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Climate change financing:
Developing countries' options and challenges for mitigation and adaptation

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Introduction

The objective of this paper is to present an assessment of existing and proposed mechanisms to financing climate change interventions in developing countries, and to provide guidance on the best ways to make progress in raising and utilizing such financing. Recent events pose major challenges to the availability and sustainability of public (official and developing countries' domestic resources) and private financial flows to developing countries. Yet, they also provide an opportunity to implement mechanisms for collective action at a global scale, particularly on issues such as climate change that affect both developed and developing countries.

After a brief description of the current context of climate change financing, the second section will review quantitative estimates of ranges of required financing for climate change interventions on a global basis, distinguishing when possible among climate change adaptation and mitigation. The third section will provide a review of existing financing mechanisms for climate change interventions including Official Development Assistance (ODA), multilateral facilities (both global and regional), private sector and international capital market financing mechanisms, proposed mechanisms currently under discussion, as well as the mobilization of developing countries' domestic resources.

In order to assess their limitations and opportunities, the report will review these financial mechanisms according to criteria such as their adequacy (match between development financing and needs of developing countries); amount and predictability; diversity (variety of instruments, institutions and programs); complementarity (links to domestic resource mobilization); and voice, representation and accountability. The analysis will also consider how different groups of countries, classified according to their capacity to mobilize external and domestic financial resources, can combine different instruments to achieve their mitigation and adaptation objectives. The paper will end with concluding remarks and key messages to the World Economic and Social Survey 2009.

1. Current context of climate change financing

Developing countries are undergoing an unprecedented global financial and economic crisis. Financial flows' trends to developing countries that characterized previous decades are reversing, although the final outcome is still uncertain since the current crisis was unfolding as this report was written. Financial flows to developing countries followed two major trends the last two

decades (Table 1): first, *private sector financial flows became the main source of financing*, through foreign direct investment, international capital markets and remittances; and second, *official flows had a volatile growth as developing countries increasingly mobilized domestic resources,* through accumulation of international reserves, use of domestic capital markets and bond issuance, while ODA resources are facing increasing pressures as development priorities are shifting from different topics and regions (Sagasti, Bezanson and Prada 2005).

TABLE 1. Net capital flows to developing countries Annual average, US$ billion)

	1970-1979	1980-1989	1990-1999	2000-2006
1 Net private flows [a]	**24.79**	**44.59**	**152.01**	**349.19**
2 Net official flows [b]	**18.21**	**46.70**	**57.08**	**9.89**
3 Net equity flows	**5.28**	**13.73**	**118.50**	**285.63**
3.1. Foreign direct investment [c]	**5.27**	**13.45**	**101.58**	**236.54**
3.2. Portfolio equity flows	**0.01**	**0.28**	**16.93**	**49.09**
4 Net flows on debt	**32.41**	**63.52**	**61.64**	**29.53**
4.1 Official creditors (a+b)	**12.90**	**32.67**	**28.14**	**-34.03**
a. Multilateral creditors	*3.60*	*12.78*	*19.10*	-3.43
-World Bank	2.07	7.24	7.49	1.61
IBRD	1.26	4.50	2.64	-3.39
IDA	0.82	2.75	4.86	5.00
-IMF	0.69	1.62	4.08	-19.03
Non-concessional	0.17	0.19	0.42	0.09
Concessional	0.55	1.43	3.66	-9.07
-Major RDBs	0.53	2.63	5.88	2.76

Non-concessional	0.18	0.87	1.69	1.70
Concessional	0.36	1.76	4.19	1.05
-Others [d]	0.30	1.29	1.66	1.19
b. Bilateral creditors	*9.30*	*19.89*	*9.03*	-30.60
Non-concessional	5.31	11.29	3.61	-26.81
Concessional	3.99	8.59	5.42	-3.79
4.2. Private creditors (a+b)	**19.51**	**30.85**	**33.51**	**63.56**
a. Net short-term debt flows	*6.52*	*7.46*	*13.17*	44.31
b. Net L-M term debt flows	*12.99*	*23.39*	*20.34*	19.26
-Bonds	0.90	1.81	15.81	17.16
-Banks	9.06	14.07	0.11	7.24
-Others [e]	3.03	7.50	4.42	-5.15
Memo				
5 Changes in reserves	**51.40**	**133.32**	**429.79**	**1,559.63**
6 Grants [f]	**5.32**	**14.03**	**28.94**	**43.93**
7 Worker's remittances	**4.33**	**20.83**	**53.86**	**155.04**

Source: Global Development Finance 2007

[a] Private debt plus equity; [b] Bilateral aid grants plus debt; [c] Net inflows; [d] Other multilateral sources (e.g. export credit); [e] Other private credits from manufacturers, exporters, and other suppliers of goods, and bank credits covered by a guarantee of an export credit agency; [f] Excluding technical cooperation grants.

The current financial crisis will reverse these trends, at least temporarily. The volatility and diminished intermediation capacity of financial markets has started to affect the real economy, challenging the world's ability to tackle simultaneously threats posed by climate change and other priorities—which in terms of the availability of financial resources to developing countries will expose several tensions and trade-offs. The most likely scenarios point towards a recession

where sluggish credit and capital markets reduce their ability to channel resources to developing countries in the amounts and conditions experienced during the last ten years. Although the crisis is still unfolding, some of its effects are already taking place and will influence the effectiveness and availability of financing mechanisms for climate change interventions:

- Agents in credit and international capital markets have drastically reduced their leverage and have been cautious allocating resources as they rebuild their capital. Other private flows such as remittances, commercial bank lending and foreign direct investment (FDI) are also slowing, although it is likely that they resume as the economic recession gradually diminish.[1] The 2008 World Investment Report argues that, although investment projects may experience delays, FDI are usually long-term investments and represent a major percentage of financial flows to developing countries (UNCTAD 2008).

- Financing flows will shift to public sources as private sources deal with capital scarcity. First, governments from developed and developing economies have announced rescue packages, interest rate cuts and monetary expansion, and in some cases direct support to economic sectors and industries. Second, multilateral sources have implemented financial mechanisms and increased their lending base in some cases. For example, the World Bank is planning to increase lending from US$13.5 in 2008 to US$35 billion on average in the next three years (2009-2011).[2] Regional development banks have also pledged additional resources: the IADB has set up a six billion fund for financial emergency response and increased available lending to LAC countries by 80 percent to US$18 billion in 2009.[3] Similarly, a group of South Asian countries has announced the creation of a US$120 billion monetary fund in February 2009 to cope with short-term liquidity difficulties.

- The slowdown of economic activity and trade (especially through reduction of commodity prices and developing countries' exports) will pose several challenges to public finances. Although some developing countries, mainly emerging economies, have accumulated international reserves and accessed to international capital markets in favorable conditions during the last decade, the current crisis will reduce tax revenues and consequently the ability to increase public investment. Depending on the macroeconomic situation of the countries, the trade slowdown may deteriorate their balance of payments, as countries face more expensive international credit, as well as future costs of financial rescue packages.

These three trends entail a reduction of the availability of financial resources to developing countries in a context of increasing pressures and trade-offs to allocate financial resources between international and domestic development priorities. As pessimistic as the current context

[1] Nevertheless, the Institute of International Finance (IIF) has forecasted that net private sector capital inflows to emerging markets will reduce to US$165 billion in 2009, less than half than 2008 (US$466 billion) and only one fifth of the amount sent in the peak year of 2007 (Financial Times, "Capital flows to developing world at risk of collapse", January 28th 2008).
[2] World Bank's President statement ahead of the G-20 meeting, November 12th 2008.
[3] IADB 's Presidente announcement in Vienna, November 23rd 2008.

appears, it also reveals emerging opportunities to encourage international collective action so that developing countries grapple with climate change more effectively:

- Although the urgency to solve the financial crisis may shift priorities against climate change, there is a major consensus on the severity of the climate change threat and the central role of developing countries. Scientific and statistical evidence show that climate change will disproportionately affect the poorest countries[4] and the pace of this threat is accelerating as the world is failing on reducing the impact of human activities over the environment.[5] On the other hand, any stabilization target of GHG concentration (around 450-500 ppm CO_2e as suggested in the Stern 2006) will require cuts of GHG emissions of around 50 percent by 2050 relative to 1990 emission levels—a growing proportion of them in emerging countries.

- The global financial crisis has heightened the importance of collective action to cope with global problems, as in the case of the coordination between Central Banks to harmonize their responses. The growing relevance of more representative institutions like the G-20 may increase the likelihood of an international consensus on climate change in the context of Poznan and Copenhagen negotiations, since G-20 countries are responsible for almost 85 percent of current GHG emissions.[6] More representative institutions still have the challenge to include smaller countries' voices and they will only succeed if they contribute to reduce transaction costs of coordinated action.

- Worldwide economic slowdown will lead to reduced demand for energy, particularly for oil, which in turn will limit greenhouse emissions a bit and ease climate change pressures a few years hence.[7] On the other hand, lower oil prices will reduce incentives (at least in the short-term) to explore and develop alternative clean energy. Nevertheless, as the impact of higher oil prices suggests, market prices are a powerful mechanism to change energy consumption patterns. Although these price levels were temporary due to the global slowdown, a window of opportunity now opens to explore bold measures, such as global or regional taxes or similar measures to internalize the cost of energy consumption (Sagasti and Bezanson 2001).

[4] World Bank staff has calculated that the number of people affected by climate related disasters during the 1990s was two billion and has estimated that almost four billion may be affected during the 2000s. Similarly, the probability that a person in a developing country is affected by climate related disasters is 50 times higher than a person in a developed country.

[5] WWF (2008) indicates that Humanity's demand on the planet's living resources, its "ecological footprint", now exceeds the planet's regenerative capacity by about 30 percent. Recent data shows that Antarctica is escalating ice loss at a higher rate than most pessimistic scenarios forecasted (*Washington Post*, January 14, 2008); while according to UNFCC emmisions are still growing at rates higher than two percent (2.3 percent during the 2000-2006 period). Similar evidence is sumarized in Gillet et al (2008).

[6] The delivery system to provide and finance global public goods require strong international political consensus, and thus, more representative institutions to reduce externalities and avoid free riders (Sagasti and Bezanson 2001).

[7] California, one American state that has set voluntary caps for emmission and was loosing track, may be able to comply with emission's reductions commitments mainly because of the production slowdown (The Economist, "Cooling off: Green trends in California", November 20th, 2008).

- Building on the momentum of the inauguration of Barack Obama as the United States President, his administration has vowed to set tougher fuel efficiency standards for vehicles at the national level and suggested the Environmental Protection Agency (EPA) to consider allowing individual states to regulate GHG emissions from vehicles—like the experience of a coalition of States led by California. The new administration has recognized the potential benefits of investment projects towards a low-carbon economy, and the likely short-term benefits to cope with the economic slowdown. However, this reinvigorated willingness to lead global efforts against climate change will be tested in Copenhagen and the technical discussions in Bonn, the recently called United Nations meeting at the opening of the UN General Assembly in September with other Heads of State to discuss specific policies, and its support the European Union proposal to invest US$230 billion (€175 billion) per year by 2020—half of that to be allocated in developing countries.

2. A review of global estimates of financial resources needed to cope with climate change

Climate change is broadly understood as the variation in the Earth's global climate or in regional climates over time. Although some processes internal to the planet (known as climate variability) or external forces (such as variations in sunlight intensity) can cause climate change, this concept in public policy commonly refers to the impact human activities over the planet's climate. In order to reduce the risks of climate change, public policies can implement *mitigation*—reduction in sources or enhancement of sinks of greenhouse gases (GHG)—, or *adaptation*—adjustments in human and natural systems to actual or expected climatic changes. On the one hand, mitigation policies have focused on reducing GHG emissions and that goal constitutes the way for assessing their effectiveness and impact.[8] In contrast, assessing the effectiveness of adaptation policies is much more ambiguous and lacks of consensual methodologies and metrics. The same observations apply when assessing the economic cost of mitigation and adaptation.

