The Challenge Presented by Climate Change in Latin America and the Caribbean

Background paper for the
World Bank's Latin American Flagship Report on Climate Change

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1 The Global Challenge

1.1 Climate change is unequivocal

Climate change has ceased to be merely an environmental problem. The growing scientific understanding of current and potential future changes in the atmosphere has confirmed that the issue is not only the greatest economic, social and environmental challenge humanity has ever faced, but perhaps more importantly, it has crystallized the fact that we must deal with the drivers urgently and effectively. The Nobel Peace prize winner Al Gore's asserts that we are facing a global emergency, and this is no exaggeration. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) warns that we are pushing beyond "*dangerous* anthropogenic interference with the climate system" and are on the path toward likely catastrophic consequences, such as the destabilization of the Greenland ice sheet, potentially causing up to seven meters of sea level rise over centuries, or perhaps quicker. The IPCC gives six possible future emission paths, which result in increased temperature ranging from 2° to 6° C, and span a change in global emissions from a decrease of 85% by 2050 to an increase of 140% by the same year (IPCC 2007, Working Group III). However, there is a widely endorsed consensus that a manageable likelihood of averting potentially calamitous consequences is only attained if we stay within a maximum temperature rise of 2°-2.4° C. This requires emissions to peak by 2015 and decrease 50%-85% relative to 1990 levels by 2050, possibly allowing atmospheric greenhouse gas concentration levels to stabilize below the 500 ppm level. Daunting as this effort may be, it does not guarantee climate stabilization, but rather carries a 17-36% risk that we may not stay within the 2° C threshold.

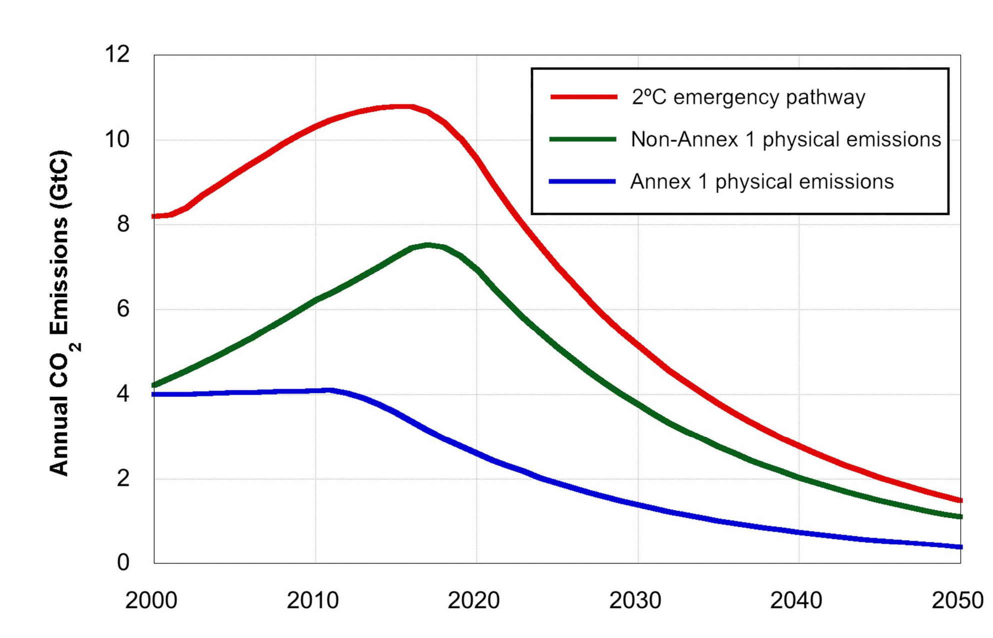
In terms of absolute emission reductions, current annual global emissions are at 45 GTCO2e. The 1990 level which serves as the baseline for most mitigation efforts was 40GtCo2e. In order to avoid dangerous climate effects we must at minimum achieve a halving of those emissions to 20GT by 2050 and continue to decrease emissions until we stabilize at an annual rate of 10GT by the end of the century. In the context of a projected world population of 9 billion in 2050, this implies an average per capita emission of approximately 2 tons CO2. Japan and most of Europe are currently emitting 10-12 tons per capita and the USA emits 25 tons. By contrast, the per capita emission level of China is 5 tons and India is approaching 2 tons. The absolute emission cuts that are necessary for global stabilization require industrialized countries (home to 1 billion people in 2050) to radically reduce their emission levels, and developing countries (home to 8 billion people in 2050) to eradicate poverty and grow without surpassing the 2ton per capital level. The carbon intensive economy of the past is no longer an option for any country. The advances of the Industrial Revolution are dwarfed by the systemic transformation which must occur over the next few decades, precipitously decoupling greenhouse gas emissions from production and consumption.

1.2 All countries must contribute to global mitigation effort

The reduction goal is ambitious, and it will only be achieved by aggressive and prompt action on the part of all major emitters, industrialized as well as developing countries. While it is undisputed that industrialized countries carry the overwhelming historical responsibility for the past growth in emissions and must therefore continue to take the lead in emission reductions, the IPCC has made it clear that these countries cannot stabilize the climate system exclusively through their own emission reductions, but rather that developing countries will also need to reduce.

In order to understand the implications for developing countries, the Stockholm Environment Institute (SEI 2007) takes the reduction scenario that provides the better likelihood of keeping global temperature rise within the 2°C threshold ("2° emergency pathway"), and disaggregates it into corresponding expected reductions for Annex I and for non Annex I, as shown in the graph below. The red line shows the global emission trajectory where global emissions peak by 2015 and then drop by 80% below 1990 levels by 2050[1].

Figure 1. Climate Stabilization Paths



Climate Stabilization Paths
Source: Stockholm Environment Institute, The Right to Development in a Climate Constrained World, 2007

[1] The trajectory shown includes CO_2 only, including approximately 1.5 GtC of emissions from land use in non-Annex 1 countries in 2000. The radiative forcing from non-CO2 gases is assumed to decline by about 50% by mid-century.

The blue line ("Annex 1") shows the SEI "conjecture" emission trajectory that would result if all Annex 1 emissions peaked by 2010, decreased by 6% annually, and dropped to 90% below 1990 levels by 2050. The trajectory is much more stringent than the mitigation proposals that are being considered by the industrialized countries, but is deemed "just barely" politically plausible by the Stockholm Institute. The green line ("non-Annex 1") is the arithmetical difference between the global constrained budget (red line) and the emissions that would be consumed by the industrialized countries. That is to say, it is the remaining emission budget for non Annex I countries within which they are expected to develop and grow. In other words, the developing world will still be facing the challenge of 1.5 billion people without electricity, one billion without access to fresh water, and 800 million chronically undernourished, while its emissions will need to rapidly decline.[2]

The inequity of this burden is further compounded not only by the incontrovertible fact that it is the industrialized countries that carry the historical responsibility for the accelerated increase in concentrations of greenhouse gases (GHGs), and that developing countries will not reach similar levels of annual emissions until 2020 (or sooner), but also by the fact that it is precisely the developing countries that are the most vulnerable to the adverse effects of climate change, and the least able to cope with the necessary adaptation. This asymmetry is the source of the principle of common but differentiated responsibilities, one of the most crucial principles enshrined in the UN Framework Convention on Climate Change (UNFCCC) and valid for any past or future agreement under the UNFCCC. The principle includes two elements: first the common responsibility of States for the protection of the global environment, and second, the need to take into account the different circumstances, particularly each State's contribution to the evolution of the problem and its ability to prevent, reduce or control the threat. From the perspective of global equity, industrialized countries will have to attain radical emission reductions within their own boundaries, and provide the technological and financial resources that will enable developing countries to leapfrog over the historical fossil fuel dependency into a low carbon path of development and prosperity.

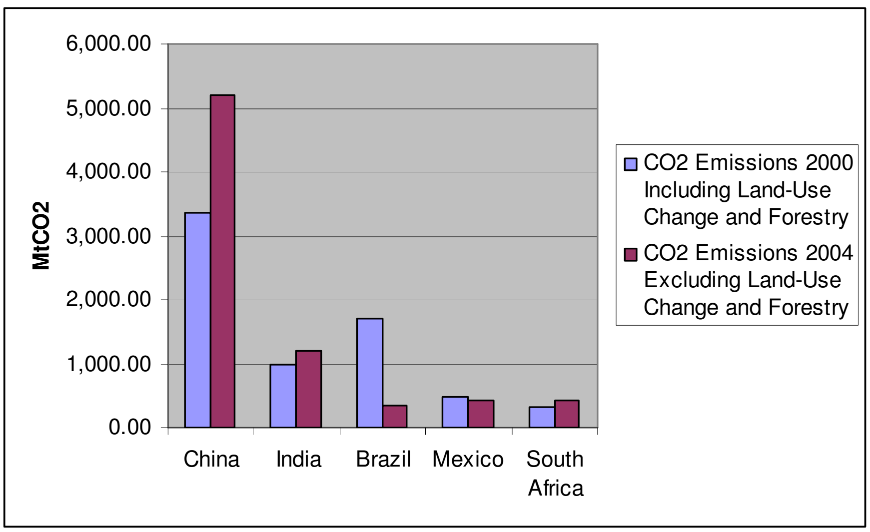
1.3 LAC region envisaged as contributing to global effort

The LAC region represents 5% of the world's energy related emissions and 10% of global emissions when land use change and forestry emissions are considered. As a minor contributor to global GHG emissions, the LAC region is not considered an imminent threat to climate stability. However, Brazil and Mexico are often identified as two of the

[2] The flexibility in this trajectory is minimal. The North could perhaps cut emissions by even more than 90% – perhaps 100% – and reduce emissions to zero by 2050, or even earlier, say 2025. But it would not change things very significantly, insofar as it would not open up that much more environmental space for the South. And, relaxing the red pathway – taking yet greater risks of exceeding 2ºc – only makes a difference if it is relaxed so much as to give up on preserving a reasonable likelihood of keeping warming below 2ºc.

five emergent countries that could engage in enhanced mitigation efforts in the near future.

China, India, Brazil, Mexico, and South Africa are widely recognized as the "Plus 5" rapidly industrializing nations with the steepest increase in both production and consumption. Together with the G8,[3] the Plus 5 countries constitute 75% of the world's greenhouse gas emissions, and have therefore over the past year been involved in consultations regarding decreases of their emission growth trends.[4] Brazil and Mexico are not yet ascribed with prime responsibility, as the populations and GDP of India and China far exceed those of Mexico or Brazil. However, when accounting for land use change and forestry, the CO2 emissions of Brazil are higher than those of India, Mexico or South Africa.

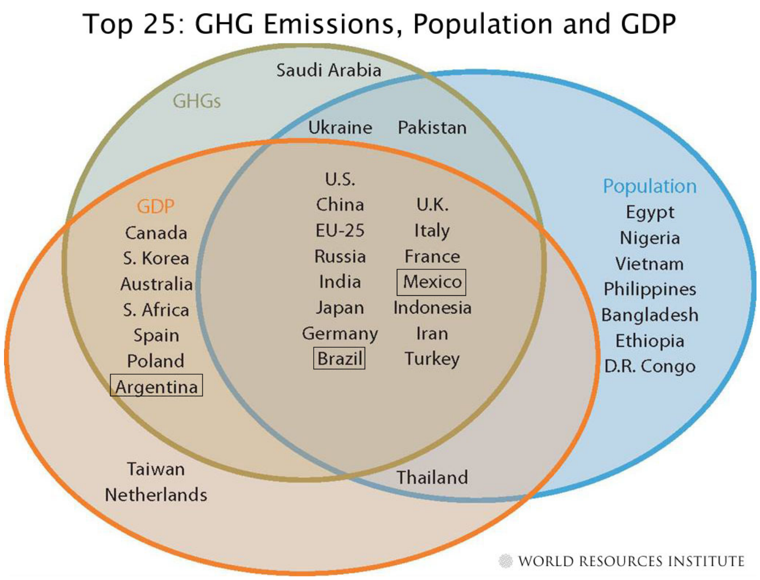


Source: CAIT, WRI

Nonetheless, it is unlikely that the post-2012 climate regime will be structured merely according to absolute emission levels. Given the prompt scale-up of mitigation that is necessary from both industrialized and developing countries, it is not realistic to assign mitigation efforts exclusively to the highest emitters, some of which are developing countries still facing basic development challenges. Rather, it is possible that countries may decide to use a combination of three factors to structure the future global mitigation effort in an equitable manner: GHG emissions (responsibility), GDP (capacity

[3] G8 is the group of leading economies which includes Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States.
[4] http://web.worldbank.org/WBSITE/EXTERNAL/NEWS, "G8 Climate Change Dialogue Moves to Washington"

to act), and population (factored as per capita for fairness). When overlapping those three factors, twenty-five countries account for 83% of GHG emissions, 71% of the global population and 86% of the global income (WRI/Pew Center on Global Climate Change 2005). We note that Brazil and Mexico fall in that group of top 25 for all three categories. In fact, Brazil is ranked 5th in the world for CO_2 emissions, 5th for total population, and 10th in GDP. Mexico is ranked 13th in the world for CO_2 emissions, 11th for total population, and 13th for GDP (CAIT, WRI).



It only stands to reason that most of the above 25 countries, if not all, will need to be engaged in the global effort to curb emissions in the near future and in some form.

Although the Fourth Assessment Report of the IPCC does not disaggregate to the country level, the LAC as a whole region has been identified by the Report as a region with significant potential to contribute to global stabilization levels. In contrast to East Asia and Centrally Planned Asia, the LAC region is envisaged as deviating from baseline trends by as quickly as 2020 for stabilization at 550 ppm, and deviating substantially from baseline by 2020 for a stabilization of 450 ppm. Only in the case of the least aggressive (and least recommendable) stabilization scenario of 650 ppm would the region not have to deviate from business as usual until 2050.

Box 13.7 The range of the difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for Annex I and non-Annex I countries as a group[a]

Scenario category	Region	2020	2050
A-450 ppm CO_2 –eq[b]	Annex I	–25% to –40%	–80% to –95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm CO_2 -eq	Annex I	–10% to –30%	–40% to –90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, especially in Latin America and Middle East
C-650 ppm CO_2 -eq	Annex I	0% to –25%	–30% to –80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

[a]The aggregate range is based on multiple approaches to apportion emissions between regions (contraction and convergence, multistage, Triptych and intensity targets, among others). Each approach makes different assumptions about the pathway, specific national efforts and other variables. Additional extreme cases – in which Annex I undertakes all reductions, or non-Annex I undertakes all reductions – are not included. The ranges presented here do not imply political feasibility, nor do the results reflect cost variances.

[b]Only the studies aiming at stabilization at 450 ppm CO_2-eq assume a (temporary) overshoot of about 50 ppm (See Den Elzen and Meinshausen, 2006).

Source: See references listed in first paragraph of Section 13.3.3.3

Source: IPCC, 4AR, WG III

2 Perspective from the Region

2.1 Development and mitigation

From the perspective of the developing world in general, and LAC is no exception, mitigation cannot come at the cost of development, but it can be achieved if climate considerations are mainstreamed into development planning and both are pursued simultaneously. Sustainable development and climate change mitigation have been presented as mutually exclusive pursuits. It is indisputable that developing countries have more pressing priorities than climate change. Poverty, employment, health, education, housing, and food security are immanent priorities. However, these objectives are in the long run served most effectively when environmental priorities are not sacrificed to economic and social priorities. In fact, the vulnerability of the region assures us that it is only through global mitigation that the region will be able to continue to grow. Several years ago the argument could be made that sustainable development required climate to be considered in domestic policy and planning. With the release of the Fourth Assessment of the IPCC it is now evident that climate cannot only be considered on the sidelines, but in fact, has to be placed at the core of development planning in developing countries. This is radically different from current practices.

Under the Kyoto Protocol, the Clean Development Mechanism (international emission reduction market in which the developing countries can participate as suppliers) was created with the triple purpose of assisting developing countries in achieving sustainable development, assisting them in contributing to the stabilization of emission concentrations, and helping industrialized countries reduce the cost of compliance with the reduction targets they assumed under the Protocol. The intent was a noble one, but the reality falls short of the intention. It has been repeatedly noted that while the CDM did contribute to cost containment for the industrialized countries, it fell sadly short of assisting developing countries in achieving sustainable development or contributing to the stabilization of emissions concentrations (Figueres 2004, IISD 2005, Schneider 2007, etc.). The only way to help developing countries achieve both sustainable development and contribute to the stabilization of emissions concentrations is to rapidly decarbonize their economies by making climate vulnerability and mitigation the guiding principle of domestic policy.

The decarbonization that the CDM did not achieve needs to be aggressively pursued in the post 2012 period. Historic economic growth has been based on increased fossil fuel energy consumption and consequent increasing GHG emissions. Future economic growth particularly in developing countries must reverse this trend. While economic growth must continue and in fact accelerate, the efficiency of energy consumption must improve, and the carbon intensity of production must swiftly decrease. Decoupling growth from emissions is the only way to pursue development and climate protection simultaneously.

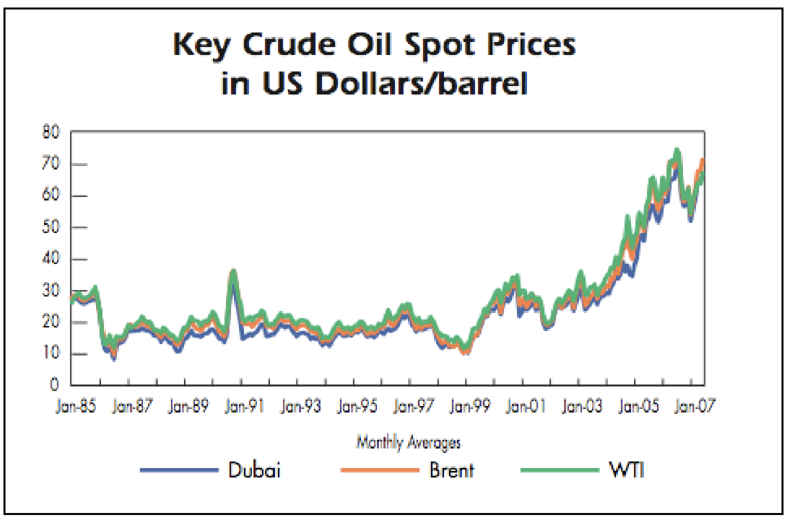
However, simultaneous pursuit does not mean that both goals are achieved in equal measure. One goal often takes precedence over the other. Thus there are two types of policy measures to be considered. A first category of policies comprises actions that have sustainable development as their main focus but which also have significant albeit indirect implications for climate mitigation. The challenge, and at the same time the opportunity, for the LAC region is to participate in the global emission reduction effort by identifying, designing and implementing 'development-first' policies (IPCC, 2007c) that are at the same time 'climate-friendly', in the sense of promoting economic growth without compromising the environment (Heller and Shukla, 2003).

The second category of policy measures that governments can take are actions aimed directly at constraining GHG emissions: these are the so-called 'climate-first' policies. By definition the primary objective of these policies is that of managing the risk of climate change. These actions may in some cases involve trade-offs with other sustainable development goals – e.g. renewable energy sources such as hydro may displace resident populations and/or cause biodiversity loss – but that does not have to be necessarily the case. In fact, many climate first policies can have a positive ancillary impact on development, in which case they can be described as 'development-smart' climate policies (WDR 2008).

Being a minor contributor to global emissions, it is possible that LAC will be able to successfully and effectively contribute to the future climate regime by focusing mainly on the first type of actions, and if need be, complement with some of the second type. Even with such a mix of policies, the prompt pursuit of a low-carbon economy would represent a number of synergistic benefits to the region.

2.2 Energy Security and Balance of Trade:

Ensuring long-term security of energy supply at reasonable prices to support the domestic economy is critical to all countries, but particularly to the developing countries that are projected to grow exponentially in the near future. In light of sharp price increases and overall volatility in energy cost, energy security is a very real concern for all oil importing nations worldwide, as oil prices in the first quarter of 2008 soared above $125 US/barrel for the first time ever. The chart below examines the volatility of crude oil prices from January of 1985 to January of 2007, showing spikes during the Persian Gulf War in 1990 to 1991 and a steep increase in prices starting in 2004.



Source: IEA Key Energy Statistics 2007

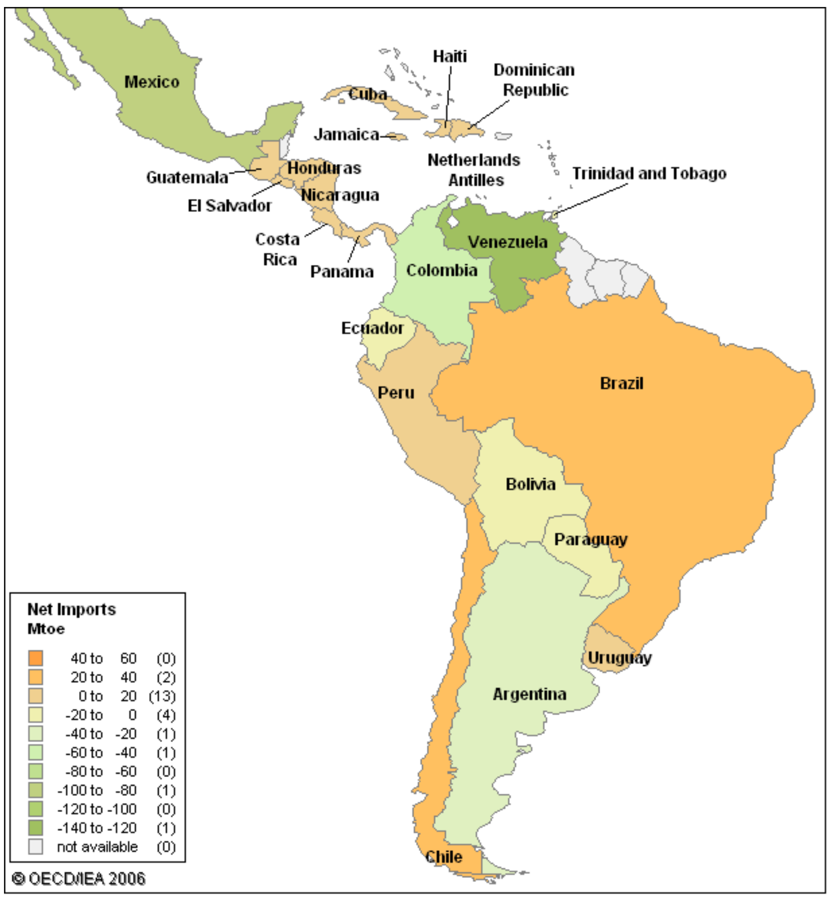
Since most developing nations are more energy intensive and less energy efficient than OECD nations, they are more intensely affected by rise in oil prices. Developing nations also have more difficulty managing the financial turmoil brought upon by higher oil-import costs.[5] The 2007 World Energy Outlook depicts a grim picture with regards to energy security in the medium and long-term for all oil importing nations based on the increase in global energy demand and the increasing concentration of remaining oil reserves in a few small countries, namely Middle Eastern members of OPEC and Russia. As the demand for oil and gas from these regions increases, it becomes more likely that

[5] International Energy Agency. *World Energy Outlook 2004*. OECD 2007

oil-exporting countries may seek to extract a higher rent from their exports and to impose higher prices in the longer term by deferring investment and constraining production.

The LAC region has a number of energy-importing countries that could be negatively impacted by increasing energy prices or decreasing fuel supply. Countries shaded orange in the map below indicate net energy (oil, gas, coal and electricity) importers. Although Brazil and Peru appear as net importers in this chart, the Energy Information Agency predicted in September 2007 that Brazil would soon become a net exporter[6] and recent statements from the Cabinet and the Energy & Mines Ministry[7] of Peru point to the fact that the introduction of natural gas and recent commercial discoveries Peru could make the country self sufficient in oil in a few years.

LAC Net Energy Importers/Exporters (IEA, 2006)



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[6] A comparison of official export and import volumes documented at the National Energy Balances published by the Mines & Energy Ministry of Brazil shows a sustained increase of exports and decrease of imports to cover domestic demand of oil and by-products. http://www.mme.gov.br/site/menu/select_main_menu_item.do?channelId=1432&pageId=6071

[7] www.minem.gob.pe

Based on 2005 data published by the IEA[8] for South America, Chile and Uruguay are net energy importers, thus vulnerable to price volatility and supply of energy. But the dependence on foreign hydrocarbons is particularly acute for the Central American and Caribbean countries, including Barbados (86%), Dominican Republic (78%), Jamaica (86%), and Panama (72%).[9]

If oil and gas imports continue as projected or even increase, the balance of trade of non-oil producing countries will be increasingly impacted with steep energy prices in the future, as predicted by the WEO 2007.[10] This exposure to oil prices has prompted Latin American countries to implement energy stabilization funds and measures to diversify their energy matrix. Decreasing the need for energy imports through increasing renewable energy generation and/or improving energy efficiency can increase trade surplus or decrease trade deficits depending on the country's trade position, while at the same time reducing greenhouse gas emissions.

The region has experience in counteracting rising prices and energy security threats with domestic fuel production. Brazil for example responded to the oil-shock of the late 70's with the launch of the National Alcohol Fuel Program (PROALCOOL). The goal of the program was to increase the production of sugarcane ethanol as a substitute for oil, at a time when Brazil was importing 80% of its oil supply. Results from the program include a reduction of oil imports and expenditure of foreign currency, job creation, and emission reductions estimated at 1.5MtCO2/yr (Szklo et al., 2005).[11]

Additionally, clean energy costs are now competitive with oil costs, strengthening the case for diversifying the fuel mix. The recent ESMAP study of the LAC energy sector[12] shows clean energy to be cost-competitive based on an oil price scenario of US$60/bbl. With current oil prices above $100, clean energy is even more competitive. The chart below displays prices based on the US$60/bbl and US$100/bbl scenarios. The levelized generation cost for high efficient diesel engines running with residual oil, used in Central America and the Caribbean, has increased from 85 to about 130 US$/MWh, higher that the levelized cost of medium and large hydroelectric in these regions (65 to 85 US$/MWh), and higher that the generation cost for wind power (estimated between US$65 and 105 depending of variations in capacity factor and distance to the grid).

In the case of countries in South America with low cost hydroelectric generation, the average generation cost for medium and large hydros varies between 30-50 US$/MWh,

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8 "Key World Statistics 2007", International Energy Agency

9 ESMAP Study, "Latin America and the Caribbean, Energy Sector – Retrospective Review and Challenges" June 15, 2007.

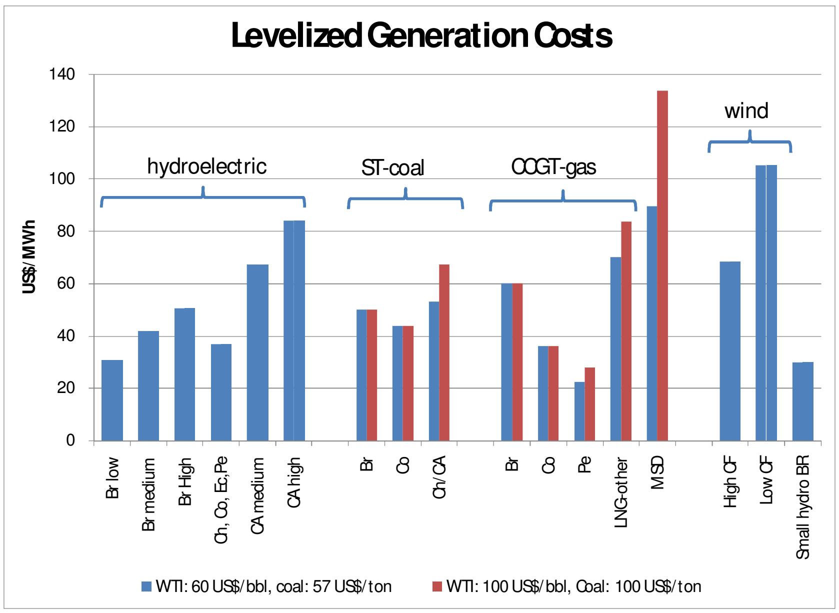
10 Taking the US as a general example of the effect of energy prices on balance of trade, trade deficits widened substantially in January 2008 due to skyrocketing oil prices even though exports of US-made goods and services totaled a record high of $148.2 billion that month. "Deficit Widens as Oil Prices Hit Record", AP, Washington DC, March 11, 2008

11 Chapter 12, Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

12 World Bank, ESMAP Study: Latin America and the Caribbean Region Energy Sector- Retrospective Review and Challenges, June 2007

which is competitive with any thermal generation option using imported fossil fuels. Only in the case of natural gas producers like Peru and Colombia, with a price of gas below US$3/MBTU, gas-fired CCGTs are competitive with hydro.

