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Structuring International Financial Support for Climate Change Mitigation in Developing Countries

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Abstract

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Keywords Financial mechanism, Risk guarantee, Development, Climate Policy

JEL Classification F30, G20, R38

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1. Introduction

To avoid the concentrations of greenhouse gases (GHGs) overshooting a level at which climate dynamics could go out of control, developing countries must curb their upward emissions trends, in addition to drastic cuts in GHGs emissions of developed countries.

The majority of emission reductions are expected to result from low-carbon and energy efficient investment choices. This is expected to result in incremental investment costs for the mitigation scenarios in the order of a few hundred billion dollars. Figure 1 shows that these volumes are relatively small compared to total annual investment volumes in developed and developing countries for the year 2030, which are projected by the International Energy Agency to be $12,000 billion and $7,000 billion respectively.

The reason for this is rather straightforward: in the energy sector, the capital intensity per unit of production is likely to be higher, but this is compensated for by a lower energy demand due to higher energy efficiency. A similar phenomena exists in the transport and building sectors.

This shows that the issue is less about changing the investment or consumption ratio of the current generation, and more about restructuring the investments. Assume, as proposed by the European Commission, that there are $15 billion transfered per year to non Annex 1 countries from Europe (e.g. 0.082% of GDP). If this would be replicated by all OECD countries, then $31 billion of public finance would have to shift $240 – 600 billion investment a year (in 2030, World Bank 2009a) towards low-carbon-intensive infrastructures and efficient end-use equipments. This is only possible if it is seen as an opportunity to leapfrog a carbon-intensive economy and to align development and climate objectives.

Debates about international climate policy architectures have often been driven by the search for a world carbon price, be it in the form of a cap-and-trade system or in the form of harmonized carbon taxes, in order to minimize costs of climate policies by abating

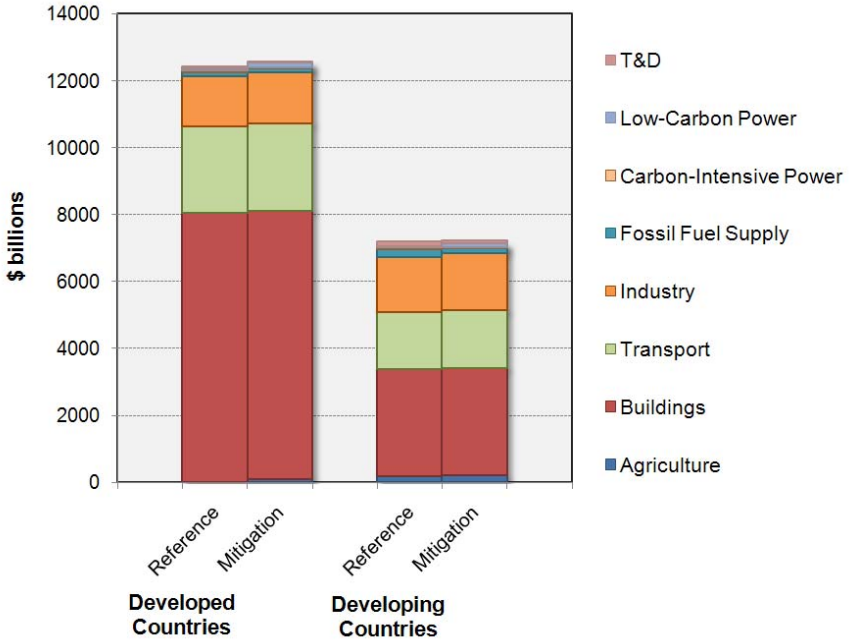

Figure 1. Developed and developing country investment volumes, in reference and low-carbon scenario for 2030, as projected by International Energy Agency

carbon emissions where it is cheapest to do so. However, developing countries will not co-operate in implementing such carbon pricing approaches as long as they perceive environmental issues as a new form of Malthusianism. Therefore global carbon markets have received increasing attention as they are seen to allow both for financial transfers to developing countries and for the creation of a carbon price signal.

However, the question remains whether mechanisms that implement carbon prices suffice to facilitate a low-carbon transition. Economists have identified a wide set of market failures that could prevent a low-carbon transition, even in the presence of a suitably defined carbon pricing regime;

- Actors are not (fully) rewarded for innovation, experimenting and learning by doing because of spill-overs or because regulatory frameworks limit upside profit opportunities.
- Time constraints limit the number of informed decisions individuals and firms can make. Hence energy and carbon savings opportunities might not receive the necessary attention.
- Incomplete information about the performance of technologies and business partners creates risks. Hence firms hesitate to shift to new technologies, business practices or products.
- Regulatory uncertainty creates risks for investors - policy changes could result in lower future carbon prices and lower profitability for low-carbon options.
- Network effects create situations where many actors have to coordinate their transition – ranging from training, infrastructure provision, technology manufacturing, installation, operation, maintenance, management.
- 'Imperfections' in policy processes can delay the development of suitable regulatory and institutional framework thus creating barriers for new technologies and processes.

These market failures are important in the context of developing countries and will not be corrected overnight given the political constraints to do so. In the case of low-carbon transitions many of them may appear simultaneously and for many sectors it is unlikely that the carbon price alone can incentivize a low-carbon transition. This paper explores the different financial instruments that are available to national governments and the international community to address market failures or to compensate for their impact. Financial instruments can increase incentives or reduce costs for low-carbon investments, address risks, and can allow governments to signal or commit to regulatory stability.

This is all the more important as in their accelerating pursuit of affluence, developing countries are set to build the bulk of their infrastructure in the next decades, rendering a bifurcation towards high-carbon development pathways irreversible in the near future. They will not slacken their pace in anticipation of a fully-fledged cap-and-trade system in which they would receive emissions allowances, affordable technology and transfers generous enough to compensate them for any significant carbon price[1].

Re-directing investments towards low-carbon infrastructures requires regulatory changes, public commitments to long-term programs, and tailored financial support and training. In short, a comprehensive set of actions capable of shifting a sector towards low-carbon development. It also requires a good interaction between domestic stakeholders (private investors and developing country governments) and potential international supporters to tailor the form of the support to the specifics of each sector and even sub-sector.

[1] And all the more so, as a dispassionate reading of the situation drawn up by the Harvard project (Aldy and Stavins 2008) about the possible International Climate Policy Architectures suggests that none of them is likely to emerge in a near future

This shows that the problem is not so much capital shortage at the global level but the direction of savings, in a period when key emerging countries are capital exporters and some rich countries capital importers. The challenge is to maximize the leveraging effect of climate finance. This requires a financial architecture which includes risk-management and risk-sharing dimensions, one which can support mechanisms tailored to many types of domestic development policies, from the project level to the program level, and offer support to economic reforms.

The paper therefore tries to delineate a form of taxonomy of the basic elements of a financial architecture from which a palatable deal could be derived, so as to accelerate the willingness of non-Annex 1 countries to accept significant pledges in a climate policy regime.

