DISCUSSION PAPER

WORLD RESOURCES INSTITUTE

Five Components of a New Financial Agreement under the Convention:

Paying for Mitigation Technology

DENNIS TIRPAK AND BRITT CHILDS STALEY

Introduction

Funding needs for climate change mitigation technology deployment are significant. In August, 2007 the UNFCCC Secretariat published a *Technical Paper on Investment and Financial Flows to Address Climate Change*. It estimated that USD $200 to $210 billion in mitigation investments will be required annually by 2030 to stabilize and begin to reduce global GHG emissions. The Technical Paper concludes that the vast majority of this investment will need to come from the private sector, but that substantial additional public funding will need to be mobilized as well. This paper was quickly followed by a number of proposals from Parties on how to raise new funds (UNFCCC 2008). In the interim, The World Bank, in cooperation with other multilateral development banks, has moved forward and created a Clean Technology Fund[1] which aims to provide incentives to demonstrate low carbon technologies through public and private sector investments in programs and projects that are embedded in national plans. However, the new World Bank fund, while commendable in several ways, responds to only a part of the technology innovation chain and some of the barriers to the development and deployment of technology.

This discussion paper seeks to expand on these existing efforts by focusing on what should be included in a new financial agreement under the UNFCCC; more specifically it proposes five specific components of a "new deal" to address technology barriers in developing countries. The paper reflects on ideas on technology and finance as put forth by countries in submissions to the UNFCCC secretariat as summarized in UNFCCC 2008. These submissions are summarized in a complementary WRI discussion paper titled *From Position to Agreement: Technology and Finance at the UNFCCC* (WRI 2008). We have also considered two UNFCCC documents that synthesize information on technology needs and financial barriers faced by non Annex 1 Parties to the Convention (UNFCCC 2006 and 2008b)

The five components of a new financial agreement presented in this paper aim to address key barriers along the technology innovation process. While other components could be added, we have limited this paper to five core elements in the interest of producing a simple proposal that could form the basis for negotiating a new financial agreement. However, a number of questions pertaining to each proposed component remain; these are identified at the end of each section. The paper does not go deeply into issues relating to the governance or how financing might be linked to actions by developing countries. Instead its goal is to stimulate an initial conversation among experts and negotiators on 'what should be funded' before launching into discussion on how funds should be managed, since the former can significantly affect the latter.

Major Gaps in the Technology Innovation Process Need to be Addressed in a New Financial Initiative to Mitigate Climate Change

Figure 1 and Box 1 illustrate the main stages of the technology innovation process. These include research and development (R&D) and efforts to improve existing technologies, demonstration, early deployment, and the eventual commercialization of technologies. Moreover, one size does not fit all for technology development and deployment, the innovation system varies for different technologies and in different countries.

R&D Stage

During the R&D stage, the barriers faced by government laboratories, universities and private companies are mainly technical and the need for financing is relatively modest. It can usually be addressed by government grants and/or tax credits to industry, although other approaches such as innovation prizes have also been used. These modest financial incentives can help to overcome the long-time horizons to commercialization, reduce the risks of technology spillover to competitors, and assist industries that might otherwise only appropriate a fraction of the benefits of R&D investments.

Demonstration Stage

As technologies emerge from government and private laboratories, they must be tested to demonstrate their technical and market viability. Sometimes a demonstration can be a 'relatively' simple exercise (e.g., a more efficient production process for producing a solar cell), where it is simply a matter of proving the concept. Other energy technologies are capital intensive; the demonstration stage can encounter significant financial barriers. In a few cases, such as Carbon Capture and Storage (CCS), the cost of demonstrations could run into the billions of dollars and extend over many years[2].

