate Collaborative Technology Research and Development, Note by the Chair of the Expert Group on Technology Transfer, United Nations Framework Convention on Climate Change (FCCC/SBSTA/2010/INF.11). Available from http://unfccc.int/resource/docs/2010/sbsta/eng/inf11.pdf, pp. 4-5 and 26.

[23] 'Reverse engineering' consists of the evaluation of the technological features, function and operation of a device, object, or system in order to replicate it. Often the outcome of this process entails improvements on the evaluated matter.

Developing countries, in particular, may face three types of barriers in their efforts to incorporate technologies for the *production and goods and services*[24] suitable for adaptation to and mitigation of climate change:

1. Lack of skills and/or financial resources to utilize freely available technologies

Significant reductions in greenhouse gas emissions may be obtained without major technological breakthroughs, by diffusing technologies in the public domain, for instance, known techniques to improve carbon efficiency. The public domain comprises of technologies that have not been subject to intellectual property rights (IPRs), and those for which protection has expired; their use does not require any permission or compensation[25].

However, the effective use of production technologies, even if freely available, requires technical capabilities and investment. The fact that a technology is in the 'public domain' does not mean that it will be applied widely or without difficulty. Technological learning is neither automatic nor free of cost. In many cases, incorporating new technologies require plant lay-out changes, purchase of equipment, adaptation to local raw materials and conditions, and training of personnel. Many developing countries lack a broad pool of skilled personnel or the financial resources necessary to ensure the utilization of ESTs even if in the public domain. This problem may be addressed through national measures and through international cooperation.

2. Reluctance to or onerous conditions for the transfer of technologies

Despite the role played by the public sector in the development of technologies relevant to address climate change, a large portion of environmentally sound technologies is covered by intellectual property rights (IPRs)[26]. Barriers caused by IPRs to technology transfer have been described in the previous section of this paper.

3. Asymmetries in R&D capabilities

Domestic R&D capacity is not only necessary to develop new technologies and provide local solutions to local problems, but also to scrutinize scientific and technological developments that take place elsewhere and to generate capacity to absorb and adapt foreign technologies. This dual role is critical for technologies relevant to climate change, largely held by entities from developed countries. An R&D capacity permits institutions and companies to screen how the scientific and technological frontier evolves. They may, through 'gatekeeping' activities, benefit from technology spillovers and choose possible partners for cooperation. "Gatekeeping" refers to a permanent search for new sources of innovation, either within or outside the firm. It requires special skills in order to identify new sources of core information, interpret and assimilate it.[27]

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[24] The adoption/consumption by final users of such products and services also face a series of problems (e.g. higher cost vis-à-vis conventional solutions, reliability, etc.) that may be addressed with various policies (e.g. tax exemptions, subsidies). This paper does not address this set of issues.

[25] Secret know-how is not part of the public domain, since it is protected as 'undisclosed information', one of the categories of IPRs in accordance with articles 2 and 39 of the TRIPS Agreement.

[26] This reflects both the importance of the private sector in the development of such technologies and the growing trend by public institutions to claim IPRs on their research outputs.

[27] W. Faulkner, *Understanding industry-academic research linkages: towards an appropriate conceptualization and methodology*, Edinburgh, University of Edinburgh, 1992..

Developing countries account for a growing but still minor proportion of global R&D.[28] Developing countries excluding China only account for around 10% of global R&D expenditures[29]. Although this share is much higher than the estimated share (4 per cent) for such countries twenty years ago[30], the world distribution of R&D is indicative of one the most dramatic North-South asymmetries[31].

C3. Types and Examples of International Cooperation in R&D

As noted above, despite the commitment originally contained in article 4.1(c) of the UNFCCC and the perceived need of massive investments in R&D, deployment and diffusion of technologies[32], it is little what has been achieved in the area of technological cooperation, particularly in relation to the development of adaptation technologies. Given the limitations of technology transfer from developed countries, and the need for a global effort to generate new technologies, developing countries must participate in the creation, transfer and diffusion of new technologies suitable to their conditions and development objectives.

Despite the weaknesses and asymmetries in R&D capabilities in developing countries mentioned above, there is great potential for cooperation among developing countries and between them and developed countries. Several possible models for such cooperation exist. They can be categorized in accordance with a number of features, such as:

- whether they are 'pull' or 'push' mechanisms, based on incentives that operate on the demand (e.g. advance purchase contracts) or on the supply (e.g. subsidies for research);
- the type of R&D to be conducted (such as basic or applied research, development of pre-competitive or competitive technologies);
- the thematic fields selected for R&D;
- the type of cooperating parties (public, private, mixed);
- the policies regarding the generation and availability of R&D results for utilization or further research (intellectual property issues); and

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[28] Defined in accordance with the OECD's *Frascati Manual* (OECD, *The Measurement of Scientific and Technological Activities. Frascati Manual. Proposed Standard Practice for Surveys on Research and Experimental Development*, Paris, 2002).

[29] While R&D investments in USA, Europe and Japan countries are generally between 1.5 per cent and 3 per cent of the gross domestic product (GDP), most developing countries invest much less than 1 per cent of GDP in R&D. See GAILLARD, op. cit. p. 96.

[30] Jean-Jacques Salomon, Francisco R. Sagasti and C. Sachs-Jeantet (eds.), *The uncertain quest: science, technology, and development* , United Nations University Press, The United Nations University, 1994. Available from http://archive.unu.edu/unupress/unupbooks/uu09ue/uu09ue0d.htm.

[31] In comparison, developing countries account for around 45 per cent of world exports.

[32] The EGTT report mentioned above estimated that 'current financing for mitigation technologies needs to increase by USD 262.670 billion annually until 2030 (to a total of USD 332.835 billion annually)' (UNFCCC, 2009, p. 3).

- the organizational structure of the R&D activities.

These aspects are briefly explored in more detail below.

1. Push-pull mechanisms

The use of *push* and *pull* mechanisms to promote technological development critically depends on the kind of outputs sought (scientific knowledge, prototypes, etc.) and on the prospective market for new products. Pull mechanisms are particularly suited to overcome insufficient markets, which they may help to create or secure. Push mechanisms, such as subsidies, essentially aim at reducing the cost or risk of R&D[33].

An example of a 'pull' mechanism is the offer of a prize that may be awarded for reaching specified results (e.g. a product with certain characteristics) or some defined milestones in the R&D process. So far, prizes have been successful in encouraging mechanical inventions, electronic systems, and engineering; they have also been proposed to encourage the development of health products needed to address diseases prevailing in developing countries. This is the case, for instance, of the Health Impact Fund (HIF). Some non-profit and for-profit organizations have experimented in recent years with this approach.

Another 'pull' mechanism is the 'advance market commitment' (AMC), which has also been broadly discussed to overcome market failures in health. For instance, in 2009 a pilot project was launched to supply 2 billion doses of pneumococcal vaccine by 2030. The funding for this pilot project is a cooperative effort among many international stakeholders, including the governments of Canada, Italy, Norway, Russia, and the UK. Other parties are the Bill & Melinda Gates Foundation, the World Bank, the GAVI Alliance, and UNICEF[34].

2. Type of R&D

Regarding the *type* of R&D, there is potential for cooperation in basic research and in different forms of applied research and technological development. The funding and organizational structure of such cooperation will significantly vary, however, depending on what their specific object is.

Scientific cooperation in climate change-related areas is not only desirable but needed to avoid unnecessary duplication, and to share skills and resources to address difficult issues, especially those demanding an interdisciplinary approach.

Technological cooperation generally requires a more complex governance structure than that centered on science. Since the main *locus* of technological innovation is the firm, such cooperation is generally sought to enhance the competitive advantages of the

[33] It is worth noting that there has been considerable scholarly debate on whether innovation is primary driven by market demand (i.e. market needs) or by technological shifts (e.g. changes in technology). See, e.g., Chidamber, Shyam R., and Kon, Henry (1994) , 'A research retrospective of innovation inception and success: the technology-push, demand-pull question', *International Journal of Technology Management*, Volume 9, Number 1 , pp. 94-112.

[34] See http://ghtcoalition.org/incentives-pull.php.

cooperating parties. However, public sector entities also play an important role in the development of ESTs.

Such cooperation may be crucial for developing countries in the area of climate change-related technologies. Development is generally more costly than research, except when it focus on incremental changes or adaptations; the pooling of funds and human resources may be the only option for developing countries to undertake large-scale or complex technological projects.

Typical objectives of technological collaborations are sharing limited resources, minimizing costs, reducing risks and achieving economies of scale and/or rationalization. However, they may be more *strategic* in nature and seek a number of indirect effects, such as strengthening the partners' capacity to undertake R&D, as well as keep open *options* that may be foreclosed in the absence of the cooperation.

Technological cooperation may, among other advantages, shorten research duration, reduce transaction costs, make it possible to reach the critical threshold necessary for undertaking large-scale projects, and spread a new technology more rapidly.[35]

Finally, cooperation schemes between R&D entities may differ depending on the resources that each of the partners bring thereto. They may be classified as 'symmetrical' when partners bring together similar resources to generate economies of scope, rationalize capacity, transfer knowledge, or share risk; and 'complementary' where partners contribute different assets and build on their respective strengths and advantages.

3. Thematic fields

Establishing the *themes* for scientific and technological cooperation is one of the greatest challenges from a technical, economic and political point of view. As noted above, the private sector accounts for a great portion of investment in R&D; as a consequence, a large part of resources will be oriented by the expectation of profit gains. The extent to which the public sector may influence (through incentives of different type) the patterns of private R&D is an open question.

The UNFCCC Secretariat noted that

> "Many developing countries have undertaken detailed assessments of their technology needs. A synthesis of technology needs in 69 developing countries was prepared in 2009…The most commonly identified technology needs for mitigation were renewable energy technologies, technologies for improved crop management, energy-efficient appliances, waste management technologies, forestry-related technologies and more clean and efficient vehicles. The most commonly identified technology needs for adaptation were related to crop management, efficient water use, improving irrigation systems, technologies for afforestation and reforestation, and technologies to protect against and accommodate rises in sea level."[36]

[35] Arranz and Fdez. de Arroyabe, op. cit., p. 8 (references omitted).

[36] Ibid. (references omitted).

On the other hand, the EGTT report mentioned above found a 'weak coverage on technologies for adaptation' and that

> "the portfolio of existing R&D programmes are strongly focused on energy technologies, in particular on renewable energy. There are far fewer collaborative R&D activities in industry, transport and energy efficiency in buildings, and forestry, agriculture and waste are covered only within more general programmes."[37]

4. Type of cooperating parties

Technological cooperation may involve different *parties* both from the public and private sectors. There are abundant examples of public-private cooperation in various fields for the development of technologies and in scientific research. A large number of public-private-partnerships (PPPs) have been established, for instance, with the objective of developing drugs and vaccines. One example is the *TB Alliance* financed by public agencies and private foundations which, in association with research institutes and private pharmaceutical companies, aims at developing novel treatments for tuberculosis that are affordable and accessible to the developing world[38]. The Asia-Pacific Partnership on Clean Development & Climate, established in 2005 by Australia, Canada, India, Japan, the People's Republic of China, South Korea, and the United States, is an example of governmental cooperation to accelerate the development and deployment of clean energy technologies.

5. Policies regarding availability of R&D results and IPRs

R&D creates intangibles that, by their very nature, are public goods, that is, goods that are non-rival and non-excludable[39]. Non-rival goods have the property that they can be available for public use[40]. Knowledge may become excludable by action of its possessor (limitations to access, secrecy) or by legal means (e.g. patent protection).

Technological cooperation may be based on different models regarding the appropriability of the results obtained. They may include the generation of results for which IPRs are not claimed or asserted, that is, they remain freely available without prior authorization or compensation. Such results, however, may be protected by IPRs, such as patents, and its utilization by third parties subject to different conditions such as:

- licensing agreements with payment of a compensation;
- licensing agreements without compensation or with special conditions for utilization by certain categories of parties, in certain countries or for

[37] UNFCCC (2009), p. 26.

[38] See www.tballiance.org/.

[39] See, e.g., Joseph Stiglitz (1999), "Knowledge as a global public good", Kaul, Inged, Grunberg, Isabelle and Stern, Marc, (Eds.), *Global public Goods. International Cooperation in the 21 ST Century*, New York, p. 309.

[40] Once knowledge has been created, its use by one agent does not reduce the amount or quality of the knowledge available for use by others.

specific purposes.

An example of a cooperative R&D arrangement designed to produce freely available R&D results is the case of the Consultative Group on International Agricultural Research (CGIAR) which will be reviewed in more detail below.

The negotiation of licensing agreements with payment of a compensation could be necessary to recover R&D costs and to finance further R&D, and to avoid 'free riding' by others. Many public R&D institutions have adopted this approach in the last two decades. In the area of agricultural research, for instance, some institutions in developing countries started to request plant variety protection to be able to obtain compensation from private companies that utilized their improved varieties.

An example of the model based on licensing agreements without compensation or with special conditions for utilization by certain categories of parties, in certain countries or for specific purposes, is provided by the 'humanitarian license reservation' (or 'equitable access license') proposed by a number of institutions and universities[41], whereby title-holders leave open the possibility of sharing their technology with third parties for the benefit of people in need. An example is the case of the 'golden rice', a genetically engineered rice rich in Vitamin A, where certain 'humanitarian uses' are allowed.

6. Organization of the R&D activities

One of the most critical issues for cooperation in R&D is its organization and governance, including funding, coordination, relationship between partners and third parties, sharing of costs and benefits, and the management[42] of the agreed upon activities.

There is a variety of models that may be applied, ranging from the conventional schemes of inter-institutional relations governed by agreements where the participants, objectives, fund allocation, tasks, etc. are defined, to the creation of a an institutionalized network of research institutions, resorting to a common pool of resources and services[43].

An interesting example of an innovative cooperative organization for R&D is the Open Source Drug Discovery (OSDD), inspired in the Open Source model for software development and the Human Genome Project.[44] OSDD was launched by the Council of Scientific and Industrial Research (CSIR) of India, with a vision to provide affordable healthcare to the developing world by providing a global platform where the best minds can collaborate & collectively endeavor to solve the complex problems associated with

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[41] See, e.g., Brewster, Amanda L., Chapman, Audrey R., Hansen Stephen (2005), 'Facilitating Humanitarian Access to Pharmaceutical and Agricultural Innovation', *Innovation Strategy Today*, Vol. 1, 3 (2005), available at http://www.biodevelopments.org/innovation/ist3.pdf.

[42] Although most literature on technological cooperation focuses on issues related to cooperation formation, adequate management is essential to achieve a satisfactory performance. See, e.g., Chen, Hung-hsin (2003), *Cooperative Performance. Factors Affecting the Performance of International Technological Cooperation*, University of Manchester, Manchester.

[43] The example of the CGIAR is considered in a separate section below.

[44] See http://www.osdd.net/about-us.

discovering novel therapies for neglected tropical diseases like Malaria, Tuberculosis, Leshmaniasis, etc. It is a concept to collaboratively aggregate the biological and genetic information available to scientists in order to use it to hasten the discovery of drugs…The OSDD consortium launched in September 2008 has more than 4500 registered users from more than 130 countries around the world, and has emerged as the largest collaborative effort in drug discovery. Launched on the three cardinal principals of Collaborate, Discover & Share, it is a community driven open innovation platform to address the unmet need of research and development of drugs for diseases that affect the developing world. Its objective is affordable health care.[45]

OSDD aims at accelerating research and reducing its cost; all the projects and the research results are reported on the web based platform http//sysborg2.osdd.net. [46]. In addition, 'to ensure affordability, the drugs that come out of the OSDD platform will be made available like a generic drug, without Intellectual Property encumbrances'. [47]

C4. Example of International Technology Cooperation: the CGIAR model

Several proposals have been made to foster climate change R&D and ensure a broad availability of their results. They include the establishment of specialized international funds, such as a 'multilateral technology fund', and the setting up of 'regional R&D networks of existing indigenous research institutions in developing countries for climate change technology development and commercialization that permit sharing of resources and cost for innovation infrastructure and expensive equipment'.

