Opportunities for GHG Mitigation in Latin America: Carbon Finance and the Clean Development Mechanism

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1. What is the Clean Development Mechanism?

The International Climate Change Framework

The establishment of the United Framework Convention on Climate Change (UNFCCC) in 1992 marked the first step toward institutionalizing international efforts to combat climate change. The UNFCCC agreement, signed and ratified by virtually every country present (including the United States), calls for industrialized countries (so-called Annex I countries[1]) to make a consolidated effort to reduce their greenhouse gas (GHG) emissions, while committing all signatories to create national GHG inventory reports, to be submitted to the UNFCCC.

It was soon found, however, that a more binding commitment would be required of Annex I countries in order to lower their emission levels. The Kyoto Protocol, which was signed at the third Conference of the Parties (COP) of the UNFCCC in 1997, established binding emissions targets for all Annex I countries. Overall, its aim is to reduce Annex I emissions by about 5% below 1990 levels. Non-Annex I countries (i.e. developing countries) have no emissions targets under the Kyoto Protocol. Following Russia's ratification of the Protocol in November 2004, it entered into force in February 2005.

The Clean Development Mechanism

One of the Kyoto Protocol's innovations is that it aims for better cost-effectiveness by giving Annex I countries the possibility to offset their own emissions by purchasing emission reductions from abroad, where marginal abatement costs are lower.[2] One of these so-called flexible mechanisms is the Clean Development Mechanism (CDM).[3]

Article 12 of the Kyoto Protocol defines the CDM as follows:

> "The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3."

Its purpose is therefore twofold: (a) to allow Annex I countries to reduce greenhouse gas (GHG) emissions more cost-effectively through the development of GHG mitigation projects abroad, and (b) to

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[1] Annex I countries include all EU-15 members, the United States, Canada, Australia, New Zealand, Japan as well as most so-called Economies in Transition (mainly Central and Eastern European nations).

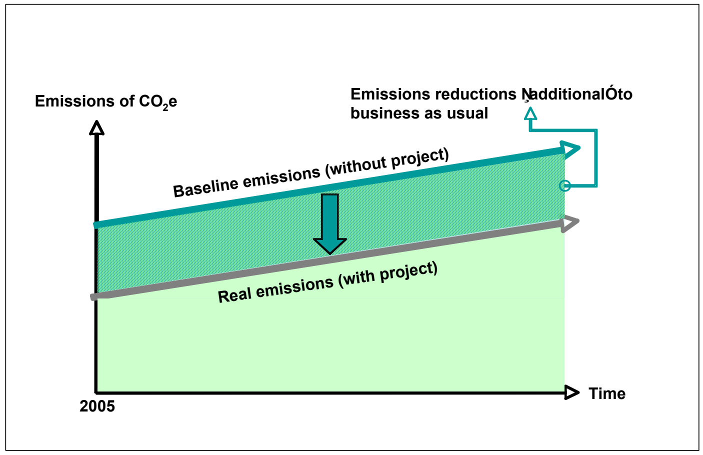
[2] In terms of their global warming impact, it does not matter where greenhouse gases are emitted, since they mix uniformly in the earth's atmosphere.

[3] *Emissions Trading* allows the exchange of Kyoto emission allowances (so-called Assigned Amount Units) between Annex-I countries between 2008 and 2012. Seller countries are generally Economies in Transition (such as Russia and Ukraine) whose current emission levels are lower than their 1990 targets, thereby giving them surplus allowances. *Joint Implementation* (JI) also allows the transfer of emission rights between Annex-I countries, but in contrast to emissions trading, these allowances can only be generated by emissions reductions from specific projects. JI is fundamentally identical to the CDM except that it does not involve non-Annex-I countries.

contribute to the sustainable development of non-Annex I countries through technology transfer and other know-how through these project activities.

With a few exceptions, all projects that reduce GHG emissions or sequester carbon are in principal eligible under the CDM. Once generated by a project activity, emission reductions are a virtual commodity that can be sold on the global market, as described in the following section. In order to quantify these emission reductions, the project design must include the projection of a ***baseline***, or business-as-usual scenario. The baseline is the reference scenario that estimates the emissions that would have taken place in the absence of the project activity. The emission reductions generated by the project are the difference between the baseline emissions and the actual project emissions. Figure 1 illustrates this concept.

Figure 1: The Project Baseline Concept



Another key requirement of CDM projects is that they must be ***additional***. This means that the project activity itself must be different from the baseline scenario, i.e. it would not have taken place under a business-as-usual scenario. This requirement is meant to prevent emission reductions being claimed for projects that would have happened anyway. Determining additionality in practice is not always an easy task, mainly because it is impossible to predict with 100% certainty whether or not a project might have occurred under business-as-usual circumstances in the near future. In general, however, additionality is understood as an indication that the project would not have taken place in its current form in the absence of revenues gained through the sale of emission reduction: either because carbon sales improved its financial viability, or because they helped to overcome barriers that previously hampered its development.[4] It is therefore important to think of the CDM as a determining factor for a project's feasibility, rather than an additional component that can be added on to existing activities at a later stage in order to improve their financial return.

The CDM Project Cycle

In order to transform emission reductions into a saleable commodity, a project developer must complete several steps included in the CDM project cycle. Figure 2 below provides a summary of this set of formalized procedures. One of the purposes of this sometimes rather complex process is to ensure that there is consistency across projects in the way that emission reductions are both estimated in advance and measured once the project activity has begun.

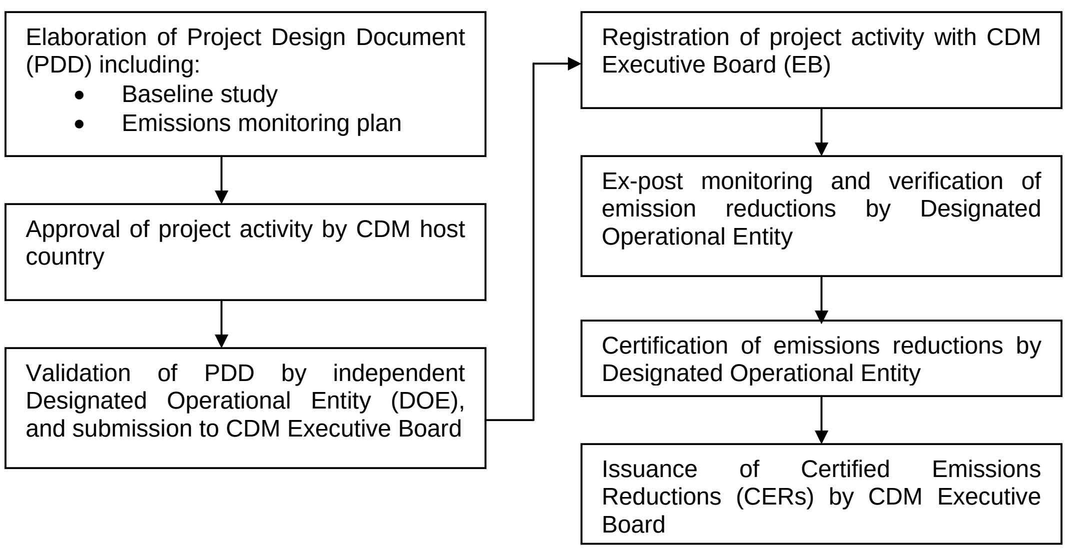
The key document at the center of a CDM project is the Project Design Document (PDD), which is based on a specific template. It includes a baseline study and a monitoring plan. Both these elements must be based on already approved methodologies from other projects. If no such methodology exists, the project developer must submit his own. Once the PDD is complete, it must gain the approval of the host

[4] In order to provide some guidance on how to determine additionality, the CDM Executive Board has issued a set of tools that can be applied on a project-by-project basis. Most projects recently submitted have made reference to these guidelines in addressing the additionality question. See: http://cdm.unfccc.int/EB/Meetings/016/eb16repan1.pdf

country's CDM contact point, usually referred to as the Designated National Authority (DNA). Each country's DNA has its own criteria for approving projects, among others whether the project contributes to sustainable development.[5]

During the PDD's validation, an independent third party performs a quality check on the document to determine whether it is in line with CDM procedures and make sure the correct baseline and monitoring methodologies have been applied. If the project is deemed eligible, it is then registered by the CDM Executive Board, the official UNFCCC body responsible for the administration of the CDM. Registration marks the official start of the project. The following steps involve the ex-post monitoring and verification of project emissions, again by an independent third party. The final step in the project cycle is the issuance of Certified Emission Reductions (CERs). CERs are the official "currency" of the CDM, and are eligible for meeting a country's Kyoto target.

Figure 2: Key Steps in the Clean Development Mechanism Project Cycle



[5] See Figueres (2004) for a detailed analysis of the state of Latin America's DNAs and their role in the CDM project cycle.

2. An Overview of the Global and Regional Carbon Market

The Global Carbon Market

The global carbon market has evolved rapidly over the last few years. A strong upsurge in emission reduction purchases was seen particularly during 2003 and 2004. In its annual report on the state of the carbon market (World Bank, 2004) the World Bank estimates that the total volume of project-based emission reduction trades grew from about 15 $MtCO_2e$ in 2001 to just under 80 $MtCO_2e$ in 2003.[6] By the middle of 2004 (when the report was released), the volume of trades had almost surpassed the level of 2003. In terms of market value, estimates point to a growth from about $100 million in 2003 to over $350 million in 2004 (Point Carbon, 2005). Trades are expected to at least double during 2005. So far, the market's total accumulated trades are estimated at about $1 billion.