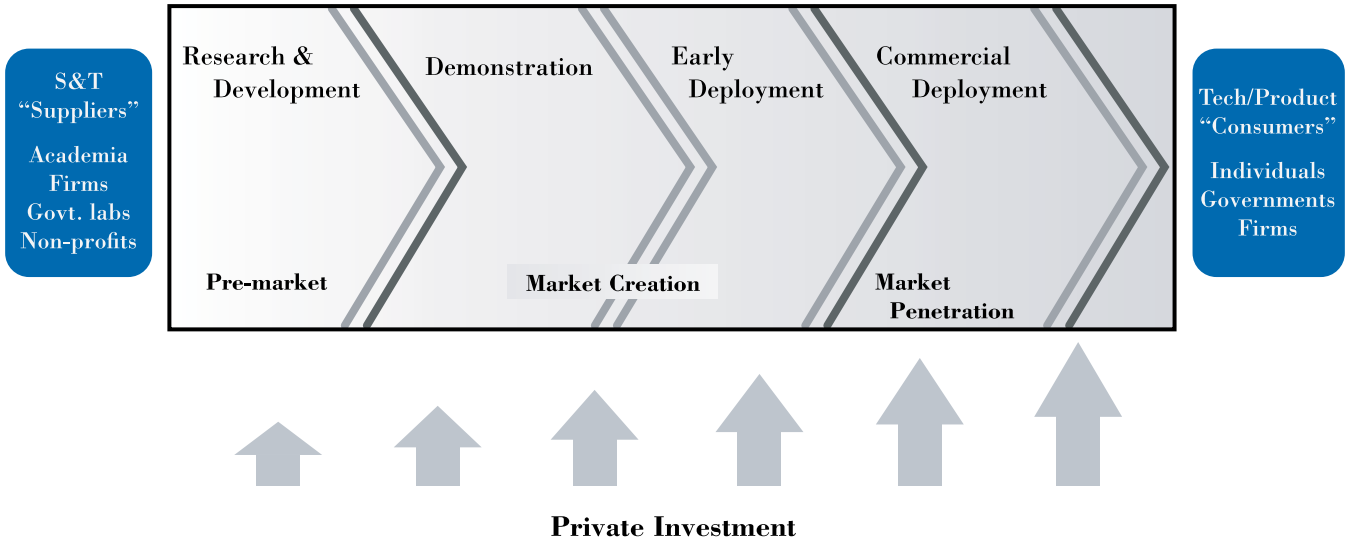
Deployment stage

As technologies reach the early deployment stage, there is usually less public financing available, and private capital may be hard to obtain because technology and investment risks remain high. National polices are often insufficient to create the initial demand needed for early deployment, and financial markets may be too weak to provide all the needed financing. A financing gap at this stage may prohibit entrepreneurs from obtaining the business development, marketing, legal, and administrative skills needed to successfully commercialize their technology. In such cases, venture capital firms and a combination of public financing instruments may improve the financial and management structure of companies or projects deploying a new technology. The roles of the public and private sectors change as the technology moves along the innovation chain, with the private sector bearing more of the financial burden as it gets closer to the deployment and commercialization stages.

Commercial stage

At the commercial stage, mature financial markets and the right mix of national policies, i.e., regulations, tradable permit systems, carbon crediting and fiscal policies are essential to mobilize capital from the private sector. In less mature financial markets, including most developing countries, public funding instruments will also likely be needed, both to make up for a lack of private capital providers and to compensate for imperfect and evolving policies.

FIGURE 1 | **The Innovation Chain**



BOX 1 Stages of the Technology Innovation Process

R&D (Pre-market): R&D seeks to discover new knowledge and to use this knowledge to devise new applications or to improve existing applications. It may seek to overcome technical barriers and to reduce costs. Government funding in the form or grants or other financial incentives is usually required.

Demonstration: The outcome is highly uncertain, but becomes less so as technology moves from the laboratory to the demonstration scale. External funding is needed to finance part or all of the demonstration.

Early Deployment (Market Creation): The technology is a successful, but not yet economically competitive except for possible niche markets. Production may be expanding, but on a small scale; with increasing deployment, technology learning will decrease costs. Many low-carbon technologies will not be cost competitive with fossil fuel generation during this stage even when the price of carbon is factored in, and supportive public frameworks may be needed.

Commercialization (Market Penetration): The technology is cost competitive in some markets, either on its own terms or supported by some limited government intervention, e.g., when externalities are considered. Market inefficiencies and barriers may necessitate some form of additional public investment. The need for carbon finance varies by country and technology, but generally declines over time.

Source: Adapted from IEA 2008

A New Financial Agreement under the Convention Must Address Key Barriers in the Innovation Process

There are significant financial barriers that stand in the way of deploying technologies in developing countries. These include:

- a lack of long term local currency financing options, foreign exchange risks for foreign currency loans,
- lack of appropriate instruments to manage commercial and political risks,
- high transaction costs and timing uncertainties all along the technology innovation process and
- the lack of appropriate intermediaries or incubators to channel appropriate financing and technical support to new entrepreneurs.

