

# SECTION ONE EXECUTIVE SUMMARY

# A Blueprint for Green Energy in the Americas

In 2007, Garten Rothkopf prepared for the IDB the first edition of *A Blueprint for Green Energy in the Americas*. Neither the IDB nor the authors anticipated the exceptionally positive response the book would get. Clearly, there is a great and rapidly growing demand for fact-based, hype-free analysis of what is happening in the areas of energy choice and climate change in the region. As a consequence, the IDB has commissioned another edition, this year's focusing on all forms of alternative energy. The objectives, unlike last year's book, are to focus on who is leading the way in each area, what the overall trends are, what the obstacles to further progress seem to be, and how these fit with the mission of the Bank and the goals of its member countries.

The resulting study is even more comprehensive than last year's, but it needed to be. This is a huge subject, and the issues involved are absolutely vital to the energy security, economic security, and environmental security of every country in North and South America. In order to make the information in the *Blueprint* as accessible and useful as possible, not only has the book been carefully organized, indexed, and footnoted, but this detailed executive summary has been prepared.

The summary is followed immediately by a series of five essays that explore key themes that have arisen in the year of research that Garten Rothkopf has conducted while preparing this year's edition of the *Blueprint*. Each of the essays looks at a cross-cutting idea that will help frame the more technical assessments and recommendations that follow.

Immediately following these essays is a summary of four important events that shaped the study, a series of scenarios with government, technical, business, and investment leaders that were conducted at the headquarters of the Inter-American Development Bank. These scenario exercises explored just what was driving the growth of green energy in the Latin America and the Caribbean, what was impeding it, and where hidden opportunities might lie. The more than 150 participants included cabinet ministers, undersecretaries, CEOs, leading scientists, portfolio managers, and others who shared their views with the Bank and made the events into a great success.

What follows is the body of the book, organized around sources of energy and, within each of those sections, by country. Throughout, the mandate has been to be

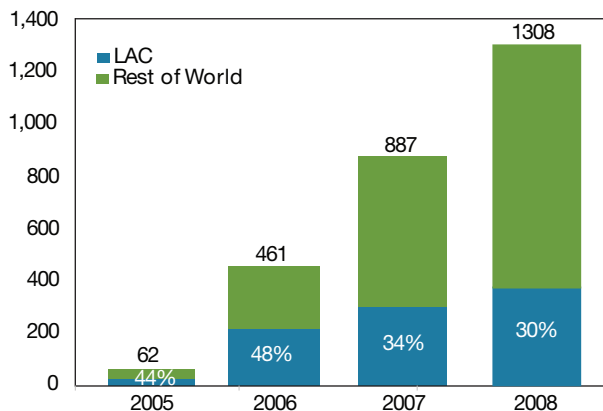
scrupulously objective, technology-agnostic, and focused on the pros and cons associated with each technological approach. We have also sought to evaluate trends in terms of the differing needs and challenges associated with individual countries. There are no magic bullets. There is no one-size-fits-all solution to rapidly reduce carbon emissions and meet, with greener technologies, the energy needs of a rapidly growing and changing region. Each country must adapt a portfolio approach (see Section 2.3 on this subject) and do so in a careful yet timely way (see Section 2.1, on the urgency of greener energy throughout the Americas). We believe this report can be a useful resource in helping each country, and companies within each country, to make key decisions that will lead them forward in what is certain to be a revolution that will change every country of the Americas in profound and lasting ways.

# Executive Summary

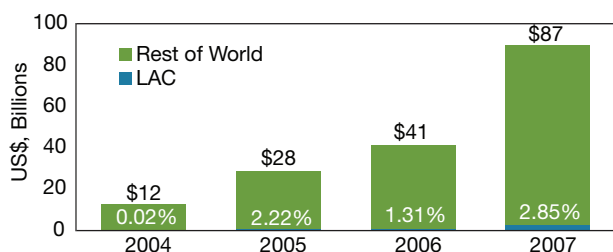
Latin America and the Caribbean are lagging behind in the global green energy revolution. By any metric, whether it be capturing a share of the \$148.4 billion in new investment last year, developing and deploying new technologies, participating in carbon markets or establishing supportive policy and regulatory frameworks, the region underperforms its competitors. And yet, thanks to its vast natural resource endowment, there is no other region on earth that has greater potential to transform its energy matrix, leapfrog old technologies, and establish new engines for economic growth and social development.

This potential becomes all the more important in the midst of a global economic downturn. The crisis is forcing governments around the world to assess their policy choices and take major decisions on how to best spur growth over the long term, including infrastructure development, investment promotion, and technology. It is an opportunity to map out a smart, green recovery that creates new jobs, enhances competitiveness and reduces their strategic vulnerabilities. Institutions like the Inter-American Development Bank will have a critical role to play in addressing both the short term challenges of access to capital, and the long-term strategic planning for a greener, more competitive future for the region.

**Chart 1.0a Global CDM Projects per Year**



**Chart 1.0c Global Renewable Power Investments**



## Perspectives on Green Energy and Climate Change in LAC: Essays on Major Themes

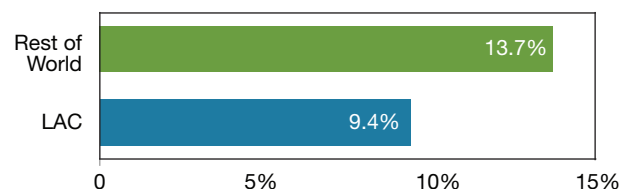
### Green Urgency

A direct human cost to climate change is being felt in Latin America and the Caribbean, with millions of lives affected each year by natural disasters of increasing intensity. The IPCC and others have projected that if we continue on our current course, the future will promise more severe droughts, heat waves, and tropical cyclones, among other phenomena, putting the development imperatives of the region at risk from rising sea levels, crop failures, water shortages and the proliferation of diseases. Green Urgency examines the ways in which climate change affects countries in the region, its anticipated future impact, strategies for mitigation and adaptation, and the potential opportunity to be seized by building on the region's low emissions profile and advancing a favorable agenda in global climate talks.

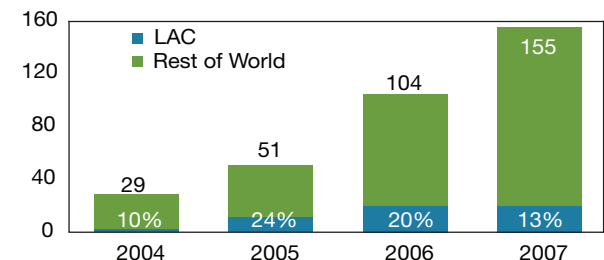
### The Microenergy Opportunity

The advent of microenergy — small scale, decentralized energy systems fueled primarily by renewable energy sources — presents an opportunity to leapfrog the traditional model of electricity grid-expansion and accelerate the spread of modern energy to millions in the Americas and worldwide. This essay examines this microenergy opportunity. It highlights the potential developmental impact of extending modern energy services to the 1.6 billion people who currently lack access to electricity and explains why microenergy's developmental, decentralized, and diversified model

**Chart 1.0b Annual Growth in Renewable Power Capacity (2004-2007)**



**Chart 1.0d Total Global Commissioned Biofuels Projects**



Sources: REN21, New Energy Finance, World Energy Council, CAMMESA, MEM, International Geothermal Association, Geothermal Resources Council, Polaris Geothermal, Business News Americas, OLADE, Global Wind Energy Council, Latin America Wind Energy Association, ANES, MEM, SEFI

represents a marked improvement over traditional grid-based energy infrastructure, particularly in rural, impoverished areas. Small and medium-sized enterprises (SMEs), rather than large utilities, have been and will likely continue to be the drivers of sustainable growth in the fledgling microenergy industry. However, support from governments, development banks, NGOs, and an increasing number of private organizations, is critical to realize the full potential of the microenergy opportunity. The ability of these supporting organizations to improve and integrate their SME financing and capacity-building services will determine the trajectory of this industry.

### Improving Energy Security: A Portfolio Approach to Energy Resource Management

The conventional wisdom that governs energy resource management needs rethinking. In today's increasingly risky energy markets, continued adherence to the traditional least-cost energy planning model exposes national power infrastructures to significant price, supply, and environmental risks. To insulate national energy markets from these risks, and thus to strengthen energy, economic, and national security, energy planners must apply a portfolio approach to energy resource management. This essay examines the application of well-established financial portfolio theory to energy resource planning. It offers an overview of the principles of portfolio theory, examines the various risks faced by undiversified energy portfolios in the Americas, and illustrates the key role that renewables play in achieving energy diversification. Energy planners face several practical challenges to applying a portfolio approach to energy resource management, such as high transition costs associated with portfolio redistribution, imperfect substitutability among energy options, and misaligned incentives between individual power producers and national energy markets. Policymakers can employ a number of alternative energy incentives and mandates, including feed-in tariffs and renewable portfolio standards, to help energy planners overcome the obstacles to diversifying and strengthening national energy portfolios.

### The Culture of Green

The answers to today's challenges of global climate change and energy security can be found in principals developed thousands of years ago. The indigenous cultures of the Americas promoted principles of interconnectedness and balance not as lofty ideals, but as principles of survival. The Culture of Green examines how indigenous views of nature and the environment can help development organizations integrate climate change considerations into development strategies. Because climate change poses a significant threat to economic

and human development, it must underlie all bank missions and country policies, not just those that take aim at the environment. Multilateral institutions, like the IDB, face significant barriers to integrating climate change into development goals, yet they may begin to do so through the indigenous principles of countries they are dedicated to serve. The concepts of interconnectedness, balance, cyclicity of time, and active stewardship guide practical solutions for integrating climate change. Approaches include full greenhouse gas emissions accounting, adaptive management, longer project lifespans, and improved member country engagement.

### Energizing Qualities of Green T[technology]

Green technology has a broad range of energizing spillover effects on economies — and nowhere is this potential greater than in emerging markets like those in Latin America and the Caribbean, where new technologies can leapfrog existing infrastructure and provide low-cost, tailored power supplies to off-grid communities. While still an understudied area, the evidence of the payoffs of green technology is becoming clearer and more quantifiable. Latin America and the Caribbean offer an abundance of opportunities for the development and deployment of green technologies. The region accounted for just over 5% of global investment in sustainable energy in 2007, with negligible investment in innovation. This essay examines the energizing qualities of green technology on markets, scientific and technological innovation, social development, national security, policy, and the environment and offers guidance for Latin American and Caribbean countries toward harnessing green technology's potential.

## Scenarios for Green Energy in the Americas

In the first quarter of 2008, Garten Rothkopf and the Inter-American Development Bank (IDB) convened three day-long, invitation-only scenarios devoted to technology, investment, and policy trends in green energy. These scenarios brought together more than 150 leading experts from throughout the hemisphere to game out the likely impact of three possible scenarios for our energy future: a baseline "Pale Green" scenario, an "Out of the Blue" shock scenario, and a "Bright Green" scenario for unprecedented international cooperation on climate change. During the sessions, participants took part in anonymous polling to frame our discussion and gauge the sentiment in the room. The discussions and polling results together produced new insights into the key challenges faced by this hemisphere in the coming years, the areas of greatest opportunity, and how the IDB can best help countries in the region adapt to the changing energy and climate future.