Broadly, measuring economic costs of climate change mitigation can follow two approaches (IPCC 2007c): The first approach focuses on the cost of investment that agents face in order to reduce their GHG emissions. In this case, the emphasis is on the investments' cost-benefit ratios across different economic sectors and regions to reduce emissions. On the other hand, after having established a relationship between GHG emissions, concentration of GHG in the atmosphere and permanent changes in the global or regional temperature,[9] the second approach

[8] Methodologies to asses the effectiveness of mitigation policies have a wide consensus and there exist abundant data on GHG emissions and its trends. Between 1970 and 2004, global GHG emissions have increased by 70 percent from 29 to 49 $GtCO_2$-eq, but the growth have been unequal across sectors: The energy supply sector increased their direct emissions by 145 percent, the transport sector by 120 percent, the industry by 65 percent and land use, land use change and forestry (LULUCF) by 40%, and agriculture and building by 26 percent respectively (IPCC 2007a).

[9] This relationship has been estimated using scientific data on the interactions of these variables over long periods of time (for example, it has been possible to measure variations in CO_2, temperature and dust over the last 450,000 years through the study of Vostok ice core). Literature on climate change policy, following the conclusions of the IPCC and the Stern Review, has established a broad consensus that, in order to avoid the risks of dangerous climate change (i.e. permanent changes in global temperature over 2ºC) GHG emissions should peak within the next fifteen

consists on estimating the economic effects of different types of climate events that would be exacerbated as a consequence of global warming. The economic effects are usually measured in terms of Gross Domestic Product (GDP) reduction, as well as other socio-economic variables.

Estimates of economic costs of adaptation have focused on the additional amount of investment needed to reduce the impact of anticipated future damages caused by weather events, mainly identified as preventive adaptation measures. In addition, adaptation costs may also include the expenditures when damages actually occur (e.g. disaster relief), and residual damages (e.g. events that would occur with or without implementing adaptation measures). Because these costs depend on the probability and severity of weather events, it is difficult to define where adaptation activities are placed in the continuum from *development measures* aimed at reducing vulnerabilities to the *response to impacts* of climate variability (McGray et al, 2007). The debate on financing adaptation has tended to emphasize adaptation measures aimed at responding to weather events attributable to climate change, considering their financing as additional to the financing of development activities. Mainstreaming adaptation on broader development activities is key to avoid this bias, because "adaptation is not just additional to development but often is development" (Baptna and Mcgray 2008, p. 2). Nevertheless, this adds an additional level of difficulty when measuring adaptation costs and contributes to explain the variance of the range of adaptation economic cost estimates.[10]

The methodologies to estimate the costs of mitigation and adaptation face several challenges due to the dynamic nature of these processes. In general, both mitigation and adaptation interventions produce externalities in almost all areas of development (such as health, livelihoods, production and income, among others), as well as significant intergenerational transfers. Moreover, interventions to mitigate or adapt to climate change take place in different time horizons and under considerable levels of uncertainty, making it difficult to calculate the impact of concurrent interventions. Therefore, recent literature is recommending to, instead of focusing on the cost of adaptation or mitigation, policy-makers should consider methodologies to assess the cost-benefit of groups of policies over socio-economic and environmental variables (OECD 2008a).[11]

There are two groups of criticisms to the methodologies to estimate adaptation and mitigation costs. The first group has centered on the models themselves, focusing on the appropriateness of the methodology, assumptions, relations between variables, value of intergenerational transfers, impact of random elements such as unexpected catastrophes, and value of externalities in other development areas, among others. The second group of criticisms focuses on the difficulties

years and halved relative to 1990 by 2050—approximately to 10 GT of GHG emissions—to ensure that GHG concentrations stabilize near or below 500ppm.

[10] In this regard, the IPCC Fourth Assessment report that "comprehensive, multi-sectoral estimates of the global costs and benefits of adaptation are currently lacking" (IPCC, 2007b, Chapter 17, p. 719).

[11] OECD 2008 utilizes a set of computational equilibrium models to estimate the impact of policy changes over socio-economic and environmental variables. It defines nine policy changes (e.g. further trade liberalization, tariffs on oil imports and more ambitious environmental policies in developing countries, among others) and compute the effect in 2030 over variables such as GDP, exports, use of land and CO_2 emissions. The model allow to disaggregate the effects in different regions and group of countries (developed and developing countries). Nevertheless, these methodologies are still under development and need to refine in order to inform public policy decision-making.

measuring concepts not clearly defined and the nature of what is being measured.[12] Whether the emphasis is on energy, GHG emissions, carbon footprints or patterns of consumption and production, every model should clearly state up front the ideological, political and ethical assumptions behind the choice of a particular emphasis.[13] In this regard, global estimates have been criticized because "numbers can be seriously misleading if adequate attention is not paid to the assumptions that underlie particular empirical estimates" (OECD 2008b, p.77).

Mitigation costs. Table 2 shows a summary of the main global cost estimates for climate change mitigation. In general, the literature has identified five ways to cut GHG emissions: (1) reducing demand for emissions-intensive goods and services; (2) increasing energy efficiency; (3) taking action on non-energy emissions, such as avoiding deforestation or restoring ecosystems; (4) promoting lower-carbon technologies for power, heat and transportation; and (5) increasing the capacity to capture and store GHG emissions. The first approach for measuring mitigation seeks to calculate the costs of implementing these activities.

UNFCC (2007), a thorough example of the first approach, has estimated the costs of these activities at around US$200-210 billion by 2030, of which 68 percent correspond to activities that should be implemented in developing countries. These figures represent the additional investment needed in 2030 to reduce global CO_2-eq emissions by 25 percent below 2000 levels under a "mitigation scenario"—consistent with the science provided by the IPCC.[14] In this sense, these figures cannot be confused with total or annual cost of mitigation for two reasons: (1) they refer to additional investments compared to a "business as usual" scenario, thus representing the costs of reducing emissions in order to achieve a pre-determined level of GHG accumulation in the atmosphere by 2030; and (2) operating and maintenance costs are not included, as well potential savings for the introduction of new low-carbon technologies. The report provides detailed analysis of the economic potential of mitigation activities in different sectors and regions (Annex 1). Along with activities that will require additional financing, such as investing on enhancing existing infrastructure to increase energy efficiency, the report includes measures with the potential to offset part of the investment costs, such as replacing fossil oil with biofuels or reducing the proportion of fossil-fired generation capacity.

TABLE 2. Range of global estimates of mitigation costs

Study	Estimate	Main characteristics
UNFCCC	US$200-210 billion	▪ Additional investment needed for mitigation

[12] For example, Pielke (2005) argues that the IPCC definition of climate change is biased against adaptation policies and this bias has contributed to the politicization of climate change interventions. This bias is reflected in the emphasis of energy policies to mitigate the effects of GHG emissions, but recently, adaptation policies are gaining more relevance in IPCC debates since "anthropogenic climate change will persist for many centuries", even under strict mitigation scenarios (IPCC 2001, 2007a).

[13] The paper will only address the first type of criticisms.

[14] Under the "mitigation scenario", global 2030 emissions would be reduced from 61.5 Gt CO_2-eq under a "reference scenario" to 29.1 Gt CO_2-eq, which is 25 percent below the 2000 emissions of 38.90 Gt CO_2-eq.

(2007a)		activities by 2030 ▪ Consistent with a pre-determined scenario of GHG stabilization ▪ Detail of investments needs by sector and regions
IPCC (2007c)	0.2-0.6% (median of global GDP reduction); -0.6-3% (range of GDP reduction)	▪ Estimates the global macro-economic cost in 2030 for least-cost trajectories towards given long-term stabilization levels. ▪ Lower stabilization levels imply higher GDP reductions.
Stern (2006)	Annual investment costs: 1% of global GDP, reviewed to 2%; Costs of inaction: 5-20% of GPD reduction by 2050	▪ Compares investment costs of mitigation to the cost of inaction to assess the cost-benefit of acting against climate change. ▪ The report aggregates several previous studies in a model to estimate the costs. It does not provide new estimates. ▪ Methodology and model assumptions are target of criticisms.
Vatenfall (2007)	0.6-1.4% of 2030 GDP	▪ More accurate methodology to asses the cost-benefit of a group of policies and interventions to mitigate climate change

Sources: UNDP (2007); UNFCCC (2007a); IPCC (2007); Stern (2006) and Vantenfall (2007)

The second approach to measure mitigation costs consists on estimating the potential reduction of GDP and GDP growth under different scenarios of GHG emission by 2030. The equilibrium model assumes a GHG stabilization level consistent with least-cost emission trajectories and calculates the median GDP reduction and its range: lower stabilization levels are related to higher GDP reductions.[15] Since these types of estimates assume a model that define how different variables interact in the long-term (population growth, energy efficiency, economic development and marginal costs of abatement), they are consider more accurate estimations of mitigation costs compared to the previous approach. However, these models utilizes several assumptions and simplifications to describe the interactions between variables, thus making them target of criticisms regarding their methodology (Henderson 2005). For example, using market exchange rates instead of PPP to describe the trajectory of economic projections was criticized because it may lead to an overestimation of developing countries emissions in the future.

The Stern Review (2006) utilizes both approaches. First, it estimates that costs to reduce GHG emissions to a given stabilization rate could amount to one percent of global GDP per year, using

[15] For example, stabilizing GHG emissions around 535-590 ppm CO_2-eq would cost a median GPD reduction of 0.6% by 2030, with a probable range between 0.2-2.5% (thus implying a reduction of annual GDP growth of 0.06%). Lower stabilization rates (445-535 ppm CO2-eq) imply a GDP reduction of around 3%.

the IPCC scenarios—though this estimate was corrected in 2008 to two percent due to an acceleration of GHG emissions compared to the reference scenario (The Guardian 2008). [16]Second, when calculating the damage costs of climate change under different emission scenarios, the Review aggregates previous studies that calculated partial effects and risks in areas such as natural disasters, unpredicted catastrophic risks, as well as effects on development areas such as health, sanitation, human displacement, water, increase of sea level, among others.[17] The Stern Review predicts that unmitigated greenhouse gas emission will lead to damages costs of between 5-20 percent of GDP by 2050. Critics pointed out that the divergence between these calculations and previous studies can be only explained by methodological flaws: in previous estimates these costs are between half and two percent of GDP reduction (Tol and Yohe 2006).

Three elements of Stern's methodology have been criticized. First, there is a risk of double counting impacts from weather events that could lead to overestimate short-term effects (e.g. by aggregating the results from studies that calculate risks of population displacement with the risk of impact over economic development). Second, when extrapolating the long-term effects of inaction, the use of a particularly low discount rate produces high estimates of discounted damages, overestimating short and medium-term interventions' benefits. Third, comparing investment costs with damage costs to asses the cost-benefits of intervene against climate change in the present is not justified by economic theory, because marginal costs should be compared to marginal benefits, rather than total costs to total benefits.

A more accurate methodology to assess the cost-benefit of mitigation interventions can be found in Vatenfall (2007). It calculates the cost per tone of reducing GHG emissions, comparing different types of interventions per region and sector. The report defines the cost of abatement[18] for different interventions, such as improving insulation in buildings and houses, introduction of fuel-efficient vehicles, use of nuclear energy, making existing technologies such as lighting systems and air conditioning more efficient, among others. This methodology allows identifying regions, sectors and measures where the costs of abatement are lower.

Adaptation costs. The methodological challenge is higher when considering adaptation costs. Unlike mitigation, which has to be coordinated globally, adaptation decisions are decentralized. In general, most methodologies have been considered partial for not taking into account the cost of climate-proofing existing natural and physical capital, or including new investments of economic agents, households or communities' adaptation needs. Nonetheless, estimating costs of adaptation is still in need to find more accurate methodologies in order to avoid the variance between different estimates and make them comparable (Table 3).

