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Climate Change Financing Requirements of Developing Countries*

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1. Introduction

This paper surveys the existing literature on the climate change financing requirements of developing countries in the two UNFCCC categories of mitigation and adaptation. The reported estimates are based on the current state of play in estimation exercises.

2. On the variety of estimates of global financing requirements for mitigation

Let us start with a brief discussion of estimates of total global financing requirements for mitigation. A plethora of assumptions and projections explain the great variety of global financing requirements.

Global studies of financing needs are classified as top-down estimates.

Formal modeling, including the application of so-called integrated assessment models, is critical in these exercises, with the notable exception of the McKinsey abatement curve approach.

It can be difficult to undertake a direct comparison of the results because of a variety of emission reduction targets.

Some well-known estimates, such as those of the World Bank, are syntheses of existing estimates.

Practically by design, formal modeling approaches generate minimum financing requirements. They are conservative of money. The financing needs they indicate should be interpreted as close to minimum requirements.

One pattern from these exercises is that financing requirements increase in the outer years because of the built-in model increases in the size of economy and its complexity, not to mention projected population size increases.

Table 1 summarizes some key examples of mitigation financing needs at the global level (including both developed and developing countries). This is not a comprehensive review of the studies but it reflects the key contrasts and approaches involved.

Table 1: Global Mitigation Financing Needs: Various Estimates

IEA (2010) "Blue Map" scenario		
up to 2030	$750 billion a year	
2030-2050	$1,600 billion a year	
Global Energy Assessment (2011)		
	$1,700-2,100 billion a year	
Edenhofer et al. (2009) "RECIPE"		
up to 2030	$480 – 600 billion a year	
in 2050	$1,200 billion a year	
McKinsey (2009) Pathways to a Low-Carbon Economy		
in 2020	$ 660	billion a year
in 2030	$1,000	billion a year

3. Mitigation needs of developing countries

The UNFCCC (2009) expert group on technology transfer indicated that at the global level an additional $300 to $1,000 billion[2] a year until 2030 in financing is required for technology development and diffusion, mainly to transform energy systems. Thus, research and development expenditures in the developing countries has been excluded in this estimate.

The expert committee indicated that the developing country share of the global additional financing need would range from $182 to 505 billion per year.

In its World Development Report in 2010, the World Bank (2010b) suggests that the incremental mitigation costs for developing countries would be $140 to $175 billion a year over the next 20 years in order to participate in meeting a global emissions target of 450 ppm. This World Bank estimate is based on a survey of existing studies.

The same report suggests that developing countries would have associated financing needs in order to meet the required level of investments, in the range of $265 to $565 billion a year (Table 2). Financing needs represent

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upfront costs for the installation of alternative energy sources, for example. Because many clean investments have high up-front capital costs, followed later by savings in operating costs, the incremental financing requirements tend to be higher than the lifetime investment costs reported in mitigation models, and the difference could be as much as a factor of three.

It is important to point out that there are two main areas in energy technological transformation from which the largest financing requirements in mitigation come from: (1) energy supply and (2) energy efficiency. The first area is that of transforming energy supply away from fossil fuels, including the required changes in infrastructure and electrical grids which these other energy sources require. For example, wind power provides intermittent electricity and the grids have to be modified to deliver a steady level of power to end-users. UNDESA (2011) estimates that the incremental (above business-as-usual) investment required for this transition is $1,000 billion a year.

The second critical part of a global strategy of mitigation will have to be obtained from improved energy efficiency of factory equipment, cars, appliances, heaters, and other modern conveniences. UNDESA (2011) estimates that $800 billion per year, globally, will be needed to finance research and deployment of new production methods and appliances. The policy effort will require providing predictable and facilitated access to new technologies for the developing countries.

The same study (UNDESA 2011) estimates that $1,800 billion per year, globally, beyond business-as-usual, will be needed to finance the required energy transformation. The study also indicates that of the global total, developing countries will require $1,100 billion a year to undertake the needed energy transformation, including $1,080 billion for energy supply and $20 billion for agriculture investment (Table 2).

Bottom-up mitigation financing estimates

India

India's Centre for Science and the Environment (CSE 2010) focused on the six most emissions-intensive sectors to determine India's low carbon growth options.

These sectors are power, steel, aluminum, cement, fertilizer, and paper.

The study consisted of detailed technical analyses and addressed the costing of options to change the production approaches of each sector.

The study indicates that after an easy start, later phases of low carbon growth paths are increasingly difficult and costs would thus increase through time.