The purpose of a scenario exercise is not to predict the future, but rather to allow a group of leaders to consider collectively how they might be affected by different outcomes, what their vulnerabilities and risks are, what their comparative strengths are, and which approaches make the most sense. Across scenarios and sessions, the vast majority of participants identified three critical gaps as the most significant barriers to green energy development in the hemisphere — policy, infrastructure, and technology — as well as proposals for how the IDB might help address them.

Participants overwhelmingly identified the policy gap as the greatest barrier to green energy in the Americas, followed by technology and innovation issues. According to 42% of participants, policy is the greatest gap. Another 24% cited R&D, while 51% cited political will as the greatest challenge to green energy. Lack of technology was the answer of 19%. It was nearly unanimously believed that countries in the region lack sufficient energy and climate change planning and have insufficient resources dedicated to these issues (94% and 88%, respectively). The issue extends beyond a mere lack of will or interest, with 68% of participants deeming policymakers in the region to be lacking in the understanding and knowledge necessary to develop sound policies in this area. Multilateral financial institutions, however, were seen as having an important role to play in addressing these gaps, with 86% of participants agreeing that institutions like the IDB should work with countries to develop new models for green energy in developing countries. A number of very specific proposals were offered:

- The IDB should sponsor a study of the economic impact of climate change on the hemisphere, at a regional, sub-regional, or national level to increase knowledge on the costs of climate change and support sound decision-making and allocation of resources by governments.
- The IDB should focus special attention on the islands and shorelines uniquely exposed to the impact of climate change.
- The IDB should consider enhancing the environmental and energy economic analysis capacity at the Bank and establish a clearinghouse for regional data.
- The IDB should continue activities like the scenario series, with a more specific regional or even national focus.

As stated above, local innovation and access to technologies were seen as the next most important barrier to the development and deployment of renewable energy in the Americas. Only 9% of participants did not perceive the region as dependent on technology imports, with experts time and again citing multi-year waiting lists for capital equipment imports such as wind turbines and the lack of tailored solutions for local conditions. Again, specific ideas were given for ways in which the IDB could

help address these issues, including the facilitation of South-South technology transfer and investment through coordination with other regional development banks. With regard to catalyzing local R&D, participants pointed first to providing financial and technical support for the development of appropriate policy frameworks (42%), followed by the direct funding of centers of excellence dedicated to green energy in the region (23%).

Finally, participants predicted the need for massive investments in new energy infrastructure over the next five years, with 75% of those polled expecting the bill to be in the range of \$50 billion to \$100 billion. The focus here was on the power-generation sector, particularly connecting the 40 million people living in the Americas today who are without access to electricity. In this context, 45% said that transmission lines to rural areas should be the priority infrastructure gap addressed in the region, with an additional 30% citing upgrading existing grids. What was not captured in these raw numbers, but was pointed to consistently throughout the sessions, was the potential for renewables to play a role in leapfrogging existing systems and providing off-grid power to rural communities.

## Global Outlook

A review of the world's leading energy information sources points to a period of substantial transition and turbulence in the global energy sector. With three of the most powerful drivers of energy markets — demand, supply, and the environment — undergoing considerable change, the future composition of the energy system remains highly uncertain. Economic growth in the developing world has caused an unprecedented increase in energy demand, with increased industrialization, urbanization, and population levels driving much of the exponential growth in demand. Although the increase in demand is a clear trend, the future availability of supply is much less certain. Several leading energy information sources predict insufficient supply levels. As the world scrambles for solutions to the current energy dilemma, environmental concerns have risen to the top of the agenda, prompting a global trend, at both the national and local levels, to enact new policies not only to reduce greenhouse gas emissions and their environmental impacts, but also to diminish dependence on fossil fuels through the diversification of energy supplies.

## Renewable Power in Latin America

LAC's prodigious renewable resources offer a true solution to the region's energy security woes in the power sector,

but major gaps in policies and financing are preventing this potential from being realized. The lack of support for renewables in most countries in the region is primarily due to their higher costs compared to conventional generation sources, a disadvantage that has been exacerbated by a precipitous fall in fossil fuel prices in the last quarter of 2008. This section aims to identify and explain the opportunities and challenges facing renewables in the region within the context of the power sector more broadly, as well as to propose a series of measures that the Bank could pursue in order to help facilitate the development of these critical energy resources for the region's future. In order to do so, Garten Rothkopf has analyzed the key drivers and trends shaping the renewable power sector globally and regionally and has explored the interplay of these factors at the country level through five case studies. A wide range of sources were drawn upon, including government, academic, and non-profit analyses, public and private data sources, news articles, and primary-source interviews in English, Spanish, and Portuguese conducted between February and September 2008.

### Energy Security in LAC and the Promise of Renewables

The drive for the development of renewable power sources in Latin America is rooted in the shortcomings of its present, crisis-prone electricity supply mix. Historically, most countries in the region outside of the Caribbean (which relies mostly on fossil fuel-fired generation) have depended heavily on large-scale hydropower installations for most of their electricity, including Brazil's reliance on hydropower for more than 90% of its generation.<sup>1,2</sup> This has left the region highly vulnerable to drought-induced power crises, which are likely to increase in severity in the future as climate change leads to more intense El Niño events.<sup>3</sup>

In the 1990s, regional struggles with these power shortages, increasing recognition of the environmental and social costs of large-scale hydropower, and widespread liberalization of the region's power sectors resulted in a shift in most countries to fossil fuel-fired plants for new generating capacity. While private investors strongly favored these thermal generators due to their fast construction times, low up-front costs, and then-inexpensive supplies of natural gas and oil, skyrocketing fossil fuel prices in recent years have caused generating costs in the region to soar. Moreover, the politicization of the energy sectors of key regional exporters, including Mexico, Venezuela, Bolivia, Ecuador, and Argentina, has created further distortions in consumption patterns and uncertainties over long-term production. Thus, large hydropower as well as fossil fuel generation are both demonstrably volatile sources of power and are likely to become increasingly insecure with time.

The problems that this dependence poses are becoming more acute as economic growth leads predictably to robust electricity demand growth, with average annual increases in power consumption of 4.9% in South America and 5.8% in Central America over the past five years (although the Caribbean has lagged, at just 2.7%).<sup>4</sup> This growth has increasingly strained the ability of many power systems in the region to keep up with demand, leading to an increasing risk of outages and power rationing from droughts or decreases in fossil fuel supplies. At the same time, the urgent need to increase power generation has led most countries to focus on the continued development of these unsustainable conventional power sources to satisfy growing demand. This is due primarily to their proven track record and historically lower costs, despite their proven risks and a changing supply landscape.

Renewable energy sources offer truly secure, long-term solutions to the region's power supply needs. Geothermal energy provides some of the most reliable baseload power in the world, and while solar and wind generation may not be able to provide baseload power without storage, they can replace a substantial fraction of conventional generation and are not vulnerable to price spikes or unexpected supply interruptions. Small hydropower is also included in this study as an important and under-utilized source of renewable power that avoids the environmental and social costs of large-scale dammed hydro, although like larger hydro installations it is subject to drought-induced shortages. In the long-term, wave and tidal power technologies also promise further diversity for the region's power mix.

### *Renewable energy sources offer truly secure, long-term solutions to the region's power supply needs.*

Further, advocates of renewable power worldwide are touting the potential social and economic development impacts of greater use of these resources, an argument that has particular appeal in Latin America and the Caribbean. In the rural development context, renewables have been used to provide the benefits of modern power services to isolated households and communities, with 13 countries in the region having created dedicated renewable power initiatives as part of their rural electrification programs. More broadly, slow employment growth in traditional energy industries, fast-growing demand for renewable power, and the greater labor intensity of renewables due to their smaller scale, have led to hopes that a more widespread adoption of renewable power could lead to a surge in new "green jobs."<sup>5</sup> While

data on the concrete impacts of renewables on socio-economic development objectives are currently very limited, they could potentially play an important role in creating political support for the sector.

However, while all of these renewable power technologies offer opportunities to provide needed improvements to reliability and price stability for the region's power sectors — and to create positive externalities that contribute to socio-economic development goals — their adoption in LAC has been much slower than in other regions of the world.

### The Current State of Renewable Power Development in LAC

Latin America and the Caribbean have lagged behind the global pace of adoption of new renewables, with geothermal, wind, and solar energy accounting for just 1.9 GW out of a total of 267 GW in the region in 2007 — approximately 0.7% of the total.<sup>6</sup> This is significantly less than the role these three technologies play in the

overall global mix, where they account for 113 GW, or about 2.5% of the 4,300 GW total worldwide capacity.<sup>7</sup> When small hydro installations are included, these figures increase to a total of 4.6 GW in LAC (1.7%) and 186 GW (4.3%) globally. The lag is even more dramatic when considering the miniscule portion of total global renewable energy investment flows entering the region, with LAC receiving \$2.5 billion in renewable power investments in 2007 — less than 3% of the global total of \$87 billion, according to New Energy Finance.<sup>8</sup>

### Renewable Power Deployment in LAC

The development trajectory of renewable power in LAC varies significantly by technology as well as by country.

#### Technologies

**Small hydro:** Due to its relatively low costs and the region's long experience with hydropower, small hydro is the largest source of renewable power covered in this report in LAC, with an estimated 2.7 GW of installed capacity. This is less than 4% of a global total of 73 GW of small hydropower, including 47 GW in China alone,

## Regional Leaders:

**Brazil:** Brazil has set the pace for wind and small hydropower development in the region, thanks to its PROINFA feed-in tariff incentive and readily available domestic long-term financing from the Brazilian National Social and Economic Development Bank (BNDES).

**Chile:** Chile has one of the most well-regulated power markets in LAC, which has been made even more attractive for renewables developers, thanks to funding for feasibility studies and financial consulting from CORFO, the state economic development agency, as well as a new renewable portfolio standard (RPS) incentive that will require 5% of the country's power to come from renewables by 2010.

**Costa Rica:** Costa Rica has long been a leader in the development of renewables in Central America, with an effective system of government-run auctions for wind and geothermal power. It could further harness the country's resources with recent consideration of a bill that would open parts of the country's park system to geothermal development.