At the Delhi High Level Conference on 'Climate Change: Technology Development and Transfer', held on 23rd October 2009, a proposal was made to create a network of international research institutes inspired by the CGIAR. In accordance with the Chair's summary of the Conference:

> "The second lesson we will take away from here is what President Nasheed called a Green Power Revolution, learning from the lessons of the Green Revolution in which India led the way, with international cooperation, in the 1960s and 1970s, to address what was then the most formidable threat faced by developing countries, the threat of famine and food insecurity. Several speakers alluded to the CGIAR network as a model for addressing the challenge of climate change as well as energy poverty…The CGIAR network provided international support and cooperation in research and education (paragraph 9) [48.] A CGIAR type of global network could provide international support for research and cooperation and ensure that they become centers of excellence (paragraph 10)."

[45] Ibid.

[46] Ibid.

[47] Ibid.

[48] Chair's Summary of the Delhi High Level Conference on 'Climate Change: Technology Development and Transfer', 23rd October 2009. Available from http://moef.nic.in/downloads/public-information/Chair%27s%20summary-FINAL.pdf

The 2010 World Development Report - Development and Climate Change- has also raised the question about the CGIAR as a model for climate change[49], while a report by the Clean Energy Group and the Meridian Institute has suggested that the CGIAR's 'Challenge Programs' [50] may provide a good model for technology sharing and cooperative research to foster open and distributed innovation. [51] Similarly, the already mentioned World Economic and Social Survey 2011 also suggested the CGIAR as an example of a successful mechanism to achieve the rapid worldwide diffusion of new technologies.

The CGIAR was born in 1971 as a result of the joint initiative of a number of international and bilateral agencies, supported by the Ford and Rockefeller Foundations. The CGIAR emerged as a loose network of international agricultural research centres that, although independently managed, worked together to create and disseminate improved plant varieties [52] in the context of what has been termed the 'Green Revolution', with the goal of alleviating hunger and poverty. The CGIAR is a strategic partnership with 64 Members that include 21 developing and 26 developed countries, four co-sponsors as well as 13 other international organizations. Most of the funding is provided by development assistance agencies of developed countries.

The existence of the CGIAR has permitted the Centers to share resources and coordinate policies at the system level, and thereby generate economies of scale and of scope that enhance the Centres's capacity to perform their missions.

Despite the proposal of a system wide IPRs policy elaborated in 2000 [53] and the establishment of a Central Advisory Service for Intellectual Property (CAS-IP), defining a common approach to IPRs has posed a complex challenge to the CGIAR Centres. The Genetics Resources Policy Committee (GRPC) elaborated a new proposal on the subject. In accordance with this proposal, the Centres might only exceptionally seek or assert intellectual property rights, such as when it is indispensable to ensure further development of a research result, or to get access to technologies under the control of private companies that are needed to fulfill the CGIAR mission.[54]

1. Can the CGIAR model be applied in the area of climate change?

While the CGIAR´s experience may provide useful lessons, the possibility of establishing a similar network of institutions for the coordinated development and broad

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[49] *The 2010 World Development Report - Development and Climate Change*. Available from http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTWDRS/EXTWDR2010/0,,menuPK:5287748~pagePK:64167702~piPK:64167676~theSitePK:5287741,00.html, p.306.

[50] See below.

[51] See Clean Energy Group and the Meridian Institute (2009), *Accelerated Climate Technology Innovation Initiative (ACT II):A New Distributed Strategy to Reform the U.S. Energy Innovation System*, available at http://www.cleanegroup.org/Reports/ACTII_Report_Final_November2009.pdf.

[52] As mentioned below, the CGIAR later adopted a more holistic view of agriculture and expanded its activities to other areas of biodiversity.

[53] See GRPC (2002), *Guiding Principles for the Consultative Group on International Agricultural Research Centers on Intellectual Property Relating to Genetic Resources,* Report of the 11th Meeting of the GRPC for ICW2000, Appendix 3, available at http://www.cgiar.org/corecollection/docs/icw0009.pdf.

[54] See the proposal by the CGIAR Genetics Resources Policy Committee for a 'Policy of the Alliance of CGIAR Centres on Intellectual Assets', available at http://cgiar.org/pdf/grpc_25th_meeting_minutes.pdf.

diffusion, as public goods, of climate change adaptation and mitigation technologies, poses a large number of political, strategic and managerial challenges.

Science is normally more amenable to cooperative work and dissemination as a public good than technology, which generally requires adaptation to particular needs and circumstances. In an international scenario dominated by the private development and appropriation of technologies, a set of public institutions of excellence in research would be a useful mechanism to undertake a common program of activities. Existing national institutions may welcome additional international funding, but governments may be reluctant to lose control over them. Given the vast array of fields where research is needed to generate adaptation and mitigation technologies, defining a set of priorities would require scientific competence and political commitment. A mechanism of monitoring and evaluation should also be put in place. As the CGIAR experience shows, such a mechanism would be essential to define priorities, ensure an efficient utilization of resources and to achieve the concrete results that are urgently needed.

In designing a possible international network of research institutions to work on climate change technologies, the following issues should be considered:

- selection of participating institutions or establishment of new ones;
- funding mechanism and plans;
- governance of collaborating institutions and capacity to engage in joint research;
- mechanisms to determine research priorities, distribute tasks, monitor progress and evaluate the achievement of the defined objectives;
- conditions for cooperation with and use of technologies held by the private sector;
- establishment of common policies on diffusion of research outputs and use of the IPRs system;
- participation of developing countries´ institutions in research and means for facilitating access by developing countries to all relevant research results.

C5. Conclusion

Since the adoption of the UNFCCC, technological cooperation has been on the agenda, but little action has been taken. There seems to be, however, an increasing recognition, at least by developing countries, that such cooperation must be effectively implemented. There are different models to do so and, understandably, delicate decisions to be made. But there are useful experiences and many options open for policy makers to put in practice what has so far remained a mere aspiration.

D. TECHNOLOGY ASSESSMENT

In order to promote the development and transfer of technologies, it is also important to assess the appropriateness of the technologies that are selected for development, transfer, and diffusion.

This is to ensure that the technologies that are so promoted are in accordance with the objectives of the UNFCCC, as well as in line with national needs and goals.

The TEC should establish principles and criteria for the assessment of appropriate and relevant technologies that meet general acceptability as well as national conditions, needs and objectives. A mechanism can then be established on applying these criteria when selection of technologies takes place.

It is proposed that the following are among the principles/criteria to be considered:

1. Relevance to the objective of addressing the climate change problem;

2. Environmental soundness;

3. Safety to the environment and to human health and safety;

4. Affordability, especially for developing countries;

5. Social acceptability and effects, including in relation to employment, equity, and cultural norms; and

6. Economic efficiency and cost-effectiveness.

It is clear that there could be trade-offs between and among some of the principles and criteria mentioned above. The methods for making choices in the context of trade-offs is therefore also important to consider and determine.

E. ROLE THAT THE TEC COULD PLAY

The following are roles that the TEC could play in the context of issues raised in this submission:

- Establish a work programme including studies to identify technology needs of developing countries, barriers to the transfer and diffusion and development of the required or desired technologies, and ways to overcome the barriers.

- As part of the above, initiate a discussion and a mechanism for the assessment of technologies including criteria for appropriate technologies, in order to assess the suitability of the technologies for selection for promotion and transfer. The criteria would take into account environmental soundness, climate friendliness, social and cultural aspects, affordability, economic cost and efficiency.

- With the goal of enabling developing countries to have affordable access to technology, the TEC could propose and promote measures for the regulation of the markets for climate-related technologies including through the development of guidelines for competition authorities that, *inter alia*, deal with refusals to transfer technology, restrictive practices in licensing agreements and the incorporation of patented technologies in technical standards. Besides proposing measures that can be undertaken by national authorities, the TEC could establish mechanisms of international cooperation and coordination in this regard.

- The TEC could take measures to promote an effective implementation of Article 66.2 of the TRIPS Agreement (that relates to obligations of developed countries to take measures to promote technology transfer to LDCs) with regard to climate related technologies

- TEC could initiate a programme to map patented technologies relevant to mitigation of and adaptation to climate change, and identify areas where the proliferation of patents, particularly may block innovation and technology transfer;

- TEC could support the improvement of patent examination through the development of guidelines for a rigorous application of patentability standards to climate-related technologies.

- TEC can arrange for studies and measures to assist developing countries to understand the use of flexibilities in the IPR regime in the context of access to technologies.

- Promote the development of relevant technical standards in a way that ensures the participation of developing countries' firms, avoid the incorporation of patented technologies or ensure access thereto on reasonable and non-discriminatory terms.

- TEC could take measures to assist developing countries in increasing their capacity for research and development with regard to climate-related technologies, in accordance with the objective of the development of endogenous technology by developing countries.

- Promote initiatives of open innovation schemes for the development of climate-related technologies.

- TEC could initiate a work programme on considering and establishing measures and mechanisms for international cooperation for research and development in climate related technologies, including financing of such schemes. Such a programme could start with a detailed study of existing cooperation schemes and programmes in other areas such as health, agriculture and industrial technology, and drawing lessons from them.

What should IRENA do in renewable energy technology cooperation?

This internal policy brief explores the potential role of IRENA in enabling international renewable energy technology cooperation based on a mapping and good practices study conducted in 2011 and 2012. International technology co-operation can involve R&D in researcher exchanges or collaborative R&D, it can be directed at demonstration of new technology in co-operation with private sector actors, or it can be in the field of policy, capacity development and public awareness.

What is already happening?

In 2011, IRENA conducted a survey among its members about renewable energy technology cooperation activities, as well as technology centres working in the field of renewable energy. IRENA also conducted a literature review, and, in collaboration with the National Renewable Energy Laboratory in the United States, held a workshop to review a number of collaborations. Good practices were investigated in a number of detailed case studies. The results are reported in a draft working paper[1].

The resulting mapping does not give a complete picture, but tells a story of much activity in some regions, countries, technologies and types of activities, and large gaps in others. It also indicates that the relevance of continuity in capabilities in different contexts is sometimes overlooked, and that coordination is largely absent. It seems that collaboration on policy, public awareness and training is much more common than on research, development and demonstration and on deployment of renewables.

Many programmes combine different types of activities in a single programme. Such a systemic approach is considered a good practice, as the different elements in the cooperation can reinforce each other; a capacity building activity can for instance enable the improved running of a deployment programme. Cooperation also works best when the reasons to collaborate of all partners are aligned, all have a deeply felt interest in the cooperation and the activities are conducted in the framework of a long-standing relation. Developed and developing partners should work on an equal footing. Although funding agencies are recommended to think well about a medium- to long-term exit strategy, they should stop when the results are achieved rather than when a project deadline has been reached, balancing accountability with flexibility.

Technology centres in many ways form the "condensation points" of any technology development, diffusion or transfer activities in developed and developing countries. Their function as places of education, R&D, capability development, information collection and analysis, and discussion of results is critical. In developing countries with low current capabilities in renewable energy, existing centres need to be enhanced to allow for even the most basic of capabilities required to operate, maintain and regulate renewable energy.

What are remaining needs in renewable energy technology cooperation?

Although much technology cooperation is taking place, by far not all needs are fulfilled. In many developing countries, technology centres are weakly developed and have poor links to government and the private sector; finance as well as industry. This hinders the maturing of a renewable energy

[1] Good practices for renewable energy technology cooperation: An investigation into country experiences. Draft IRENA working paper, May 2012.

innovation system where government, research and industry reinforce each other's work towards greater renewable energy diffusion and transfer. A well-networked, competent technology centre can enable that a renewable energy technology cooperation activity is better embedded in national policy priorities.

Especially in developing countries, data on renewable energy potentials and information on renewable energy technology in local languages are often not publicly available or non-existent. It happens that partners are not aware of good practices in renewable energy technology cooperation; there is a need to share information on what have been success factors in programmes. Lastly, there is no central location where an overview of technology collaborations and centres is kept. Although some redundancy in technology cooperation is not necessarily a bad thing, it is inefficient if similar activities are undertaken in the same region, when it unknowingly results in overlap, unproductive competition and lack of peer learning.

What could be activities that IRENA could undertake?

As an international organisation with membership from many countries in the world and an objective to promote technology cooperation in the field of renewables, IRENA is well-placed to either fill some of the needs itself, or catalyse further activities in them. It should be noted upfront that several international organisations and multilateral banks are already conducting such activities. IRENA should therefore coordinate explicitly with those already working on the matter. Below is a summary of activities that IRENA could undertake.

IRENA as a facilitator of technology cooperation to meet un-met needs: Stimulate RD&D cooperation, provide tools and training material for managing RE projects, help countries find funding.

IRENA as a promoter of strategic approaches in cooperative activities: Encourage continuity of activities, cooperation with private sector, good practices and regional cooperation.

IRENA as a coordinator and knowledge hub in renewable energy technology: Data repository, go-to place for independent information, effective dissemination, keep inventory of existing cooperation and centres.

IRENA as institutional support and provider of policy advice: Promote policy dialogue and learning, help countries establish centres and generate local innovation capacity.

GLOBAL CCS INSTITUTE

United Nations Framework Convention on Climate Change (UNFCCC)
Technology Executive Committee (TEC) Secretariat
tec@unfccc.int

RE: Call for input

Dear Sir/Madam,

I am writing to you in my capacity as the General Manager of the Policy and Membership Group at the Global Carbon Capture and Storage Institute (the Institute). The Institute became an accredited observer to the UNFCCC in late 2011.

The Institute accelerates the adoption of carbon capture and storage (CCS), a key solution in mitigating climate change and providing energy security. The Institute advocates for CCS as one of the options required to reduce greenhouse gas emissions, both from power generation and industrial sources. It shares information from its international Membership, while building capacity to ensure that CCS can become a widely-used technology as quickly as possible.

As an accredited observer, the Institute welcomes the opportunity afforded by recent decisions arising from the Third Meeting of the Technology Executive Committee (TEC) held in Bonn over the period of 28-29 May 2012.

The TEC called for inputs on:

- inventory on technology road maps and action plans;
- ways to promote enabling environments and to address barriers to technology development and transfer; and
- actions undertaken by accredited observer organisations relevant to the TEC in performing its functions.

The Institute hopes its views will positively assist the TEC in its deliberations on such issues at its Fourth Meeting expected to be scheduled in September 2012.

Please do not hesitate to contact Mr Mark Bonner, Principal Manager – Policy at mark.bonner@globalccsinstitute.com or on +61 (0)439 343 117 should you have any questions or additional requirements.

Yours sincerely,

Barry Jones

SUBMISSION TO

THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC) TECHNOLOGY EXECUTIVE COMMITTEE

Technology Executive Committee decision – Third Meeting:

- technology roadmaps and action plans;
- ways to promote enabling environments and to address barriers to technology development and transfer; and
- actions undertaken by observer organisations relevant to the TEC in performing its functions.