In 2006, the UNFCCC secretariat synthesized information from twenty three developing countries on financial barriers. They found that a lack of financial resources, incompatible prices, high investment costs and a lack of financial incentives were among the most common barriers to deploying climate mitigation technologies in developing countries. Overcoming these barriers requires first and foremost a sound financial system, strong financial and commercial institutions and national policies that encourage investments. Assistance from the international community can address some of these needs, but others require national actions. Funding and related interventions from governments and the international community can bring down market barriers, bridge gaps and share risks with the private sector. However, different market inefficiencies and barriers will usually necessitate different forms public finance mechanisms to get technologies through the early deployment stage in the absence of efficient pricing mechanisms or other policies to incorporate environmental externalities.

TABLE 1 Examples of non-financial barriers to the deployment and commercialization of new technologies

Political barriers	Social acceptance and political and country risks, including development policies, tax rules, ownership restrictions
Information	Lack of clear information about a new product
Regulatory risks	Excessive or insufficient regulations, arbitrary import/export rules, electric market design, grid access rules
Administrative	Planning delays, lack of coordination among authorities
Capacity	Availability of technical, financial, and legal expertise, project development skills, and strong financial institutions, lack of skilled labor for operation and maintenance
Commercial risks	Ability to exit, insufficient/unpredictable supply chain for components of new technologies, credit-worthiness of customers

In some cases non-financial barriers may be equally or even more important to the success of a new technology. Generally these non-economic barriers (See Table 1) have a significant impact on efforts to deploy technologies, irrespective of the availability of financing as they increase risks for businesses. Paramount among these is the lack of technical and financial capacity of entrepreneurs to originate and develop technology projects capable of securing financing either by government or private funds. In addition, without political stability, regulatory certainty, and administrative simplicity, the perceived risk level can undermine incentives for investing in projects that have significant up-front costs.

Criteria [Principles] that Should Guide a New Financial Agreement

In the context of the UNFCCC negotiations, Parties to the Convention are currently struggling to find ways to expand financing for climate change mitigation particularly the deployment, commercialization, and transfer of new technologies to developing countries. Any new agreement will need to be based on sound criteria, while recognizing that adjustments and improvements in implementation will be needed as experience is gained in the future. The following six criteria should guide the operation of a new financial agreement:

- **Accessible —** allow all developing country Parties[3] to access financing,
- **Comprehensive —** seek to fill the major financing gaps in the innovation stages and barriers that prevent the development and deployment of technologies[4].
- **Flexible —** allow for the use of a variety of financial instruments, such as, debt credit lines, guarantees, public finance funds, innovative uses of carbon finance, grants and contingent grants and other forms of risk sharing.
- **Encourage the use of leverage —** promote the maximum mobilization of commercial financing
- **Adaptable —** meet the unique circumstances, i.e., priorities and market conditions of each country
- **Verifiable —**support the use of metrics for reporting and assessing implementation

In addition, consideration should be given to whether a new financial agreement will encourage reforms of national policies that underlie financial

Five Components of a New Financial Agreement

We present here five basic components of a new financial agreement. The components are designed to target all the stages of the technology innovation process and some of the most significant barriers and weaknesses of the current international effort to finance the development and deployment of climate change mitigation technology. Greater emphasis is given to the early stages of the technology innovation process, as we assume that a carbon crediting system will promote the deployment of many technologies in the later part of the early deployment and commercialization stages.[5] We also believe that the need for, and priorities for the use of, public monies change and in some cases decline over time, hence any financing will need to adapt over time. The components addresses five critical barriers to the development and early deployment of technologies, failures of the technology innovation process and need for additional R&D as identified in IEA 2008, namely:

- Insufficient R&D for critical technologies
- Inadequate capital for early stage deployment of new technologies
- Limited pipelines of good technology projects
- Limited financial resources to promote the deployment of commercially available technologies
- Lack of technical and financial capacity within developing countries

Component No. 1: An International Critical Technologies R&D Effort

The IPCC and the IEA have documented the decline in financial support for R&D for new energy technologies over the last several decades (IPCC 2007). Funding dropped after initial interest created through the oil shock in the 1970s subsided and has stayed constant, even after the UNFCCC was ratified. The USA and Japan, the two largest investors in energy R&D, spent on average of U.S. $3.38 and $2.45 billion, respectively, between 1975 and 1999. However, such figures mask important underlying trends. For example, a large percentage of the funding designated for energy R&D has gone into nuclear power – nearly 75% in the case of Japan. The support of the U.S. government for R&D declined by U.S. $1 billion from 1994 to 2003, with reductions implemented in nearly all energy technologies. The IEA and others have often called for a substantial boost in R&D through a five- to tenfold increase in public funding and other financial incentives for private industry.

