WORKING PAPER

Key Functions for a UNFCCC Technology Institutional Structure: Identifying Convergence in Country Submissions

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This paper identifies the key elements needed to ensure enhanced action on technology transfer and development and then evaluates the approaches taken in major country positions. It finds a number of important convergences in these positions and identifies four types of institutions that recur in country positions: central bodies, dedicated funds, regional institutions and coordinating committees. Matching these institutions to functional needs suggests that a combination of institutional structures best meets all the institutional needs of a technology agreement.

World Resources Institute Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback and to influence ongoing debate on emerging issues. Most working papers are eventually published in another form and their content may be revised.

An earlier version of this paper was written by WRI and E3G to assist Chinese and EU participants of the "Informal Workshop on Technology Co-operation and Transfer in Relation to UNFCCC Negotiations," on October 26, 2009 in Shanghai. WRI and E3G would welcome reviews and suggestions as we refine this paper further.

Suggested Citation: Seligsohn, Deborah et al. November 2009. "Key Functions for a UNFCCC Technology Institutional Structure: Identifying Convergence in Country Submissions". WRI Working Paper. World Resources Institute, Washington DC. Available online at http://www.wri.org/climate/cop-15

November 2009

SUMMARY

In the context of ongoing negotiations under the United Nations Framework Convention on Climate Change (UNFCCC) to catalyze enhanced action on technology development and transfer, as called for in the Bali Action Plan, this paper focuses on the fundamental issue of institutional options. It identifies seven essential functions that technology institutions must enable in order to successfully address the challenges posed by climate change. These include the two fundamental aspects of technology development and transfer as well as key functions for facilitating that action:

- Technology development; i.e. the innovation and production of new technologies
- Technology transfer and diffusion; i.e. the actual arrangement by which either the knowledge or the ownership of the knowledge is transferred from one actor to the other and adopted
- Strategic planning and needs assessment
- Coordination
- Information sharing
- Capacity building
- Monitoring and assessment

The paper then summarizes major country positions on institutional arrangements and compares these positions to the seven critical functions. The paper does not include financing as a separate function because all of these functions require adequate financing. Finally the paper outlines how

institutional proposals can be compared and combined to meet all the functional requirements.

While proposals to enhance technology development and transfer vary among Parties, several institutional elements recur:

- Central bodies within the UNFCCC,
- Dedicated technology funds within or outside the UNFCCC,
- Regional institutions within the UNFCCC,
- Coordinating committees integrated into or coordinated with the UNFCCC.

Each of the institutional elements appears well suited to address only some of the necessary functions. This suggests that combining the elements based on a careful consideration of the functions they are meant to serve could prove a promising way forward.

Developing countries – both in the "G77 and China" group and individually – as well as some developed countries, including the European Union, have made detailed proposals and/or presentations on technology mechanisms in the UNFCCC context. An analysis of these country proposals reveals significant areas of agreement:

- A forceful technology push through increased public spending for research and development (R&D), demonstration and deployment of technologies. There is broad agreement that these public funds should be used to leverage private capital, using venture capital-like approaches and public-private partnerships, among other tools.
- Increased strategic planning on technology under the UNFCCC, using tools such as Technology Needs Assessments (TNAs), action plans and convening stakeholders to inform decisions.
- Increased strategic cooperation, e.g. regional centers of technological excellence.
- Scaled up international joint R&D and demonstration projects.
- Enhanced enabling environments and capacity building for technology development and diffusion e.g. through policy dialogue, coordination and reform.
- Country driven formulation of technology needs and strategies that are then linked with developed country support.

SECTION ONE: INTRODUCTION

Technology development and transfer are essential to mitigating greenhouse gas emissions and adapting to the impacts of climate change. Developing countries need access to high efficiency and low or zero emissions technologies to both avoid locking in high carbon infrastructure and to achieve low carbon development.[1] They will also need access to a broad range of technologies for adaptation to now unavoidable climate impacts.[2] Meeting global greenhouse gas mitigation and climate change adaptation goals requires significantly scaled-up development, deployment and diffusion of technologies.[3]

An effective technology mechanism within a Copenhagen agreement will be a key element of the global community's eventual success.

Aggressive assumptions on the early commercialization of key technologies such as carbon capture and storage, advanced biofuels, renewables, electric vehicles and low carbon cement and steel production underlie the most optimistic emission reduction trajectories.[4] Innovation is not yet happening at the pace necessary to support these assumptions. In addition to increased efforts at the domestic level, international technology cooperation is critical to transfer and diffuse existing and near market solutions and invest successfully in advancing technology for the future. Copenhagen must therefore help deliver a global system for international technology cooperation.

It is possible to distill five key issues under discussion in the UNFCCC technology negotiations as outlined in the Bali Action Plan:[5]