AUGUST 2012

Introduction

Announced by the Australian Government in September 2008, the Global CCS Institute (the Institute) was formally launched in April 2009. It became a legal entity in June 2009 when it was incorporated under the Australian Corporations Act 2001 as a public company and began operating independently and as a not-for-profit entity from July 2009. The Institute works collaboratively to build and share the expertise necessary to ensure that carbon capture and storage (CCS) can make a significant impact on reducing the world's greenhouse gas emissions. Please refer to the following website for further information on the Institute (www.globalccsInstitute.com/Institute).

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Overview

CCS is recognised by the United Nations Framework Convention on Climate Change (UNFCCC) as a technically legitimate mitigation option capable of delivering permanent abatement outcomes. It is also recognised as an eligible project level activity in the Clean Development Mechanism (CDM). This demonstrates that CCS activities can be readily and systematically institutionalised and rewarded in market-based mechanisms, and is internationally accepted as being consistent with the sustainability development requirements of developing countries.

CCS consists of four components:

- emissions sources (where CO_2 emissions are produced);
- CO_2 capture (where a physical or chemical separation process isolates CO_2 from other components in the source's exhaust gas);
- CO_2 transport (moving the captured CO_2 from point source to a sink); and
- CO_2 storage (where CO_2 is injected into a geological formation and subsequently isolated from the atmosphere).

CCS has the potential to deliver one of the single largest emissions abatement outcomes of all currently known mitigation options. The International Energy Agency (IEA) estimates that CCS could contribute about 19 per cent of the required abatement by 2050[1]. The Intergovernmental Panel on Climate Change (IPCC) estimates that CCS could contribute between 15 and 55 per cent of the required abatement by 2100.

[1] to hold atmospheric concentrations of greenhouse gases to about 450 parts per million (ppm)

CCS can also drive negative emissions (i.e. remove greenhouse gas emissions from atmosphere) when combined with carbon neutral energy feedstocks (i.e. sustainable biomass) and permanently storing the captured emissions deep into the geological sub-surface.

Third Meeting of the Technology Executive Committee

In May 2012, the Institute attended the TEC's Third Meeting in Bonn. The meeting included a dialogue on technology research, and while no specific discussion on CCS was held, much of what was discussed was directly applicable to the challenges of deploying large-scale clean energy technologies such as CCS.

The meeting included a discussion on the TEC's evaluation of the bids to host the Climate Technology Centre (CTC), noting that it will now begin negotiations with the United Nations Environment Programme (UNEP) whose application ranked the highest. The Institute acknowledges the critical role that the CTC can and must play in assisting the successful deployment and diffusion of environmentally sustainable large-scale clean energy technologies in developing countries, including CCS, and welcomes the decision to appoint UNEP as the host.

The Institute also supports the TEC's intent to continue with its thematic dialogues on technology at its meetings, complemented by consideration of various inputs by relevant public and private sector organisations. The TEC is examining how it might better engage with other UN (i.e. CTC, Green Climate Fund) and non-UN institutions (i.e. intergovernmental organisations such as the IEA and other similar organisations to the Institute).

The Institute strongly applauds the TEC's position of encouraging private sector expression on its capacity to support clean energy technology development and project implementation experiences, and it remains at the ready to enthusiastically engage as is deemed appropriate and allowed in all TEC processes. While no formal reporting relationship exists between the TEC and the CTC, the Institute is also committed to proactively support UNEP in its role as host of the CTC, especially as a potential participant in the supporting technology networks.

The TEC established an internal taskforce of Committee members to document existing roadmaps in a report to be potentially presented to the Eighteenth Meeting of the Conference of Parties (COP 18). This current call for submissions will inevitably help the TEC to compile such an inventory of relevant work.

The work of the TEC will be instrumental in providing the COP with the advice it needs to give effect to low-emissions technology (LET) decisions (including both mitigation and adaptation) that can further support and assist deployment in developing countries. The Institute's interest in the mitigation aspect of this agenda is to serve as a primary channel of information on CCS related matters, and influence the institutionalisation of CCS within UNFCCC processes through evidence-based advocacy.

As such, the Institute considers that several current UNFCCC agendas are important to the successful deployment of CCS technologies, including the:

- need for, and the evolution of, ever-increasing carbon constraints through the implementation of the Kyoto Protocol's second commitment period and the development of the Durban Platform for Enhanced Action;
- negotiations on the institutional arrangements supporting the UNFCCC's organisations and mechanisms such as the Green Climate Fund (GCF), the Technology Mechanism (including the CTC&N), and new market based mechanisms (NMBMs);
- finalisation of the outstanding issues affecting the institutionalisation of CCS in the CDM, including the approval of appropriate project level methodologies; and
- operationalisation of UNEP as the host of the CTC, and the processes that will underpin the selection and operation of the supporting technology networks.

Inventory on technology road maps and action plans

In the next decade, CCS technologies will have a significant impact on the ability of the global community to hold greenhouse gas emissions to an atmospheric concentration level where the dangerous impacts of climate change can be avoided.

The benefits of a successful deployment of CCS technologies as a primary mitigation option to prevent emissions to atmosphere will be apparent in terms of: provision of reliable and clean base-load energy; avoidance of many environmental issues that afflict other large-scale clean energy options (such as land-use, fracking processes, substantial water-use, radiation); prevention of many health problems (as a consequence of particulate pollution and/or climate change related impacts), and sustainable industrial production processes capable of supporting continued economic prosperity.

Most roadmaps offer readers analytical insights into the future prospects and transition pathways of technology solutions including: areas of convergence and complementarity with other technologies; development of new applications; and information that aims to inform future deployment strategies, technologies, markets and investment opportunities.

The development of technology roadmaps tend to bring together core stakeholders (governments, industry participants, research community, civil society) who have an interest in better understanding the potential of a particular technology/technologies to deliver on a broad range of stated policy objectives, as well as identifying key roles.

For CCS, roadmaps often cite the policy drivers as: ensuring base-load energy reliability, delivering large-scale, timely and dependable mitigation outcomes, and/or obtaining a social license for projects to operate through the public acceptability of industrial operations. Other potentially relevant global and national challenge considerations, other than those mentioned above, might include:

- capturing economic opportunity (such as optimising the value of natural resource endowments (such as fossil fuels) in a sustainably responsible manner;
- national security issues and energy independence; and
- global competitiveness and productivity of industry.

Roadmaps usually outline future transition pathways derived under varying scenarios, constraints and time horizons, and often include an exploration of variables such as:

- enabling drivers (market push versus market pull instruments);
- resources required (including nature and scale of financial investment);
- commercial opportunity (size of market potential or market penetration capacity);
- policy, regulatory, and technical barriers (including market failures);
- financial and technical risks (including contingency risk management and premiums); and
- potential to address global and national challenges (as referred to above).

Scenarios explored tend to include exogenous constraints as defined in terms of time, mitigation aspirations and/or share of energy contribution. Themes examined tend to include the potential of:

- technologies that are currently considered commercial or mature;
- technologies that are currently under development with expectation of commercialisation within say a decade; and
- long-term (often characterised as 'blue sky') technologies and applications – including step-change and/or disruptive technologies capable of materially impacting on existing production processes.

All roadmaps are products of the scope of their analytical frameworks including assumptions and data generation approaches. This can often call into question the extent to which the reports:

- capture all of the key technological developments and potential applications;
- reflect the most current published and unpublished data and intelligence relative to what is contained in the reports; and
- identify all key issues, opportunities, risks, barriers and potential of technologies to deliver on the stated policy objectives and/or constraints.

While roadmaps are mostly valued as a theoretical tool by policy makers to assist them propose and design approaches to better support technologies through their innovation chain (concept to commercial) and/or project lifecycle (planned to operational), they are also essential in determining the likelihood of global and national challenges being effectively addressed under current policy settings, what sorts of changes to the prevailing policy and regulatory environments may be deemed necessary, and the roles of key entities.

While the Institute has not produced a CCS roadmap, it has supported many organisations and governments in their consideration and development of their own roadmaps. For example, the IEA's CCS Unit depends on substantial financial support from the Institute. The Institute is also a key participant in agendas such as the Carbon Sequestration Leadership Forum (CSLF), and capacity development efforts in many developing countries.

The following two tables represent a broad (not exhaustive) inventory of CCS related (possibly not specific) roadmaps known to the Institute. Table 1 includes roadmaps for specific countries, while Table 2 lists roadmaps of a generic nature. They have been prepared by national governments and/or non-government organisations (NGOs), intergovernmental organisations, or financial institutions.

The Institute is not in a position to express a view on the merits or value of these roadmaps and plans of action, and provides the inventory list on the basis of information purposes only.

Table 1: Country level CCS roadmaps

Country	CCS Technology Roadmaps and Action Plans
Australia	Carbon Storage Taskforce, National Carbon Mapping and Infrastructure Plan – Australia
	National Low Emission Coal Council, National Low Emission Coal Strategy: Accelerating Carbon Capture and Storage in Australia
Brazil	Centre of Excellence in CCS R&D, The Brazilian Atlas of Carbon Capture, Transport and Geological Storage (in process of being published)
Canada	Natural Resources Canada, Canada's Clean Coal Technology Roadmap
	Natural Resources Canada, Carbon Capture and Storage: CO2 Capture and Storage Roadmap
China	Asian Development Bank, People's Republic of China (PRC): Carbon Dioxide Capture and Storage (CCS) Demonstration - Strategic Analysis and Capacity Strengthening
Greece	Bellona, A Bridge to a Greener Greece: A Realistic Assessment of CCS Potential
Hungary	Bellona, The Power of Choice: CCS Roadmap for Hungary
Indonesia	Indonesia CCS Study Working Group, Understanding Carbon Capture and Storage Potential in Indonesia
Malaysia	Global CCS Institute, Ministry of Energy, Green Technology and Water, Clinton Climate Initiative, Malaysia CCS Scoping Study (not published)
Mexico	North American Carbon Storage Atlas (including Mexico)
	Secretariat of Energy, National Energy Strategy 2012-2026

Country	CCS Technology Roadmaps and Action Plans
Poland	Bellona, Insuring Energy Independence: CCS Roadmap for Poland
Romania	Bellona, Our Future is Carbon Negative: A CCS Roadmap for Romania
South Africa	Geological Atlas
	South Africa Centre for CCS, Roadmap Strategy
South East Asia	Asian Development Bank, Determining the Potential for Carbon Capture and Storage (CCS) in Southeast Asia (in process of being published)
United Kingdom	Department of Energy and Climate Change, CCS Roadmap: Supporting deployment of carbon capture and storage in the UK
	Scottish Government and Scottish Enterprise Carbon, Capture and Storage – A Roadmap for Scotland
	UK Energy Research Centre, The UKER/UKCCSC Carbon Capture and Storage Roadmap
USA	DOE/NETL, Carbon Dioxide Capture and Storage RD&D Roadmap
	NETL, Carbon Sequestration Technology Roadmap and Program plan

Table 2: Generic CCS roadmaps

Organisation/Agenda	Technology Roadmap and Action Plans
Asia Development Bank (ADB)	Asian Development Bank, Carbon Dioxide Capture and Storage Demonstration in Developing Countries—Analysis of Key Issues and Barriers
Carbon Sequestration Leadership Forum (CSLF)	Carbon Sequestration Leadership Forum, Technology Roadmap 2011: A global response to the challenge of climate change
Clean Energy Ministerial (CEM)	Global CCS Institute (in collaboration with a sub Working Group of the Clean Energy Ministerial), CCS Funding Mechanisms for Developing Countries
International Energy Agency (IEA)	IEA, Technology Roadmap Carbon Capture and Storage
	IEA, A Policy Strategy for Carbon Capture and Storage
IEA and United Nations Industrial Development Organisation (UNIDO) sponsored by the Institute	UNIDO/IEA, Technology Roadmap Carbon Capture and Storage in Industrial Applications
The World Bank	World Bank, Carbon Capture and Storage in Developing Countries: a Perspective on Barriers to Deployment

Ways to promote enabling environments and to address barriers to technology development and transfer

The Institute's flagship report on the global status of large-scale integrated CCS projects (LSIP), *The Global Status of CCS: 2012*, is expected to be publicly released in October 2012. The latest status of CCS projects, as at June 2012[2], indicates that there are currently 73 LSIPs around the world. This includes 15 LSIPs that are currently operating or in construction, and capturing some 35.4 million tonnes of CO_2 per year ($MtCO_2$). A further 58 LSIPs are in the planning stages of development (i.e. pre-financial investment decision stage, covering from concept identification to financial and technical feasibility evaluations), with an additional potential capture capacity of more than 115$MtCO_2$ per year.

These projects provide examples of viable business cases for CCS technology given specific circumstances. *The Global Status of CCS: 2011* revealed that a number of LSIPs had been cancelled or put on hold over the previous 12 month period, with reasons anecdotally given as adverse project economics under their current design, reflecting an insufficiency of prevailing policy environments rather than engineering failures.

The 2011 Report also indicated a healthy evolution of early stage CCS projects, in that there had been substantial movement over the two previous years between the early project lifecycle stages. The report cites: *that the low number of projects in the Identify stage should not … be viewed as an adverse development ... as projects are advancing through the project lifecycle out of the Identify stage*.

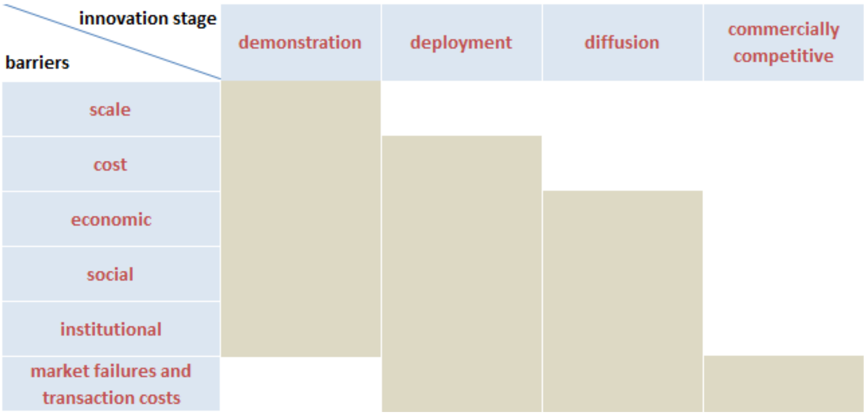
CCS project activity is predominantly in the demonstration phase, and this partly explains why the focus of many governments to date has been mostly on providing public funding for pilot and demonstration-scale projects. But it is vitally important that governments continue to send strong policy signals during the demonstration phase that the institutional arrangements (including legislative and regulatory frameworks) can and will be in place in a timely manner to efficiently support the early stages of commercial deployment.

In the absence of stable and predictable carbon regimes, private sector participation in CCS projects is typically reliant on the transitional pathways afforded by governments. These pathways need to be sufficient and robust enough to provide businesses with options to hedge their medium to longer term emission risks in a commercially attractive manner.

As illustrated in Figure 1 below, the nature of the barriers that afflict the demonstration and deployment of large-scale clean technologies, including CCS, change over the innovation stage. The efficiency and effectiveness of policy responses depend on the innovation stage being supported, and the extent to which complementarity between policies is implemented. It might be expected that as more market based policies are established, existing policies will be reviewed, revised and possibly even abandoned over time.