However, coal-fired generation is a cost-competitive option in countries with high-cost or scarce hydroelectric potential (Mexico, Central America and the large Caribbean islands) or countries with indigenous coal reserves that don´t have access to international markets (Colombia and Brazil). The generation cost of coal-fired plants for base load operation, using imported coal, is estimated to be in the range of 50-70 US$/MWh, and for coal fired plants in Colombia and Brazil, between 45 and 50 US$/MWh.



The development of coal-fired generation raises environmental concerns and is of course a threat to the abatement of CO2 emissions of electricity generation in some countries in the region (its emission factor in tons of CO2/MWh doubles the factor for a gas-fired CCGT), but it cannot be ignored as long as it remains attractive cost-wise. For example, the Dominican Republic is in the process of developing 1,200 MW in coal-fired generation by 2013 (for a projected peak load demand of about 3,000 MW), because of high oil and LNG prices[13].

Wind power with high capacity factors is becoming competitive in a scenario of high oil prices and high CER prices for most countries in the region which do not have access to low cost hydroelectric generation, have introduced legislation to promote development of small renewable power and have access to funding by CDM. Wind

[13] Dominican Republic has an LNG regasification terminal serving about 400 MW of gas-fired thermal generation

projects may cover levelized cost by selling energy to the grid under long-term contracts at avoided costs (marginal generation costs) and selling CERs in the CDM market. However, development of wind power in Brazil has only been possible under the quota-based incentive program (PROINFA) which allows to buy power from wind at a much higher prices than from biomass and small hydro projects. In this case, the generation costs of wind projects are not competitive with the costs of other renewable options.

The development of the large potential of low-cost medium and large hydroelectric projects in South America and some Central American countries, which is included in the generation expansion plans, although very important to reduce the rate of growth of carbon emissions of power generation, is not realistic without Government support in most countries that have adopted a competitive electricity market with private participation. Private investors have difficulties and are unwilling to manage the high project risks of hydro plants: high capital cost, need of expensive and time-consuming feasibility studies, higher construction risks, long execution and amortization periods and protracted and politically-sensitive processes to obtain environmental licenses. It is difficult to reconcile climate change objectives with other environmental considerations and private sector participation under a competitive market.

Brazil has adopted a power market which relies on competitive bids for awarding long term concessions contracts to new hydroelectric projects with environmental licenses, which are included in an official generation expansion plan. This scheme reduces market and mitigates project risks for developers and has been effective in the development of hydroelectric projects thanks to a strong participation of state-owned generators and local construction companies.

2.3 Technology Lock-in and Competitiveness:

Low carbon technology lock-in may be one of the most important ways in which short-term reductions contribute to long-term stabilization. Investments in long-lived capital assets and their corresponding greenhouse gas emissions can last forty to fifty years. The region is projecting a 4.8% annual rate of growth in electricity demand over the next ten years, corresponding to a net increase of 100,000 MW in generation capacity, of which 60,000 MW is not under construction and has not been contracted (ESMAP 2007). The carbon intensity of this new generation capacity will be decided over the next few years as investment decisions are made. Policies and incentives that would steer investment toward a low-carbon path can avoid lock-in of carbon-intensive technologies for the lifetime of the project. These policies would help the region avoid installing technologies that in an increasingly carbon-constrained world will soon become obsolete, and make the region lose competitiveness. In fact, in the context of the post-2012 climate regime, the European Union is already considering imposing an import tax on goods supplied by countries that have no emission policies and measures, in order to protect the competitiveness of the European industry which is under increasing emission controls.[14] The proposal has major industries' support, and represents a potential trade barrier of concern to developing countries.

It is hardly disputable that we are moving toward a carbon constrained future. The introductions of low-carbon technologies in the next few years may well avoid much costlier mitigation costs in the future, when regulations have become more stringent and carbon leniency has been taken out of the system.

2.4 Energy conservation and lower production costs:

Energy efficiency is widely recognized as one of the lowest-cost "sources" of energy. It is often more cost-effective to invest in energy-efficiency improvements, particularly on the end-use or demand-side, than to increase energy supply to meet the growing demand for energy services. See the table below for a comparison of energy generation and energy efficiency prices.

Chart 1: Technology Price Comparison

Technology	**Price (¢/kWh)**
Coal	3-4
Biomass	4-9
Hydro	2-3
Photovoltaic	20-30
Wind	4-6
Geothermal	5-6
Energy Efficiency	2-3

Source: Komor, 2004

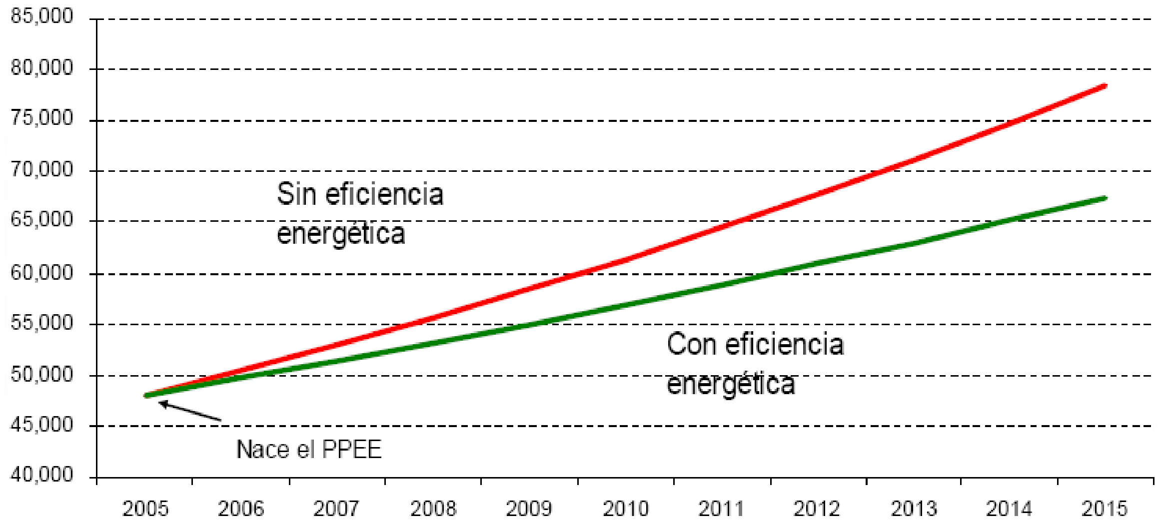
Energy efficiency is by far the most promising source of emission reductions over the next few decades. Energy efficiency could potentially account for more than half of the energy-related emission abatement potential achievable within the next 20-40

[14] European Commission, proposal for Phase III of European Trading Scheme

years, as identified by the International Energy Agency Outlook (2006), the Fourth Assessment of the Intergovernmental Panel on Climate Change (2007), and the study on cost curves published by the McKinsey Quarterly 2007.

Despite their low per capita greenhouse gas emissions, the greenhouse gas intensity of developing countries is nearly double that of developed countries, making them particularly interesting targets of energy efficiency measures. Not surprisingly, energy efficiency is one of the most frequent measures to manage the exposure to oil imports. For instance, the successful experience of Mexico also shows that savings of about 15% of peak electricity demand are possible (ESMAP 2007), and in 2005, Chile launched a national program on energy efficiency (PPEE) that aims to improve energy efficiency by 5000 GWh by 2010 and provide the country with an additional 15% of electricity supply within ten years.

FIGURE xx. ELECTRICITY DEMAND IN CHILE WITH AND WITHOUT ENERGY EFFICIENCY



Successful energy efficiency attainments require legislation, application of regulations, appropriate inventive or financing mechanisms, programs to label appliances and equipment and the promotion of Energy Service Companies (ESCOs), all of which have a domestic cost and the challenge of breaking the market and institutional inertia on energy efficiency. However, the pursuit of early action on energy efficiency in developing countries is compelling not only for the purpose of reducing current energy consumption but even more so because the most economically attractive abatement options are "time-perishable": every delay in producing energy-efficient commercial buildings, houses, industries, and processes causes the most efficient options to be lost. The additional cost of incorporating efficiency measures into a building at the planning stage is typically a fraction of the cost of retrofitting it later, or retiring an asset before its useful life is over because its operating costs have become too high (Dernbach 2008).

Furthermore, more energy-efficient processes often reduce the cost of goods and services supplied to the market. As manufacturing and production processes become more energy efficient, production costs drop and increase competitive positioning. This phenomenon is especially true as energy costs rise, leaving those companies reliant on traditional fossil fuel sources at a competitive disadvantage. Although progress on energy efficiency is far from being mature in the region, EE technology transformation on the supply side is paving its way in Latin America as electricity companies are considering, whenever possible, to use combined cycle electricity generation or cogeneration where heat and steam is available. This emerging practice is being boosted by the Clean Development Mechanism reducing the natural gas bills of the energy companies and decreasing GHG emissions in a cost effective manner with the aid of carbon credits.

2.5 Sustainable development at large:

The economic, environmental, security, and social co-benefits of climate change mitigation are considerable. From the perspective of the environment and human health, these benefits include higher agricultural productivity, reduced stress on natural ecosystems, lower air pollution and better health conditions. The human health benefits from improved transportation systems may offset a substantial fraction of mitigation costs since they range between 30 and 50% of estimated mitigation costs (Burtaw et al., 2003; Proost and Regemorter, 2003). Others estimate that these benefits are three to four times greater than mitigation costs (Aunana, et al., 2004; McKinley et al., 2005), depending on the stringency of the mitigation level, the source sector, and the measure and the monetary value attributed to mortality risks. Studies have calculated that for Asian and Latin American countries, several tens of thousands of premature deaths could be avoided annually from moderate CO2 mitigation strategies (Aunana, et al. 2004; McKinley et al, 2005).[15] These deaths are avoided due to a reduction in air pollution, including SO_2 emissions, NO_x emissions, and particulate matter emissions from fossil fuel burning vehicles and power sources.

Climate mitigation also has ancillary energy-related sustainable development benefits: systemic urban transport efficiency improvements can provide better transport service and methane capture projects can improve solid waste treatment and generate an additional source of energy.[16] Rural electrification efforts can also be furthered by mitigation activities. Decentralized renewable energy generation can provide substantial social and economic development benefits to under-served populations who are dependent on traditional sources like biomass, kerosene, diesel generators, and car batteries. Compared to costly grid extensions, off-grid renewable electricity provides a more cost-effective way of providing power to the estimated 50-65 million people living without electricity in Latin America, particularly in Bolivia, Nicaragua and Honduras where electrification rates of rural areas are below 30% (ESMAP 2007). These social and economic benefits cannot be underestimated when considering the costs and benefits of prompt mitigation efforts in LAC.

2.6 A word of caution

During the early years immediately following the signing of the Kyoto Protocol, Latin America was the unquestioned leader in emission reductions through the Protocol's Clean Development Mechanism. Even outside of the market mechanism, several LAC countries have embarked on national policies/programs that have resulted in substantial emission reductions (e.g. biofuels in Brazil, energy efficiency in Mexico, reduction of deforestation in Costa Rica). While these efforts were undertaken for reasons other than purely emission mitigation, they did have a synergistic mitigation effect. The cost of these efforts was covered by the countries, without any support or

[15] Chapter 11, Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

[16] IADB, "GHG Mitigation and Sustainable Development: Opportunities and Challenges for Latin America and the Caribbean" Presentation

recognition from the international regime. As the region proceeds with more and deeper efforts, it will be increasingly important to "protect the baseline" in terms of achieving international recognition of the effort, particularly if it is supported by third party verification of the emission reductions. The region has served as an effective "experimental laboratory" for climate mitigation activities, and could do so once again, but this time with a more strategic approach to the international negotiations.

In so doing, the region could serve as a global model. Perhaps the most important challenge in addressing climate change is the low level of confidence with regard to the ability of both developed but particularly developing countries to address this issue without compromising human well-being and future economic growth. Early and substantial reductions that are cost-effective, foster sustainable development, and avoid carbon intensive technological lock-in could create a track record of achievement that would build confidence in the global ability to successfully address this issue, making it easier to achieve the additional reductions that are required over the longer term in other regions (Dernbach 2008).

Although having a much lower level of emission responsibility than Asian emergent countries, it is conceivable that the LAC region could take on the important role of confidence builder. With less population pressure than Asia and greater institutional capacity than Africa, the region could build on its early mitigation leadership experience to exemplify a low-carbon development path that decouples economic growth from GHG emissions, promoting prosperity despite carbon constraints.

3 LAC Emissions

All LAC countries have ratified the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP). All of them have submitted at least the first National Communication on the implementation of the UNFCCC (which include national inventories of greenhouse gases, mitigation activities, and assessments of vulnerabilities). Argentina and Uruguay have submitted the second, and Mexico has already submitted its third National Communication.

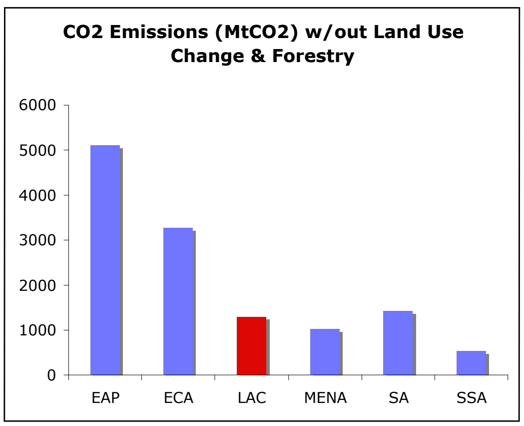
Latin America represents 6.3% of world GDP, and is home to 8.6% of the world's population. The economy of the region is dominated by the five largest countries: Brazil, Mexico, Argentina, Venezuela and Chile, which together represent 80% of the region's GDP (Brazil alone represents 35%). Taken as a whole the region exhibits low greenhouse gas indicators if compared to OECD (Organization for Economic Cooperation and Development) countries, and not surprisingly, an intermediate position between these and the low income countries of Asia and Africa.

3.1 Annual emissions.

While the region is a minor contributor of emissions, its emission levels are quite different depending on whether they are quantified based on energy-related activities only, or whether emissions from land use change and forestry are also accounted for.

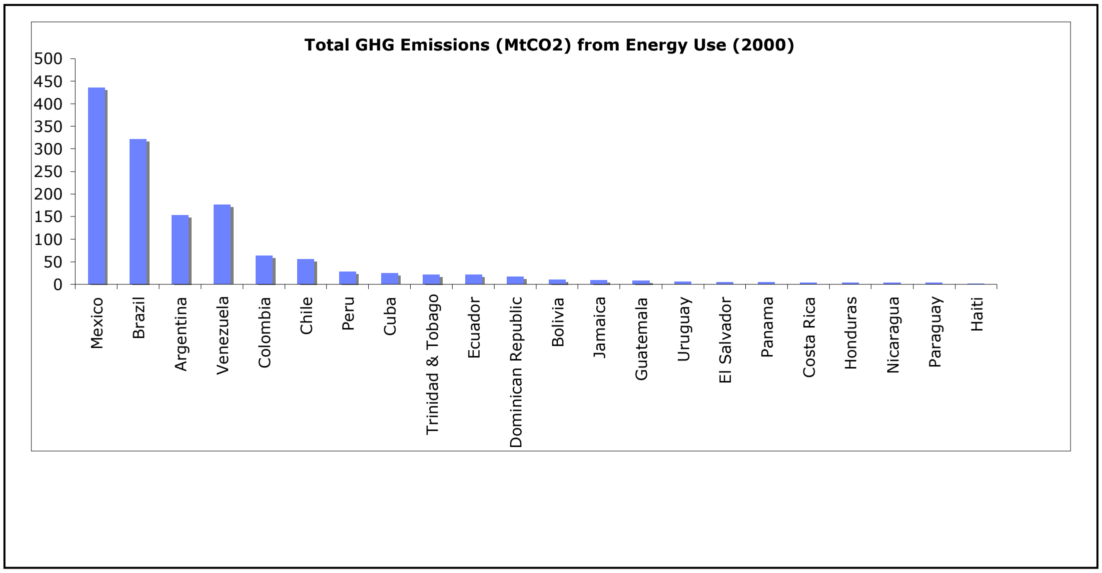
Comparatively low energy-related emissions

When emissions from land use are not included, the LAC region emits 4.9%, (WDI, 2005) of global energy-related CO2 emissions, one of the lowest emission levels of all regions due to the relatively high proportion of renewable energy sources in the generation mix. The graph below shows that LAC's total emissions are significantly below those of East Asia & the Pacific and Europe & Central Asia. LAC's emissions are also below South Asia's, and only above those of the Middle East & North Africa and Sub-Saharan Africa.



Source: WDI, 2005 Data

The region's emissions are highly concentrated in just a few countries. Energy-related emissions stem predominantly from Mexico, Brazil, Argentina, Venezuela, Colombia, and Chile, which together contribute 87.3% of LAC energy emissions. Mexico is the highest energy-related emitter, accounting for 31.5% of the region's energy emissions, followed by Brazil with 23.2%.

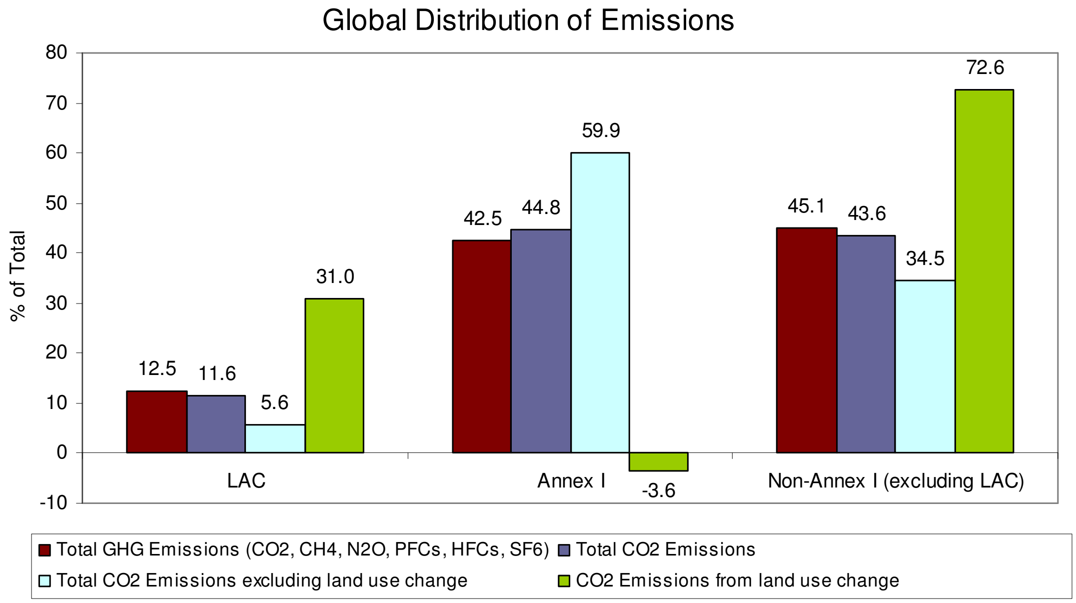


Source: CAIT, WRI

In addition to being a relatively low emitter from energy-related sources overall, LAC is also not one of the regions of highest projected growth in annual emissions. According to the IEA's World Energy Outlook 2006, energy-related CO2 emissions in Latin America are expected to grow by 70% between 2004 and 2030. However, the increase in Latin American CO2 emissions is more modest than in the sum total of developing countries, where they are expected to more than double (IEA, 2006).

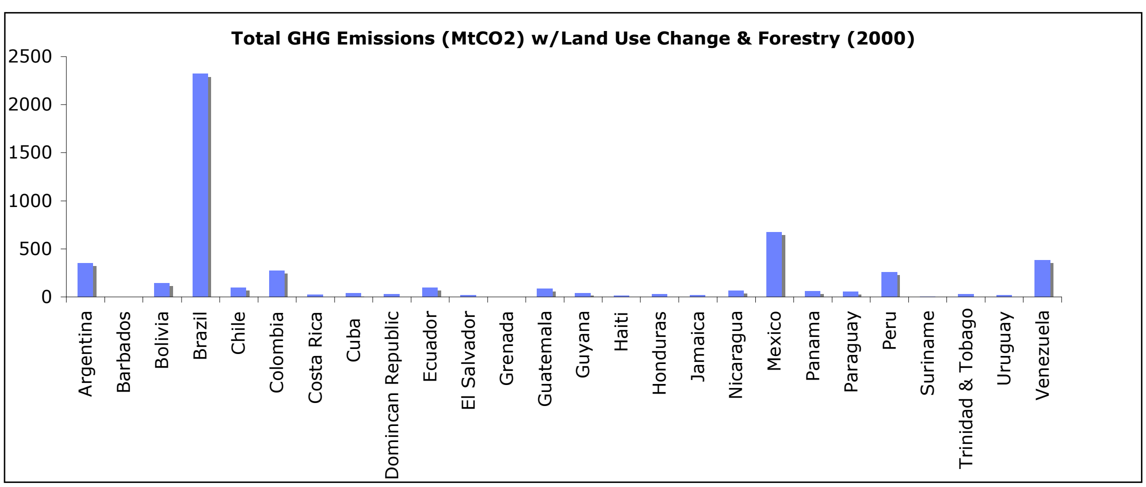
Disproportionately high emissions from land use and forestry conversion

When land use emissions are included in global emission levels, the LAC contribution to world CO2 emissions increases from 4.9% (energy related) to 10.3% (total). This total percent of emissions ranks higher than the region's contribution to global population (8.6%) or GDP (6.3%). Even so, the LAC region emits less than a quarter of all non-Annex I emissions, with non-Annex I East Asia and South Asia emitting 40% and 30% respectively (IPCC 2007).



SOURCE: Climate Analysis Indicators Tool (CAIT) Version 5.0. (Washington, DC: World Resources Institute, 2008).

If land use change and forestry emissions are considered, Brazil is by far the single highest emitter with 59% of the region's total emissions, followed by Mexico with 17%, and Venezuela and Peru with 10% and 8% respectively. As a single country, Brazil's emissions from agriculture and deforestation account for 59% of Latin American and 18% of the world's land use change and forestry emissions (CAIT 2000).

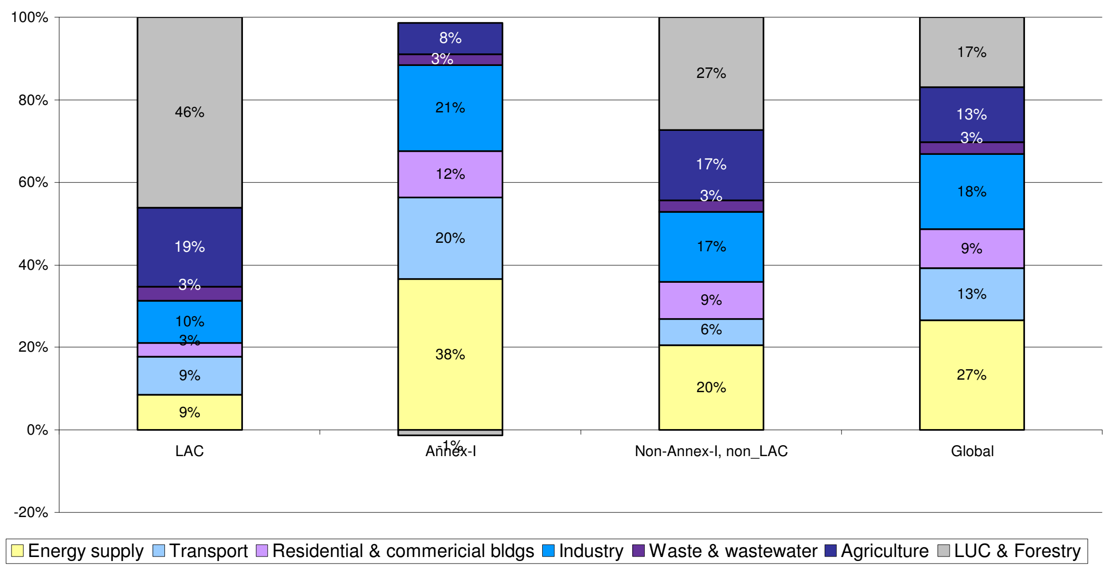


Source: CAIT, 2000 Data

3.2 Composition of emissions.

The LAC region is unique in the composition of its emissions, both with respect to OECD countries as well as to other developing regions.

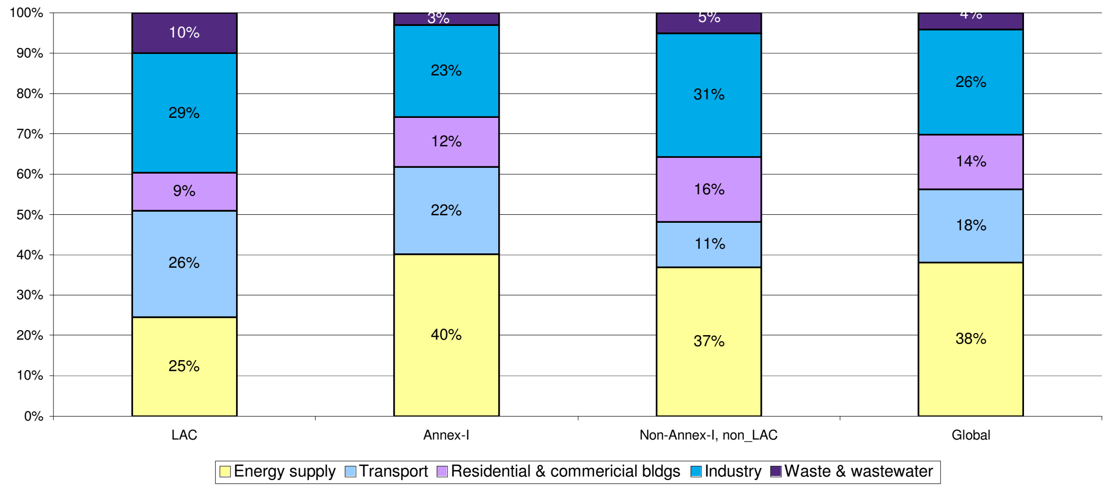
First, LAC has disproportionately high land use and forestry emissions that account for 31% of the world's land use and forestry emissions. While Annex I countries have only 7% land use emissions and developing countries have 44%, emissions from land use change and forestry account for 65% of total LAC emissions. One-third of those emissions are agriculture-based, and two-thirds are due to deforestation. In other developing countries only one quarter of emissions are due to deforestation and at a global scale this percentage drops to 17%.



Source: EDGAR & CAIT (CAIT used to estimate LUCF)

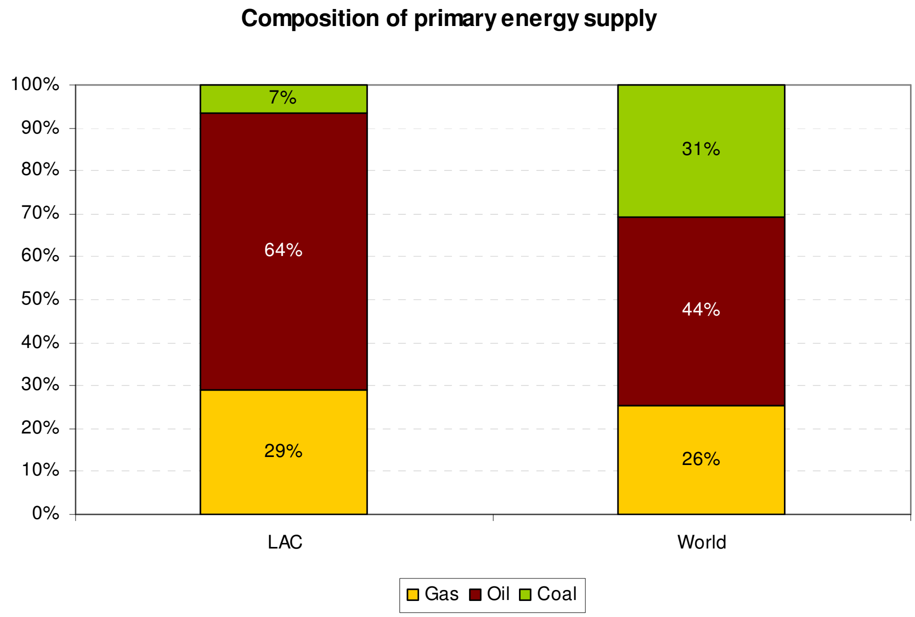
Low emissions from energy supply

Even when land use change and forestry emissions are excluded, LAC still exhibits a unique emissions profile. In all other regions, energy supply accounts for approximately 40% of energy-related emissions, whereas in LAC it represents only 25%.