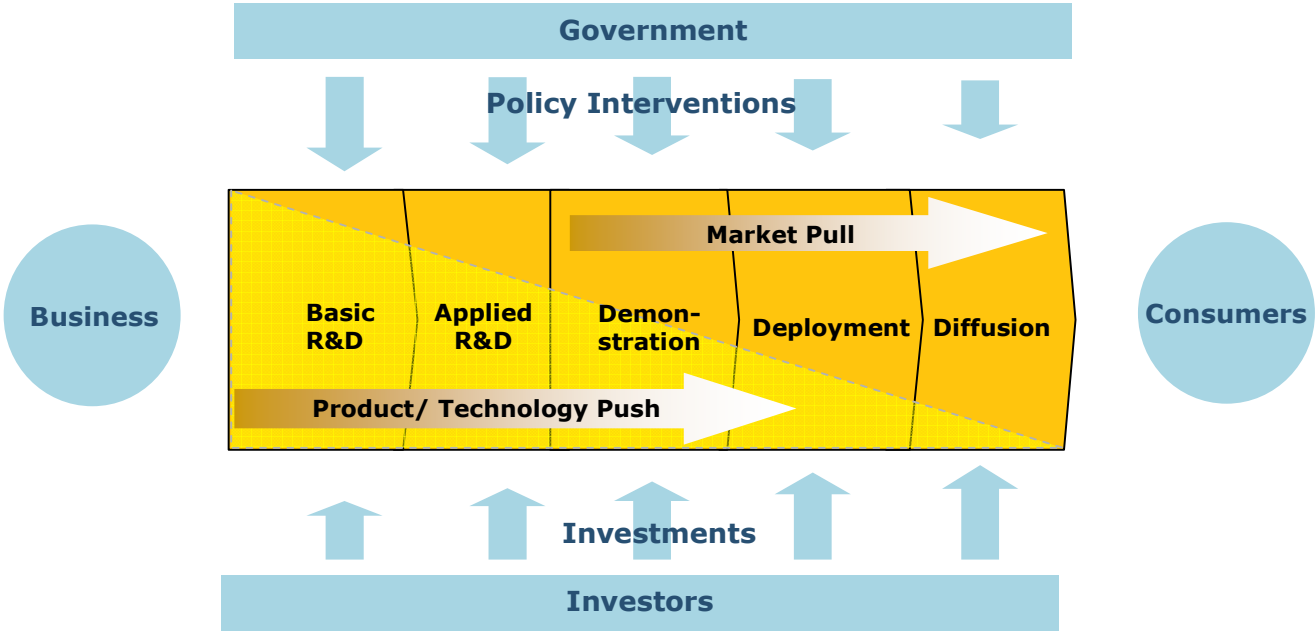
1. Joint research and development (R&D)
2. Intellectual Property Rights (IPR)
3. Financing
4. Performance assessment
5. Institutional arrangements

This paper does not make recommendations as to which technologies should be supported by a technology mechanism. Rather, it focuses on the fundamental issue of institutional arrangements that would be useful to support the development and transfer of mitigation and adaptation technologies. It aims to assist negotiators in identifying useful strategies and common ground. The paper identifies functions which need to be addressed by international technology institutions, whether inside or outside the UNFCCC; provides a summary of major country positions in the UNFCCC process; and outlines how different options can be compared and combined.

SECTION TWO: FUNCTIONS TO BE ADDRESSED BY TECHNOLOGY INSTITUTIONS

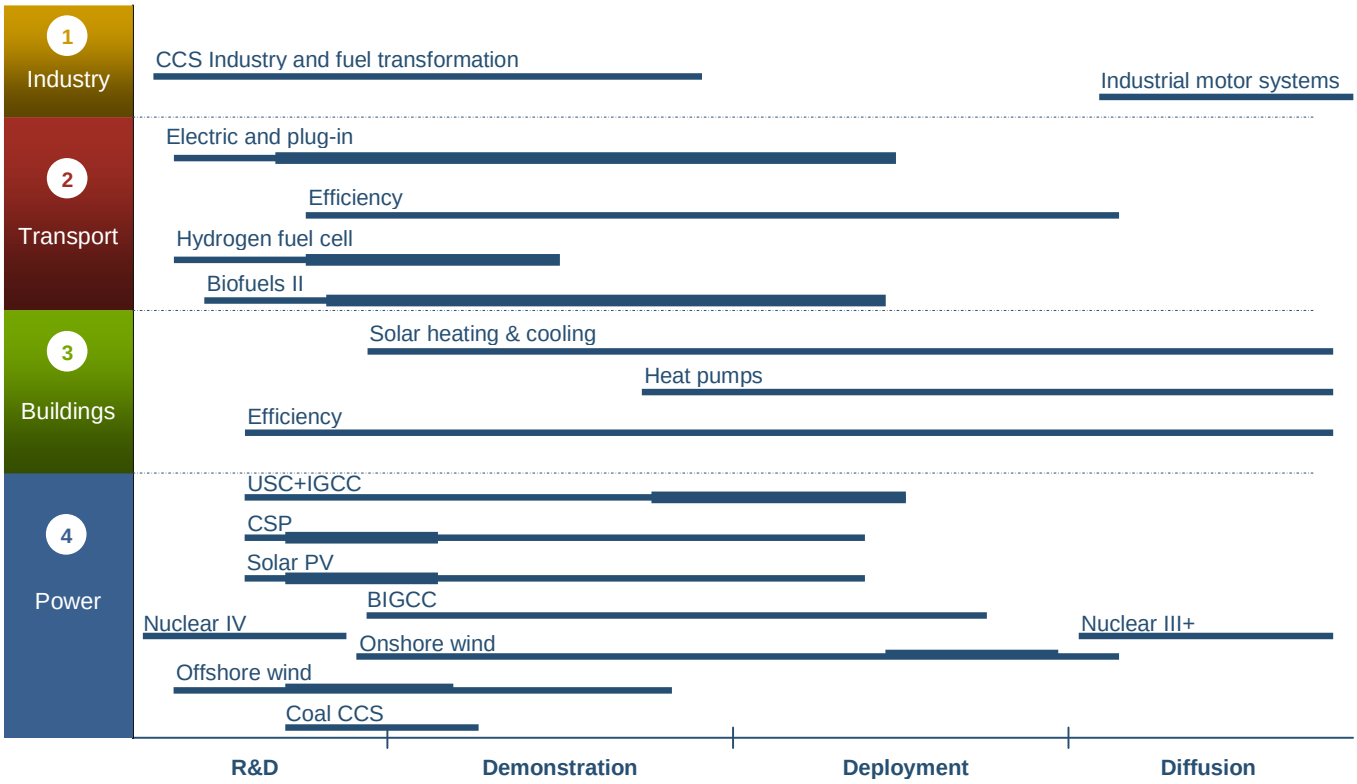
Most country proposals recognize the establishment of new institutions and/or the strengthening and redefining of existing institutions as a prerequisite for enhanced action on technology transfer under the UNFCCC. In order to make informed choices about the institutional arrangements that will spur a transformation in clean energy technology and address pressing adaptation technology needs, negotiators need to agree on the functions the institutions are meant to serve. Developing and deploying technologies is understood as a process with several stages: basic research and development (R&D), applied R&D, demonstration, deployment, and diffusion (see figure 1). Different technologies that could help to address the climate change challenge are currently at different stages of the innovation chain, as the example of greenhouse gas mitigation technologies in figure 2 illustrates. There is general agreement that in the context of climate change, public policy can and should intervene at every stage of the chain, facilitating and accelerating both the development of new and the deployment and scaling-up of existing technologies.