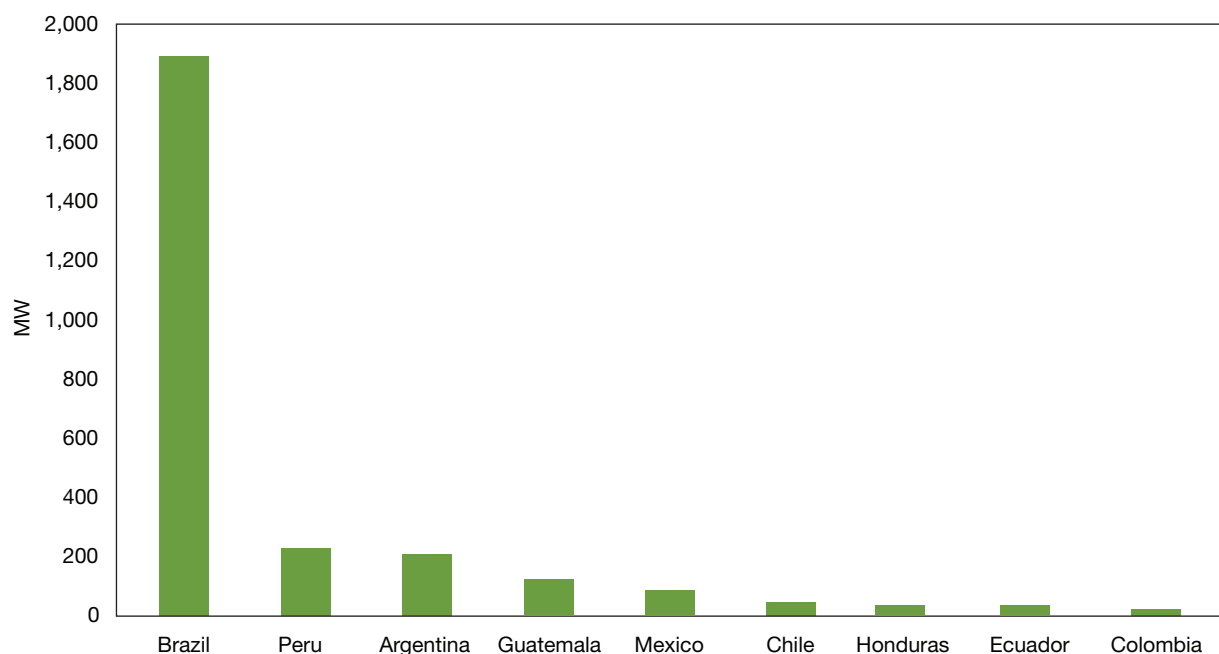
## Laggards:

**Argentina:** Argentina's power sector development, as a whole, was derailed by the economic crisis of 2001–2002, and the maintenance of tariff freezes enacted during the crisis have caused private sector interest in the sector to vanish. Wind power development is thus almost completely stagnant, with only government-sponsored projects being explored, despite attempts to introduce new incentive programs.

**Mexico:** Mexico has maintained its power sector as a state-owned monopoly, which has struggled to concession wind farms due to the below-market prices it has offered. New rules and incentives for renewables in November could stimulate investment in the sector, but details of their implementation will not be finalized until mid-2009.

**Colombia:** Despite a wide range of renewable resources and financing assistance in recent years for renewables from the World Bank and IDB, Colombia has yet to pass any incentives to support the sector's development, limiting prospects for private sector investment.

**Chart 1.0e Small Hydro Capacity, LAC Region**



Sources: New Energy Finance, World Energy Council, CAMMESA, MEM

where it has been used as a primary resource for extending electricity access to rural communities.<sup>9</sup> While it is also one of the most widely used renewable power technologies in the region, with significant installations identified in nine countries in both Central and South America, this capacity is heavily concentrated in Brazil, which alone accounts for nearly 1.9 GW.<sup>10</sup>

Small hydropower's low costs, particularly when integrated with existing hydraulic infrastructure such as irrigation canals, will likely ensure that it will continue to play a leading role in the development of the region's renewable resources. Moreover, these projects can provide more robust power supplies for rural development than photovoltaics and are increasingly being integrated with local environmental initiatives, which can serve to improve generation performance as well as create jobs and enhance relations with local communities. However, its usefulness in enhancing energy security is limited because it is even more vulnerable to droughts than large hydro due to a lack of dam storage.

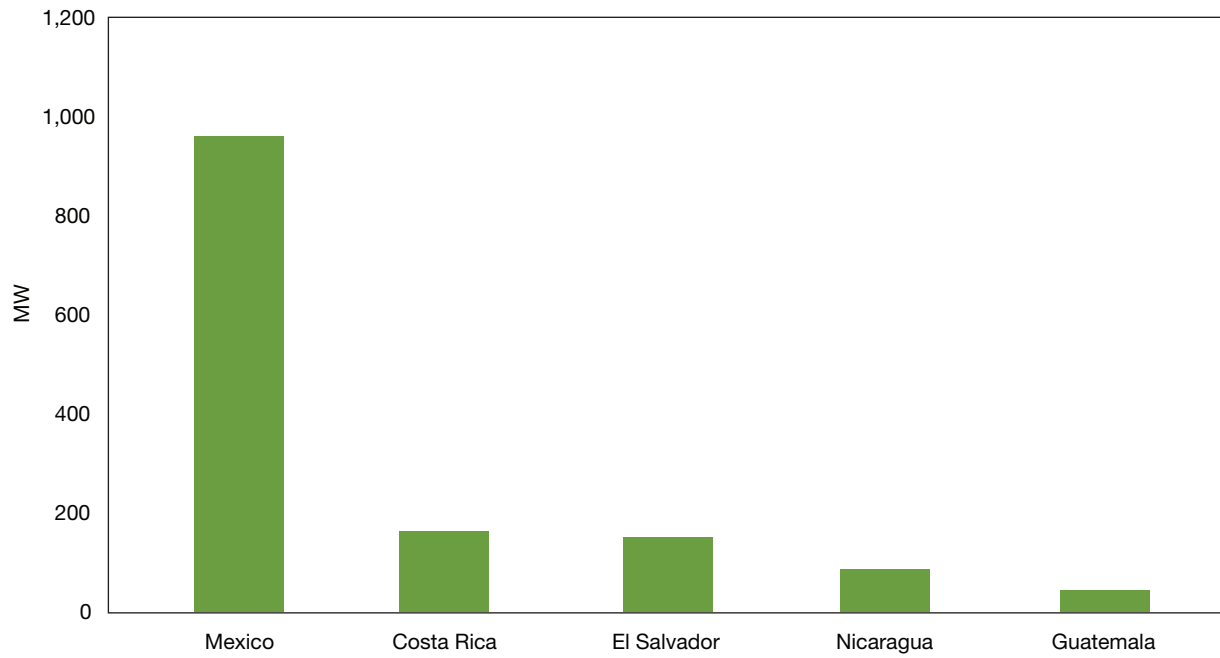
**Geothermal:** Geothermal is the largest and most established source of non-hydro renewable power in Latin America and the Caribbean, but this generation is currently confined to Central America and Mexico, and its expansion has been slow. There is 1.4 GW installed throughout the region, of the roughly 10 GW worldwide.<sup>11</sup> Mexico leads by far, with its 960 MW ranking third in the world in installed geothermal capacity.<sup>12</sup> Despite its

unsurpassed reliability and competitive costs, high up-front project risks and a limited number of potential development sites have made geothermal the slowest-growing renewable power source worldwide, with annual growth of just 2%–3% per year, and it has similarly seen just 26.5 MW added in LAC since 2005.

Geothermal power capacity is expected to continue to grow in Central America, and potentially at an increased pace, thanks to a new geothermal feed-in tariff in Nicaragua and a plan to open sections of Costa Rica's national park system to geothermal development. Moreover, moves to develop the excellent geothermal potential in northern Chile's mining areas could mark an important first step toward the wider development of the vast geothermal resources located along the continent's Pacific coast.

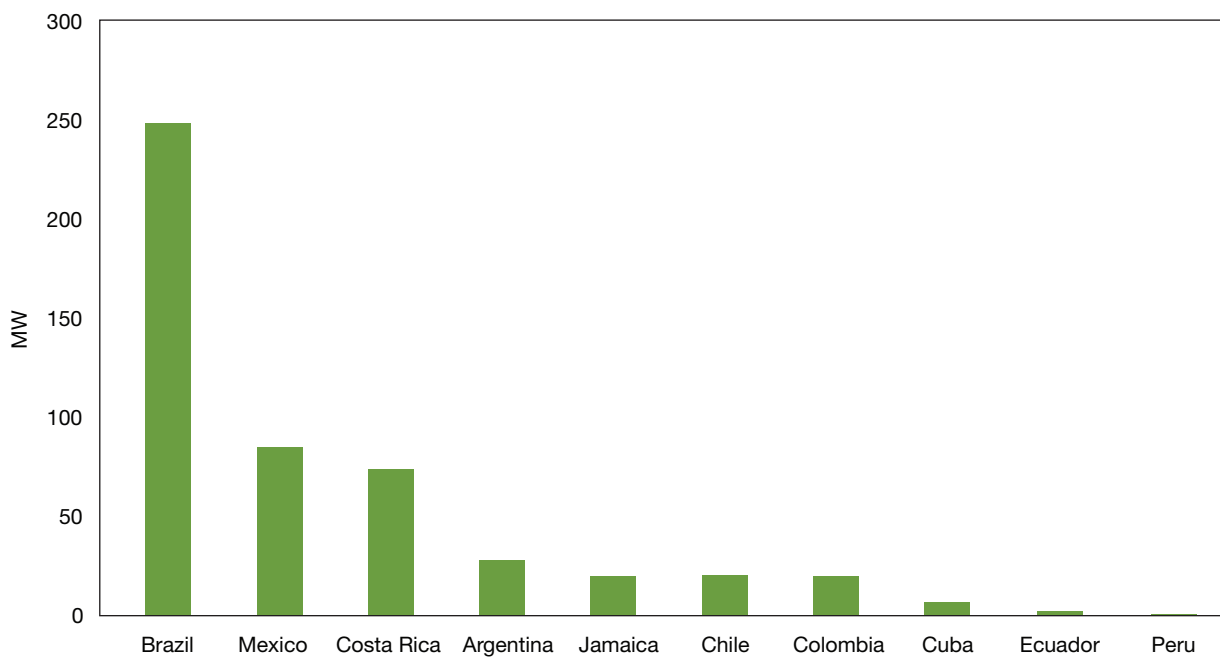
**Wind:** Wind is the fastest growing non-hydro renewable power source in Latin America, but two-thirds of wind capacity added since 2005 have come from Brazil,<sup>13</sup> where future growth is uncertain due to the winding down of its PROINFA subsidy program. Wind power's fast construction time, widespread applicability, and increasing competitiveness with conventional power sources have made it the largest and one of the fastest-growing renewable power sources worldwide, expanding at a pace of 25% per year between 2002 and 2006 and reaching 95 GW installed worldwide at the start of 2008.<sup>14</sup> This study has identified 506 MW of installed

**Chart 1.0f Geothermal Capacity, LAC Region**



Sources: International Geothermal Association, Geothermal Resources Council, Polaris Geothermal, Business News Americas

**Chart 1.0g Wind Capacity, LAC Region**



Sources: GWEC, OLADE, LAWEA, NEF

wind power capacity in LAC, nearly half of which is in Brazil. The rest is spread across nine other countries in Central and South America as well as the Caribbean, making this already the most widely used renewable power technology in the region.