The OECD (Ellis et al, 2004) currently estimates total cumulative CER supply to reach about 350 Mt CO_2e by 2012 (the end of the first Kyoto commitment period). Of these, about 90 Mt will be generated prior to 2008, and another 50 Mt annually during 2008-2012. As the report points out, this is more than triple the estimated size at the end of 2003 (when uncertainty regarding the market's development was greater). Haites (2004) estimates the potential annual CER supply at 50-90 Mt CO_2e by 2010, with annual CER demand ranging from 50 to up to 500 Mt CO_2e. As a comparison, the annual "Kyoto gap", i.e. the total annual emission reductions necessary for all Annex I countries (excluding the US and Australia) to reach Kyoto compliance is at around 800 Mt CO_2e. The CDM could therefore become an important compliance tool for many countries. The large range in numbers for total CER supply during the first commitment period is related to uncertainty concerning: (a) a future Kyoto commitment period, which will be necessary to ensure market continuity (discussed in more detail below), and (b) the rate at which CDM projects currently in the pipeline will be registered by the CDM board, as well as the possible discrepancy between ex-ante estimated emission reductions, and actual ex-post results.

Most recently, two events have helped to stimulate demand for emission reductions. The first is the entry into force of the Kyoto Protocol in February 2005 (referred to above), which gave investors (public and private entities alike) more certainty concerning their future emission constraints. The second important development was the inauguration of the EU Emissions Trading System (ETS) on 1 January 2005. The system covers over 12,000 installations in various industrial sectors, and accounts for about 45% of EU GHG emissions. A crucial factor for the global carbon market is the so-called Linking Directive, which permits the use of emission credits from CDM and JI projects within the trading system. As a result, many of the future buyers of such credits will be private entities located within the EU ETS.

Another strong indication for future growth of the market is also the rising number of carbon funds, both public and private, over the last few years. Currently at about 20 or so, their total investment is at around $1.5 billion. The World Bank, which pioneered this type of arrangement with the establishment of the Prototype Carbon Fund (PCF) in 1999, now manages several funds worth around $750 million, thus commanding a large part of the market share. Other examples include the Netherlands' government procurement programs, now being emulated by a number of other European companies. See Annex 3 for a list of current carbon funds.

[6] It should be noted that these are forward trades on a project-by-project basis, as no actual CERs have yet been issued at the time of writing. A spot market for CERs, which could become a reality during the first commitment period, would require a substantial number of CDM projects to be registered.

The Latin American CDM Project Pipeline

Latin America was an early and active player in the carbon finance business from its start in the mid-nineties. It played a major role in the CDM's precursor, the Activities Implemented Jointly (AIJ) pilot program, where its project portfolio was significant.[7] When the CDM became operational in 2003, six of the nine first project methodologies approved by the Executive Board were from Latin American projects. Since then, other regions have begun to catch up in terms of their share of total projects, in particular Asia (headed by India and China), but Latin America continues to be significant in the market.

The following charts offer a basic overview of the region's current CDM project pipeline. Project data was taken from CDM Watch[8], an NGO that tracks global CDM activity. The projects included below are in various stage of development (some have already been submitted for CDM registration, while others are still in a preliminary project design phase). All of them are sufficiently advanced, however, to have estimated potential emission reductions. It should also be noted that the numbers below are by no means definitive, as the pipeline is growing quickly.[9]

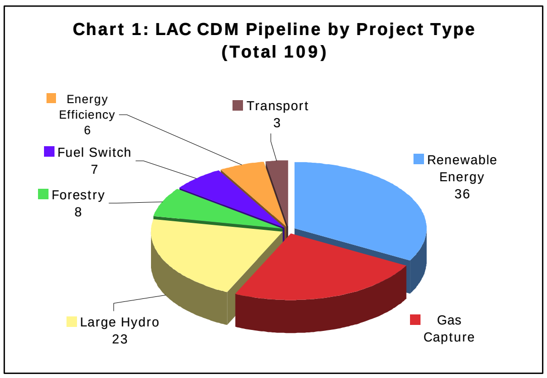


Chart 1: LAC CDM Pipeline by Project Type (Total 109)

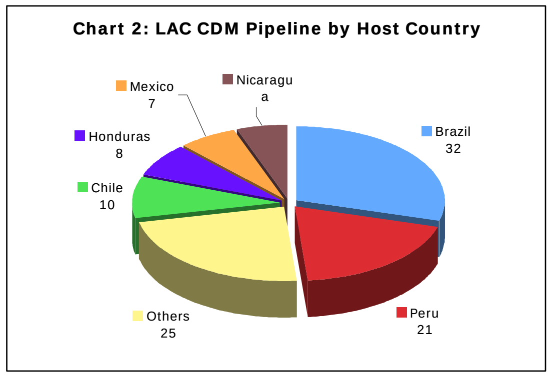


Chart 2: LAC CDM Pipeline by Host Country

Chart 1 illustrates the breakdown of the project pipeline by project type. Out of 109 identified projects, renewable energy, gas capture and hydro account for 85 projects, or about 78% of the total. The category renewable energy consists almost only of biomass projects (such as bagasse or risk husk based cogeneration) and small hydro (all hydro projects below a capacity of 10MW were included by CDM Watch under the renewable energy category). Only four out of the 36 renewable energy projects are wind energy. Gas capture projects fall into two categories: (a) methane recuperation and utilization from solid waste landfill sites (the majority of projects), and (b) biogas recovery from livestock (such as swing manure). Hydro includes all hydroelectric projects above 10MW capacity, and consists only of run-of-the-river projects, rather than dams.

For a number of reasons, energy efficiency and fuel switching projects have not yet been able to find a significant foothold in the CDM market. Partly this is due to technical difficulties in the project design involving additionality and baseline elaboration. Although the potential for forestry projects in Latin America is great, CDM modalities for this project type were only recently developed, previously making

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[7] The AIJ pilot program, which was started in 1995 and has since been terminated, was meant to give countries an opportunity to acquire experience in the area of carbon finance. Credits generated by AIJ projects are not eligible for the CDM market.

[8] See www.cdmwatch.org.

[9] As an illustration of the rapid growth in the LAC project pipeline: the number of CDM projects identified by CDM Watch in May 2004 was about 40, growing to 80 in December 2004. At the time of writing (April 2005) it had reached 109.

the prospects for forestry based CERs somewhat uncertain. Transport CDM projects are still extremely difficult to develop for a number of reasons (discussed below), explaining their limited role so far.

As far as host country participation is concerned, there are a handful of dominant countries in the region. First and foremost is Brazil, which took on an early role in project development. After Peru, a number of smaller countries such as Chile, Honduras and Nicaragua have also developed a growing project pipeline. Mexico's role is still somewhat limited, but there are indications that its pipeline is growing rapidly too.

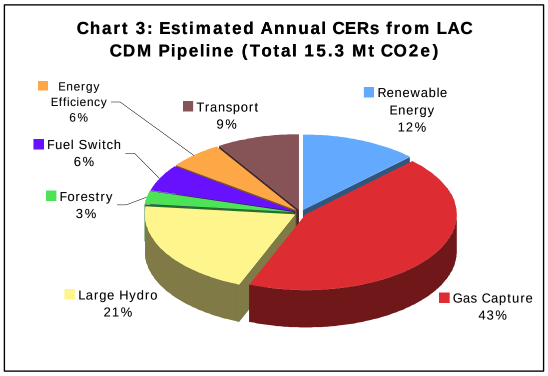

Chart 3: Estimated Annual CERs from LAC CDM Pipeline (Total 15.3 Mt CO2e)

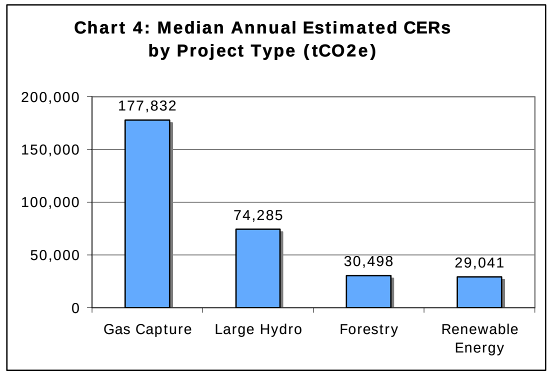

Chart 4: Median Annual Estimated CERs by Project Type (tCO2e)

When the project pipeline is analyzed in terms of annual estimated GHG reductions, the breakdown is somewhat different. Gas capture is by far the dominant project type, claiming about 43% of annual estimated emission reductions. The main reason for this is the high global warming potential of methane, which is 21 times more powerful than CO_2 in terms of its impact on the global climate. This is also confirmed by looking at the median[10] (or "typical") gas capture project, which claims just under 180,000 tCO_2e per year. As a comparison, renewable energy projects claim only an average of 29,000 t annually. The second most important project category in terms of emission reductions is hydro, accounting for about 21% of total annual CERs. As the graph shows, both renewable energy and forestry, areas for which the technical potential in Latin America is great, account for much smaller percentages (12% and 3% respectively). The role of transport projects may be somewhat overrepresented by Chart 3, as the outcome of the three projects in the pipeline is still uncertain (see below).

3. The CDM in Practice: Opportunities and Challenges

Opportunities

The Clean Development Mechanism and carbon finance in general is emerging as an important tool to improve the viability of many clean technology investments. It offers a number of important opportunities. Among these are the increase of a project's internal rate of return (IRR), and its impact on project risk and overall credibility.

The extent to which CER sales can boost a project's IRR depends very much on the project type. As noted above, methane and other more potent greenhouse gases usually offer the best possibilities. The table below presents some estimates made by the World Bank. It should be noted that $3 per tCO_2e is a relatively low price for today's market, making these numbers quite conservative. What is important,

[10] To show the emissions reductions claimed by a "typical" project of each category, the median rather than mean was chosen, because a handful of unusually large projects in some categories significantly inflated the average.

however, is that for some projects, like solid waste, CER revenue can have a significant impact, boosting IRR by up to 10% or more. At $4 per ton, IRR increases of up to 15% are possible (Bishop, 2004). At the upper end of the scale therefore, revenues generated by carbon finance alone can make a project financially feasible.