[16] The Energy Modeling Forum calculated investment costs between 0-7 percent of annual GDP (Chesnaye and Weyant 2006).

[17] "The Stern Review does not present new estimates of either the impacts of climate change or the costs of greenhouse gas emission reduction. Rather, the Stern Review reviews existing material." (Tol and Yohe 2006: p.4).

[18] Defined as additional cost (operational costs + depreciation) of a low-emission technology/opportunity compared to the business-as-usual, measured as EUR/ton of avoided CO2e emissions.

Stern (2006) follows the methodology of World Bank 2006. It estimates the percentage of "climate-sensitive" investment of three sources of financing in developing countries: FDI, gross domestic investment and ODA. Their conclusions differ because of the chosen percentage of investment, which is problematic in the case of gross domestic investment: an additional percentage point of "climate-sensitive" investment would raise overall adaptation costs as much as US$1.5 billion per year. Oxfam 2007 adds to these calculations the cost of adaptation of communities and NGO-lead projects that can potentially scale up. In general, this group of estimates is not robust since they depend on the proportion considered as "climate-sensitive" investment. These studies have not provided a framework to separate normal and "climate-sensitive" investments, especially in the case of FDI and domestic investment.

TABLE 3. Range of global estimates of adaptation costs

Study	Estimate (US$ billion per year)	Main characteristics
Stern 2006	4 – 37	▪ Follows the methodology of the World Bank (2006) but changes proportions of "climate-sensitive" investments.
World Bank 2006	9 – 41	▪ Estimates a proportion of "climate-sensitive" activities regarding FDI, ODA and gross domestic investment.
Oxfam 2007	around 50	▪ World Bank (2006) methodology plus additional investment, such as those from communities and NGOs.
OIES 2006	2 – 17	▪ Extrapolates adaptation costs from National Adaptation Programs of Action (NAPAs) in LDCs to all developing countries.
UNDP 2007	86 (by 2015)	▪ Adds up on previous methodologies (calculating a proportion of "climate-sensitive" investments) plus the costs of adapting PRSPs to climate change and strengthening disaster response systems.
UNFCCC 2007a	49 – 171 (by 2030)	▪ The proportion of investment in developing countries amounts to US$28-59 billion. Instead of focusing on financial flows, it calculates investment needs in specific sectors and regions.
NAPAs	1.5 in 385 identified projects	▪ Investment needs in Least Developed Countries (LDCs). It is not annual cost, but overall cost of identified projects based on adaptation needs. ▪ Project Identification includes stakeholder consultations.

Sources: UNDP (2007); OECD (2008b); World Bank (2006); OIES 2006 in Müller and Hepburm (2006).

UNDP 2007 calculates adaptation costs based on three elements: costs of "climate-proofing" development investments, costs of adapting poverty reduction strategies to climate change and costs of strengthening disaster response systems. UNDP also estimates that a desirable annual investment target in developing countries should be US$40 billion by 2015. UNFCCC 2007a applies a different methodology based on adaptation costs in five sectors: agriculture, forestry and fisheries; water supply; human health; coastal zones; and infrastructure. As the Stern Review does when calculating the impact of climate change, UNFCCC 2007a compiles several studies in each of the areas, trying to make compatible different methodologies and aggregating the results. As in previous methodologies, it calculates adaptation costs as a percentage of observed annual financial flows, but with a focus on sectors rather than global costs.

Global estimates may be useful as a basis for international agreements to establish overall targets for adaptation investment flows to developing countries. However, more accurate estimates at the regional or sector level are needed in order to allocate resources more efficiently. For example, climate change vulnerable LDCs are elaborating National Adaptation Programs of Action (NAPAs) to identify urgent and sensible projects for adaptation.[19]

Limitations and alternatives to current estimates. OECD (2008c) and UNFCCC (2007a) provide disaggregated data of adaptation costs in specific sectors and regions, allowing the analysis of different adaptation needs across them. The first report establishes a baseline scenario with no policy changes to calculate the costs of inaction,[20] while the second utilizes current financial flows of investment. Similarly, a recent World Bank report has calculated costs of inaction in LAC countries according to the countries adaptation capacity, focusing on the key environmental challenges in the region such as deforestation, socio-economic impact, bio-diversity, environmental services of ecosystems, agriculture and disaster-related responses (Torre, Fajnzylber and Nash 2008). Although there exists case studies at the regional level and studies that are exploring alternative ideas to estimate adaptation costs, there is still need to improve these methodologies. For example, there is need to improve the conceptual framework for estimating adaptation costs and capture the dynamics of the investment—for example, including operating and maintenance costs, as well as activities that provide offsetting savings, such as reduced energy costs.[21]

[19] See the NAPAs database in http://unfccc.int/adaptation/napas/items/4583.php

[20] This methodology has been utilized in some country case studies projecting trends of future costs. For example, air and water pollution in China amounted to almost 8% of GDP in 1995 (World Bank, 1997); the annual damage cost of environmental degradation in 2000 in Lebanon was estimated to be 3.4% of GDP and Tunisia was 2.1% of GDP (World Bank, 2004a).

[21] The World Bank will lunch the study 'Economics of adaptation' in 2010, "to help decision makers in developing countries better understand and assess the risks posed by climate change and to better cost, prioritize, sequence and integrate robust adaptation strategies" http://worldbank.org/environment/eacc

Estimates of mitigation and adaptation costs provide an idea of the task ahead and have contributed to show synergies and positive/negative externalities of climate change interventions. Nevertheless, there is not a clear link between these estimates and the setup of mechanisms for climate change interventions, especially in the case of adaptation. In this regard, Muller (2008) observes an "adaptation funding chasm" between needs, financing and absorptive capacity of recipients. Therefore, it is suggested that estimations of mitigation and adaptation costs should lead to new, additional, predictable, appropriate, equitable and adequate sources of finance.

3. Financing mechanisms for climate change interventions in developing countries

Developing countries need *access to a comprehensive range of financial mechanisms from different sources so that they could finance their own adaptation and mitigation interventions* according to their capacity to mobilize domestic and international resources, their assessment of vulnerabilities and risks they face, and their domestic policies in compliance with broader international agreements for collective action against climate change.

They also face different challenges regarding mitigation and adaptation to climate change. As a result, developing countries need to make decisions about combinations of different instruments to finance their adaptation and mitigation objectives, according to this criteria: (1) *adequacy*, whether there is a match between the purpose of the mechanisms and the investment needs and priorities of developing countries; (2) *amount and predictability*, regarding the time horizon and risk assessment of mitigation and adaptation activities; (3) *diversity and flexibility*, if there is an adequate supply of instruments, institutions and programs, promoting competition and innovation; (4) *complementarity*, whether the mechanisms are effective at mobilizing additional resources; and (5) *voice, representation and accountability*, to ensure that different stakeholders are represented and developing countries are able to tailor these financial instruments to better suit their mitigation and adaptation objectives.

Figure 1 provides a framework for strategic choices[22] so that developing countries can choose the most appropriate combination of financial mechanisms to finance their adaptation and mitigation activities. The framework makes a distinction between three types of financial sources: resources from internalizing externalities, private and public sources. Each of these sources has a different role and emphasis regarding their potential to finance mitigation or adaptation activities.

Under a global public good approach to financing climate change interventions, the main challenge is assessing up to what extent is possible to *internalize externalities.* Whether the instrument is the (1) creation or enhancement of markets or (2) use of taxes, fees or levies, the main purpose is including the cost of GHG emissions into consumption and production functions

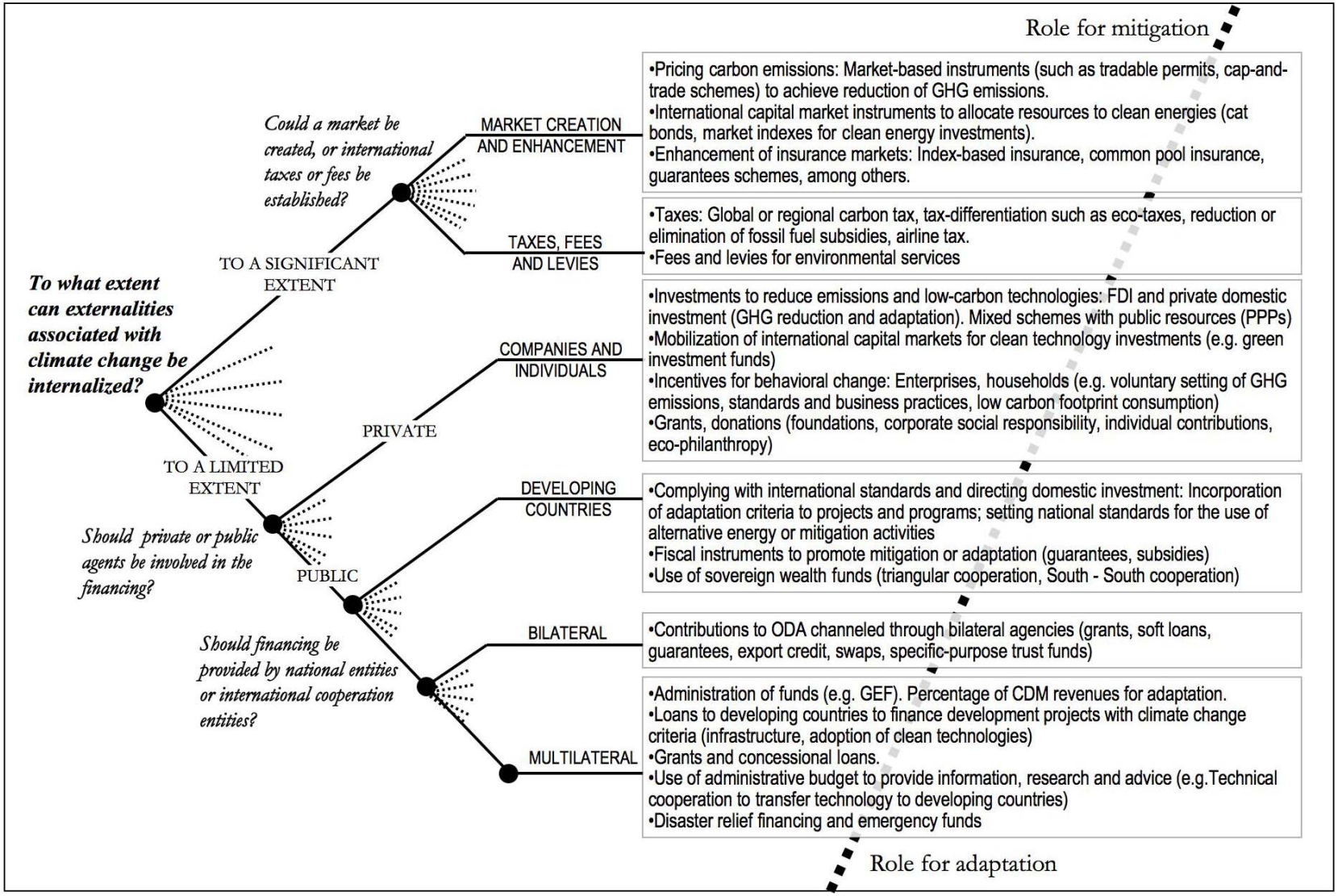
[22] This roadmap has been adapted from the framework of strategic choices for the provision and financing of global public goods (Sagasti and Bezanson 2001)

by pricing carbon emissions, so that agents pay accordingly to the damage caused. Internalizing externalities is a key strategy for mitigation, although a small part of the Clean Development Mechanism's revenues will fund adaptation activities. Similarly, strengthening insurance markets contribute to better align risks and insurance premiums, thus providing incentives to invest on mitigating risks of hazardous weather events and adaptation strategies.