Wind power's costs are increasingly similar to conventional power in many cases, but they are higher on average than small hydro or geothermal and are thus more sensitive to the availability of incentives to attract investors. The most proven incentive program in the region by far, Brazil's PROINFA, is winding down, which could jeopardize continued growth in this key market. However, a number of countries have recently created policies of their own that are expected to benefit wind power, including Chile, the Dominican Republic, and Guatemala. Two of the region's most promising wind power markets, Argentina and Mexico, have seen their development of this resource hamstrung by heavily politicized energy sectors, although in November 2008 Mexico passed a renewable energy law that will require the creation of Mexico's first renewable power incentive program by mid-2009.

**Solar:** The high costs of solar power have made its development almost completely dependent on the availability of generous subsidy programs that have been largely absent in LAC, resulting in negligible development of this resource. Grid-connected solar is the world's least-developed renewable power source, with an estimated 7.8 GW capacity at the end of 2007, but it is also the fastest growing, with 50% annual increases in installed capacity in both 2006 and 2007, thanks largely to feed-in tariff incentives in Germany and Spain.<sup>15</sup>

While Brazil's PROINFA program included incentives for small hydro, biomass, and wind, it offered no support for photovoltaics. Ecuador and Argentina have passed their own regulations for feed-in tariff incentives that included subsidies for solar, but they have not been utilized, as political risks in both countries have virtually eliminated private sector financing, and heavily subsidized tariffs for end-users have removed the incentive to develop distributed generating sources. Mexico created the region's first net-metering policy, which allows any solar PV generation to count against a consumer's electricity bill, but, as with Ecuador and Argentina, subsidized power tariffs give users little incentive to invest in their own power generation. Power sector reforms in these countries could help catalyze solar power development in the region, but otherwise the use of this huge potential resource will be limited to small-scale, off-grid applications until countries develop effective incentive programs and solar generation costs drop overall.

### Renewable Power Potential in LAC

This relatively low level of renewable power development is a shadow of Latin America and the Caribbean's enormous potential, as its diverse geography has richly endowed it with a broad range of renewable resources. These include:

- Substantial untapped small hydro resources throughout the region, including Mexico and Guatemala in Central and North America, the Dominican Republic in the Caribbean, and Brazil, Peru, and Colombia in South America;
- Widespread wind energy resources including some of the world's most promising sites, such as Oaxaca in Mexico, Southern Patagonia in Argentina, and the Pedernales region in the Dominican Republic;
- Geothermal resources along the region's Pacific coast, thanks to the "Ring of Fire," the volcanically active area around the borders of the Pacific tectonic plate that accounts for most of the world's present geothermal generation;
- High levels of solar insolation in many countries, including Mexico, Guatemala, Cuba, and Haiti north of the Equator, and northern Chile, southwestern Bolivia, northeastern Argentina, northern Brazil, and southern Peru in South America; and
- Promising wave and tidal resources that have only just begun to be considered, including the superior wave energy resources off Chile's long coastline and expected tidal generation potential in Mexico and Argentina.

This lack of renewable power development is thus due primarily to a lack of regulatory support and financing barriers, and not a lack of potential for these forms of generation.

### Gaps Preventing the Wider Adoption of Renewables in LAC

Renewable power technologies face similar challenges when competing with conventional generation sources everywhere, primarily due to their higher up-front costs. However, Latin America and the Caribbean have been much less successful than other regions of the world in overcoming these obstacles, due to regulatory shortcomings, a lack of policy incentives, and limited access to financing. The region's renewable power development is also hindered by a lack of funding for innovative research and development and demonstration projects, including

adaptations of existing technologies to regional needs, as well as opportunities to become an early leader in the adoption of newer renewable power technologies.

### Electricity Sector Regulation

Following the perceived and real failures of the region's move toward deregulation in the 1990s, power sectors in Latin America and the Caribbean today are frequently characterized by ad hoc mixtures of regulated and deregulated approaches, reflecting global trends away from rigid ideological prescriptions and toward more pragmatic approaches to regulation.<sup>16</sup> However, some countries in the region have moved to roll back elements of previous reforms in dramatic ways, which has often negatively impacted the development of renewables and the power sector more broadly by driving away private investment. In Argentina and Ecuador, government interference in tariff-setting has made power sector investments unprofitable and has scared off foreign capital, and in Venezuela the 2007 nationalization of AES-owned La Electricidad de Caracas (EDC), the country's largest private power producer, was only one in a string of a moves by President Hugo Chávez to assert political control over the energy sector.

*Power sectors in Latin America and the Caribbean today are frequently characterized by ad hoc mixtures of regulated and deregulated approaches.*

At the same time, elements of liberalization that have been either retained from previous reforms or created as parts of newer policies hold the promise of opening the power sector up to a broader range of actors, including small IPPs as well as large industrial and commercial consumers. Although Brazil has taken steps to increase the regulation of its power sector in the aftermath of the 2001 power crisis, it has also created a new category of consumers that allows commercial or industrial users contracting for 0.5 MW or more of renewable power to participate in the spot market, compared to a 3 MW minimum for regular users. This offer is attractive because spot market prices are generally lower than the regulated market, and a growing number of users are taking advantage of this opportunity.

Mexico provides a dramatic example of this dynamic as well, where very high commercial tariffs — the result of large and highly inefficient subsidies to residential users — have driven a wide range of these large consumers to plan

up to 2 GW in combined wind power projects in Oaxaca.<sup>17</sup> These projects are being developed in joint ventures with wind power developers under “self-supply” arrangements created by 1996 reforms to the country's constitutionally mandated state-run power sector, one of the few avenues available for private sector development.

### Policy Incentives

Patterns of renewable power development globally have been strongly determined by the availability of adequate policy incentives to make up for gaps in competitiveness with conventional sources of power. Brazil's PROINFA feed-in tariff program has played a central role in making it the region's biggest renewable power developer by far since 2004, but its abandonment of this policy in favor of a competitive auction system for renewables could endanger this leadership. While government tendering policies have been successful in catalyzing wind and geothermal power projects in Costa Rica, they have struggled in Mexico and countries in other areas of the world, such as the UK, where auction prices were set too low to attract developers. Similarly, the first renewable power auction in Brazil, in June 2007, failed to attract any bids from wind projects due to a bid ceiling set more than a third below the level that developers claim is necessary.

The nascent policy landscape in the region outside of Brazil is largely characterized by potentially successful but largely untested policies, along with policies that have been rendered ineffective by regulatory or policymaking failures.

- Several countries in the region have created a range of promising incentives for renewable power development in 2008, including a renewable portfolio standard (RPS) in Chile, a feed-in tariff for geothermal in Nicaragua, and a package of tax credits and exemptions in the Dominican Republic. A range of new projects is currently planned in each of these countries, auguring well for their success, even if their impact has yet to be felt.
- At the same time, several major policies in the region have been ineffective due to broader regulatory issues or implementation difficulties, demonstrating that adequate incentives are a necessary, but not sufficient, condition to stimulate renewable power development. Argentina and Ecuador have both created feed-in tariff programs, but these have barely been utilized due to political risks surrounding their power sectors; Ecuador's program will close at the end of 2008. In Mexico, the government first proposed a wide-ranging incentive law in 2005, but struggled to pass it for years. In November 2008, a new renewable energy law was finally passed, but this legislation only outlined a strategy for the Secretary of

Energy (SENER) and Energy Regulatory Commission (CRE) to develop several new rules and incentives for renewables over the course of 2009, and did not include specific implementing policies.

### Access to Financing

Renewables often face greater challenges than conventional power plants in securing sources of debt finance, for a range of reasons including high up-front costs, perceived riskiness, and a lack of a commercial track record with some areas and technologies.<sup>18</sup> Brazil has garnered over 90% of the region's investments in new renewable power generation since 2005, due not only to PROINFA but also to the availability of long-term, low-interest loans from the Brazilian National Social and Economic Development Bank (BNDES).<sup>19</sup>

By contrast, outside of Brazil, debt financing for renewable power projects in LAC has been rare, and it has consisted almost entirely of concessionary loans from multilateral and international development banks. This has helped to limit the universe of renewable power project developers in most countries to large entities with access to large reservoirs of their own capital, including major international developers like Iberdrola and Enel, state-owned utilities and energy companies, and governments themselves. Moreover, available sources of concessionary finance are often biased toward larger projects, due to the lending economies of scale of these international and multilateral institutions. The lack of financing for smaller developers is a major hindrance to the unlocking of the renewable power sector's full potential.

*Outside of Brazil, debt financing for renewable power projects in LAC has been rare, and has consisted almost entirely of concessionary loans from multilateral and international development banks.*

This may change, as opportunities for domestic loans in Mexico and Chile are beginning to emerge through programs administered by Banobras, the Mexican development bank, and CORFO, Chile's economic development agency. However, most projects in the region outside of Brazil will likely depend on financing from developer equity and/or loans from international and multilateral banks, making it critical for these institutions to provide financing instruments that address the unique challenges and opportunities of the renewable power sector.

### Innovation in LAC

Energy sector R&D in LAC is extremely limited in size and scope, compared to the U.S., the EU, and Asia, and this imbalance is even more pronounced in the renewable energy segment, due to the relative newness and technical challenges posed by many of these technologies.<sup>20</sup> Although it is unlikely that the region will produce its own renewable energy manufacturing giants that can compete with international leaders like Vestas, General Electric, or Q-Cells anytime soon, it still could benefit from the stimulation of domestic renewable power R&D and manufacturing capacity geared toward the needs of local markets. There are already efforts underway to adapt wind turbine designs to the harsh winds of Mexico and Argentina, and there is substantial untapped opportunity to develop applications for small hydro and solar photovoltaics that are appropriate to the region's needs. The encouragement of this in-region R&D capacity could help ensure the availability of equipment and plant designs suitable to local conditions, increase the jobs created by the renewable power sector, and encourage growth in domestic science and engineering education.

Looking beyond existing renewable power technologies, the LAC region also has excellent resource bases that could be harnessed by emerging renewable technologies such as wave power, tidal power, concentrating solar power (CSP), and engineered geothermal systems (EGS). Although there has been negligible research within the region on these technologies so far, there are a fast-growing number of start-ups pursuing their commercialization in the U.S. (and in Europe to a lesser extent), and these companies must frequently compete for a limited number of suitable testing sites, transmission capacity, and financing in their home countries. Due to its wealth of resources, LAC could provide an appealing alternative destination for these early-stage projects, given sufficient financing incentives, potentially including financing for necessary transmission capacity, as well as sufficient intellectual property rights assurances.

### Recommendations

While realizing the region's renewable power potential will pose requirements that will vary widely by country and by technology, five core pillars will undergird any comprehensive effort on this front. The IDB can play a major role in providing guidance as well as support for each of these pillars through loans, loan guarantees, policy-based and innovation loans, and other instruments administered by the Bank and its International Investment Corporation (IIC) and Multilateral Investment Fund (MIF).