Table 1: Impact of Carbon Finance on Project IRR (at $3/tCO_2e$)

Technology	IRR increase
Hydro	0.8-2.6%
Wind	1.0-1.3%
Bagasse	0.4-3.6%
Energy Efficiency	~2.0%
Gas Flare Reduction	2.0-4.0%
Biomass	2.0-7.0%
Municipal Solid Waste	5.0-10.0%

Source: Prototype Carbon Fund, Pinnoi (2004)

This is not the case for most other project types, including renewable energy. Nevertheless, the additional income stream generated by CER sales can contribute significantly in some cases. The values estimated for energy projects depend very much on the baseline, i.e. the fuel that would be displaced at the margin. Again, the World Bank estimates that at $3 per tCO_2e, the IRR of renewable energy projects (including hydro) can be increased by between 0.8-2.6%. In terms of electricity generation, this comes out to about $2.00-3.40 per MWh delivered (Bishop, 2004). For biomass projects, IRR can be boosted by about 3-7%, still a significant increase. It should be emphasized, however, that these values can vary strongly from project to project, as well as region to region.

A second, and closely related opportunity offered by carbon finance is its impact on a project's lending conditions. In most CDM host countries, clean technology investments like renewable energy usually face significant difficulties in obtaining financing. Partly this is due to the nature of financial markets in many developing countries, but also because CDM projects sometimes tend to be capital intensive and are perceived as relatively risky by investors, especially if they involve less tested technologies. Carbon finance can help to address some of these issues. This is particularly important for renewable energy, where the IRR improvement alone offered by CER sales may not be enough to overcome prevailing barriers.

One benefit of carbon finance in this context is the mitigation of exchange rate risk. Carbon contracts are denominated in hard currency (dollars or euros) as the investor is per definition based in an Annex I country. Even a small income stream of hard currency over a period of ten or more years can have a strong impact on lowering the default risk based on currency fluctuations. A second important way to harness carbon finance is by using CER payments as a way to service debt. In the case of one Brazilian CDM project, the Prototype Carbon Fund structured the transaction in such a way as to match the loan amortization schedule with the expected CER payments (Bishop, 2004). Rabobank, the project lender, consequently extended its loan tenor from two to five years, in effect agreeing to lend against the carbon income stream. While this approach is still novel, it could become more common as investor awareness of carbon finance grows. In addition, for forestry and other projects where revenue is not collected for several years, CER payments, although not immediate, can make an important difference by defraying investment costs during the project's first few years when debt servicing is most expensive.

Thirdly, the institutional credibility of AAA rated investors like the World Bank or OECD country governments can have a significant impact on obtaining financial closure, even if it amounts to no more than psychological assurance of additional investors. One example is a PCF 30MW hydro project in Mexico. In addition to documenting other financial and technology barriers, a key argument made by the PCF in demonstrating additionality was that the involvement of the World Bank in carrying out environmental and socio-economic assessments was seen as an implicit endorsement of the project, bringing on board other financial institutions that had previously been uncertain about investing. In fact, as the Project Design Document states, several investors demanded evidence of the PCF's involvement before reaching financial closure.[11]

Challenges

Several of the challenges to applying carbon finance have already been alluded to in the above discussion. These challenges could be categorized under three headings: technical, financial, and market risk.

Technical challenges basically involve the UNFCCC requirements for methodology approval and project registration. Arguably, the extent to which these requirements pose a difficulty depends very much on the project type. Whereas landfill gas projects are largely and successfully established in terms of baseline elaboration, emissions verification and additionality, the same cannot be said for transport for example (as is discussed in more detail below). While in theory any activity that produces greenhouse gases is eligible for carbon finance, practically speaking, many project categories are extremely difficult to develop for methodological and measurement reasons.

Challenges involving financing are essentially the flip side of some of the benefits presented above: carbon finance's impact on both the IRR and overcoming financing barriers is still limited in many cases. The basic difficulty is that, as a rule, carbon finance cannot, with the exception of some gas capture projects, financially sustain a project on its own. At the same time, projects that are already above an accepted IRR threshold without CER sales tend to be viewed as non-additional (because it is likely they would have gone ahead even in the absence of carbon finance). In many cases, the challenge is therefore to select projects that require the additional revenue offered by carbon finance to become feasible, or at least to overcome existing barriers. But as was indicated by the figures above, the additional CER revenue can be relatively small in many cases. As a result, the applicability of the CDM from a financial point of view is often quite limited. In addition, there is still some reluctance on the part of many financial institutions to lend against carbon streams. Smaller investors do not have the clout of the World Bank, making leveraging more difficult. Lastly, CDM transaction costs are non-trivial, especially for small projects.

In terms of market risk, there are two challenges beyond the conventional risk factors (such as country or currency risk). The first is that a project's registration with the CDM Executive Board is never guaranteed. Without being registered, it is not eligible to generate CERs, and cannot therefore benefit from additional income. Although careful preparation can mitigate this risk, it nevertheless remains a factor. This uncertainty can be very frustrating for investors willing to put up money to cover project development costs. In many cases, CER purchasing contracts are structured so that project developers take on this so-called registration risk. For small entities, this can be a significant liability.

A second, and more long-term risk is the uncertainty about a second commitment period. Negotiations about a post-Kyoto framework start in earnest in 2005. Currently, it is still far from clear what this framework will look like and if it will build on Kyoto in any way. For CDM project developers, however, this means some uncertainty about demand for CERs post-2012. Currently, forward purchases of credits for after 2012 are worth very little on the market. This also means that the window for projects that can

[11] See the Project Design Document for more information:
http://www.dnv.com/certification/climatechange/Upload/PDD_El%20Gallo_2004-04-21.pdf

deliver credits within the first commitment period (2008-2012) is quickly closing. Given the time it takes for a project to move from its preparation phase to registration to actually generating credits, most projects that want to attract buyers will have to be in place by 2007 or 2008 at the latest.

4. Opportunities for CDM Projects in Latin America

As noted above, the LAC region has taken on a substantial role in the global carbon market, beginning with the AIJ pilot phase in the mid-nineties, and continuing with the growth of the CDM market today. Although current trends suggest that Asia will take the largest share in the years to come (particularly India and China)[12], the Latin American region will nevertheless continue to play an important role. Several countries' institutional capacities have already evolved to a very advanced level, and the growth of the CDM market has also spawned significant regional expertise in carbon finance, both in the public and private sector.

In theory, carbon finance can be applied to reduce greenhouse gas emissions from almost any source. From a technical point of view therefore the LAC region offers opportunities for CDM project development in almost all sectors that emit greenhouse gases or sequester carbon: energy, transport, forestry and waste management. In practice, however, the applicability of carbon finance is limited by a number of factors. These include the current level of carbon prices, relatively high transactions costs, methodological issues like baseline development, and questions about the additionality of certain activities. These constraints give certain project types an obvious edge over others, and have largely shaped the development of the current project pipeline. At the same time, some of these issues may diminish in importance as the CDM market continues to grow and mature. Higher carbon prices, for example, could expand market opportunities for project types currently not commercially viable. Similarly, increased experience with certain methodologies may make relatively complex projects (e.g. in the transport sector) more attractive in future.

At the moment, uncertainty surrounding the post-Kyoto debate makes it difficult to forecast how the market will develop over the coming years. Current demand has been almost exclusively for CERs eligible for the first commitment period (2008-2012). There is reason to believe, however, that regardless of the post-Kyoto climate framework, the CDM market will continue to exist, even if slightly changed in form or scope. In terms of evaluating the region's opportunities for CDM project development, this is crucial because it would mean that the window of opportunity for project development would be extended well beyond 2007-2008 (by which most projects will have to be in place in order to deliver credits for the first commitment period). This would have an effect not only on the quantity of projects and emissions reductions generated over the next few years, but possibly also on the relative shares of project types in the region's CDM portfolio. While it can be expected that gas capture will remain the most attractive activity, the LAC region also offers strong opportunities in two sectors that, for a number of reasons, have not yet managed to establish a foothold in the market: forestry and transport. In addition, it is possible that

[12] This trend derives in part from the carbon intensity and inefficiency of the energy systems in these countries, but it has been bolstered in particular by the development of a number of GHG-intensive projects involving gas capture and destruction. The destruction of HFC23, for example, is extremely profitable due to this gas' high global warming potential (it is 11,700 times more potent as a greenhouse gas than CO_2). Many of these projects are able to deliver extraordinarily large quantities of CERs at very low cost, which some commentators have suggested could lower the market price of CERs. Although it is clear that gas capture in Asia has a huge potential (including also N_2O and CH_4), it is not certain that all projects in the pipeline will deliver as many credits as anticipated. During the fall of 2004 the CDM Executive Board put two previously approved baseline methodologies for HFC23 projects on hold because of additionality issues.

renewables will manage to increase their market share as well, although this depends to on the level of carbon prices as well as on broader trends in the region's energy sector.

On a sector-by-sector basis, the following sections provide an overview and evaluation of some of the key issues that are most likely to shape the potential for project development in the years ahead. Although many factors that determine the success or failure of a particular activity are very project-specific, a number of issues can nevertheless be identified on a sectoral level. In general, the region's project potential is determined by practical considerations involving the details of CDM project development, and not just a purely technical or engineering potential in different sectors. In other words, while opportunities for greenhouse gas mitigation are abundant, carbon finance is inevitably limited to a subset of activities which are conditional on number of factors. In spite of these limitations, however, the CDM should continue to provide an important impetus for the region's efforts to support climate change mitigation.