We propose a new collaborative international R&D effort that would be open to all countries and the business community. Such an effort could build on the experience of the IEA's implementing agreements (OECD/IEA, 2005), which have traditionally been under-funded with limited membership, the experience of other international efforts to share information, such as the Carbon Sequestration Leadership Forum, and the large body of project management expertise gained with big projects, such as the Large Hadron Collider. Recognizing that some technologies may be more critical than others, we suggest that such an effort should focus on select technologies with the highest potential to reduce emissions per dollars of investment, for example, carbon capture and storage, and those whose costs cannot be born entirely by the private sector.

How would a new collaborative R&D program be connected to the UNFCCC? Unlike previous efforts promoted by some countries and independent of the UNFCCC, we suggest that a new international agreement explicitly provide for recognition of such an effort, but leave its organization and management to those countries which contribute financially and play an active role in the effort. The elements of an agreement could be left to experts and need not be the subject of negotiations under the Convention (See Box 2). Membership would be open to all, with countries contributing financially and/or in human capacity according to their capabilities. Intellectual property rights emerging from this program would be held in common by all participating countries proportional to their financial and in kind contributions. Annual progress reports to the COP could be a requirement in return for recognition of the efforts. The COP could monitor progress and take any actions necessary to ensure its success.

Component No 2: International Venture Capital Fund

The transition from development to deployment is often difficult as technologies emerge from universities or government laboratories. At this stage it is rare that entrepreneurs can achieve commercialization of their technology solely by relying on their own personal investments or monies from friends and families. They require a large injection of investment capital to pay for the engineering, marketing, legal and administrative skills necessary to demonstrate and scale up the technology. Venture capital firms play the critical role of providing this financial support at this stage[6].

However, until recently, when it came to the clean energy industry, investors were hesitant to provide financing at these early stages for several reasons:

- Capital intensity of the industry
- Uncertain regulatory policies
- Lack of expertise of energy industry
- Perceived lack of consumer need
- Low cost of existing hydrocarbon energy technologies
- Relative high cost of clean energy technologies
- No sample of successful investor exits

BOX 2 Elements of an International R&D Agreement for Innovative Technology

Goals
- Do all the participants have the same goals?
- Identification of critical technology barriers

Participation
- Who can participate – sub-national and non-government entities;
- Responsibilities of participants;

Development of a Project Plan
- Delineate the tasks to be carried out, the skills and resources required, and the sequencing and duration of the tasks.
- Identify milestones and metrics to monitor progress.
- Identify procedures to redirect or terminate tasks

Structure
- Determine the institutional, technical and financial structure
- Identify decision-making apparatus, legal or bureaucratic rights and obligations, dispute resolution and ownership elements.

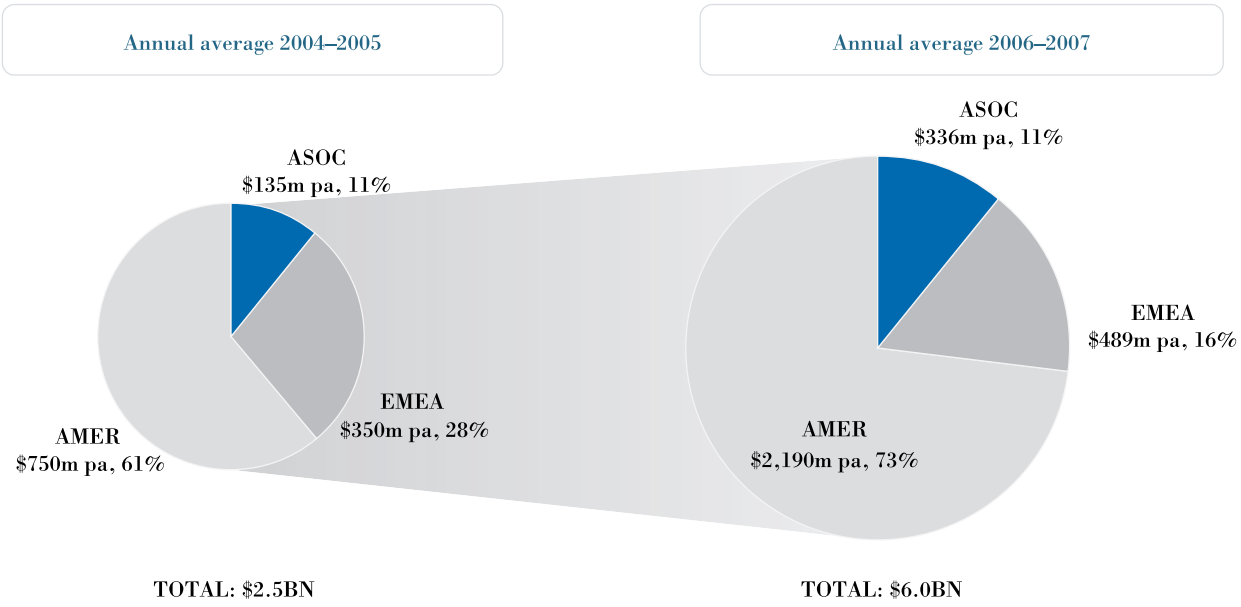
Support
- Determine the range of cost-shared versus task-shared elements
- Develop consensus on equitable funding, sharing or subsidy arrangements
- Secure financial support through various means.