Figure 1 | Innovation Chain



Source: Modified from Stern et al., 2006[6]

Figure 2 | Key technologies for greenhouse gas mitigation and their position along the technology chain



Source: Modified from IEA (2008)[7]

In designing support mechanisms for technology development and transfer, the international community should consider the following seven functions. These have been identified through WRI-E3G analysis of the institutional requirements needed to fulfill Article 4 of the UNFCCC and clause 1d of the Bali Action Plan, as well Article 10 of the Kyoto Protocol. This analysis also included a review of the functions identified in national submissions (see Section 4) and in academic research on technology transfer and development (see Annex).[8] The first two functions are related to specific stages of the technology chain: Technology Development is concerned with the R&D and demonstration stages, while Technology Transfer and Diffusion is related to the deployment and diffusion stages. The remaining five functions cut across the entire innovation chain. No single institution must necessarily address all seven functions nor is it necessarily best to address every function within the UNFCCC.

Technology Development

In the R&D stages of the innovation chain, the key function is embodied by private and public laboratories developing new technologies and applications. Investing in technology development involves higher risk then later stages, as many research projects never reach the marketplace. Private investment is harder to attract and public funding usually required to fill the gap. Alternatively, higher risk implies the potential for larger rewards, making R&D an attractive area for venture capital investments.[9] Similarly, the demonstration phase requires significant amounts of capital, while the risk of failure remains high. Joint R&D and demonstration projects can increase the rate of innovation by pushing the key technologies forward along the learning curve. Similarly,

cooperation can quickly reduce costs, share risks among several countries and other entities, and enable poorer countries to participate in technology development.[10] Many studies point out that a number of key low carbon technologies will need to be demonstrated and deployed simultaneously in developed and developing countries in order to stabilize global temperatures.[11] One additional class of cooperation in development and demonstration is public private partnerships, which could effectively mobilize private sector financial and technical resources. Establishing knowledge sharing arrangements, particularly where public finance was provided for the original innovation could also accelerate deployment.[12]

Technology Transfer and Diffusion

Once technologies are developed and demonstrated, they need to be deployed. In the case of low carbon technologies, this process is often slowed by diverse barriers, including incomplete enabling environments and insufficient financial support.[13] Enabling environments refer to policies and measures to support deployment and diffusion. These policies and measures could be 'direct' actions, such as increases in R&D funding, deployment schemes, or procurement plans and 'enabling' actions, such as market reforms, carbon pricing, and training of experts. They also involve a technical component, for example investment in grids.

Rapid deployment also requires scale up of financing. Projects incur costs, including licensing fees or the early replacement of existing installations. Building the enabling environment requires investments in human capacities, political frameworks and technical infrastructure. International technology institutions could support technology transfer by funding some of these start-up and incremental costs and by helping to lower them through the sharing of best practices.

Strategic Planning and Needs Assessment

Technology development and deployment involve choices about where funds, expertise and time are best invested. Clear priorities driven by needs assessment can sort between the often competing options. Institutions can work on two levels: identifying global priorities for technology development and assisting countries in assessing their own priorities in terms of sectors they most urgently need to develop and deploy low carbon technologies within. Strategic planning can thus involve country-driven processes such as Technology Needs Assessments (TNAs)[14] and national technology action plans as well as top-down assessments of the 'appropriate' technologies for international support.

Capacity Building (policy and technical)

Enhanced capacity is necessary to speed up the development, deployment and transfer of technology. Countries need to increase their absorptive capacity and the strength of their innovation systems. Skilled people, who understand the technologies are necessary to develop, install, maintain and adapt technologies to local circumstances. Capacity building is also crucial to enhance enabling environments, by strengthening policy makers' ability to design and implement policies and measures that support and accelerate the innovation and diffusion process.

Monitoring and Assessment

Institutions should assess whether their activities and the actions they support are effective and achieve their goals. In the climate context, this function would extend beyond good management practices to include monitoring whether Parties meet their commitments. The Bali Action Plan (BAP) established a reciprocal relationship between measurable, reportable and verifiable (MRV) mitigation actions by developing countries actions, which could include policies and measures supporting the development and deployment of low carbon technologies, and the provision of finance, technology and capacity building support by developed countries that also met MRV criteria. Whether, when and to what extent activities or arrangements outside the UNFCCC could count towards developed and developing country commitments remains a critical issue for discussion.