The remainder of the paper is structured as follows. Section 2 discusses the nature of the different needs, and provides criteria to identify suitable financial support mechanisms. These are discussed in more detail in section 3, with reference to experience in climate change and development co-operation. Moving from the demand side of financial support, section 4 shifts to the supply side of financial support mechanisms, and discusses the experience of different bilateral and multilateral institutions in the provision of such mechanisms. Section 5 gives some insights about how to avoid the risk of a fragmentation of climate finance by showing its potential links with the reform of the international financial system.

2. Financing Needs: what are we talking about?

Most of the financial flows will come from institutions which are highly sensitive to the risk-return ratio of climate projects, including sovereign wealth funds, state and public pension funds, private and corporate pension funds, insurance companies, endowments, private banks, and investment management companies. The ratio for low-carbon investments will not compete with that of conventional projects as long as there is no credible and significant trend of rising carbon prices supported by a credible international climate architecture. But the ability of less-developed country (LDC) governments (like any government) to commit to overcoming the transaction costs, which block institutional and economic reforms that would generate the number of projects, to realize the necessary economies of scale, in addition to lowering the investment risks, remains questionable.

Development of an appropriate policy and regulatory framework demands reforms which touch a wide range of socially sensitive sectors like transportation and buildings, and the overall national architecture of public policy, including taxation, incentives/subsidies, pricing policies in energy and transportation, non-financial support mechanisms (e.g. standards, procurement, and urban planning). Developing country governments will not engage in such reforms without large-scale financial support for the initial investments required to implement these new regulatory frameworks, and for transition costs. But this financial support is itself frozen by uncertainty over whether governments' will fulfil their commitments.

Climate negotiation can break this double-bind, by providing incentives for governments not to default on their policy commitments, and to trigger climate finance which will in turn help governments to fulfil these commitments. Since a fully-fledged Kyoto-type architecture is not likely to be developed in time to provide such incentives, the key is in the financial devices themselves. But the negotiation so far as been framed in terms of additionality to official development aid, which is, in part, misleading: it focuses attention on a new 'climate finance' which could be additional to 'normal finance', whereas the big challenge is a re-allocation of investment flows.

To explore the practical ways of maximizing this leveraging effect and to drastically change the portfolio of investors, we will start from two important although seemingly trivial reminders:

First, low-carbon investments usually fall into one or both of the following categories: (i) substitution of operational costs with capital expenditures, for example energy costs for buildings or power plants are substituted with investment costs for insulation or renewable energy plants, (ii) a shift of capital expenditures, such as the shift from high- to low-carbon technologies in many industrial processes and choices in energy infrastructure, but without attributable decrease in operational costs.

Second, the choice of suitable financial instruments (aid, provision of loans, and credit guarantees versus direct financial transfers) must be made in the context of the microeconomic specifics of the project or program: and of the type of actors that are to be supported (governments, institutional investors, project developers).

To illustrate the many facets of such financial devices and better understand how they can match the diversity of financing needs in the real world, we will explore, following the structure pictured in Figure 2, the choices between the various forms of financial support (provision of loans, credit guarantees, direct financial transfers, etc.)

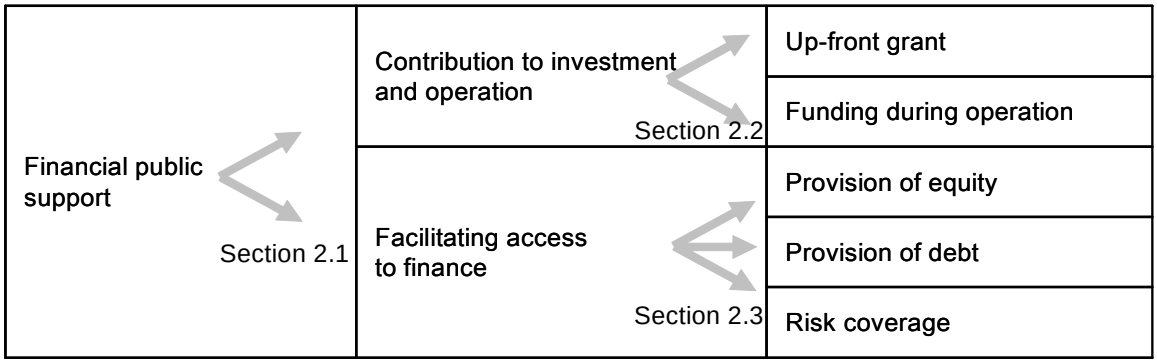

Figure 2. Financing instruments

2.1 Incremental Cost Support versus Access to Finance

To shift private investment to low-carbon options requires national governments to undertake one or both of the following actions: first, increasing their return, relative to carbon-intensive alternatives, by providing direct subsidies and/or increasing the costs of emitting for carbon intensive competitors by carbon pricing; second, reducing their risks, either by enhancing the stability of low-carbon policy frameworks, and/or by offering risk guarantees and/or by facilitating access to capital.

International financial mechanisms can support and complement these actions of national governments by:

- providing direct grants to projects to cover incremental project costs or to create additional revenue streams, for example through carbon credits. International mechanisms can also provide financial support to countries as a contribution to the incremental costs which countries incur when implementing feed-in tariffs, supporting energy-efficient buildings, or introducing carbon pricing.
- reducing financing costs through the provision of preferential loans and equity, or through public credit guarantees which reduce the costs of commercial loans by eliminating country, currency, policy, technology or even project risk.

These two options are, in many cases, equivalent. It is common practice to measure the value of such support by the amount by which it reduces the need for grants, and to label it as grant-equivalent support.

Figure 3 illustrates the parameters which influence the relative merits of international support schemes providing direct transfers, versus facilitating access to finance. The small symbols, referring to insights from country policy case studies, illustrate how sector- and country-specific aspects influence the optimal choice.

The structure of international financial support should be particularly geared towards providing access to finance, through loans, credit and risk guarantees or equity finance, where ***constraints in capital access prevent low-carbon projects***. New technologies face high risks because the intrinsic uncertainty about their reliability and future maintenance costs (CSP in South Africa) is aggravated by uncertainty about the regulatory frameworks (Renewable Energy projects in Ghana, Energy Efficiency agricultural pump sets in India, and alternative transport infrastructure in Brazil).

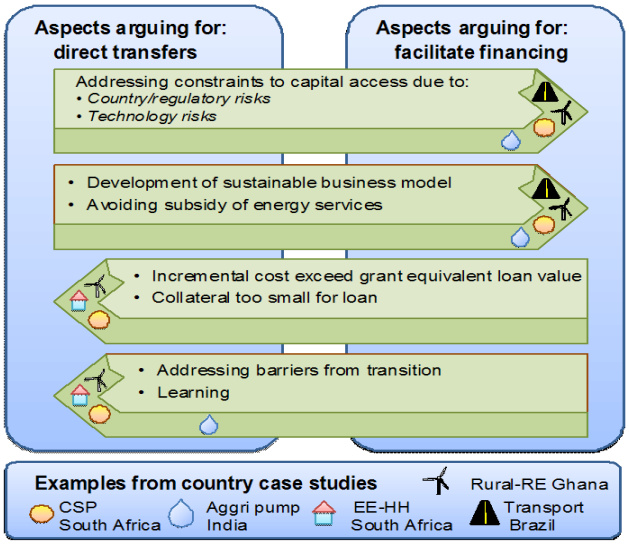

Figure 3. Parameters determining whether a project/action is better supported with grants versus loans or credit guarantees

Together, these factors prevent investors from providing large-scale finance for low-carbon projects in developing countries, and limit financing sources to those private actors and funds which are prepared to bear higher risks in exchange for higher rates of return on employed capital. Credit guarantees can selectively remove some of the risk (e.g. currency, country, policy risk) and thus allow access to finance. Costs can therefore be reduced, and the necessary scale of low-carbon investment can be supported by institutions which are prepared to participate in financing. This process can be initiated or complemented by direct provisions of loans.