Source: EDGAR 32FT2000 by RIVM/TNO (Olivier, J.G.J. and Berdowski, J.J.M., 2001, Global emission sources and sinks. In: J. Berdowski, R. Guicherit and B.J. Heij (eds.), The Climate System: 33-77. Lisse: Swets & Zeitlinger Publishers).

The low percentage of emissions from energy supply reflects a cleaner energy mix than other regions. Not only does 22% of the region's energy supply come from renewables particularly hydro (IEA 2005), but also the carbon intensity of the region's fossil fuels is lower than other regions. LAC increased its use of natural gas (half the carbon content of coal on a per unit of energy basis) from 13% of all fossil fuels used in 1980 to 23% in 2004. During those years the use of oil-based products fell from 73% to 64% (Marland, Boden, and Andres 2007). The region also uses 20% more oil (75% the carbon content of coal) than coal, as compared to the rest of the world.



Source: Marland, G., T.A. Boden, and R. J. Andres. 2007. Global, Regional, and National CO2 Emissions. In Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.

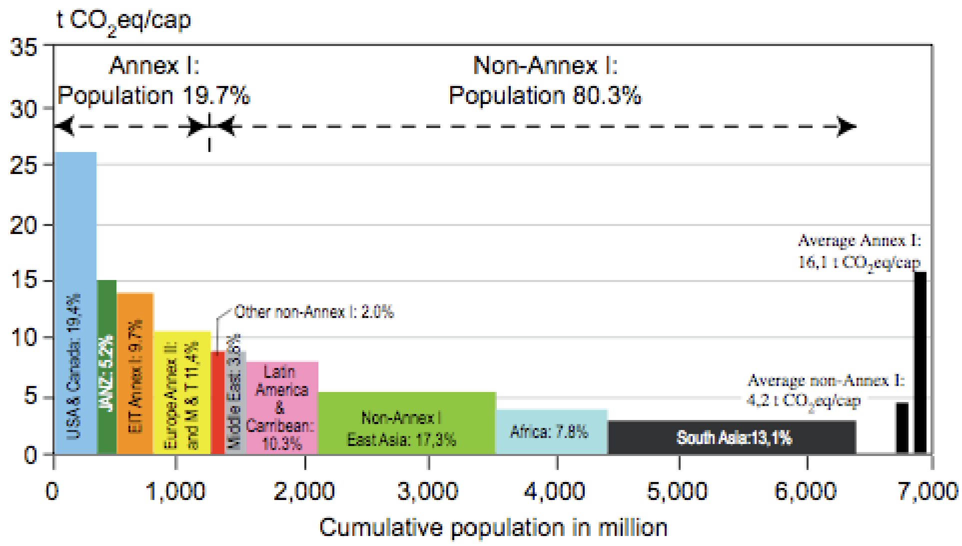
High emissions from transport and waste management

In contrast to all other regions, emissions from buildings in LAC are the lowest, while emissions from transport and waste management are higher than in any other region due to intense urbanization. 75% of the population in Latin America already lives in urban areas (GEF 2008) and most of the travel and waste production occurs there. The transportation sector alone accounts for one quarter of the energy-related emissions in Latin America, and is the fastest growing sector. The International Energy Agency projects that CO2 emissions from worldwide vehicles will increase by 140%, from 4.6 gigatonnes in 2000 to 11.2 gigatonnes in 2050. The vast majority of this increase will take place in developing regions, especially Latin America and Asia, as a result of increased motorization and vehicle use.

3.3 Emissions per capita.

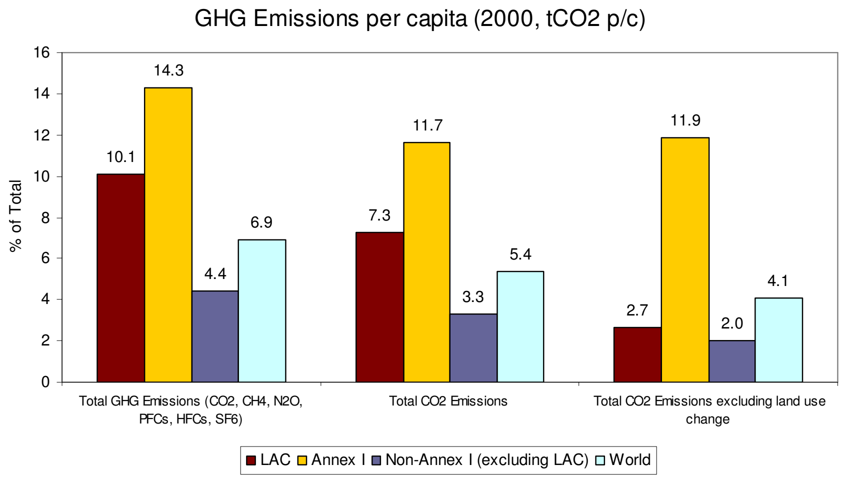
CO2 emissions per capita in LAC are at an intermediate level between developing and industrialized countries. In the below Figure (IPCC 2007), the height of the bars gives the average per-capita annual emissions of each region. The width of the bars gives the population. The percentages in the bars indicate a region's share in global GHG emissions. When weighted by population, emissions in high income countries are more than six times higher than in low income countries: while industrialized nations emit an annual average of 16.1 tons per capita, developing countries emit an average of 4.2 tons per capita, and the world average is 5.6 tons (including land use change and forestry, 4.3 tons if excluded). (CAIT)

Distribution of regional per capita GHG emissions (all Kyoto gases including those from land-use) over the population of different country groupings in 2004.



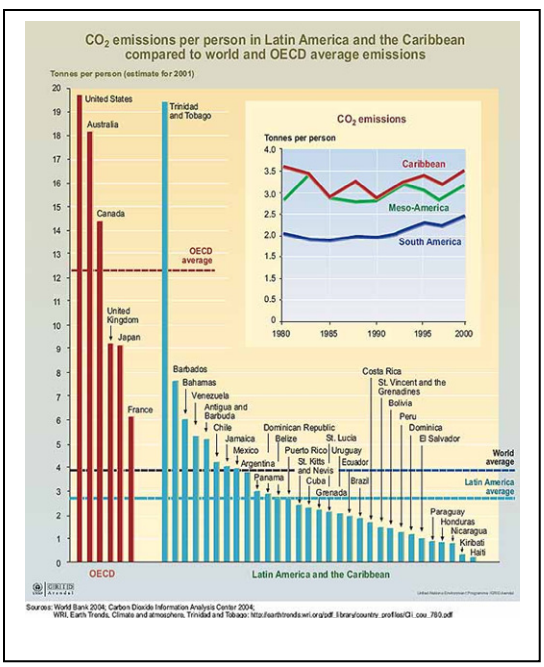
Source: Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

As with annual emissions, the per capita emission level of the region is highly impacted by the land use and forestry factor. Excluding land use change, LAC CO2 per capita emissions are 5.1 tons CO2-eq, only 35% above other developing regions and 80% below OECD. However, once land use emissions are factored in, emissions per capita in LAC rise to 9.4 tons CO2-eq, 130% higher than those of other developing countries, and only 30% lower than developed countries. (CAIT, WRI)



SOURCE: Climate Analysis Indicators Tool (CAIT) Version 5.0. (Washington, DC: World Resources Institute, 2008).

At the country level, and considering only energy related emissions, all LAC countries except Trinidad and Tobago are well below the OECD per capita average, and many of them are below the world average.



The inclusion of land use change and forestry emissions has again a major impact on the per capita emission level of many countries, as they have a preponderance of emissions from land use. The countries shaded in the below table (notably not including Mexico) have total per capita emissions that are higher than the world average of 5.6 tons due to the high incidence of land use emissions. The global effect of these emissions is of course most meaningful when stemming from countries with high population levels such as Brazil.

Comparison of energy-related and land use change emissions

	Tons CO2 per capita from Energy related emissions (2000)	Tons CO2 per capita from Land Use Change (2000)	Total per capita emissions (tons CO2)	% of Land Use Change in Total Emissions
Belize	No info (prob very small)	85.5		
Guyana	No info (prob very small)	46.9		
Panama	2	16.1	18.1	89%
Nicaragua	0.8	10.9	11.7	93%
Bolivia	1.5	10.1	11.6	87%
Brazil	1.9	7.9	9.8	81%
Peru	1.1	7.2	8.3	87%
Venezuela	5.7	5.9	11.6	51%
Guatemala	0.9	5.1	6	85%
Ecuador	1.9	4.8	6.7	72%
Paraguay	0.7	3.9	4.6	85%

Honduras	0.8	2.7	3.5	77%
Colombia	1.5	2.5	4	63%
Costa Rica	1.3	2.5	3.8	66%
Mexico	3.8	1	4.8	21%

Source: CAIT, 2000 Data

3.4 Intensity

LCR contributes only 5% of the world CO_2 emissions related to energy, from the consumption and flaring of fossil fuels, but emissions have been growing faster in LAC than in the world during the past 25 years (2.3% to 1.7% p.a.). Furthermore, there are substantial differences in the structure and evolution of energy emissions, mainly in electricity generation and transportation. The contribution of emissions from electricity generation in 2004 was much lower in LAC (22% vs. 31% in the world), but have been growing much faster (3.7% vs. 2.5%). On the other hand, the contribution of transportation in 2004 was much higher (34% vs. 21%). The growth of energy related emissions in the region can be explained by the growth in population and changes the carbon intensity of energy use (CO_2 emission per unit of primary energy) and in energy use (primary energy used per capita), which is driven by economic growth and energy intensity (energy consumed per unit of GDP).

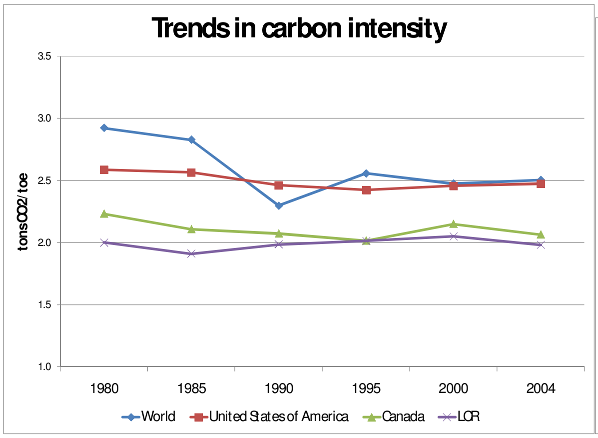
LCR- Composition of energy emissions
(excludes land use change and international bunkers)
1980-2004

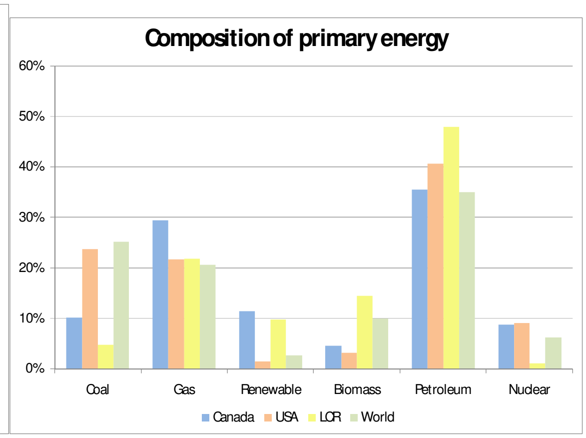
	1980	1990	2000	2004	Annual rate of growth 1980-2004
LCR					
Energy (Mtons CO2)	733	875	1208	1258	2.3%
Electricity	15%	17%	20%	22%	3.7%
Heat & other energy industries	10%	12%	10%	9%	1.9%
Manufacturing & Construction	28%	25%	23%	23%	1.4%
Transportation	34%	33%	33%	34%	2.4%
Other Fuel Combustion	11%	12%	11%	11%	2.2%
Fugitive Emissions	2%	2%	3%	1%	0.8%
Energy emissions in LCR (% of world)	4%	4%	5%	5%	
The World					
Energy (Mtons CO2)	17,797	20,740	23,812	26,759	1.7%
Electricity	26%	25%	30%	31%	2.5%
Heat & other energy industries	10%	16%	13%	13%	2.9%
Manufacturing & Construction	27%	23%	20%	21%	0.6%
Transportation	18%	19%	21%	21%	2.4%
Other Fuel Combustion	18%	16%	15%	14%	0.6%
Fugitive Emissions	1%	1%	1%	1%	-1.8%

Source: Climate Analysis Indicators Tools (CAIT), version 5.0 and IEA online data servi

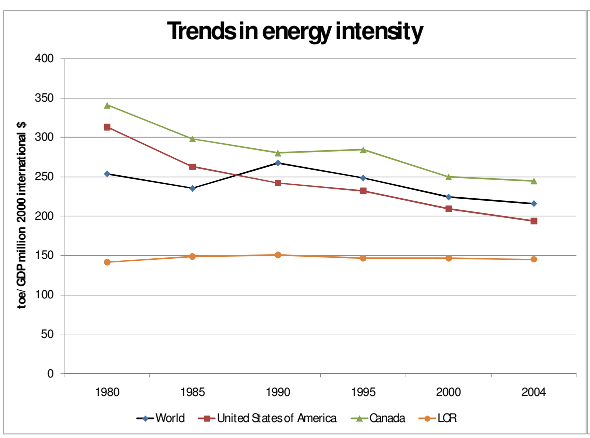
Electricity	CO2 emissions from electricity generation from public plants and autoproducers
Heat & other energy industries	CO2 emissions from heatplants and CHP generation and fuel combuested in other energy industries
Manufacturing & Construction	CO2 emissions from fossil fuel combustion in manufacturing and construction industries
Transportation	CO2 emissions from fossil fuel combustion in domestic
Other Fuel Combustion	CO2 emissions from fossil fuel combustion in commercial, residential and angricultural activities
Fugitive Emissions	CO2 emissions from natural gas flaring and venting

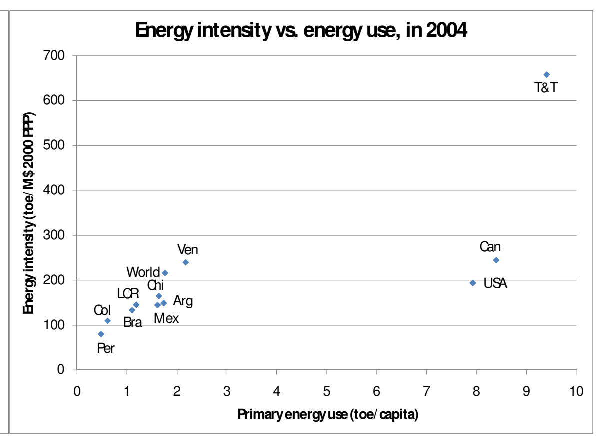
Carbon intensity of energy use in LCR has been about 2 tons of CO2/toe during the past 25 years, which is lower than the world average or developed countries like USA (2.5 tons CO2/toe). This is explained mainly by a cleaner energy matrix in LCR, with a low participation of coal (5% vs. 25%) and a higher participation of renewable energy (10% vs. 3%). Some developed countries like Canada, with a clean energy matrix, have also low carbon intensity like LCR.



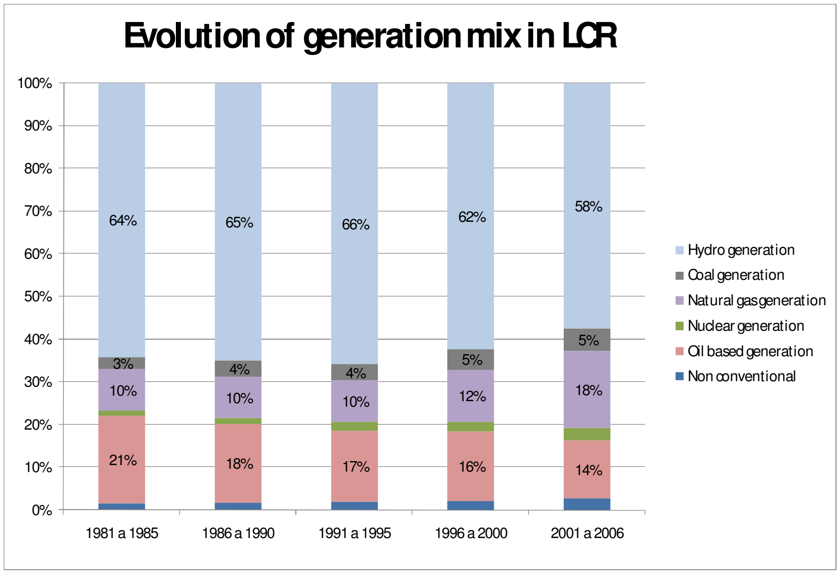


Energy intensity in LCR is low, about 150 toe/million GDP, as compared with world averages or developed countries like USA and Canada, with values in the range of 200 to 250. However, while developed countries have been able to reduce energy intensity during the past 25 years, LCR does not show any improvements. This can be explained by differences in economic development and energy use. The consumption of primary energy per capita in developed countries like USA and Canada is about 5 times greater than in LCR and these countries have been able to reduce energy intensity as the services sector grow and the participation of industry in the economy drops. Countries in LCR with energy intensive industries like Trinidad and Tobago, show high levels of energy use and energy intensity.





The low share of electricity generation in energy related emissions in LCR and the high rate of growth of electricity emission during the past 25 years can be explained by a low carbon intensity of electricity generation due to a cleaner generation mix (hydroelectric generation had a 66% share in the generation mix in 2005), a gradual increase in the participation of thermal generation after power sector reform and private participation were introduced in the early 1990´s in many countries in the region, and a high rate of growth of electricity demand.



Electricity demand increased at an annual rate of 4.7% in LCR during the past years as a result of economic development and major progress in electricity coverage which reached 90% in 2005, which combined with an increase of the share of conventional thermal generation in the generation mix from 34% to 37%, drives up emissions. On the other hand, LCR has a much lower carbon intensity of generation than the world average (261 vs. 500 grams CO2 per kWh).

CO2 emissions
Electricity generation

	CO2 emissions in Mtons CO2						Annual growth (%)/ 80-/ 04		Carbon intensity		Share of region in 2004 (%)		
	1980	1985	1990	1995	2000	2004	Emissions	Electricity generation	(gCO2/ kWh)	% Increase / 80-/ 04	World	LCR	South America
World	4,630.4	4,906.7	5,158.9	5,944.6	7,084.4	8,318.9	2.5%	3.1%	500	-13%	100%		
USA	1,534.8	1,624.4	1,752.0	1,879.8	2,196.5	2,209.2	1.5%	2.3%	555	-17%	27%		
Canada	72.6	85.8	94.6	96.2	127.2	119.4	2.1%	1.9%	205	4%	1%		
LCR	113.1	118.3	147.0	171.3	245.2	271.1	3.7%	4.7%	261	-20%	3%	100%	
Central America	2.7	1.7	0.9	5.2	5.7	8.1	4.8%	5.3%	253	-11%		3%	
Caribbean	5.7	7.2	7.8	13.2	15.9	18.8	5.1%	5.6%	712	-11%		7%	
South America	66.8	62.0	71.9	73.2	108.3	127.2	2.7%	4.6%	165	-35%		47%	100%
Brazil	8.5	9.8	12.1	15.2	30.8	33.1	5.8%	4.3%	87	41%			26%
Argentina	22.1	17.0	20.0	18.3	30.1	31.7	1.5%	3.5%	332	-37%			25%
Venezuela	21.1	21.4	19.2	16.1	17.9	24.2	0.6%	4.7%	252	-62%			19%
Chile	3.8	3.0	8.3	7.3	13.7	17.7	6.6%	6.2%	356	11%			14%
Colombia	4.8	6.5	7.6	8.8	8.9	8.3	2.3%	3.9%	169	-31%			7%
Peru	2.8	2.3	2.5	3.0	3.0	5.0	2.4%	3.8%	206	-27%			4%
Mexico	37.9	47.4	66.5	79.8	115.3	117.0	4.8%	4.9%	552	-2%		43%	

Sources: Emissions (IEA online data services), Generation (EIA)

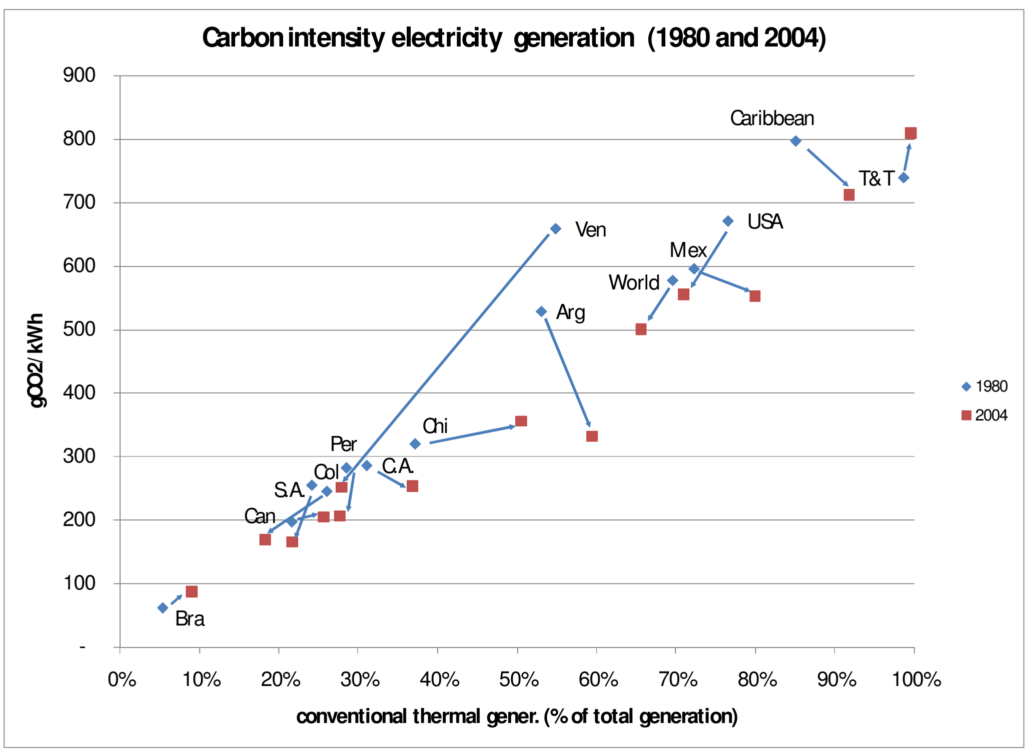
In general, as shown in the graph, there is a high correlation between carbon intensity of electricity generation and the participation of conventional thermal plants in the generation mix. However, LCR was able to decrease carbon intensity of electricity generation by 20% from 1980 to 2004, in spite of an increase of 3 percentage points in the share of thermal generation, by development of cleaner fuels (natural gas) and improvements in thermal efficiency (retiring old steam turbines and development of CCGT and medium speed diesel engines). However, there are striking differences between countries:

a) Brazil, with a hydro-based generation system and a very low carbon intensity of electricity generation (87 grams CO_2/kWh in 2004), increased its carbon intensity as the share of thermal generation increased.

b) Argentina and Mexico, big countries in the region with relatively high carbon intensity, were able to reduce carbon intensity and at the same time increase the share of conventional thermal generation mainly by an aggressive plan of developing high-efficiency gas-fired plants and retiring obsolete low-efficiency oil-fired steam plants.

c) Venezuela made spectacular progress in reducing carbon intensity by the development of low-cost generation projects mainly in the Caroni basin and reducing its reliance on thermal generation.

d) Central America reduced carbon intensity and at the same time increased the participation of conventional thermal generation by developing high-efficiency diesel engines running with residual oil.



4 Emissions Projections

The growth of emissions from LAC has to be examined individually for each major emitting sector, separating energy-related emissions from emissions due to land use change and forestry.

4.1 Energy-related emission growth

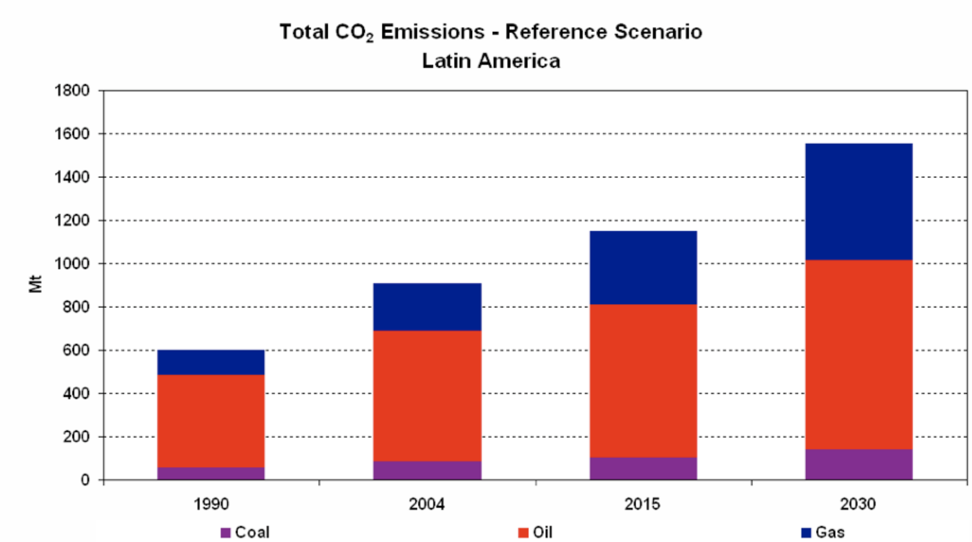
4.1.1 Energy

Energy demand is the main driver of world emissions' growth predictions. The World Energy Outlook (WEO 2007) predicts that under a business-as-usual (BAU) scenario, in 2030 the world's energy needs will be 55% higher than today, increasing at an approximate annual rate of 1.8%, and with 74% of the growth occurring in developing countries. By 2030, developing countries will account for more than half of the global energy market, up from 41% today. However, it is important to note that China and India are the primary growth nations, accounting for 45% of total increase in world demand.[17] Additionally, fossil fuels will continue to dominate the combined energy supply, and they will account for 84% of the overall increase in demand under the BAU scenario. As energy needs are predicted to increase substantially due to rising demand in developing countries, and fossil fuels are predicted to hold significant weight as an energy supply, a significant increase in GHG emissions is imminent in the BAU scenario.

In Latin America energy demand is expected to grow at 2.6% per year. Despite the region's current low carbon intensity, the comparative cleanliness of the energy matrix will tend to decline as a result of increasing use of both thermal generation and fossil fuels for transportation. Oil demand is expected to increase at 2.3% per year, driven by an increase in transport demand. Gas demand in the power sector will increase at 4.4% per year, increasing to 12% of

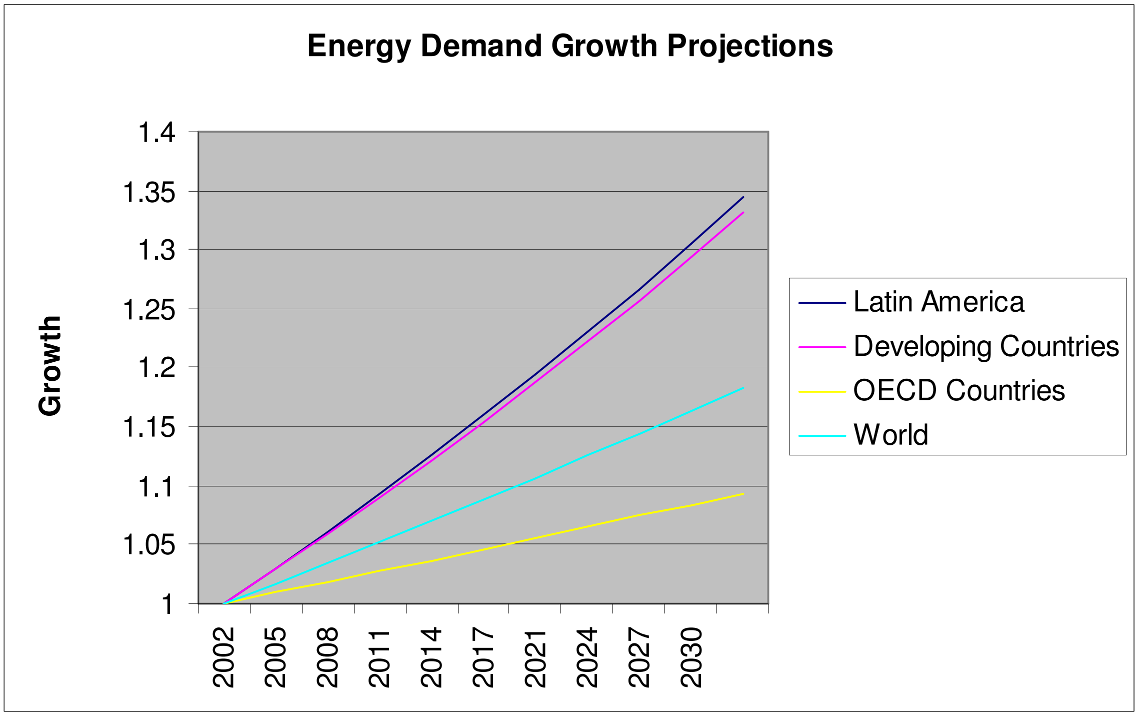
[17] International Energy Agency. *World Energy Outlook 2007, Executive Summary*. OECD 2007.

the fuel mix by 2030. According to the International Energy Agency reference scenario, traditional fuel-based emissions in Latin America from coal, oil, and gas will almost double from about 900Mt in 2004 to nearly 1600 Mt in 2030, with the most growth occurring in the gas sector.