For the most important sector, power generation, a low-carbon strategy could reduce emissions in India cumulatively by 3.4 gigatons (Gt) by 2030-31 (CSE 2010). The additional cost of generating power from renewable technologies in the low-carbon strategy over business-as-usual until 2030-31 is estimated at 8,470 billion rupees (US$203 billion) at 2010 constant prices, or about $10 billion a year (Table 3).

This means an average cost of 2,500 rupees, or $60 per tonne of CO2 emissions avoided. The cost is therefore many times the price of carbon credits traded on the European Climate Exchange either under the Clean Development Mechanism (CDM) or the European Union Emissions Trading Scheme. "This means that the CDM cannot pay for the transition to low carbon in the power sector in India, and a new international mechanism will be required to fund the transition" (CSE 2010,pp. 36-37).

While the UNFCCC (2009) suggests that a large majority of the emission reduction potential in developing countries can be realised at a cost of below $25 per tonne of carbon, the CSE (2010) obtains a cost of $60 per tonne for the Indian power sector, so payments through a carbon trading regime would not be able to finance the needed level of mitigation.

China

At the end of 2009, China announced that it would reduce CO_2 emissions per unit of GDP by 40 to 45 per cent by 2020 compared to 2005 levels.

The 2009/10 China Human Development Report (UNDP 2009/10) undertakes a scenario-based evaluation of China's low carbon development choices. Achieving substantial emissions reductions while sustaining economic growth will require significant rates of incremental investment.

The study used the PECE (Programme of Energy and Climate Economics) Technological Optimization Model, with 2005 as base year, and targets for 2020, 2030, and

Table 2: Developing Country Mitigation Financing Needs: Some Estimates

World Bank 2010b:		$140 to 175 billion a year
with associated financing costs:		$265 to 565 billion a year
UNDESA (2011):	energy supply	$1,080 billion a year (central estimates)
	agriculture	20 billion a year
	total mitigation	$1,100 billion a year

2050 and projections for the tapering off of the GDP growth rates.

PECE covers 388 technologies in energy intensive sectors.

Three scenarios were used –

- business as usual,
- the Emissions Control Scenario (3.2 billion tonnes lower in 2020, 5.1 billion tonnes in 2030, and 6.7 billion tonnes in 2050) and
- the Emissions Abatement Scenario (emission peak in 2030 and maximum possible reduction in 2050).

In the most ambitious "emissions abatement" scenario (maximum emission reduction by 2050 with peaking in 2030) $14.2 trillion will have to be invested between 2010 and 2050 or $355 billion per year (UNDP 2009/10, p. 62). In the less ambitious "emissions control" scenario, the annual investment required would still be at the level of $240 billion (Table 3). The need to scale up incremental investment through time, as the size and diversification of the economy grows, is an important issue in both scenarios.

4. Adaptation requirements of developing countries

Adaptation involves a wide range of sectors that are also interdependent with each other. Sector-by-sector estimation procedures are the norm.

Natural disasters do not discriminate between rich, poor, and very poor populations. In the simplest case, it is the impact on human populations of natural disasters that we care about and this impact is a function of the level of economic development (WESS 2011).

Using the language of the climate change convention, human vulnerability in the case of weather-induced natural disasters can therefore be seen as a consequence of inadequate adaptation (Parry *et al.* 2009).

UNFCCC (2007)'s sector-by-sector study of adaption costs suggested that global costs are in the order of $49-171 billion a year. Adaptation costs to developing countries were estimated to be in the order of $27 to $66 billion a year. This estimate has been found to be grossly underestimated (see below).

The World Bank's adaptation cost estimates indicate a range of $75 to 100 billion per year. Within the $102 billion annual adaptation cost based on a wetter weather scenario, the World Bank estimates that $29 billion are needed for East Asia and the Pacific, $23 billion for Latin America and the Caribbean, $19 billion for Sub-Saharan Africa, $17 billion for Europe and Central Asia, and $4 billion for the Middle East and North Africa.

A team of scientists (Parry *et al.* 2009), led by Martin Parry, the former IPCC co-chair of the working group on impacts, vulnerabilities, and adaptation, comprehensively evaluated available estimates for adaptation, including the UNFCCC secretariat study (UNFCCC 2007). (See Table 4 in the next page.)

The Parry *et al.* (2009) study finds that the UNFCCC seriously underestimated adaptation financing required because it left out several sectors (mining, manufacturing, energy, retail, finance, tourism) and under-stated the costs in the sectors it covered by two to three times.

In addition, Parry *et al.* (2009) found that the adaptation costs to protect/revive ecosystems worldwide, which were not included in the UNFCCC estimate, would cost $65-300 billion.