Facilitating access to financing also allows projects to be pursued on a commercial basis and thus contributes to the ***development of sustainable business models.*** Publicly initiated and financed projects can only constitute a small share of the total volume of projects necessary to deliver low-carbon growth. Thus it will be important to develop sustainable business models to deliver low-carbon and energy efficient technologies (using the same examples as above). Provision of loans and credit guarantees to private actors can contribute to the development of business models and companies. This option also argues in favour of using risk guarantees and loans as instruments to provide financial support for low-carbon development in developing countries.

However, incremental costs of some new technologies are significant and can require additional **support beyond grant-equivalent value of loans.** In these cases, there may be insufficient collateral or income streams to provide capital to cover incremental investment cost. Grants can allow for local ownership, which is often seen to be essential for project success and to initiate microfinance schemes.

Also **initial learning and transaction costs** create barriers that can be overcome with regulatory design, technology co-operation and some additional costs for initial projects. In this case, direct grants can be simple, and create low transaction costs. They also provide support, where benefits are difficult to appropriate by individual actors, e.g. from technology improvements through learning-by-doing.

2.2 Up-front Support versus Support during Operation

Direct support in the form of grants can be provided through up-front investment support or as support throughout the duration of the project.

Up-front support is easy to implement and typically reduces transaction costs apt to block the project. It also can facilitate capacity building, for example as illustrated by a scheme of the European Investment Bank that pays for initial management fees of venture capital funds (European Investment Bank, 2007).

However, this up-front support provides no hedging against moral hazard and no incentive to maximize the performance of projects. This is the lesson from up-front tax credits to support wind projects initially in California and later in India, and has resulted in the underperformance of many projects due to inappropriate locations, quality of turbines and maintenance. Spreading support over the lifetime of low-carbon projects allows support to be linked to project performance, thus generating incentives for effective implementation, installation and operation.

This type of support can be provided through feed-in tariffs, which provide long-term guarantees to buy renewable energy, often above market prices. Thus additional revenues are provided to investors, but are conditional upon project delivery, while the guaranteed price reduces investment risk and financing costs. International support could provide grants to contribute towards these incremental costs.

A similar form of operational support is the CDM, which allows off-set credits to be sold to developed countries. Administrative complexity, however, limits the regional and sectoral scope of its application, particularly for smaller scale or complex projects, and the uncertainty in demand for offsets, and resultant price volatility, has resulted in significant discounting of the value of offsets in financing decisions. In addition to direct support, there are three additional options for international support to enhance the ability of domestic governments to implement low-carbon investment frameworks.

First, domestic efforts to reduce energy subsidies increase the value of energy savings and thus enhance the profitability of energy-efficiency measures. International support can help to address some of the political economy barriers to achieving this, and facilitate the transition by supporting adoption and diffusion of energy-efficient technologies.

Second, domestic carbon pricing schemes such as carbon taxes or cap-and-trade schemes with auctions increase the costs of carbon-intensive processes, products and services. This creates market opportunities and enhances the profitability of low-carbon projects. International support can facilitate the implementation of carbon pricing and contribute to policy stability by increasing low-carbon opportunities through financial support, technical co-operation, technical assistance and capacity building.

Third, technical assistance grants can also focus on the removal of some of the constraints in the wider investment environment which may limit investment, e.g. grants to improve the capacity of regulatory authorities or improve the ability of commercial financial institutions to assess applications for finance for low-carbon projects.

2.3. Equity, Loan, or Risk Coverage

To clarify the relative merits of equity, loan and risk coverage for providing finance targeted to low-carbon projects, a distinction can be drawn between mechanisms that transfer risk to the public sector and mechanisms under which the public sector share in risk through the provision of capital.

The main option to transfer risks to the public sector are insurance or guarantee products. They are logically suited to cover currency, country and policy risk, which are largely determined by public policy decisions. This would encourage the simultaneous provision of credit risk guarantees and development of an attractive investment framework, with enhanced credibility of the overall domestic policy framework, possibly through contracts where two countries declare themselves to be jointly and severally liable.

The amount of compensation provided can be full or partial. They can also be provided just to creditors or to all providers of capital. Alternative government support schemes can be structured so that private insurance companies take the first hit and governments back insurance companies, e.g. to cover systematic risks.

Such products can provide protection against certain specific events that cause non-performance, e.g. political instability, or against general non-performance. However, if risk guarantees are expanded to encompass the majority of potential risk components, then it is more justified for public agencies to provide direct loans or equity, thus avoiding complexities and transaction costs.

The other principal means for the public sector to improve access to finance is by direct provision of capital on terms that are advantageous compared to that which would be available from private capital markets. Typically corporate and project finance will rely on a mix of credit and equity finance, balancing their specific risks (Myers, 1984). The capital provided governments can accordingly either be debt capital (loans) or equity capital, depending on the requirements of the project/enterprise and the risk aversion of the public investor. Debt does not dilute the shareholdings of existing owners; however excessive leverage (or weak creditor supervision) may introduce both moral hazard problems and, in case of underperformance, the leverage effect can be reversed into a trap. Equity finance dilutes shareholdings but has the advantage of providing new funders with access to information, as well as aligning incentives between fund providers and entrepreneurs.

In summary, loans or, potentially, equity contributions are preferable where comprehensive risk coverage is necessary. Risk guarantees would be best focused on currency, country and, potentially, policy risk components. Section four will introduce additional considerations from the perspective of the supply side which might influence the choice of the preferred instrument.

	Public Finance Mechanism	Advantage
Contribution to investment and operation	Up-front grant	• Easy to implement • Reduces cost of capital
	Funding during operation	• Incentives for performance of project (Feed in, CDM, Carbon pricing/removal of energy subsidy)
Facilitating access to finance	Provision of equity	• Where comprehensive risk coverage necessary • Initial experience to subsequently attract private sector investment
	Provision of debt	
	Risk coverage	• Targeted to specific risk components (regulatory, currency)

Table 1. Summary of public finance mechanisms and their specific advantages

3. Instruments to provide Financial Support

Although the typology set out above is helpful for clarifying distinctions in the properties of different instruments, hybrid instruments will make an important contribution in the real world. Many program of public support combine different mechanisms within an overall package.

In this section, we outline the different support mechanisms that are available for use by the public sector to stimulate private-sector engagement, discuss options for these mechanisms to be made available by different parties and to different parties, and then consider the factors that might lead one mechanism to be preferred over another.