4.1 Renewable Energy and Hydro[13]

Experience to Date

Experience with energy sector projects, and in particular renewables has been relatively mixed up to now. On the one hand (as shown in Chart 1), the current LAC pipeline reveals a strong interest in renewable energy projects. A total of 36 projects were identified, and this number will undoubtedly continue to grow. In global terms, the LAC pipeline is also relatively significant, making up about one third of total renewable energy projects identified by CDM Watch.[14] This interest is also consistent with the more general technical potential for renewable energy in Latin America. As noted above, most of the renewable energy projects identified in the pipeline are biomass (mainly bagasse) and small hydro under 10MW capacity. Only four out of 36 projects were involved wind based energy.

On the other hand, two factors seem to somewhat mitigate the success of this project type up to now. The first is that although the number of renewables projects is relatively large, their share in terms of estimated emissions reductions is rather limited (12%). Chart 4 indicates that at about 29,000 tCO_2e /year, the median project size for renewables is only a fraction of gas capture, and even hydro. As will be seen further on, projects of this small size also face difficulties in terms of recuperating upfront transaction costs. Secondly, the number of methodologies for renewables approved by the CDM Executive Board so far has been small. This is not necessarily an indication of failure, but it suggests that the complexity of methodological issues could remain a barrier for some projects. As is discussed in more detail below, baseline issues in particular can be challenging for energy projects. At the same time, increased experience and the availability of previously approved methodologies should serve to facilitate the approval process.[15]

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[13] In the context of the CDM, many methodological and eligibility issues apply to hydro and smaller renewables alike, which is the reason they have been included in the same section. Although most hydro projects tend to be larger in scale than other technologies such as wind or biomass, the current CDM Watch pipeline includes only a few projects that are larger than 50MW. Hydro projects under 10MW capacity are included under renewables in the project portfolio, while those above 10MW are listed under hydro.

[14] Worldwide, India hosts the highest number of renewable energy projects.

[15] Currently, approved methodology AM0005 (*Small grid-connected zero-emissions renewable electricity generation*) and AM0019 (*Renewable energy project activities replacing part of the electricity production of one single fossil-fuel-fired power plant that stands alone or supplies electricity to a grid, excluding biomass projects*) are relevant for renewable energy projects. The CDM Methodology Panel has also put together a "consolidated" methodology (*Consolidated methodology for grid-connected electricity generation from renewable sources*) based on a number of approved projects.
See: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

Larger Hydro (above 10MW) has certainly been more dominant in terms of estimated emissions reductions than renewables. A total of 23 identified projects are estimated to generate about 21% of total emissions reductions. As will be seen below, in many ways large hydro projects face the same difficulties as renewables, but are more profitable as CDM projects because of the larger volume of CERs produced. Compared to gas capture projects, however, they are not easy to develop. In particular large upfront costs and the additionality question could cause a number of projects in the pipeline to stall later on the in project cycle. In the global CDM market, hydro projects are currently almost exclusively from Latin America, indicating an especially strong potential in the region.

Project Eligibility and Methodological Issues

Additionality

As suggested previously, one of the main difficulties faced by project developers is to demonstrate that the project activity is additional – that is, it would most likely not have taken place in its current form without the benefit of carbon finance. At the very least, it must be demonstrated that CER revenues have helped to overcome existing barriers that would probably have prevented the project from being implemented under business-as-usual circumstances. For many energy projects, but particularly hydro, the additionality test has been a difficult barrier.

A few examples taken from projects already submitted to the CDM Executive Board serve to illustrate this point. One important aspect of demonstrating additionality is timing. It is a common misconception that carbon finance can be incorporated into a project shortly before it is about to go into operation. As a general rule, once a project's underlying finance is settled, it is probably already too late to consider the CDM. The reason is that for large investments like hydro and also some renewables, it is not credible to argue that carbon finance played a significant role if there is no evidence it was taken into consideration until the project was about to go into operation. An instructive example is the El Canada hydro project (43MW) located in Guatemala.[16] It was submitted to the CDM Executive Board during its first round of projects in the spring of 2003. One of the reasons it was rejected was insufficient demonstration of additionality. Most importantly, construction on the project had already begun in 2002, about a year before project submission. Secondly, a 10-year purchasing agreement for electricity sales to the grid had also been agreed. In terms of additionality, these two factors made it very difficult to argue that the project would not have gone ahead anyway (indeed, it had already started).[17]

Another examples relates to the project's financial attractiveness.[18] In the absence of barriers that could have prevented a project's implementation, a financially competitive investment may be considered non-additional. For many renewables, this may not be an issue, if alternative energy sources like natural gas are feasible alternatives that are less costly per unit of electricity generated. For hydro, however, it is sometimes difficult to demonstrate that other and cheaper alternatives for power generation exist. In the case of the Peñas Blancas hydro project in Costa Rica (35.4MW),[19] submitted to the CDM Executive

[16] For Project Design Document, see:
http://cdm.unfccc.int/methodologies/PAmethodologies/publicview.html?OpenRound=1&OpenNM=NM0006&cases=C#NM0006

[17] It is possible, in some situation, for a project to have entered the construction phase and still be eligible for CDM registration. However, in this case there must be evidence (e-mail correspondence, project identification reports, etc.) that the CDM was taken into consideration from the beginning.

[18] The additionality tools issued by the CDM Executive Board require an investment analysis, in the form of a simple cost analysis, an investment comparison analysis, or a benchmark analysis, and must demonstrate that other project alternatives are financially more attractive.

[19] See:
http://cdm.unfccc.int/methodologies/PAmethodologies/publicview.html?OpenRound=1&OpenNM=NM0008&cases=C#NM0008

Board in 2003, one of the reasons why the additionality argument was not accepted was that its project document stated the power plant would be able to supply electricity at a competitive rate (although there were other important factors as well). In other words, if the project was already competitive, there was no reason it would not have gone ahead in the absence of carbon finance.

In some cases, however, a financially competitive project may still be additional if there are existing barriers that carbon finance helps to overcome. A good example of where this was successfully shown is the PCF's El Gallo hydro project (30MW) in Mexico.[20] The project demonstrated that a number of barriers, including both investment and technological, existed that made this particular project very difficult to carry out. Finally, it was shown how the impact of carbon finance helped to alleviate these barriers and make the project feasible.

Common practice is another important aspect of additionality that can be applied in an energy project context. If there is evidence a project is very uncommon, or even the first of its kind in a particular area, the argument that barriers currently prevent project implementation is bolstered. This demonstration may favor projects such as wind, which are not yet very widespread in the LAC region. Hydro, however, is obviously much more common, and even a dominant power source in many regions. The existence of many similar project types in a particular region may therefore make the additionality requirement more difficult to pass.

Baselines and Estimated Emissions Reductions

For many energy projects, the elaboration of a baseline can be a relatively complex exercise. This is because estimated emission reductions are based on calculating how much power from other sources will be displaced (or substituted for) when electricity from the project activity is sold to the grid. Particularly in countries where data availability is very low, these estimates can be quite challenging.

Two key concepts are generally applied to estimate how much power in the grid is being displaced by the project activity: *operating margin* and *build margin* (OECD, 2002). It has long been argued that the impact of a project activity can be better calculated by analyzing its effect on the margin, rather than the average, i.e. the overall fuel mix of the power sector. Both the operating and build margin are based on this approach. The operating margin tries to measure the effect that a project activity has on the operation, i.e. the electricity produced by other grid-connected power plants. The build margin, on the other hand, takes into account to what extent the project activity may have delayed investment in a new electricity source (e.g., because of a new hydro plant, a coal plant will either not be built [cancellation effect], or its construction will be delayed by a certain time period [delay effect]).

Applied on their own, both approaches have serious limitations, however. That is why most baselines use a combination of both operation and build margin (*combined margin*).[21] One reason is that where a delay effect exists, it may take several years before manifesting itself because of long lead times in construction and the inertia of investment decisions. In this case, the operating margin may be a better approach in the project's first years, while the build margin might be more suitable later on. Another reason is that the combined margin leaves more room for error, serving as a more standardized approach.

Project Financing and Cost

Project Profitability

As discussed previously, carbon finance has only a limited effect on the profitability of both renewable energy and hydro projects. On its own, the sale of CERs is generally not enough to meet investment

[20] See: http://cdm.unfccc.int/methodologies/PAmethodologies/process?cases=A&OpenNM=NM0023

[21] Consolidated methodology AM0005 and AM0019 both use a combined margin approach.

expectations in developing countries. At the same time, however, there are some important differences between various technologies in this respect. Table 1 above indicates that at $3 per ton CO_2e, the range of IRR improvements among renewable energy technologies is relatively large. At 1.0-1.3%, wind is the least profitable. Hydro, due to its size advantage, performs better, with up to 2.6% additional IRR. In the Latin American context, however, bagasse (0.4-3.6%) and biomass in general (2-7%) are of particular interest.

As was seen in the analysis of the present renewables portfolio, biomass, although more or less equal in number to wind and small hydro, was responsible for over half of estimated emissions reductions by renewables. It is likely that its advantage over other technologies in terms of profitability is related on the one hand to size (although this does not apply to hydro), and on the other hand to the GHG-intensity of the fuels replaced, or fuel savings generated. In this respect, biomass combustion is often more advantageous than hydro, which relies only on grid displaced power for carbon savings. In general, it can be assumed that higher CER prices already seen in today's market will help to increase the numbers presented in Table 1, which could be especially important for wind, and some small hydro, whose investment impact remain somewhat marginal.

Transaction Costs

In view of the rather lengthy and somewhat complex CDM project cycle, as well as the need for baseline and monitoring methodologies, it is not surprising that transaction costs can be significant. Two general observations are worth making in this context. First, and not surprisingly, transactions costs are relatively higher for small projects. Second, we can reasonably expect these costs to diminish over time, due to: increased project experience; an increase in the number of approved baseline and monitoring methodologies that will future projects easier and less costly to develop; and hopefully a growth in the number of private sector entities providing project development services, increasing competition.