Not all mitigation activities can be financed through internalizing externalities strategies. Whether markets are not complete—causing that carbon prices does not reflect the social costs of mitigation—or the consequences of GHG emissions cannot be reversed—therefore requiring adaptation strategies—, climate change interventions will require additional funding from *private sources* (companies and individuals). Available financial mechanisms include: (1) investments to reduce GHG emissions, introduce low-carbon technologies and reduce exposure to climate change in foreign direct investment (FDI) and private domestic investment; (2) mobilization of international capital markets to finance clean technologies, as in the case of green investment funds; (3) strategies for changing behavior so that enterprises and households apply voluntary caps of their GHG emissions, comply with standards and business practices consistent with reducing their impact over climate or adjust their consumption patterns to low carbon footprint levels and (4) grants and donations from foundations, corporate social responsibility investments, eco-philanthropy and individual contributions.

Public financing should complement private sources when externalities are internalized only to a limited extent. The first reason is that financing public goods through private sources has limited incentives due to the free rider problem, so public resources could act as a catalyst to mobilize private resources. Second, public resources will not be able to provide the amount of resources needed to cope with the consequences of climate change. The financial crisis has reduced private flows to developing countries and public resources will not be able to substitute them. Public resources are mobilized through two sources, each of them having a mixed role when funding mitigation or adaptation activities: (1) developing countries through regulation and tax policies, public investment, south-south cooperation and sovereign wealth funds; and (2) international cooperation through multilateral and bilateral ODA including technical cooperation, technology transfer, loans, grants and the administration of funds for specific purposes.

FIGURE 1. Financing climate change mitigation and adaptation: Decision framework for financial instruments



Source: *Adapted from Sagasti and Bezanson (2001)*

3.1. Mechanisms to internalize externalities

Mitigating climate change, in the context of the UNFCCC, is equivalent to creating economic incentives to drive GHG emission reductions, i.e. internalizing externalities so that agents account and pay for their level of emissions. There are two main groups of instruments for this aim: (a) creating markets to establish a price of GHG emissions, using international capital markets to value specific activities or enhancing insurance markets to price risks through premiums; and (b) charging taxes, fees and levies on inputs, final products or activities/services.

a. Creation and enhancement of markets

Pricing GHG emissions is a central pillar of mitigation policy. The response of the international community materialized in the UNFCCC in 1992 and led to negotiations towards a Protocol that would set legally binding targets to reduce GHG emissions.[23] The Kyoto Protocol was concluded in 1997 and set differentiated targets for industrialized countries while setting up a framework to elaborate joint implementation schemes, setting up an emissions trading scheme and creating a Clean Development Mechanism (CDM). These three mechanisms are designed to support a cap-and-trade program, where governments set an overall emissions cap and then issue tradable allowances—permits to emit an amount of GHG. Those agents who can reduce their emissions more cheaply are able to sell their allowances, promoting competition and reducing long-term costs. Price and quantity equilibrium in GHG permit markets depend on decisions about where to establish a ceiling (cap), distribution of allowances and how many of the allowances should be sold rather than given away free. UNFCC (2008) has estimated that the mitigation potential in 2020 in developing countries is approximately seven Gt CO_2 eq. and most of the potential projects are available at a cost less than US$25 per t CO_2 eq.[24]

Nevertheless, this potential has not unleashed for three reasons. First, there is a problem of scale and high transactions costs to cover potential demand: total demand for emission reduction credits (CERs) in 2020 is estimated between 0.5 and 1.7 Gt CO_2 eq. which can represent between US$10-34 billion in additional investments in developing countries (New Carbon Finance 2008; IDEACarbon 2008; Point Carbon 2008). On the other hand, the CDM has implemented 700 projects between 2004 and 2007—mobilizing around US$6 billion to developing countries—but most projects (78%) are concentrated in just four countries: Brazil, China, India and Mexico (UNFCCC 2007b). CDM is still project based, and this is a barrier to increasing supply from other developing countries due to the cost of monitoring and assessing the level of additionally for each project (Elis and Camel 2007; Capoor and Ambrosi 2008).

[23] The UNFCC only requires parties to commit towards stabilizing their emissions at their 1990 levels by the year 2000, without legally binding targets.

[24] These figures consider technologies currently eligible under the clean development mechanism (CDM), reducing emissions from deforestation and forest degradation in developing countries (REDD), and carbon dioxide capture and storage (CCS).

Second, changes in the global economic structure have challenged the assumptions in the Kyoto Protocol, raising equity and responsibility issues. In 2007, some non-Annex I countries have higher *per capita* income and higher Human Development Index (HDI) than countries with reduction commitments in Annex I (Aldy 2008). Nordhaus (2007) argues that economic growth and the introduction of technologies may complicate negotiations to establish a base-year emission because any change on permit allocation implies welfare transfers and bring concerns about trade competitiveness. International negotiations towards a Post-Kyoto Protocol should address this situation, probably establishing targets by sectors with standardized benchmarks (Harvard Project on International Climate Agreements 2008). Third, even though financial flows and participation levels have grown since its inception, CDM should be evaluated according their effectiveness at mitigating climate change.[25] In order to improve and scale these mechanisms, the international community should overcome several barriers and negotiate an improved framework to define property rights, harmonize regulatory frameworks to facilitate a global market, mitigate risks for investors and countries, and improving depth and liquidity of carbon markets to reduce price volatility (Elis and Camel 2007).

The experience of the EU Emission Trading Scheme (EU-ETS) illustrates the impact of these barriers. The EU-ETS has grown six times in volume and value transacted during the 2005-2008 period, corresponding to two billion EU emissions allowance (EUAs) and a US$50 billion market value. But it has been ineffective at reducing emission among the main traders. The main reason is that ill-defined property rights led to an excessive initial supply of permits, thus reducing their market price and the incentives of private companies to reduce their emissions on a larger scale—within a year, the price of permits decreased 60 percent. Moreover, the EU allocated free permits and some companies could profit by selling these permits at market prices, without evidence that overall reductions occurred (Capoor and Ambrosi 2008). Without ambitious targets for emission reductions, the scheme may not be effective (WWF 2007): the 2008-2012 cap has just been set at two percent lower than 2005 emission levels. Other factor that hinders the potential of carbon markets is price volatility. Without adequate scale and liquidity, carbon markets cannot absorb external shocks and may distort the profitability of emission reduction projects: the financial crisis caused a 35 percent price reduction of EUAs.

A second approach to create markets has been putting a price to activities through transactions in international capital markets. An example is the New Energy Innovation Index (NEX) that tracks clean-tech companies' stocks globally, creating a benchmark to compare with others. Currently, only 88 companies participate, including those in developing countries, therefore lacking of adequate scale to reduce exposure to economic factors: the reduction of the NEX has been higher than other indexes such as Dow Jones or S&P. A second example is the development of market

[25] A recent GAO Report says global programs to curb emissions fall short. [Juliet Eilperin; Washington Post, Saturday, December 6, 2008; A09]: "The Government Accountability Office, in a report issued as negotiators convened the latest round of U.N. climate talks in Poland, has concluded that two key international programs aimed at curbing greenhouse gas emissions are not getting the job done (…) The study (…) highlights problems in the European Union's emissions trading system and in a U.N. program that allows industrialized countries to offset their domestic greenhouse gas emissions."

instruments to cope with weather-related events, such as the Catastrophe Bonds (cat bonds). In this case, investors acquire a floating-rate corporate bond whose principal would be forgiven if conditions are met, usually a catastrophic weather event. Therefore, by transacting these bonds, markets may establish a value for the risk and exposure to these events (for example, insurance companies have issued cat bonds to transfer their exposition to catastrophic events).

Strengthening insurance markets is a third instrument to internalize externalities, and it can also be applied for adaptation. By estimating the risk of weather-related events through insurance premiums, the size of premiums may inform companies to reduce their exposure to climate change (Warda *et al* 2008). However, insurance markets are not well developed in developing countries, let alone for climate-related events.[26] Another approach has been the use of index-based insurance to cope with recurrent risks, as in the case of the agriculture sector. In this case, small farmers will receive compensation if an event occurs (e.g. a "drought-index insurance" will trigger payments to a group of small farmers if rainfall falls below a prescribed target). In general, promoting insurance markets require a clear assessment of the risk that the industry may face in a specific country, which can be carried out with public funding at early stages (Mechler *et al*, 2006). However, recurrent weather events in the context of climate change may increase premiums and thus exclude population from the insurance market, or moral hazard may occur reducing the incentives for adaptation.

Markets are not panacea, but their potential to cope with emission reductions is significant. Without adequate regulation, incomplete markets—incomplete information, limited number of agents, biased exercise of market power, prices that do not reflect the actual costs, among others—, may cause higher transaction costs and volatility that discourage investments and hinders participation. Even when markets function properly, there is no certainty that developing countries will permanently benefit. For example, in the emission trade markets some distortions may appear: (a) investment decisions are sensitive to price changes and technological change plays a major role setting future prices (developing countries may only have an initial advantage with lower average costs for mitigation projects); (ii) countries may establish barriers that hinders gains in productivity in other countries (for example, comparing Brazilian and US production of ethanol); and (iii) in a context of short-term financial urgencies, developing countries may race-to-the-bottom and end up liquidating their holdings of emissions allowances at disadvantageous market prices (Baumert, Perkaus and Kete 2003).

b. Taxes, fees and levies on inputs, final products or activities/services.

Internalize externalities is also possible by charging taxes, fees or levies that incorporate social costs/benefits to the price of specific activities. Two financial mechanisms can be implemented:

[26] Less than 5 percent of companies in developing countries is insured against impacts of climate disaster events (Bannet and Mahul 2007). This market has a huge potential, and Climate Wise, grouping more than 40 international insurance companies, presented a plan in Poznan to increase their participation in climate change negotiations.

(1) taxation as an alternative to market mechanisms to put a price on carbon; and (2) charging fees and levies for activities/services that have no market price but provides benefits that can be privately appropriated under certain conditions through regulation or defining property rights.

Taxing carbon use is usually compared to cap-and-trade schemes as an alternative to internalize externalities of carbon use, since both strategies affect the structure of incentives via prices.[27] In general, a carbon tax requires less administrative expenses because it can rely on existing government structures. However, these potential savings depend on the scope of the tax: if administered nationally, a tax can take advantage of existing institutions, but a global tax would also require negotiations to harmonize tax systems and jointly decide the level of the tax, who should pay and how to allocate the revenues. UNDP 2007 indicates additional advantages of a carbon tax:[28] (1) since emissions are concentrated in few large emitter, enforcement may be less costly; (2) a carbon tax has a fixed effect on energy prices, in contrast, a cap-and-trade system can exacerbate price volatility; and (3) potential revenue has been calculated at US$265 billion if a US$20 tax per ton of CO_2 is charged in OECD countries at current emission levels.

Establishing taxes is usually considered a sovereign decision. Some OECD countries have implemented carbon taxes aimed mainly at financing their domestic budgets (OECD 1997) and not for international cooperation purposes or financing low-carbon development. Other schemes have been proposed to specifically finance climate change activities. A tax proposal, similar to the "French Solidarity Tax" intended to finance access to HIV/AIDS treatment in low-income countries, indicates that a US$7 levy per passenger on international flights could result in US$14 billion per year (UNDP 2007; UNITAID 2007). However, it raises the question to what extent this type of tax discriminates against other transportation modes (ICAO 2002). In developing countries, reducing subsidies to fossil fuels could help to reduce emissions and provides incentives for the transition towards a low-carbon economy: IEA (2006) estimated that subsidies to oil fuels—the difference between the end-user price and the price in a competitive market—amount to US$170 billion per year.