[2] http://www.globalccsinstitute.com/publications/global-status-ccs-update-june-2012

Figure 1: Barriers to deployment



source: UNFCCC/SB/2009/3 7 May 2009 (Figure 5)

Many countries are engaging in robust public policy discussions on major next generation climate change policies (refer to the Institute's *The Global Status of CCS* for updates on policy developments). There are also innovative industry led initiatives which aim to secure broad support for policies that increase energy security (i.e. domestic oil supply or electricity supply) while limiting and managing emissions through CCS.

As indicated, the current enabling environment for large-scale clean energy technologies such as CCS is largely reliant on governments adopting appropriate policy settings to: address inherent market failures; their public sectors to subsequently and efficiently implement the policy settings (i.e. policy in many cases drives the economics of projects); and the capacity and propensity of the private sector to respond to those settings.

There are a number of reasons why governments intervene to address market failures, including to:

- correct for externalities (i.e. either in terms of the harm caused by the release of CO_2 in the atmosphere or an inability to monetise the full benefit of investing in research and development activities);
- provide public goods (i.e. as learn-by-doing (LBD), information generation);
- address imperfect markets (i.e. monopolistic structures often found in distribution networks);
- address imperfect information (i.e. information asymmetry between decision makers and market participants); and
- oversee vertically integrated markets (i.e. different ownership structures between markets can result in the undersupply of a service or capacity).

The capacity of any bureaucracy to give effect to overarching policy settings and implement programmes is critical to the successful deployment of any technology. If implementation is inefficient (i.e. made overly administratively burdensome or prescriptive) or ineffective (i.e. insufficient or not dependable) then the policy objectives are unlikely to be met, and can often impose undue cost on related economic activities – further undermining and/or slowing the rate of LET deployment.

Capacity development for policy makers, regulators and project developers is very much a priority focus of the Institute's work program in its efforts to enhance the global capacity to accelerate the deployment of CCS (refer to the next section).

While government programs are often implemented on the basis of supporting technology development to deliver positive spillover effects (such as LBD), the success of large-scale clean energy projects is also linked to the: ability of project proponents to strike compelling business cases; and the extent to which proposals can deliver on a broad range of investor/s interests, such as (among others):

- investment viability under current and likely future policy regimes (including expected duration of policy frameworks);
- sovereign risk associated with changes to prevailing (or announced) policies or incentives, and the way this affects existing investments;
- financial attractiveness of projects relative to other investment opportunities (including outside the energy sector); and
- maturity and risk of the technologies being considered.

Investors (both private and public sector) often need to strike a balance between the likelihood of realising the benefits of risk-adjusted rates of return over time (i.e. risk premiums reflect the nature of the associated risks), with the ability to minimise the cost of delivering a broad range of objectives, such as sustainably operating in carbon constrained environments and/or satisfying eligibility requirements to claim project level abatement as tradable offsets. If investment hurdle rates rise unacceptably over time, project developers may decide to mothball a project completely or to put it on hold indefinitely.

As shown in Figure 1, government support for large-scale and pre-commercial demonstration projects (such as CCS, solar thermal with energy storage, geothermal) can help drive the benefits of scale. Most technologies have learning or experience curves which arise from the positive spillovers of experience and LBD at and across the various stages of a technology's lifecycle. This can often drive over time, as a technology's footprint globally expands and engineering efficiencies gained, material reductions in the price point per unit installed. This clearly has a subsequent positive impact on the future cost of mitigation efforts.

Positive LBD effects for CCS are currently being generated by countries with a high reliance on fossil fuels to drive economic activity, as well as high emitting sectors with either relatively low CCS costs (such as natural gas processing and enhanced oil recovery) and/or low trade exposure (such as the power sector). This is driven to a large extent by the common nature of CCS operational requirements such as geological site characterisation, emissions monitoring, reporting and verification (in both the surface and sub-surface), and project approvals processes (including risk assessments and securing public acceptability).

Evidence that positive spillovers result from these learning curves is demonstrated by the price of photovoltaic (PV) modules, which have fallen by some 60 per cent per megawatt (MW) since 2008, and wind turbine prices which having fallen by 18 per cent per MW over the period 2009 to 2010[3]. The potential economies of scale for CCS, especially for capture technologies (which can contribute between 60 to 80 per cent of the total cost of an integrated system) and CO_2 pipelines is significant, especially when considering the scale of

[3] Investment Grade Climate Change Policy - Financing the Transition to the Low Carbon Economy, p7 (2011)

opportunity to apply CCS to global industrial applications such as power generation and steel production, and the volume of CO_2 needing to be transported (i.e. the daily volume of CO_2 needing to be handled by 2050 could be some 2.5 times the current volume of oil being produced and transported[4]).

The IEA has recently released an information paper titled *A Policy Strategy for Carbon Capture and Storage* (January 2012), as a guide to policy makers to assist them in designing national and international policy related to CCS. It highlights that CCS policy needs to address: the creation of new markets (such as new mechanisms currently being explored under the UNFCCC agenda and national emissions trading/offset schemes); market barriers and failures, and promotion and regulation of infrastructure. The IEA observe that not only is the policy architecture (i.e. what the policy objectives are, such as addressing certain types of market failures) important but so too is the selection of policy instruments to address certain issues, and to support technologies as they inevitably evolve and mature over time.

The IEA examine a ‘gateway’ approach to CCS policy development that provides for changes in policy focus over time as CCS technology matures. For example, CCS is currently in a pre-commercial large-scale demonstration phase. This phase aims to not only firm up manufacturer engineering performance guarantees that can reduce the technical risk of commercial project investments, but also to enhance the LBD effects and information generation that ultimately helps drive down the cost of deployment over time.

Demonstration projects also provide time for the necessary institutional arrangements to be established such as appropriate regulations to govern industrial-scale activities, and the required distribution infrastructure (i.e. pipelines and other transport networks).

While first and second of a kind technology projects are less about providing short-term abatement, as large-scale and generally long-lived (40+ years) assets, many will ultimately need to transition to commercial operations after the demonstration phase is completed (say between 5 and 10 years).

A policy framework that can deliver on the needs of large-scale CCS demonstration projects is very different to the commercial needs of CCS deployment, and so a ‘gateway’ approach can help trigger a need to revise, and provide for, a predictable transitioning of a prevailing suite of policy settings to a new and more appropriate suite of policies in a timely manner.

Currently, CCS projects need policy support to generate LBD to drive the costs of construction and operation downwards. Over the short to medium-term, CCS projects will need the type of policy support that drives commercially attractive mitigation and energy. The former application may benefit from a policy portfolio of strong international collaboration and direct funding support to assist with the high upfront capital costs. The latter from more regulatory and/or market based approaches to assist with the longer-term operating costs. The IEA report provides a sound synopsis of the policy options at the various stages of CCS developments.

[4] M Bonner, Carbon Dioxide (CO_2) Distribution Infrastructure: The opportunities and challenges confronting CO_2 transport for the purposes of carbon capture and storage (CCS), Global CCS Institute

Actions undertaken by accredited observer organisations relevant to the Technology Executive Committee in performing its functions

The Institute has been engaged in the UNFCCC since 2010 (COP 16). The UNFCCC agenda continues to evolve since COP 16 (Cancun) and COP 17 (Durban) with many new agendas arising that either directly affects the ability of CCS to be deployed globally and/or national climate change policy settings capable of supporting the development of CCS.

The Institute has a number of work programs that aim to: leverage the LBD from the existing global fleet of planned and active CCS projects; enhance the capacity of policy and rule makers to implement policy architectures capable of efficiently supporting and effectively governing CCS activities; and a capacity development program aimed at facilitating the development of enabling environments in developing (non-Annex I) countries.

The Institute's focus on projects, policy and regulatory culminates in the release of its annual flagship report, *The Global Status of CCS*. The Institute regards the active interaction and dialogue between governments (for which it has 37 national and provincial Members), policy makers and regulators, and industry (for which it has over 310 Members) essential in distilling information to optimise the LBD effects, optimise planning and policy deliberations, and ultimately helping to bring down over time the cost of construction and operation of CCS plants and integrated systems.

The Institute's capacity development approach is tailored to the specific needs and situation of each country, and involves:

- conducting a needs-based scoping study, ideally with a key country stakeholder as the lead author;
- undertaking a capacity assessment, in consultations with key stakeholders;
- a tailored capacity development program of activities based on the scoping study and capacity assessment, as well as designed in consultation with key stakeholders;
- implementation activities, and evaluations and refinement of the capacity development program; and
- development of reports, case studies, webinars and the like that can be assessed by a broader audience.

In addition to the information provided in Attachment 1 (as the TEC requested), the Institute would be pleased to present to the TEC its current work plan in more detail and discuss ways in which the Institute may value-add to the TEC's decision making and functional operation.

Annex II

Ways to promote environments and address barriers to technology development and transfer

The following is a submission to the Technology Executive Committee (TEC) from the World Business Council for Sustainable Development (WBCSD) as a response to the request for input on ways to promote enabling environments and address barriers to technology development and transfer in relation to TEC work plan.

For this submission we would like to reiterate our understanding that the role of the TEC would be at a high-level focusing on international policy guidance and advice, gap analysis, coordination, facilitation of activities, fostering cooperation rather than on implementation at a national or regional level which would be the preserve of the Climate Technology Centre and Network (CTCN).

Why enabling frameworks?

Appropriate enabling frameworks can reduce the risk of investment and attract low-carbon technology deployment. The appropriate environment to attract low-carbon investment in available technologies will need to be determined nationally and/or regionally. Countries would be supported by the work of the CTCN to identify and build an environment which is conducive to business investment. The role of the TEC would be to create the international policy framework and guidance to support this. This could include recommendations for enabling frameworks, facilitating a knowledge bank, fostering partnerships to support capacity building and training and working with other institutions to roll out support programmes.

The "right" public framework, or environment, can also enable research and development, and demonstration and piloting early deployment of a range of technologies that support the transition to a low-carbon economy. These "enabling environments' will need broader more focused approaches for specific technologies - these could include public private partnerships, creation of consortia etc. and may require international support policies. Here the role of the TEC for strategic vision and climate public funds could be critical. Examples of these would be in the research, development and demonstration phases of as yet non-commercial technologies including forest genetics, fuel cells, and carbon capture and storage (CCS).

There has been a lot done on technologies that mitigate greenhouse gas emissions, including the full research and development to commercial deployment chain, and mapping out the roadmaps for low-carbon technologies in general and for some specific categories. Less appears to have been done in terms of technologies that could support adaptation and resilience. The TEC could go far in addressing this balance and drawing attention by focusing some work on the gaps including adaptation road maps and action plans. One critical area is the question of climate resilience in the electric utility sector, but other sectors will need to consider the impacts of climate change on their businesses.

The business case

Current estimates by IEA in the 2011 WEO estimate that based on government pledges and plans, 38 trillion US dollars of in cumulative spending between 2011 and 2035 will be needed in energy supply-related investment. Roughly two thirds of this will be in developing countries. Such a scale of investment will have an enormous impact on a range of actors- including all businesses along the value chain, academia, workers and communities. At the same time, there will need to be considerable investment in energy efficiency so that economies can grow while reducing energy use.

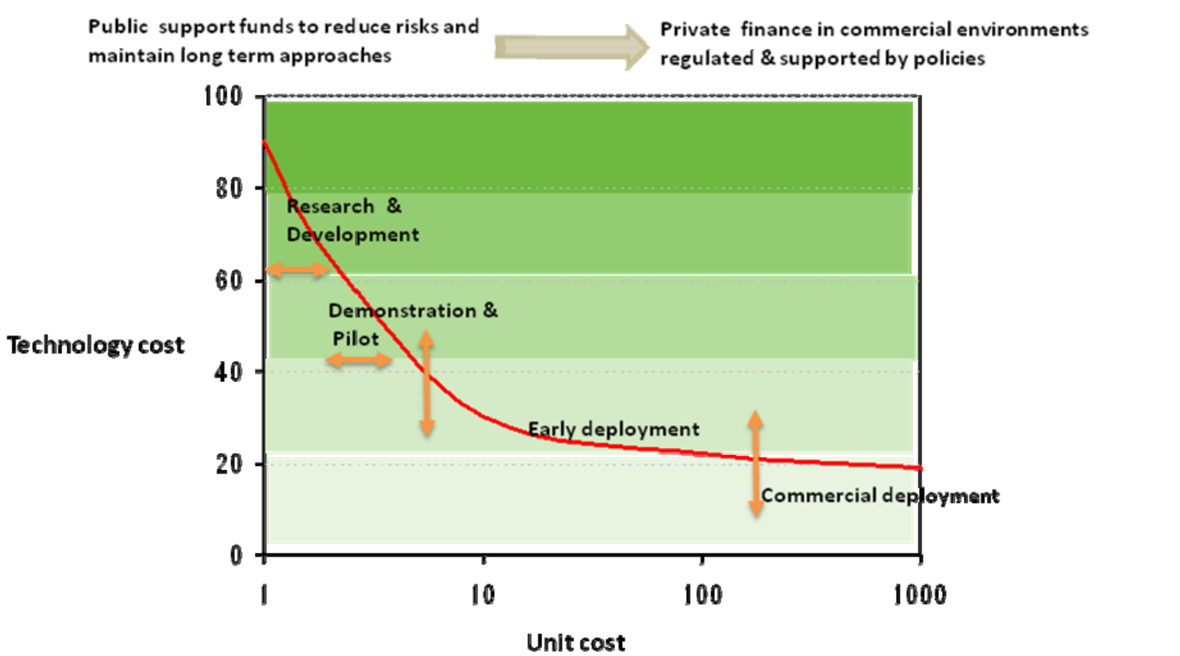
Business is the main source, developer and deployer of technologies in the world. Business carries out the full range of the technology cycle from research through to deployment. At each stage there are commercial reasons for the activity. Business carries out research to develop new products for a new demand or a potential future demand, to improve existing technologies and to remain competitive. Business deploys technologies as part of a **commercial** activity – either as sales to another concern, as a part of its own project or investment. It is this commercial driver that supports the continuing development of new products and deployment of technologies.

Business has finite resources and hence invests its capital and resources where it can be put to best use, ie in projects that produce a sufficient return to fund future investment. Good projects or proposals tend to get the necessary financial backing and business support. There are already flows of circa 55 billion US dollars[1] flowing annually from the private sector to developing countries for low- carbon technologies, but the estimates indicate that this needs to be seriously scaled-up. How can this be done?

There are many advantages in learning from what has worked and is working to allow clean energy investments. There is no single factor or set formula that attracts business investment rather a mix of elements ranging from government strategies and policies, regulations, capacity, financial and economic considerations and legal frameworks which work together to make projects attractive. Different technologies and the different stages of the technology cycle have different need-mixes to reduce the risks and increase the incentives for investment.

In the case of the different stages of technology, as one moves from left to right along the curve the considerable costs and risks relating to technology research, development and demonstration give way to a commercially viable technology which is affordable.

The diagram below illustrates different stages:



The TEC should consider developing its strategy using a framework like this. What is needed to ensure commercial deployment of low-carbon technologies? Which technologies in the pipeline could make the most difference and how to accelerate implementation? What needs to be supported for pilot and demonstration projects and where? What are the broad range of policies available that incentivize the deployment of these technologies? It is assumed that the CTCN would advise countries on which ones to adapt for their specific circumstances.