Parry *et al.* (2009) recognized the reality of damages from extreme natural events that adaptation investments cannot prevent – either because it is physically impossible or it is not economically feasible. For these kinds of cost damages, Parry *et al.* (2009) use the term "residual damage". Dlugolecki (2007, p. 11), in a study undertaken for

Table 3: Bottom-Up Mitigation Needs

As in macro-studies, pattern of increasing cost as economy grows

India (Centre for Science and Environment 2010)
6 key sectors: power, steel, aluminum, cement, fertilizer, and paper

$10 billion a year for power sector alone

China (Human Development Report 2009/10)

2010-2050: $ 240 – 355 billion a year depending on emission ambition

	Emission Control Scenario	Emission Abatement Scenario
in 2030	$ 269 billion a year	$269 billion a year
2050	$ 523 billion a year	$1,584 billion a year

UNFCCC, suggests that the annual economic losses due to weather-related damage were $200 billion in the period 2000-06 in a medium case scenario. He also estimates that the economic losses will increase to $955 billion in year 2030 (at 2006 values). He also cites another study that in 1987-2003, donor aid has covered less than 10 per cent of the financing of disaster losses in developing countries and that this was generally used for emergency relief and not reconstruction (Dlugolecki 2007, p. 14). If we conservatively take half of the annual $200 billion loss as that suffered by developing countries, then we can estimate an annual loss of $100 billion in the 2000-06 period. The losses would have increased from this level in the present post-2010 period, and thus $100 billion is an underestimate.

Estimate of the total adaptation requirements

Using the analytical ideas from Parry *et al.'s* (2009) analysis, and the Dlugolecki (2007) study, one could derive a range of reasonable estimates for annual adaptation financing needs for developing countries. Therefore, given the above, an estimate of the total adaptation costs could be derived from the following:

- Take the upper end of the UNFCCC 2007 range, and multiply it by two – the lower end of the two to three times underestimate factor suggested by Parry *et al* (2009) and recognizing that even the upper end of the range excludes adaptation costs for mining, manufacturing, energy, retail, finance, and tourism (Table 4).
- Parry *et al.* (2009) suggests that protecting ecosystem services worldwide would cost $65 to 300 billion. One could take one-half of the upper part of the range, as the cost applicable to developing countries.
- For the residual damage costs, our estimate as explained above is $100 billion annually.

Using this method, an estimate of developing country total adaptation costs would be around $380 billion a year, in round figures (Table 4). It should be noted that this estimate is on the conservative side and the actual costs are likely to be higher.

5. Conclusion

This survey of estimates of the costs of climate related actions in developing countries shows that a financing level of $100 billion a year by 2020 is an underestimation compared to what is required by developing countries.

The annual cost of mitigation (including associated financing costs) is estimated by the World Bank as $265-565 billion a year over the next 20 years (Table 2); while UNDESA estimates present mitigation requirements of $1,100 billion per year.

Regarding adaptation, the earlier estimates by the UNFCCC (2007) secretariat have been shown to be an underestimate by a later comprehensive study (Parry *et al.* 2009). If the economic losses from weather-related events are also taken into account (as "residual damage"), the adaptation financing requirements of developing countries can conservatively be estimated at $380 billion a year.

Therefore, total adaptation and mitigation financial requirements of developing countries could well add up to at least $1,000 billion a year at the present time. This does not include costs of preparing national communications, scientific development, data collection, building institutions to address climate change, education and training and other aspects of capacity building.

End note:

[2] UNFCCC (2007) had earlier suggested that $200-211 billion is needed globally in one year (2030) in order to reduce emissions worldwide by 31.7 Gt CO_2e (CO_2 equivalent). Developing countries would require $65 billion of this annual amount to reduce emissions by 21.7 Gt (or 68 per cent share of global emissions). In an updated estimate (UNFCCC 2009, p. 56) the original value is indicated to be an under-estimate, because the $200-210 billion covers only the initial capital cost of new physical assets and the use of known technologies. It does not factor in the costs of the development and use of new technologies, capacity building, and the creation of an enabling environment. The report also recognizes that the cost of additional investment needed in 2030 has gone up from the original report (for example the cost of reducing energy-related CO_2 emissions is 170 per cent higher in a 2008 report than in the 2007 report). However, UNFCCC (2009) does not provide a new estimate of overall mitigation costs.

Table 4: Estimates for Adaptation Costs in Developing Countries
(refer to text for assumptions and details)

Two times of upper end of UNFCCC (2007) study estimate	$132 billion a year
Half of upper end cost of protecting ecosystem services	$150 billion a year
Residual damage estimate	$100 billion a year
Total	$382 billion a year

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