Another approach is the introduction of differentiated taxes to less clean technologies, inputs or activities (also known as eco-taxes). The EU applies taxes to products or processes that contaminate more, like in the case of natural gas compared to diesel or products with higher footprint. Without an international framework, differentiated taxes may serve to political/trade purposes rather than climate change mitigation (for example, US subsidies to ethanol and barriers to Brazil's ethanol). Moreover, such taxes or subsidies generate their own externalities: for example, increase of food prices due to increased demand of grains to produce biofuels or further deforestation to produce ethanol in the Amazon basis.

[27] For example, the World Bank estimates that a price of US$27/t CO_2 would induce conservation of 5 million km_2 of rainforest by 2050, preventing the release of 172Gt CO_2 (Chomitz et al, 2007).

[28] IPCC 2007a proposed a gradual introduction of a global carbon tax: between US$10-20 per tCO_2 by 2010 with annual increments between US$5-10 adjusted on a rolling basis to account for national trajectories.

In general, taxes and subsidies create resistance from groups that take the burden (Newell 2000). One concern is the redistributive effect: a carbon tax is regressive *ceteris paribus*, since fuel bills are a large portion of the poor's budget. In least developed countries, it may further pressure on firewood, as fossil fuels would become less affordable (Jha 2002). Taxes may not generate stable revenues when technological changes reduce the tax base or energy efficiency increase (Hurfbauer 1999). Despite all these shortcomings, it is important to explore alternatives to introduce a carbon tax in a context of low oil prices, even though it will generate additional resistance when the world is facing a financial crisis. The transition to a low-carbon economy requires powerful signals so that individuals and companies can adjust their incentive structures.

An alternative approach is charging fees and levies for activities/services whose benefits have not been adequately valued to have a market value—mainly because of their public good attributes. This is the case of ecosystem services, such as: (1) provisioning, such as the production of commons; (2) regulating, such as the control of climate or carbon sequestration; (3) supporting, such as nutrient cycles and crop pollination; (4) cultural, such as hedonistic benefits; and (5) preserving, such as maintenance of biodiversity (Millennium Ecosystem Assessment 2005). Due to their specificity, ecosystem services cannot be traded as easily as in the case of liquid financial assets, thus creating a market to put a price on these services through market transactions could be rather difficult. As an alternative, several methodologies have been created to assess market value of these services and charge the potential beneficiaries—"pay as you use the service", for example, estimating shadow prices (Constanza et al, 1997). When the value of these services is taking into account, and the property rights defined accordingly, it is possible to internalize these criteria to inform investments.[29] The idea of preserving ecosystems due to the services they provide is at the core of the strategies to reducing emissions from deforestation (REDD).

3.2. Private sources of financing

In economic theory, pricing carbon emissions contribute to align incentives so that economic agents engage in mitigation and adaptation activities. However, when externalities cannot be fully internalized, mobilizing private sources requires a combination of regulation to align incentives and cooperation from companies and households. This is possible because investing in adaptation or mitigation also responds to non-market signals (e.g. reputation, demand trends and reducing production costs, among others). These mechanisms are available: (1) investments to reduce GHG emissions, introduce low-carbon technologies and reduce exposure to climate

[29] UNDP (2007: p.158) provides an example in Indonesia: "oil palm cultivation generates an estimated value of US$114 per hectare. As the trees that stood on that hectare burn and rot, they release CO_2 into the atmosphere—perhaps 500 tons a hectare in dense rainforests. At a carbon price of US$20–30 a ton, the carbon market value of that release would amount to US$10,000– 15,000 a hectare. Put differently, farmers in Indonesia are trading a carbon bank asset worth at least US$10,000 in terms of climate change mitigation, for one worth US$114, or around 2% of its value. Even commercial logging, which generates a higher market return, represents less than one-tenth of the value of the carbon bank. And these figures do not include the market and non-market values of environmental services and biodiversity".

change in FDI and private domestic investment; (2) mobilization of international capital markets to finance clean technologies, as in the case of green investment funds; (3) strategies for changing behavior so that companies and households apply voluntary caps to their GHG emissions, comply with standards and business practices consistent with reducing their impact over climate or adjust their consumption patterns to low carbon footprint levels; and (4) grants and donations from foundations, corporate social responsibility investments, eco-philanthropy and individual contributions.

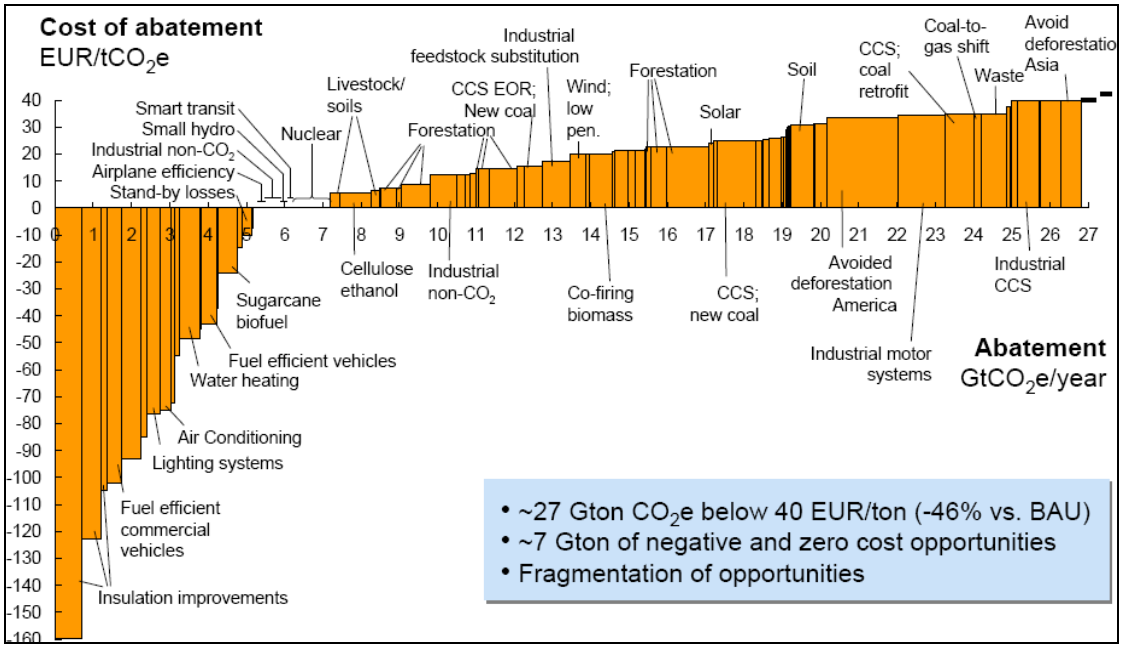
Private investment (FDI and domestic private investment). Between 2004 and 2007, investments in energy efficiency and renewables—clean energy—, increased from US$33 billion to US$148 billion in developing countries (UNEP SEFI, 2008). However, the potential of private investment for mitigation and adaptation activities could be greater taking into account that both domestic private investment and FDI are major components of total gross fixed capital formation (GFCF) in developing countries—60 and 12 percent respectively of an estimated total of US$1.9 trillion in 2006.[30] UNCTAD (2008) has calculated that transnational companies (TNC) generated 24,000 FDI greenfield projects in developing countries between 2003 and 2007, and only 210 of them in the alternative/renewable energy and recycling sector.

Private investment is higher where there exists a stable political environment, a strong legal system, macroeconomic stability and availability of skilled labor. For climate change mitigation, additional elements are needed. First, more information should be made available about opportunities to reduce operation costs through a more efficient use of energy and transportation, among others.[31] Vantenfall (2007), with inputs from McKinsey (2007), developed a cost curve for greenhouse gas abatement (Figure 2). This curve plots the potential size of each abatement measure versus the cost of that measure (in euros per ton of avoided greenhouse gas emissions) and it is available for sectors and regions. Second, governments can provide incentives through enabling regulatory frameworks, subsidies, guarantees, financing of incremental costs of switching technology, among other financial instruments. Third, it is worth to explore the synergies between cap-and-trade schemes and technology transfer, while promoting the use and improvement of existing technologies. For example, the Harvard Project on International Climate Agreements (2008) has proposed promoting technological change and the use of cleaner modes of production as part of a Post-Kyoto cap-and-trade scheme. Vantenfall (2007) calculated that 70 percent of the total 2030 abatement potential is not dependent on new technology. For example, developing economies already account for 40 percent of existing global renewable resources and 70 percent of solar water heating capacity (UNEP 2008).

[30] Calculated using data from World Development Indicators (World Bank) and UNCTAD 2008). Other flows that compose GFCF are public investment (24 percent), international debt (2.2 percent) and bilateral and multilateral flows (1.8 percent).

[31] The experience of CDMs suggests that there exists potentital to generate mitigation projects in developing countries, even though the scale is currently not adequate to significatively reduce emissions in developing countries. For example, there exists 1,370 CDM registered projects out of a total 4,474 in the CDM pipeline, and 465 have generated Certified Emission Reductions (CERs). From January 2006-January 2009, registration of projects have grown from 100 to 1,350.

FIGURE 2. Cost of abatement of climate change interventions



Source: Vatenfall (2007)

In the case of adaptation, less attention has been given to the role of market and regulatory mechanisms to mobilize private action, even though private actors are currently undertaken most of the task and the scope of the challenge will exceed public budgets (OECD 2008b: p.14). One measure—acknowledging and accounting the risk of capital reduction due to weather events in FDI projects—could generate incentives to promote adaptation strategies. This is adequate for private-public partnerships, where the costs of adaptation could be shared between consumers, private operators and governments (OECD 2008b: p.124). As an alternative, insurance is still an expensive option in developing countries, where less than five percent of companies are insured against extreme weather events (Bannet and Mahul 2007). Nevertheless, developing countries may find difficult to balance the effect of measures to mobilize private capital with the need of more strict regulation to promote adaptation.

Mobilization of international capital markets. Investors allocate their investments in order to maximize future expected returns. Future returns of clean technologies for mitigation are related to the performance of existing alternatives that have not fully incorporated the cost of their emissions, and their returns have been lower on average. Green funds and stocks appeal to those investors that are willing to allocate their investments to options that may generate less return, but have potential returns in terms of mitigation as well as more progressive business practices. Initially set up to attract individual investors, it has engaged institutional investors[32] as well—

[32] The main actors are: the Norwegian Government Pension Fund-Global; ABP, the Dutch government pension fund; the pension fund of the British Environment Agency; the California State Teachers' Retirement Fund.

sometimes motivated by stakeholders' pressures. Nevertheless, this approach has two main limitations. First, investors maximize expected returns while diversifying their portfolio to reduce risks. By investing in specific sectors, especially in those whose returns may be more volatile such as in alternative clean technologies, investors may face higher risks and be less protected to changes in fundamentals (for example, value of biofuels stocks reduced significantly due to lower energy demand and oil prices). Second, in order to become an important vehicle for investment in developing countries, the supply of stocks has to increase significantly. Currently, almost all investment opportunities are concentrated in developed countries.[33]

Voluntary standards. Some companies have started to implement voluntary emission caps and a growing number of consumers are adjusting their consumption patterns to lower footprint levels. This is a powerful trend promoting a more rational use of resources, but the key question is whether these trends are enough and timely to reduce GHG emissions in the amount needed to cope with climate change. Moreover, the adoption of voluntary emissions standards may hurt relative competitiveness and increase production costs in the short-term, thus reducing incentives to adopt more stringent standards. When combined with public regulation, voluntary action may help to mobilize financial resources from private sources and obtain tangible results in terms of GHG emission reduction. California adopted emission standards and reduction targets by negotiating with private companies, and it has been able to raise awareness among consumers and producers—average per-capita consumption of energy in California is 50 percent of the US average. In conjuction with other 20 states, California has also established targets for the use of alternative energy. The California Renewable Portfolio Standard (RPS) requires the use of 20 percent renewable energy by 2010.[34]

Global GHG emitters, such as oil companies (BP and Shell), as well as chemical companies, have started to measure their emissions and agreed to voluntary reductions including their operations abroad. This may give them first mover advantage towards adopting and testing low-carbon modes of production. In general, private companies are willing to show awareness to climate change. For example, the United Nations released Principles for Responsible Investing in 2005, where signatories pledged to integrate environmental issues with investments: membership doubled to 381 companies in 2008, representing US$14 trillion in assets (Rosenthal 2008). The Carbon Disclosure Project has set standards so that companies—there are 155 institutional investors with combined assets of US$21 trillion represented—periodically report their emissions (Pew Center 2007).