Using the categorization of potential support set out in the previous section (Table 1), the table below presents examples of the support falling into each of the different categories. It also shows that international support can either be targeted directly to specific projects and local implementing agencies or that it can back national efforts of support provision.

3.1 Contribution to Investment and Operation Cost

Grants

Grant payments are made by the public sector to help reduce the capital costs of a project or, more typically, to provide complementary institutional support (technical assistance, capacity building, due diligence support, etc.). To trigger low-carbon carbon investments, grants are helpful when the capital costs of the low-carbon technology are greater than the costs of a fossil-based technology. This is the philosophy of the Global Environment Facility (GEF), whose mandate is to pay the "incremental cost" of global environmental projects. However, the bulk of grants for supporting particular projects continue to be provided by national governments, often in the context of bilateral overseas development assistance.

One specific case of such grants is devoted to technical assistance with the objective of removing constraints on investment by, for example, improving the capacity of regulatory authorities or the ability of financial institutions. These grants are provided by multilateral and bilateral financial institutions and can leverage significant amounts of private capital in the medium to long term.

It is worth noting that concerns (as expressed above), about the risk of moral hazard problems involved in such grants, have prompted some innovations to prevent these risks. For instance, the European Bank for Reconstruction and Development (EBRD) supports energy-efficiency projects in Eastern Europe but only provides grants *ex post*,

when the projects are accredited as having delivered the identified improvements (Table 2). Contingent grants take the form of a grant up to the point when the project meets a criterion for success, at which point it transfers to a loan. Conversely, on some occasions, contingent grants are converted to loans only if the project fails. This approach is designed to provide strong incentives for project success. Encouragingly, the local financial sector has developed instruments that cover the gap: for instance, lending short-term loans against a grant approval document.

	Public Finance Mechanism	**Direct support**	**Indirect support**	
		International to project	*International to national*	*National to project*
Contribution to investment and operation	**Up-front grant** - Standard Technical assistance grants - 'Smart' grants	GEF grants Other bilateral and multilateral DFIs	ODA	Investment support
	Funding during operation	Offset mechanisms (CDM) WB support	Grant linked to continuous delivery (finance +regulatory stability)	*Incremental payment to renewable *Removal of energy subsidies * Carbon tax/cap and trade scheme
Facilitating access to finance	**Provision of equity** - Private equity - Venture capital - long-term investment	ADB Clean Energy PE fund EIB/EBRD Sovereign Wealth Funds	EIB/EBRD support for VC fund setup costs, and co-investment in funds	Carbon Trust VC fund Transition economy VCs
	Provision of debt and equity - Loans (usually with governance conditions) - Credit lines - Equity (large projects, alongside foreign investors)	IFIs e.g. EBRD, IFC	IMF and WB loans	
	Risk coverage - Full or partial guarantee - Policy to cover all or specific causes of non performance - Other financial products	MIGA political risk insurance	WB/IFC Partial Credit and Partial Risk Guarantees	Export credit agency guarantees

Table 2. Example of public finance mechanisms provided by different institutions

Operating Support

Rather than supporting the upfront capital outlay of a project, public contributions can provide ongoing support. This can take the form of a subsidy to the firm/project or to its customers, to compensate them for any increase in prices that they experience. Such support schemes are best known for renewable energy typically in the form of feed-in

tariffs or tradable certificates. This can be made also through the CDM which allows operators to sell CDM credits for every tonne of CO_2 avoided through implementation of their project.

Operating support has the main benefit of improved incentive properties – private-sector actors will aim to implement projects rapidly and choose suitable quality and maintenance parameters, so as to receive ongoing support. In developed countries, the incremental costs created by renewable support schemes are typically allocated to electricity users, so as to avoid subsidies to energy consumption. However, should such costs become significant in developing countries, then international support could either contribute directly towards these costs, or could support energy-efficiency measures to allow energy users to reduce their consumption.

3.2 Facilitating Access to Finance

Debt Capital

Public support can come in the form of debt capital on terms that are advantageous compared to the terms available in private capital markets: longer tenors, reflected in longer period of time before repayment must be made or lower interest rates. These loans are most often provided by international financial institutions (IFI), like the International Finance Corporation (IFC), other parts of the World Bank (WB) group, or the EBRD. To augment the leveraging potential of these loans, a part of it is often syndicated to other (private) lenders.

As well as by IFIs, providing debt capital to projects can be also performed by specialised agencies of national government, mostly in cases where there is perceived to be an important benefit to having the loan on the host country's balance sheet (e.g. "strategic infrastructure"). This encourages the host country government to implement sound and reliable regulatory frameworks. In addition, the IMF is an example of an IFI which provides loans to national governments, although this is primarily to promote macroeconomic stability rather than support the growth of specific sectors.

Credit Lines for On-lending

As well as direct provision of debt capital to projects, credit lines can be provided to local Financial Institutions (FI) for on-lending, typically towards projects that meet certain criteria. The intention is that the credit line provided to the local FI should form only part of the debt that is lent on, and that, in turn, the total debt made available from the local FI will leverage other forms of (equity) capital. Consequently, the total value of the projects undertaken should significantly exceed the size of the credit line. UNEP (2008) reports that leverage rates associated with credit lines are typically 2x to 4x the value of the credit line.

The structure of these facilities vary, depending on the interest rate charged to the local FI, whether there are any conditions placed on the local FI's on-lending, and whether the local FI has any recourse to the provider of the credit line in the event that specific projects fail.

These facilities have the advantage of being able to use the existing distribution networks of financial institutions in a host country and hence are often most suitable for large numbers of small diffuse projects. They are typically provided both by IFIs – e.g. the EBRD has extended a number of credit lines to support energy-efficiency projects in various countries of Eastern Europe – as well as by national governments, e.g. the government of Thailand provides credit lines to local FIs for energy-efficiency investment, with the credit lines underpinned by revenues from a petroleum tax. The US Export-

Import bank provides an example of a bank facilitating the financing of equipment export from a developed to developing economies.

In any situation in which debt capital is provided, it is possible for the debt to be either senior or subordinated. This relates to the order in which cash flows are allocated to creditors in the case of insolvency: senior debt holders receive their interest/principal repayments in priority to subordinated debt holders. As public provision of subordinated debt implies lower risk for private senior debt providers, leverage rates for subordinated debt are typically higher than for senior debt.

Equity Financing

While equity capital can be provided by the public sector to finance specific projects, or parastatal companies (e.g. Eskom in South Africa), it is (more) often invested in funds specializing in investment in specific geographical regions and/or technologies, with the funds allocating capital to specific projects. This provides both specialization and diversification benefits to the providers of the equity capital. Two main sorts of equity fund can be distinguished: private equity/infrastructure funds and venture capital funds. In addition, Sovereign Wealth Funds have adopted elements of the private equity investment approach, but with investments potentially held for longer periods. As risks for investments in least developed countries and new technologies are larger, often policy-related, and therefore more difficult to assess, there might be a justification for more public-sector investment to provide equity to enhance the scale of private-sector activities for low-carbon development.