Ownership
- Develop agreement on how to share results
- Establish the terms of intellectual property and patent rights, including pre-existing proprietary information

Communication
- Consider how information is to be communicated
- Develop an external communication strategy for interim and final task results

Source: Adapted from OECD 2005

FIGURE 2 | **Venture Capital Average Per Annum Investment by Region (USD $m) & Growth (%)**



Note: AMER for the Americas (North & South); EMEA for Europe (EU and non-EU, Middle East and Africa; ASOC for Asia and Oceania (Australia and New Zealand). Labels denote total amount raised per annum and its corresponding percentage of global total.

Source: New Energy Finance, SEF Alliance Public Venture Capital Study, 2008

- Long gestation period from prototype to eventual commercialization
- Lack of government support for roll-out of proven technologies

Analysts have termed the deployment stage the 'valley of death' since many technologies never go beyond this point. Entrepreneurs in all countries face this problem, but those in developing countries with immature financial institutions have even fewer options (See Figure 3). A new study by New Energy Finance has noted that there is a critical "global" funding gap at the early stages of the early deployment (post R&D) stage. Early stage venture capital financing in 2007 represented a small fraction of the overall investment in clean energy, totaling $3.6 B of the $13.5 B of total venture capital and private equity money invested in companies[7]. While small, this $3.6 B is arguably one of the most important investments, as it is the foundation of future innovation and market creation in clean energy. Early stage venture financing provides capital for clean energy entrepreneurs to build clean energy start-ups and develop revolutionary ideas into game-changing technologies with the potential to become companies advancing the development and delivery of clean energy services. These new ventures push the frontier of clean energy development, looking for improved solutions to better exploit renewable resources and drive down the cost of producing and delivering clean energy. Without strong investment in early stage financing, the well of new clean energy ventures will eventually go dry, leaving the industry with no spring board for the future technological breakthroughs that are necessary for long term sustainability of a clean energy economy.

Because of underinvestment by private firms in developing countries, we propose the creation of an **International Public Venture Capital Fund** that would be open to all developing country entrepreneurs. Such a fund would bring investment into the energy sector of developing countries, allow investments over a longer time horizon, make investment decisions on factors other than just return on investment, have due diligence fees relatively indiscriminate of the deal size and could draw on the experience of existing public funds. (See BASE/UNEP 2006 for listing of small public venture capital funds that are operating in a few developed countries.). *However, such a fund should not be a substitute for private venture*

capital; rather it should serve to entice private capital by adding value especially with respect to the impact of policies and networking advantages due to their familiarity with the public sector players.

The fund would need to be independent of the UNFCCC in order to have the best chance of success, although some form of recognition might be acknowledged in a future climate agreement. Independence would allow it to take equity positions, hire investment professionals, and create partnerships with private investors. Flexibility would also be needed to structure investments in the most appropriate manner including direct investments and limited partnerships. Additional issues that would need considerations in setting up an International Venture Capital Fund are listed in Box 3. As in the case of the International R&D effort, design and operational issues should be left to VC experts, and need not be the subject of negotiations under the Convention.

Component No. 3: International Project Development Facility

The lack of a well-developed project pipeline in the early deployment stage of clean energy/technology investments, capable of using both public and private capital, has been a problem facing financial institutions for decades. Various efforts have been made by bilateral and multilateral institutions to address this issue, with successes in a few countries. We note, for example, the effort of the Corporación de Fomento de la Producción (CORFO), Chile's economic development agency, which has overcame this problem by establishing a High Technology Investment Promotion Program to develop transnational strategic networks of individuals, business associations, and universities to facilitate learning in order to devise strategies and promote investments[8].

The project pipeline problem has many facets, including:

- the need to package many small projects,
- high pre-investment development and transaction costs relative to total capital deployed,
- complicated technical and financial information requirements,
- lack of finance experience within financial institutions,
- lack of collateral offered by equipment manufacturers, and
- difficulties creating creditworthy financing structures and the sheer range of financing structures needed to address the financing needs of various end-use sectors.