## I. Establishing the Potential for Renewable Power

While low-resolution maps are available for basic evaluations of renewable resources in the region, more detailed, higher-resolution maps of the most promising areas can play a significant role in encouraging project development by reducing the time and cost of resource prospecting. In addition to providing valuable information for project developers, these efforts can play a critical role in informing policymakers who are formulating goals for the sector's development.

More detailed studies of specific low-cost, high-impact technology applications, such as irrigation canal-integrated small hydro projects, can also help to ensure that “low-hanging fruit” in the sector are picked. Broad-based technical assistance for feasibility studies for small and medium-sized project developers can also serve to lower the information and up-front investment barriers to participation in the sector by a broad range of generators.

### Program Ideas

- **High-Resolution Resource Mapping Project:** Provide technical assistance and financing for the development of improved, high-resolution mapping of promising renewable resources, including both established and emerging technologies.
- **Inventories of Low-Cost, High-Impact Project Sites:** Technical assistance and financing for surveys of low-cost, high-impact renewable power applications that represent “low-hanging fruit” for project developers.
- **Feasibility Study Funding — Small and Medium-Sized Project Developer Program:** Expand existing feasibility study funding through the Multilateral Investment Fund (MIF), with a focus on grants for small- and medium-sized enterprises and potentially paired with ongoing financial consulting and business-development assistance.

## II. Encouraging Renewable-Friendly Regulation

The smaller scale of renewable power plants has the potential to open the sector to a wide range of participants beyond traditional utility players and international independent power producers, including local developers, municipalities, cooperatives, and large commercial and industrial users. However, in order to facilitate this broader participation, electricity sectors must be well regulated enough to attract a broad pool of private sector investment and must have provisions that allow and/or encourage smaller generators.

Furthermore, although the gap between the cost of conventional power generation sources and renewable

alternatives is closing, the development of the renewables sector remains largely contingent on the creation of appropriate regulatory and policy supports. Few countries in LAC have had significant experience with them, most notably Brazil and Costa Rica, but a growing number of are adopting new incentive policies of their own.

### Program Ideas

- **Latin America and Caribbean 21st Century Power Markets Initiative:** Develop a regional initiative to assist in the transition toward a more decentralized, energy-secure, and low-carbon power sector based on increased renewable power generation, including steps to identify key market frameworks and the use of policy-based lending (PBL) to support their proliferation.
- **LAC Renewable Power Policy Incentives Working Group:** Create a regional forum to share experiences with the region's growing range of renewable energy policies, with participation from policymakers, regulators, investors, and other relevant stakeholders and experts.
- **International Exchange Program for LAC Legislators:** Hold a series of exchanges to bring LAC elected officials abroad to learn from countries that have had longer experiences with renewables-appropriate policies, as well as bringing legislators from abroad to key countries in LAC to share their views.

## III. Expanding Access to Finance for Renewable Power Projects

Brazil's BNDES is the only widely used source of domestic project finance for renewable power projects in the region, forcing projects to rely on international and multilateral lenders for debt financing or else to fund projects wholly through developer or syndicated equity. While reforms to the region's banking sectors are improving access to finance in general, long-term loans for renewable power projects are very rare due to the high up-front costs of these technologies as well as perceived risks due to their lack of a track record. Particularly given the recent turmoil in global credit markets, international and multilateral finance will likely continue to be critical to the expansion of the renewables sector. Moreover, finance must not only be available in general, but it must be scaled to project sizes smaller than many of these institutions typically fund.

### Program Ideas

- **LAC Renewable Power Financing Facility:** Target existing IDB financing support to the smaller average size of renewable power projects in several ways, including loan guarantees for domestic banks, IIC loans for small- and medium-sized developers (including

large commercial and industrial end-users), and the packaging of several similar projects together in portfolios.

- **LAC Renewables Exposition for International Developers:** Hold an annual LAC Renewables Exposition to bring together top international renewable power developers and energy officials from LAC countries seeking to promote potential projects in their countries, possibly including international financiers as well.
- **LAC Microenergy Initiative:** Instead of providing direct financing and assistance for rural electrification programs using renewables, IDB would provide support for SMEs and microfinance institutions capable of bundling together many small-scale microenergy projects into attractive investment portfolios through a Microenergy Support Fund. Experiences could be shared with similar initiatives in other regions of the world through a Global Microenergy Network.

In addition to these overarching program changes, a number of more region- and technology-specific programs could be created to improve access to financing in key areas.

- **Loans and Loan Guarantees for the Development of Wind and Solar Manufacturing Plants:** Provide loans and loan guarantees to support the development of manufacturing plants in key markets, boosting potential for job creation and technology transfer.
- **South American Geothermal Fund:** Create a program offering grants and loans for geothermal project development as well as geological risk insurance, focused on the undeveloped geothermal resources of South America.
- **Small Hydro for Community-Based Rural Electrification:** Expand support for off-grid small hydro installations, where this technology is relatively underutilized compared to solar PV and in absolute terms compared to its enormous potential for this type of application.
- **Integrated Support Packages for Solar PV Programs:** Design integrated support packages for public-private sector solar initiatives focused at the national, state, or even city levels that bring together assistance for a wide range of stakeholders, including suppliers; developers; installers; commercial, residential, and institutional end-users; policymakers; and other relevant parties.

#### IV. Providing Funding for Innovation and Cutting-Edge Technologies

While there are limited near-term opportunities for Latin

American companies to compete directly with highly competitive international renewable power equipment manufacturers like Vestas, Q-Cells, or Ormat, there is significant potential for research and development funding efforts by regional manufacturers to adapt existing technologies to local contexts, particularly with small hydro and solar power. R&D labs in the region's larger markets are also working on long-term efforts to develop their own wind turbine designs, including Argentina's IMPSA and INVAP and the CERTE research center in Mexico.

In addition to opportunities to adapt and manufacture existing technologies where possible, the region could seek to achieve leadership in the development of key emerging technologies. A growing number of cleantech startups are developing new renewable power generation technologies that often struggle to secure permits and financing for demonstration or commercial-scale plants as well as the transmission lines needed to serve them. By providing funding for demonstration projects and/or R&D testing facilities, the region could attract projects using these early-stage technologies, potentially establishing it as a leader in their development as well as deployment.

#### Program Ideas

- **Innovation Loans for LAC Renewable Power Research and Development:** Offer innovation loans targeted toward both relatively simpler, near-term efforts to license and adapt technologies to local conditions as well as more comprehensive, long-term R&D to develop original technology designs.
- **Financing for Demonstration and Deployment of Emerging Renewable Energy Technologies:** Provide technical assistance grants and innovation loans to support small-scale pilot projects as well as loan guarantees for larger, utility-scale plants using emerging technologies such as concentrating solar power (CSP), wave power, and enhanced geothermal systems (EGS).

#### V. Understanding the Impacts of Renewables

As noted above, the availability of appropriate policy incentives is critical to the development of renewable power technologies, but these programs require ongoing political support to maintain. Given rising energy prices as well as growing economic fears, energy policymakers will be pressed to justify incentives that promote a wide range of social, environmental, and economic benefits in the long term but cost taxpayers and/or ratepayers in the short term. Thus, the availability of improved data on these wider benefits — including improved energy security, rural economic development, and the creation of green jobs —

could play a critical role in creating and maintaining political support for renewable power incentives.

#### Program Ideas

- **Measuring the Benefits of Renewable Power in LAC**

**Initiative:** Offer technical support grants for the execution of important studies in a number of areas that currently lack significant LAC-specific data, including developing new accounting methodologies to account for the long-term energy security benefits of renewables, improving data on rural electrification projects that use or could use renewables, and monitoring the “green jobs” created by the industry’s development.

### Biofuels in Latin America

In the midst of a global backlash against biofuels, LAC is well positioned to emerge as a leader in the sustainable production of biofuels and bioenergy. However, bridging the current technology gap through homegrown innovation will be critical to determining the direction of LAC’s biofuel future. This section seeks to identify the major trends impacting the development of the biofuels and bioenergy sectors and to identify means by which the IDB can assist stakeholders in the region in a strategic and sustainable manner. As each country faces a unique set of challenges, the report does not assert a blanket prescription for sector development but rather seeks to identify the tools necessary to make informed decisions regarding potential biofuel expansion, including in-depth feasibility studies, R&D centers, financing for agricultural and industrial capacity expansion, and investment in infrastructure projects.

### *The spike in food and feedstock prices challenges biofuels sustainability and alters the biofuels landscape.*

To this end, Garten Rothkopf has analyzed the primary drivers and trends in the global and regional biofuel sector and has selected Brazil, Peru, Colombia, Argentina, Honduras, and the Dominican Republic as case studies to highlight areas of success and to outline the challenges that apply to the rest of the region. The information contained in this report stems from a range of primary and secondary research sources from government, academic, and scientific data, including direct interviews and in-country research.

#### An Altered Landscape

Despite the rise in energy commodity prices, increased energy insecurity, and growing awareness of the potential

impacts of global warming, the role of biofuels in addressing these challenges has been questioned. While the region experienced a surge of investment in the sector over the last two years, the initial optimism surrounding global and regional biofuels potential has since waned. First-generation biofuels projects that are dependent on edible feedstocks have come under intense scrutiny and skepticism in the context of rising agricultural commodity prices and concerns over food security, worries about their environmental impact, skyrocketing feedstock costs, and doubts about their economic viability. The strategic expansion of biofuels and bioenergy projects within the region continues to hold tremendous promise for diversifying the region’s energy base, adding value to LAC’s agricultural sectors, and attracting private investment. The region has an opportunity to strengthen its competitive advantage vis-à-vis the relatively inefficient grain-based biofuels industries of the U.S. and the EU and to become a leader in sustainably produced biofuels.

Given Latin America’s vast wealth of natural resources, favorable climates, and available arable land, the region has been, and continues to be, well positioned to become a leader in the generation of biofuels and bioenergy and must harness the benefits of advanced technology to maintain a competitive edge. Biofuels and bioenergy are not a panacea for fossil fuel displacement, but they can provide a means of energy diversification, economic growth, and rural development, provided that policies are balanced with sound sustainability criteria, agricultural best practices, appropriate technology, and provisions for food security.

The spike in food and feedstock prices challenges biofuels sustainability and alters the biofuels landscape. From 2003 to their peak in July 2008, the prices of maize, soy oil, and palm oil - primary biofuels feedstocks - rose 135%, 166%, and 139%, respectively.<sup>21</sup> While the high commodity prices are a boon for farmers, particularly those who are integrated into global markets, they have a stinging impact on consumers and first-generation biofuels producers. The rapid escalation in food prices has sparked riots in Mexico, Haiti, Ethiopia, and elsewhere throughout the developing world.