SECTION THREE: MAJOR COUNTRY POSITIONS ON INTERNATIONAL ISSUES

This section will outline the institutional implications of some of the major submissions made in the UNFCCC process through the last negotiation meeting in Bangkok in October 2009.[15]

G77 + China

The G77 + China group of developing countries has submitted a detailed proposal for the establishment of a new Technology Mechanism under the UNFCCC. The main institution within this mechanism would be an **Executive Body** (EB), functioning as a subsidiary body under the Convention. The EB would be made up of government representatives and experts on technology transfer, with balanced regional representation, and would be supported by a Strategic Planning Committee, Technical Panels, a Verification Group and a Secretariat.

One of the EB's tasks would be to develop a global Technology Action Plan to accelerate research and invention. The plan would include "the establishment of national and **regional technology excellence centers** and will reinforce north-south, south-south and triangular cooperation, including joint research and development." The supporting Technical Panels would compile information on policies and measures, intellectual property rights and intellectual property cooperation and assessment, monitoring and compliance.

The G77 + China also proposes creating a **Multilateral Clean Technology Fund** (MCTF) under the UNFCCC that would provide technology-related financial support as determined by the Executive Body. The fund would partly act like a venture capital fund, where public investment leveraged private capital for emerging technologies. It would also cover the incremental costs of new installations and capacity building, including costs of research, development and demonstration as well as enhancing human and institutional capacity.

China

In line with the G77 + China group proposal, China has made an individual proposal that provides additional details on the suggested institutional set-up. China calls for the establishment of a **Subsidiary Body for Development and Transfer of Technologies** under the UNFCCC with a strategic planning committee and panels for technology needs assessment, dialogue and coordination on enabling policies and IPR, management of financial resources, capacity building, and monitoring and assessment of performance.

China also provides more details on the fund, which it calls the **Multilateral Technology Acquisition Fund** (MTAF). The MTAF would cover the full cost of capacity building and R&D and support deployment through public-private partnerships by linking public finance with the carbon market, the capital market and the technology market. Mechanisms to leverage private capital with public funds could include insurance, loan guarantees, or investments via stocks, bonds and other financial products. China proposes the fund cover the incremental costs of low carbon technologies, measured against a baseline of technological change in given technology areas.

Other G77 Countries

A number of other G77 member countries have also made submissions that generally reflect and support the G77 position, including Argentina, Brazil, Ghana, India, South Africa and the group of Least-Developed Countries. Brazil offers a concrete proposal to establish **Technology Excellence Centers**, which would serve as local technology hubs and would stimulate capacity building, improve access to information, and facilitate international cooperation. Mexico has made the proposal for a **Clean Technology Fund** that would be a part of their proposed **World Climate Change Fund (Green Fund)**. The Clean Technology Fund would be replenished by a levy on contributions to the Green Fund.

The European Union

The EU proposal emphasizes the role of **existing institutions**, discussing how these institutions, including the Global Environment Facility and international and regional technology initiatives such as the Carbon Sequestration Leadership Forum, could be improved and reinforced. The

EU suggests that support for technology development and transfer through different channels, including the World Bank and regional development banks, should be recognized under the UNFCCC. However, the EU has also proposed mechanisms under the UNFCCC, such as a general **coordinating mechanism** to assess Low Carbon Development Strategies and Nationally Appropriate Mitigation Actions, match support to actions, and validate both. This mechanism would apply to actions and support in general, including those related to technology.

Major issues for the EU include strengthening barrier-removing policies and measures and finding incentives to attract private sector investments. The EU proposes expanding existing **Technology Needs Assessments (TNA)** to cover obstacles to innovation and deployment and making TNAs available to all relevant stakeholders. The EU also believes there is a need to establish a **facilitating body** under the UNFCCC to promote international cooperation on technologies for mitigation and adaptation. This new body would serve an advisory function, providing strategic guidance for R&D and international cooperation. It could also provide advice on how to address barriers to technology diffusion and build on the existing Expert Group on Technology Transfer (EGTT). The EU emphasizes that the institutional arrangements for technology should provide adequate technological support, including the provision of global roadmaps on key technologies. These roadmaps would identify gaps, inform Low Carbon Development Strategies, make recommendations on actions and monitor progress globally.

The EU also favors "establishing and strengthening **national and regional centers of technological innovation,** and networks between these" as well as of cooperative joint R&D and large-scale demonstration and deployment projects in developing and developed countries.

The United States

The United States has also promoted an approach using "the full range of available management tools and financing options in implementing local, national or regional programs of action." It stresses the importance of national actions to advance environmentally sound technologies, notably through enabling policy frameworks.

The United States has also proposed a new structure referred to as **Hub and Spokes**. The "hub" refers to a new central institution that would serve as a center for information and analysis in support of enhanced action on technology. The center would compile information on technologies and develop tools and models to assist technology needs assessments, technology roadmapping and policy design relating to all stages of the innovation cycle. The proposal emphasizes training, both through a "train the trainers" approach and through direct "on the job" training, provided by the experts working at the hub and an additional group of people drawn from international agencies, national governments, academia and the private sector. This second group would form a corps or "spokes," traveling to countries to assist with technical and policy development capacity building.

The U.S. proposal focuses almost exclusively on information sharing and capacity building. While actual technical research is not envisaged at the hub, the United States has also indicated interest in scaling up joint R&D. The proposal does not specify how technology transfer should be funded, but suggests solving this as a part of the overall financing negotiations.