Because of their relatively smaller size, many renewable energy projects are particularly affected by high transactions costs. Michaelowa et al (2004) estimate that for projects delivering over 200,000 tCO_2e annually (or over 2Mt over ten years), transaction costs are very low, or almost negligible, at around €0.1 per tCO_2e. Between 20,000 and 200,000 tCO_2e per year, they rise to about €1 per ton, representing a substantial portion of the CER sales price (which is currently likely to be between €4-5 per ton). Smaller projects delivering less than 20,000 tCO_2e per year are no longer profitable, with estimated transactions costs of up to €10 per ton.

In terms of the project cycle, the World Bank (Eguren, 2004) estimates that an average project costs about $200,000 to develop. Of this, just under $100,000 are counted as costs related to project identification, design, and methodology elaboration. Again, it can be assumed that more complex activities will be more expensive in this respect as well. Private sector consultants, however, can be expected to provide the same services for significantly less. One company (Eguren, 2004) estimates its total costs at around $90,000 per project. Part of the discrepancy is a result of the high project evaluation costs run up by the World Bank. At the same time, the World Bank's carbon funds have other benefits, such as higher leverage on capital markets and strong credibility that cannot easily be valued in monetary terms.

Small-Scale Projects

In view of some of the above-discussed barriers for renewable energy, and indeed many CDM projects in general, the UNFCCC elaborated special modalities and procedures for small-scale activities. The main purpose of this was to reduce transactions costs, and encourage the development of smaller, and in many cases more developmentally beneficial CDM projects. Small-scale projects fall under the following three categories:

(i) Renewable energy project activities with a maximum output capacity equivalent of up to 15 megawatts (or an appropriate equivalent);
(ii) Energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, by up to the equivalent of 15 gigawatt hours per year;
(iii) Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotons of carbon dioxide equivalent annually.

One of the main benefits of small-scale projects is that they can make use of a number of already existing and simplified baseline and monitoring methodologies that have been developed by the CDM. Less stringent data requirements and less complex methodologies mean that project development costs are significantly reduced. In addition, the registration fee for these projects is lower too ($5,000 for projects with annual emission reductions of 15 Kt or lower). In order to be more efficient, several projects can also be "bundled" and submitted as one project activity.

In terms of transaction costs, these measures seem to have an effect. The World Bank (Haites, 2004) estimates project development costs of about $100,000, which would be less than half of regular CDM projects. Another estimate (Coto and Gouvello, in Euguren 2004) arrives at numbers between $23,000 and $78,000. However, the general estimates from Michaelowa et al (2004) still seem to remain true: projects delivering less than 20,000 or at the very least 10,000 tCO_2e annually will probably still be unprofitable. At the same time, it must be said that some buyers are willing to pay higher prices for projects with particularly good environmental co-benefits.[22]

4.2 Transport

Experience to Date

In Latin America, the transport sector currently accounts for about one third of total GHG emissions. It is also the fastest growing sector. Within the transport sector the primary source of emissions (over 80%) is road transportation. The strong upward trend in emissions, which is projected to continue, is largely due to the growth of the private vehicle fleet and increased vehicle use. This relationship between vehicle use and economic growth is well documented in Latin America as well as other regions. Fuel efficiency improvements, although not insignificant, are unlikely to make a strong dent in the future emissions curve.

It would seem, therefore, that the transport sector (and in particular urban transport), offers strong possibilities for greenhouse gas mitigation projects. Up until very recently, however, the only practical experience in this area had been in the context of the Global Environment Facility (GEF), which has been funding urban transport projects for a number of years (with mixed success). CDM projects have only developed over the last year or so, and are still very few in number, both in LAC and other regions. Nevertheless, interest and activity is growing. Significant challenges to developing transport projects under the CDM remain, however, particularly in view of the methodological issues (baselines, emissions monitoring, and additionality) involved.

Possible Project Types

The transportation sector, and in particular urban transport, provides a multitude of opportunities for greenhouse gas mitigation. In theory, any activity that reduces fuel consumption (which is the underlying source of greenhouse gas emissions) of vehicles could be eligible for carbon finance. Latin America has

[22] For example, some small-scale renewable energy projects being developed by the Finnish government are being paid up to €6.30 per ton (Haites, 2004).

some experience concerning urban transportation improvements (notably in Curitiba, Brazil and Bogotá, Colombia). The challenge, as suggested above, is to design a project that will be compatible and feasible within the CDM framework.

Salon (2001) notes five factors for reducing greenhouse gas emissions in the transport sector:

- Vehicle efficiency
- Greenhouse gas intensity of the fuel used
- Level of transport activity (i.e. distance traveled)
- Mode of transport chosen
- Level of capacity used (load factor)

Many projects aim to address more than one factor. Indeed, of the CDM projects currently identified in LAC, two in particular (Transantiago in Santiago de Chile, and TransMilenio in Bogota, Colombia) include all five factors at least to some extent.

The following table (Johnson, 2003) provides a useful summary of GHG emissions from different transport modes. Note that modal shift from private to public transport, although difficult to achieve, carries the most potential in terms of GHG emissions reductions.

Table 2: Average GHG emissions by transport mode

Mode	CO2-equivalent emissions (grams/ vehicle–km)	Maximum capacity (passengers)	Average capacity (passengers)	CO2-equivalent emissions (grams/ passenger–km)
Pedestrian	0	1	1	0
Bicycle	0	2	1.1	0
Gasoline motor scooter (2-stroke)	118	2	1.2	98
Gasoline motor scooter (4-stroke)	70	2	1.2	64
Gasoline car	293	5	1.2	244
Gasoline taxi car	293	5	0.5	586
Diesel car	172	1.2	1.2	143
Diesel minibus	750	20	15	50
Diesel bus	963	80	65	15
Compressed natural gas bus	1,050	80	65	16
Diesel articulated bus	1,000	160	130	7

Project Eligibility and Methodological Issues

Additionality

Many of the issues relating to additionality discussed above apply likewise to transportation projects. Generally speaking, it is not enough to show that the project activity reduces emissions below the baseline. There must be some evidence that carbon finance played a role in making the project possible in its current form. As with other large projects, for example hydro, this can be very difficult. The three transport projects identified in LAC at the time of writing all involve tremendous cost and planning, partly because of infrastructure investments, and partly because they envisage the re-organization of an entire urban transportation network.

In the case of the Transmilenio project in Bogotá, Colombia for example, submitted to the CDM Executive Board in the summer of 2004, additionality was one of the main reasons for non-approval.[23] The project developers failed to show that the second phase of Transmilenio (of which the construction had already begun), for which they were claiming emissions credits, was in any way dependent on CER revenues. The project included the addition of articulated buses, bus lanes, as well as feeder routes, improving the overall efficiency of the system. Both the institutional and financial inertia behind a program of that scale (which took years to prepare), as well as the small financial impact of CER sales (see section below), made the additionality argument unconvincing. A similar project type is currently in the pipeline (Transantiago in Santiago de Chile). In its case, the project developers argue that the CDM was taken into account from the beginning, and will significantly help to overcome current barriers to implementation. It remains to be seen how the CDM Executive Board reacts to this argument.

Baselines and Monitoring

The literature on baselines for CDM projects is surprisingly sparse. In addition, there have been no official guidance documents issued by the UNFCCC or the CDM Executive Board on this sector (as oppose to forestry, for example). Project developers currently have little to go on, therefore, and it is likely that several methodologies proposed in the near future will have difficulties in being approved. Indeed, in the case of TransMilenio, it was not only the additionality question that led to its rejection, but also several measurement issues as well as the baseline elaboration.

Salon (2001) identifies two types of baselines that could be applied to the transport sector: subsectoral and regional. Subsector baselines are more specific and limit themselves to projecting trends such as emissions-per-km-traveled. Projects that affect only a specific indicator (such as vehicle fuel efficiency) can use subsector baselines. For example, a project consisting of upgrading a bus fleet to a newer and more efficient model, the baseline would consist of projecting the average emissions-per-km-traveled in a business-as-usual scenario. Where more than one indicator is impacted, regional baselines would be more adequate. As Salon notes, regional baselines represent a more holistic approach and try to estimate emissions from an entire city or region, partly based on indicators that are not necessarily linked to the project activity, such as population growth or income. A regional baseline may be necessary where a project includes a package of measures that may have complex interaction and spillover effects. This would certainly be the case for TransMilenio or Transantiago. For example, where mode shift is targeted by a project activity, the baseline must project driving behavior under a business-as-usual scenario over a number of years within a given geographic area.

As in the power sector, there is a clear tradeoff between accuracy and transactions costs. In addition, much of the data required for regional baselines may simply not be available or very difficult to come by, particularly in developing countries. Where projects seek to change the urban transport system of an entire city, establishing a credible baseline will be a challenging exercise.

Project Financing and Cost

Given the limited experience with transport CDM projects so far, there is little information concerning the financial impact of carbon finance in this sector. In addition, the range of project possibilities is much

[23] See:
http://cdm.unfccc.int/methodologies/PAmethodologies/process?OpenRound=6&OpenNM=NM0052&cases=C#NM0052

larger than in other areas, so that the contribution made by CER sales to a project's IRR will be very specific to the type of activity involved.

In a study that assesses the potential of GHG reductions for increased systemic efficiency as well as technology upgrades for buses in Santiago de Chile, O'Ryan (2004) makes the following conclusions: in terms of GHG reductions, a re-organization of the current public transport system, including the construction of BRT and feeder routes, as well as the consolidation of existing private minibus operators, has a relatively strong potential. Greater efficiency as well as some degree of mode shift could reduce emissions by an estimated 450,000 tCO_2 annually. However, in terms of costs per tCO_2e, the project is relatively expensive. At a total projected capital cost of about $300 million (partly offsest by fuel savings of $16 million), the estimated incremental cost of GHG reductions would be above $30 per ton (Morgenstern, 2004). At a price of $5 per ton, the contribution of CER sales to the project profitability are relatively limited, at about 0.5-1% additional IRR.