While biofuels have shouldered much of the blame for so-called “food inflation,” the diversion of corn to ethanol production is only one in a myriad of factors currently driving up commodity prices. Other primary factors include:

- High oil prices increasing cost of production until late 2008
- Decrease in global stocks in the midst of increasing demand

- Inclement weather damaging harvests
- Global population growth and increased food demand
- Increased incomes in emerging markets and dietary shift to include grain-fed meat

The confluence of factors has contributed to a generalized increase in food prices. Consumer demand is relatively inelastic, with consumers unable to substitute away from higher-priced staples. Mexico's "tortilla crisis" in January 2007 marked a turning point for the global biofuels industry, as the tripling of corn prices led to riots in the streets of Mexico City and forced President Calderon to institute temporary price controls.<sup>22</sup> While a variety of components contributed to the price spike, the situation illustrated the harsh impact of food inflation on the poor and underscored the need for the biofuel industry to evolve away from dependence on edible feedstocks.

Deteriorating biofuel economics for grain and oilseed producers challenge many first-generation biofuels producers. In addition to fueling concern over food security, grain and edible-oil price increases have challenged the economics of first-generation biofuel production as feedstocks account for 50%–70% and 70%–85% of overall production costs for ethanol and biodiesel, respectively.<sup>23</sup> Record high prices have directed feedstocks toward the commodity markets rather than biofuels projects, limiting access to necessary inputs. Further, as recently reported by the UN, biofuels subsidies and tariffs, primarily in OECD countries, increasingly distort the market and limit opportunities for developing countries to benefit from growing global biofuels use.

A noticeable reduction in investment in the sector reflects the deteriorating economics, with asset-based financing slipping from \$1.82 billion in the first three quarters of 2007 to \$805 million during the same time period in 2008.<sup>24</sup> High operational costs, coupled with reduced margins, have forced smaller players out of the market and have resulted in the consolidation of the industry across global biofuel markets. Such consolidation could limit the degree of participation by small- and medium-scale producers, necessitating targeted assistance to help SMEs access supports for biofuels and bioenergy.

Developing sustainability criteria are forcing changes in the industry. In addition to food security, rapid expansion of feedstock cultivation has sparked concern that unsustainable agricultural and industrial practices will lead to widespread deforestation, illegal logging, biodiversity loss, and pollution and hasten climate change. Such concerns have induced national and international coalitions to develop criteria and related

certification schemes for sustainable biofuels. While at present the guidelines lack harmonization, are voluntary, and are largely unenforceable, they are driving changes within the industry. As such criteria may present barriers to biofuels trade, major producers in countries such as Brazil are committing to agro-environmental protocols and improved harvesting to maintain international market access. The early establishment of land-zoning and permitting programs could help to diminish risks to biodiversity throughout the region by directing feedstock cultivation and expansion to underutilized areas that are suitable for agricultural production and not deemed ecologically sensitive. Monitoring will be a critical component of such programs to help ensure compliance and enhance environmental protection over the long term. The IDB's pioneering "Biofuels Sustainability Scorecard" provides a useful tool that can be utilized by various stakeholders to evaluate the environmental and social impacts of projects throughout the project lifecycle. While this Scorecard could be augmented further to incorporate food security provisions, it does provide a means to preliminarily assess project performance. It, as well as other tools, will need to be periodically updated as evaluation methodologies are refined.

## Current State of Biofuels Development In LAC

### Expanding Legal and Regulatory Frameworks

Since the publication of the first *Blueprint*, a number of countries in the region have adopted legislation and have established regulatory frameworks for biofuels and bioenergy production and commercialization, but new challenges facing the industry necessitate that each country adapt its biofuels strategy in the context of its natural resource base, energy mix, and socio-economic and environmental goals. Of the 20 countries in LAC, 11 have legal frameworks in place, six are under preparation, and three have laws under revision. While countries in the region are currently at varying stages of development, experience throughout the region has demonstrated that biofuels sectors cannot advance without an established legal and regulatory framework that sets the parameters for biofuels production and consumption and provides clear indication of government support for biofuel-related investment.

This is also the case for bioenergy. The paucity of frameworks and incentives for biomass and biogas represent a barrier to sector investment. While the IDB has provided support in this regard, additional strategic planning support will be needed to account for socio-

economic, environmental, and technological considerations as well as technical assistance to strengthen the regulatory institutions that will be implementing policy.

### **Fossil Fuel Dependence**

Record high energy prices have made energy diversification a high priority. With 39% and 27% of the region's energy derived from petroleum and natural gas, respectively, the development of alternative energies is urgent, particularly for countries in Central America and the Caribbean that rely highly, if not exclusively, on the importation of fossil fuels. In addition to reducing reliance on petroleum-based fuels, the evolving geopolitical situation in South America, and the Southern Cone specifically, has hastened the transition toward biofuels. In fact, the decrease in natural gas supplies from Argentina to Chile prompted the Chilean Ministers of Economy, Energy, Agriculture and Revenue to eliminate a specific tax on biofuels, which in effect reduced prices to one-third that of fossil fuels, to promote consumption.<sup>25</sup>

Ironically, the shift away from fossil fuels is being driven largely by national oil companies, notably Brazil's Petrobras, Colombia's Ecopetrol, Mexico's PEMEX, and Uruguay's ANCAP, whose investment in biofuels production is naturally facilitated by the fact that they are often the entities charged with the blending and distribution of the fuels. Engagement by the national oil companies has injected significant capital into biofuels development, with the companies often becoming major players in influencing the direction of biofuels policy. State and private oil companies will likely continue to drive biofuels development in LAC as the companies expand investments into logistics, infrastructure, and trade, but safeguards should be put in place to maintain market competitiveness and participation of independent producers.

### **Current Capacity for Biofuels Development**

#### **Land Resources and Current Feedstock Cultivation**

With the exception of the Caribbean Basin, most countries in the region have vast expanses of land available for the expansion of biofuel feedstock cultivation, without compromising the food supply. The countries with the greatest potential for sugarcane expansion include Brazil, Bolivia, Argentina, Colombia, Paraguay, and Uruguay, while those with the greatest potential for palm oil and soybeans expansion are Brazil, Argentina, Peru, Colombia, and Bolivia.<sup>26</sup> In principle, land need not be a constraint for food or feedstocks cultivation, and prudent biofuels expansion need not infringe on agricultural processes or disrupt the food chain.

Research suggests that sugar and palm oil present less of a food security risk to the region than do fluctuations

in corn and soybean prices. While sugarcane, palm oil, and soy oil continue to be primary feedstocks throughout Latin America, their expanded use should not be promoted in countries where they are a primary foodstuff and in short supply. The productive efficiency of feedstocks per acre of land and per unit of water will be critical to ensure that first-generation feedstocks do not divert resources from edible crop production.

Expanding the production of alternative, inedible feedstocks on marginal land could help alleviate pressure on edible commodities. A variety of alternative feedstocks for ethanol, biodiesel and biomass are currently being developed including canola, sugarbeet, sweet sorghum, jatropha, and miscanthus. Yet projects are dispersed and uncoordinated and unable to benefit from the other test trials and demonstrations occurring throughout the region due to the absence of formal networking, resource and collaboration channels.

*Expanding the production of alternative, inedible feedstocks on marginal or under-utilized land could help diminish competition for arable land.*

### **Concentrated Industrial Base — Need for Technology Upgrades and Bioenergy Capacity**

Latin America and the Caribbean accounted for 10.1% of world biodiesel capacity and 22.3% of ethanol capacity, respectively, with 9,655 and 41,027 million liters per annum, respectively, in 2008,<sup>27</sup> yet, the region could capture a larger share of the world market if gaps identified in this report related to R&D development, expanded financing, and infrastructure are addressed. The opportunity to secure a larger market share grows as biofuels producers in the U.S. and Europe (corn-ethanol producers in the U.S. and rapeseed-biodiesel producers in Europe) are pressured by falling margins and as new, more competitive projects come online in Latin America and the Caribbean.

The relative competitiveness of sugarcane ethanol has fortified Brazil's major producers and induced consolidation. The industry's consolidation trend has been most noticeable in 2007, evident in the 25 mergers and acquisitions carried out in the industry that year, as compared to nine in 2006. Observers estimate that within 10 to 15 years, the Brazilian ethanol industry will comprise of 20 large groups. A similar phenomenon is occurring in Argentina's soybean-based biodiesel industry. Maintaining

a competitive edge will require the integration of advanced technologies for greater efficiency.

The region has seen an increase in development in the bioenergy sector, much of it driven by revenues from the sale of emissions reduction through the Clean Development Mechanism (CDM). According to New Energy Finance, bioenergy capacity in LAC for 2007 totaled 5.5 GW, a paltry 6.7% of world bioenergy capacity, which totals 81.3 GW, mostly concentrated in Asia, and barely 2.1% of regional installed capacity. Yet, within renewables, bioenergy stands head and shoulders above other sources. Solar, wind, and geothermal, combined, account for 1.9 GW (.7%) of capacity in a region with total installed capacity of 267 GW. Still, additional industrial capacity is needed to harness the latent energy potential of the region's vast biomass resources.

#### **Financing for Feedstock and Industrial Capacity**

A range of actors have played an important role in financing biofuel capacity to date, including: multilateral, regional, and private lending institutions; regional lending institutions; investment banks; domestic private and public-private lenders; and private-sector investors. Within the private sector, intra-regional South-South investment is an important trend. Another source of financing frequently used in biomass and biogas projects is the CDM, usually with the involvement of carbon credit aggregators and brokers such as EcoSecurities, though uncertainty about the replacement framework beyond 2012 inhibits further expansion of these projects. Additionally, multilaterals and governments frequently act as brokers and guarantors to facilitate debt financing.

As more governments define their legal and regulatory frameworks for biofuels and bioenergy in the region, local and foreign equity investors and lenders of all types have engaged in the region by financing projects that expand feedstocks and bioconversion capacity. Brazil leads in all categories, though significant investments have been reported in Mexico, Argentina, Peru, and Colombia. Private investment into the region's biofuels sector will likely continue apace, with the countries that have the clearest and most stable legal and regulatory frameworks attracting the bulk of the investment.

The majority of financing that has occurred has largely been limited to first-generation production. Select sugarcane and ethanol producers in the region, primarily Brazil and Colombia, have installed or plan to install high-efficiency bagasse boilers for electricity co-generation and sales of excess power to national grids. However, additional resources are needed to upgrade technology in dilapidated sugar mills and to integrate advanced technology in existing first-generation facilities throughout the region.

Investment in second-generation biofuels, biomass, and biogas has not been nearly as vigorous reflecting the lack of incentives and regulatory signals from regional governments. Several large-scale second-generation feedstock and capacity-expansion projects have been announced; most are jatropha-based, such as a 100,000 hectare private-sector jatropha investment in Colombia. However, few are actually underway or completed. Biomass-to-liquids fuels projects are beginning to take hold in Argentina and Chile.

Small- and medium-scale producers often lack the resources to engage in agricultural or industrial biofuel production. Other barriers that SMEs face are the lack of economies of scale inherent in their mode of production, the need for individual growers and producers to associate or enter into cooperative arrangements, and a lack of technical and administrative expertise. Many regional governments are attempting to overcome these barriers through tax incentives, though governments are not mandated to originate or identify projects that can take advantage of the fiscal incentives. NGOs and multilateral financial institutions are attempting to bridge that gap by providing preferential financing and technical assistance targeting relatively small-scale projects.