[1] CPI 2011 The Landscape of Climate, Climate Policy Initiative, October 2011

The potential policy responses are illustrated in more detail with real technology examples in the following diagram taken from the WBCSD Enabling Frameworks publication of 2010:

	LONG TERM		MID TERM	SHORT TERM		
	DISCOVERY	DEVELOPMENT	DEMONSTRATION	DEPLOYMENT		
Technology type	Breakthrough	New in experimental phase	Almost mature but not yet competitive	DEVELOPED COUNTRIES Mature and almost competitive	DEVELOPING COUNTRIES Mature if carbon costs are internalized	ALL COUNTRIES Mature and competitive
Policy responses	• National R&D programs • Direct public support	• National R&D programs • Public support to pilot projects, fiscal incentives, loans	• Public funds for supporting infraestructure • International public-private funding to develop number of projects	• Carbon market • Complementary regulation: feed in tariffs, fiscal & financial incentives • Technology standards	• Carbon market linked to variety of mechanisms • CDM reform and new mechanisms	• Regulatory frameworks to facilitate diffusion • Public acceptance
Technology example	• Nuclear Fusion • Forestry genetics	• Fuel cell vehicles • Electric vehicles	• CCS • Generation IV nuclear • 2nd generation biofuels • Plug in hybrid cars	• Wind • Heat pumps • Solar thermal • Biofuels • Alternative fuels • PV • Concentrated solar		• Energy efficiency in buildings • Hydropower • CCGT • Nuclear • Advanced coal • Efficient combustion engines • Sustainable plantations
	INTERNATIONAL COOPERATION					

Source: WBCSD, 2009[2]

wbcsd

What are the enabling frameworks?

The following are the enabling frameworks that can help feed the drivers of business investment and catalyze scale-up of low-carbon investments in clean technologies in developing countries?

1. Strong signals from governments for low-carbon growth nationally and internationally, either through targets or regulatory measures

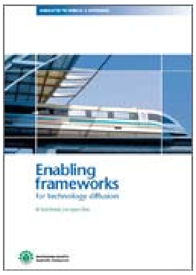
2. Adequate institutional frameworks that provide stable policies, transparent investment regulation and supportive local conditions

3. Appropriate absorptive capacity in institutions, business and society including a functioning education system, a receptive environment and targeted capacity building programs

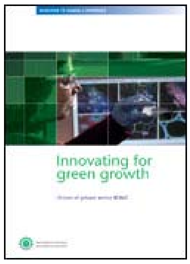
4. Economic and financial incentives to bridge the cost gap for low-carbon solutions and to make them commercially viable

5. Removing barriers such as perverse subsidies, introducing economic incentives and consumer outreach to maximize energy efficient measures.

These frameworks may be found in more detail in some of the work that the WBCSD has done on technology development and diffusion.

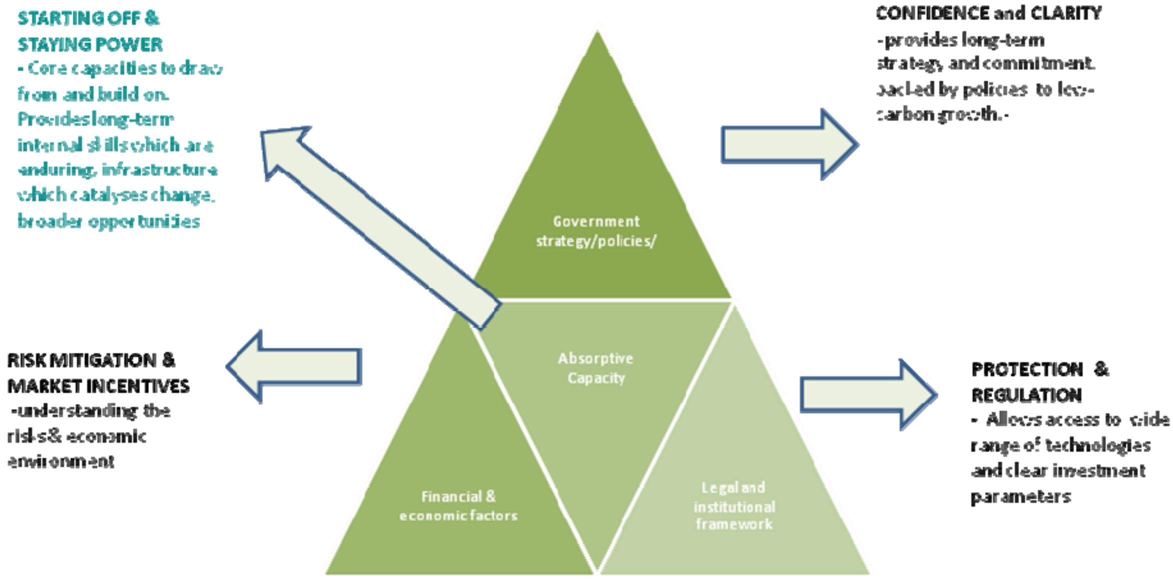


WBCSD member companies produced "Enabling Frameworks for Technology Diffusion" and "Innovating for green growth" as contributions to the EGTT discussions in 2009 -2010 These publications provide clear messages from business as well as providing more specific needs from the perspective of different sectors – power, cement, road transport, buildings and forestry. These publications are available on the WBCSD website.



WBCSD has worked with its members to disentangle the critical **drivers** for business investment – which accounts for more than 85% of foreign direct investment.

- Gaining ***competitive advantage*** in new markets
- Responding to a ***growing market*** for products, services etc
- Attracted by a ***supportive and vigorous business*** environment
- Provided with access to ***reliable information*** to understand the risks – financial, technical and manpower



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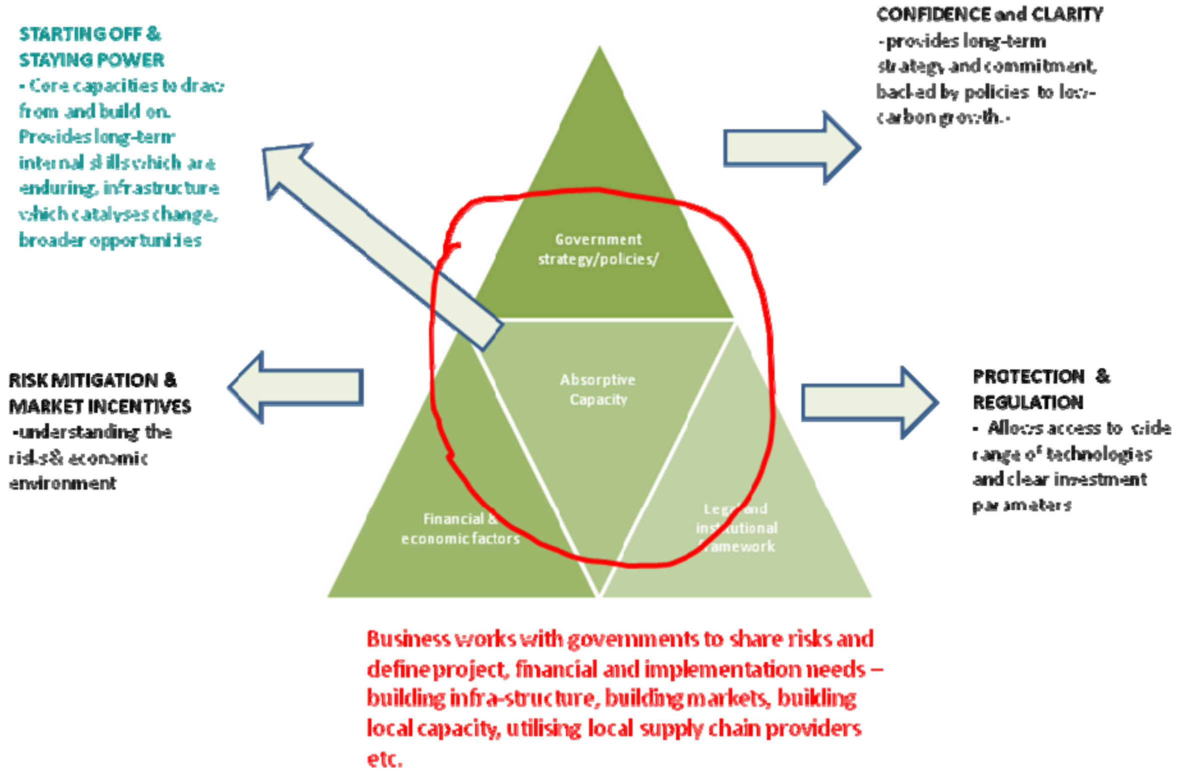
Of the above, **developing absorptive capacity** in developing countries is an essential pillar for low-carbon growth, which is often underestimated or even neglected. This involves investing in people, infrastructure and institutions:

- **people –** education at all levels, developing local business capacity, and ensuring appropriate training for government officials and municipalities, developing a technically skilled workforce and managerial capacity.
- **infrastructure** – a good road network to facilitate transport of resources, products, and workforce, bridges, grid systems, reliable electricity supply, suppliers, setting up industry clusters
- **institutions** – banking sector, support the development of the market, regulatory framework, protect IPR, disseminate information to public and local businesses, provide a secure environment.

Critical role of capacity-building

In this submission we want to focus on the importance of ***capacity building***, since companies believe is a fundamental and often neglected element in the development and deployment of low-carbon technologies.

Building capacity requires new forms of collaboration between the public and private sector. The private sector not only needs certain skills in order to invest but will also contribute to building up even more specialist skills during its investment. These partnerships have the potential of sharing knowledge and creating value.



Identifying and building capacity

Adequate capacity to develop and use technology is an important consideration for business when planning to invest in any country, as is the appropriate choice of technology. Below are some examples of what can support business investment:

- **Build trust between technology developers and users.** Many projects fail in developing countries because they use technology that is inappropriate due to lack local technical and managerial skills, ill-defined ownership, or lack of infrastructure. Any new technology framework should minimize these risks to ensure efficient diffusion of the appropriate technologies. Technology assessments should take a holistic approach that encompasses "host-country" capabilities with the technologies needed.

TEC should identify any gaps in the overall TNA approach which may need addressing to assure holistic approaches to technology deployment

- **Develop local management capability.** One of the biggest obstacles to technology deployment is the availability of skilled local business partners in some developing countries. For energy projects, especially renewable energy, a local partner who can put the deal together is critical. This demands business and political skills, along with strong ethics.

TEC could facilitate the sharing of appropriate regional and national information on potential partners

- **Be specific in identifying the needs.** Clear requirements create the opportunity for tangible solutions and are more meaningful and actionable than vague "we need technology" demands. Products and technology identified through systematic government processes including the Technology Needs Assessment under the United Nations Framework Convention on Climate Change (UNFCCC) are more likely to be addressed successfully.

TEC should identify any gaps in the overall TNA approach which may need addressing to assure holistic approaches to technology deployment

- **Collect necessary data for the implementation of appropriate policies appropriate policies**. Solid data is a prerequisite for policy-makers and business. This will help policymakers design the most cost-effective policy options and impact assessments, while business can reduce uncertainty and thus risk premiums. Often there is a substantial lack of reliable statistical data on issues such as energy use, infrastructure, or demand.

TEC should foster partnerships with development agencies and national institutions to promote improved data collection and data sharing

- **Be prepared to partner with business for solutions.** Many companies look to developing countries for growth opportunities. A country can create a bigger opportunity by selecting a few key technologies and competitively seeking partners who will work with them over the longer term on research, application development and deployment. Focusing a country's academic resources on the most appropriate technologies is crucial.

TEC could be instrumental in raising the awareness level on the opportunities for adaptive technology development and creative research possibly through competitive funding and prizes.

- **Address installation and maintenance as a key element of technology development or technology deployment**. Much of the focus around technology diffusion is on the manufacturing of technologies. For many energy technologies, scale and experience are needed to ensure quality products at cost efficient prices. Achieving indigenous manufacturing in every country is unrealistic. But building the infrastructure for these technologies and their maintenance, can lead to long-term, high-quality jobs related to installation and servicing of equipment. Utilize existing expertise.

TEC should foster partnerships between business, institutions, governments and training centres to build the next generation of skilled workers

Accessing the necessary skills

To create a pool of skilled workers and trainers, capacity building programs should be developed. These could utilize existing expertise by:

- **Establishing training and support services as a commercial activity.** Many large multi-nationals and consulting firms have capacity to provide detailed training and technical support. However, it would be rare for a business to divert those resources from other commercial activities.
- **Using external donor funds.** Traditional foreign aid projects are an effective mechanism to help address specific needs. This is especially true in areas such as the design of the regulatory system or staffing permitting processes. These are inherently government functions and critically important to enabling technology deployment.

TEC should foster partnerships between business, institutions, governments and training centres to build the next generation of skilled workers

Expanding the opportunities

- **Bundle opportunities for implementation.** Companies invest in countries and technologies that fit into their business strategy. Sometimes a single country might not be attractive for investment, but bundling different possibilities could create opportunities for implementation:
- **Bundle customers (or countries).** Companies will expend significant resources doing business in a country like China and India because the opportunities are immense. It is much harder to justify that effort in a small country. If countries with similar needs around a specific technology type are grouped together, the larger opportunity they present would be much more attractive for business.

- **Bundle solutions or services.** Some companies would be interested in providing a larger service, e.g. equipment or operation and maintenance across a range of infrastructure technologies, to create a bigger opportunity and present the upside of a long-term business relationship.
- **Bundle standard packages.** Standardizing bundled solutions or technology offerings to customers with similar needs is another way to speed up deployment. If the need for customized engineering can be reduced, costs typically come down.

TEC could be instrumental in providing sources of information – data, contacts, TNAs, projects to help guide prospective business investors

Real examples of partnerships

Case Studies

For WBCSD members these activities are part of their everyday activities. Over the years they have gained experience with investments in different corners of the globe and in different sectors. These provide valuable experiences and lessons of what to do and importantly what not to do. Failures provide powerful messages.

The power sector is a critical sector for all economies and in particular those which are still developing. It is also a sector which accounts for a growing high proportion of the emissions of most countries (Figures – circa 20%). The Global Sustainable Energy Partnership (GSEP) previously the E7 and E8, has been working with UN Energy to develop a recommendations for policy makers and private sector actors on Public Private Partnerships to promote deployment of low-carbon and zero- emitting electricity technologies.

These recommendations were developed following surveys with the actors involved – initially private sector and stakeholders, and then including the public sector and MDBs.

The case studies and recommendations for mutually effective PPPs are found attached in Strengthening Public-Private Partnerships to accelerate Global Electricity Technology Deployment 2011 & 2012 which may be accessed at http://www.e8casestudies.org and on page 45 of the report at
at http://www.globalelectricity.org/upload/File/2nd_edition_strengthening_ppps_-_joint_report_gsep-un-energy_2012(3).pdf

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CLIMATE INVESTMENT FUNDS

Response to Call for Inputs from the Technology Executive Committee

1. The Climate Investment Funds through a Technology Lens

Developing, demonstrating, deploying and diffusing environmentally sound technologies are activities that form part of the critical response to the climate challenge. As recognized by the United Nations Framework Convention on Climate Change (UNFCCC) and the Technology Executive Committee, the mitigation of and adaptation to climate change therefore depends upon the successful transfer and absorption of these technologies within developing countries.

The Climate Investment Funds (CIF) are a unique set of financing instruments that enable developing countries to jump-start their path towards utilizing technologies and approaches that support climate-smart development. CIF activities focus on facilitating the adoption of technologies and practices to promote energy efficiency policy development, renewable energy production, sustainable transport, climate change adaptation and best-practice forest use and management.