In Lima, a project that also involves the re-organization of the city's public bus system, annual GHG savings are estimated at about 200,000 tCO_2.[24] The project, which is jointly financed by the IDB and the World Bank, is likely to be submitted to the CDM. At total project costs of around $214 million, CER sales would be able to contribute between $0.8-1 million annually (at carbon prices of $4-5 per ton). Again, in terms of total project costs, the CDM's impact appears to be rather limited. In addition, transactions costs, which would include not only the initial pre-feasibility and baseline studies, but also annual monitoring of emissions from multiple sources, are likely to be significant.

It should be emphasized, however, that experience with transport under the CDM has not been sufficient to produce a solid range of numbers concerning project profitability. In addition, the large number of possible project types all falling under the category of transport makes general estimates difficult.

4.3 Forestry

Experience to Date

Like transport, forestry projects have not yet established a significant foothold in the CDM pipeline. Although a relatively large number of pilot projects were developed during the pre-CDM Activities Implemented Jointly phase (particularly in Latin America) their number today is still very limited. The main reason for this is that UNFCCC guidance on the modalities and procedures for forestry projects was relatively late in coming (at the COP 9 in December 2003, two years after the COP 7 Marrakech Accords decided the overall CDM procedures). This delay is partly due to the fact that forestry projects (as is discussed below) are different from energy or gas capture CDM activities in several ways, justifying a separate set of specific guidelines. Another factor was that many parties to the UNFCCC, responding in part to severe criticism by some NGOs, expressed only very hesitant support for this project type.

Today, however, interest in forestry projects is growing, and it is already clear that Latin America will command an important share of the future project pipeline. Currently, the most important actor in this field is the Bio Carbon Fund, managed by the World Bank. Capitalized at about $50 million, its purpose is to catalyze the market for sequestration projects by building up a portfolio. Its investors are a mix of private and government entities. Among its initial project portfolio, projects from Latin America feature very strongly.

[24] See: http://www.fonamperu.org/General/mdl/documentos/13.-Mass-Transp-FICHA-ENERG.pdf

Carbon Sequestration Potential in LAC

The small number of CDM forestry projects developed so far is in no way a reflection of the technical potential for carbon sequestration in the LAC region. On the contrary, the opportunities for biological carbon uptake are significant. Benitez et al (2003) provide a summary of literature estimates for the total landmass available for reforestation in LAC: the numbers range from about 17-40 million hectares. It should be noted that these estimates already take into account market and institutional constraints, and primarily include degraded lands where agricultural productivity is already very low. The potential for forest regeneration (not eligible for carbon credits as discussed below) is most likely well above 100 million ha. Not surprisingly, Brazil offers the largest reforestation potential, followed by Argentina and Mexico.

In terms of total carbon uptake, the range of estimates is very large, based on a number of ecological factors such as soil quality, precipitation, and temperature. Land and forest management also plays a significant role, including tree species selection, rotation intervals, and plantation density. In general, estimates range between 50-200tC/ha, the equivalent of 180-730 tCO_2/ha.[25] Even a relatively conservative estimate (assuming a sequestration potential of 100tC/ha over a surface of 20 million hectares) would still yield a cumulative carbon uptake of about 7,300 $MtCO_2$ over the next few decades. On a more short-term horizon, Benitez et al (2005) estimate that at a price of $20/tC (the equivalent of about $5.5/$tCO_2$e – corresponding to today's CDM prices) the cumulative carbon sequestration by 2012 and 2020 is about 460 $MtCO_2$e and 1,235 $MtCO_2$e respectively.

The Current UNFCCC Framework

As mentioned above, one of the key constraints to project development so far was the absence of official UNFCCC guidelines for A/R projects under the CDM. As one of the last outstanding questions from the Kyoto Protocol, it was finally addressed at COP 9 in December 2003. The following section briefly outlines the most important results of the COP 9 decision.[26]

Eligible Project Types

As was decided at the COP 7 in 2001, the eligibility of sinks projects is limited to afforestation and reforestation (A/R) activities.[27] This excludes several other modalities previously under consideration, such as natural revegetation, forest management, cropland management, grazing land management and avoided deforestation (the last of which was resisted with particular fierceness by many NGOs).[28]

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[25] These numbers are estimates of total, rather than annual carbon uptake per ha. That is, they represent the potential amount of carbon sequestered by a hectare of forest over the average time period it takes for the tree species to reach maturity.

[26] The relevant document (*Decision CP.9: Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol*) can be downloaded at: http://unfccc.int/resource/docs/2003/sbsta/l27.pdf.

[27] "Afforestation" is defined as the direct human-induced conversion of land that has not been forested for a period of at least 50 years.

"Reforestation" is defined as the direct human-induced conversion of previously forested, but now non-forested, to forested land. Only areas that did not contain forest on 31 December 1989 are eligible for reforestation.

[28] The controversy surrounding these activities is related to Articles 3.3 and 3.4 of the Kyoto Protocol. Article 3.4, as elaborated on in 2001, allows for the use of revegetation, forest management, cropland management and grazing land management activities since 1990 to meet a country's Kyoto target. Parties may choose which of these activities will be included to account for net carbon removals during the first commitment period. The inclusion of these activities under Article 3.4 was controversial because it was seen by many as allowing Parties to take significant credit for carbon capture that was already taking place under a business-as-usual scenario, reflecting no real policy changes. For the same reason activities such as avoided deforestation were excluded from being CDM

Accounting and Non-Permanence

One of the most difficult issues related to making carbon sequestration eligible under the CDM is non-permanence. In contrast to CDM projects in the energy sector, where GHG emissions reductions are achieved in the course of the project activity, via for example, fuel switching or greater energy efficiency, A/R activities sequester or store carbon in biomass, i.e. they "remove" already emitted CO2 from the atmosphere. Because biomass carbon storage is vulnerable to both natural and anthropogenic disturbances (such as fires, disease or logging), this storage cannot be regarded as fully permanent. When such interference causes sequestered carbon to be re-released into the atmosphere, the project's climate benefits are reversed and the accrued carbon credits no longer represent actual removals.

Non-permanence is therefore one of the principal reasons why carbon sequestration requires a separate set of procedures and modalities. Over the last few years, a number of approaches have been suggested to deal with this issue. Among these, the most influential has probably been a proposal put forward by Colombia in response to a UNFCCC working document on sinks under the CDM in 2000.[29] Its basic tenet is to make credits from A/R activities only temporary in nature, thereby obliging the buyer to replace them after a certain expiry date. In a later proposal, the European Union drew on this idea, and suggested that the crediting period of these co-called temporary Certified Emissions Reductions (tCERs) should be limited to the first commitment period (i.e. a period of five years). It is this proposal that forms the basis of the COP 9 decision.

COP 9 created two credit types: temporary CERs (tCERs) and long-term CERs (lCERs). Despite the difference in name, both credits are essentially temporary, that is, they must be replaced upon expiry. However, while tCERs have a crediting period of only 5 years, lCERs have a lifetime of up to 60 years (either 30 years, or three times 20). In practice, it is likely that most projects will choose to select lCERs (the Bio Carbon Fund portfolio consists exclusively of lCER projects). This is primarily because they allow a substantially longer payback (replacement) period with no other disadvantages over tCERs. Neither credit type may be banked (unlike conventional CERs), that is, they may not be carried over to subsequent commitment periods. In addition, verification (i.e. the monitoring of actual carbon uptake) must be carried out every five years over the entire crediting period. Loss of sequestered carbon (e.g. through fire) must be accounted for by transferring an equivalent number of conventional CERs (or other credits) into a special replacement account. As mentioned above, both tCERs and lCERs must be completely replaced after the end of the crediting period. That is, the issuance of either credit type is equivalent to borrowing credits from the commitment period in which the crediting period ends.

Baselines and Additionality

The definition of a baseline is slightly different than in the Marrakech accords. The Milan decision permits the following baseline approaches:

(a) Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary;
(b) Changes in carbon stocks in the carbon pools within the project boundary from a land use that represents an economically attractive course of action, taking into account barriers to investment;
(c) Changes in carbon stocks in the pools within the project boundary from the most likely land use at the time the project starts.

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modalities, because they risked generating credits for agriculture or forestry policies that were already in place, i.e. identical to the baseline.

[29] See http://unfccc.int/resource/docs/2000/sbsta/misc08.pdf

Option (a) is essentially backward looking, in that it estimates baseline carbon removals based on past and/or present land use within the project boundary. Using this methodology, historical or existing land use is assumed to continue in future, constituting the business-as-usual scenario of the baseline. Option (b), on the other hand calls for an investment analysis, in order to determine what the most likely land use is in terms of economic return. In other words, in the absence of carbon credits generated by the project activity, what is the most profitable land-use, taking into account barriers to investment? In many cases of course the economically most attractive alternative is likely to be the same as the existing or historical land use. Option (c) is in practice likely to be identical to option (b).

Additionality is defined the same way as in the Marrakech Accords: an A/R project activity under the CDM is additional if the actual net GHG removals by sinks are increased above the sum of the change in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of the project activity. It is likely that project developers will be expected to apply the CDM Executive Board additionality tools to A/R projects as well.

Socio-Economic and Environmental Impacts

Another important issue in the negotiations concerned socio-economic and environmental impacts of sinks projects. Many NGOs have long been critical of projects based on large-scale commercial plantations, arguing that only forests can yield tangible benefits for local biodiversity and ecosystems. Furthermore, plantations may even have adverse effects on the local environment by occupying non-degraded land with previously intact ecosystems and the heavy use of fertilizers and herbicides to speed up tree growth.