As projections show significant growth in energy demand in Latin America, and as this energy is increasing in carbon intensity, CO_2 emissions for the region increase substantially, from 854 Mt in 2002 to 1929 Mt in 2030 (WEO 2004). This increase represents a 3% growth rate per year, slightly above the predicted growth rate for all developing countries at 2.9% per year, far above the OECD growth rate of 0.9%, and significantly above the world growth rate of 1.7% per year. See figure X below for a graphic representation of this projection. [18]

[18] Y axis isn't growth rate, it is the absolute growth from these various rates applied to 1.



A WEO 2004 sector-level breakdown of CO2 emissions from Latin America as a region[19] and Brazil and Mexico as individual countries reveals that the two sectors with the highest emissions growth are Transport, and Power Generation & Heat Plants.[20]

4.1.2 Transport

Transport emissions worldwide are expected to reach 9 GtCO2e by 2030 by which time they will account for one third to one half of energy-related emissions, growing fastest in non OECD countries. In Latin America transportation is already the fastest growing emission sector, and is expected to continue to grow by an average of 3.2% due to the fact that Latin America is a highly urbanized region with over 75% of the region's population living in urban areas, and expected to grow to 89% by 2030. Transportation emissions will increase by 3.0% in Brazil and 2.9% in Mexico. (GEF 2008) In addition to being the major source of energy related GHG emissions, the transportation sector is the leading cause of air pollution in Latin America, leading to significant health impacts.

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[19] LAC region data in WEO does not include Mexico, which is included in North America.

[20] Power generation refers to fuel use in electricity plants, heat plants and combined heat and power (CHP) plants. Both public plants and small plants that produce fuel for their own use (autoproducers) are included.

4.1.3 Electricity

Generation expansion in the region faces new conditions, quite different of the situation in the 1990´s. Competitive markets in LCR had in some cases difficulties in ensuring sufficient power capacity to meet demand and stable electricity tariffs, two ingredients that are essential for the political survival of any government. There is political opposition to the divestiture of public assets to foreign investors. Energy security has become a major concern due to the threats to energy supply posed by financial and energy crisis (Argentina energy crisis and limitations in the gas supply from Argentina to Chile and Uruguay), the increased energy import dependency of many countries and the prospects for high and volatile oil prices (central America and the Caribbean), power shortages during draught periods in countries dependent on hydroelectric generation (Chile, Brazil, Colombia), and the need to tackle climate change. Furthermore, private investors are reluctant to take the country and project risks in many countries in the region and the support of the public sector is needed.

The countries dependent on imported fuels have adopted a policy of diversification of energy sources to improve energy security, reduce generation costs and mitigate the volatility of liquid fuel prices. Mainly, development of indigenous renewable resources (hydro, wind, geothermal, biomass, biofuels), importation of other fossil fuels (LNG, pipeline natural gas, coal), implementation of energy efficiency programs and expansion of the capacity of electricity interconnections with neighboring countries. Other countries in the region, less dependent on imported fuels, have adopted the same policy to improve energy security and accelerate the development of clean energy.

The energy plans prepared at regional level and at country level in general consider a reference scenario where these policies are implemented but no strong actions are taken. In some cases, these reference plans can be considered a "business as usual" scenario.

Most projections show a strong growth of electricity demand at regional and country level, between 3.7% and 5% p.a. for the medium term (10 years), slowing down to 2.8% to 3.9% p.a for the next 15 years. The region continues to rely on the development of its large potential of medium and large hydroelectric projects, complemented with small renewable. IEA´s World Energy Outlook 2006 report calls for the development of about 5,000 MW/year of renewables in South and Central America, but the National Energy Plan 2030 of Brazil considers the development of about 4,400 MW/year only for this country, an indication that IEA uses a lower rate of growth of demand and a less aggressive expansion of hydro plants. On the other hand, the generation expansion plan for Mexico, a thermal base generation system, considers only 300 MW/year.

In spite of the plans to develop renewable power in the region, CO2 emissions related to power generation at projected to grow at relatively high rates, because the share of renewables in the generation mix declines in all projections in 2005-2030, from 70% to 59% in IEA´s reference case and 86% to 78% in the Brazilian case.

However, emissions are projected to grow in the medium term at annual rates of 3.2% to 3.8% at regional level, at a lower rate than demand growth, which drives down carbon intensity of electricity generation. This is mainly due to the development cleaner and more efficient technologies (gas-fired CCGT) and a gradual retirement of old oil fired plants. The participation of nuclear and coal-fired generations remains marginal in the IEA´s projections (below 6%), stable in the Mexican case (about 19%), and growing but marginal in the Brazilian case (from 4% to about 7%). Carbon intensity declines at annual rates between -0.3% to -0.5% at regional level, and at a faster pace in Mexico, a country with a thermal based generation system that starts from high carbon intensity levels. On the other hand, carbon intensity would grow in Brazil at annual rates of about 1%, due to the fact that it starts from a very low level and increases its share of conventional thermal generation.

LCR- Generation expansion 2005-2030
Reference case
Generation mix and CO2 emissions

		IEA World Energy Outlook 2006 (South and Central America)			OLADE- Energy Prospective (all region)		BRAZIL-National Energy Plan 2030 (only Brazil)			MEXICO- Electricity Prospectives 2007 (only MEXICO)	
		2004	2015	2030	2008	2018	2005	2020	2030	2006	2016
Installed capacity renewables	TW	132	182	256			70	125	177	12	15
Share of renewable energy	%	70%	64%	59%			86%	79%	78%	16%	12%
Medium and large hydro	%	67%	61%	55%			82%	73%	68%	13%	9%
Other renewables	%	2%	3%	4%			4%	7%	9%	3%	3%
Annual rate of growth											
Generation	%		3.7%	2.8%		4.1%		4.7%	3.9%		5.0%
Emissions	%		3.2%	2.8%		3.8%		5.7%	5.6%		4.2%
Carbon intensity	%		-0.5%	-0.1%		-0.3%		1.0%	1.6%		-0.7%

4.1.4 Solid waste

A recent study by the US Environmental Protection Agency (EPA 2006) estimates methane emissions and trends from solid waste and wastewater in the LAC region. The EPA study collected data from national inventories and projections reported to the United Nations Framework Convention on Climate Change (UNFCCC) and supplemented data gaps with estimates and extrapolations based in IPCC default data and mass balance calculations. The study shows that emissions are currently at 95 MMtco2 eq, and under a BAU scenario will increase to 109 MMtCo2 by the year 2020, a 13% increase. Table x presents values from the US EPA study.

Table x Methane Emissions from Landfilling of Solid Waste							
Country	**Methane Emissions (MMTCO2)[21]**						
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Argentina	5.51	5.89	6.28	6.66	7.02	7.36	7.68
Bolivia	0.38	0.42	0.47	0.52	0.56	0.61	0.66
Brazil	12.98	14.54	15.56	16.56	17.47	18.29	19.00
Chile	1.43	1.55	1.66	1.76	1.86	1.96	2.06
Colombia	6.55	7.21	7.88	8.53	9.16	9.77	10.34
Ecuador	0.84	0.93	1.01	1.09	1.16	1.24	1.30
Mexico	26.04	28.51	30.95	33.28	35.45	37.42	39.16
Peru	1.84	2.01	2.19	2.36	2.53	2.70	2.86
Uruguay	0.60	0.62	0.64	0.67	0.69	0.71	0.73
Venezuela	5.60	6.29	6.97	7.65	8.32	8.96	9.56
Rest of Latin America	10.80	11.59	12.42	13.25	14.04	14.79	15.52
TOTAL	**72.57**	**79.56**	**86.03**	**92.33**	**98.26**	**103.81**	**108.87**

Source: US EPA (2006)

Methane emissions from solid waste landfills are expected to increase due to the growth of solid waste generation rates caused by growing urban population and increased economic activity. Ironically, improvements in landfilling operational practices are expected to increase anaerobic conditions in landfills causing more methane emissions, which can then only be reduced by capturing and flaring techniques, or in the best of all cases capturing for power generation.

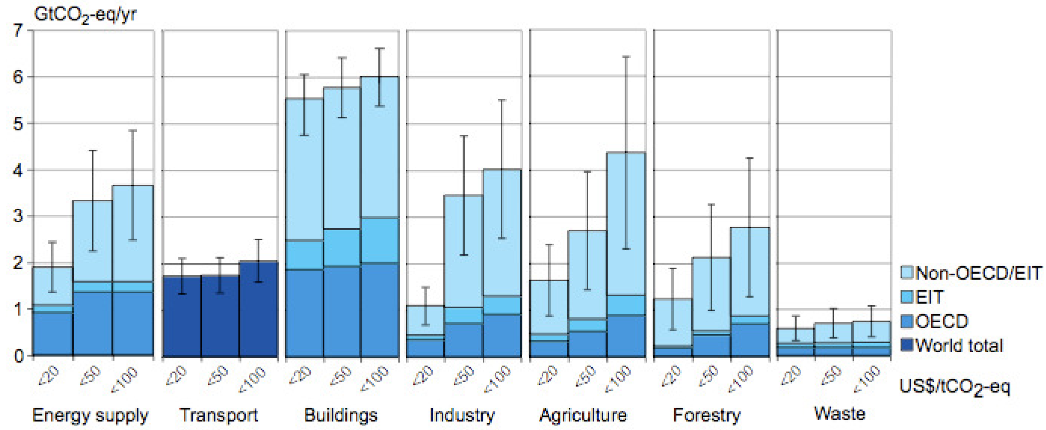
[21] MMT (Million Metric Tons)

5 Mitigation Potential

On a global level, there is the potential to reduce emissions by around 6GtCO_2/yr in 2030 with net negative costs, as they focus mainly on energy efficiency.[22] In addition, at the <US$100/t$CO_2$-eq level, reductions are in the range of 15.8 to 31.16 GtCO_2/yr. The most comprehensive study on mitigation potential by sector, published in the IPCC Fourth Assessment Report, looks at the aggregated regions: Non-OECD/EIT, EIT, OECD, and World and breaks the sectors down into energy supply, transport, buildings, industry, agriculture, forestry, and waste. As LAC falls in the greater Non-OECD/EIT region, it would be most appropriate to apply results from this region to LAC.

According to the economic mitigation potential chart below, constructed by bottom-up studies, the sectors with the highest potential for the non-OECD/EIT region at the <US$100/t$CO_2$-eq level include buildings at 1.8 to 2.3GtCO_2-eq/yr, agriculture at 0.45 to 1.3 3GtCO_2-eq/yr, and industry at 0.60 to 1.2 3Gt CO2-eq/yr. In the buildings sector alone, fuel savings could produce anywhere from 1.0 to 1.3 3GtCO_2-eq/yr while electricity savings could produce 0.8 to 1 3GtCO_2-eq/yr.

[22] "Working Group III Report "Mitigation of Climate Change, Summary for Policy Makers", IPCC Climate Change 2007



(potential at <US$100/ tCO_2-eq: 2.4 - 4.7 Gt CO_2-eq/yr)	*(potential at <US$100/ tCO_2-eq: 1.6 - 2.5 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 5.3 -6.7 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 2.5 - 5.5 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 2.3 -6.4 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 1.3 - 4.2 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 0.4 - 1 Gt CO_2-eq/yr)*

Figure SPM.6: *Estimated sectoral economic potential for global mitigation for different regions as a function of carbon price in 2030 from bottom-up studies, compared to the respective baselines assumed in the sector assessments. A full explanation of the derivation of this figure is found in Section 11.3.*

Notes:
1. The ranges for global economic potentials as assessed in each sector are shown by vertical lines. The ranges are based on end-use allocations of emissions, meaning that emissions of electricity use are counted towards the end-use sectors and not to the energy supply sector.
2. The estimated potentials have been constrained by the availability of studies particularly at high carbon price levels.
3. Sectors used different baselines. For industry the SRES B2 baseline was taken, for energy supply and transport the WEO 2004 baseline was used; the building sector is based on a baseline in between SRES B2 and A1B; for waste, SRES A1B driving forces were used to construct a waste specific baseline, agriculture and forestry used baselines that mostly used B2 driving forces.
4. Only global totals for transport are shown because international aviation is included [5.4].
5. Categories excluded are: non-CO_2 emissions in buildings and transport, part of material efficiency options, heat production and cogeneration in energy supply, heavy duty vehicles, shipping and high-occupancy passenger transport, most high-cost options for buildings, wastewater treatment, emission reduction from coal mines and gas pipelines, fluorinated gases from energy supply and transport. The underestimation of the total economic potential from these emissions is of the order of 10-15%.

In non-OECD/EIT countries in general, mitigation potential is highest in buildings, agriculture, and industry. However, different conclusions are reached in the context of the LAC region. From the above discussion on current emissions in the region and the projected growth under a BAU scenario, it is evident that the greatest potential for mitigation in the region is in the land use sector, and secondly in those energy-related sectors of highest emissions and emission growth.

5.1 Energy related mitigation potential

As it is unique in its emission profile, the LAC region is also unique in its energy related mitigation potential. In general, the highest mitigation potential in developing countries is found in energy efficiency in buildings, agriculture and industry (IPCC 2007). By contrast, LAC's energy-related mitigation potential with respect to growth projections is mainly in energy energy efficiency and supply, transport and waste management.

5.2 Energy Efficiency

A recent report produced by the Collaborative Labeling and Appliance Standards Program (CLASP) for the Japanese Ministry of Economy, Trade and Industry (METI) assessing the potential global and regional impacts of Standards and Labeling in the building sector (residential and commercial) if S&L best practices were adopted shows that Standards and Labeling in Latin America could reduce 67 megatonnes of CO_2 per year by 2020 and 125 megatonnes per year by 2030 (McNeil et al 2008). The same report indicates that EES&L programs could account for about 20% of total "zero cost" potential in 2020, and about 33% of the potential in 2030 from all energy efficiency measures. The remaining potential could presumably be achieved through all other approaches, including building codes, utility programs, incentives, and behavioral changes.

5.2.1 Electricity supply

LAC´s mitigation potential of CO_2 emissions related to electricity generation is mainly in supply, a more aggressive development of clean energy, and energy efficiency in the demand side.

Both IEA´s and OLADE´s report consider an alternative generation expansion scenario to reduce the rate of growth of CO_2 emissions related to power generation, based on energy efficiency and development of clean energy in IEA´s case, and energy and economic integration in OLADE´s case. According to IEA it is possible to reduce in the medium term total generation related CO_2 emissions in about 12%, by saving 5% of projected demand by 2015 and increasing the participation of small renewable power in the generation mix from 3% to 7%. By 2030, IEA report estimates that energy savings of 13% would reduce emissions by 29%. On the other hand, OLADE estimates that strong energy integration (gas and electricity interconnections) will foster f economic development and electricity demand in the region (increase of 4.1% to 5.5% in annual growth) and, at the same time, reduce the rate of growth of CO_2 emissions from 3.8% to 2.7%.

Brazil´s national energy plan already considers an aggressive development of renewable power generation resources in 2005-2030, an addition of 88 GW of medium and large hydros to the existing capacity of 69 GW, and 19 GW in small renewables (small hydros, biomass and wind) to the existing capacity of 1.4 GW. Furthermore, the plan considers energy savings of about 5% of projected demand by 2030 as a result of the continuation of the existing energy efficiency policies. The plan estimates that additional savings of 5% could be possible by a stronger promotion of energy efficiency, which could displace in the margin the expansion of about 5000 MW in conventional thermal generation, reducing about 13 Mtons of CO_2 emissions, equivalent to 15% of total projected emissions of electricity generation.

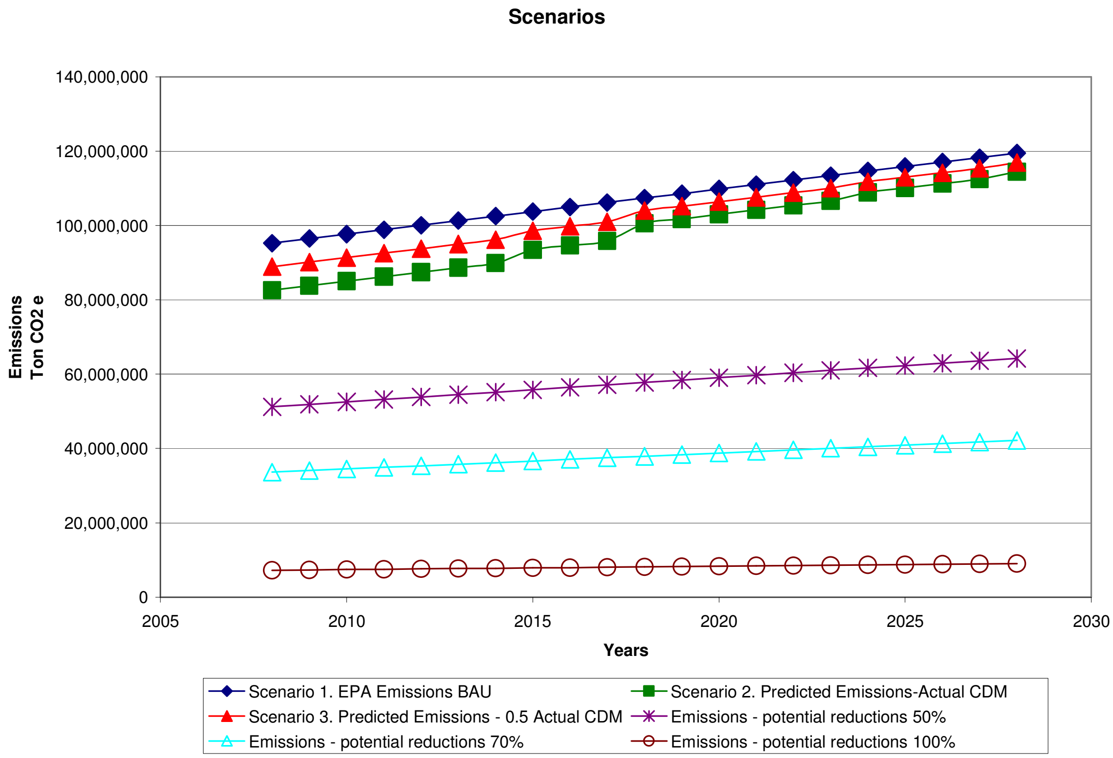
Mexico´s generation expansion plan includes the continuation of existing energy efficiency programs (CONAE, FIDE and PAESSE), which according to official estimates may have saved in 2007 about 11% of demand. The expansion plan assumes energy savings of about 10% by 2016, which represents an increase of total energy saved from 22 to 33 TWh. Assuming that energy saved by these programs would have been generated by high efficient CCGT, these programs could be credited for a reduction in CO2 emissions of 14.5 Mtons CO2/year or 8% of projected emissions.

5.2.2 WASTE MANAGEMENT

The mitigation potential from waste landfills in LAC has been estimated and is shown in Figure xxx. The estimation takes into account only municipalities with population higher than 500.000 inhabitants, as these are the only ones that would meet the general criteria for feasible LFG projects (i.e. landfills with over one million tons of waste place with depth of 12-20 meters). There are currently 117 cities of greater than 500,000 inhabitants with a total of 225 million people generating 74 million tons per year of solid waste.

Scenario 1 presents the predicted emission by EPA showing business as usual (BAU). *Scenario 2* presents the predicted emissions by EPA taking into account the reductions with the Actual registered CDM projects, assuming that 100% the predicted CERs will be captured. *Scenario 3* presents the predicted emission by EPA with 50% of the estimated reductions with the actual registered CDM projects, this based on World Bank experience. *Scenario 4* assumes that only half of the 117 cities with more than 500.000 inhabitants meet the general criteria for feasible LFG-to energy projects. *Scenario 5* assumes that 70% of the cities meet the criteria, and *Scenario 6* assumes that all of the cities meet the criteria. Population growth rates were taken from the World Urbanizations Projects (United Nations, 2003), and the broadly recognized generation constant of 64 m3 CH4 / Ton solid waste was used to estimate the methane emissions.

Figure X



The currently registered CDM projects in LAC represent only 4 – 15% of the total waste related emissions. However, the potential future avoided emissions from LFG projects in LAC could represent 60 -110 Mtons CO2eq,[23] or a range of 46% to 95% of the total waste related emissions, assuming appropriate technology, financing and policies are in place.

5.3 Country level mitigation potential

In addition to sectoral assessment of mitigation potential, it is also helpful to provide some analysis of mitigation opportunities at the country level.

5.3.1 Mexico

As previously discussed, Mexico is the highest energy related emitter in the LAC region. Major factors affecting growth in Mexican greenhouse gas emissions are

[23] The potential future avoided emissions in this estimate only represent possible LFG projects in landfills, and do not take into account those related to better solid waste management practices, such as composting, proper recycling, etc

population growth, economic development, increase in energy supply and land use change. Over the last decade Mexico began to reduce deforestation rates, switch to natural gas and save energy, reducing annual emissions growth over by 5 percent, or 10 million tons of carbon per year (Pew Center 2002).

As a further contribution to the global mitigation effort, Mexico has recently released its National Strategy on Climate Change (2007), which acknowledges the importance of urgent and concerted action on climate change mitigation and adaptation. The Strategy emphasizes Mexico's willingness to engage in more ambitious climate change framework than that established by the Kyoto Protocol and its willingness to adopt long-term targets of a non-binding nature. Mexican government representatives have frequently stated their opinion that developed countries should make deeper commitments while major developing countries, such as Mexico, should progressively increase their participation in the climate regime.

One of the major objectives of the strategy is to decouple the increase in emissions from economic growth. The two sectors targeted for mitigation effort are energy and land use change and forestry. In terms of energy generation and use, Mexico intends to not only reduce emissions, but also to provide a "cleaner, more sustainable, efficient, and competitive energy strategy". Energy and industry related emissions in 2004 amounted to 367 Mtons, and projections for 2014 increase emissions to 500 Mtons. The 2007 Strategy identifies a total mitigation potential of 107 Mtons in the energy sector by 2014, representing a 21% reduction from BAU over the next six years. Most of the mitigation will come from end use energy efficiency (28 MtCO2), increase in the use of natural gas (21 MtCO2) and increase in the cogeneration potential in the cement, steel and sugar industries (more than 25 MtCO2).

ENERGY SECTOR OPPORTUNITIES FOR GHG MITIGATION TO 2014		
AREA OR ACTIVITY	**PROPOSED MEASURES**	**ESTIMATED REDUCTION ($MtCO_2e$)**
Energy efficiency		
Standards and programmes of the National Commission for Energy Conservation ("CONAE")	Continue application of current energy efficiency standards and develop and implement new ones.	24.0
Energy efficiency and savings programmes of the Trust Fund for Energy Saving ("FIDE").	Strengthen current FIDE programmes and promote new ones.	3.9
Mexican Oil Company (PEMEX)		
Combined Heat and Power (CHP)[1] in PEMEX	Install CHP plants in the facilities of the National Refining System and in other PEMEX facilities.	7.7
Centralized power supply to offshore platforms	Substitute individual generation plants for a 115 MW combined cycle plant connected to offshore platforms.	1.9
Improvement of energy performance in refineries	Increase PEMEX's energy efficiency target by 5%.	2.7
Fugitive emissions of methane (NH_4)	Reduce fugitive NH_4 emissions from natural gas production, transportation and distribution; increase efficiency of flares on offshore platforms.	2.4
Power generation and distribution (Federal Electricity Commission and Central Light and Power)		
Power transmission and distribution	Increase the efficiency of transmission and distribution lines by 2%.	6.0
Thermal efficiency in fuel oil-fired thermoelectric plants	Increase thermal efficiency of fuel oil-fired thermoelectric plants by 2%.	0.7
Conversion to natural gas and repowering of thermoelectric plants on the Pacific coast; modernization of the facilities of the National Refining System	This proposal requires simultaneous action: phase out and reorient fuel oil production incentives; install on the Pacific coast a gasification terminal for imported liquefied natural gas, and convert fuel oil-fired thermoelectric plants to combined cycle.	21.0
Industrial sector		
CHP	Develop the CHP potential of the national cement, steel and sugar industries, among others.	>25
Renewable energy		
Power generation from renewable energy sources	Install 7,000 MW of renewable energy capacity to generate 16,000 GWh per year (additional to the El Cajon and La Parota hydroelectric plants).	8.0
Biofuels	Introduce sustainably produced biofuels.	NA
Transport sector		
Vehicle replacement	Replace freight trucks and diesel busses ≥10 years old from 2008 onwards.	2.0
Freight by rail	Increase rail coverage for freight transportation by 10%.	1.5

[1] Combined Heat and Power (CHP) = Cogeneration

In the land use change and forestry sector in 2002 Mexico emitted 90 billion tons of CO2, mostly from combustion of biomass and conversion of forested lands. In the Climate Change Strategy Mexico considers three categories of mitigation actions: conservation of existing carbon stocks, sequestration through reforestation and commercial planting, and substitution of fossil fuels with biofuels. The Strategy identifies a mitigation potential that ranges from 11 to 21 billion tons CO2 in the land use and forestry sector by 2012, most of which will come from public reforestation and private planting, and will depend on the level of available resources.

It is important to note that Mexico's strategy has not only identified and quantified the mitigation potential in all relevant sectors, it has done so for the 2012-14 timeframe. Thus Mexico is not waiting for a post 2012 climate regime to be negotiated at the international level, but is rather taking the unilateral initiative to make a concrete and early contribution to global mitigation efforts. The next chapter of the climate regime will have to recognize and reward these early actions from developing countries.

OPPORTUNITIES FOR CARBON CONSERVATION IN FORESTS TO 2012

TYPE OF ACTIVITY	PROPOSAL	CARBON CONSERVATION ($MTCO_2e$)
Sustainable Forest Development	Increase the area under sustainable forest management by 2.6 million hectares per year.	6,000-12,000
Payment for Environmental Services	Expand coverage of current programmes of payment for environmental services ("PSAH" and "PSA-CABSA", for their Spanish acronyms) to cumulatively reach 2.49 million hectares by 2012.	1,500-3,100
Conservation of forest ecosystems in Protected Areas	Increase coverage of Protected Areas by 500,000 hectares per year to accumulate 3 million hectares in the National Protected Areas System ("SINAP", for the Spanish acronym).	500-1,000
Wildlife Management Areas	Integrate approximately 6 million hectares of tropical, temperate and arid zone ecosystems within Wildlife Management Areas ("UMA").	3,000-4,250
Forest health	Carry out phytosanitary diagnosis and treatment in approximately 640,000 hectares of forest per year.	1,800-3000

5.3.2 Brazil

The government of Brazil is currently elaborating its climate change strategy, which is due for publication by the end of 2008. A 2002 Pew Center on Global Climate Change report on mitigation potential in Mexico and Brazil[24] offers some preliminary insights.

Brazil is the highest emitter in Latin America. However, Brazil's annual emissions are 10 percent lower than they would be if not for aggressive biofuels and energy efficiency programs aimed at reducing energy imports and diversifying energy supplies. A tax incentive for buyers of cars with low-powered engines, adopted to make transportation more affordable for the middle class, accounted for nearly 2 million tons of carbon abatement in the year 2000. Flex-fuel cars took off in 2003, when the Brazilian government instituted a 14 percent sales tax for cars capable of burning ethanol, instead of the 16 percent levied on gasoline-only vehicles. The mitigation scenario considered in the Pew study assumes that 10 percent of the existing car fleet would use ethanol by 2020. In fact, Brazil already satisfies nearly half of its domestic passenger vehicle fuel demand with ethanol, and 70% of all new cars are flex fuel. The mitigation scenario further assumes that the efficiency of bagasse-fired cogeneration is improved by some 50 percent, small-scale hydro reaches 14 GW by 2020, all-natural gas-fired cogeneration replaces all thermal power plants, and additional electricity conservation saves 20 percent of projected electricity consumption in 2020. If all these measures were to be successful, Brazilian emissions would fall below the BAU scenario by 18 million tons of carbon, or 13 percent, in 2010; and by 45 million tons, or 20 percent, in 2020 (see Table below).

[24] The Brazil data is taken from a study done by Schaeffer, Szklo, and Schuler of the Federal University of Rio de Janeiro.