Private Equity and Infrastructure Funds

These funds invest equity, often leverage with significant amounts of debt, into established companies in search of additional capital to expand. In some cases, Investment Banks take on equity stakes in projects, typically for a short-term period of 1-3 years, with the aim of restructuring a company. However, most of these funds have been invested in existing facilities such as ports or networks, and very few in large-scale new-build facilities.

In the event that private-sector investors in such funds consider the risk profile of the projects in which the fund specialises to be too risky, the public sector can play a role by providing part of their equity capital. This role is typically played by both bilateral and multilateral financial institutions. Cases include the Asia Development Bank's five Clean Energy Private Equity investment funds and investments by the IFC in a private equity fund investing in Asian clean energy technology (where funding is also supplied by Swedfund – a risk capital company of the Swedish government – and Proparco, the private-sector financing arm of the French Development Agency.) Providing equity to funds is generally considered to be associated with reasonably high leverage potential, reflecting the fact that the equity investment has more volatile returns and therefore requires taking on more risk.

Venture Capital Funds and Other Early-Stage Equity Finance

These funds provide equity to emerging companies engaged in the development of new, potentially breakthrough, technologies that can change whole industries. As such, the risk associated with these funds is greater than for private equity funds and the corresponding expected returns are higher.

The public sector plays much the same role as for private equity funds although, in the case of low-carbon technologies, the need for public investment is likely to be greater, given the additional market failure problems associated with innovation and the fact that many of the concerned sectors are very capital-intensive. Most of the few examples of

this form of support are from national governments, e.g. the UK Carbon Trust Venture Capital Fund and the Qatar-UK Clean Technology Investment Fund, both supported by their respective governments.

Several factors suggest that private Venture Capital funds (VCs) may only offer a partial solution to the early-stage funding problem. VCs are focused on a trade sale to incumbent companies or Initial Public Offerings (IPOs) on the stock market as a way of realizing large investment proceeds. Therefore, VCs are focused on best-of-breed companies. In combination, this means that even in the best of times VCs will only invest in a minority of "superstar" companies. Yet the policy challenge is to stimulate wider diffusion of technology: the returns from a widely diffused technology may frequently be just above market average, which is insufficient to attract VC funding.

This points to the need for alternative equity finance sources for early-stage companies. Business angels are generally seen as the most important source of seed funding for start-up companies in the USA and EU. They are also typically a provider of more "patient" capital. Alternative direct investment might be used towards setting up or scaling up key intermediaries, e.g. in re-capitalising national or regional development banks and scaling up their activities. Such models may be particularly important in micro-diffusion, e.g. urban photovoltaic (PV) installations and energy-efficiency retrofitting.

Insurance / Guarantee Products

The main form of support which increases access to finance consists of guarantee products. Guarantees are financial instruments which transfer risk by either attributing some responsibility to the guarantor for the performance of another person or entity, or by allocating losses to them in the event of failure. The guarantor provides protection to the buyer of protection with respect to the performance of a third party (Kothari, 2007).

Insurance products have an economically equivalent effect to that of guarantee products although there can be some technical differences, e.g. insurance products tend to focus on the loss suffered by the party buying the product – and hence are typically bilateral arrangements – while guarantees tend to relate to the non-performance of a third party.

Although both insurance and guarantee products are available from the private sector, the public sector can offer preferential rates, extend the scope of the coverage,[2] or provide some form of reinsurance.

Products can differ depending on whether they pay out in response to non-performance irrespective of the reason or due to specific reasons. Examples of the former include IFC's direct debt substitutes or ADB's partial credit guarantees. Political risk cover provided by MIGA, a World Bank organization, is an example of the latter; this provides cover for Foreign Direct Investment in relation to expropriation, currency transfer restrictions, war and civil disturbance and breach of contract. The instruments can also differ depending on whether coverage is available to protect lenders only or both debt and equity investors, and whether the coverage provided is full or partial (the latter is often preferred by providers to alleviate moral hazard concerns).

For partial guarantees, for debt investors, products can be designed either to specifically cover debt service of later maturing debt (appropriate when commercial lenders are unwilling to provide a financing tenor long enough to match the cash flow of a project) or alternatively a portion of payments throughout the borrowing term. Partial credit guarantees also vary depending on whether, in the event of non-performance, any recovered monies are proportionately shared by the guarantor and the creditor (a *pari*

[2] This may not be concessional pricing, but rather reflect the fact that the public sector can control the risk more effectively and hence can offer better terms.

passu guarantee structure) or whether the creditor has a priority on all recovered monies (subordinated structure). As in the earlier discussion, a public guarantee that involves the public sector assuming more risk (subordinated guarantee) is typically associated with higher leverage than provision of debt with lower risk. Often products are only available, or available on significantly more preferential terms, if matched by a counter-guarantee by a host government.

As well as international support for projects, national governments frequently guarantee products for their exporters through export credit agencies. The World Bank also offers Partial Credit Guarantees (PCGs) to support government borrowing from commercial lenders or from the bond markets, although these require a government counter-guarantee.

Other Products

There are other ways of alleviating risks and hence improving access to finance:

National or international bodies could offer financial instruments to underpin the carbon price in a particular country. Such instruments include contracts for difference (a contract between a buyer and a seller of an asset, specifying that the buyer will receive from the seller the difference between the current value of the asset and its value at contract time) and put options (a contract where the buyer purchases the right to sell the asset at a contractually agreed price) (Ismer and Neuhoff, 2009).

The public sector can provide equity/debt investment to private-sector providers of guarantee/insurance products or other risk mitigation activities. For instance, the Currency Exchange Fund (TCX)[3] is a fund that offers those investing in developing markets the opportunity to hedge their local currency risk through selling currency and interest rate derivative products, initially to those who have invested in the fund. The fund mitigates its risk through having a diversified geographic base coupled with a first-loss tranche of capital provided by the Dutch Ministry of Foreign Affairs. Other investors include DFIs such as the African Development Bank, EBRD and KfW and ABN AMRO.

Pooling of asset classes in climate technology diffusion is likely to be another important channel for improving finance. Mortgage-backed securitization is seen as one of the key culprits for the financial crisis. At the same time, the securitization methods underlying MBS have been well-proven, over many years, and have been used to stimulate the development of HP/lend-lease markets, credit card receivables and other liability classes. One applications of securitization to climate change technology could be funding large scale retrofitting of energy-saving technologies in households (where the payoff may be over 20 years or more), or energy-efficient transport-fleet financing. Therefore government support for securitization (e.g. guaranteeing a portion of the income to investors) would make it cheaper to buy an electrical pick-up truck, compared to a diesel truck.

Finally, existing microfinance schemes can be used to stimulate diffusion of clean cooking and domestic technologies in developing economies.

[3] TCX (2009) 'The Currency Exchange Fund N.V.', May. Available at: http://www.tcxfund.com/smartsite.dws?ch=TCX&id=1617

Text Box 3. Case study Energy Efficiency - EBRD energy-efficiency credit lines

Often, packages of support provided by DFIs make use of a number of different instruments in concert to promote private-sector engagement. A paradigmatic case of this is provided by the EBRD credit lines for financing energy-efficiency and renewables investments in the residential, municipal, SME and industrial sectors in various countries across Central Europe to Central Asia.