However, project developers are required to submit only an *analysis* of socio-economic and environmental impacts of their project. If any negative impact is considered to be *significant* by the project participants or the host Party, a socio-economic and/or environmental impact assessment must be carried out in accordance with the procedures required by the host Party. This point clearly leaves considerable room for interpretation. It is not clear what the scope of an environmental or socio-economic analysis is meant to be, nor is it obvious when an impact should be considered “significant”. Discretion on these questions is thus passed on to host Parties, whose varying definitions and standards (as well as monitoring capacity) will affect the outcome of individual projects.

Project Financing and Cost

Due to the limited experience with A/R projects so far, financial details of existing projects are scarce. Moreover, financial analyses and the potential impact of CERs on the rate of return tend to be very project and location specific, perhaps even more so than in other sectors like energy. Partly this is due to ecological factors that affect carbon uptake (soil, tree species, growth curves), and partly because of strong differences in regional or national market conditions and institutional frameworks that can significantly affect a project’s profitability (e.g. subsidies, local timber prices, land costs, other land practices such as cattle ranching etc.). Despite theses caveats, however, there is good reason to believe that CER revenues can make a substantial difference to the financial return of forestry projects.

Some indicative numbers come from an IDB sponsored case study in Patagonia, Argentina (Chidiak et al, 2004). The authors find that in Patagonia, forest projects (i.e. tree plantations) are only marginally profitable without plantation subsidies or CER sales. In the absence of both subsidies and CER revenue, the net present value (NPV) of a project is only positive for discount rates of 8% or lower. Assuming a continuation of existing subsidies, at CER prices of $3 per tCO_2, a project of 300ha would be profitable at a 12% discount rate. One caveat is that CER payments must take place within the first five years of the project lifetime to be significant financially (in practice, this is the most likely scenario, as carbon verification takes place every five years anyway). Furthermore, in the absence of a subsidy, CER revenue must be spread out over more than five years (i.e. one commitment period under Kyoto) for the project to be profitable at a discount rate of 12%. In general, the estimated minimum size of a profitable project is between 231 and 618ha. Other preliminary numbers from the Bio Carbon Fund tell a similar story. That is, CER revenue can in principle push forestry projects over the minimum IRR required to attract investors.

Future demand for Temporary Credits

As discussed above, tCERs as well as lCERs must be replaced upon expiry of the crediting period (either 5 years, or 20-60 years respectively). Unlike conventional CERs, which represent an asset and can be banked between commitment periods, temporary CERs are essentially a liability, to be paid back in the future. This partly explains why buyers so far may have been hesitant to invest in temporary credits as oppose to permanent emissions reductions generated by conventional energy projects. Indeed, the market for tCERs/lCERs has been tepid so far, with the BCF still representing the largest source of demand.

In view of these issues, it is not obvious why investors would choose to buy temporary credits at all. Three factors may determine the level of demand in the next few years. The first is a purely financial consideration. Because of their temporary nature, and also because of the existing risk of carbon loss throughout the crediting period (which has to be covered by transferring permanent credits), A/R credits are likely to be strongly discounted. Currently, there is still little information on lCER transactions, but initial prices set by the BCF are at least 20-30% below those set by other World Bank managed carbon funds.

A second factor is the contribution of projects to sustainable development. While less tangible, it may be at least equally important, particularly for governments. As oppose to say, methane capture from landfills, forestry projects can create significant benefits for the local population and environment. If well designed, they may result in job creation as well as the protection of the local ecosystem with co-benefits such as improved watershed management and decreased erosion. This tends to apply more to multi-species projects that are not plantations, but opportunities are nevertheless abundant. With strong NGO criticism of large-scale projects that produce little more than cheap carbon credits (e.g. HFC23 destruction), governments may face growing pressure to accommodate these groups.

The third factor is essentially a function of expectations concerning the future of the international climate change regime (Dutschke et al, in *Climate Investment Newsletter* 2004). One aspect is a purely financial consideration and concerns future carbon prices. The purchase of cheaper temporary credits only makes sense if allowance prices grow by less than the discount rate over the selected crediting period (i.e. over the time period after which the credits have to be replaced). The longer this period, the less likely this is to be the case, as emission reductions commitments become increasingly stringent. Another aspect, however, that may be even more important is the likelihood of future commitments actually taking place under the Kyoto regime. More specifically, what is the probability that lCERs with a 60-year crediting period will actually have to be replaced at all? From an environmental point of view, carbon capture from a project that has survived over 60 years is unlikely to be suddenly reversed. But beyond these environmental considerations, it is not unreasonable to believe that given the uncertainty over a time period of this length, the international climate framework may have changed and evolved to the extent that targets met within the first commitment period of the Kyoto Protocol may no longer be relevant.

4.4 Gas Capture

Experience to Date

Gas capture projects have been the most successful project type in Latin America up to now. Making up about a quarter of all LAC projects identified in the pipeline, they account for 43% of annual estimated emission reductions. The median gas capture project generates about 178,000 CERs per year, compared to only 74,000 for hydro and about 29,000 for renewables.

The potential for gas capture in Latin America is significant. Only very few sites make use of gas capture today, and it is likely that over the next few years almost all additional sites will make use of the economic incentives offered by the CDM. The World Bank estimates that if half of all landfill sites from cities with 500,000 of more inhabitants were utilized for methane capture, the potential installed capacity could reach over 800MW (Terraza, 2004).[30]

Project Technology

In the current pipeline, gas capture projects involve mainly landfill gas capture and utilization. Through anaerobic digestion, organic matter in landfill sites decomposes and generates methane emissions that seep through the waste and escape into the atmosphere. Gas capture projects essentially involve the construction of an airtight layer over the waste site, allowing the collection and combustion of methane gas at several outlet points. This technology is well tested and has long been used in North America and also Europe. Other projects in the pipeline involve gas capture from agricultural sites (such as hog farms), where animal also produces methane. Emission reductions can take place in two ways: (a) by generating electricity from methane combustion, which can either be sold to the grid and replace other sources, or used for on-site consumption; (b) from simple methane flaring at the landfill site, transforming CH_4 into CO_2, and thereby reducing the global warming impact of the gas.

Project Eligibility

Methane gas capture presents a win-win situation for project developers. It can constitute an important source of electricity, and at the same time improve safety at landfill sites by reducing the risk of explosions. In terms of project eligibility under the CDM, this project type presents little challenges. The first advantage is that in most developing countries landfill gas projects are almost always additional. Most countries in Latin America only mandate minimal gas capture from landfill sites to avoid the risk of explosion (usually between 10-20% of methane released). This means that there is no legal requirement for landfill site operators to prevent the remaining methane emissions from being released into the atmosphere. From a financial point of view, there is usually little or no incentive to invest in equipment for gas capture, even if it allows for electricity generation. The financial return for such an investment in the absence of the CDM will vary from site to site (and depends significantly on the quantity of methane released by the site), but it is clear that in general, additional income is needed to make this kind of project financially viable. As discussed above, carbon finance alone can contribute up to a 15% additional IRR, providing an excellent investment boost. The additionality issue can therefore be addressed from a financial as well as legal point of view.

A second advantage is that by now, baseline and monitoring methodologies are relatively well developed. From project developer's point of view, this simplifies project preparation significantly. Currently, six methodologies covering methane gas capture and utilization have been approved by the CDM Executive Board (four relate to landfill management, and two to animal waste). In addition, there is a consolidated

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[30] To find out more about landfill gas potential and technology in Latin America, consult the World Bank Landfill Gas to Energy Initiative: http://www.bancomundial.org.ar/lfg/default.htm

methodology that draws on all of these proposed projects (most of which are based in Latin America). From a methodological point of view, therefore, there are few challenges to deal with.

As a result, gas capture, whether from landfill sites or animal waste, represents an excellent opportunity for cost-effective GHG mitigation. It can be expected that the current project pipeline will continue to grow, and that gas capture will remain the major source of emission reductions in Latin America.

5. Conclusions

The IDB has pledged to address both GHG mitigation and sustainable energy development in its Environment and Energy Strategies, and in its draft Energy and Environment Policies. The new and enlarged interest in GHG mitigation and carbon finance since the entry into force of the Kyoto Protocol and the full operation of the CDM provide the occasion to revise/redirect/reinvigorate programs and activities as needed to meet beneficiary country needs in this arena

Many potential possibilities exist, including:

- Increase lending to support climate-friendly actions within the Bank's core programs, including projects in renewable energy, energy efficiency, municipal waste, and landscape protection via carbon sequestration. This would include increased activities through the Global Environment Facility.
- Greater technical support by the Bank for capacity building for carbon management and carbon finance, in the context of actual carbon projects.
- Development of innovative project financing mechanisms focused on CDM projects (potentially including risk guarantees, additional financial support for project initiation and transactions costs, and provision of financial and other services to support economically beneficial access to carbon markets by project proponents in beneficiary countries.

In evaluating its options, the IDB would be well served to focus on how to maximize its leverage and how to work in partnership with other institutions that have acquired experience in various activities supporting GHG mitigation over the years, while also emphasizing its own core objective of advancing economically and environmentally sustainable development to the benefit of the borrower countries.