1.1 Overview of the Climate Investment Funds

The CIF's financial architecture is rooted in two trust funds. The Clean Technology Fund (CTF) finances scaled-up demonstration, deployment, and transfer of clean technologies, by piloting investments in countries or regions with potential for significant greenhouse gas (GHG) abatement. The Strategic Climate Fund (SCF) finances three programs that pilot new approaches in target sectors with the potential for scaling up: The Forest Investment Program (FIP), the Pilot Program for Climate Resilience (PPCR), and the Program for Scaling Up Renewable Energy in Low-Income Countries (SREP).

CLEAN TECHNOLOGY FUND (CTF) $5 Billion	**STRATEGIC CLIMATE FUND (SCF) $2.3 Billion**		
Demonstrate, deploy and transfer low emission technologies for low-emissions development	Targeted programs to pilot new approaches to initiate transformation with potential for scaling up climate resilience		
	PILOT PROGRAM FOR CLIMATE RESILIENCE (PPCR) $1.2 Billion	**FOREST INVESTMENT PROGRAM (FIP) $639 Million**	**PROGRAM FOR SCALING UP RENEWABLE ENERGY IN LOW INCOME COUNTRIES (SREP) $410 Million**
Renewables, energy efficiency, urban transport, commercialization of sustainable energy finance	Mainstream resilience in development planning	Reduced emissions from deforestation and forest degradation, sustainably manage forests and enhance forest carbon stocks	Demonstrate economic, social, and environmental viability of low carbon development in low income countries' energy sector
15 CTF country investment plans and 1 regional plan: Chile, Colombia, Egypt, India, Indonesia, Kazakhstan, Mexico, Morocco, Nigeria, Philippines, South Africa, Thailand, Turkey, Ukraine, Vietnam, Middle East and North Africa	**9 PPCR country pilots, 2 regional pilots**: Bangladesh, Bolivia, Cambodia, Mozambique, Nepal, Niger, Tajikistan, Yemen, Zambia, Caribbean, S. Pacific	**8 FIP pilots**: Brazil, Burkina Faso, Democratic Republic of Congo, Ghana, Indonesia, Lao PDR, Mexico, Peru	**7 SREP pilots**: Ethiopia, Honduras, Kenya, Maldives, Mali, Nepal and Tanzania

Figure 1: Overview of the Climate Investment Funds

The CIF provides developing countries with grants, concessional funds, and risk management instruments that leverage significant financing from the private sector, Multilateral Development Banks (MDBs), and other sources. Five MDBs-the African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (IDB), the Inter-American Development Bank (IDB), and the World Bank Group (WBG)-implement CIF-funded projects and programs.

At the country-level, governments and the MDBs work together with other development partners, including UN agencies and bilateral development agencies. These partnerships help mobilize national-level engagements, build on existing initiatives, and encourage contributions to the achievements of the programmatic objectives of the CIF.

1.2 Governance

The governance and organizational structure of the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF) includes Trust Fund Committees, a Partnership Forum, an MDB Committee, an Administrative Unit and a Trustee. The Administrative Unit, MDB Committee and Trustee are shared by both Trust Funds. Each Fund has its own Trust Fund Committee, and the SCF designates Sub-Committees to govern each of the targeted programs. Each Trust Fund Committee and Sub-Committee is composed of equal representation by contributor countries and eligible recipient countries.

1.3 Overview of Approach Taken

This report illustrates how the CIF promotes technology transfer and fosters an enabling environment for the diffusion of climate-smart technologies. The CTF and SREP have a clear focus on technology. In the case of the FIP and the PPCR an alternative approach to the analysis is taken as the links between, for example, forest management and technology transfer are not as explicit. Therfore the focus with the FIP and the PPCR will be on investigating how different sectors link to broader technological applications.

Section 2 of the report presents an overview of how the different programs within the CIF are designed to promote technology transfer (refers to point 1 in the Technology Executive Committee input call). Section 3 of the report goes on to identify how investments in CIF countries are supporting technology transfer and the creation of an enabling environment for further technology development (refers to point 2 in the Technology Executive Committee input call). Section 4 will give an overview of the main initiatives undertaken by the CIF in the area of knowledge management and stakeholder engagement that support the technologies and approaches being pioneered by the CIF (refers to point 3 in the Technology Executive Committee input call).

It is important to note that the CIF is a relatively new initiative and so a full assessment of the impacts of investments is not possible at this stage; instead, the report provides comprehensive information on the types technologies being implemented under the CIF and the extent to which CIF investment are facilitating the creation of an enabling environment for technology transfer in developing countries.

2. Operations of the Climate Investment Funds

This section outlines the various aims and objectives that underpin the different technologies and approaches being pioneered under the CIF. It describes the investment plans and project pipelines, which capture project activities and serve as proxies for technology maps and action plans.

2.1 Clean Technology Fund (CTF)

Background:

Large scale deployment of low-emissions technology is a critical step on the path to climate-friendly development solutions. However, there is a gap in development finance at a level that would enable developing countries to effectively scale-up the deployment of low-emission technologies.

The CTF is a multi-donor trust fund created in 2008 as part of the CIF to provide scaled-up financing for the demonstration, deployment and transfer of low carbon technologies that have significant potential for long-term GHG emissions savings. CTF resources amount to approximately US$5 billion. Leveraging in the CTF is approximately 1:8 illustrating how the concessional funding is raising additional finance from governments, other development partners and the private sector.

Scope of Activities:

The CTF aims to provide scaled-up financing to contribute to demonstration, deployment and transfer of low-carbon technologies with a significant potential for long-term GHG emissions savings. As country circumstances differ, investment programs are developed on a country-specific basis to achieve nationally-defined objectives.

Investments include, amongst others, low carbon actions addressing the power sector (renewable energy, as well as increased efficiency in generation, transmission and distribution); transportation (modal shifts to public transportation, improved fuel economy and fuel switching); and large scale adoption of energy efficient technologies and other demand management techniques in the industrial, commercial and residential building sectors.

Aims and Objectives:

Building on the scope of activities outlined above, the CTF aims to:

- Provide positive incentives for the demonstration of low carbon development and mitigation of GHG emissions through public and private sector investments.
- Promote scaling-up, deployment, diffusion and transfer of clean technologies by funding low carbon programs and projects that are embedded in national plans and strategies to accelerate their implementation.
- Promoting the realization of environmental and social co-benefits thus demonstrating the potential for low-carbon technologies to contribute to sustainable developments.
- Foster international cooperation on climate change and support agreements on the future climate regime.
- Utilize skills and capabilities of the MDBs to raise and deliver new and additional resources.
- Provide experience and lessons in responding to the challenge of climate change through learning-by-doing.

Overview of Current Pipeline:

To date, the CTF has endorsed 15 country investment plans (Chile, Colombia, Egypt, India, Indonesia, Kazakhstan, Mexico, Morocco, Nigeria, Philippines, South Africa, Thailand, Turkey, Ukraine, Vietnam) and 1 regional plan for Concentrated Solar Power (CSP) across Algeria, Egypt, Jordan, Morocco, and Tunisia. The pipeline below outlines the country-level programs and projects, the technologies, the implementation agencies and the expected co-financing.

Pilot Countries	Project Title	Technology Investments[1]	Multilateral Development Bank	Public/Private	CTF Funding	Co-Financing
Colombia	Sustainable Transport System (SITP)	Transport and Energy Efficiency	IBRD	Public	40.0	1,265.8
	Sustainable Transport System (BOGOTA SITP)		IDB	Public	40.0	960.0
	Energy Efficiency-Private-Public Sector Energy		IDB	Public	16.4	173.7
	Energy Efficiency-Public Sector		IDB	Public	10.0	105.3
	Energy Efficiency		IFC	Public	6.1	64.4
Egypt	Wind Energy Scale Up Program (IPPs)-200MW Wind farm in the Gulf of Suez	Wind and Transport	AfDB	Private	50.0	406.0
	Egypt Urban Transport		IBRD	Public	100.0	765.0
Indonesia	Indonesia Energy Efficiency and RE (Private Sector)- Global Climate Partnership Fund	Energy Efficiency and Geothermal	ADB	Private	50.0	500.0
	Indonesia-Geothermal (Public Sector)		ADB	Public	125.0	505.0
	Geothermal		IFC	Private	25.0	337.5
	Indonesia Geothermal (Private Sector)		ADB	Private	25.0	337.5
	EE/RE through FIs		IFC	Private	50.0	500.00
Kazakhstan	Renewable Energy III-Renewable Energy Development Framework Facility	Hydropower, Wind, Solar Power, District Heating and Energy Efficiency	EBRD	Private	28.4	100.0
	Renewable Energy IV		EBRD	Private	45.0	180.0
	District Heating		IFC	Private	20.0	90.0
	Energy Efficiency		IFC	Private	22.0	80.0
MENA-CSP	Egypt Kom Ombo CSP	Concentrated Solar Power	IBRD	Public	50.0	128.2
	Egypt Kom Ombo CSP		AfDB	Public	50.0	128.2
	Jordan Maan CSP		IFC	Private	36.5	383.9
	Jordan CSP Transmission		IBRD	Public	40.0	301.7
	Tunisia STEG CSP		IBRD	Public	37.0	342.6
	Tunisia STEG CSP		AfDB	Public	25.0	245.8
	Tunisia STEG CSP		IFC	Private	25.0	133.4
	Tunisia ELMED CSP		AfDB	Public	23.3	245.8
	Tunisia ELMED CSP		IFC	Private	23.3	133.4
	Tunisia ELMED Transmission		IBRD	Public	20.0	73.1
	Tunisia CSP Transmission		AfDB	Public	20.0	73.1

[1] Not exhaustive. Please see individual country Investment Plans for further details.

	Algeria Meghair CSP		AfDB	Public	38.7	195.3
	Algeria Meghair CSP		IBRD	Public	32.7	165.0
	Algeria Naama CSP		AfDB	Public	32.7	165.0
	Algeria Naama CSP		IFC	Private	16.3	89.5
	Algeria Hassi R'Mel CSP		IBRD	Public	15.0	-
	Algeria Hassi R'Mel CSP		AfDB	Public	15.0	168.4
	Algeria Hassi R'Mel CSP		IFC	Private	15.0	91.4
Mexico	Public Sector Energy Efficiency	Wind, Hydropower and Energy Efficiency	IDB	Public	51.6	231.5
	Renewable Energy		IFC	Private	14.4	144.0
	Energy Efficiency		IFC	Private	20.0	200.0
Morocco	Renewable Energy	Wind	IBRD	Public	25.0	174.0
Philippines	Philippines E-Trikes	Solar Power, Energy Efficiency and Transport	ADB	Public	101.0	400.0
	Philippines Energy Efficiency		ADB	Public	24.0	400.0
	Philippines RE/EE		IBRD	Public	45.0	722.5
	Philippines BRT		IBRD	Public	45.0	722.5
	Philippines BRT		IBRD	Public	25.0	150.0
South Africa	RE - SWH	Solar Water Heaters	AfDB	Private	25.0	220.3
	RE - SWH		IFC	Private	25.0	220.3
Turkey	Turkey Transmission -RE/EE Projects	Renewable Energy and Energy Efficiency	IBRD	Public	50.0	400.0
	Private RE -RE/EE Projects		IFC	Private	28.3	118.9
Ukraine	Energy Efficiency	Wind, Hydropower, Biomass, Smart Grids and Energy Efficiency	EBRD	Private	50.00	200.0
	Zero Emissions Power from the Gas Network		EBRD	Private	50.0	250.0
	Ukraine EE		IBRD	Public	50.0	430.0
	Ukraine HRSG		IBRD	Public	50.0	400.0
	Ukraine Transmission		IBRD	Public	50.0	300.0
	Energy Efficiency		IFC	Private	25.0	115.0
	Renewable Energy Financing Facility		IFC	Private	25.0	65.0
Vietnam	Vietnam Transport (HCMC)	Transport, Hydropower, Wind, Biomass and Energy Efficiency	ADB	Public	50.0	1,000.0
	Vietnam EE - Industrial Energy Efficiency		ADB	Public	50.0	215.0
	Vietnam Transport (Ha Noi)		ADB	Public	50.0	1,100.0
	Renewable Energy		IFC	Private	40.0	945.0

Table 2: CTF Pipeline[2]

[2] Based on June 2012 pipeline that is available online at: http://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org /files/CTF_PIPELINE_QUARTERLY_ACCTG_JUNE2012_C_ONLINE.pdf (these projects still need to be approved)

2.2 Program on Scaling-Up Renewable Energy in Low-Income Countries (SREP)

Background:

Low-income countries face a duel challenge in increasing the availability of electricity and other commercial fuels needed for economic development and increasing access to the 1.5 billion people who have no access to electricity and are completely dependent on biomass fuels for energy services.

The need to ramp up modern energy use in low income countries coupled with the availability of renewable energy resources provide a fertile opportunity to help countries secure a sustainable energy base. SREP was established to scale-up the deployment of renewable energy solutions, expand renewable energy solutions and develop renewable energy markets in the world's poorest countries. SREP aims to pilot and demonstrate the economic, social and environmental benefits available for the deployment of renwable energy technology in low-income countries vulnerable to energy insecurity. US$410 million have been pledged towards SREP as of June 2012.

Scope of Activities:

SREP provides financing for renewable energy generation and use of energy using proven "new" renewable technologies. In SREP, new renewable energy technologies include solar, wind, geothermal, bio-energy and hydropower (normally not exceeding 10 MW per facility). SREP also supports complementary technical assistance. This could include support for planning and pre-investment studies, policy development, legal and regulatory reforms, business development and capacity building as an essential and complementary part of the renewable energy investment operations. SREP investment plans are designed to support a country level programmatic approach to scaling-up renewable energy. Emphasis is placed on the long-term transformative outcomes and successful market transformative outcomes rather than individual investments or activities.

Aims and Objectives:

Building on the scope of activities outlined above, SREP aims to:

- Be country-led and assist countries in developing or strengthening policies for renewable energy.
- Take a programmatic and outcome-focused approach for investing in renewable energy. SREP funded programs should consist of both renewable energy and technical assistance, together with support for policy changes.
- Give priority to renewable energy investments that create 'value added' in local economies.
- Commit sufficient funding and leverage significant additional financing from MDBs, bilateral agencies/banks and from other public and private sources to achieve a large scale impact.
- Target the entire value chain, by utilizing the transformational potential of the private sector and civil society groups (including financial intermediaries) to achieve economic development and sustainability.
- Proactively seek to build on synergies with other programs in the field of renewable energy, including those of the MDBs, GEF and other development partners.

Overview of Current Pipeline:

SREP has selected 7 pilot countries (Ethiopia, Honduras, Kenya, Mali, Nepal, Maldives and Tanzania) to receive scaled-up financing for renewable energy investments that will help countries transition to a new pattern of energy generation and use. Additional funding was made available for the preparation of investment plans in 5 additional countries: Armenia, Liberia, Mongolia, Pacific Regional Program and Yemen. The pipeline below outlines the country-level programs and projects, the technologies, the implementation agencies and the expected co-financing.