#### **Research and Development Lagging**

Biofuels R&D is occurring throughout the region, but it often occurs in isolated pockets. With the exception of leading countries such as Brazil and Colombia, R&D is often not coordinated with biofuel producers or with the entities developing and implementing biofuel policy. Within the private sector, some sugar industry producers and oil palm trade associations in the region fund sugarcane research through dedicated institutions. While a myriad of large-scale projects have been announced, private-sector R&D in second-generation feedstocks and biofuels production is largely limited to demonstration plots, often ranging from 10-50 hectares in size, for sweet sorghum, sugar beet, jatropha, and castor oil plant. Several national and multinational oil and energy companies are also investing in biofuels development in the region, but their public is often not able to benefit from their proprietary research.

*Developing Latin America's infrastructure will be a critical component of strengthening the region's biofuel competitiveness.*

LAC countries have lagged the U.S. in advanced biofuels and bioconversion investment and R&D, though some indigenous efforts that circumvent expensive enzyme development have taken place in Brazil. The

vast majority of ethanol and biodiesel projects throughout the region were developed with first-generation technology and have yet to integrate advanced technologies, such as high-pressure boilers, cogeneration, and recycling techniques for greater efficiency. While select biomass-to-energy projects are underway, they are largely at the hands of foreign investors with imported technology. While advanced technologies have application across the region, local technology development and technology transfer remain limited, particularly with respect to SMEs in rural areas. The ability to bridge the technology gap for both industrial and small-scale producers will largely determine LAC's biofuel future.

### **Underdeveloped Infrastructure**

Infrastructure remains a primary barrier to biofuels development in the region. Despite favorable agricultural and political conditions, many countries in Latin America and the Caribbean continue to suffer from underdeveloped or dilapidated infrastructure, which affects bioenergy-sector competitiveness and hinders expansion of biofuels production due to increased logistical costs and biofuels use by limiting access and distribution. Transport costs exceed tariffs and export costs across the region with few exceptions.<sup>28</sup> Infrastructure expansion over the last two decades has been slow in LAC inasmuch as barely 2% of GDP is invested in infrastructure regionally (except for Chile with 6% and Colombia with 4%); just enough to conserve the existing infrastructure base. CEPAL estimates that countries in the region would have to increase their infrastructure investment by 2%–4% in order to prevent the infrastructure gap with respect to southeast Asia from growing.<sup>29</sup>

Developing Latin America's infrastructure will be a critical component of strengthening the region's biofuel competitiveness. While grid development and extension would facilitate the uptake of biomass-based energy, the expansion and upgrade of roadways and highways will most readily facilitate the expansion of both agro-industrial and liquid biofuels production throughout the region. Poor conditions of roadways and congested ports are already impacting the efficiency and increasing the cost of biofuels operations throughout regional supply chains. Furthermore, agricultural expansion projects, particularly those targeting under-utilized land, will likely be inhibited without access to improved and expanded infrastructure. In many countries in the region, waterways and ports also serve as essential links in the biofuels logistics chain. These connections are particularly critical for intra and inter-regional transportation of feedstock; the heavy soybean trade on the Parana River from Brazil and Paraguay to crushing facilities in Argentina is a case in

point. Further, waterways serve as a means to transport biofuels from producing regions to the coast, as is the case with the Amazon river in the transport Peruvian biodiesel from the port of Ipaiales. Peru provides a clear example of how cabotage could be explored as an alternative to costly ground transport. Pipelines will help to facilitate the transport of biofuels from remote regions to consumption centers, particularly in Brazil, but port maintenance and expansion must remain priorities lest LAC's already high logistics costs grow and further weaken its export competitiveness.

Two regional initiatives, the Meso-American Integration and Development Project (PIDM — previously known as Plan Puebla-Panama) and the Initiative for the Integration of Regional Infrastructure (IIRSA), seek to address the infrastructure investment gap at a supranational level. These mechanisms could emerge as one of the main regional platforms for the facilitation of biofuels and bioenergy production and distribution. Developments in rail network expansion and modernization related to the two regional initiatives could help mitigate some of the region's road infrastructure shortcomings in the medium to long term, though they are not significantly represented in the design- and execution-phase portfolios of the two regional initiatives. Riverine waterway and port rehabilitation, expansion, and construction could also play a major role in the expansion of biofuels production, especially in remote growing areas, but IIRSA's priorities indicate that these projects will not be designed, much less executed, in the near future.

With the exception of the highest-profile projects, the private sector will not likely replace the public or multilateral sector as the primary funding source for the majority of roads, rail, and waterway projects, and the successful attraction of private funding may depend on creative intergovernmental cooperation and low-cost financing from sources such as the Inter-American Development Bank, the Inter-American Investment Corporation or other such institutions.

## **Potential to Lead Through Best Practices, Technology and Innovation**

### **Improving Land and Resource Efficiency with Advanced and Alternative Feedstocks**

Advanced ethanol feedstocks, such as energy cane and sweet sorghum, have the potential to further enhance the competitiveness of sugarcane-based ethanol and diminish the sector's impact on the environment and food production. Enhanced varieties can substantially increase ethanol and biomass yields while reducing agricultural

inputs and water requirements. Countries with advanced sugar and sugarcane ethanol industries, such as Colombia and Brazil, could translate higher yields into higher ethanol production. Others with less-developed sugar and ethanol industries, such as Peru, Argentina, and the Dominican Republic, could benefit as well but require major capital investments in sugar and ethanol plant equipment.

With respect to biodiesel, inedible feedstocks, such as jatropha, animal fats and grease, and algae, provide alternatives to conventional oilseeds. While palm oil remains a superior feedstock in terms of yield, jatropha is a promising high-yield and low-input alternative. Tallow from concentrated cattle operations in Argentina and Brazil presents another low-cost alternative. Fish oil is used in Honduras to produce biodiesel, and there are already small-scale projects that incorporate residual oils and fats into the diesel supply chain in Dominican Republic and Peru. Greater integration of animal fats, used or residual oils, and greases would increase access to low-cost feedstocks, reduce industrial waste, and add value to waste products.

#### **Potential to Develop R&D Capacity for Feedstock and Bioconversion Technology**

While biofuels R&D is occurring throughout the region by public, private, and non-profit groups, it is often clustered in leading agricultural producing nations and uncoordinated with biofuel entities. R&D in second-generation feedstocks is occurring on demonstration plots for sweet sorghum, sugar beet, industrial yucca, jatropha, and castor oil plant, but researchers lack integrated means of sharing results and benefiting from regional expertise. Millions of dollars are being channeled into advanced feedstock R&D globally, particularly in U.S. universities and dedicated bioenergy research institutions, with Latin America and the Caribbean falling behind.

*While a few countries in the region are beginning to produce ethanol and biodiesel equipment, the grand majority of producers are dependent on costly, imported technology.*

With the clear exception of Brazil, there is even less R&D in bioconversion processes, be it for ethanol, biodiesel, or biomass and biogas power generation. The noticeable dearth of research and development into industrial technology necessitates the import of costly processing technology from abroad. While a few countries in the region are beginning to produce ethanol and biodiesel equipment,

a large majority of processing plants have been imported from U.S. and European manufacturers at great cost to producers. Bioconversion technologies are being developed and employed in the U.S., the EU, and India, catalyzing the transition to next-generation production. Developing a domestic industrial production capacity through the support and financing of technology corridors or technology incubators could help LAC countries expand their industrial base as well as reduce the current costs associated with expanded domestic biofuels programs.

With respect to both feedstock and bioconversion technology, R&D institutions in the region need to be networked so that existing and potential project developers may access existing knowledge through more centralized means. Centers of Excellence, such as those recommended in the first *Blueprint* and now under development in Brazil, are working toward this end, but similar coordination is needed elsewhere in the region.

#### **Harness LAC's Vast and Underutilized Biomass Resources through Advanced Technology**

Biomass and biogas technologies are expanding, but they still represent great unrealized potential. Biomass represents 13% of the region's primary energy supply, mainly woody biomass consumed inefficiently in the residential sector, and bagasse and other agricultural waste in the agricultural sector. Biogas is hardly represented at all in the region's energy matrix. Industrial biomass- and biogas-based heat and electricity generation have unrealized potential to displace fossil fuels in the region, especially in the rural sector and in nations such as Honduras and the Dominican Republic, which are highly dependent on imported diesel for power generation. Wood residues from forestry industries in Peru, Chile, and Argentina in particular are an untapped energy source.

#### **Capture Latent Waste Energy Ripe for Biogas Conversion**

While biomass has been utilized for decades as a power source, biogas production is just beginning to gain ground. Anaerobic digestion of municipal solid waste (MSW) can convert waste into electricity, biodiesel, water, and animal feed, a process that generates revenue from electricity sales to the grid and reduces the pollution that accompanies straight incineration. Such technology has direct application across LAC's major cities, where waste management has become a burden. Far from urban areas, biogas can also be captured from industrial and small-scale agricultural activity for sale to the grid or use as heating and cooking fuel. Biomass is the primary source of heat and cooking energy in rural areas, and the anaerobic digestion of biomass is among the most promising renewable energy processes, particularly for

developing countries, as it converts organic waste streams into renewable energy, heat, liquid fuels, compost, and fertilizer while reducing pollution. While such technologies have ubiquitous application across the region, technology development and transfer remain elusive, particularly with respect to SMEs in rural areas.

### **Incorporate Sustainable Practices for Greater Efficiency and Competitiveness**

While methodologies vary, such sustainability and emissions-reduction requirements could actually bode well for LAC producers that are able to demonstrate and verify their production methods. Corn-based ethanol and rapeseed-based biodiesel, primary biofuel products in the U.S. and EU, respectively, have relatively low energy balances when compared to sustainably produced sugarcane-based ethanol and palm oil-based biodiesel, and they have been demonstrated to be greater contributors to food shortages and price inflation. While first-generation feedstocks that are utilized in LAC — for example, sugarcane, soy oil, and palm oil — still present challenges, sustainable agronomic practices coupled with advanced technology can help producers in the LAC region to capture the energy, socio-economic, and environmental benefits of biofuels-sector expansion. However, this will require additional support to improve production practices and establish monitoring and certification systems to help secure a competitive position in the increasingly discriminating global biofuels market. The convergence of factors presents an opening for LAC to become a world leader in sustainable biofuels.

While the impacts on water, air, and soil quality could be degraded by both agricultural and industrial processes, the incorporation of advanced agronomic techniques and technology can mitigate environmental impacts and reduce operational costs. Zoning programs can identify suitable land for feedstock expansion that does not encroach on ecologically sensitive areas. Reduced use of chemical fertilizer, utilization of organics, and the controlled application of treated vinasse can minimize contamination while the elimination of cane trash burning and utilization of agricultural waste for co-generation improve air quality and minimize erosion. Further, incorporation of advanced feedstocks, such as energy cane or sweet sorghum, has the potential to double yields with a fraction of the water requirements, further reducing biofuels' environmental footprint and promoting food security.