BOX 3 Examples of Issues Relating to Setting up an International Venture Capital Fund

- How will the fund be structured?
- How should it be initially capitalized and at what level?
- What will be the relationship with private investors and private VC firms?
- Will there be any restrictions as to geographical local, technology or capital stage, i.e., what will be the investment goals?
- Will it have the necessary in-house investment expertise?
- Will it undertake its own due diligence?
- What would be a typical management fee?

If these problems persist, it will be difficult to develop the momentum needed to deploy capital in a timely fashion in the time frames needed to ensure that emissions do not continue to climb in developing countries.

We propose the creation of an **International Project Development Facility** to tackle the weak pipeline problem head-on. The objective of the Facility would be to address the need for: 1) financial toolkits and resource materials to assist financial institutions, ESCOs, vendors and project developers, 2) market analysis to justify investments, 3) trained practitioners in public and commercial finance practices, 4) country-based institutions or units to serve as focal points for aggregating projects that can meet the requirements of public financial institutions and private banks; and 5) seed money for feasibility studies relating to the deployment of new technologies in the host country and the purchase of technology and financial data not publicly available.

Developing institutional capacities is central to implementing and expanding the clean technology project pipeline. These capacities need to be developed at the local level and include commercial financial institutions, energy efficiency and renewable energy businesses, end-user groups, and government agencies. Additional considerations in setting up an International Project development Facility are listed in Box 4.

Component No. 4: Scaling up Investments to Deploy Technology

A number of proposals have been put forth by countries to scale-up funding to mitigate climate change. Few of these proposals stipulate how any additional funds should be managed to maximize their effectiveness. However, a recent study by the UNEP concluded that:

> "Having assessed experience with a number of different models of public finance mechanisms the typical leverage ratios range from 3 to 15 times. Based on this experience it is estimated that if a concerted program of public finance were scaled up, $10 billion in public monies could leverage $50 to $150 billion in total investment in the climate mitigation sectors."[9]
>
> —UNEP 2008

This message from the UNEP study is clear: the use of appropriate public financial instruments could make a significant contribution to mitigation efforts in developing countries, if public finance instruments are used to leverage public monies. Concessional funds from multilateral and bilateral sources can be used to mobilize commercial finance though the use of loans, equity, credit lines, guarantees and other partial risk-management products, but to do so, the concessional monies need to be put in high risk positions to create financing structures that support senior (more secure) debt from commercial sources. When concessional funds are used as equity, matching equity funds from other sponsors can be used. Furthermore, the use of structures which result in reflows to the concessional fund source would allow the finance program to preserve and therefore reuse its capital for additional finance activity. The use of concessional monies must push the clean energy technology market along the path toward fully commercial activity and seek to maximize the demonstration value of projects. Finance which is structured closest to commercial terms will have the greatest potential for replication. There is considerable experience with these structures, for example, concession funds from the Global Environment Facility (GEF) have been matched with guarantees from the International Finance Corporation and private bank funds to finance substantially larger projects than would have other wise been possible (citation). Public finance can also be used to demonstrate innovative financing mechanisms, allowing the private sector to either share participation (and risk) or take them up once demonstrated. For example, the IFC has structured guarantees for ESCO finance with Russian and Chinese banks that lets them gain experience with IFC taking a "first-loss" position on the investments.[10]

Building on this experience, **we propose to expand existing clean technology investment funds such as those under the direction of the Multilateral Development Banks (MDBs)[11] and give them flexibility to use a range of public finance instruments to aggressively leverage private sector funds.**[12] Combined with the carbon market, such an effort could go a long way toward meeting the financing needs identified by the UNFCCC Secretariat.

Box 4 Issues relating to setting up an International Project Development Facility

- What specific responsibilities would it have?
- What institution should provide administrative support for the core staff? How would it relate to the UNFCCC?
- What criteria would govern the selection of in-country partners?
- How would it be capitalized and at what level?
- How would it be monitored and what would constitute success?

Guidance from the COP to the fund managers may be needed to create the conditions necessary to empower or mandate the banks to pursue the use of high levels of leverage. However, it is important to keep in mind that the banks are independent entities and have their own mandates, therefore new relationships will need to be forged between the managers and the COP, including reporting provisions that clearly identify how public monies have been used to maximize commercial funds.