Pilot Countries	Project Title	Technology Investments[3]	Multilateral Development Bank	Public/Private	SREP Funding (net of Project Preparation Grants)	Co-Financing
Ethiopia	Aluto Langano Geothermal Project	Geothermal and Wind	IBRD	Private	23.6	207.6
	Aluto Langano Geothermal Project		AFDB	Public	-	-
	Geothermal Sector Strategy		IFC	Private	1.5	-
	Assela Wind Farm Project		AFDB	Public	18.3	230
	Clean Energy SMEs Capacity Building and Investment Facility		IFC	Private	3.6	8
Honduras	Strengthening the RE Policy and Regulatory Framework (FOMPIER)	Electricity Infrastructure and Cookstoves	IDB	Public	0.9	0.7
	Grid-Connected RE Development Support(ADERC)-Transmission		IDB	Public	4	108.7
	Grid-Connected RE Development Support(ADERC)-Generation		IDB	Private	6.2	108.7
	Grid-Connected RE Development Support (ADERC)		IFC	Private	6.2	-
	Sustainable Rural Energization (ERUS)		IBRD	Public	9.8	12.3
	Sustainable Rural Energization(ERUS)-cook stoves(includes operational expenses for investment implementation for all component)		IDB	Private	2	12.3
Kenya	Menengai Geothermal Project-200 MW Geothermal-Phase A-Resources and Infrastructure Development and Mobilization of Private Sector	Geothermal, Wind and Solar Hybrid System and Electrical Infrastructure	AFDB	Public	-	478.0
	Menengai Geothermal Project		IBRD	Public	15	-
	Hybrid Mini-Grid System		IBRD	Public	10	58
Mali	Solar PV IPP	Solar Photovoltaic Energy, Rural Electrification Hybrid Systems (Solar, Biofuels) and Mini and Micro Hydro Power Plants	AFDB	Private	11.1	48
	Rural Electrification Hybrid Systems		IBRD	Public	15	40.5
	Development of Micro/Mini Hydroelectricity for Rural Electrification in Mali (PDM-Hydro)		AFDB	Public	8.8	126.5
	SREP-Mali Program Strategic Coordination		AFDB	Public	1.5	1.5
Nepal	Small Hydropower Development	Small Hydropower, Mini/Micro Hydropower, Solar Photovoltaic Energy and Biogas	IFC	Private	10	46.7
	Small Hydropower Development		ADB	Private	10	46.7
	Mini and Micro Initiatives: Off Grid Electricity		ADB	Public	11.4	131.4
	Waste to Energy Project		IBRD	Public	8	126.4

Table 2: SREP Pipeline[4]

[3] Not exhaustive. Please see individual country Investment Plans for further details.

[4] Based on June 2012 pipeline that is available online at: http://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/SREP_PIPELINE_QUARTERLY_ACCTG_JUNE2012_ONLINE.pdf (these projects still need to be approved with the exception of the Kenya Geothermal 200 MW Project)

2.3 The Pilot Program for Climate Resilience (PPCR)

Background:

Mainstreaming climate risk and resilience into core development planning is of paramount importance to developing countries as climate change poses an enormous threat to the development gains of the past couple decades and could hinder future sustainable development if left unchecked. The PPCR has around US$1.2 billion to develop comprehensive strategies that address challenges to key economic sectors exposed to climate risks.

Scope of Activities:

There is a wide range of activities being funded by the PPCR. The interventions target sectoral challenges and so it is possible to group the technologies according to sectors. Table 3 below is a comprehensive, though not exhaustive, enumeration of the technology-based interventions which are being funded by the PPCR.

Many adaptive measures rely on technological inputs or proven technologies in the particular sectors (see table 3 below). PPCR resources are being used to apply these technologies in the context of climate change adaptation in areas where financial constraints and investment priorities previously precluded their use or scaling-up

Aims and Objectives:

The overarching objective of the PPCR is to finance adaptation activities in those countries most vulnerable to climate change impacts.

Specifically, the PPCR aims to:

- Demonstrate ways to integrate climate change adaptation into core development planning via a country led programming process.
- Compliment existing adaptation strategies.
- Leverage additional financing for climate resilience.
- Generate lessons and experiences in designing scaled up adaptation financing.
- Build capacities across sectors to cope with challenges associated with climate vulnerability and change.

Overview of Current Pipeline:

To date, the PPCR is working in 9 countries and 2 regions (Bangladesh, Bolivia, Cambodia, Mozambique, Nepal, Niger, Tajikistan, Yemen, Zambia, Caribbean and the Pacific) and has 50 projects in the pipeline with a total projected value of around US$733 million. Each project utilizes PPCR resources to respond to a particular sectoral challenge, building resilience to climate change hazards through a myriad of adaptive measures. Figure 2 below depicts the relative sums of money being invested in applying technologies in the various climate affected sectors in the PPCR pilot countries.

Sectoral Focus	Development Challenge	Technological Application	Development Impact	Countries
Water Resources Management	-salt water intrusion -flooding -water stress -shortages -quality/sanitation	-desalinization plants -sluice gates -pumps -water tanks -drip irrigation technology -bore holes, -dams -treatment plants	-enhanced water security -water use efficiency -sanitation and public health -protection of lives and livelihoods	Bangladesh Mozambique Niger Tajikistan Bolivia Cambodia
Infrastructure	-vulnerable infrastructure (buildings and roads) -limited access to markets and public services post disaster event	-ottaseals, geocells, etc. to seal roads -paving and raising roads -groynes and beach protection and replenishment -housing design -culvert and drainage	-access to markets and public services (health and education) in bad weather -savings from avoided retrofitting -protection of life and livelihoods	Zambia Mozambique Samoa
Agriculture and Landscape Management	-infertile soil -low productivity -food insecurity -erosion	-mangrove restoration -adaptive crop varieties -drip irrigation and irrigation zoning -mulching -rehabilitation -nursery development	-sustainable production -food security -livelihoods -poverty reduction	Cambodia Nepal Tajikistan Mozambique Grenada Bangladesh
Coastal Zone Management	-beach erosion -destructive storm surges -fisheries decline -salt water intrusion	-mangrove reforestation -sluice gates -beach replenishment -regulators -drainage	-secure beaches -protection to coastal life and property -water security	Samoa Bangladesh
Urban Development	-vulnerability to flood -sanitation issues	-waste treatment -drainage technology -sanitary landfills	-sanitation and health	Bangladesh Cambodia
Climate and Information Systems	-misinformed planning -data collection -delayed response to hazards	-hydromet stations -GIS -climate modelling -clearing house mechanism	-evidence based decision making -improved disaster preparedness	Cambodia Mozambique Nepal Jamaica Yemen Caribbean Regional track Niger
Disaster Risk Management	-economic and physical vulnerability to climate change	-vulnerability mapping tools -GIS and shoreline mapping assessments	-minimize economic and physical risks from climate hazards	Dominica South Pacific Regional

Table 3: Scope of Technology Activities in the PPCR

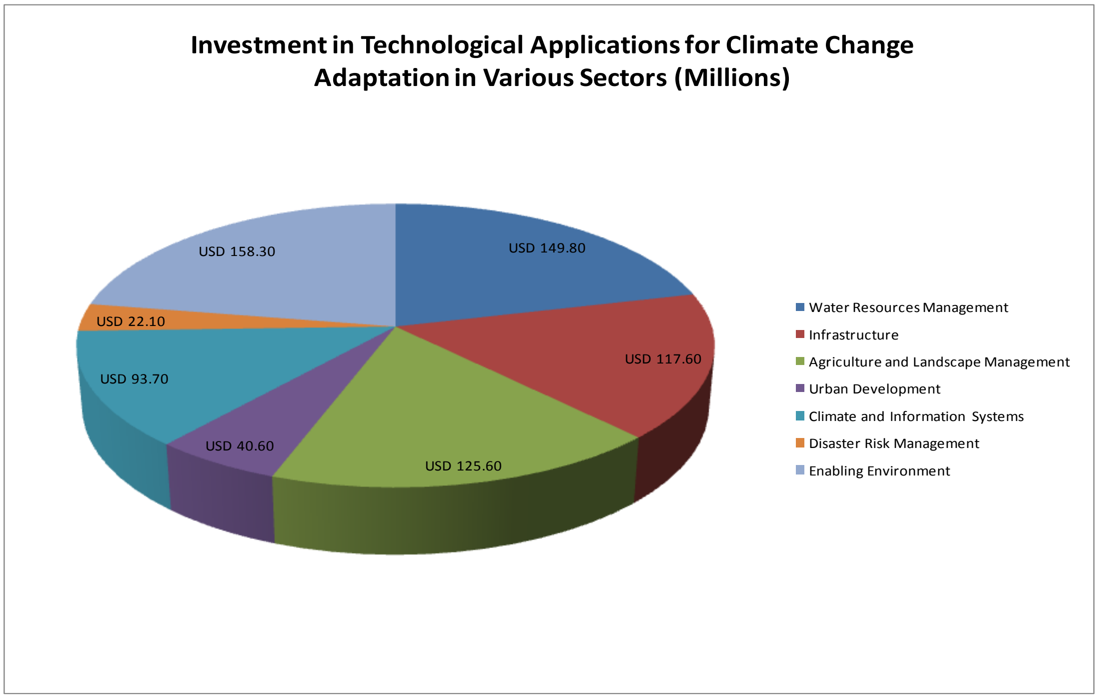

Figure 2 : Comparative Levels of PPCR Investments Across Key Sectors[5]

2.4 Forest Investment Program (FIP)

Background:

Land use and land use change account for the second largest source of GHG emissions, and as such are second leading cause of global warming. Although there are divergent opinions as to how deforestation and forest degradation should be included in any future climate change regime, there is an emerging consensus that this issue must be addressed effectively. Several reports indicate that tackling forest and tree loss is a critical activity in achieving stabilization of greenhouse gas concentrations in the atmosphere at a level that avoids the worst effects of climate change. FIP resources total approximately US$639 million dollars and 8 countries have been selected to pilot approaches to address deforestation and forest degradation.

Scope of Activities:

Similar to the PPCR, the activities under the FIP are not necessarily technology oriented but in meeting the FIP objectives, technology remains an important factor. Table 4 below gives a comprehensive, though not exhaustive, enumeration of the various technological applications that are being promoted in FIP. It is important to note here that the following analysis is based on the current pipeline representing only four (Brazil, Democratic Repulic of Congon, Lao PDR, Mexico) of the 8 FIP pilot countries. The remaining four are yet to complete programming their activities and as such are not included here.

[5] Sums are based on what is currently in the PPCR pipeline, and may be subject to change as the pipeline is updated. As such the numbers should be taken as taken as relative indicative sums and not conclusive estimates.

Aims and Objectives:

The main purpose of the FIP is to support developing countries' efforts in reducing emissions from deforestation and forest degradation and the enhancement of carbon stocks and conservation co-benefits. The FIP provides up-front bridge financing for readiness reforms and public and private investments identified through national REDD+ readiness strategies.

Specifically, the FIP aims to:

- Initiate and facilitate steps towards transformational change in developing countries forest related policies and practices.
- Serve as a vehicle to finance investments and related capacity building necessary for the implementation of policies and measures that emerge from inclusive multi-stakeholder REDD+ planning processes at the national level.
- Strengthenen cross-sectoral ownership to scale up implementation of REDD+ strategies at the national and local levels.
- Addressing key direct and underlying drivers of deforestation and forest degradation
- Support change of a nature and scope necessary to help significantly shift national forest and land use development path.
- Link the sustainable management of forests and low carbon development.
- Facilitate scaled-up private investment in alternative livelihoods for forest dependent communities that over time generate their own value.
- Reinforce ongoing efforts towards conservation and sustainable use of forests.
- Improve forest law enforcement and governance, including forest laws and policy, land tenure administration, monitoring and verification capability, and transparency and accountability.

Overview of Current Pipeline:

There are currently 12 projects in the pipeline with a total projected value of around US$178 million. Each project utilizes FIP resources to address the drivers of deforestation and forest degradation with a view to conserve forests and the ecosystem services provided by them. The drivers of deforestation operate across several sectors which affect land use and land use change and ultimately the extent of forest cover in any given country (see table 4 below). FIP funds are being used to promote technologies in various sectors to address the drivers of deforestation and forest degradation.

Figure 3 below depicts the relative sums of money being invested in applying technologies in the various sectors relevant to forest conservation as promoted in the FIP. It also shows the resources apportioned to creating an enabling environment for the use of technology and strategies to reduce deforestation and forest degradation.

Sectoral Focus	Challenge	Technological Application	Impact
Forestry (timber production) and Non-timber	-deforestation -forest degradation -biodiversity loss	-reduced impact logging -seed tree protection -silviculture	-carbon mitigation -Increase in forest carbon stocks -livelihoods and income generation -biodiversity and habitat conservation
Sustainable Agriculture and Agro-Forestry	-deforestation -food security	-mixed farming (trees and crops) -no tillage practices -soil management	-reduced pressures on forest -GHG (incl. methane) mitigation -livelihoods and food security
Energy (incl. charcoal)	-inefficient use of energy -high consumption of fuelwood (deforestation)	-energy efficient stoves -enhanced charcoal production -energy alternatives	-reduced deforestation and forest degradation -energy security benefits
Forest Monitoring	-lack of information (eg forest inventory, incl. species and carbon stocks) -tracking results	-GIS -Remote sensing -standardized inventories -carbon stock assessments	-evidenced based decision making -results tracking (need to be consistent in terms of use of technology)

Table 4: Scope of Technology Activities in the FIP

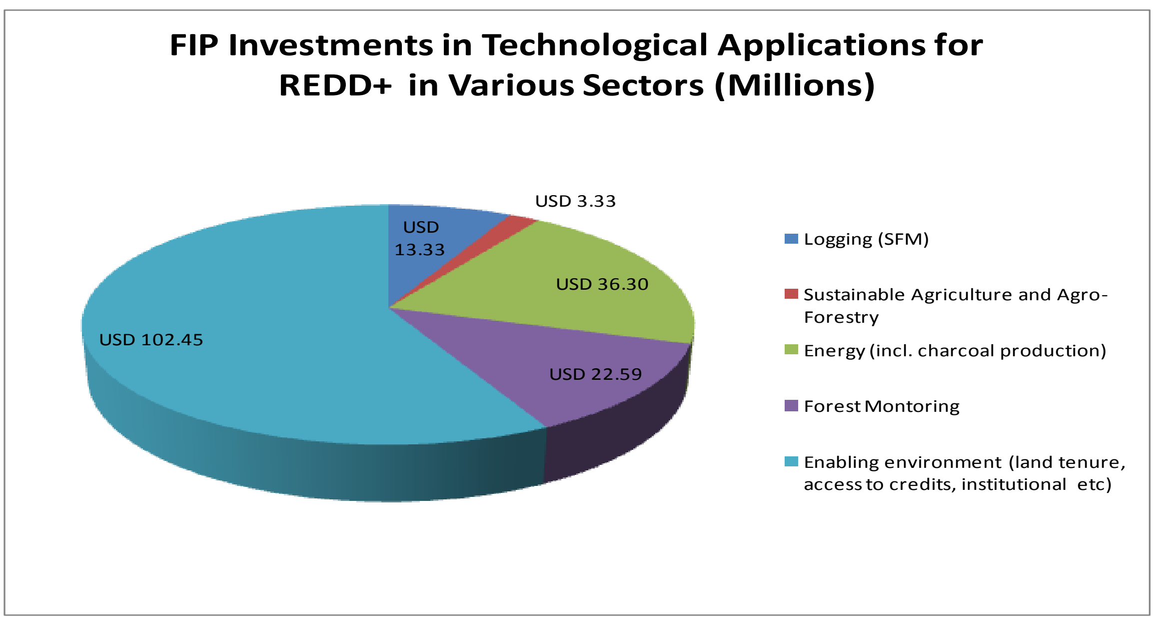

Figure 3: Comparative Levels of PPCR Investments Across Key Sectors[6]

[6] Sums are based on what is currently in the PPCR pipeline, and may be subject to change as the pipeline is updated. As such the numbers should be taken as relative indicative sums and not conclusive estimates.