The scheme makes use of four separate instruments, each designed to target a specific barrier to private sector engagement:

- Credit lines are made available to local banks for on-lending, at the banks' risk, to (part) finance energy efficiency and renewable investments in the industrial, SME, residential and municipal sectors. Although provided on commercial rates to participating banks, these help to overcome the problem that required tenors can often be longer than those typically provided for business lending.
- Problems of technical expertise are tackled through technical assistance packages, resulting in e.g. consultants providing free-energy efficiency advice, assisting potential borrowers in preparing loan applications, building the capacity of loan officers in local banks to understand and evaluate energy-efficiency investments.
- In many instances, performance fees of 1-2% of the eligible loan value are paid to the bank upon agreement of the on-loan, helping to overcome concerns that banks may have about market demand and potential misperceptions of risk
- Capital grants covering between 7.5% and 20% of the capital cost of specific projects are disbursed when the project is accredited as delivering the improvements identified, helping to overcome straightforward cost problems.
- The relative importance attached to each of these different instruments differs across the countries in which the schemes haven been implemented.

To date, framework credit lines in excess of €850m have been agreed, with 11 schemes operational across nine countries/regions. A further two schemes are expected to be introduced in 2009, with framework credit lines totalling €120m. Up to the end of 2008, the EBRD reported that €362m had been disbursed across 25 banks and that this, in turn, had supported more than 24,500 sub-loans.

The schemes to date have been successful at both leveraging private-sector capital and reducing CO2 emissions. Across a typical cross-section of countries, leverage rates of between 0.1x and 1.5x have been achieved when measured against all EBRD contributions, and between 5.8x and 70.5x when measured against the subsidy component of the EBRD support. Subsidy per tonne of annual CO2 saving varies between €5 and €235, depending largely on the sector where support is targeted.

These case studies are based on research an*d analysis undertaken for UNEP (2009b).*

Text Box 4. Self-Sustaining Markets in Solar Homes Systems in the Developing World

Many homes in rural areas in the developing world lack electricity because they are remote and there are insufficient funds to connect them to the grid. Such households typically rely on biomass fuels, kerosene and batteries for their heating, lighting and electrical appliances. Small-scale solar PV systems can act as a low-cost means of rural electrification. However, self-sustaining markets in such solar homes systems (SHS) often do not tend to emerge without some degree of public support, because even small systems are nevertheless expensive for many households, and both households and distributors may lack access to credit.

The WB and IFC, working in tandem with the Global Environment Facility, have supported the development of SHS markets in over 20 countries (IFC, 2007; Miller, 2009), with varying degrees of success. Such interventions typically need to simultaneously tackle more than one barrier to market development, often related to financial infrastructure. For example, potential customers may lack access to credit, distributors may be unable to raise loans for inventory and recruitment without collateral, and consumers may have low confidence in an unfamiliar technology. Rural areas by definition imply higher overheads for distribution and after-sales service, and initial low sales volumes create few opportunities for economies of scale for distributors.

The public support offered typically takes the form of: concessional refinancing of small loans to consumers by micro-finance institutions and local banks; provision of direct incentives to dealers in the form of installation grants; technical assistance in the form of grants for staff training or development of quality standards; and concessional loans and guarantees offered to dealers to supplement their working capital. Social enterprises may be key distributors in addition to, or instead of, profit-making enterprises.

Two countries where efforts to develop the market for SHSs have been particularly successful are Bangladesh and Sri Lanka. In Sri Lanka, credit institutions borrow money on concessional terms to on-lend to dealers and customers. In Bangladesh, concessional loans to refinance consumer credit have been disbursed to dealers. In addition, a major Bangladeshi SHS social enterprise, Grameen Shakti, was support by an IFC/GEF (Global Environmental Facility) loan at an early stage of its development. Installation grants have also been deployed in both countries.

These two countries have seen an exponential increase in sales of SHS units, with hundreds of thousands of units now installed. However, specific circumstances related to country characteristics or timing of support may have played a part in this success. The experience of Bangladesh and other countries such as Kenya and Papua New Guinea suggest that making use of existing social ties and infrastructure created by micro-finance lenders or large employers can be a significant factor in scheme success.

These case studies are based on research and analysis undertaken for UNEP (2009b).

4. Experience with the Provision of Support through the Different Mechanisms

Investment is financed predominantly through private sources. However, a wide array of public and not-for-profit organizations play a role in facilitating these investment flows, including development institutions, investment promotion agencies, international institutions and philanthropic organizations. Typical current annual financial flows via the organizations/mechanisms identified are presented in Table 2 (for all purposes, not solely those which are climate change-related).

They will all have a role to play in financing the investment needed to build a low-carbon economy. Every organization has its distinct profile and comparative advantages, which it derives from its mandate, expertise, governance structure, size and location and it makes sense to use organizations according to their specific strengths. Without undertaking any organization-specific diagnostics, we can surmise how the needed financial instruments might best be deployed.

Grant support may most naturally be provided through bilateral development agencies such as the UK's DFID, Sweden's SIDA or the USA's USAID. These organizations currently support individual projects, and, increasingly, to governments in the context of mutually agreed poverty reduction strategies or similar plans. A share of their funding is channelled through multilateral development banks or the UN, often via dedicated facilities such as the Clean Investment Funds or the UN-REDD Programme Fund. An organization that specifically provides environmental grants (covering the incremental cost of a globally beneficial activity like GHG mitigation) is the GEF. The GEF serves as the financial mechanism to the UNFCCC, which means that most Convention-related finance is channelled through the GEF. Philanthropic institutions and NGOs complement traditional development aid in important ways, usually focusing on small-scale projects and the grassroots level.

Public finance, and technical assistance concerning the policy environment, is the purview of multilateral development agencies such as the WB and regional development banks. Also active in this field are bilateral development banks such as Germany's KfW. These are the organizations that could most naturally support, for example, the development of renewable support programs such as a national feed-in tariff. UN agencies like the UNEP and FAO are also strong on technical assistance, often smaller-scale and more narrowly focused, but they do not generally provide finance.

Commercial finance and risk coverage need to be provided by organizations with an explicit private-sector focus and mandate. Experience has shown that differences in corporate culture can be an important barrier to the effective implementation of public-private partnerships (see UNEP, 2009b). Organizations with this comparative advantage include export credit agencies at the bilateral level and international financial institutions with a private-sector orientation (e.g. IFC and EBRD).

Using existing organizations and leveraging their strengths has the advantage of drawing on decades of relevant experience. But there are risks, beyond the fact that not all organizations have an equally good track record, that existing institutions would not wholeheartedly endorse the new objectives and adjust their workings accordingly, and would see climate change finance as a means to pursue their original objectives. This is why there is a role for new institutions set up for specific purposes but making them operational will take much longer, and risks duplication with existing players.