Component No. 5: Promoting Capacity Building - Capacity Building Forum on Investments

All of the above components of a new financial agreement will require capacity building, if the barriers to the early deployment of technology in developing countries are to be overcome. Without sufficient in-country capacity, financing is not likely to flow from public and private financial institutions to the ultimate users and customers for technology. To address this issue, capacity building needs to be focused on government agencies, financial institutions and the business community in developing countries. Many developing countries have an array of equipment vendors and engineering firms, some with turnkey contracting capability. Complementary marketing, financing and new transaction structuring and contracting methods can be made part of a project and bought to these firms. Many commercial financial institutions offer term lending for plant and equipment; some have leasing units, others structured finance and project finance capacities. Thus, the government agencies, financial institutions and commercial firms may already be engaged and have some of the requisite skills. It then becomes a matter of seeing how these can be adapted and improved. Topics that could be addressed include: 1) improving policy analyses, 2) creating market research and marketing support skills, 3) staff training and business planning, 4) assistance in establishing technical standards, and 5) creating market aggregation programs. Technical assistance could be directed at:

- Government policy makers responsible for the development of national standards, regulations, taxes and charges and information instruments as these essential if investors are to be sure that a market will develop for technologies and financial products.
- Vendors who often play an important role in trying to stimulating and aggregating demand for products and technologies. Vendors are a source of financing that flows to businesses from financial institutions. In some cases, the vendors can provide credit support and help financial institutions offer financing to more customers.
- Energy Service Companies (ESCO) who develop, engineers, and installs clean energy products. ESCOs operate with a range of business models and often provide financing for their projects. ESCOs and/or their customers need debt financing from public or commercial financial institutions.
- Public and private utilities in developing countries can be effective agents and aggregators for marketing and delivering equipment, projects and financing. Utilities can act as or establish financial intermediaries to finance energy projects for their customers and work with commercial banks. They are also a billing and collections mechanism that can be used to collect finance payments from end-users to enhance the credibility of financial instruments.

There are two approaches to building technical and financial capacity, i.e., technical assistance can be a complementary part of each technology investment structured by a development agency, Venture Capital Firm, MDB or commercial bank, or can be provided by an independent institution such as the International Project Development Facility proposed above. The former arrangement can better ensure that the right skills are developed for the unique circumstances of associated with each technology and sector, while the latter may be more efficient since many generic skills are applicable to several sectors. For many areas, both approaches could be used; indeed a multiplicity of approaches may lead to more creative, country driven and relevant capacity building efforts. The issue then is how a diversity of capacity building efforts can be monitored to ensure that a significant expansion of capacity building efforts is taking place.

Given the previous difficulties the UNFCCC has had in tracking efforts to promote capacity building; a new start is needed! Toward that end, we propose the creation of a **Capacity Building Forum on Investments** under the COP to monitor and oversee capacity building efforts associated with public financing. An initial task would be to identify what capacity building data should be collected, how it should be collected and by whom. Only if there are data will the Parties have an understanding of the adequacy of current efforts, what programs have been successful and why, what gaps need to be filled, and what additional steps should be undertaken We do not anticipate that such a Forum would have operational responsibilities, since others such as the MDBs, UN Agencies and bilateral institutions are better suited and have more experience in such matters. Box 5 contains a list of questions that such a forum might seek to address.

BOX 5 Questions that might form the basis for a Capacity Building Forum on Finance

- What data are currently being collected and by whom?
- What questions were such data intended to address and are they relevant to the needs of the Convention?
- What would be necessary to enhance such efforts?
- Would it be most advantageous to build on existing efforts or to create a data collection effort tailored to the needs of the Convention?
- How could successful efforts be replicated and scaled up?

Concluding Thoughts…

This paper proposes five components that can make a significant difference to the development and deployment of advanced, low and zero carbon technologies in the near and long-term. The recommendations outlined herein focus on financial interventions and to a more limited extent on the institutional arrangements needed to overcome nascent market structures, financial barriers and limited capacity on-the-ground. The paper stops short of suggesting levels of financial support for each component. A range of such estimates can be found in UNFCCC 2008. While the issue of how much money should be available is not insignificant, what is important is to structure a system that addresses the major technology development and deployment barriers and that can endure over time. Other approaches such as prizes, technology centers and the need to address intellectual property rights have been proposed by others. While these may have a role to play, they do not by themselves provide a broad foundation for the future. Perhaps more importantly is to 'begin' …to create a consensus…to create a framework as soon as possible. A central tenant is that neither private funds nor public investments operate effectively in isolation. New models, new criteria and new partnerships are required along side public policy if we are to succeed.