Table 3

Mitigation Potential

in Brazil, 2010 and 2020

Mitigation Options	Incremental abatement in emissions (MtC)[1] 2010	2020
Use of ethanol[2]	1.2	1.7
CHP fired by sugar-cane bagasse[3]	3.4	5.3
Wind power[4]	1.9	3.5
Small-scale hydro[5]	2.9	4.5
CHP fired by natural gas	1.8	4.4
Electricity conservation[6]	7.1	25.2

Notes:
(1) Reductions from CNPE Scenario's projected CO_2 emissions of 136.7 MtC/year in 2010 and 223.1 MtC/year in 2020.
(2) Assumes that 5% of the fleet still consists of automobiles fueled solely by ethanol in 2010 and 10% in 2020.
(3) Assumes that the power generation efficiency enhancement program for cogeneration plants continues.
(4) Assumes the pace of implementation forecast for the next four years and 15 GW installed by 2020.
(5) Assumes that capacity reaches 7 GW in 2010 and 14 GW in 2020.
(6) Assumes conservation savings of 10% of energy consumption in 2010 and 20% in 2020.

Mitigation potentials may not be completely additive.

Source: Estimates by Roberto Schaeffer, Alexandre Salem Szklo, and Marcio Edgar Schuler, Federal University of Rio de Janeiro, 2002.

Brazil's mitigation potential has been more recently estimated by the Center for Clean Air Policy (CCAP 2006) at a higher level than the 2002 Pew report. The CCAP report covers only emissions in the electricity, industrial, transportation, and residential and commercial sectors. Using these sectors as a baseline, the report states that GHG emissions in Brazil are projected to more than double from 2000 over the next two decades due to increases in population, economic activity, and urbanization. However, since 2000 Brazil has been implementing two programs that have GHG mitigating effects. The Program for Incentive of Alternative Electric Energy Sources (PROINFA) is estimated to reduce electricity sector emissions by 14 percent below BAU levels in 2020. The above mentioned ethanol program, which has led to the development of flex fuel vehicles and cost competitive ethanol, is estimated to reduce transportation emissions by 18 percent below BAU levels in 2020. The program is estimated to achieve its reductions at greater than $30 per ton CO2, yet has been pursued aggressively. If fully implemented, these two programs will slow the projected growth in GHG emissions in the selected sectors and reduce emissions by 14 percent below projected levels by 2020.

Beyond ongoing programs, the study identifies additional opportunities for cost-effective reductions in the electricity, transportation and cement sectors. Implementation of all measures identified would reduce emissions from the sectors evaluated by nearly 30% below BAU in 2020—a reduction of 147 MMTCO2— which is more than the total emissions in 2000 from electricity, cement, iron and steel, pulp and paper, and light-duty vehicles combined. (table on page 108 of CCAP report).

The above mentioned energy and industry measures would reduce investment requirements by enhancing energy efficiency, reducing net energy imports and improving the balance of trade by further expanding renewable energy use, and providing several ancillary social benefits such as improved health conditions. As discussed, if implemented on a broad scale, these measures would sharply curtail projected increases in carbon emissions. However, the largest source of carbon dioxide emissions in Brazil is land use change, primarily deforestation. Mitigation efforts in Brazil will have to focus primarily on the adoption of specific measures to curb deforestation.

6 Mitigation under the Kyoto Protocol

Large reductions in the growth of GHG emissions have already been achieved indirectly in a number of developing countries – including in Latin America – as a result of development policies that do not explicitly target the mitigation of climate change, do not fall under the Kyoto Protocol, and were implemented without carbon finance. As shown by Chandler et al. (2002), over the past three decades Brazil, China, India, Mexico, South Africa and Turkey have reduced carbon emissions by about 300 million tons a year. From the climate perspective, these policies are described as 'no-regrets' policies, in the sense that the development policies were considered to be socially desirable, even without considering their benefits in terms of mitigating climate change.

In Brazil, for example, tax incentives to increase the production of small and inexpensive automobiles (fewer than 1000 cc) and improvements in the management of energy supply and demand were responsible for an 11 percent reduction in CO2 energy emissions, with respect to what would have been the case in 2000 without the above policy measures (Szklo et al. 2005). Similarly, Brazil has provided several examples of the feasibility of reducing deforestation while addressing other development challenges. For example, from January 2004 through December 2006, Brazil created 23 million hectares of public forest reserves in the Amazon, including large reserves at the edge of the agricultural frontier and contributing to a 50 percent reduction in deforestation rates between 2004 and 2006 (Nepstad et al. 2007).

Above and beyond these policies that respond to needs and benefits other than climate, the LAC region also undertook a series of mitigation projects motivated mainly by the purpose of reducing emissions. Most of these projects were either funded by a donation of the GEF or are being channeled through the CDM and receive carbon finance in exchange for the sale of the Certified Emission Reductions.

6.1 Global Environment Facility (GEF)

The Global Environment Facility provides grants for climate change mitigation and adaptation. As the financial mechanism of the Climate Convention, the GEF allocates and disburses about US$250 million USD worldwide per year in projects in energy efficiency, renewable energies, low carbon technologies and sustainable transportation. From the time of its inception in 1991 to July 2007, the GEF had allocated a total of just over USD 3.3 billion to climate change projects from the GEF Trust Fund. Further co-financing in excess of USD14 billion has been leveraged for these GEF projects.

The largest share of GEF Trust Fund resources for the climate change focal area has been assigned to long-term mitigation projects: renewable energy (USD 861.1 million); energy efficiency (USD 719.8 million); low GHG emitting technologies (USD 318.2 million); and sustainable transport activities (USD 160.6 million).

In LAC specifically, over its sixteen year lifetime the GEF has approved a total of USD400 million distributed over 40 full-sized projects and 14 medium-sized projects. (See excel document of full-sized and medium-sized projects.) In addition, 176 small grants projects have also been approved through the GEF Small Grants program.

The targeted amount of funding from the fourth replenishment of the GEF (GEF 4) is USD 990 million over the period 2006–2010. Replenishment of funds in the GEF depends on voluntary contributions from donors. The trust fund contributions follow predefined burden sharing by donors. The amount of funding under the GEF after 2010 will depend on negotiations on GEF5. The trustee of the GEF has already begun to make arrangements for GEF 5. However, if the funding available under the GEF remains at its current level and continues to rely mainly on voluntary contributions, it will clearly not be sufficient to address the future financial flows needed for mitigation (or adaptation).

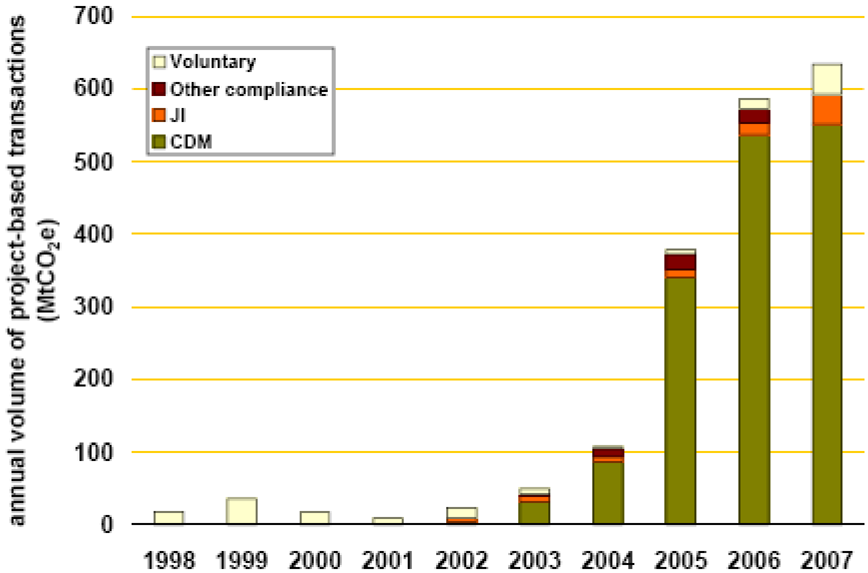
6.2 Clean Development Mechanism (CDM)

Another source of funding for mitigation activities is currently being derived and will continue to be derived from the Clean Development Mechanism (CDM). The objectives of the CDM are, first, to assist industrialized countries in achieving compliance with their emission reduction commitments under the Kyoto Protocol and, second, to assist developing countries both in achieving sustainable development goals and in contributing to climate mitigation efforts (Figueres, 2004). Through the CDM market mechanism, investors in climate-friendly projects in developing countries can be remunerated for generating emission reductions credits that can be applied toward developed country emission reduction targets. To that end, investors need to prove that the emission reductions generated by their projects are "additional" with respect to what would have occurred in the absence of the corresponding CDM credit or, in other words, in a business as usual scenario. As shown by Ellis et al. (2007), while demand for CDM projects comes from so-called Annex I countries that have assumed mandatory emissions constrains in the context of the Kyoto Protocol, the interest of host countries in this mechanism arises from the possibility of attracting new investment to projects that can contribute both to sustainable development and to climate change mitigation. Thus, from the point of view of developing countries, the CDM can be a source of finance, technology transfer, and strengthening of institutional capacity in the area of climate change policy.

The CDM evolved rapidly since the adoption of the Kyoto Protocol in December 2007, growing from 20 Mt CO2e in emission reductions traded in 1998, to 100Mt CO2 traded in 2004, and 374 Mt CO2e in 2005. Despite the fact that the year 2006 was marked by significant uncertainty and volatility in the pricing of emission reductions, the carbon markets were evaluated at USD 30 billion in 2006, with $5 billion in project-based emission reductions, and then more than doubled to US$64 billion in 2007 (State and Trends, WB 2008). Market volumes transacted under the Clean Development Mechanism seemed to level off from 537 million tons of carbon dioxide equivalent (MtCO2e) in 2006 to 551 MtCO2e in 2007 due mainly to procedural delays within the system.[25] A summary of the growth of project-based emission reductions is included in Figure xx.

Figure XX: Annual Volumes of Project-Based Emission Reduction Transactions (vintages up to 2012)

[25] World Bank, State and Trends in the Carbon Market 2008



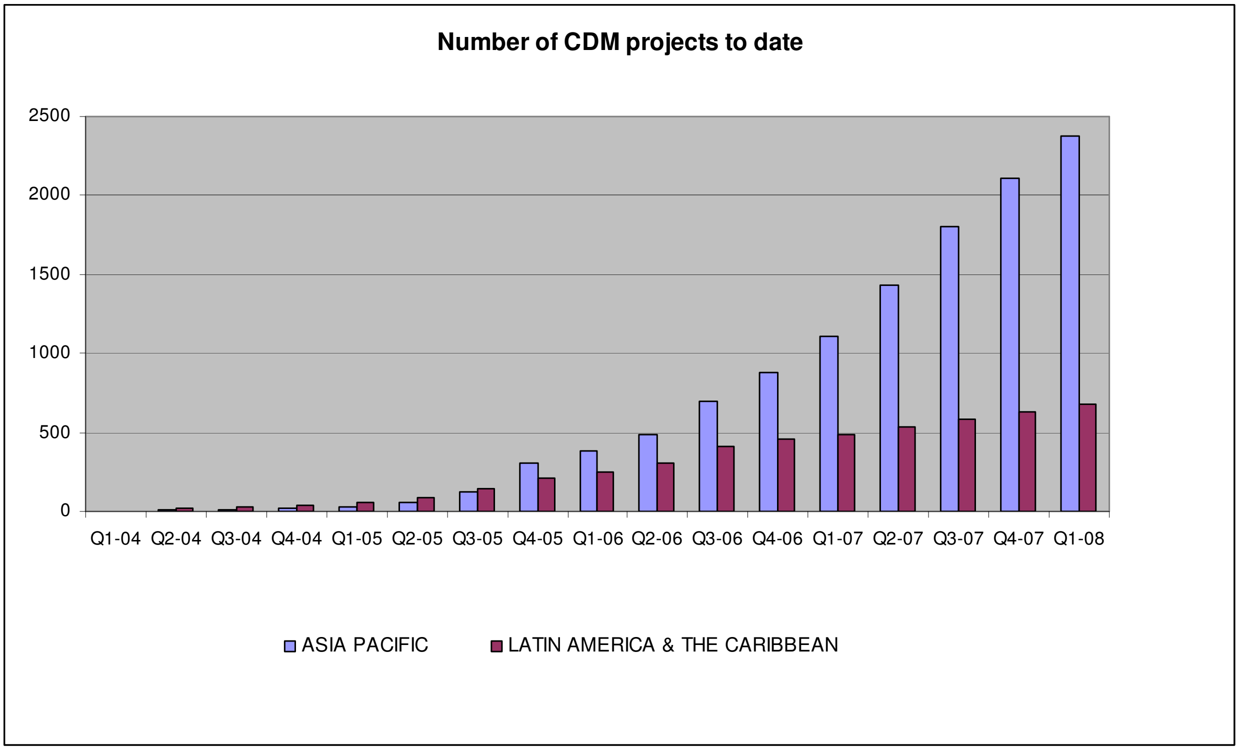
Source: State and Trends of the Carbon Market 2008, World Bank, Washington, D.C.

Out of the 2.5 billion Certified Emission Reductions projected worldwide by the market for 2012, 387 million tons of CO2 will be sourced by Latin America.[26] Assuming an average price of USD 15 per ton, the investment in emission reductions in the region will be USD 5.8 billion in the region by 2012. We note that for the period 2006 –2007 the increase in project based transactions was moderate. Furthermore, if we add the fact that LAC share in the CDM has decreased in the last years to 15.5%[27] (and continues to shrink), the volume transacted by the region is decreasing as well.

The following figure shows that Latin America CER volume is growing slower than Asia Pacific's both in absolute as well as in relative terms.

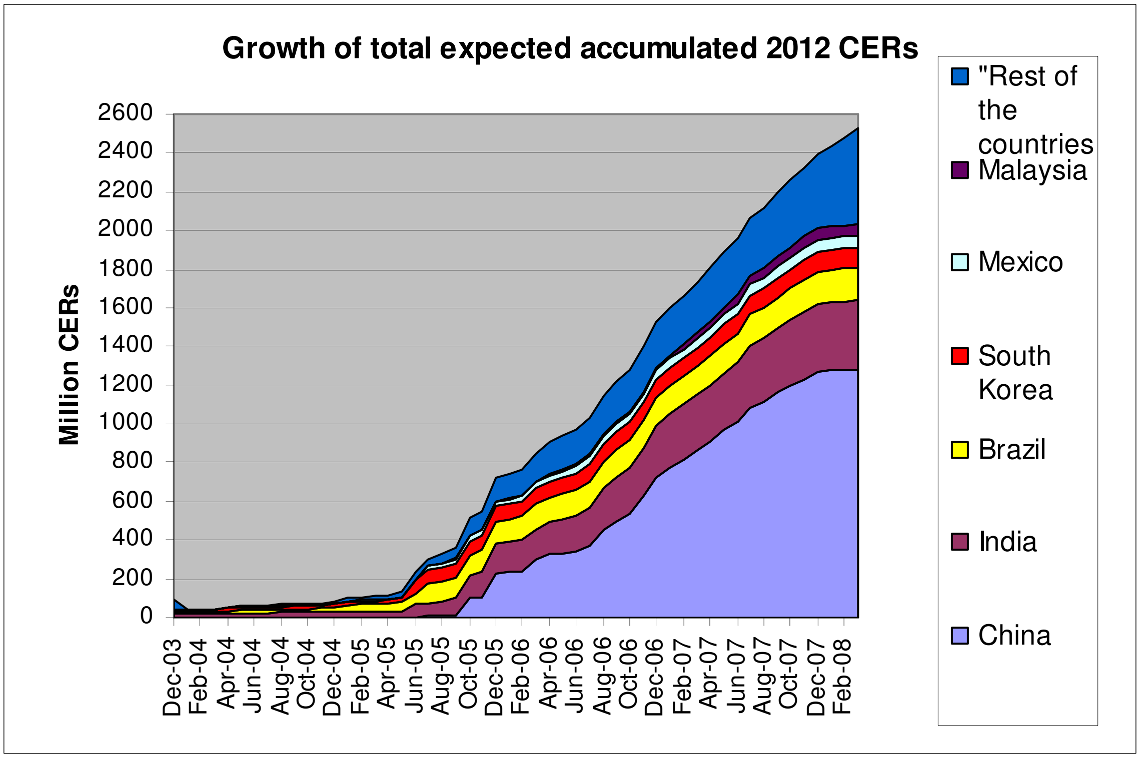
[26] CD4CDM CDM Pipeline April 1, 2008

[27] **Status of development of CDM market, How is Latin America doing?,** Jørgen Fenhann UNEP Risoe Centre, Denmark presentation at the Latin American Carbon Forum Lima, September 5, 2007



Source; prepared with data from the CDM Pipeline database published by UNEP Risoe May 2008.

Figure XX shows the steady growth of supply as projected to 2012 from China and India, as compared to the stagnant even retreating supply from Brazil and Mexico.



6.2.1 LAC's Performance in the CDM

The LAC region was clearly the early mover in the CDM. The region began experimenting with Activities Implemented Jointly (precursor to the CDM) in the early 1990's. The *Programa Latino Americano del Carbono* (PLAC), the first carbon finance program to be established by a regional development bank, was created by the Andean Development Corporation in 1999, even before the Marrakesh Accords established the modalities and procedures for CDM. From 1999 to 2002, the region had more Designated National Authorities, the entities which handle the host country CDM project approval process, than any other region in the world, and received a total of USD18 million in CDM-related capacity building.[28] The investment in technical training bore immediate fruits, as from 2001 to 2004 the region had submitted 62% of all CDM projects to the EB, and had prepared 68% of all approved CDM methodologies. The first project to be registered by the EB was the landfill methane capture project of Nova Gerar in Brazil in 2004, and the first certifications of emission reductions were issued to Rio Blanco and La Esperanza projects in Honduras in 2005.

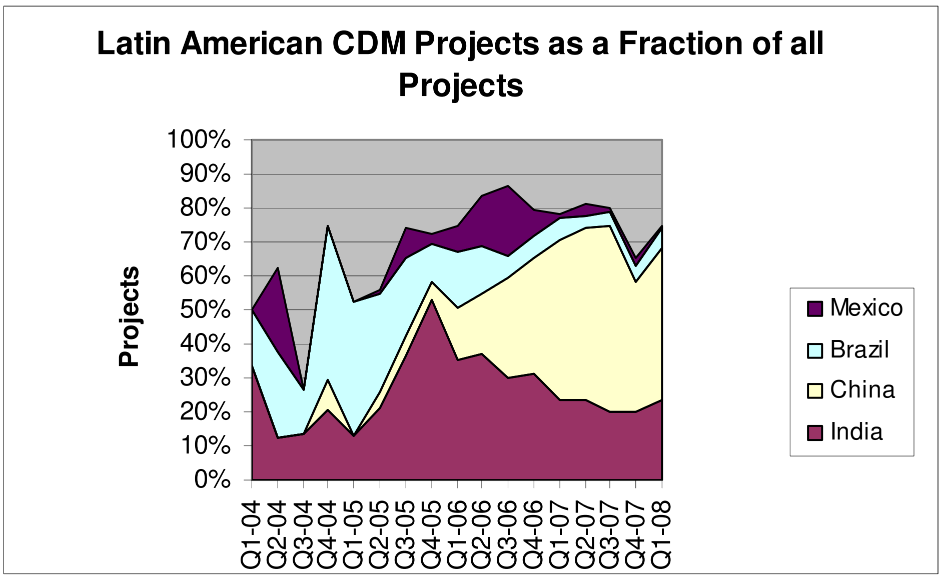
An early 2006 survey of market participants[29] identified the following strengths as compared to other regions of the world: better understanding of the CDM project

[28] Figueres, C. 2004 "Institutional Capacity to Integrate Economic Development and Climate Change Considerations: An Assessment of DNAs in Latin America and the Caribbean." Inter American Development Bank.

[29] Figueres, C. 2006 "CDM Trends in Latin America", prepared for OECD, Paris

cycle, more solid PDDs, higher participation of the private sector, more knowledgeable local consultants to prepare PDDs, and clear mandate from respective governments to actively engage in the CDM. However, the same survey pointed to the fact that the region was losing its first mover advantage in the market, and identified the following weaknesses in LAC: major differences in procedures among DNAs in the region, more host country requirements than other regions, slower national approval processes, and lower reduction potential as compared to Asia.

By the middle of 2006 the region had lost its dominant position in the market, as India and China entered with much higher volumes. Originally the predominant market share of China and India was due to a few HFC-23 destruction projects that achieved extremely large volumes of Certified Emission Reductions (CERs) given the very high global warming potential of HFC-23 as compared to CO2.[30] However, this type of project has been nearly exhausted worldwide and over the past few years, China and India have been able to diversify their supply, expanding their CDM portfolio to other sectors (renewable energy, energy efficiency improvement in the industrial sector, and methane recovery and utilization) and maintaining their hold on the market.



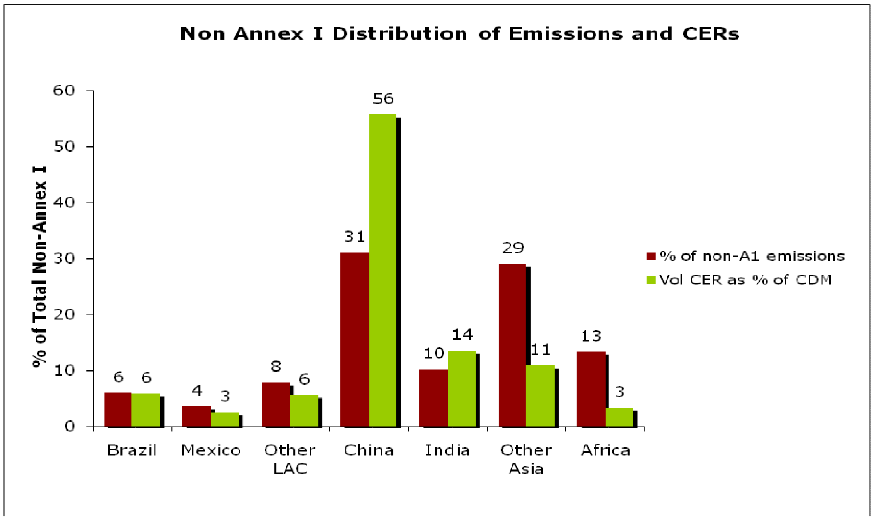
Source: www.cdmpipeline.org

6.2.2 Supply potential

While it is clear that China and India will outperform all other countries as CER suppliers, it should not be a surprise that the countries with the highest emission levels are also the countries with the highest supply of emission reductions, i.e. highest mitigation potential. The graph below shows the CER volume of projects in the pipeline in various countries and regions expressed as the corresponding fraction of the total number of CERs in the pipeline, compared to emissions shown as a percentage of emissions of non Annex 1 countries, the only ones that can supply the CDM. Land use change and forestry

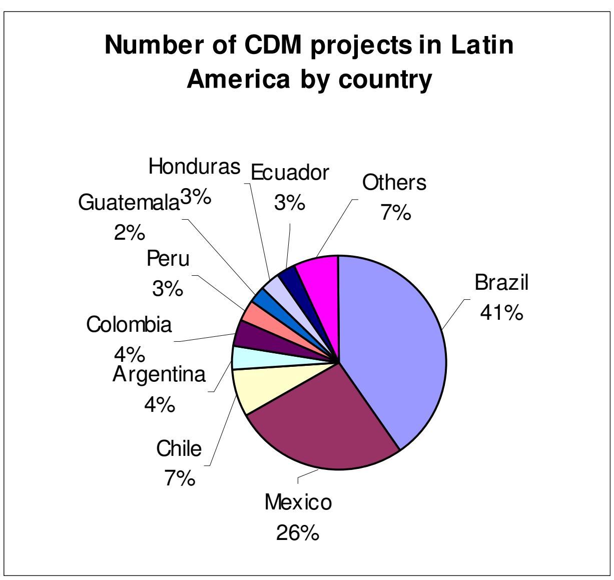
[30] 1 ton HFC equals 117000 tons of CO2.

emissions are not included as most of these emission reductions cannot be included in the CDM. If emission levels are any indication of potential supply, Mexico and Brazil are "on target" with supply, whereas India and particularly China are oversupplying, and the rest of Asia and Africa are undersupplying.



Sources: Emissions data is from CAIT, year 2000, excluding LULUCF emissions, CER Volume data is from cdmpipeline.org, April 2008

The pattern of the highest emitters being the largest suppliers is evident not only on a global level, but in fact also repeats itself at the regional level. Within the LAC region the market is clearly dominated by Brazil and Mexico, both in terms of absolute numbers of CDM projects, as well as in volume of CERs. From either perspective the two countries represent more than 60% of the supply from the LAC region.



Volume of CERS until 2012 in Latin America by country

Brazil and Mexico have dominated the LAC market primarily because they are large enough to support industries that have the potential for large reduction projects. These projects initially consisted of HFC-23 projects, and later renewable energy and methane capture from landfills and agro-industries. Smaller countries do not have as much potential for reductions because their industries do not have the high emission levels, nor are they of a size that is large enough to cover CDM transaction costs. The non participation of small and medium economies in the CDM was one of the reasons for creating the option to register programs under the CDM. Programmatic CDM is discussed below.

6.2.3 LAC portfolio

An analysis of LAC's current CDM portfolio by sector indicates some issues of concern. Industrial gases (HFC-23 and N20) continue to predominate, but that situation is an outgoing trend, as most major industrial gas projects have now been tapped and are being gradually balanced out by other types of projects. Today's portfolio shows that renewables have a healthy 27% participation in the market, probably commensurate with the mitigation potential of renewable energy in the region, if large hydro is excluded.[31] The sugarcane industry's use of bagasse has comprised most of the remainder of the CDM renewable energy projects in the region and will likely continue to do so.

Another major category of reduction projects in the region is methane capture from landfills, the agroindustry, and the emerging field of sewage treatment. These projects collectively make up 31% of the region's reductions (CD4CDM CDM Pipeline March 2008). There are still many undeveloped landfills and agro-industry opportunities in the region, however sites that may seem ripe for development may yield fewer reductions than expected for a variety of technical reasons. Unlined and unsorted landfills are susceptible to leakage of methane and low organic content to produce methane (Zeller, 2007). Agro-industry methane capture success depends on the pH, temperature, and antibiotic and water content of the excrement, which is determined by the relationship of the farmer and the farm doctor with the project developer (Gavaldon, 2007). For these reasons, despite the high global warming potential of methane, the CDM has not provided a sustainable solution to the burgeoning urban waste management problem.

However, what stands out most predominantly in the analysis of the portfolio is the absence of two asset classes that represent high emission levels in the region:

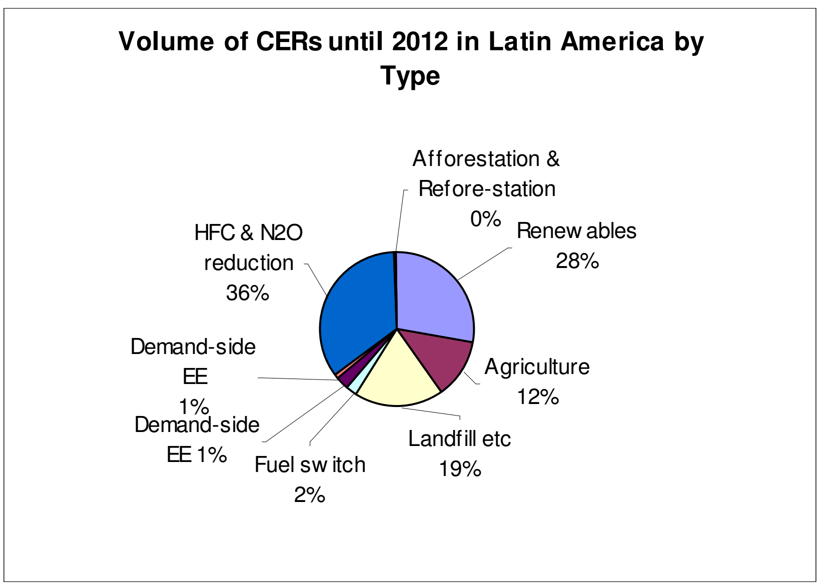
Reduction of emissions from deforestation: there is no doubt that one of the region's main contributions to mitigation efforts could be its carbon sequestration possibilities.