Other Annex I Countries

Like the EU and the United States, other Annex I countries, including Australia, Japan, Iceland and New Zealand, have expressed preference for strengthening existing institutions, including those outside the UNFCCC. Many have expressed openness to increased joint R&D and demonstration projects and for international research centers. Annex I countries also often express a preference for a sectoral approach to technology.

Table 1 | Functions and Institutional Elements in Country Submissions

	G77+China	European Union	United States
Technology Development	**Regional Institutions**: Joint R&D and Demonstration through regional technology excellence centers; **Dedicated Funds:** Multilateral Technology Fund reporting to the COP	**Regional Institutions**: Regional centers of technological innovation; cooperative R&D and demonstration; **Coordinating Committees:** coordinate joint R&D among multiple institutions	Interest in scaled-up joint R&D (institutional set-up not specified); funding through existing institutions – to be specified in financing negotiations
Technology Transfer and Diffusion	**Central Institution:** Central Secretariat; **Regional Institutions:** regional technology excellence centers; **Dedicated Funds:** Multilateral Technology Fund reporting to the COP	Cooperative, large-scale deployment projects (institutional set-up not specified); Diffusion support through CDM or Sectoral Crediting Mechanism	Diffusion through capacity building in "spokes"
Strategic Planning	**Central Institution**: Executive Body under UNFCCC to develop Technology Action Plan, supported by Strategic Planning Committee	**Central Institution**: Coordinating mechanism to assess Low Carbon Development Strategies (not specifically for technology); **Coordinating Committee:** Facilitating Body (for technology) to develop global technology roadmaps	Domestic strategic planning assistance through Hub and Spokes
Coordination	**Central Institution**: Executive Body to coordinate activities within UNFCCC	**Central Institution**: General coordinating mechanism to link NAMAs to support and validate both (MRV – not specifically for technology); **Coordinating Committee:** Facilitating Body (for technology)	**Central Institution:** Hub and Spokes
Information Sharing	**Central Institution**: Technical Panels (under Executive Body within UNFCCC); **Regional Institutions:** regional technology excellence centers	**Coordinating Committee**: Facilitating Body; **Regional Institutions**: regional centers of technological innovation	**Central Institution:** Hub and Spokes
Capacity Building	**Regional Institutions:** regional technology excellence centers	**Regional Institutions**: regional centers of technological innovation	**Central Institution:** Hub and Spokes
Monitoring and Assessment	**Central Institution**: Verification Group, supported by Technical Panels (both under Executive Body within UNFCCC)	**Central Institution**: General coordinating mechanism to validate NAMAs and support (MRV – not specifically for technology)	Not specified

Japan has proposed the establishment of **sectoral expert committees** with participants from the public and private sectors to identify relevant technologies, analyze their current situation and barriers to their deployment, and recommend measures to accelerate technology development and transfer.

Commonalities Among Parties

The analysis of the country submissions reveals significant areas of agreement among a number of the major Parties:

- A forceful technology push through increased public spending for research and development (R&D), demonstration and deployment of technologies. There is broad agreement that these public funds should be used to leverage private capital, using venture capital-like approaches and public-private partnerships, among other tools.
- Increased strategic planning on technology under the UNFCCC, using tools such as Technology Needs Assessments (TNAs), action plans and convening stakeholders to inform decisions.
- Increased strategic cooperation, e.g. regional centers of technological excellence.
- Scaled up international joint R&D and demonstration projects.
- Enhanced enabling environments and capacity building for technology development and diffusion e.g. through policy dialogue, coordination and reform.
- Country driven formulation of technology needs and strategies that are then linked with developed country support.

The functions framework developed in Section Two can be usefully applied to the country proposals. Table 1 shows how key proposals address each function.

SECTION FOUR: COMPARING AND COMBINING THE OPTIONS

Four institutional elements emerge from the analysis of country submissions and a review of academic research:

Central Bodies within the UNFCCC

With variation in detail, submissions propose the creation of a new Executive Body or Secretariat within the UNFCCC responsible for functions such as strategic planning, coordination, information sharing, capacity building and monitoring and assessment. This body could be supported by a range of technical panels for research and development, market mechanisms, etc. Central bodies within the UNFCCC could also potentially establish a new technology 'hub' to guide international cooperation, information sharing and capacity building efforts for technology transfer.

Dedicated Funds

Financial flows for developing countries' decarbonization and adaptation are estimated between €65-100 bn ($97-149bn / RMB660 bn-1 trillion) annually from 2010 through 2020.[16] IEA estimates that developing, deploying and diffusing 17 key technologies globally will require about €672 billion ($1 trillion / RMB6.8 trillion) per annum between now and 2050.[17] The private sector is expected to play a very important role in delivering these technologies, but only if the public sector creates a new risk and reward balance through financial incentives and a legal and regulatory framework. Direct public funding is expected to play a critical role, especially at the earlier stages of R&D and deployment. Considering a wide range of estimates, the European Commission suggested global public support for energy R&D should at least double to €13.5 billion ($20 bn / RMB137 bn) per year by 2012 and quadruple to € 27 billion ($40 bn / RMB 273bn) per year by 2020.[18] Similarly, estimates from studies such as the Stern Review and Bosetti et al. suggest a doubling of public support of energy R&D to €13.5 billion ($20 bn / RMB137 bn) per annum between 2015 and 2025 and a further increase of up to seven times to €47 billion ($70 bn / RMB478 bn) per annum by 2050.[19]

Financing for technology is strongly linked to the finance and mitigation negotiation tracks. Some Parties have proposed a new Multilateral Climate Change Technology Fund operating under the responsibility of the UNFCCC, while others prefer to use existing multilateral or bilateral funding support complemented with measurable, reportable and verifiable (MRV) criteria. Both approaches could lead to the creation of a dedicated fund (or dedicated window within existing funds) for technology development, diffusion and transfer. Such a fund or funds could cover a range of costs, including those related to technology development, technology transfer and diffusion and capacity building. Public funds should be used to leverage private investment through tools such as grant financing, risk sharing and cooperative R&D.