Acknowledgments

The World Resources Institute is grateful for the cooperation of the UNEP for sharing its information on public finance instruments.

References

BASE/UNEP 2006. Public Finance Mechanisms to Increase Energy Efficiency. Basel Agency for Sustainable Energy and United nations Environment Programmes Sustainable Energy Finance Initiative, Basel, 2006.

IEA 2008. Energy Technology Perspectives: Scenarios and Strategies to 2050, International Energy Agency, Paris.

IPCC 2007. Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O. R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

New Energy Finance, SEF Alliance Public Venture Capital Study, 2008.

OECD/IEA 2005. International Energy Technology Collaboration and Climate Change Mitigation: Synthesis Report, COM/ENV/EPOC/IEA/SLT(2005)11, Paris.

UNFCCC 2006. Synthesis report on technology needs identified by Parties not included in Annex I to the Convention. UNFCCC/SBSTA/2006/INF.1, April 2006, Bonn.

UNFCCC 2008. Ideas and proposals on paragraph 1 of the Bali Action Plan, FCCC/AWGLCA/2008/16, Nov. 2008, Poznan.

UNFCCC 2008 b. Interim report on identifying, analysing and assessing existing and potential new financing resources and relevant vehicles to support the development, deployment, diffusion and transfer of environmentally sound technologies. UNFCCC/SB/2008/INF.7, Nov 2008, Bonn.

UNEP 2008. Public Finance Mechanisms to Mobilize Investment in CC Mitigation, United Nations Environment Programme, Paris 2008.

WRI 2008. From Position to Agreement: Technology and Finance at the UNFCCC. (Discussion paper), 2008. Washington.

Notes

1. http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTCC/0,,contentMDK:21713769~menuPK:4860081~pagePK:210058~piPK:210062~theSitePK:407864,00.html
2. The FutureGen Industrial Alliance was cooperating with the US Energy Department to develop a coal-fired power plant designed to gasify and store carbon emissions within the Earth. The Energy Department withdrew its support because of ballooning cost estimates on what was initially supposed to be a $1 billion project but which grew to $ 1.8 billion. http://archives.chicagotribune.com/2008/jan/31/business/chi-thu_futuregenjan31
3. Many barriers can only be addressed by national governments, i.e., not all barriers are well-suited to solutions through international cooperation.
4. Financing through the use of the carbon credit market is a necessary complement to the components in this paper, but is likely to be treated as a separate issue as it is linked to discussions on national commitments and improvements to the Clean Development Mechanism.
5. In analyzing the issue of 'what' should be funded we considered an approach based on the marginal cost of existing technology as it partially reflects the innovation pathway. Using a marginal cost curve, more costly technologies are likely to require the use of carbon credits while others that have lower marginal costs are likely to need public finance mechanisms to overcome barriers. In such an approach upgrading old inefficient power plants would likely be a candidate for public finance instruments, while the deployment of a new biomass to liquid fuel process would likely need carbon credits to be deployed. However, considering only existing technologies would leave out the research and development and early deployment of technology. The framework and components we propose are broader and intended to address crucial barriers in these stages as well
6. There are no hard boundaries that demarcate where VC companies play a role, for example, they may support the design of a prototype, development of a demonstration, construction of a pilot facility. VC firms also fuction differently in different parts of the world.
7. In 2007, new investments in clean energy technology reached USD $148 B and accounted for 1 percent of total global infrastructure investment.
8. http://findarticles.com/p/articles/mi_qa4000/is_/ai_n19432211
9. This estimate does not take into account the fact that many public finance mechanisms "roll over" and support multiple generations of investments before they are fully expended and therefore that the long term capital mobilization can be even larger. However it is important to consider that these calculations represent program capacity; the actual amount of projects supported depends on program operations in commercial practice and relies on sufficient volumes of bankable projects
10. The fund has structured 126m in loans in China, allowing 1776m of total investments. The Climate Group. *China's Clean Revolution.*
11. http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTCC/0,,contentMDK:21826742~menuPK:5173003~pagePK:210058~piPK:210062~theSitePK:407864,00.html
12. While it is difficult to be precise when it comes to estimating leverage, the IFC is currently leveraged by approximately 2-3. Most conservative commercial banks are usually leveraged by a factor of about ten. Prior to the current financial crisis some more risky institutions were leveraged by a factor of 20 or more. Some greater use of leverage therefore seems entirely feasible and appropriate even in the current financial environment.

WORLD
RESOURCES
INSTITUTE

10 G Street, NE
Suite 800
Washington, DC 20002
www.wri.org