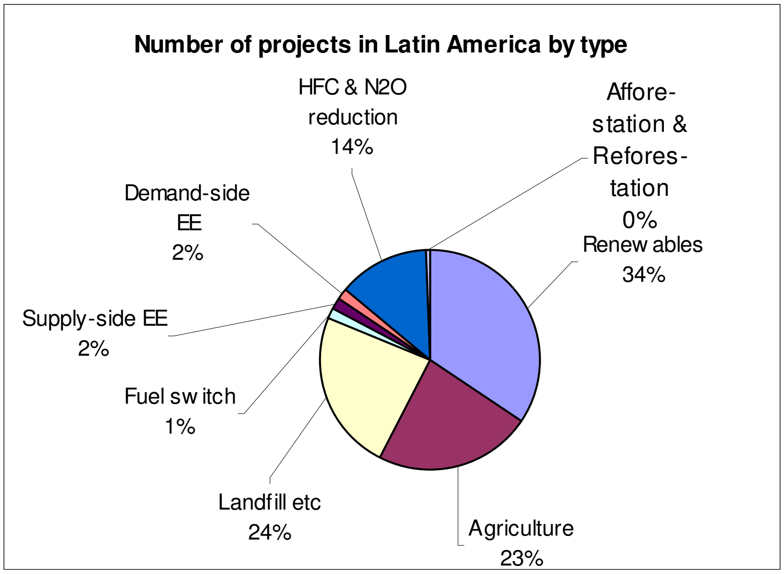
[31] Currently the European Union, the main buyer in the market, requires that CERs derived from hydro projects over 20 MW must comply with the guidelines of the World Commission on Dams, which adds complexity to project registration and practically prevents the registration of those projects. Thus the inclusion of large hydro in the CDM has been limited to mostly smaller size plants. However, Annex I DNAs are sovereign while applying its own criteria on whether or not a given hydropower project complies with the WCD. In an effort to bring homogeneity to WCD compliance criteria for CDM projects, the EU Commission foresees the future introduction of an EU guideline on this matter.

However, activities that reduce emissions from deforestation are not eligible under the CDM until the end of 2012. Until then land use, land-use change and forestry assets in the CDM are limited to afforestation and reforestation activities. Discussions are underway about the role that emissions from deforestation may have in a post-2012 regime, but until then that mitigation potential –perhaps the largest of all sectors for the region- remains untouched by the CDM.

Transportation: as has been discussed, transportation is the major source of energy related emissions in the region. However, the potential of this asset class in the CDM is curtailed by the lack of methodologies. Currently there is only one approved CDM methodology in the transportation sector (rapid transit lanes in Bogota, Colombia, under the Transmilenio project). Several other types of transportation methodologies are under preparation (construction of underground transportation system, use of biofuels, etc.) but until they are approved, transportation will remain underrepresented in the CDM portfolio of the region, despite the fact that it is one of the major emitting sectors.

The LAC portfolio by sector is shown in the below two graphs.





6.2.4 Carbon finance through development banks

Mulitilateral development banks have had an active role in fostering the participation of LAC in the CDM.

6.2.4.1 World Bank

The World Bank initiated its activities in carbon finance in 1999 with one initial prototype carbon fund, and has since then has expanded its fund management to nine funds and facilities: the Prototype Carbon Fund (PCF); Netherlands JI and Netherlands CDM Facilities; Community Development Carbon Fund (CDCF); BioCarbon Fund; Italian Carbon Fund; Spanish Carbon Fund; Danish Carbon Fund; and the Umbrella Carbon Facility (UCF). These funds are public or public-private partnerships managed by the Carbon Finance Unit (CFU) of the World Bank. Unlike other World Bank development products, the CFU does not lend or grant resources to projects, but rather contracts to purchase emission reductions similar to a commercial transaction, paying for them annually or periodically once they have been verified by a third party auditor. The carbon funds and facilities are capitalized by government and private company investors in industrialized nations that are under emission reduction commitments and are interested in the expansion of the carbon market. The funds under WB management have a total capitalization of USD 2 billion, most of which has been channeled through the CDM. Of this total, approximately $96 million or 5% has been invested in emission reductions sourced by projects in LAC countries. The table below provides the breakdown by fund.

WB Managed FUND	TOTAL	INVESTED IN

	CAPITAL in MILLION $	LAC PROJECTS
Prototype Carbon Fund	180	27.08
Bio Carbon Fund	92	8.74
Community Development Carbon Fund	129	7.23
Italian Fund	155.6	-
Netherlands CDM Fund	N.A.	N.A.
Netherlands European Fund	N.A.	N.A.
Danish Fund	68.5	11.60
Spanish Fund	278.6	42.07
Umbrella Carbon Fund	719	-
Carbon Fund for Europe	-	
Forest Carbon Partnership Facility		
TOTALS	2 billion including all funds	96

Netherlands Funds are treated confidentially

6.2.4.2 Andean Development Corporation (CAF)

In 1999 the Andean Development Corporation established the Programa Latinoamericano del Carbono (PLAC) to support the development of potential CDM projects in the LAC region, as well as to offer capacity building and strengthen climate change institutions in all shareholder countries. The Program has recently also begun to develop innovative financial instruments focused on renewable energy and energy efficiency, whether or not eligible for the greenhouse gas (GHG) reduction market. PLAC managed an emissions reduction contract from the government of the Netherlands for a total of 77 million euros, and has successfully delivered the corresponding 8.7 million tons of certified emission reductions all of which stem from 19 mitigation projects in Latin America and have been channeled through the CDM. In addition PLAC has an emission reduction purchasing contract from the government of Spain for a total of 9 million tons, 3 million of which have been committed to LAC projects. PLAC has invested USD 1.5 million in technical cooperation and capacity building in the region

6.2.4.3 Inter-American Development Bank (IDB)

The Inter-American Development Bank created a Sustainable Energy and Climate Change Initiative (SECCI) in March of 2007, with an initial capitalization of USD 10 million. The goal of this Initiative is to support the Latin American and Caribbean region in finding economically and environmentally-sound energy solutions. SECCI focuses on financial solutions and will complete its task by helping renewable energy and energy efficiency projects achieve financing, removing institutional barriers and promoting novel policy ideas, making sustainable energy investment and financing tools more mainstream and accessible, utilizing the carbon finance market, addressing adaptation needs, and forming new partnerships with both the public and private sectors [63].

6.2.5 Barriers to CDM in LAC

The decreasing participation of LAC in the CDM can be traced to several factors.

6.2.5.1 Uncertainty Regarding Post-2012 Regime

Long term commitments by industrialized countries are necessary to sustain the carbon markets. The recent proposal of the European Union for the Third Phase of the European Trading Scheme severely limits the use of CDM for European compliance if there is no acceptable multilateral agreement, and expands the use of CDM only marginally even in the case of an agreement. The proposal has not been ratified by the European Commission, but the potential ceiling on demand for CERs has already had a stifling effect on market optimism. Should it be carried through, the ceiling could result in an increased emphasis on projects with short lead times and projects where the financial closure does not strictly depend on the forward sale of emission reductions. This means that carbon finance would have limited influence in investment decisions for large scale infrastructure projects with long gestation periods that have the potential to deliver a large quantity of emission reductions until the uncertainty is significantly reduced. In the LAC region, where many CDM projects of substantial infrastructure require high and long term investments, the absence of a long term carbon market signal may already be reflected in a dwindling CDM.

6.2.5.2 Lack of Concerted CDM Strategy

Only a very few countries in the region (e.g. Mexico, Brazil underway) have a concerted mitigation strategy and most times this strategy does not involve any specific measure to boost CDM utilization. A handful of countries however were benefited some years ago with the National Strategy Study Program (NSS) of the World Bank that assisted selected countries to identify the best way to implement CDM. Many of the initial CDM portfolios were drafted through this initiative but further follow up and commitment from usually divorced public and private sectors prevented them from going much further. A remarkable exception to this was Chile, where an unusual synergy between the private sector and the government served as a framework to promote CDM from business organizations such as the Manufacturers Society (SOFOFA) and the Chilean investment promotion agency (CORFO).

6.2.5.3 Lack of Methodologies

As has been discussed, several asset classes that are critical to the region's abatement potential have not been incorporated into the CDM. Land use, land-use change and forestry assets in the CDM are limited to afforestation and reforestation activities, and even those are restricted in size and type. The issue is compounded by the fact that there is a lack of demand, since the European Union ruled out forestry projects from the sectors eligible as offsets in the ETS. Nevertheless, some isolated efforts reached maturity and now we have approved methodologies for these project scopes, as well as some projects underway. In the transport sector there is only one approved methodology. Broader and less onerous methodologies have to developed for mass public transit, as well as methodologies to support the switch to liquid biofuels for vehicles.

6.2.5.4 Price

It is no secret that most buyers are interested in buying emission reductions in the region for mere portfolio diversification purposes. However the will to buy CERs from the region is constrained by procurement policies that demand projects with high volumes and quick returns which are not the common profile for projects of the region. "Carbon finance" is limited to upfront payments which generally require bank guarantees not easily available to project owners lacking of enough credit worthiness. Expectations of CER selling prices are far higher in the region (10 – 13 euro/fwdCER) compared to Asia which are beyond authorized bidding prices of compliance funds (7 – 10 euro/fwd CER) and close to the feasible limit of private carbon funds (8 – 12 euro/fwd CER).

6.2.5.5 Non participation of the Public Sector

In addition to the basic concern regarding disclosure of data, there are several procedural constraints additional that contribute to the lack of involvement of the public sector, specifically the state owned utilities that hold much of the generation in the region.

Although a privatization wave of public utilities across the region is taking place some countries keep a major share of electricity and other public services in state owned companies. In those countries the opportunities of the carbon market have largely been recognized by the smaller private sector but with a more limited awareness among the larger public and private enterprises. In countrie where state-run utilities are mandated to pursue least-cost generation options, CDM revenues are usually not yet considered in the least-cost planning process. Thus CDM projects that hope to make the financial additionality argument usually cannot be pursued by the utilites (Mayorga, 2007). Furthermore, as state utilities must declare all major capacity additions in their future expansion plans. This listing makes the additionality argument complex as expansion plans represent the business as usual scenario (Mayorga, 2007 and Barnes, 2007). Thirdly, state run utilities have little incentive to engage in the complex CDM process since the regulator determine the tariff calculation that will dictate the state utility's profits. In fact, the Public Utility of Medellín was audited for participating in CDM: the regulator questioned why the prices the Utility received for the sale of CERs were so low and why the process took so long (Velez, 2007).

For these reasons, independent power producers (IPPs) are better positioned to participate in the CDM and capture CDM revenues. However, in many of the Latin American countries with state-run electric power utilities, there are barriers to market entry for these IPPs. In Costa Rica, IPPs can, by law, not make up more than 30% of the overall generation (Villa, 2007).[32] In Mexico, IPPs can only generate when they structure a power purchase agreement (PPA) with a shareholder. If the IPP produces more than their shareholder uses, then they must accept 85% of the state-run utility's avoided cost of generation. Also, IPPs in Mexico must pay a transmission tariff that is equal to 15-30% of their energy sale price ("Ley del Servicio Publico" 1992).

6.2.5.6 Relative Absence of Financial Sector

In addition to the well known reluctance of banks to lend for renewable energy or energy efficient projects, commercial banks in the region have not accepted CER revenues as a valid income stream. At best, banks are heavily discounting the carbon revenue stream, in part due to lack of knowledge or uncertainties regarding the carbon market, and will not consider Emission Reduction Purchase Agreements as part of collateral or guarantees to finance a project with climate-friendly technologies. Thus the majority of CDM projects are either financed on the balance sheet or financed without taking into account potential carbon finance revenues. This restriction affects the size of CDM project that is possible to bring to the market.

6.2.5.7 Lack of Aggregation Possibilities

A further barrier to CDM development in LAC is the small size and distributed nature of some types of emission reductions. The CDM modalities and procedures have been implemented mostly on the basis of single mitigation sites that offer a relatively high volume of emission reductions per site. This practice privileges the larger economies and the highest emitting sectors, and disfavors smaller economies with lower mitigation potential as well as those sectors in which the mitigation potential is dispersed, such as energy efficiency, distributed rural energy, and transportation.

Programmatic CDM is a new option for registering CDM projects that expands the CDM beyond single point source reductions. Under a CDM "Program of Activities" (PoA), emission reductions are achieved by multiple actions executed over time as a result of a government measure or a private sector initiative. This option to aggregate and structure many small mitigation efforts means that the CDM can reach large numbers of individual households and small industries, offering them improved technology (efficient cooking stoves, appliances, lighting, motors, air conditioners, etc.). Smaller countries without large emitting facilities and therefore not yet participating in the CDM can design CDM programs that involve many small users who achieve reductions not

[32] This figure was increased from 15% in XX year.

concurrently but over a period of time. The PoA option can be used to incorporate widely diffused emission reductions such as those in end-use energy efficiency and transportation. Unlike traditional CDM that focuses on individual efforts at a "carbon upgrade" within the limited boundary of a single facility with little or no transformational effect on the sector or economy, programmatic CDM promotes decarbonization of the respective sector. The programmatic option is further discussed below.

6.2.6 Sustainable Development and the CDM

Despite the considerable resources channeled through the CDM towards climate friendly projects in developing countries, there are some concerns about its ability to contribute to sustainable development issues. In particular, the international governance of the CDM focuses on ensuring the additionality of the corresponding GHG emission reductions, including the assessment of baseline and monitoring methodologies (Ellis et al. 2002). As for the responsibility for ensuring that the projects are consistent with the other objective of the mechanism, namely to contribute to sustainable development goals, it is left entirely to the developing countries that host the projects. Thus, as argued by Figueres (2004), the CDM has tended to give more weight, at least implicitly, to helping industrialized countries meet their emission reduction obligations than to contributing to sustainable development objectives. In particular, the CDM modalities and procedures defined in the 2000 Marrakech Accords are silent with respect to the criteria for assessing the contribution of CDM projects to sustainable development objectives, which are to be defined by each of the Designated National Authorities (DNAs) to be set up by developing countries in order to evaluate CDM projects and issue national approval letters. From the point of view of developing countries, the lack of standardization of the sustainable development criteria may have the advantage of making explicit their sovereign right to determine their development priorities and strategies. However, this aspect of the Accords has also implied a lack of international guidance on how to achieve and monitor the sustainable development objective of the CDM. In practice, not all host countries have made explicit their sustainable development criteria for assessing CDM projects, and among those who have established those criteria there is considerable heterogeneity with regard to their level of stringency. Moreover, DNAs tend to interpret the requirement that CDM projects should help achieve sustainable development in terms of the project's congruency with the existing legal framework and sectoral guidelines, most of which are not carbon-friendly (Figueres, 2004).

A second fundamental weakness of the CDM, in terms of its ability to promote sustainable development, is related, somewhat ironically, to its main strength as a mechanism to support reductions in GHG emissions, namely the fact that it uses market forces to allocate resources to projects that offer the lowest mitigation costs. Indeed, as shown by Elis et al. (2004, 2007), there is a great variety of project types to reduce GHG emissions, and market forces naturally direct resources to those that offer lowest costs and capital requirements, as well as the lowest payback periods and risk. The problem is that those projects that are most attractive under these criteria – e.g. brownfield "end-of-pipe" projects for HFC, N2O or CH4-reductions – are not necessarily those that offer larger local development benefits. In contrast, projects that do have more important co-benefits, including in terms of potential for technology transfer and replicability, such as those in renewable energy, energy efficiency and transport, tend to be more risky and involve higher costs and upfront investments, which makes them less attractive for CDM investors.

6.2.6.1 Additionality and the issue of perverse incentives in the CDM

In order to have a substantial impact on the GHG emissions of developing countries, mechanisms such as the CDM would have to be able to help transform overall development policies and make them more climate-friendly. One important obstacle for achieving this objective has been related with the additionality requirement embedded in the CDM. Indeed, this requirement can potentially make ineligible for the CDM all the projects that are driven by climate-friendly policies that had already been announced by developing countries at the time of project submission, as these policies could be considered part of the baseline or business as usual scenario. This is problematic for several reasons. First, as argued by Heller and Shukla (2003), baseline scenarios are often difficult to determine because they hinge on a range of policy decisions that are not yet sufficiently settled. As a result, the execution of the corresponding policies is in many cases uncertain and one could argue that including them in baseline scenarios – and thus failing to support them through mechanisms such as the CDM – would amount to missing an opportunity for providing critical further incentives for the implementation of climate friendly policies. More generally, whereas many climate-smart development policies could be justified solely on the basis of their domestic benefits, explicitly recognizing their contribution to climate change mitigation could be useful for gathering additional political and financial support, and ultimately for reinforcing their chances of success.

Second, the additionality requirements of the CDM could create perverse incentives for Governments in host countries, leading them to delay the issuance of climate friendly policies (Ellis, 2006). In other words, countries with the least climate friendly policies are implicitly rewarded while those that are more proactive run the risk of having most of their mitigation projects excluded from the CDM (Figueres, 2004). A good example, in this regard, is Costa Rica's 1995 requirement that privately generated power stem from renewable sources: while this measure has contributed to de-carbonizing the country' energy matrix, the CDM Methodology Panel has questioned the additionality of private hydroelectric plants and thereby severely limited Costa Rica's participation in the CDM.

Similarly, the original interpretation of the Marrakech Accords lead CDM stakeholder to believe that if a country issues regulations to toughen energy efficiency standards, projects aimed at upgrading existing technologies to meet the new standards could not be eligible for CDM financing. As a result, countries could have an incentive to keep their climate-friendly policies in the realm of plans and programs, and to not take the additional step of embedding them into their official regulatory framework. This was reportedly the decision made by Colombia during 2003/2004, following country-wide consultations aimed at identifying potential CDM projects and low carbon policy options in the sectors of transport, energy and forestry (Hinostrosa et al, 2007).

Fortunately, in November 2005 the Executive Board of the CDM issued a new guidance on how to take into account national policies when calculating a CDM project's baseline, which to a large extent eliminated the perverse incentives for host countries to adopt carbon-friendly policies. The new guidance requires the exclusion from baseline scenarios of climate-harmful policies and regulations issued after the adoption of the Kyoto Protocol in December 1997, thus eliminating the incentive for host countries to inflate their claims for emission reductions by means of enacting policies that favor more emission-intensive technologies or fuels.

In addition, the new guidance allows for the exclusion from baseline scenarios of policies or regulations that give a comparative advantage to lower emission intensive technologies (e.g. through subsidies to renewable energy or more stringent energy efficiency standards), provided that they were enacted after the adoption of the CDM Modalities and Procedures in November 2001. The issue, however, is far from being settled, as the application of the new guidance for the definition of baseline scenarios may be hampered by methodological challenges associated with disentangling the effects of various policies. Moreover, as argued by Ellis (2006) the new guidance explicitly allows for either the exclusion or the inclusion in baseline scenarios of recent policies regulations, with the second alternative having the advantage of curtailing the incidence of "free-riders" and helping avoid non-additional credits.

6.2.7 From project to sector-wide approaches: Programmatic CDM

A separate fundamental concern with the current functioning of the CDM is whether its focus on project-level emission reductions, relative to baseline scenarios, is sufficient for achieving an adequate engagement of development countries in global mitigation efforts. As argued by Figueres, Haites and Hoyt (2005), the CDM's single project approach makes it unlikely to "catalyze the profound and lasting changes that are necessary in the overall GHG intensities of developing countries' economies." A more effective approach would entail transforming the baselines themselves so as to make development pathways more carbon-friendly (Heller and Shukla, 2003). In this context, rather than focusing on actions at the project level, mitigation efforts in developing countries would have to shift towards promoting reforms across entire sectors – e.g. energy, transport, agriculture, forestry.

One way of implementing such sector-wide approaches is to broaden the market mechanism to include reductions obtained by developing countries while pursuing climate-friendly "development-first" policies – not unlike the way in which domestic emission reductions of industrialized countries are counted towards their commitments under the Kyoto Protocol regardless of their source. One first important step in this direction was the decision to include programs of activities in the CDM, taken in December 2005 at the 1st session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (COP/MOP 1) in Montreal. The inclusion in the CDM of so-called programmatic CDM project activities, along the lines of a proposal made by Figueres et al (2005)[33], has increased the ability of the CDM mechanism to support lower carbon development pathways, without requiring a re-negotiation of the basic architecture of the Kyoto Protocol.

The decision made in Montreal states that while Government policies, regulations or standards cannot be submitted as CDM projects, "project activities under a programme of activities can be registered as a single clean development mechanism project activity." As argued by Figueres and Haites (2006), the decision to not incorporate into the CDM the adoption of a policy, in and of itself, is well justified. Indeed, even after being officially adopted, Government policies oftentimes fail to be implemented, either because of financial or technological barriers, or due to the Government's failure to enforce its laws and regulations. However, if a policy is implemented through a group or program of concrete activities whose emission reductions can be measured and verified under the rules of the CDM, then the whole program of activities can be submitted as a single project. As defined in the specific guidance issued by the CDM EB in June 2007, a CDM program of activities (PoA) can be coordinated by a private or a public entity, and it may involve the implementation of an unlimited number of voluntary actions. The latter should lead to emission reductions, or removal of GHG by sinks, in addition to what would have occurred in the absence of the PoA. Programs stemming from mandatory Government policies are eligible provided that the PoA increases their level of enforcement (Hinostrosa et al. 2007).

Traditional CDM modalities already allowed for the bundling of stand-alone projects for registration purposes. Moreover, the new December 2005 CDM guidance incorporated

[33] Among the various precedents to their proposal, Figueres et al. (2005) mention the "sectoral approach" proposed by Samaniego and Figueres (2002), the "programmatic crediting mechanism" proposed by Bodansky et al (2004), and the "policy-based" mechanisms proposed by Cobey et al (2005) and Sterk and Wittneben (2005).

the possibility of bundling large scale projects (Ellis, 2006). However, when using "bundling" the sites of all projects have to be specified ex-ante and all projects need to take place at the same point in time (Figueres and Philips, 2007). The bundling approach is thus not well suited to dispersed activities that are the result of a larger number of decisions made over a period of time, for instance by households, offices or factories in the context of energy efficiency programs. In particular, it may not be possible to accurately predict at the outset the level of GHG emission reductions that will be achieved through a particular public sector incentive scheme or private initiative. This is not a problem, however, in the case of the programmatic CDM, which allows for adding subsequent emission reductions during the duration of the PoA, for a period of up to 28 years. In other words, when using pCDM one does not need to specify ex-ante all the constituent activities of a PoA.

As argued by Figueres et al. (2005), the programmatic approach is especially relevant in the areas of energy efficiency and fossil fuel switching. Indeed, in these areas the deployment of carbon-friendly technologies usually does not occur on an individual basis but rather by multiple coordinated actions executed over time, often by a large number of households or firms, as the result of a Government measure or a voluntary program. Moreover, the transaction costs associated with CDM submissions, coupled to the relatively small credits generated by each individual activity or project, would often eliminate the possibility of CDM funding at the level of individual stand-alone projects. However, programmatic submissions could allow for diluting those transaction costs across many projects and, even in less developed small and medium countries, take advantage of the large potential for emission reductions associated with the implementation of national or sector-wide programs.

As of May 2008, only two PoAs were in validation: a solar home systems project in Bangladesh and a methane capture project in swine farms in Brazil. The slow uptake of this new registration opportunity is probably due to the fact that the modalities and procedures are still not well understood, and to the reticence of Designated Operating Entities (DOEs), the auditors of CDM projects, to engage in PoAs due to a perception of undue liability. Faster deployment of the pCDM approach may also point to the need to better address complicated methodological issues in the context of pCDM projects – e.g. leakage, baseline, double-counting and monitoring (Ellis, 2006). Once the initial hurdles are overcome, pCDM will be limited in its scope as long as the current restriction to one single methodology remains, limiting the potential for supporting large scale initiatives that involve system-wide efficiency improvements that may require the combination of several methodologies.

Despite these difficulties, studies undertaken by the World Bank show that there is a significant potential for deploying pCDM projects in Latin America. In Peru, for instance, Hinostrosa et al. (2007) show that the most promising options are in energy efficiency in the public sector, small landfill programs, solar energy in the highlands and industrial boilers. The latter project, for instance, is estimated to have the potential for generating a yearly GHG emission reduction of more than 600,000 tCO2e. More generally, the pCDM approach allows for dealing with several of the obstacles that limit the deployment of energy efficiency programs, which are considered the single largest source of potential reductions in GHG emission reductions over the next decades (IPCC, 2007). In particular, end-use energy efficiency improvements account for two thirds of energy-related abatement potentials (EIA, 2006). One example is the conversion of the inefficient and contaminating public transportation systems in the megacities of many developing countries, which could be accompanied by a reduction in the excessive and inefficient use of private vehicles (Figueres, 2007).

Among the advantages of using pCDM for supporting energy efficiency programs is the possibility of offering guaranteed financial revenue to households or businesses that invest in appliances or equipments that reduce GHG emissions. This approach can thus help overcome the "split incentive" barrier to energy efficiency programs, which is derived from the fact that those who pay for the costs of the corresponding technologies – e.g. landlords who want to keep building costs as low as possible – are often not the same as those who benefit from them – e.g. tenants who pay the energy bills (Figueres and Philips, 2007). By using the expected revenues from the sale of certified emission reductions (CERs) to be generated by the program to compensate those pay for the more efficient technologies – e.g. landlords or developers – the pCDM approach could help align their incentives with those of the users who benefit from the energy savings. As a by-product, the use of pCDM in energy efficiency programs can contribute to the standardization of national procedures for reporting GHG emissions to DNAs – standardization is a must given the large number of participants in those programs – thus contributing to the strengthening of the environmental governance of host countries (Hinostrosa et al. 2007).

Perhaps most importantly, CDM programs mark an important step in the meaningful participation of developing countries in the global climate regime. Programmatic CDM is the first opening toward policy-based and sector-wide emission reductions in developing countries. By assigning a CER value to reductions achieved under a program of activities, the regime is providing the first incentive for developing countries to adopt and implement climate friendly policies and measures, helping prepare developing countries for a broader participation in the future climate regime.

Nonetheless it is clear that the potential of the carbon market has only just been tapped. The year 2008 marked the beginning of the first commitment period of the Kyoto Protocol, and much can be done to further strengthen the carbon markets, both for this commitment period as well as beyond 2012. The decision to create a market mechanism based on projects was perhaps a necessary way to initiate mitigation efforts and lay the institutional groundwork for an international market, but it has curtailed the potential of the market to promote the needed sector-wide transformation, attained by cost effectively channeling capital and know-how to decarbonize carbon intensive sectors such as energy, transport and infrastructure. The project-by-project approach cannot stimulate technology development and underwrite the risk of major scale ups in R&D in low carbon/zero carbon technologies. From a financial perspective, project-based CDM cannot stimulate an adequate and reliable new source of risk capital to finance technology shifts and required policies/incentives on the scale of whole economies. It has yet to provide the essential investment climate of regulatory certainty and manageable business risk to ensure that a stream of anticipated CERs is bankable collateral for financing specific projects. Without this assurance, it is also unable to finance rapid expansion of already commercially proven leading edge lower carbon power and infrastructure technologies.

While the rules for the post-2012 regime are only just being negotiated, there is ample consensus that CDM will undergo transformation and that the carbon markets will continue. And yet, the challenge of mobilizing the capital necessary for stabilizing the climate is one that goes substantially beyond the sum total carbon markets, GEF and ODA. There is no doubt that significant capital from the private sector will have to be mobilized, and that this will only be invested if the necessary policies and measures are put in place in developing countries in order to provide the regulatory certainty, catalyze the technology shifts, and spur the required production/consumption changes on the scale of whole economies. It is to the national level regulations that we now turn our attention.

7 Domestic policies

Science has determined that GHG emissions must soon peak and then be rapidly reduced. The timely reduction requires not just a tweaking of the energy system but full-scale industrial transformation, based on technologies that have been marginal in the past but that will flourish in the future. Current investments and carbon finance denote a weak but existing market signal in this direction. The challenge for governments, energy planners and policy makers is to incorporate climate change into development planning, providing a robust regulatory environment that will effectively mobilize the investment needed for the energy and industrial transformation. If the current market signal is strengthened through effective national policies and international agreements that provide financing to lower carbon emissions, it may actually be possible to decouple economic growth from emissions in a timely manner in the South.

The following reviews some of the development enhancing/climate friendly policies that are either already in place, being considered, or could potentially be implemented for the transport, energy, energy efficiency, waste management, land use, and industrial sectors.

7.1 Renewable energy

Different types of legal, regulatory, institutional and financing schemes to promote the use of renewables for electricity generation are at different stages of development in the region. These policies have recently been implemented in many countries due to the drop in investment in natural gas infrastructure, high cost of fossil fuels and El Niño and La Niña-related droughts that showed how susceptible hydro generation can be to the whim of nature. Even though there are common denominators among different countries in the region, no integration of renewable energy policies can be observed and each country has followed its own path to implementation of renewable energy technologies. Many have done so recently during 2007 as a response to high fossil fuel prices. The most recent and proposed renewable energy legislation in the region is summarized in Chart 1 below.