Beyond GHG emissions, private companies have been complying with voluntary frameworks of good practices regarding environmental protection and sustainability. For example, members of the International Council on Mining and Metals (25 transnational mining companies) have agreed on a "sustainable development framework" of ten principles to reduce the impact of their

[33] See http://www.sustainablebusiness.com/index.cfm/go/progressiveinvestor.stocks for information about green stocks.

[34] Under this apporach, every participant state's RPS is shaped by a variety of regional factors including cost, political climate, resource availability, state electricity consumption, and so on. RPS laws are thus structured very differently across the states, and requirements for renewable energy production vary greatly.

operations and periodically report their activities. Similarly, financial institutions have adopted the "Equator Principles" to comply with environmental standards when funding development projects. Moreover, private companies also comply with sound environmental standards when applying for certification, such as ISO14000 or the Leadership in Energy and Environmental Design (LEED) in the case of buildings.

Grants, donations and individual contributions. Philanthropy has been a powerful instrument for change in the past because it is a source for funding innovative approaches. At a small scale, individuals may allocate resources to climate change activities, as in the case of green credit cards. This mechanism allows card users to donate a small amount from transaction with credit cards, and sometimes they may be matched by a similar contribution from banks or foundations (Credit Card Watchers 2008). On a larger scale, eco-philanthropy has engaged in activities to protect ecosystems (CNN March 2nd 2008) and fund small-scale projects. For example, a group of billionaires have pledged resources to fight global warming—Richard Branson from Virgin, pledged US$3 billion but has recently to scale down his plans to fund clean alternative energy projects due to the financial crisis. Ted Turner, George Soros and Luciano Benetton have bought land in South America for ecosystem conservation, close to 2.5 million of acres. Because it depends on individual's motivations and financial wealth, this source of financing may be volatile, but it is key for innovation, experimentation and development of high-risk projects.

3.3. Public resources for financing

Public financing has two key roles for adaptation and mitigation. First, it should complement and mobilize private financing when externalities can be internalized only to a limited extent; and second, it should contribute to reduce market failures and promote actions to internalize externalities. Nevertheless, the policy debate to finance for climate change interventions in developing countries has mostly focused on costs, raising public funding through international cooperation, and mechanisms to allocate these resources. In this sense, the policy debate is biased towards how to make use of scarce international public resources rather than utilizing these resources to unleash the potential of other sources of financing. Public resources for climate change come from two sources: (1) developing countries' regulation and standards, fiscal instruments and incentives, public investment, and south-south cooperation; and (2) international cooperation through multilateral and bilateral channels including loans, grants and the administration of specific funds for climate change purposes.

a. Developing countries' public resources to mobilize financing for climate change

The United Nations Environment Programme (UNEP) has called for a "Global Green New Deal" to tackle simultaneously the consequences of the current financial crisis and climate change. It has proposed that at least one third of the US$2.5 trillion-worth of planned stimulus packages in developed countries should be invested on "greening" the economy (UNEP 2009). HSBC Global

Research (2009) has estimated that stimulus packages in 14 developed nations and China include US$432 billion (16 percent of the total) for low carbon power, energy efficiency, water treatment and pollution control—and half of that will be spent in 2009. Developing countries, although not in the same scale, can mobilize resources to help their economies and pave the road towards a low carbon economy through a variety of instruments.[35]

Regulations and standards. Although not strictly a financial mechanism, regulation and standards have the potential to mobilize domestic resources and generate incentives consistent with low-carbon modes of production and consumption. In the case of mitigation, governments can introduce the use of abatement technologies to reduce emissions. For example, Mexico has established norms to reduce energy use from light bulbs, air conditioning and refrigerators, and has also established a fund to support poor families (US$55 million with the support of the Inter-American Development Bank). Similarly, some developing nations have voluntarily established targets to reduce emissions. Brazil has committed to reducing the current rate of deforestation by 70% in 2018 compared to the 1995-2005 median of 19,5 km^2 of lost forest per year (Parlow 2008).[36] Establishing fuel efficiency standards is a more common measure.[37]

UNDP (2007) draws attention that establishing standards may confuse means with ends if targets are not set properly. Some governments have established targets for reduced carbon intensity as equivalent to climate change mitigation goals, when what should matter is an overall reduction in emissions. Another shortcoming is that voluntary regulations and standards are not substitute of global agreements, because they are less enforceable, and the sum of voluntary targets may not lead to significant overall reductions in emissions. These targets, if fulfilled, may have significant impacts since most of these measures are coming from the largest GHG emitters.

Financial and fiscal incentives. These instruments have two main purposes. First, by providing financial incentives, governments are signaling the direction of future policies (for example, direct financial aid for R&D in wind energy projects); and second, they provide the initial funding through tax breaks, guarantees, apex funds or direct project funding. Most of these instruments are appropriate for the introduction of mitigation technologies whose initial costs may be prohibitive; but may well be used to support adaptation of small and medium enterprises (SMEs). Annex 2 presents a list of these instruments, the risks that seek to mitigate, and the targeted market sector. The main argument to utilize them is that government action may help to

[35] Tirpak (2008) has presented a typology of instruments and policies for this aim: (1) regulations and standards; (2) taxes and charges, so agents internalize the cost of externalities; (3) support to research and development on new technologies and more effectives adaptation measures, and also providing information to consumers like in the case of labeling, certification and measures for public disclosure; (4) non-climate related policies, such as trade, social, economic, water, energy and land use policies that have an indirect impact over climate change outcomes; and (5) financial incentives, such as direct and indirect subsidies, price support schemes, tax credits, guaranteed loans, among others.

[36] Brazil is the fourth world's largest GHG emitter, with 80 percent explained by deforestation. The destruction of the world's rain forest accounts for about 20 percent of annual greenhouse gas pollution, of which Brazil makes up 40 percent. This measure will prevent emitting up to 4,800 million of tCO_2–eq.

[37] Europe averages at 45 miles per gallon (mpg) with an expected 50 mpg by 2012, while China has an standard of 35 mpg and the United States only at 25 mpg (Copenhagen Climate Council 2008).

overcome barriers or market failures to initiate projects with high risks but high returns. For example, the Commission of the European Communities (CEC 2007) has estimated that the consequences higher sea level will cost US$7.6 billion per year by 2020 in Europe, but with adaptation measures the cost will be reduced to US$2.5 billion (20 percent is the actual cost of adaptation and the rest is total residual costs). The same argument can be made in the case of funding public infrastructure in developing countries: There will still be 1.4 billion people lacking access to electricity in 2030, and one third of the world's population—2.7 billion people—will still be using biomass (IEA 2006).

Governments can also establish taxes to fund public investment for mitigation and adaptation. For example, a percentage of the Brazilian sales tax on merchandises and services (ICMS) is earmarked for environmental management in states and municipalities, which is allocated on the basis of the volume, distribution and quality of local public spending on the environment (Acquatella and Bárcena 2005). On the other hand, developing countries still provides subsidies for fossil fuels at a high cost (approximately US$180 billion per year let alone environmental costs) to support poor segments of society and the benefits to reform them my be significant (UNEP 2008). But subsidies can be a powerful instrument to start up industries. Here, the case of Brazil and biofuels, where sugarcane-based ethanol can be produced at half the unit price of maize-based ethanol in the United States, helping Brazil to cuts emissions by some 70 percent compare to just 13 percent in the United States (Baumert *et al*, 2005; IPCC 2007c). Decisions to use fiscal instruments are technical and political as well. In this sense, governments may face pressures and lobbies to introduce a particular technology or generate opposition from interest groups. On the other hand, it may crowd out private investment or lock in technology may lead to market failures and inefficient investments.

South-South cooperation. This is a source of financing that has not been fully studied, but has great potential providing regional public goods for adaptation (for example, harmonizing responses to common weather risks). For example, the Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a pool-resource fund that provides member countries with index-based insurance against government losses caused by natural disasters. Under this scheme, governments will purchase catastrophe coverage to provide them with an emergency liquidity line within one month after a major hurricane or earthquake. CCRIF has contributed to reduce premiums by 40 percent, and has received also the support from donors (see www.ccrif.org).

Additional proposals. Discussions about a post Kyoto Protocol are considering new ways that developing countries—especially emerging economies—can participate mobilizing additional resources for less developed countries. Emerging economies have accumulated international reserves and some of them have established sovereign wealth funds. The first proposal, in order to inject liquidity to carbon markets, is participating more actively on carbon funds or the CDM. Currently, 32 percent of the US$9.5 billion-worth carbon funds in 2007 came from government investors (Cochran and Leguet 2007). Similarly, four percent of CERs (US$297 million) have been bought by national governments. Emerging economies are already benefiting from these schemes, and additional resources will contribute to generate economies of scale, more competition and better conditions to fund clean energy and technology projects.

Second, IPCC (2008) has also suggested the idea of developing countries issuing "climate bonds" so private investors allocate money for climate change mitigation projects. By guaranteeing these bonds, it may be possible to reduce risks to invest in these types of projects. This proposal may be contested by some developing countries: it may be not fair that developing countries acquire additional debt for this aim. However, it may contribute to finance mitigation projects that can later be exchanged with carbon market resources at maturity. In this sense, this proposal could provide seed capital for risky projects, especially in emerging economies with more developed capital markets.

b. International cooperation: Bilateral and multilateral sources of financing

International cooperation can contribute to realize the available mitigation potential and allocate adaptation funding to countries with less capacity to mobilize private and domestic public resources. Through loans and grants, bilateral and multilateral institutions can support the implementation of national policies regarding climate change, provide funding to projects whose potential cannot be realized due to lack of private investment, leverage private investments, and provide funding for research and development and early deployment of technologies.

Table 4 presents a list of three groups of financial mechanisms from international cooperation sources. First, financial mechanisms under the UNFCCC consist of multilateral funds to provide grants: (1) Global Environment Facility (GEF), currently in its fourth replenishment, provides grants to cover for the incremental costs to increase energy efficiency, adopt renewable energies and sustainable transportation; (2) Sustainable Forest Management (SFM), a cross-cutting program under the GEF-4, to conserve globally significant forest biodiversity and to promote sustainable management and use of forest resources; (3) Strategic Priority on Adaptation (SPA), a special provision from the GEF Trust Fund to finance pilot adaptation projects that generate global environmental benefits; (4) Special Climate Change Fund (SCCF), to complement GEF financing when climate change affect areas of agriculture, health or infrastructure; (5) Least Development Countries Fund (LDCF), to finance NAPAs that prioritize adaptation projects in LDCs; and (6) Adaptation Fund, in contrast of the previous mechanisms that relies on voluntary contributions, finance adaptation projects and programs mainly with resources from a two percent levy on transactions under the CDM.