Regional Institutions

Technology development, information sharing and capacity building can be scaled up through proposed new Centers of Excellence in developing countries. These Centers can also facilitate increased R&D by building on models similar to the Consultative Group for International Agricultural Research (CGIAR). An alternative proposal is to develop an international corps of trained practitioners to build capacity in regional 'spokes' linking back to a central hub within the UNFCCC.

Coordinating Committees

Coordinating Committees can link existing institutions and processes together in order to facilitate strategic planning and coordination and to share information and best practices. These could be independent, newly created committees or they could be structured to include or interact with existing technology partnerships fostered by organizations such as the Major Economies Forum (MEF), the Asia Pacific Partnership (APP) and the Asia Pacific Economic Cooperation (APEC).

Drawing from research and insight into the existing institutions, Table 2 links functions as defined in section two to the institutional elements described above.

The table highlights opportunities for complementarities between the different institutional elements. Each institutional element appears well suited to address only some of the functions identified as needed for technology development and transfer. This suggests that combining the elements based on a careful consideration of the functions they are meant to serve could prove a promising way forward

Table 2 | Institutional Elements and Functions

	Central Body under UNFCCC	*Dedicated Funds*	*Regional Institutions*	*Coordinating Committees*
Technology Development	Promoting and supporting role	RD&D promoted through funding	Can contribute to R&D (in the case of centers of excellence)	Information sharing and joint development among innovators
Technology Transfer	Promoting and supporting role	Transfer promoted through funding	Can administer or broker with funding	Can support transfer within the partnership
Strategic Planning	Strategic priority setting for technology development and transfer	Limited to own finances	Can assist national governments in strategic planning/needs assessment	Can fulfill specific strategic functions e.g. MEF Technology Action Plans
Coordination	Coordinates within UNFCCC and informs processes outside UNFCCC	N/A	Can coordinate regionally	Within the partnership; also linked to other similar committees
Information Sharing	Promoting and supporting role	N/A	Can promote regional information sharing; strong on dissemination	Strong sharing within the partnership
Capacity Building	Promoting and supporting role	Promotes through funding	Build capacity and enabling environments	Limited to the partnership
Monitoring and Assessment	Monitors and assesses progress on reciprocal commitments; reports to COP	Limited to own finances	Can monitor and assess technology transfer and deployment effectiveness, and assist countries in their own M&E programs	Own programs only

■ Core Function ▭ Partial coverage ☐ Not Applicable

ANNEX: RECENT STUDIES ON TECHNOLOGY DEVELOPMENT AND TRANSFER IN THE UNFCCC CONTEXT

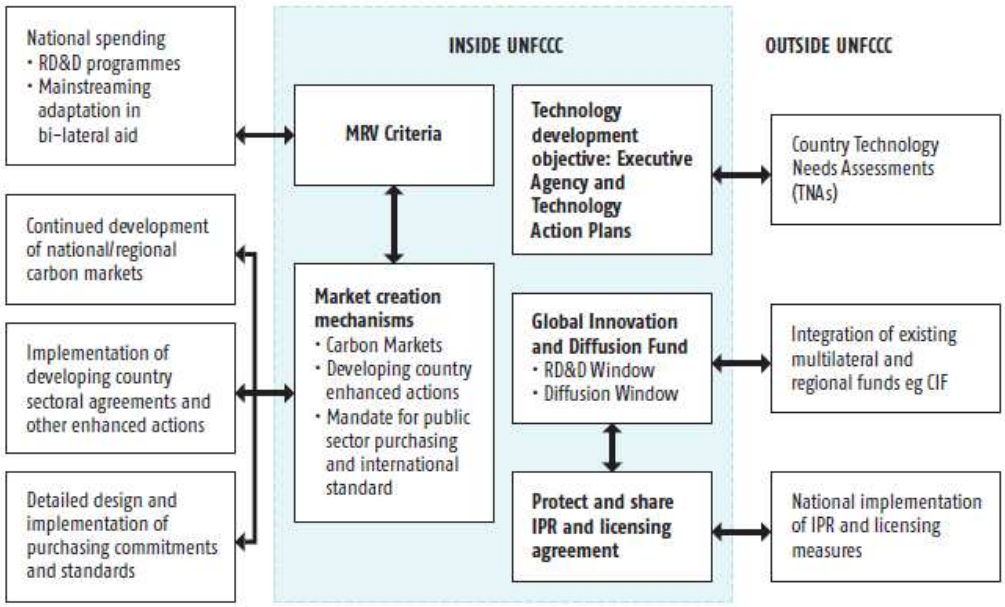
Below is a summary of some of the most recent research in this area that was consulted in the drafting of this working paper. It is by no means an exhaustive list. Please refer to Tomlinson et al. (2008) for a more complete review of the technology literature.[20]

E3G and Chatham House Analysis[21] of Institutional Proposals

The report "Innovation and Technology Transfer: Framework for a Global Climate Deal" suggests that there are some critical functions needed both inside and outside the UNFCCC system (see figure 3). Within the UNFCCC this analysis recommends establishing seven mechanisms:

- A Technology Development Objective to scale-up market creation and finance for new technology.
- Technology Action Plans (TAPs) covering market development, global demonstration and orphan areas of research for critical technologies.
- A Technology Executive Board under the UNFCCC to oversee the creation of global roadmaps covering all relevant technologies and setting out overall goals and milestones to deliver mitigation and adaptation respectively, as well as TAPs for individual technologies and report back on progress to the COP.
- Measurable, reportable and verifiable criteria (MRV) to track bi-lateral and multilateral support and actions for technology transfer.
- A Global Innovation and Diffusion Fund under the UNFCCC with two windows: one for RD&D support; and one for diffusion support.
- Market creation mechanisms including reform and scale-up of the CDM to ensure it can support technology diffusion in developing countries.
- A "protect and share" framework for IPR, with capacity building support to strengthen IPR protection in developing countries and provide a clear framework for using existing flexibilities in national and international law.

Figure 3 | Breakdown of proposed action within and outside of the UNFCCC



E3G – WWF Technology Action Programs[22]

This paper proposes to organize the future technology efforts under the UNFCCC in a set of Technology Action Programs for specific adaptation and mitigation technologies. These programs would run for periods of five years, and have clear targets and an adequate working budget. They would run within a wider technology framework under the UNFCCC in order to guide the overall objectives of funding and action on technology cooperation and innovation.

The programs would divide the technology challenge into manageable smaller steps; therefore E3G and WWF suggest there should be at least 20 action programs for both adaptation and mitigation technologies such as early-warning systems and renewable energy grid systems. The programs should be developed in relation to developing countries National Adaptation Plans of Action (NAPAs) and Technology Needs Assessments and relate to country enhanced actions. Inputs and resources should be predictable and conditions for participation should be clearly defined.

WRI - Tsinghua University Case Studies

China's Tsinghua University's Low Carbon Energy Laboratory and the World Resources Institute undertook case studies on technology transfer in China in three power sector-related areas — super and ultra-supercritical coal fired power plants, wind power and end-use efficiency in the steel sector. Key findings from the forthcoming report are:

- In all cases, significant Chinese government research funding (through the so-called 863 and 973 funds, primarily) appears to have been essential for creating the enabling environment that facilitated the transfer. This included training personnel and developing facilities that were able to successfully receive, transform and continue to develop these technologies.
- Technology transfer can happen through different channels: The steel case study provides a successful example of bilateral government-to-government agreement, while the coal and wind case studies provide examples of technology transfer through joint ventures, direct foreign investment and Chinese purchases of foreign companies.
- The single biggest impediment that foreign companies identified was a shortage of skilled personnel in developing, diffusing or implementing new technologies worldwide. The research grants provided by the Chinese governments were able to partially overcome this, but further capacity building support is required. It was notable that the international companies did not point to intellectual property protection as a major impediment to technology transfer.

Renmin University – Proposal for Innovative Mechanisms for Environmentally Sound Technologies[23]

This report proposes the establishment of a new innovation mechanism with the following key institutional components:

Subsidiary body under the UNFCCC - A new subsidiary body, parallel to SBI and SBSTA, should be established under the UNFCCC. This body would have an implementation role, and would be in charge of planning, coordination, organizing, assessing and monitoring of Environmental Sound Technology (EST) development and transfer, and would also promote technology information and experience exchange between different stakeholders.

Financial mechanism - A Multilateral Technology Acquisition Fund (MTAF) should be established under the UNFCCC, with the sources mainly based on public finance from developed countries. The MTAF would build public-private partnerships in developing countries, linking public finance with carbon, capital and technology markets to leverage private sector activity.

Performance monitoring and assessment mechanism - A set of indicators, data bases, steps and modalities should be developed to monitor and assess technology flows from developed to developing countries.

The proposal includes other elements, including an IPR mechanism that is dedicated to balancing the benefits between IPR owners and global climate protection; a corporate social responsibility and capacity building mechanism; and a technology transaction mechanism which is aimed at increasing transparency of technology information and reducing transaction costs.

Studies and Examples of Networks of Innovation Centers

CGIAR model –The Consultative Group on International Agricultural Research (CGIAR), established in 1971, is a strategic partnership, whose 64 Members (countries, intergovernmental organizations and non-governmental foundations) support 15 international centers, working in collaboration with many hundreds of government and civil society organizations as well as private businesses both in developed and developing countries. Its objective is to achieve sustainable food security, particularly in developing countries, through scientific research such as developing climate-resilient varieties of a number of essential crops. Currently, more than 8,000 CGIAR scientists and staff are active in over 100 countries.

Carbon Trust model[24] –Low Carbon Technology Innovation and Diffusion Centers, located in selected developing countries, would act to enhance local and regional engagement with global technology developments and catalyze domestic capacity to develop, adapt and diffuse beneficial innovations. They would provide a variety of services such as enterprise creation, incubator services, and early stage funding for low carbon ventures. The centers would be set up as Public-Private Partnerships that could work collaboratively with a range of partners and stakeholders. Initially, a network consisting of five national centers would be established supported by a central secretariat that monitored progress and ensured knowledge transfer. The Carbon Trust estimated the cost of such network at around $1-2.5 billion (RMB 6.8 – 17 billion) over 5 years.