Chart 1: Summary of Renewable Energy Legislation [1]

Country	Legislation
Argentina	Law 26,190 of 2006 provides a production tax credit of 1.5 Peso cents/kWh for wind, hydro under 30 MW, biomass, and geothermal, and .9 Peso cents/kWh for solar; Law 25,019 of 2001 provides a 15-year exemption from income taxes [2]
Bolivia	Norma 1056 requires standards for PV installations [3]; several rural energy programs, including the National Rural Electrification Program (PRONER), Plan Bolivia para Energía Renovable (PLABER), Rural Electrification Decree of 2005, the Common Fund for Universal Access to Public Electricity Service (FOCO) ,and Electricity

	for Living with Dignity, exist [4] and **[5].**
Brazil	PROINFA (Incentives Program for Alternative Sources of Electric Energy) requires MW capacity additions in 2 phases: phase I requires 1422 MW wind, 1191 MW small hydro, and 685 MW by 2008 with a 60% local component requirement, and phase II may require 10% of overall generation by 2022 and a 90% local component requirement suggested [6].
Chile	Short Law I (Ley 19,940) of 2001 provided guaranteed grid access and reduced transmission rates for projects under 20% [7]. Short Law II (Ley 19,940) of 2005 mandated that 5% of country's generation for residential customers be sourced from renewable energy by 2010 [8]. Short Law III (Ley 20,257) passed in March of 2005 requires 10% of residential customers energy sourced from renewable sources by 2024. Penalties for non-compliance are $27/MWh for the first year and $40/MWh for three years of non-compliance in a row [9].
Colombia	Law 697 of 2001 provides exemption from income or value-added tax on importations for the first 10 years of operation. Also, other taxes on salaries, research equipment, and machinery are exempted for "first-of-a-kind" projects [10] and [11]. More recently, a 35% income tax waiver for projects that give 50% of CERs to community development is available [12].
Costa Rica	Law 7200 of 1990 provided a feed-in tariff for small renewable energy [4]. Law 7508 of 1995 stipulated that the Instituto Costarricense de Electricidad (ICE) will only buy renewable generation from Independent Power Producer (IPPs), and that IPPs must have a 35% Costa Rican ownership structure, can make up only 30% of market, must sign contract with ICE for generation price, and relinquish plant operations to ICE after 18 years of operation in a Build, Operate, and Transfer agreement [13], [14] and [15].
Dominican Republic	Hydrocarbon Law 112 of 2000 created a renewable energy fund from 5% of hydrocarbon sales [16]. The Renewable Energy Sources and its Special Regimes (Law No. 57-07) of 2007 provides subsidized financing during 10 years for a part of the capital required for installations not exceeding 50 MW, 100% exemption from import tariffs on the equipment and tools needed for renewable energy

	generation, a 10-year exemption from income tax on revenues obtained in generation of renewable energy; a tax incentive for self-production and dispatch priority [17].
Ecuador	Organic Law of Guarantees to Promote New Electricity Generation of 2004 and Regulation 004 provided feed-in tariffs for hydro under 10 MW and wind, solar, geothermal, and biomass under 15 MW. These special tariffs apply until 2% penetration of renewables in grid [18]. Under this law renewables get guaranteed dispatch and exoneration from import and income taxes [19]
El Salvador	Fiscal Incentives Law for the Promotion of Renewable Energy of 2007 provides no taxes on renewable energy projects below 10 MW for 10 years. Projects between 10-20 MW are exempt from taxes for five years. Projects do not have to pay taxes on CER revenues from projects [20]. Projects under 5 MW have streamlined permitting [21]; A fund for renewable energy (SIFER) and soft loans (FOGES) have been considered for years [22].
Guatemala	Law 52 for the Incentives of Renewable Energy Development of 2003 provides exoneration of import tax for equipment and income tax for first 10 years. Also under this law retailers are obligated to buy electricity from private generators [14] and distributors have to buy generation for projects under 5 MW [23].
Honduras	For renewable energy under 50 MW, Decree 70 of 2007 provides no import tax for equipment and no income tax for first 10 years. Also, this law established that the state distribution company Empresa Nacional de Energía Eléctrica (ENEE) has to buy electricity from generators, ENEE pays its short-term marginal avoided cost + 10% for generation, transmission tariff set at .01 cents/kWh; systems under 3 MW do not need a generation license, generators can sell directly into the Central American grid or to large consumers, and permits may take a maximum of 2 months to process [24].
Mexico	Resolution 140 of 2001 allows Renewable energy can be "banked" and counted towards fulfilling the goal of satisfying customer's demand for the month [25], accelerated depreciation for renewable investors [26], and lower transmission tariffs for renewables based on capacity factor [27]. A new LAFRE (Ley para el Aprovechamiento de las Fuentes Renovables de Energía) law

	debated since 2005 would allow first dispatch, provide a green fund to support renewables, accelerated depreciation on profits, and lower transmission capacity charges base on the average capacity of the renewable source [28].
Nicaragua	Law 532 of 2005 provides exoneration from import tax for equipment, no income tax for first 7 years [29]. Law 272 of 1998 providesa maximum of 5.5 to 6.5 cents/kWh paid for hydro generation [30].
Panama	Law 45 of 2004 provides projects under 500 kW with exemption from equipment taxes. Projects under 10 MW do not pay transmission and distribution charges. Up to 5% of project costs can be reimbursed if the project contributes to national infrastructure development and up to 25% can be reimbursed based on the carbon reductions the project represents. Projects greater than 10 MW can only obtain half of the carbon reduction potential. Currently projects cannot receive both CERs and reimbursement for project costs based on carbon reduction [31].
Peru	The 2006 Law for Assuring the Development of Efficient Electrical Generation (28832) made renewable energy exempt from value-added tax [32] and allowed combined heat and power systems get priority dispatch [33]. Law 26848 of 1977 promotes geothermal resources promoted [33]. Recent Decree 1002 of May 2008 provides 5% renewable mandate, priority dispatch and transmission for renewables, funding for renewables research, and special tariff-setting to reflect the higher cost of renewables [34].
Uruguay	Decree 77 made a bid for the elicitation for 20 MW of wind, 20 MW of small hydro, and 20 MW of biomass. A similar elicitation in 2008 was made for 26.2 MW. For these elicitations, the least-cost bid process only applies among renewable generators [35] and [36].

The policies implemented in the region can be classified into five main types of policies, as discussed below [37].

7.1.1 Tax exemption

In an effort to stimulate investments in renewable energy projects, countries may elect to reduce or eliminate certain taxes for a set number of years (usually 5-10) of project operation. Tax exemptions may include income taxes, depreciations allowances, and import taxes. The incentive laws of Argentina, Colombia, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Panama, and Peru are of such a nature.

7.1.2 Renewable Energy Mandate or Portfolio Standard

A renewable energy mandate requires existing and new generators to source a certain percentage of their generation from renewable sources by a given target year. It can be applied to all large suppliers with diverse portfolios, or can be set for the country as a whole, and combined with some type of tradable credit system or systems benefit charge which ensures that all power providers share the cost of supporting the renewables portfolio. Binding mandates typically involve non-compliance fees that can serve to create a premium for renewable energy. If the mandate hopes to promote a certain type of technology, it can create a set-aside for it, requiring that a percentage of the overall renewable energy requirement be sourced from a given technology [38]. These mandates can also be made in terms of MW capacity additions, such as those in Uruguay and Brazil. These mandates achieve a set amount of installations, but fail to take into account electrical growth rates.

Renewable energy mandates are economically efficient and beneficial as they allow market pressures to lower the cost of generation to exist. Generators still compete against each other to provide the least-cost energy and are selected and contracted by power providers in power purchase agreements. This situation differs from a feed-in tariff, which provides generators with a fixed price and does not encourage innovation to lower generation costs. A fuller description of feed-in tariffs follows below.

There are negative aspects to mandates if they are not structured well. A mandate without set asides that require that a portion of generation be sourced from a particular technology does not help promote a diversity of technology types. Also some administrative costs are imposed as regulated entities must be checked for compliance [38].

Countries that have adopted a renewable energy mandate include Chile in the form of a percentage of generation that must be sourced from renewables and Brazil and Uruguay in the form of concrete MW additions by target years.

7.1.3 Production Tax Credit

A production tax credit (PTC) can be a useful way to help renewables compete with other types of generation technologies by providing the difference in generation costs. But PTCs can also be a detriment to an industry if they are not consistently supported by the federal government. In the U.S. the PTC for wind generation has expired and been renewed several times, causing a boom and bust in the wind industry [39]. If a developer begins the process of measuring wind speeds on a site, buying or renting the land, earning the requisite land, generation, and environmental permits, and sources the wind turbines, but does not begin generation on the site before the PTC has expired, he is not eligible for it. The time required to procure permits and turbines (especially during this global turbine shortage period) is so uncertain that often wind and other renewable developers cannot rely on the PTC. Only Argentina has adopted a PTC in the region.

7.1.4 Feed-in Tariff

Feed-in laws require distributors to buy renewable energy at a fixed rate that is higher than the average wholesale market price and usually close to the retail price of electricity. Some feed-in laws are structured to pay different rates for different types of renewables, which are based on the cost of generation [38].

The benefit of feed-in laws is that they are an effective way of promoting renewables since developers can get loans for projects more easily because the bank is assured that generation will be purchased at a predictable price. However, critics of feed-in tariffs argue they are not an efficient way to allow renewables to penetrate the market, as they provide little incentive for innovation or cost minimization since generators are not competing against each other in an energy auction [38]. In addition, the phase out of feed-in tariffs can be problematic as generators have incorporated the preferred tariff into their financial viability analysis. Thus phasing out tariffs may require waiting for the lifetime of the plants built under the tariff structure to expire.

Ecuador and Costa Rica have adopted traditional feed-in tariffs while Peru recently pledged to cover the difference between the cost of conventional and renewable generation in a derivation of a feed-in tariff.

7.1.5 Renewable Energy Resource Laws

Using natural renewable resources to generate electricity requires specific legislation that governs their use. For example, experience has shown that tapping geothermal resources for power generation is more successful when governed by a geothermal resources law, than under generic minerals or water acts. Geothermal resource laws such as those in Peru, Guatemala, El Salvador and Nicaragua address matters such as drilling rights, resource concessions, and environmental protection that is unique to the industry. The same can be demonstrated for hydropower, wind, and biomass.

7.1.6 Comparison

The effectiveness of the chosen policy is highly dependent on national circumstances. Chile is able to successfully implement a mandate because it has a stable economic climate and is ripe for foreign investors, making it likely that the mandate will be filled by competitive bids. Using a direct subsidy in Chile would have incurred unnecessary governmental spending as a feed-in tariff for generators is more costly for the government than allowing generators to source the required levels of renewable generation and passing on the extra cost to the consumer.

A similar mandate for renewable energy development in a less economically stable country may not be as effective. Under these circumstances such a policy could cause new generators to be hesitant to enter the marketplace until the final moment before non-compliance fees for regulated, existing generators came into effect. Existing generators probably would have to pay a premium for this generation that would be close to the non-compliance fee in order to incite investment in a country of high economic and political risk. These new generators would expect a higher rate of return on their investment because of the country risks. In this example, using a mandate over a direct incentive could lead to a lag in developer interest and may fail to create a competitive marketplace where generators could pass on a minimal cost for renewable generation to customers. Instead, the increased cost to customers would probably be high since generators would have to pay a high premium for the required generation.

Ecuador may have recognized this phenomenon when it chose to implement a feed-in tariff to promote renewables. While perhaps not the most elegant and efficient policy instrument, the feed-in tariff is probably appropriate for this country given its economic crisis of 1998 and rapid succession of presidential changes since 1995 [40]. The feed-in tariff provides a guaranteed profit for generators that bolsters project finances and makes it easier to earn a loan from banks.

However, using a fixed feed-in tariff or PTC also has its dangers and does not automatically stimulate development in a given sector. Countries with an unstable currency are at risk of having the PTC and feed-in tariff be meaningless if it is fixed and cannot be easily adjusted to reflect devaluation. This situation occurred in Argentina in 2002 when the Argentine Peso was devalued 30% to the U.S. Dollar. The PTC was reset years later in 2006 to 1.5 Peso ¢/kWh for wind, hydro under 30 MW, biomass, and geothermal, and .9 Peso ¢/kWh for solar [2]. But, the PTC now fails to provide complete investor confidence as it could again become meaningless if the currency is devalued.

The best policy choice for each country is case and site specific. The country's prevalent electrical sector structure, portfolio mix, and investment climate should be considered when making this decision.

7.2 End use Energy Efficiency

Energy efficiency (EE) measures can lower the need for current and future energy generation, thereby reducing the need for fossil fuel-derived energy. EE measures are defined as technological switches that provide the same output with less energy, such as replacing an old inefficient boiler with a more efficient one or an incandescent light bulb with a compact fluorescent one. Conservation measures are defined as those that involve the behavior of customers to use less electricity. Both of these types of practices can be driven by incentives and mandates and can be achieved by implementing the policies proposed in this section. This section does not address supply side efficiency which refers to improvements in the generation and distribution of electricity.

While EE improvements can be undertaken one technology at a time, the best practice involves the implementation of a package of measures. And, while implementation can take place on a one-off, single-site and project-specific basis, such as in a single factory or building, a far greater impact can be achieved when energy-efficiency measures are implemented on a widespread, systemic basis amongst many users, using a combination of incentives, information, and policies to achieve the necessary market transformation.

There are a variety of EE programs throughout the region, most of which are described in Chart 2 below.

Chart 2: EE Policies in Latin America

Country	Policies
Argentina	Energy Saving and Efficiency Program of Argentina (PROENER) helps disseminate EE technologies throughout the country, create EE standards and policies, and promote the private sector to increase its EE efforts [41]. The Argentine Accreditation Organization (OAA) accredits certification units and testing laboratories, the Argentine Institute of Rationalization (IRAM) of materials develops national standards in all fields and conducts voluntary product certification, and the National Institute of Industrial Technology (INTI) performs efficiency testing and certification [42].
Brazil	National Electricity Conservation Program (PROCEL) is operated by Electrobras in '86. The country has a national EE label program run by Inmetro´s Brazilian Label Program and the Procel Seal for Energy Management [42]. Rationalization of the Use of Oil and Natural Gas Derivatives (CONPET) is run by the Ministry of

	Mines and Energy and was founded to reduce use of diesel, foster use of natural gas, educate youth, encourage use of best technology in household appliances, and promote rationing in industrial sectors [43].
Chile	National Energy Efficiency Program's (PPEE) was created by the Chilean government in 2005 to perform energy evaluations for members of the private sector [44]. It has the goal of educating, implementing, and regulating the various energy sectors and in 2008 created mandatory labeling on the EE performance of refrigerators and light bulbs [42].
Colombia	The Unidad de Planeación Energética (UPME) designs and enacts energy efficiency standards and labels including the CONECE labeling program. The Colombian Institute of Technical Standards and Certification designs these standards [42].
Costa Rica	Demand Side Management and Rational Use of Electricity in the Central American Isthmus created a long-term plan for the state-run Companía Nacional de Fuerza y Luz launched in 1994. The Ministry of Mines and Energy coordinates the National Energy Conservation Commission, which developed standards for fluorescent lamps, refrigerators, freezers, fixed combustion systems and energy labeling of equipment. The state-run Instituto Costarricense de Electricidad through its Area of Energy Conservation, runs the EE Lab, the "energy seal" project, and the Energy Savings Information Program[43].
Cuba	In 1997, the Program for Energy Savings in Cuba (PAEC) was created to handle rapid electrical growth demand. Incandescent light bulbs and inefficient televisions and refrigerators were replaced [43].
Jamaica	EE and sustainable development are emphasized by Jamaica Bureau of Standards. Refrigerator efficiency labelling has been required since 1992 [43].
Mexico	Energy Savings National Commission (CONAE) was created in 1989 separate from energy secretariat to make national standards and programs and provide technical assistance. CONAE supports all activities from energy production to end-use. The Trust Fund to Save Energy (FIDE) created in '90 finances

	efficiency projects, and provides technical assistance, training, and certification [43].
Peru	The Centre for Energy and Environment Conservation (CENERGIA) formed in 1985 with board members from public and private entities to promote EE in all sectors. It has NGO status and its funds are derived from consulting and international cooperation contracts. A law called the Promotion of Efficient Use of Energy was passed in 2000 to reduce environmental damages from power production and promote electrical competitiveness [43].
Uruguay	The Uruguay Energy Efficiency Project is a $6.8 million project funded by the Global Environmental Facility to imported fuel, improving air quality, and reducing the cost of energy in the production of goods and services by helping the Ministry of Industry, Energy and Mining develop energy efficiency policies [42].
Entire Region (EE Ministerial Declaration)	There is an initiative for efficiency in small and medium-sized enterprises and buildings, sustainable transportation, and training of professionals [43].

Estimates of EE potential to reduce electricity consumption in the region range from 10-20%. If just 3-5% of this potential were tapped, savings of 156 billion USD would be reaped between 2003 and 2018. These cost savings rely on the implementation of national EE plans in each nation [45]. Clearly there is huge potential to save on energy and a need for more energy efficiency policies in the region. Like the diverse renewable energy programs implemented in each country, EE plans should be country-specific, taking into account the electrical sector structure and the political and economic conditions of each country.

Energy-efficiency programs encompass a wide range of interventions to influence the timing, type, and amount of energy consumed by various sectors in the economy. Interventions can be classified into three broad types of programs: policy & regulatory, institutional, and financing.

7.2.1 Policy & regulatory

As seen in the above chart, some Latin American countries have adopted national energy policies, legislation, and regulations for EE. These policies and plans are often not effective or in some cases not even implemented, due to the lack of political will, institutional support, and/or financial resources. However, there is ample evidence to show that EE policies can not only be cost effective, they can in fact have negative costs if well implemented. Effective EE policy and regulatory measures include the following.

● Energy price rationalization -- Energy prices in developing countries are frequently below the cost of supply, and government subsidies of energy prices and energy supply institutions such as utilities or district heating companies are common. While some of the targeted subsidies are useful to alleviate the problems faced by low-income energy users, there are often subsidies and cross-subsidies that end up being applied to large end-use sectors as a whole (most commonly, residential and agricultural sectors as seen in most countries) thereby discouraging large sectors from implementing energy-efficiency measures and instead encourage excessive and wasteful use of energy. It is well known that raising energy prices to rational levels is a necessary though often difficult step for improving EE.

● Reducing import duties -- In many countries, energy-efficient products are simply not available because the products are not domestically manufactured and have to be imported. Frequently, the product vendors simply do not perceive markets for such products. There also may be high import duties, frequently imposed to protect domestic manufacturers from foreign competition, with the result that imported energy-efficient products are too expensive. The high duties not only retard the entry into the market of imported high-efficiency products, but of domestically manufactured energy-efficient products as well. Without competition from imported energy-efficient products, there is no incentive for protected domestic manufacturers to improve the efficiency of their products. A simple energy-efficiency policy step is to reduce import tariffs on energy-efficient products and their component parts.

● Performance risks -- Developing countries often suffer from problems in their energy supply infrastructures that limit the use of energy-efficient products routinely used in industrialized countries. For example, electric utilities frequently have problems with voltage fluctuations and voltage imbalances, which decrease appliance efficiencies and lead to premature motor burnout. These conditions serve as disincentives to users to purchase more expensive high-efficiency products. In addition, most developing countries lack well-developed low-pressure natural gas distribution networks, so the use of efficient gas-consuming equipment is often impossible. Although energy-using products can be "hardened" to accommodate power quality problems, the hardening can add considerably to the cost of the products. Reducing power quality problems is a key policy precondition to implementing a robust end-use energy-efficiency program.

● Appliance efficiency standards and labeling -- While many energy-efficiency programs involve voluntary steps by energy users and other stakeholders, appliance efficiency standards involve mandatory actions on the part of appliance manufacturers, assemblers, importers, and retailers, and an obligatory labeling of appliances. To be effective, they also require effective enforcement, which is often lacking. Many countries have taken the easier step of establishing appliance-labeling programs without imposing standards. Labeling programs require that labels be affixed to appliances that provide energy-efficiency information or ratings to consumers. They are easier to adopt than standards from both a political and regulatory standpoint but have to be carefully designed as well as accompanied by aggressive information campaigns to disseminate the information amongst consumers who would make the investment decisions on efficient (or inefficient) appliances based on the information on the labels.

● Energy-efficient building codes –EE building codes generally cover new buildings but sometimes also existing buildings, and both building envelope and building energy systems. However, even though incorporating energy-efficiency into the codes is the first step, it is difficult to enforce these codes due to lack of institutional set ups, training, availability of materials and equipment, etc. In order for such policies to produce meaningful results it is essential to promote a market development and capacity building process, involving architects, building developers and engineers to understand and comply with the codes, along with local code officials on how to enforce the code, and for suppliers of construction materials so they know the kinds of materials and products to make available to builders.

7.2.2 Institutional

Energy-efficiency programs typically involve the existence or establishment of an institution to carry out much of the analytic work or oversight of the implementation of energy-efficiency program elements emanating from the EE policies, regulations and/or legislations. The institution can be public, a para-statal, an energy utility, or a public-private entity. It may or may not have the regulatory or enforcement authority, but advises the government on policies and regulations, and then helps to carry out the policies. Institutional programs can include:

● Public information programs – One of the most common institutional interventions is the provision of energy-efficiency information to households, businesses, and other energy users. The information includes explanation of the benefits and costs of various energy-efficiency measures, how to get energy-efficiency products, and how to get help deciding what measures to pursue. The program can take the form of a public information campaign to save energy or can involve technical information for engineers, factory managers, and building owners. Information programs are essential components of overall energy-efficiency programs, but have been found to be relatively ineffective if they are not carried out in conjunction with more substantive actions like financing programs, financial incentives, or government regulatory requirements.

● Bulk procurement – The purchase of efficient equipment is typically more costly than its inefficient equivalent. One way to overcome these higher costs is to do bulk procurement of energy-efficient products, under which municipalities, schools, hospitals, and other large energy users form what is essentially a buyers' cooperative that can negotiate lower prices with product suppliers. Electric utilities (generally through what is called Demand Side Management programs) can also facilitate bulk procurement of efficient appliances and equipment and have them distributed directly or through intermediaries (including ESCOs) to consumers at a cost or subsidized prices.

● Training programs -- Facility managers, responsible for maintaining the physical plant at municipalities, schools, public buildings, hospitals, and other energy-consuming facilities, often lack knowledge of energy-efficient operations and maintenance practices. They may not know how to accurately track energy consumption, how to tune up equipment, when to replace certain parts, or how to procure higher efficiency equipment – which are essential activities to deliver the energy savings and associate GHG reductions. Training programs, particularly those that provide monitoring equipment and that have a certification component, can have a significant impact on reducing energy waste in buildings and other facilities.

7.2.3 Financing

Appropriate financing and financial incentives available to energy users is the key to gaining widespread market penetration of energy-efficiency measures. However the availability of affordable financing is often a barrier to EE implementation. Many countries do not have mature commercial banking sectors and may not even have term lending programs, which are conducive to EE sector. Other countries that have active banking sectors and high liquidity, also perceive both performance and technical risks associated with energy saving projects. Furthermore, energy bill savings that stem from a retrofit project are considered less bankable than a cash flow from a new investment. Therefore these savings are more difficult to finance.

● Affordable financing -- Even if energy users are willing to invest in energy-using products on the basis of their life-cycle costs, they may not have the investment capital to pay the higher initial costs of the more efficient products. If they do have the capital, they may face competing investments. Particularly in the industrial sector, firms with limited capital tend to concentrate their investment on expanding production or developing new products rather than on cost-cutting projects and services. One way to overcome this barrier is through the provision of affordable financing, for example through the establishment of a low-interest loan or loan guarantee program for energy-efficiency investments.

● Financial incentives -- Energy users, be they individuals, businesses, or governments, should ideally select products that have the lowest life-cycle cost. In practice, they tend to select products with the lowest first cost. If a more energy-efficient model is available, the users tend to spend the additional capital for it only if they think the financial return on the investment will be very high in the near term. That is, consumers apply high discount rates to energy-efficient investments. This behavior is characteristic of energy users everywhere, but in developing countries where incomes are low, discount rates tend to be even higher than in industrialized countries.

These discount rates are far in excess of the market rates that are used, for example, by electric utilities to evaluate the long-term financial benefits of power plants. If a utility applied its discount rate to a range of energy-efficiency investments, many of the efficiency investments would have much higher rate of return than that of a new power plant. But unless the utility is participating in a program to purchase energy savings, for example through a demand-side management (DSM) program, the efficiency investments are left to individual consumers, whose high discount rates make the investments prohibitive.

One way to overcome the high discount rate barrier is for an energy-efficiency program to provide a financial incentive, for example, by providing a rebate for the purchase of a high-efficiency refrigerator, air-conditioner, industrial motor, etc. A government energy program, a utility operating a DSM program, or a non-profit corporation tasked by a government or utility to operate energy-efficiency programs could provide the incentive payments. The payments can go to the energy users, the product retailers, or the manufactures. Many programs focus on the users, but it is often more cost-efficient to provide the incentives upstream in the supply chain.

7.3 Waste management

Methane emissions from solid waste landfills are expected to increase in LAC due to the growth of solid waste generation rates caused by the increase in population and economic activity, and improvements in landfill operational practices that are expected to increase anaerobic conditions in landfills. Compost practices may contribute to a reduction in methane generation, but it is extremely difficult to predict the potential of composting practices in the short and medium term. Nevertheless, policies and financial incentives could accelerate the capture and flare or use of the methane in the short term, decreasing the net effect of the increase of methane emissions.

In terms of policy, the region needs to start working on various fronts. In the medium term burning of land fill gas should become mandatory for security and sanitary reasons. Minimization practices (reduction, re-use, recycle) and compost need to be instituted for sanitary, environmental and economic reasons. The World Bank is currently developing a recycling methodology which is expected to have a significant impact in the sector, not with respect to methane emissions, but just as importantly in regard to the improvement of living conditions of waste pickers.

Even in the case of LAC, a region with minor climate responsibility, it is not prudent or advisable to postpone implementation of mitigation policies and measures that are already cost-effective and have ancillary sustainability benefits. Some fraction of the world's greenhouse gas emissions can be reduced now or in the near future in most countries of the world, and ample reasons exist to accomplish those reductions that are possible as no regrets measures in the LAC region.

8 INTERNATIONAL FRAMEWORK FOR MITIGATION POST 2012

Any international architecture for the post 2012 climate regime will have to build on the pillars of the Bali Action Plan. With regard to mitigation, the Bali Action Plan distinguishes between commitments, actions or emission targets of industrialized countries (that must be comparable to each other), and actions on the part of developing countries. Mitigation efforts on both sides must be measurable, reportable and verifiable, and mitigation of developing countries must be supported by technology and financing from industrialized countries. The international negotiations that will define this architecture are still underway, and will not be finalized before the end of 2009. However, some elements can be identified which have some probability of being considered a part of that architecture.

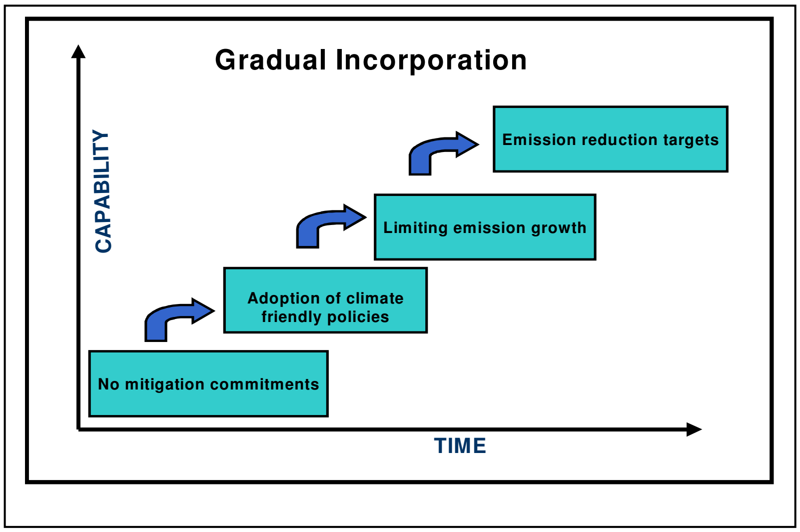
8.1 Emission reductions in industrialized countries

As mentioned at the beginning of this study, global emissions need to decrease….etc. etc etc .. As yet there is no definition of benchmarks in terms of timetables or targets for any country or set of countries. It is only clear that the industrialized countries participating in the Kyoto Protocol are expected to commit to legally binding targets that are deeper than those assumed for the first commitment period of the Kyoto Protocol. The United States signed the KP in Kyoto in December of 1997, but then with the change of administration withdrew from the Protocol in March 2001 and has not ratified it. The imminent change of administration in November 2008 will not likely bring about a ratification of the Kyoto Protocol. However, various versions of greenhouse control legislation are under consideration by the Senate, and it is probable that one of those may be passed in 2009. From an international perspective, the expectation is that the unilateral legislation of the USA deliver comparable reduction efforts to those already undertaken by Kyoto Protocol participants.