Annex 1: Acronyms

A/R	Afforestation/Reforestation
AIJ	Activities Implemented Jointly
BCF	Bio Carbon Fund
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
DNA	Designated National Authority
DOE	Designated Operational Entity
EU ETS	European Union Emissions Trading System
GEF	Global Environment Facility
GHG	Greenhouse gas
IRR	Internal Rate of Return
JI	Joint Implementation
Kt	Kiloton
lCER	Long-term Certified Emission Reduction
Mt	Megaton
MW	Megawatt
PCF	Protype Carbon Fund
PDD	Project Design Document
tCER	Temporary Certified Emission Reduction
UNFCCC	United Nations Framework Convention on Climate Change

Annex 2: LAC Project Pipeline Identified by CDM Watch (April 2005)

Project Name	Country	Type	Estimated Annual CERs
Aluar Aluminium project	Argentina	Energy Efficency	863221
Shell fuel switching project	Argentina	Fuel Switch	2251662
Villa Dominico landfill gas project	Argentina	Gas Capture	363,331
Olavarria landfill gas project	Argentina	Gas Capture	636,331
Mountain Pine Ridge sinks project	Belize	Foresty	1,848,000
Guaracachi combined cycle efficiency project	Bolivia	Energy Efficency	3,418,210
Santa Cruz landfill gas project	Bolivia	Gas Capture	1,776,561
AES-Tietê resevoir reforestation project	Brazil	Foresty	5,287,550
CST steel making efficiency project	Brazil	Energy Efficency	331,156
Nobrocel Fossil to Biomass Fuel Switch project	Brazil	Fuel Switch	809,991
Corn products oil to gas fuel switch project	Brazil	Fuel Switch	903,175
Cargill fuel switching project	Brazil	Fuel Switch	1,372,010
Granja Becker animal waste reduction project	Brazil	Gas Capture	50,860
Onyx landfill gas project	Brazil	Gas Capture	700,000
Estre Paulínia landfill gas project	Brazil	Gas Capture	1,484,016
Irani biomass project	Brazil	Gas Capture	3,702,046
Marca landfill gas project	Brazil	Gas Capture	4,859,503
Imbituva biomass project	Brazil	Gas Capture	6,560,050
Inácio Martins biomass project	Brazil	Gas Capture	6,684,852
Gerdau carbonisation improvement project	Brazil	Gas Capture	8,542,416
Lara landfill gas project	Brazil	Gas Capture	10,953,988
NovaGerar landfill gas project	Brazil	Gas Capture	11,800,000
Caieiras landfill gas project	Brazil	Gas Capture	14,694,224
Salvador de Bahia landfill gas project	Brazil	Gas Capture	16,102,938
São João landfill gas project	Brazil	Gas Capture	18,127,264
Passo do Meio hydroelectric project	Brazil	Hydro	865,115
Jalles Machado bagasse project	Brazil	Renewables	119,825
Barralcool bagasse project	Brazil	Renewables	123,338
Nova América bagasse project	Brazil	Renewables	139,544
Lucélia bagasee cogeneration project	Brazil	Renewables	170,125
Alta Mogiana bagasse cogeneration project	Brazil	Renewables	279,670
Vale do Rosário bagasse project	Brazil	Renewables	281,877
Aquarius hydroelectric project	Brazil	Renewables	313,782
Cerradinho bagasse project	Brazil	Renewables	369,788
Santa Elisa Bagasse project	Brazil	Renewables	422,931
Moema bagasse efficiency project	Brazil	Renewables	428,340
Cosipar blast furnace gas project	Brazil	Renewables	429,577
UTE Barreiro fuel switch project	Brazil	Renewables	709,358
Rickli biomass project	Brazil	Renewables	2,675,570
Metrogas Package cogeneration project	Chile	Energy Efficency	115,302
Graneros fuel switching project	Chile	Fuel Switch	432,960
Metrogas methane recovery from pipeline rehabilitation project	Chile	Gas Capture	150,800
Cosmito Landfill gas project	Chile	Gas Capture	1,034,904
Peralillo swine manure treatment project	Chile	Gas Capture	1,838,713
Corneche and Los Guindos swine manure treatment project	Chile	Gas Capture	1,863,239
Copiulemu landfill gas project	Chile	Gas Capture	2,904,004
Pocillas and La Estrella swine manure treatment project	Chile	Gas Capture	5,507,412
Chacabuquito hydroelectric project	Chile	Hydro	2,812,000

Trupán biomass project	Chile	Renewables	1,831,130
La Vuelta and La Herradura hydroelectric project	Colombia	Hydro	1,559,984
Agua Fresca hydroelectric project	Colombia	Renewables	420,200
Jepirachi wind project	Colombia	Renewables	1,168,000
TransMilenio urban transport project	Colombia	Transport	2,503,517
Rio Azul landfill gas capture project	Costa Rica	Gas Capture	2,185,169
Rio General hydroelectric project	Costa Rica	Hydro	740,520
The Costa Rica Umbrella Project for Renewable Energy Sources. Cote hydroelectric sub-project	Costa Rica	Renewables	204,000
The Costa Rica Umbrella Project for Renewable Energy Sources. Chorotega wind sub-project	Costa Rica	Renewables	300,000
The Costa Rica Umbrella Project for Renewable Energy Sources. Vara Blanca wind sub-project	Costa Rica	Renewables	327,000
Sibimbe hydroelectric project	Ecuador	Hydro	1,435,917
Abanico hydroelectric project	Ecuador	Hydro	1,941,311
Candelaria hydroelectric project	Guatemala	Hydro	505,000
Las Vacas hydroelectric project	Guatemala	Hydro	1,994,033
Rio Hondo II hydroelectric project	Guatemala	Hydro	2,140,488
El Canada hydroelectric project	Guatemala	Hydro	3,030,000
Cuyamapa hydroelectric project	Honduras	Hydro	356,720
La Esperanza hydroelectric project	Honduras	Hydro	719,571
Zacapa hydroelectric project	Honduras	Renewables	9,548
Yojoa hydroelectric project	Honduras	Renewables	11,560
CECECAPA hydroelectric project	Honduras	Renewables	20,290
Rio Blanco hydroelectric project	Honduras	Renewables	178,000
Cortecito and San Carlos hydroelectric project	Honduras	Renewables	374,190
CarbonTrade wind project	Honduras	Renewables	1,156,650
Electric motor replacement In Mexico	Mexico	Energy Efficency	2,668,361
Petrotemex efficiency project	Mexico	Energy Efficency	3,043,840
Benito Juarez hydro power project	Mexico	Hydro	856,153
Chilatan hydropower project	Mexico	Hydro	1,087,668
El Gallo hydroelectric project	Mexico	Hydro	1,480,157
Trojes hydropower project	Mexico	Renewables	473,804
Cruz Azul wind project	Mexico	Renewables	2,996,000
Coffee and Forest reforestation project	Nicaragua	Foresty	506,460
San Jacinto Tizate geothermal Project	Nicaragua	Fuel Switch	7,599,921
Cuá-Bocay hydroelectric projects	Nicaragua	Renewables	46,760
Gemina rice husk project	Nicaragua	Renewables	212,395
Monte Rosa bagasse project	Nicaragua	Renewables	753,340
Vinasse anerobic treament project	Nicaragua	Renewables	775,200
Fortuna hydroelectric project	Panama	Hydro	261,000
Bayano hydroelectric project	Panama	Hydro	366,923
Esti hydroelectric project	Panama	Hydro	3,575,927
Algarrobo Forest project	Peru	Foresty	25,098
Pias project	Peru	Foresty	150,994
Central Selva reforestation project	Peru	Foresty	183,000
Aguaytía reforestation project	Peru	Foresty	304,975
Oxygen Factory project	Peru	Foresty	744,468
Cartavio fuel switch project	Peru	Fuel Switch	328,800
Retama municipal solid waste project	Peru	Gas Capture	401,261
Portillo Grande Landfill gas project	Peru	Gas Capture	1,689,863
Huaycoloro landfill gas project	Peru	Gas Capture	1,793,766
Poechos hydroelectric project	Peru	Hydro	669,438
La Virgen hydroelectric project	Peru	Hydro	1,750,000
Quitaracsa hydroelectric project	Peru	Hydro	2,464,179
San Gaban I hydroelectric project	Peru	Hydro	5,096,750
Andina hydroelectric umbrella project	Peru	Hydro	6,493,330
Santa Rosa hydro projects	Peru	Renewables	96,915

Chiclayo rice hull power plant	Peru	Renewables	148,917
Paramonga bagasse project	Peru	Renewables	873,394
Iquitos waste to power project	Peru	Renewables	1,466,841
Monder sugar cane foliage biomass project	Peru	Renewables	2,960,000
Protransporte project	Peru	Transport	1,997,439
Lima and Callao mass transit electric system project	Peru	Transport	9,044,326

Annex 3: List of Current Carbon Funds (January 2005)

	Name of Fund	Investors up to date	Founded	Capitalization
Mixed funds (government/private)	Prototype Carbon Fund	6 governments, 17 companies, three banks	1999	$180m
	Community Development Carbon Fund	5 governments, 10 companies	2003	$100m
	Bio Carbon Fund	3 governments, 2 companies, one investor, AFD	2004	$40m
	Italian Carbon Fund	Italian government	2003	$15m
	KfW-Klimaschutzfond	KfW, German govt.	2004	€50m
	Baltic Sea Region TGF	5 governments	2004	€30m
	Denmark Carbon Facility	Danish government	2004	€8m
	Pan European Carbon Fund	…	…	€100m
Private funds	European Carbon Fund	CDC, Fortis	2004	€100m
	Japan GHG Reduction Fund	JBIC, DBJ, Japanese industry	2004	$140m
Managed by Int. Institution	Spanish Carbon Fund	Spain	2004	€170m
	Netherlands European Carbon Facility	Netherlands	2002	€92m
	CAF-Netherlands CDM Facility	Netherlands	2002	€45m
	Netherlands Clean Development Mechanism Facility	Netherlands	2002	€44m
	Netherlands EBRD Carbon Fund	Netherlands	2003	€32m
Managed by national agency	Austrian JI/CDM Program	Austria	2003	€217m
	Belgium	Belgium	2004	€120m
	Denmark	Denmark	2003	€117m
	ERUPT	Netherlands	2000	€50m
	CERUPT	Netherlands	2001	€32.5m
	Swedish International Climate Investment Program	Sweden	2002	€15m
Private management	Rabobank Carbon Procurement Program	Netherlands	2003	€45m

Source: Caisse des Depots (2005). *Les fonds d'investissement dans les actifs carbone: état des lieux*. Paris, France.

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