3. Technology Transfer and the Enabling Environment

The following section provides four case studies of national investment plans, one for each CIF program. This section illustrates how technology transfer considerations are integrated into investments in the pilot countries. In addition, this section will address how the investments by the CIF are aimed at creating an enabling environment to address barriers to technology development and transfer in the pilot countries. As mentioned in Section 1.3, this analysis will vary according to the different funds being discussed.

3.1 The Clean Technology Fund: The Case of South Africa

Overview:

Since the end of apartheid in 1994, South Africa has been transformed into a stable and robust economy, with a four percent average annual economic growth rate over the past 10 years. This strong economic performance has resulted in a 60 % increase in demand for electricity by industry and households since 1994, with coal accounting for 75% of total energy consumption.

The South African CTF investment plan is a "business plan" jointly shared by the Government of South Africa, the IBRD, the AfDB and the IFC. It supports the low-carbon objectives and priorities of key national energy and development strategies.

Description of Technologies:

The CTF investment plan for South Africa is designed to use $500 million in CTF co-financing to mobilize investments of more then $1.8 billion from bilateral and multilateral financiers as well as private sector financing. The plan identifies four priority investment areas:

- Convert half a million households from electric to solar water heaters (SWH) over the next five years, by providing support to municipalities and the private sector.
- A 100 MW-capacity Concentrated Solar Power (CSP) plant in Uppington. This is the first-ever commercial scale CSP plant in Sub-Saharan Africa which is envisaged to be built in collaboration with Eskom (South Africa's electricity public utility).
- A Wind Energy Facility (1, 100 MW wind farm), in the Western Cape Province, in collaboration with Eskom. This will be the first utility-scale wind power plant.
- Increase energy efficiency investments through expansion of bank lending to commercial and industrial sectors through lines of credit to commercial banks, contingent financing to foster energy service companies (ESCOs), and financial incentives or risk products to market lenders.

Technology Transfer and the Enabling Environment:

There are various stages to the technology transfer process and one of the key elements is the assessment of a country's technological needs. This process occurs in various stages under the CTF. When South Africa expressed interest in accessing CTF financing, the MDBs concerned conducted a joint mission, involving other relevant development partners, to discuss with the government, private industry and other stakeholders how the CTF could help finance scaled-up low carbon activities. This process is a key step in establishing recommendations on appropriate interventions, technologies, financing and implemntation mechansisms to encourage low-carbon development. The outcome of this process was the Investment Plan for South Africa, which lays the overall foundation for the technology process as it assesses country needs, identifies financing streams (including private sector investments) and lowers the risk and cost of "new" technologies.

In addition to a thorough technology needs assessment, the CTF investment is enabling South Africa to accelerate the development pathway of certain technologies such as CSP. CSP is the renewable energy source with the largest potential in South Africa. Depending on how it is configured, grid-connected solar thermal power can not only provide large volumes of electricity, but it can also produce firm generation capacity, comparable to what is currently provided by coal fired power plants. However, in addition to being more costly, the initial CSP plants will have higher risk than any coal-fired power plant. The CTF will support the development of the CSP project by financing a portion of the first project in South Africa. Overall this, amongst other projects in the South Africa Investment Plan, lays the foundation for an enabling environment for future technology development in the Southern African region.

3.2 Program on Scaling-Up Renewable Energy in Low-Income Countries: The Case of Nepal

Overview:

Nepal is a low-income country grappling with an energy crisis. The 706 MW total installed capacity, supplemented by purchases from India, falls short of the energy needs of the country. Forced load shedding frequently occurs in the country and only about 56% of the population has access to electricity, despite the vast hydropower potential.

The Nepal SREP Investment Plan (SREP-IP) is designed to utilize US$40 million in grant funding to implement a structured program to scale-up renewable energy in the country. The SREP-IP was prepared under the leadership of the Government of Nepal (GoN) with assistance from the ADB, the IFC and the World Bank. The SREP-IP complements the GoN's program to increase the access to energy services from alternative energy sources.

Description of Technology:

SREP investments will enable the development of on-grid and off-grid small hydro power and off-grid min/micro energy initiatives, with the latter focused on hydropower, solar photovoltaics and biogas for cooking. It is estimated that these initiatives would enable:

- The rapid takeoff of small hydro power projects, resulting in roughly 50 MW of additional capacity through private sector participation.
- The mainstreaming of commercial lending through financial institutions for small hydropower projects and other renwable energy projects where applicable.
- 250 000 households to gain energy access through 30 MW of micro/mini hydropower.
- 500 000 households to obtain energy services through solar home systems totaling 10 MWp capacity.
- 160 000 households to obtain access to clean cooking fuels through biogas plants.
- The rationalisation of fund delivery for mini and micro-energy projects through a single channel (the Renewable Energy Fund).
- The transition of the Alternative Energy Promotion Centre into Alternative Energy Promotion Board, which will serve as a one-step shop for renewable energy development in the country for projects up to 10 MW in capacity.

Technology Transfer and the Enabling Environment:

One of the prerequisites of creating an enabling environment for technology transfer is that circumstances of the host (or technology recipient) country are integrated into any technology-related plans and strategies. In the case of the

SREP-IP in Nepal, one of the key approches is that the SREP support is integrated into the Government of Nepal's Renewable Energy Road Map. One of the main goals of working with the government is to strengthen the existing institutions and assist in policy development. For example, the SREP technical assistance component is supporting the restructuring of the Alternative Energy Promotion Centre to create the new Alternative Energy Pomotion Board with a new mandate of developing renewable energy technologies of up to 10 MW. The Alternative Energy Pomotion Board will maintain a high profile Central Renewable Energy Fund and the SREP funds will be channeled through it.

3.3 Pilot Program for Climate Resilience: The Case of Mozambique

Overview:

Mozambique is extremely vulnerable to the adverse effects of climate change as a result of frequent occurrence of droughts, floods, and cyclones. Over 58% of the country stand to be affected by climate change hazards. The PPCR for Mozambique makes several strategic investments which respond to the country's adaptation needs. One notable investment that demonstrates the relevance of enabling environments for technology transfer in adaptation programs is the investment in Mozambique's sustainable land and water management sector (SLWM). This investment targets issues of food security and poverty reduction.

Description of Technology:

PPCR resources in Mozambique's sustainable land and water management sector will enable the adoption of sustainable water use technologies in the agriculture and food production sectors, and enable the up-take of land management technologies and farming practices that improve soil quality and land productivity. Specifically, PPCR resources will finance:

- Wide scale diffusion of community irrigation infrastructure.
- Construction of water troughs, boreholes, and small earth dams for water storage.
- Promotion of soil conservation practices.
- Reforestation and land rehabilitation technologies.
- Enhanced charcoal production technologies.
- More energy efficient cooking stoves to reduce fuel wood consumption.

Technology Transfer and the Enabling Environment:

Successful technology application in the context of climate change adaptation, most necessary in the poorest and under-resourced countries, requires complimentary capacity building activities to stimulate institutional memory and transformational change in managing climate change challenges. Mozambique is ensuring that there is both institutional and technical capacity within government agencies and local communities to support the use of these technologies. Specifically, the investments in SLWM technologies is being complimented by training workshops for community representatives in both water management and sustainable forest management practices. 12 communities are targeted for training completion by the year 2016. In addition to investments in capacity building, Mozambique is creating an enabling environment for technology adoption by providing dedicated credit lines for financing capital investments in sustainable land use technologies (such as water harvesting infrastructure and agroforestry inputs etc). The dedicated credit lines will also support small enterprise ventures in value-added agricultural and forest production so as to increase earning potential for the rural poor.

The provision of capacity building exercises and financial support services will allow small farmers to shift out of conventional practices and forms of land uses that degrade forest landscapes and exacerbate food insecurity issues.

3.4 Forest Investment Program: The Case of Brazil

Overview:

The focus of the Brazil FIP investment plan is the Cerrado biome. The Cerrado is an important 200 million hectares expanse of savannah and woodlands known for its high levels of biodiversity and conservation value, and in more recent decades for its extremely high levels of agricultural productivity. Environmental protection laws in the country require that agricultural lands are subject to environmental regulation, and that farmers use best practices and appropriate technologies to ensure soil conservation and sustainable production. Due to the high estimates of carbon stock in Cerrado soils, the livelihoods opportunities generated in the biome, and the value of the Cerrado for reducing pressure on the Amazon forests, it is imperative that best practices which allow for the maintenance of its ecological integrity be adopted wholesale by land users in the biome. However, the costs associated with regulation can be preclusive to small farmers.

Description of Technology:

FIP resources in Brazil will help reduce the financial barriers that limit small farmers from adopting sustainable land and forest technologies. Specifically, the FIP will enable:

- The expansion of no-tillage regimes will which decrease levels of emissions from soil disturbances and improve soil quality.
- The rehabilitation of degraded lands through reforestation.
- The expansion of agro-forestry regimes and integrated landscape management.
- The adoption of biotechnologies that convert animal waste from livestock to biogas for energy.
- The adoption of composting technologies for solid organic material to reduce the amount of methane emissions.

Technology Transfer and Enabling Environment:

FIP funding is supporting the implementation of a federal program to promote environmental compliance. The program implementation, shared by federal, state, and municipal governments offers an opportunity for landowners and squatters to regularize the legal status of their properties in the event of having deforested land over and above the size of areas permitted by Law (Legal Reserves, or of failing to maintain Areas of Permanent Preservation (APPs). Smallholders, land reform settlers, family farmers and traditional peoples/communities are special beneficiaries of the program, and receive, free of charge, government support to restore the degraded APPs and RLs. They also receive technical assistance, environmental education, seeds/seedlings and appropriate training. The support provided with FIP resources helps farmers overcome the financial and technical capacity contraints that would have otherwise precluded their full participation in the environmental compliance program.

In a similar vein, the Government has embarked on a more encompassing mission to encourage further investments in sustainable land management by the private sector. US$16.6 millions of FIP funding is being used to create a National Forest Information System that will collect and collate data pertaining to the value, quantity and quality of forest (and land) resources to better allow would be investors to gauge potential rates of return on investments and offer some sense of surety in terms of evidence-based decision making in forest management. Information will also be collected that would inform risk assessment and help investors, small farmers, and public entities to quantify the risks from forest fires and other natural hazards that might undermine the value of land resources. The National Forest Information System will remove the information barriers that often deter investors from putting private sectors resources into sustainable land management projects. Giving the increasing global concerns around food security, land availability and forest conservation, creating the right investment environment for capital and equity injections into projects that try to balance the demands on land resources is essential.

4. Actions Undertaken in Knowledge Management and Stakeholder Engagement to Promote Technology Development, Transfer, and Deployment

Regular stakeholder engagement, south-south learning, and knowledge management are all key for generating knowledge around technology transfer and the conditions needed to foster enabling environments for technology application in different country contexts. For this reason, the CIF facilitates the regular meetings of pilot countries and stakeholders and has designed targeted initiatives for them to share their experiences and lessons learned. These meetings are not limited to climate change and technology discourse, but span a full range of issues such as inclusive and effective project design and implementation, sustainable financing, results monitoring and communications. These activities all fall under the CIF knowledge management platform and have effectively helped reduce the barriers and impediments to capturing, storing and sharing of knowledge around best-practice in creating enabling environments to address the barriers to technology development.

4.1 The Global Support Program

The Global Support Program (GSP) was established to provide CIF pilot countries with the appropriate platforms to communicate, share lessons, and access knowledge and expertise. To those ends, the GSP plans, organizes and manages frequent pilot country meetings and coordinates the development and management of web-based tools, amongst other activities. The following are examples of web-based tools and products developed by the GSP: a searchable and interactive repository of tools and resources for low carbon and climate resilient development; a sourcebook for monitoring and evaluating CIF investments; a series of webinars for internal and external audiences; and an online training course on the low carbon investment planning process.

4.2 Pilot-Country Meetings

Every year, the people who work on CIF-financed operations in CIF pilot countries gather in a series of open and collaborative Pilot Country Meetings (PCMs). In these meetings, representatives of CIF pilot country governments are joined by their counterparts from the MDBs, donor country governments, and other stakeholders to share knowledge, learn from experience in CIF implementation, and foster mutual trust and accountability. CTF pilot countries meet annually, SCF pilot countries meet semi-annually, and all CIF pilot countries meet once a year to address CIF issues as a whole. A total of 8 PCMs were organized between July 2010 and July 2011.

The PCMs have already demonstrated added value. Participants have begun to establish cross-country relationships, creating a growing global network of practitioners that can be relied upon for knowledge and support. By discussing common issues, pilot country representatives have also found areas of common understanding, and have transmitted their views on how to improve the CIF to the CIF's governing committees.

In many instances the PCMs act as an opportunity to showcase technologies, and discuss their applicability and their limitations in different pilot countries. At this year's FIP PCM (April, 2012) one presentation looked at an innovative model for integrating landscape approaches in a Payment for Ecosystem Services scheme to transform agricultural practices in a defined geographic area. Another presentation looked at a business operation model that integrated sustainable technologies for clean energy production with land rehabilitation, illustrating how timber plantations can provide a cleaner source of energy for pig iron production.

4.3 Partnership Forum

As governments and institutions undertook to design the CIF in 2007-2008, it was recognized that if the CIF is to contribute to an effective global solution to climate change, it would be crucial for its lessons and experiences to be shared in an inclusive, transparent and strategic manner. With that purpose in mind, it was agreed that a Partnership Forum would serve as regular venue at which relevant stakeholders could share CIF-related ideas and experiences and engage in dialogue on the CIF's strategic directions, results and impacts. The stakeholders who convene together at the Forum include: representatives of donor and eligible recipient countries, MDBs, UN and UN agencies, the Global Environment Facility (GEF), UNFCCC, the Adaptation Fund, bilateral development agencies, NGOs, Indigenous Peoples, private sector entities, and scientific and technical experts.

The Forum also showcases particular projects from the participating pilot countries. This is an opportunity for parties to the UNFCCC, and climate finance partners among others, to see what technologies and institutional mechanisms are being applied at the country and even sectoral level to address climate change mitigation and adaptation. These exchanges are captured on video and in summary texts to share with partners who are unable to attend the Forum.

4.4 Learning Products

Both the FIP and PPCR have been developing a "learning product" over the last year, which consolidates the experiences of the pilot countries in the respective programs for knowledge-sharing purposes. Like the PCM mentioned above, the learning products provide an opportunity for countries to exchange experiences on implementing their strategic programs and it simultaneously captures information for sharing with the global community. The PPCR learning product, for instance, takes the form of online and web-based events and video-conferences which allow pilot countries to dialogue in "face-to-face" meetings throughout the year. One such web-based event for the PPCR focused on the institutions and technologies relevant to early warning systems in Bolivia and Niger. It was an innovative means in which to facilitate south-south co-operation between these countries in a cost-effective manner using a popular and convenient mode of communication. Summaries and images (including some videos) of the "learning product" can be found on the CIF website under the "Knowledge and Learning" tab.

4.5 The Dedicated Grant Mechanism

The Dedicated Grant Mechanism (DGM) is an important CIF initiative specific to the FIP. This is a direct intervention that aims to remove the financial barriers which ordinarily restrict the full and effective participation of indigenous peoples and local communities in forest governance, sustainable forest enterprise and livelihood issues. In addition, the DGM will enable the FIP projects to incorporate local needs and visions around appropriate technologies and approaches.