	Public Finance Mechanism	Direct support	Indirect support	
		International to project	*International to national*	*National to project*
Contribution to investment and operation	Up-front grant	GEF: $735 million [3] Cool Earth Partnership (Japan): $400 million[5] International Climate Initiative (Germany): $160 million[3] UN-REDD Fund: $50 million [4]	Bilateral ODA: $81 billion[2] Multilateral ODA: $13 billion [2]	
	Funding during operation	Primary global CDM market: $2-3 billion World Bank IDA grants: $2.6 billion [3]		Fossil fuel subsidies in 20 largest non-OECD countries: $220 billion [7] Direct world-wide government support for renewables deployment: $10 billion[8] EU ETS market: $92 billion [3]
Facilitating access to finance	Provision of equity	IFC: $1.7 billion [3] ADB: $120 million[3] AfDB: $220 million [3] EBRD: $1.6 billion [3]	n/a	Example: UK Carbon Trust has co-invested $10.8 million since inception
	Provision of debt	IFC: $5.7 billion [3] ADB: $1.8 billion[3] AfDB: $1.1 billion[3] Cool Earth Partnership (Japan): $1.6 billion[5]	IMF: $0.7 billion [2] WB: $24.7 billion [3] ADB: $8.7 billion[3] AfDB: $2.9 billion[3]	Diffuse examples of governments lending to businesses, often for specific policy purposes (SME support, energy efficiency, etc.)
		Unclear split between sovereign and non-sovereign lending IADB: $11.1 billion [3] EBRD: $5.9 billion [3]		
	Risk coverage	MIGA guarantees: value of $1-1.5 billion per annum[1]. Actual payouts are very rare, amounting to only a few million.	WB PCGs: $1.6 billion since 1990 WB PRGs: $0.8 billion since 1994 IFC guarantees: $1.8 billion per annum [3]	Export credit agency guarantees: e.g. UK $1.8 billion[4], USAID $0.2 billion[2], US Ex-Im Bank Sub-Saharan Africa $575million.[4] OECD to IDA countries only: $1.3 billion per annum [2]

Table 2. Illustrative values of different financing mechanisms[4]

[4] Sources: World Bank (2009b); EBRD (2009); IADB (2009); AfDB (2009); ADB (2009); GEF (2009); OECD (2009a); OECD (2009b); Capoor and Ambrosi (2009); IFC (2008); Carbon Trust (2009). USAID (2009), Export Credits Guarantee Departmnet (2009), Export Import Bank of the United States (2008) [1] Based on typical figures over the period 1999-2007. [2] 2007 figure.[3] 2008 figure.[4] 2009 figure.[5] Based on total figure of $10 billion for 5 years announced in 2008.[6] These figures do not imply that developing countries have benefitted from financing of the same magnitude as these are

A key challenge for all organizations, old or new, will be scaling. Financing needs for mitigation and adaptation have been estimated at close to $500 billion a year by 2030 (World Bank, 2009). This is about five times the current level of official development assistance, and ten times the IFIs' annual lending volume. No single public institution has the capacity to administer this volume of flows or, indeed, to ensure effective use in a context of limited absorptive capacity.

Moreover, efficiency in implementation may not be the only concern and cannot be disconnected from the question of governance i.e. ownership and control. This has proven to be a crucial issue because, among developing countries, there is a fair amount of distrust and disillusion with existing international financial institutions, in particular the GEF. There has been a strong push, therefore, for institutions in which developing countries can feel a stronger sense of ownership. At the same time, developed countries want to maintain some control over the use of the resources they provide. In the case of climate change adaptation, the result of this tension has been a dedicated new institution, the Adaptation Fund, which has a governance structure acceptable to all. It is an untested question whether a similarly suitable governance structure can be developed that allows a multilateral mitigation fund to make effective decisions on sector and country specific needs for effective implementation of low-carbon development strategies.

Figure 6 illustrates the relative size of different mechanisms of development and climate co-operation, using areas proportional to their volume listed in Table 2. It shows that the majority of grants are provided in bilateral co-operation to governments in developing countries. In contrast, almost all products promoting access to finance (or providing finance) are provided through multilateral organization, with the larger share provided to individual projects and programs.

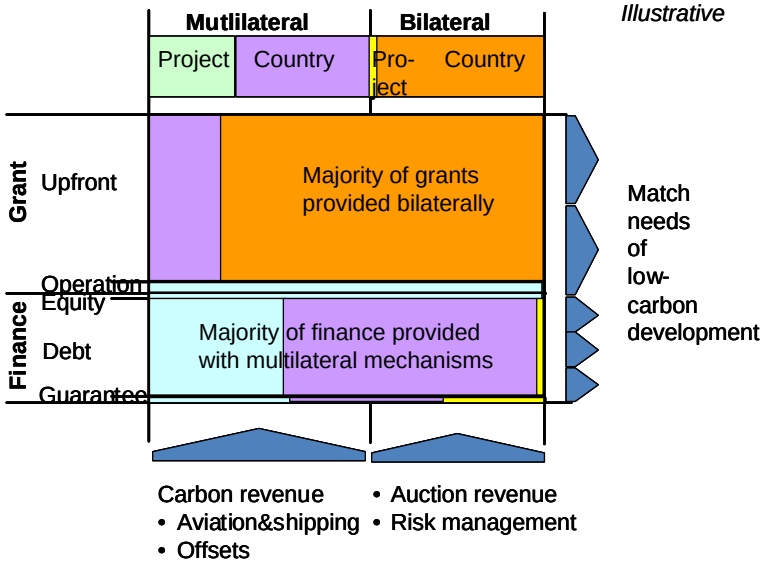

Figure 6 Mapping needs for low-carbon development through mechanisms to institutions *(Please note figure is illustrative and does not translate volumes of debt into grant-equivalent values)*

First, the shares of the different support mechanisms required to facilitate low-carbon transitions in developing countries need to be considered in allocating funds and designing institutions. The examples discussed in Section 3 suggest that both access to finance and grants have a relevant share.

Second, if bilateral mechanisms provided the majority of grant support, then commitments to provide support through bilateral co-operation and hypothecation of

estimates of the value of EPRAs closed in 2008 and actual payments would depend on project registration and performance.

auction revenue from national emissions trading schemes would have to match the needs for grant support of developing countries.

Third, if multilateral mechanisms are to provide the majority of grant-equivalent support through capital provision, then again they need to be equipped with the corresponding resources. This has two components. (i) pledges of soft money that can be used to complement (subsidize) commercial lending and cover the incremental costs of low-carbon options. This could take the form of IDA-style replenishment rounds. It is money that can be "used up", as it does not count against the share capital. (ii) Capital increases in IFIs

Fourth, public risk guarantees and insurances are currently provided to a limited extent by multilateral organizations and to a larger extent by national governments. Multilateral organizations struggle to expand their provision of such guarantees, as this requires reserving capital on their balance sheets. National governments are less constrained, as they can underwrite debt or risk guarantees. Risk guarantees, either provided in a bilateral manner or issued by national governments to allow multinational organizations to provide additional debt, are therefore likely to play a far stronger role in future climate co-operation, and will also require more careful monitoring to avoid undue exposure of individual actors and countries.