Second, bilateral agencies provide loans and grants trough funds and programs: (3) Japan Cool Earth Partnership will provide loans and grants to complement activities in developing countries that are already making efforts to reduce GHG emissions; (2) Norwegian Climate and Forest Initiative (CFI) finances mitigation projects addressing deforestation and forest degradation, as well as establishing methodologies and practices to include emissions from deforestation and forest degradation in a new international climate regime post-Kyoto; (3) the UK International Window-Environmental Transformation Fund (ETF-IW) that will provide resources to the World Bank's Climate Investment Funds; (4) Amazon Fund to finance Brazilian efforts to reduce deforestation; (5) German International Climate Initiative (ICI) will mobilize resources from

private companies by auctioning ten percent of its CERs allowances to finance domestic and international projects; (6) Australian International Forest Carbon Initiative (IFCI) has similar objectives than Norwegian CFI plus a component to increase monitoring and accounting capacity

TABLE 4. Bilateral and multilateral financing mechanism for mitigation and adaptation (US$ million, exchange rate November 2008)

Name	Total	Use	Notes
Under the United Nations Framework Convention on Climate Change (UNFCCC)			
GEF-4	1,030	M	Timeframe: 2006-2010, US$352 million already committed as of December 2008.
Sustainable Forest Management	154	M	Special program under GEF-4 for Land Use, Land-Use Change and Forestry.
Strategic Priority on Adaptation (SPA)	50	A	Pilot program on adaptation of the GEF Trust Fund. All resources have been allocated.
Special Climate Change Fund (SCCF Adaptation)	90	A	Include pledges as of December 2008. US$68 million have been allocated to 15 projects as of November 2008. Operated by GEF.
Least Developed Countries Fund (LCDF)	172	A	Include pledges as of December 2008. US$91.8 have been received as of November 2008. Operated by GEF.
Adaptation Fund	400-1,500	A	Timeframe: 2008-2012. As of October 2008, US$91.3 was available (four million CERs at €17.5 per CER).
Bilateral			
Cool Earth Partnership (Japan)	10,000	A, M	Provides grants and loans. Timeframe: 2008-2012. Up to US$2 billion to improve access to clean energy, and US$8 billion for preferential interest rate loans for mitigation projects.
Climate and Forest Initiative (CFI) (Norway)	2,250	M	Provides grants. Timeframe: 2008-2012. Pledged US$102 million to the Amazon Fund.
International Window of the Environmental Transformation Fund (ETF-IW) (United Kingdom)	1,182	A, M	Provides grants and loans. Timeframe: 2008-2010. Most of the funds will be allocated trough the WB's Climate Investment Funds.
Amazon Fund (Brazil)	1,000	M	So far, only Norway has pledged US$102. Donations to be administered by the Brazilian National

			Development Bank.
International Climate Initiative (ICI) (Germany)	764	A, M	Provides grants. Funding for the initiative will be generated from auctioning 10 percent of its allowances from the EU-ETS. It has earmarked up to €120 million for the next five years.
International Forest Carbon Initiative (IFCI) (Australia)	129	M	Provides grants. Timeframe 2007-2011. As of November 2008, US$50 million were allocated.
UNDP-Spain MDG Achievement Fund - Environment and Climate Change thematic window	90	A, M	Provides grants. Timeframe: 2007-2010. Spain has pledged €528 to the Fund and US$90 million has been allocated for the Environment and Climate Change thematic window.
Global Climate Change Alliance (GCCA)(European Commission)	76	A, M	Provides grants. Timeframe: 2007-2011. Targets most vulnerable countries (least developed countries and small islands)
Multilateral			
Forest Carbon Partnership Facility (World Bank)	300	M	Provides grants and loans. Timeframe 2008-2020.
Global Facility for Disaster Reduction and Recovery (GFDRR)	84	A	Provides grants. Timeframe 2007-2010. Targets high-risk low and middle income countries to mainstream disaster reduction in development strategies
UN Program on Reduced Emissions from Deforestation and Degradation (UN-REDD)	35	M	Provides grants. Administered by the UNDP. Norway, trough its Climate and Forest Initiative, is the first donor with US$12 million.
Climate investment Funds:	*6,340*		Timeframe: 2009-2012. Administered by the World Bank.
▪ Clean Technology Fund	4,334	M	Provides grants and loans. The Fund was funded by the United States to be administered by the World Bank (US$2 billion), and the UK and Japan have pledged the additional resources.
▪ Strategic Climate Fund	2,006	M, A	Provides grants and loans. This includes the Forest Investment Program (US$58 million) and Scaling-up Renewable Energy (US$70 million) for mitigation; and the Pilot Program for Climate Resilience (US$240

			million) for adaptation.
Sustainable Energy and Climate Change Initiative (SECCI)	29	A, M	Provides grants and loans. The fund backs major investments in the development of biofuels, renewable energy, energy efficiency, and a wide range of sustainable energy options.

Notes: M=Mitigation; A=Adaptation; Adapted and updated from Porter et al (2008) and UNFCCC (2007a).

for REDD projects; (7) Environment and Climate Change thematic window of the UNDP-Spain MDG Achievement Fund, supports interventions that improve environmental management and service delivery at the national and local level and enhance capacity for adaptation; and (8) EC Global Climate Change Alliance (GCCA) will support pro-poor strategies that integrate environmental and climate change related policies.

Third, multilateral institutions have established several funds to provide loans, grants and concessional funding through: (1) Forest Carbon Partnership Facility utilizes money contributed by governments and companies in OECD countries to purchase project-based GHG emission reductions in developing countries;[38] (2) Global Facility for Disaster Reduction and Recovery (GFDRR) that provides liquidity for disaster relief;[39] (3) UN Collaborative Program on Reduced Emissions from Deforestation and Degradation (UN-REDD) will finance projects for sustainable management of forests to reduce GHG emissions; (3) Climate Investment Funds, administered by the World Bank, aim at supporting the rapid deployment of low-carbon technologies on a large scale, with the objective of cost-effective reductions of GHG emissions and comprises the Clean Technology Fund and the Strategic Climate Fund; and (4) Sustainable Energy and Climate Change Initiative (SECCI), is an example of similar investment funds administered by Regional Development Banks (RDBs).

Despite the variety, magnitude and scope of these financial mechanisms, overall funding from international public sources falls short when compared to mitigation and adaptation costs. South Centre (2009) calculates the gap between needs and availability of funding: while UNFCCC has estimated total needs at US$260 billion (mitigation and adaptation), total available and pledged resources (including GEF, UNFCCC and non-UNFCCC mechanisms) amount to US$29 billion. This size of this gap may be misleading: international cooperation sources of financing should be considered complementary to other sources of financing and contribute to catalyze larger investments through co-financing. In order to mobilize resources to close this gap, international cooperation for climate change faces several challenges.

[38] Similar funds are administered by the World Bank Carbon Finance Unit (CFU), such as the BioCarbon Fund,□Carbon Fund for Europe,□Danish Carbon Fund□, Italian Carbon Fund□, The Netherlands CDM Facility,□Prototype Carbon Fund,The Netherlands European Carbon Facility,□Spanish Carbon Fund,□and Umbrella Carbon Facility. See http://go.worldbank.org/51X7CH8VN0

[39] The Inter-American Development Bank recently established a US$600 million credit facility to provide short-term financing in case of disaster. Members countries may borrow up to US$100 million in case of a natural disaster.

First, international cooperation should contribute to mainstream mitigation and adaptation in developing countries' national policies under the ownership principle. The Cool Earth Partnership will support projects that developing countries prioritize in their country strategy papers, and seeks to complement resources for national programs already under implementation. In the case of the LDCF, financing is available after the preparation of NAPAs—as of October 2008, 38 LDCs had completed their NAPAs and 24 had officially submitted NAPA implementation projects to the GEF (GEF 2008b). The GFDRR has the explicit objective to provide technical and financial assistance to high-risk low and middle-income countries to mainstream disaster reduction in national development strategies.

Second, international cooperation should enhance its capacity for innovation and demonstration effect. Bilateral funds such as Norwegian CFI and Australian IFCI have contributed to raise awareness over the mitigation potential of REDD and will measure the performance of their projects in order to position REDD as part of a Post-Kyoto agreement. Similarly, international cooperation can also contribute to raise awareness over specific topics. Disaster relief is one of the fastest growing areas of international aid, with bilateral spending reaching US$8.4 billion—or 7.5 percent of total aid—in 2005 (Gurria and Manning 2007).

International cooperation also innovates by introducing methodologies and making concepts more operative. For example, calculating incremental costs in GEF funding—"the costs imposed on vulnerable countries to meet their immediate adaptation needs" (GEF 2007)—requires costly pre-investment studies that may have generated a bias against smaller but cost-effective mitigation or adaptation projects. For this purpose, GEF has introduced the concept of "sliding costs" (a fixed percentage for GEF financed related to the total project cost)[40] and "co-financing" (when countries already have resources committed and need financing for the additional costs of adaptation). On the other hand, The US Overseas Private Investment Corporation (OPIC) has committed to reducing the carbon footprint of the private projects that contribute to finance. In ten years, it will reduce GHG emissions from the estimated baseline is 54.7 million tons of CO_2-eq in its active portfolio as at 2007 to a target planned of 44 million tons in 2016. This implies generating methodologies to calculate emissions in private projects, but also incentive the mobilization of resources from the private sector towards clean technology projects.

Third, international cooperation should reduce or eliminate barriers so that developing countries can have access to financial resources, especially for the poorest and smallest countries. In this case, blending instruments may help: the Austrian JI/CDM Program covers up to 50% of project related documents (baseline preparation, validation fees, among others) with a maximum of €40,000. Another example is the CAF-Netherlands CDM Facility, which offers to cover up total costs for project related documents. The World Bank's Community Development Carbon Fund (CDCF) also offers to initially cover all these costs but these will be reimbursed using CERs.

[40] Instead of determining additional costs through a complete baseline/alternative scenario analysis, additional costs are estimated as a percentage of total project funding request, with the LDCF/SCCF funding a proportionately larger share of smaller projects, and a smaller share of larger projects (with the remaining funding to be leveraged in co-financing). E.g. under the SCCF the steps are: <US$1million (GEF provides up to 50 percent); between US$1-5million (GEF provides 33 percent), and above US$5million (GEF provides 25 percent).

Fourth, there is a need to generate stable sources of funding in order to provide financing in a sustainable way. Since provisions to these funds are mainly voluntary contributions and there are no explicit targets for funding, fulfilling commitments is at donor's discretion. For example, US$120 million of the US$312 million pledged to the UNFCCC adaptation funds (LDCF, SPA and SCCF) are still outstanding (Bapna 2008). China has proposed a target for adaptation funding at 0.5 percent of each donor's GNP, with the potential to generate US$185 billion for adaptation, mitigation and technology transfer. However, these types of targets are hardly enforceable, as the 0.7 GNP target for ODA contributions suggests. Automatic funding may be a potential alternative: German ICI is funded through auctions of CERs (10 percent of total CERs) and has earmarked an estimate of €120 million per year for adaptation and mitigation.

Fifth, multilateral institutions have been criticized because of their lack of transparency and donor-driven approach when setting up specific-purpose funds. For example, the PPCR and other related funds were set up to mobilize up to US$12 billion from the United States, United Kingdom and Japan to be administered by the World Bank. In contrast, the UNFCCC Adaptation Fund is severely under-funded. This situation describes a trade-off when donors allocate resources for international cooperation: more resources have been allocated through institutions whose governance rules allow them to exert more influence (Bretton Woods Project 2008). This trend may hinder progress on the Paris Declaration aid effectiveness agenda regarding the principles of partnership and mutual ownership (Muller and Winkler 2008). Environmentalists have also been skeptical of the role of MDBs promoting clean energy projects: Between its 2007 and 2008 fiscal years, the Bank increased oil, coal and gas lending by 94%, to over $3 billion, despite claims of being committed to renewable energy (Anderson *et al*, 2008). Moreover, Nakhooda (2008) shows that only a small percentage of MDBs projects include climate change criteria in their operation plans and calls for mainstreaming climate change adaptation in national strategies as well as in MDBs strategies.