The Bali Action Plan would require reductions on the part of industrialized countries to be measurable, reportable and verifiable, but these requirements would probably be satisfied with the accounting practices already underway under the KP.

8.2 Emission reductions in developing countries/ LAC

While it is clear that developing countries will have to enhance their participateion in the global emission reduction effort, this does not mean that LAC countries would necessarily assume hard national emission targets under a future climate regime. Currently, industrialized countries that have ratified the Kyoto Protocol have emissions ceilings based on their 1990 emissions level. It is highly unlikely that this type of emission reduction target will be accepted by developing nations in the near future. In order to uphold the principle of common but differentiated responsibilities and foster a smooth transition toward increasing responsibility, a gradual incorporation approach could be applied whereby some developing countries would gradually move over time and based on demonstrated capability from no reduction commitments, to the adoption of climate-friendly policies, to limiting emission growth, and finally, some of them would adopt emission reduction or at least intensity targets. In order to ensure fair and equitable participation, the threshold could be defined through the discussed combination of responsibility[34], capability[35], potential to mitigate[36] (Yamin 2006). Moving from one category to the next could be further linked to industrialized countries' verified performance (consisting of both emission reductions as well as of provision of financing for developing countries). This type of trigger would have the advantage of setting fair rules for all countries on the basis of objective and predictable timetables and



[34] Measured as cumulative CO_2 emissions since 1990
[35] Measured as GDP per capita
[36] Measured as GHG emissions per capita

progressive commitments, although the relationship between the various stages and participation in market mechanisms would have to be addressed. While Kyoto-bound countries would continue to take the lead, other industrialized countries would have to catch up, and developing countries -- or at least the larger ones -- would gradually enter.

In the post 2012 period the emission reductions of developing countries will have to measurable, verifiable and reportable (MRV). There is still much discussion as to how to comply with this requirement, where some countries argue that MRV can only be done domestically, and others state that it must be performed by a third party on an international basis.

8.2.1 Sectoral approaches

One of the issues under discussion for the post 2012 mitigation effort is the possibility to move toward sectoral approaches, possibility which is mentioned in the Bali Action Plan. The CDM was conceived as a project-based instrument. Most of the project activities in the CDM are individual efforts at a carbon upgrade or "end-of-pipe fix" within the limited boundary of a discreet facility or enterprise, with limited transformational effect. While a project activity may well pilot a new technology or otherwise improve the carbon intensity of its own performance, there has been little incentive to disseminate the technology broadly and in a consistent manner. The bottom–up single project approach severely diminishes the potential of the CDM to implement climate friendly policies that would transform carbon-intensive economies and mainstream climate into the economic growth patterns of the South.

The recent opening of the CDM to programs of activities (PoAs) may be the first step in the direction of promoting mitigation activities that go beyond single sites. PoAs promote activities that could be sector-wide, allowing multiple projects implemented at different times that comply with a governmental regulation or private sector initiative to be registered together. Programmatic CDM therefore provides an incentive for developing countries to devise policies that promote greenhouse gas reductions [46]. However, programmatic CDM operates under modalities and procedures of the CDM established in the Marrakesh Accords, and its potential to foster policy-based and sector wide mitigation may be limited. While the mitigation experience that has been gathered during the first commitment period of the Kyoto Protocol has been extremely valuable, it is clear that the reduction levels called for in the Fourth Assessment Report of the IPCC cannot be attained through the CDM on a project-by-project basis. However, the implementation of a set of policies and measures that are already being considered or which developing countries might reasonably adopt could deliver the necessary emission reductions. The sectoral approach is one way to promote these policies and measures.

Since the original proposal for a sectoral CDM (Samaniego and Figueres 2002) there has been growing academic interest in sectoral approaches (Bodansky et al 2004, Bosi and Ellis 2005, Figueres 2005, Schmidt 2005, Cosbey et al 2005, Sterk and Wittneben 2005). The interest permeated the political spheres with the 2005 OECD high level roundtable on transnational secoral agreements for climate policy, the G8 Gleneagles Plan of Action, and the Major Economies Meetings.

As the concept is still relatively new to the climate regime, there is yet no universally accepted definition of a sectoral approach. Instead, the term is used in various contexts to mean different things. In general, the discussion about sectoral approaches can be organized into two broad categories, depending on whether the focus is a country or a particular industry on a transnational basis.

8.2.2 Country specific

In an effort to promote decarbonization of a particular sector or sub sector, a country can establish a specific policy for that sector, ranging energy or carbon intensity to participation (e.g. renewable portfolio standards). The sector could have benchmarks, aspirational or mandatory emission targets, and could involve international crediting for the attainment of the target or for surpassing the established target. An example would be a law that mandates higher boiler efficiency for all industrial and electrical heating applications.

8.2.3 Transnational

This approach would be an industry-led initiative that aims to engage a sector on a broad international basis. A current example is the Cement Sustainability Initiative formed under the auspices of the World Business Council for Sustainable Development (WBCSD). The CSI intends to propose industry baselines, to be negotiated on a country level. The transnational approach focuses on maintaining transboundary industrial competitiveness and is relevant for trade-exposed energy intensive industries such as cement, aluminum, and steel. Crediting could be considered between companies within the same industry in both developed and developing countries.

Within a regime that would allow for a gradual incorporation of developing countries over time, it is conceivable that as a next step the larger developing countries would consider some no-regrets country specific sectoral approaches such as energy efficiency benchmarks. The efficiency targets announced by China and Mexico are examples of such approaches, which could be encouraged and complemented with international verification in order to be considered a quantified contribution of those countries. At the same time, some key energy intensive sectors might consider transnational approaches for their sector. This would open the door to the incorporation of aviation and maritime emissions, neither of which are currently covered by the regime.

8.2.4 Cap and trade

The Kyoto Protocol established a cap-and-trade system in the participating industrialized countries. Developing countries are not foreseen to be assuming a cap and trade system in the near or medium future. A cap-and-trade system involves the distribution of permits to emitters/polluters in regulated industries. Emitters that need more permits can buy them from other entities that do not need as many or from projects that represent an offset of greenhouse gas emissions that, without the revenue for the emission reductions, would not otherwise have occurred. Emitters that do not have enough permits for the amount of emissions they are releasing at the target date of compliance must pay a fine for each ton of carbon dioxide-equivalent that they are over the cap. In a mature cap-and trade system the cap is gradually ratcheted down as regulations become more stringent [55]. The European Union is considering this increasing stringency for the Third Phase of the European Trading Scheme.

The benefits of a cap-and-trade system are numerous. In general, cap-and-trade systems are considered efficient since the market decides how to best control emissions. If implementing abatement measures is cheaper than buying a permit, companies will pursue this option. Also, by allowing for the inclusion of offsets in a cap-and-trade system, reductions can be made at the cheapest price possible by pursuing projects in the developing world [57]. Allowing companies to trade permits provides an incentive for emitters to constantly refine their technology and decrease their emissions. With a carbon tax, this incentive is non-existent. Because of these advantages of a cap-and-trade system over a tax, it has been selected not only for the Kyoto Protocol, but also for the U.S. Regional Greenhouse Gas Initiative (RGGI), the cooperative effort of eleven Northeastern and Mid-Atlantic states to reduce carbon dioxide emissions within the boundaries of the participating states.

Despite its adoption in existing greenhouse gas regulations, a cap-and-trade system is not perfect. It is difficult to foresee the right level of allocation and lobbying industries can influence the number of allowances initially allocated to a given sector [55]. In the spring of 2006 the price of one ton of CO2 in the European Trading Scheme bottomed out from nearly €30 to €.1 due to the fact that allowances for the ETS's Phase I had been over allocated [60] and [61]. If allowances are simply given to emitters instead of sold to them in an auction, there is less revenue generated that could be utilized for greenhouse gas mitigation activities than through a carbon tax. This is one of the reasons why the EU is proposing increasing levels of allowance auctions for the Third Phase of the ETS.

8.3 Technology

The promotion of technology transfer for greenhouse gas mitigating activities could help accelerate the process of addressing climate change. Technology transfer has no strict definition but is generally known as the availability of know-how and equipment from a developed country to a developing one [48]. Proponents of technology transfer for climate change mitigating activities argue that market imperfections that prevent technology transfer from occurring must be overcome by non-market interventions. The cost of new technology is a market barrier because it is usually prohibitively expensive for adoption and externalities of pollution are not considered in the pricing of most generation and other activities. Also, there is a market barrier to the transfer of technology occurring equitably [48].

Transfer of technology is a component of the United Nations Framework Convention on Climate Change, although it has not been fulfilled to the satisfaction of many developing countries and continues to be a point of contention between the North and the South. The UNFCCC has been engaged in technology transfer efforts since 1995 when a coalition of OECD countries and the European Union established the Climate Technology Initiative (CTI). More recently the UNFCCC has established other programs such as the Experts Group on Technology Transfer, the Technology Cooperation Agreement Pilot Project (TCAPP) and the Climate Technology Partnership (CTP) [48]. Each of these programs is discussed below in the chronological order in which they were implemented.

The Climate Technology Initiative (CTI) developed in 1995 by 16 OECD and EU member countries operates under the International Energy Agency and attempts to bring countries together to promote the utilization of climate-friendly technologies and practices. The CTI tries to achieve its objective primarily through education in training courses and seminars [49]. CTI also established the use of a Cooperative Technology Implementation Plan to assess priorities and an action plan for members. This program is currently active in Southern Africa, India, and Nigeria [48].

In 1997, the U.S. government developed the Technology Cooperation Agreement Pilot Project (TCAPP) as a way to show how a host country-driven, market-oriented approach could work. TCAPP members worked with representatives from Brazil, China, Egypt, Kazakhstan, Mexico, Philippines, and South Korea to identify the highest priority clean energy technologies. Then, the TCAPP members worked with these countries to develop strategies to promote these technologies. In 2001 the TCAPP program was terminated as the U.S. embarked upon a new effort to provide more focused support for technologies.

After completion of the TCAPP, the U.S. then adopted the Climate Technology Partnership (CTP). The lessons learned from the TCAPP were used in the CTP. The CTP differs from the TCAPP in that direct technical assistance from the National Renewable Energy Laboratory, Winrock International, and E+Co are utilized [50]. The CTP is active in China, Republic of Korea, Mexico, Philippines, South Africa, and Egypt, where cogeneration plants are being installed [51].

The results of these programs have varied and vital lessons learned from them should apply to future technology transfer efforts. A National Renewable Energy Laboratory report of the results of these programs provides the following lessons learned: 1) the host country should drive the process to ensure an appropriate fit to the problem; 2) existing programs should be built upon in future efforts since methodologies and background work has been done; 3) participation from a variety of stakeholders is essential for project success; 4) technology needs and market barriers should be assessed and prioritized; 5) the implementation process should match the technology needs assessment; 6) consideration of a lack of local expertise, limited resources, lack of information, and difficulty engaging the private sector should be considered before implementation; 7) the private sector, international donors, the host country government, and community should be linked in the process of implementation; 8) technology transfer can fall into the categories of capacity building, investment stimulation, and market conditioning; 9) climate change technology transfer will be most effective in areas where in-dept action and implementation can occur because adequate financial and human resources are available; 10) climate change technology transfer should be adaptable to changing conditions; 11) definition of an evaluation of programs should be created to guide the whole effort [48].

After the 2005 Gleneagles Summit, the G8 decided that there was a need to develop and advise on alternative technology scenarios to avoid climate change and energy insecurity, leading to the publication of the IEA study "Energy Technology Perspectives". In this publication, the Accelerated Technology Scenarios show how CO2 levels can be stabilized at today's levels by 2050 and how energy efficiency measures can cut energy consumption by one-third of today's levels and 56% of the growth in petroleum products can be offset. These gains are made by placing increased emphasis on efficiency in the buildings, transport, and industry sectors, shifting electrical generation to renewables and nuclear, using carbon capture and sequestration for coal and gas-based generation, and increasing the use of biofuels in the transport sector [52].

8.4 Financing

In the case of developing countries, where a number of mitigation opportunities may in theory be economically feasible, the burden of the additional investment required for implementing mitigation programmes may be significant enough to adversely affect GDP growth assumptions due to the budgetary diversion from other social and economic sectors that have a higher level of priority (La Rovere 2006).

Thus mitigation that is both timely and deep enough for global stabilization will not occur in developing countries without concerted international financial support. In considering this support, it is helpful to estimate the possible level of funding that is necessary.

8.4.1 Investment necessary

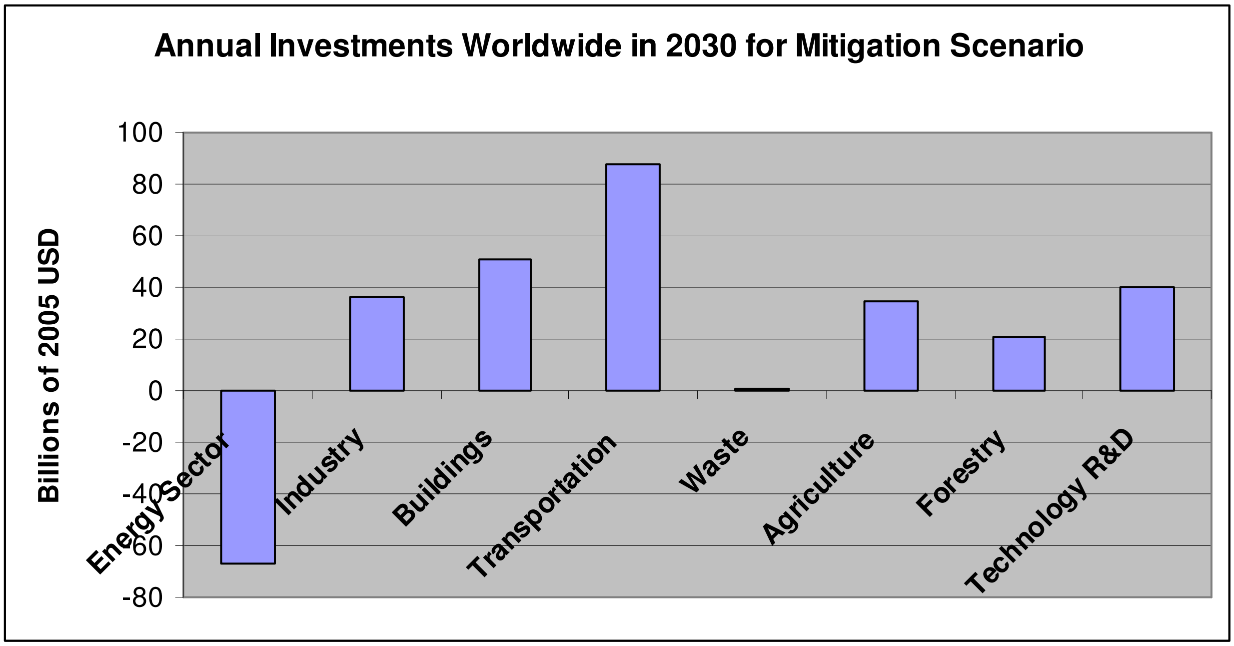
The Secretariat of the UNFCCC has released a study that assesses the additional investment and financial flows needed to return energy related global (CO2 eq) emissions to 2004 levels by 2030.[37] To build the reference scenario the study uses 1) the International Energy Agency World Energy Outlook (WEO) 2006 reference scenario, which contains 2005 data, 2) the baseline non-CO2 emissions projections from the US EPA extrapolated to 2030, 3) current CO2 emissions due to land use, land use change and forestry, and 4) industrial process CO2 emissions from the World Business Council on Sustainable Development (WBCSD). The alternative emission scenario is taken from the energy-related CO2 emissions of the IEA WEO 2006 Beyond The Alternative Policy Scenario (BAPS) scenario, the US EPA baseline non-CO2 emissions projections minus the reductions possible at a cost of less than USD 30 per ton of CO2 equivalent, potential CO2 sinks increases due to agriculture and forestry practices, and industrial process CO2 emissions from WBCSD [1].
Global emissions in 2000 under both the reference and mitigation scenarios are 38.87 GtCO2e. Under the Reference Scenario they would rise to 61.52 GtCO2e in 2030. The Mitigation Scenario would reduce global emissions in 2030 to 29.11 gtCO2e. Thus the Mitigation Scenario provides a 25% reduction from 2000 global emissions, with the additional reductions coming mainly from forestry and agriculture.

In the study, "additional investment" is identified as the difference between the business as usual (BAU) planned investment projections, and the investment needed to deploy the upgraded technology that will achieve the production expected for 2030 without exceeding 2004 emission levels. The annual additional investment is the amount that would need to be invested in the year 2030. Annual additional investments would also be required during the intervening years but they are smaller than the additional investment in 2030.

The Secretariat study estimates that an additional $200–210 billion will be needed worldwide in 2030 to return to current emission levels. The cost estimates for mitigation in each sector are provided below. Of particular note are the energy sector costs, which are negative. Because energy efficiency upgrades would need to occur in energy transmission, distribution and generation, overall electricity consumed would fall, thus reducing investment requirements with respect to the BAU planned investments [2].

Figure X

[37] UNFCCC, Report on the analysis of existing and potential investment and financial flows relevant to the development of an effective and appropriate international response to climate change, Dialogue working paper 8 (2007)



Additional investment and financial flows are needed worldwide to move from the reference scenario to the mitigation scenario, but they are particularly cost-effective in developing countries [2]. Additional investment flows in non-Annex I Parties are estimated at about 46 per cent of the total needed in 2030, while the emission reductions achieved by those countries amount to 68 per cent of global emission reductions.

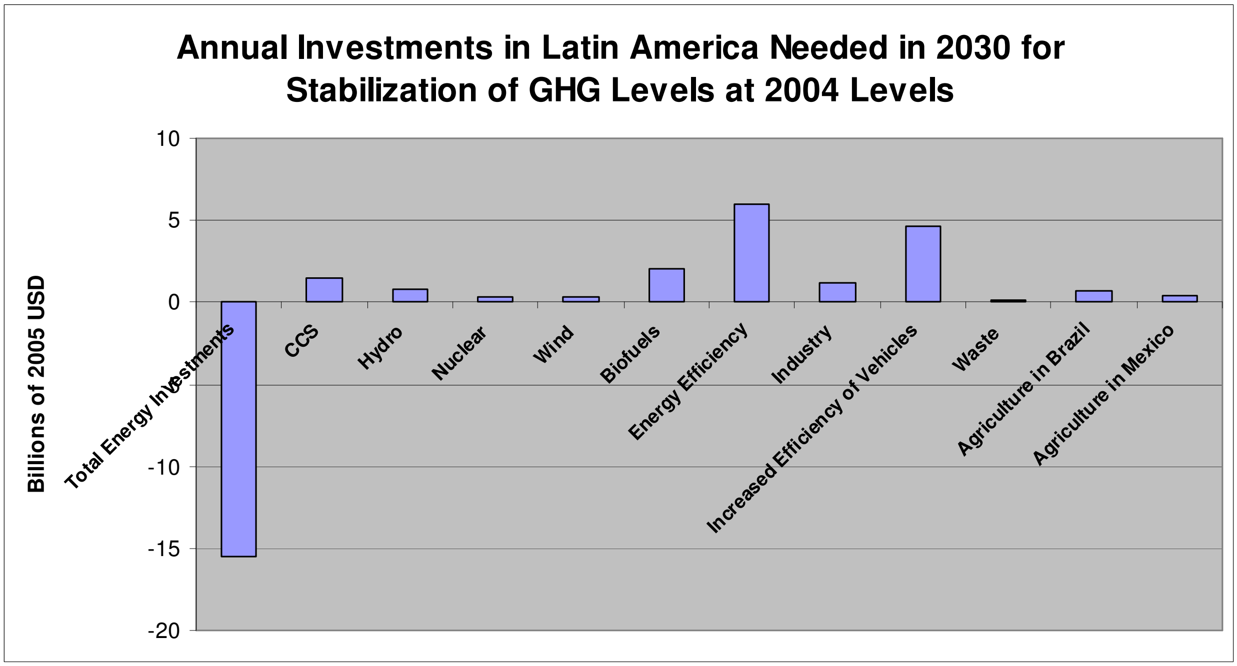
For purposes of estimating the necessary investment in LAC, this study uses the same databases as those used by the Secretariat study, albeit realizing that many datapoints are missing. Thus the numbers presented here can only be understood as indicative and not absolute. Based on available data it can be estimated that Latin America would require 17.8 billion 2005 USD in annual additional investment by 2030 to reduce its GHG emissions from the projected level of 1929 MtCO2 emissions in 2030 to close to the 2002 level of 854 MtCO2 [1] and [3]. This represents 8.6% of the estimated global investment, and would achieve 14% of the global reductions needed to return to 2004 emission levels in 2030 [4].

Under the mitigation scenario, energy efficiency upgrades in Latin America cause the region's electrical demand to fall from 1982 to 1589 TWh annually for the region by 2030. This reduced demand would mean that by the year 2030, 7 billion 2005 USD annually would be saved on transmission and distribution and 0.3 billion USD on generation capacity. Fifteen billion USD annually or 192 million tons of oil equivalent would be shifted away from coal, oil, and natural gas energy production causing a 37% decline in these industries while the amount of energy from nuclear and renewable energy would be increased annually by 43 million tons of oil equivalent.

The total increased investment in nuclear, renewables, biofuels, and carbon capture and sequestration would be 4.9 billion 2005 USD by 2030 [4]. Investments in energy efficiency would need to be approximately 6 billion 2005 USD annually by 2030. Of this total, 1.1 billion 2005 USD in 2030 would be invested annually into building efficiency where 19 million tons of CO2 equivalent would be reduced [1].

Mitigation and reference scenario data for other sectors shows that within the industrial sector, by 2030 1.2 billion 2005 USD is required annually to reach the targeted mitigation scenario of stabilization at current greenhouse gas levels. The industrial sector reductions include methane, nitrous oxide, hydrofluorocarbons, and carbon capture and sequestration. The transport sector would require a total annual investment of 4.6 billion 2005 USD each year by 2030 for the increased efficiency of vehicles and 2 billion 2005 USD in biofuels. Within the waste sector, 88 million 2005 US dollars is required annually by 2030 for destruction of methane produced during anaerobic digestion and nitrous oxide in wastewater processing. The agriculture sector mitigation potential and investments needed is only available for Brazil and Mexico. In Brazil, 3.7 tons of CO2 equivalent could be mitigated from rangelands for a total of 125 million 2005 by promoting activities like low till agriculture. In Mexico, 9.3 tons of CO2 equivalent from croplands could be reduced for a total of 315 million 2005 USD. Within the livestock sector, Brazil could reduce 16.2 tons of CO2 for 549 million 2005 USD while Mexico could reduce 2.1 tons of CO2 for 71 million 2005 USD [1].

Figure 2: Summary of Additional Investments in Latin America Required in 2030 for Stabilization Scenario [1]



8.4.2 Strengthening the market

The international carbon market could be one channel of financing for the mitigation efforts of developing countries. However, the relatively low levels of carbon finance that is flowing through the CDM is to a great extent the result of the low level of demand on the part of industrialized countries. In turn, this is due both to the minimal reduction commitments made by the industrialized countries under the Kyoto Protocol as well as to the withdrawal of what would have been the largest buyer on the market. The CDM pipeline is projected to deliver 2 billion tons by 2012. The mitigation scenario used by the UNFCCC Secretariat for the financial flows study identifies a needed reduction of 20 gtCO2eq by 2030. Any stabilization scenario demands from the industrialized countries much deeper reduction commitments than they have had during the first commitment period. Not all, or perhaps even not the greater portion, of the reduction commitments will be able to be achieved through international offsets. On the other hand there is much discussion about a strengthened market mechanism for the post 2012 period.

One possible evolution of the market would be to use the experience gained from programmatic efforts to graduate into a sectoral crediting mechanism, which may be more appropriate for the rapidly industrializing nations and less so for the smaller economies. Under this market mechanism, a developing country would voluntarily opt to set sector-wide reference lines for carbon intensive sectors at levels that coincide with its domestic economic interests (Figueres and Newcombe 2007). Reference lines could be progressive over time (reduced in carbon intensity year on year), embodying the Government's commitment to reduce the carbon intensity of growth while achieving domestic economic efficiency targets in parallel. These reference line trajectories could be independently assessed by UNFCCC panels, just as the inventories of sources and sinks are independently assessed in Annex B countries.

A rapidly industrializing country could then design and present for independent assessment, additional policies, measures and investments to reduce carbon intensity below the accepted reference level of efficient domestic economic performance, with the purpose of earning emission reductions to the extent that they exceed the agreed domestic reference line, thus performing a global service. On the basis of this rigorous process of review and reporting, Parties would agree to the forward sale of a proportion of the anticipated emissions reductions to help underwrite accelerated low carbon economic growth. This latter provision is crucial to leveraging investment on a scale sufficient to make a difference to the underlying economics of more advanced zero carbon alternatives, and support aggressive fiscal policy instruments (subsidies, tax concessions, matching grant programs, etc,) that would otherwise place a heavy burden on domestic budgets.

8.4.3 New climate finance

It is likely that even a strengthened market will not be able to deliver the necessary investment needed to transform developing country economies. Thus other complementary forms of finance are being considered. Having taken stock of the need to support the transition to low carbon growth in developing countries and identified the need for increased resources and instruments to meet the financing gap for scaling up emission reductions, several governments and multilateral development banks have proposed or established new financing vehicles to support mitigation and adaptation activities worldwide.

8.4.3.1 UK Environmental Transformation Fund

The Environmental Transformation Fund (ETF) was launched in April 2008 to accelerate the development of new low carbon energy and energy efficiency technologies in the UK, and to help developing countries tackle climate change challenges. The domestic fund has a budget of £400 million for the period 2008-2011, and the international fund manages £800 million for the same period. The first £50 million has been earmarked to help tackle deforestation in the Congo basin.

8.4.3.2 US Clean Technology Fund

The US government has proposed a Clean Technology Fund to help China, India and other developing countries finance advanced technologies to cut greenhouse gas emissions. The fund seeks to stimulate private-sector capital by making challenging clean energy projects more attractive investments and encourage emerging economy governments to adopt more environmentally friendly policies. The US government is committed to investing $2 billion over the next three years in the Fund, and is in discussions with other G8 governments to raise more capital.

8.4.3.3 Japan Cool Earth Partnership

As part of its Cool Earth Partnership plan which envisions global long-term goal of cutting global emissions in half by 2050, the Japanese government has proposed the creation of a new funding mechanism based on international cooperation to support curbing emissions in developing countries interested in moving toward a low-carbon economy. The proposal includes $2 billion in grant funding for adaptation, and $8 billion as ODA loans for mitigation, particularly focusing on sectoral approaches that will improve energy efficiency of power generation and transfer Japanese technologies. Developing countries with which Japan is holding consultations include Indonesia, Tuvalu, Senegal, Madagascar, Nigeria, Guyana and Gabon. No Latin American country is yet in consultations with Japan about the Cool Earth Partnership.

8.4.3.4 World Bank

The World Bank has recently invited other multilateral banks (Asian Development Bank, African Development Bank, European Bank for Reconstruction and Development, and InterAmerican Development Bank) to establish two Climate Investment Funds (CIFs) that will provide incentives for scaled-up action and transformational change in developing countries. The Clean Technology Fund, with a target capitalization of $5billion) will focus on encouraging the deployment of new technologies as climate change solutions. The Strategic Climate Fund will provide financing for new approaches to address climate change. It is conceived as an umbrella fund, and will have targeted programs such as greening energy access, sustainable forest management and carbon capture and storage. It will start operations with the Pilot Program for Climate Resilience ($500 million) to explore ways to promote adaptation to climate change. [64].

The CIFs will be additional to existing Official Development Assistance (ODA), will be host country-led and created as an equal partnership between the implementing entity and the host country. The CIFs will utilize a blend of financial instruments (grants, concessional loans, guarantees) to catalyze increased flow of commercial capital as the basis for transformative investments at scale.

The new carbon finance that is being put on the table is a good start, but they can be interpreted only as a signal of movement in the right direction. The UNFCCC study on financial flows estimates developing countries will need US$92-95 billion in annual additional investment in 2030. If industrialized countries are serious about reaching stabilization by then or soon thereafter, they have to start moving toward those levels of financing, with the reassurance that developing countries will seriously engage in mitigation actions.

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