5. Climate Finance as part of a Decarbonisation Strategy

The above sections can be read as taxonomy of available mechanisms to support carbon abatement initiatives. However this toolbox will not be capable to redirect capital flows towards low-carbon intensive infrastructures in developing countries on the scale of $140 – $675 billion a year for mitigation and $30 – $100 billion for adaptation, as estimated by the recent WB Development Report (World Bank, 2009) unless used within a consistent view of the reforms of global finance.

We will indeed enter a learning process about how to mobilize the various elements of the toolbox so as to make investors and firms perceive the low-carbon technologies and strategies as lower risk options. The risk is, in the absence of fully-fledged carbon markets, associated with the difficulty of how to decide on which sectors, firms or projects receive the support and what volume of support is granted.

In other words some consistency rules are needed to minimize the costs of the fragmentation of funding mechanisms. A “social value of carbon” could serve as a reference price in all these mechanisms and could express the political will the international community to meet some long-term GHGs concentration target. More precisely, this is a series of values increasing in time in order to respect an emissions trajectory consistent with a long-term objective. Obviously, this value is uncertain but modelling literature provides orders of magnitude and, ultimately, this value will be a matter of political negotiation.

Also, sector specific assessments might be pursued to identify the potential transformational impacts. Support would only be granted if the overall transformation approach promises success. The volume of support could be tailored to the incremental costs incurred or the costs of removing barriers for the transformation.

A reform of international funding to provide support based on a social value of carbon and transformational opportunities would constitute a credible offer that the Annex 1 countries could make within the current political and economical constraints. It is clear indeed that aid alone will not suffice in meeting the financial needs, as the usual drivers of donor fatigue will be exacerbated in the context of economic crisis and of a re-calibration of global economic wealth (rendering the North/South division line an inaccurate Rich/Poor division line). But this does not change the fact that, given their past responsibilities in causing the problem, the Annex 1 countries have the

responsibility of proposing a framework to trigger flows of climate oriented funding to the South. Margins of freedom exist because the problem is not so much one of capital shortage at the aggregated level as with a problem of misdirection of savings.

A social value of carbon could obviously first be used in concessionary funding, but it could also been used to leverage private and public finance through the development of risk mitigation instruments targeted at climate-friendly investment, and of financial assets capable of realigning and increasing households' savings in the direction of such investments, while securing the liquidity of the lent money. Indeed, the challenge is to reconcile the desire of borrowers and investors, to secure long term funding on infrastructure projects, with the desire of the lenders to hedge against investment risks and to readily access money.

This paper cannot go beyond pointing out the necessity of further research, but it is worth noting that securing an increase in the power of climate-oriented funding, insurance and re-insurance mechanisms requires two major building blocks. The first is the collection of households savings in bonds or liquid deposit accounts dedicated to carbon-saving investments which could be paid at – as a minimum – interest rates akin to those of similar financial products, due to the lower risk-premium attached to the loans funding these investments. There would be the additional benefit from the rise of an environmental ethic in public opinion (fair trade products, ethical funds). The second is the reform of the banking system itself. The financial crisis is basically due to the development of a "shadow banking system" relying on a form of a commerce of promises. A 'social value of carbon' could be a component of the reform of international financial systems and used to incentivizing banks to provide more credit for low-carbon or carbon-saving activities. This starts by allowing lower deposits for such activities, with the risk borne by the Central Banks of Annex 1 countries and re-insured through an arrangement akin to Special Drawing Rights at the IMF, backed by new deposits from the same Central Banks. This is not the place to discuss the details of such a system, but to invite the best specialists in the field to internationalize this perspective in the debates on the future of the financial systems.

6. Conclusion

The shift to low-carbon development trajectories requires that private and public sector investment choices be shifted from energy-inefficient and carbon-intensive infrastructure and technologies towards low-carbon choices.

Governments have to provide domestic policy frameworks to attract and shift the corresponding investment volumes. International climate change support is not about aid, with donors and recipients, but about cooperation between the developed and developing countries towards implementing the necessary policy framework, with each party contributing according to their means and their common but differentiated responsibilities. Financial mechanisms can support the implementation of the policy framework by contributing to incremental costs, creating incentives to maintain effective frameworks and thus enhancing regulatory stability, and by facilitating access to finance for low-carbon investments.

This paper starts with an assessment of financial needs of private actors that need to be addressed to facilitate low-carbon choices. These needs differ across technologies, sectors, and countries. They can require contribution to incremental costs or facilitation of access to finance. Even within these categories needs differ, and can require support up-front or support during operation, or improved access to finance through risk guarantees, the provision of loans or equity contributions.

Governments already use all these categories of instruments, to support private actors within their countries as well as in international cooperation to support developing countries or actors in developing countries. However, the different volumes of support provided across the instruments suggest that the choice of financial instruments is also linked to the institution able to provide it.

- Bilateral co-operation offers the flexibility to tailor a grant to the specific needs of a sector or country, and might therefore be the preferred option to facilitate transition strategies. Only where incremental costs are clearly defined, e.g. with technology demonstration projects, are multilateral organizations more able to use standardized methodologies to offer grant support.
- Multilateral organizations offer a stronger track record in the provision and management of loans and project finance, e.g. for infrastructure development.
- Risk hedging instruments like project and currency risk guarantees are likely to play an increasing role, as they tackle a main barrier for the access to finance for investors in low-carbon technologies and sectors. They can be provided both bilaterally and through multi-lateral bodies.

Many of these mechanisms provide effective support while being less of a burden on balance sheets and current accounts. For example, if governments issue credit guarantees, this may not have direct implications for balance sheets and current accounts, but can still offer effective help. It allows pension funds and other private investors to offer lower-cost capital and learn about new technologies and regulatory frameworks, thereby reducing the need for future public intervention. The provision of such support in parallel by many governments may allow private sector investment to reach critical mass: resulting in a "crowding in" of private sector investment. If the value of financial instruments such as loans, equity and risk guarantees is reported in terms of grant equivalent contribution, then a fair comparison of contributions by different actors with their commitments will be possible.

Ongoing reviews will be necessary to ensure effective use of scarce resources. It will be essential to anchor the different support frameworks in an overarching framework, preferably a UNFCCC umbrella, to create synergies of international co-operation, rather than risk fragmentation of efforts. Transparent reporting will be crucial to facilitate implementation of effective frameworks, rapid learning and accountability of all parties involved.

Ultimately, this paper opens a broader perspective. Since the 2005 Gleneagles G8 Summit, developed countries have asserted their willingness to link climate policies to the transformation of economic globalization, in a mutually beneficial process, and the prevention of new threats to security (energy, climate refugees and local political instability). The current financial crisis provides an impetus to make a step further in that direction, through linking the reform of financial systems to the decarbonization imperative, and by the same token shortening the duration of the economic crisis and/or to securing a steady exit from the crisis. Changing the patterns of international capital flows may be an opportunity to trigger and sustain a long wave of climate-friendly infrastructure works in both developed and developing countries, which would accelerate global economic recovery in a sustainable way.

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