Assessments of the Impact of Intellectual Property Rights on Technology Transfer

There have been relatively few comprehensive studies of IPR issues in relation to climate technologies. Chatham House recently published one of the most comprehensive assessments based on a database of close to 57,000 patents across six key technology sectors covering a span of over 30 years.[25] The key findings of the study are as follows:

- Business-as-usual practices of technological innovation and diffusion will not bring low carbon technologies to markets fast enough. Evidence from each of the six sectors examined (wind, solar photovoltaic, concentrating solar power, biomass-to-electricity, cleaner coal and carbon capture) indicated that it currently takes an average of around 24 years for a patented technology to become widely used in subsequent innovations.
- Innovation and technological development primarily take place within the OECD countries. Companies and research institutions from the United States, Japan and Germany are clear leaders in energy innovation. Large incumbent companies – whether multinationals or national corporations – are the main players with about 80% of the patents across all included technologies.
- The concentration of patent ownership cannot be assumed to be synonymous with a lack of competition or a monopoly, but it can slow innovation and diffusion in some types of markets depending on companies' business models.
- Among emerging economies, China is in a unique position to bring new, clean energy technologies to maturity because of the size of its domestic market and its position as a supplier of consumer and industrial goods to international markets.

Earlier studies had suggested that IPR may not act as a major barrier. For instance, a study by Copenhagen Economics & the IPR Company[26] suggested that IPR does not in itself constitute a barrier to the transfer of carbon-abatement technology from developed countries to developing countries. John H. Barton, a leading scholar in issues surrounding the

transfer of technologies and the distribution of intellectual property across the developed and developing world, conducted an assessment of solar PV, biofuel and wind energy technologies in China, Brazil and India. He concluded that IPR did not appear to be a major barrier for developing countries to access the current generation of technologies. However, he also cautioned that this could change with new generations of technologies.[27] In a more recent assessment of the transport sector, Barton outlined some possible barriers in relation to accessing new enzymes and converter organisms for second generation biofuels, but concluded that the sector is already globalised and therefore access is more likely to be a competition issue than an IPR issue.[28]

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ACKNOWLEDGEMENTS

The authors would like to thank Letha Tawney and Stephanie Hanson for their editorial assistance with this paper, and Rob Bradley, Jennifer Morgan, Janet Ranganathan and Ji Zou of WRI for their insight and advice in preparing this paper. An earlier version of this document was prepared under a grant from the Swedish Ministry of Environment, and the authors would also like to thank Patrik Brodd from the Ministry, Ping Hojding from the Swedish Embassy in Beijing and Magnus Gislev from the European Commission for their advice on the earlier paper and support for the project. The original research for the project took place under a longer term project funded by the United Kingdom Foreign and Commonwealth Office and the authors greatly appreciate the advice and support of the Chinese National Development and Reform Commission and of the British Embassy in Beijing for WRI's ongoing technology policy research.

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NOTES

[1] International Energy Agency (2008) *Energy Technology Perspectives: Scenarios and Strategies to 2050*. OECD/IEA, Paris; Lee, B., Froggatt, A. et al (2007) *Changing Climates: Interdependencies on Energy and Climate Security for China and Europe*. A Chatham House Report. Chatham House, London.

[2] UNFCCC (2008) Investment and financial flows to address climate change: an update. Technical paper, FCCC/TP/2008/7.

[3] Stern Review (2006) Stern Review on the Economics of Climate Change. HM Treasury.

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[5] Besides the Bali Action Plan, this paper also reflects country submissions and proposals through the first portion of the 7th session of the AWG-LCA in Bangkok in October 2009.

[6] Stern, Nicholas et al. (2006*) Stern Review on the Economics of Climate Chang*e. HM Treasury, p. 396, figure 16.1.

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[8] The functions listed here are also among those mentioned by the participants at the EU-China Informal Workshop on Technology Co-operation and Transfer in Relation to UNFCCC Negotiations," on October 26, 2009 in Shanghai. Participants also suggested two aspects that we consider integral parts of all functions, namely financing and the creation of enabling environments. Enabling environments are a part of both the "Technology Development" and the "Technology Transfer and Diffusion" functions, supported by "Information Sharing" and "Capacity Building" and potentially to be assessed within the "Monitoring and Assessment" function. As all of the functions incur costs, we consider financing a part of each function.

[9] Staley, B.C., Goodward, J., McMahon H. *From Positions to Agreement: Technology and Finance at the UNFCCC.* WRI Working Paper, June 2009. World Resources Institute, Washington DC, p. 3.

[10] Stern Review (2006) Stern Review on the Economics of Climate Change. HM Treasury.

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[13] UNFCCC (2008) Investment and financial flows to address climate change: an update. Technical paper, FCCC/TP/2008/7.

[14] In UNFCCC Decision 3/CP.13, non-Annex I Parties were encouraged to carry out "Technology Needs Assessments" (TNAs). Their purpose is "is to identify, evaluate, and prioritize technological means for achieving sustainable development in developing countries, increasing resilience to climate change, and avoiding dangerous anthropogenic climate change". See UNDP and UNFCCC Secretariat (2009) *Technology Needs Assessment Handbook*. United Nations Development Program. Advance Document, September 2009.

[15] This section draws heavily on existing WRI research and summaries of country positions, particularly Staley, B.C., Goodward, J., McMahon H. *From Positions to Agreement: Technology and Finance at the UNFCCC.* WRI Working Paper, June 2009. World Resources Institute, Washington DC; Staley, B.C. with Freeman, C. (2009) *Tick Tech Tick Teck. Coming to Agreement on Technology in the Countdown to Copenhagen*. WRI Working Paper, June 2009. World Resources Institute, Washington DC; McMahon, H. et al. (2009) *Summary of UNFCCC Submissions*, WRI Working Paper, September 18, 2009. World Resources Institute, Washington DC. See McMahon et al. 2009, Section 5 for a comprehensive overview of technology submissions by all parties through September 2009.

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