Sixth, international cooperation should find a balance between duplication and competition in the supply of financial mechanisms. In general, there has been a proliferation of specific funds administered by bilateral agencies, which widely differs on purposes, amount mobilized, time horizon and mechanisms to channel resources to developing countries. Part of these resources will be channeled through the World Bank's Climate Investment Funds (CIF). The Bank will use the CIF to promote innovative approaches to mitigation and adaptation, including increasing climate resilience among the world's most vulnerable countries.[41] Nevertheless, the tendency of "bilateralization" of multilateral aid should be avoided by increasing synergies between the funds and integrating resources: funding for REDD, an emerging topic in climate change mitigation, could continue combining resources and approaches from different institutions (UN-REDD, Norwegian and Australian forestry funds, and the Amazon Fund).

[41] As of September 2008, developed countries (including Australia, France, Germany, Japan, The Netherlands, Sweden, Switzerland, the United Kingdom, and the United States) have pledged to contribute US$6.3 billion to the funds (Table 3).

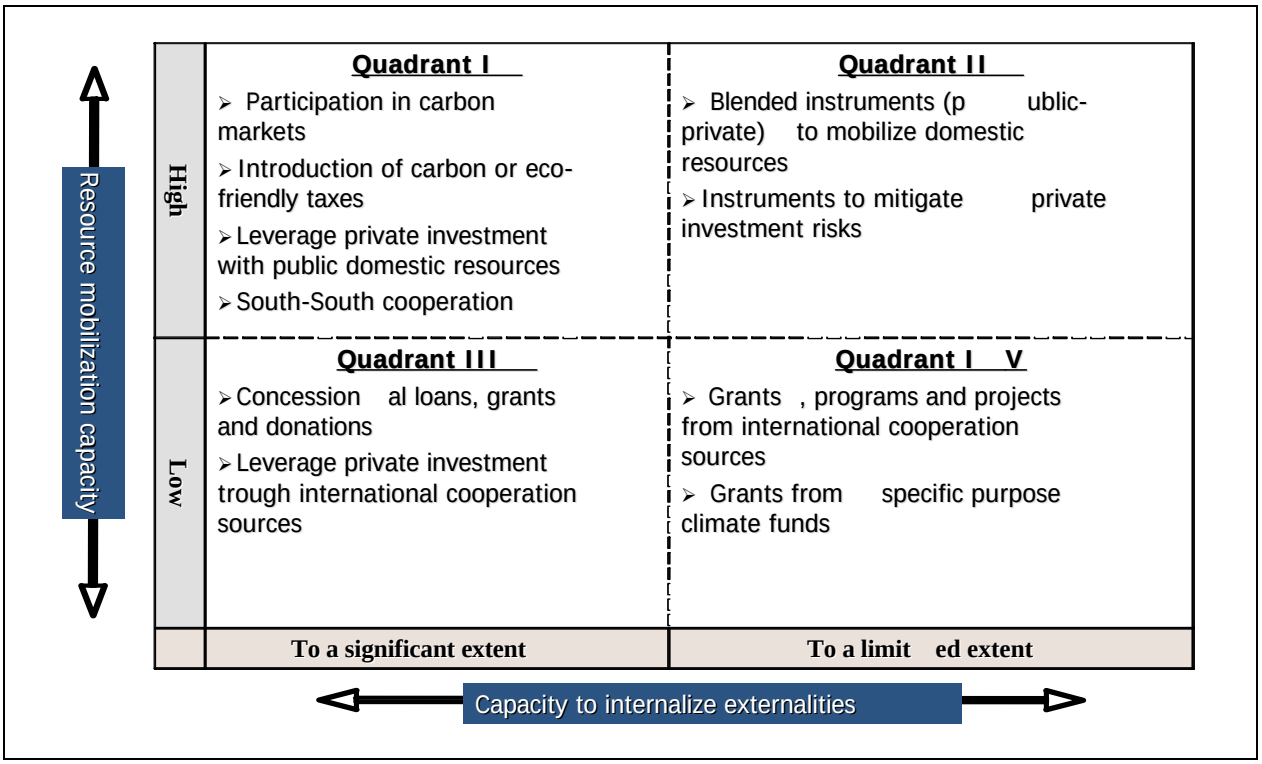
Seventh, exposure of MDBs portfolio to climate change is high, but measures to cope with this problem have been slow to implement. In a review of the vulnerability of the World Bank project portfolio (sampling projects from FY03 to FY06), it was estimated that 55% of the projects are sensitive to climate risks and roughly 25% are at significant risk (World Bank, 2006b). Levina (2007) suggests that more than 60 per cent of overall ODA could be relevant to adaptive capacity and adaptation and UNDP (2007) calculated that aid portfolio vulnerable to climate change is between 17 and 34 percent—this represents between US$16 and 32 billion. Without addressing this problem, additional funding may be compromised in the future to reduce this risk.

3.4. Integrating financial mechanisms and developing countries' capacity to mobilize internal and external resources

The previous sections have described available financial mechanisms to cope with the effect of climate change and finance their interventions, as well as their potentials and limitations. Figure 3 presents a map to identify which financial instruments are suitable to developing countries according to two criteria: (1) their capacity to mobilize external and internal resources; and (2) the extent that externalities can be internalized. Sagasti, Bezanson and Prada (2005) calculated a ranking of developing countries according to their capacity to mobilize external resources (for example, accumulation of international reserves, FDI and official inflows and trade) as well as domestic resources (for example, gross fixed capital formation, fiscal resources and internal savings).[42] On the other hand, the extent to which is possible to internalize externalities, as depicted in the previous section, will provide reference to decide which type of financial source is more appropriate to finance adaptation and mitigation activities.

[42] In general, emerging economies such as China, India, Brazil, Russia and Mexico ranked high in the list, whereas LCDs ranked lower. Therefore, there is a strong correlation between the size of the economy and their capacity to mobilize resources.

FIGURE 3. Financial mechanisms according to the capacity to internalize externalities and mobilize internal and external resources



The combination of both criteria allows classifying the array of financial instruments available into four groups. Developing countries in quadrant I and II are able to mobilize resources to finance climate change interventions—generally emerging economies as well as larger middle-income countries—, whereas countries in quadrants III and IV have only limited capacity to do the same—LDCs and smaller countries with less linkages to the global economy.

Developing countries with high capacity to mobilize resources can make use of financial instruments in quadrant I when it is possible to internalize externalities to a significant extent. These countries should eventually participate in carbon markets, not only implementing mitigation projects but also acquiring emission permits for their own mitigation objectives. These countries should be first in line to eliminate subsidies to fossil fuels and gradually introduce carbon and eco-friendly taxes. Regarding mobilization of private resources, these countries may introduce fiscal incentives to finance their transition to a low-carbon economy, as well as providing resources for research and development and cooperating with other developing countries through South-South cooperation schemes. When it is not possible to internalize externalities to a significant extent, instruments in quadrant II are more appropriate for these countries. Here, the challenge is how to provide incentives so that economic agents can redirect their investment and consumption to mainstream adaptation and mitigation. In this case, a combination of blended resources, where national governments utilizes domestic financial

resources to reduce the risk of private investment and attract more FDI with higher environmental standards.

When countries are not able to mobilize resources in the same magnitude, they can make use of the group of instruments in quadrant III and IV, which heavily rely on resources from international cooperation. When it is possible to reduce externalities (quadrant III), countries will rely on concessional funding, loans and grants to finance their climate change needs and, when possible, leverage private investment with risk mitigation instruments provided by international cooperation. When it is not possible, the use of grants to cover for adaptation costs can be the preferred group of financial instruments.

4. Concluding remarks

The report has reviewed the existing and proposed financial mechanisms available to developing countries to finance their mitigation and adaptation activities. The central idea of this report is provide a comprehensive vision on how it is possible to finance climate change activities by realizing the potential of markets, private sector and public domestic financing to mobilize resources to this aim. This implies moving beyond the debate over the use of international cooperation resources that is dividing developed countries, emerging economies and other developing countries. This is a great challenge in the current context: the financial crisis and economic recession is making all countries turning to public sources of financing, shifting development priorities and adding more pressure over scarce international resources.

Climate change is one of the most important challenges that the international community is facing. And it is costly too, not only in terms of potential future GDP losses from not reducing GHG emissions, but also in terms of facing the consequences and adapting to increasing global temperatures. Currently available resources, mainly from international cooperation and not fully developed global carbon markets, represent only a small proportion of what developing countries need. By framing the climate change financing challenge under a global public goods approach, the first strategy is ensuring that economic agents are able to internalize the externalities that their activities cause and contribute accordingly.

When this is not possible to a significant extent, developing countries still have access to several financial mechanisms such as their own financial resources, combination of fiscal incentives with national legislation and international cooperation flows. In this case, developing countries can utilize different combinations of financial instruments according to their capacity to mobilize resources.

ANNEX 1. **Additional investment and financial flows needed for mitigation in 2030, by sector**

Sector	Areas/mitigation measures considered	Global cost (2005 USD billion)	Proportion needed in developing countries (%)
Fossil fuel supply	▪ Lower production due to reduced demand and greater use of biofuels	–59	54
Power supply	▪ Lower fossil-fired generation capacity ▪ More renewables ▪ Carbon dioxide capture and storage ▪ Nuclear energy ▪ Hydropower	–7	49
Industry	▪ Greater energy efficiency ▪ Carbon dioxide capture and storage ▪ Reduced emissions of non-CO_2 gases	36	54
Buildings	▪ Greater energy efficiency	51	28
Transportation	▪ More fuel-efficient vehicles ▪ Greater use of biofuels	88	40
Waste	▪ Capture and use of methane from landfills and wastewater plants	1	64
Agriculture	▪ Reduced methane emissions from crops and livestock	35	37
Forestry	▪ Reduced deforestation and forest degradation ▪ Sustainable forest management	21	99
Technology research, development and deployment	▪ Double the amount that is currently spent in this area	35–45	

Total net additional investment	**200-210**	

Source: UNFCCC 2007a

ANNEX 2. Possible public finance mechanisms for financing mitigation technologies

Mechanism	Description	Barriers addressed	Market segment
Credit line (senior debt)	Debt facilities provided to commercial FIs for on-lending	Commercial FIs lack funds and have high interest rates	Large-scale RE and EE, wholesale loans for energy access markets
Credit line (mezzanine debt)	(Subordinated) Debt to (project sponsors through) commercial FIs, for on-lending, in combination with senior debt	Project sponsors lack equity, restrictive debt-to-equity ratios	Medium and small-scale RE projects
Guarantee	Shares project credit (i.e.loan) risks with commercial FIs	High perceived credit risk	Large-scale and grid-connected RE and EE and energy access markets
Project finance fund	Debt facilities by entities other than commercial FIs that provide direct project financing to clean energy projects	FIs lack experience with and capacity for clean energy project finance	Medium and small-scale EE and RE
Private equity fund	Equity investments in clean energy companies and/or clean energy projects	Lack of long-term capital, restrictive debt-to-equity ratios	Large-scale grid-connected RE, energy companies
Venture capital fund	Equity investments in technology companies	Lack of risk capital for new technology development	Any new technology
Contingent grants	Grants "loaned" without interest or repayment until projects are financially viable	Lack of sufficient capital during project development stage	Large-scale grid-connected RE perceived to be high risk
Carbon finance	Monetization of future cash flows from the advanced sale of carbon credits to finance project investment costs	Lack of early stage project development capital, lack of cash flow for additional security;	Large-scale and grid-connected RE and EE, programme of activities such as in energy access markets

		uncertain delivery of carbon credits	
Grants for technical assistance	Funds aimed at building the capacities of market actors involved in project development, financing and operations	Lack of investment-ready projects, lack of skills and knowledge among market actors	All segments in the supply side of the market, demand side, FIs

***Source*:** UNEP, A contribution to the update of the UNFCCC Technical Paper on Investment and Financial Flows to

Address Climate Change [Reproduced from UNFCCC (2008), pp. 74]

Abbreviations: EE = energy efficiency, FI = financial institution, RE = renewable energy.

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