## **Recommendations**

By matching assistance with regional needs, the IDB can continue to play an important role in facilitating

biofuels and bioenergy expansion in the region. The five main action areas are described below, accompanied by four program ideas. In all of its biofuels efforts, the IDB should strive to tie financing to socioeconomic sustainability criteria including food security. Establishing a clear legal and regulatory evaluation methodology or rubric that incorporates such criteria will help to ensure that public and private investments are sustainable.

### **I. Strengthening Policy Support for Biofuels and Bioenergy**

The need for a regional initiative at the IDB that would provide technical assistance for the regulation of biofuels and bioenergy production has become more acute since the publication of the original *Blueprint*, where this same program idea was first proposed. A growing number of countries in the region have acted to remove policy- and regulation-based barriers to biofuels production with assistance from the IDB. Yet there is no systematic, long-term, regional initiative to identify and disseminate information regarding effective regulatory frameworks established in specific countries. The need is all the greater in the bioenergy sector, where significantly fewer advances have been made in terms of regulation and policy development. Furthermore, incongruent policies among nations continue to impede potential for international trade in biofuels. Greater harmonization of regulatory frameworks and technical standards would facilitate greater engagement in expanding global biofuels markets.

#### **Program Ideas**

- **A Hemispheric Biofuels and Bioenergy Regulatory Initiative:** Such an initiative would establish a platform from which the Bank could provide technical assistance for development of regulatory frameworks and strategic planning, increasing support for bioenergy frameworks in particular. Such an initiative could establish a methodology for benchmarking and measuring regulatory progress as well as provide technical assistance for institutional strengthening of designated biofuels and bioenergy regulatory agencies and bodies.
- **A Sustainable Biofuels Certification Initiative:** The IDB could assist policymakers in integrating sustainable production criteria into existing legal and regulatory frameworks. The policy support could be supplemented with a program designed and funded to conduct life-cycle assessments of biofuels and bioenergy projects and develop a sustainable biofuels certification scheme in line with developing international criteria to help producers improve production and remain competitive in the increasingly restrictive global biofuels markets. Such

a program could utilize the IDB's recently developed "Biofuels Sustainability Scorecard" as a tool to facilitate the certification process.

## II. Supporting Innovation and Technology

For countries across the region, there continues to be a profound need to advance technology and training to support the development of competitive and efficient biofuels industries. The lack of technology-development capacity in the region threatens to undermine the region's competitive edge in the sector. As proposed in the first *Blueprint*, efforts need to go beyond supporting and cultivating individual efforts to advance innovative capacity within countries to support countrywide and regionally based innovation centers. A Biofuels and Bioenergy Innovation Initiative would create an umbrella program for projects aimed at promoting research and development, as well as a platform to promote technological cooperation and integration at a regional level. Such an initiative, if undertaken, would lend substantial support and leverage to the formation of regional Centers of Excellence in Biofuels and Bioenergy recommended in the first *Blueprint*.

### Program Ideas

- **Conduct Feasibility Studies for Integration of Advanced Technologies:** Such studies would be designed to examine agronomic variables, such as soil quality and climate regimes and water resources, and pilot cultivation programs to test various first- and second-generation biofuels and bioenergy feedstocks.
- **An Advanced Biofuels and Bioenergy Technology Education Initiative:** The initiative could lend region-wide financial support for advanced studies in science and engineering fields relevant to biofuels and bioenergy through the provision of funds and expertise for scholarships, fellowships, and grants; improving curricula and education infrastructure; support for biofuels and bioenergy research initiatives; support for inter-country exchanges, internships, and distance learning.
- **Next-Generation Support Programs:** These programs could lend technical and financial assistance to promote advanced feedstocks and bioconversion R&D projects through feasibility studies and assessments for technology upgrades to existing first-generation projects; loan guarantees to producers seeking to integrate advanced technology into current biofuels projects; support for public-private partnerships to advance pilot projects incorporating next-generation technology; and support for the strengthening of regional trade agreements and patent-enforcement laws to facilitate the transfer of ideas and technology across borders.

## III. Enhancing Sustainable Biofuels and Bioenergy Production

As several countries in the region have moved forward with plans to initiate or expand biofuels and bioenergy production, the IDB and other multilateral or bilateral agencies have responded with several feasibility studies and pilot projects in various stages of execution. However, existing methodologies do not incorporate provisions for indirect environmental or socio-economic impacts of production. Further, efforts to improve the environmental and socio-economic performance of projects remain isolated, with producers unable to access instructive information from successful initiatives elsewhere in the region.

### Program Ideas

- **Life-Cycle Analysis (LCA):** Each biofuel project under consideration would undergo a thorough LCA with consideration for earth-to-engine production that accounts for carbon and other pollutant emissions from land clearing, cultivation, and biofuels and bioenergy production.
- **Food Security Impact Assessments:** Such assessments would be designed specifically for biofuels projects, would carry the same weight as environmental impact assessments and follow the four dimensions set forth by the Food and Agriculture Organization: availability, access, utilization of resources, and remuneration.
- **Land Zoning for Efficient and Sustainable Land Use:** Government officials and project developers would conduct surveys of available, under-utilized and marginal agricultural land to provide basic parameters for expanded biofuels feedstock cultivation based on adequate first- or second-generation feedstocks.
- **Biofuels and Bioenergy Information Warehousing Project and Resource Directory:** Such a directory could provide players in the biofuels and bioenergy sectors with a centralized, web-based and publicly accessible data repository that would include information on pilot projects, R&D project plans, policy frameworks, and technical specifications. The Warehouse and Directory would gather existing data on current projects in the region and provide a forum for stakeholder exchange of expertise.

## IV. Financing for Broad-Based Technology Upgrades and Support for SMEs

While there has not been a shortage of financing for large-scale biofuels producers, small- and medium-scale producers continue to lack access to low-cost financing to

invest in feedstock and bioconversion technologies, limiting the potential for biofuels to contribute to rural development in the region. Financing bottlenecks not only impede the development of new projects, but they also inhibit existing first-generation producers, small- and large-scale, from integrating more advanced and efficient technologies into current operations. Primary targets for financing include:

#### Program Ideas

- **A Financial Education and Public Outreach Initiative:**

Such an initiative would provide finance workshops and trainings to small- and medium-scale producers to support business planning and provide critical information regarding available financing options and application procedures.

- **Targeting Financing to Small- and Medium-Scale Producers:**

Programs could be designed to extend financing support through loan guarantees, purchase guarantees, or equity shares for SMEs that are unable to access capital markets. Such programs would also help SMEs to access existing fiscal incentives for biofuels and bioenergy.

- **Financing Technology Deployment:**

Financing support should target existing facilities where technology upgrades would improve efficiency and environmental performance. In addition to continued financing for well-established technologies such as cogeneration, financing can be extended to greenfield, second-generation feedstock and bioconversion projects to help offset technology risk.

#### V. Expanding Biofuels and Bioenergy Infrastructure

Inadequate infrastructure remains a primary obstacle to efficient and competitive biofuels production in the region. Dilapidated roads and railway networks, coupled with congested ports, continue to create bottlenecks between major supply and demand centers. Routes connecting remote agricultural areas with demand centers remain among the most neglected of these bottlenecks, yet they have the greatest potential to boost agricultural productivity, enhance competitiveness, and extend the benefits of biofuels to the rural poor. As the private sector has largely failed to engage in this sector, there remains an opportunity for the IDB to fill the gap.

#### Program Idea

- **An Agro and Bioenergy Infrastructure Investment**

**Initiative:** Such an initiative would serve to expand traditional IDB investment in transportation infrastructure in support of biofuels production and distribution beyond expanding road networks, to include pipelines,

rehabilitating and expanding rail networks, establishing dedicated fuel export terminals and facilities, and promoting waterway and maritime cabotage. The initiative would provide continued support for grid expansion, interconnection, and facilitate bioenergy uptake.

## Carbon Markets

LAC's natural resources offer a considerable force for sustainable development in the form of carbon market projects, but policy, finance and institutional gaps in many cases inhibit the region's true potential. This section of the report seeks to identify and explain the opportunities for success as well as the challenges facing specific countries in the region. It also proposes a series of measures that the IDB could pursue in order to facilitate the development of these development resources to better the prospects for the region's future.

*The worldwide carbon market grew almost twelve-fold between 2005 and 2008, from \$10 billion to \$118 billion.*

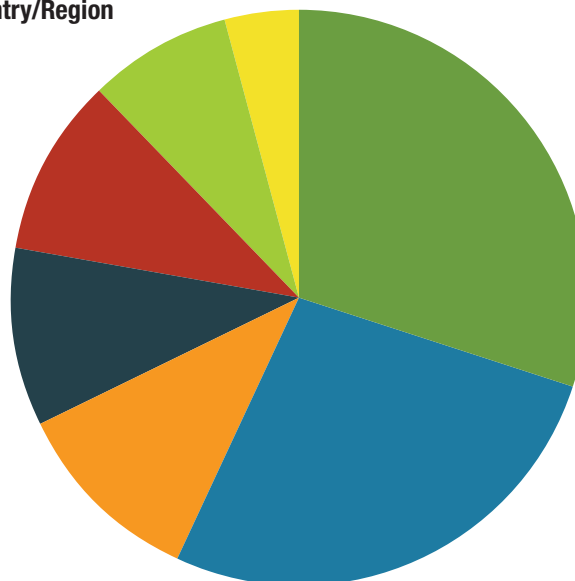
For this analysis, Garten Rothkopf has analyzed the key trends shaping the carbon markets in five countries in the region as well as two in Asia — China and India — in an attempt to compare the relative strengths and weaknesses of each. The analysis that follows is derived from a wide range of sources, including government, academic, and non-profit analyses, public and private data sources, news articles, and primary-source interviews in English, Spanish, and Portuguese conducted between February and September 2008.

The worldwide carbon market has seen tremendous growth over the past few years. After tripling in size between 2005 and 2006 to reach an estimated \$30 billion, it doubled again in 2007 to reach \$64 billion. Analysts estimate that the world's carbon markets reached a value of \$118 billion in 2008. The regulated European Union Emissions Trading Scheme (EU ETS) accounts for about 80% of the current market value. Regulated accounts will likely dominate for the foreseeable future, but the voluntary carbon market is also emerging as a force of its own, especially in the developing world.

For the purposes of this study on carbon markets in Latin America and the Caribbean, most of the focus will be on the Clean Development Mechanism market and the voluntary carbon offset market, as these are the two

**Chart 1.0h Percent of Registered Global CDM Projects by Country/Region**

India	30%
China	27%
Brazil	11%
Other LAC	10%
Other Asia/Pacific	10%
Mexico	8%
Africa/ME	4%



Source: UNFCCC

markets that are most involved in the region today. The CDM market is the second-largest component of carbon markets worldwide, both in terms of volume transacted and value. The voluntary market, by comparison, is much smaller, though it is showing impressive growth. Taken together, these two markets could prove to be a considerable force for sustainable development in Latin America and the rest of the developing world.

### The Current State of Carbon Markets in LAC

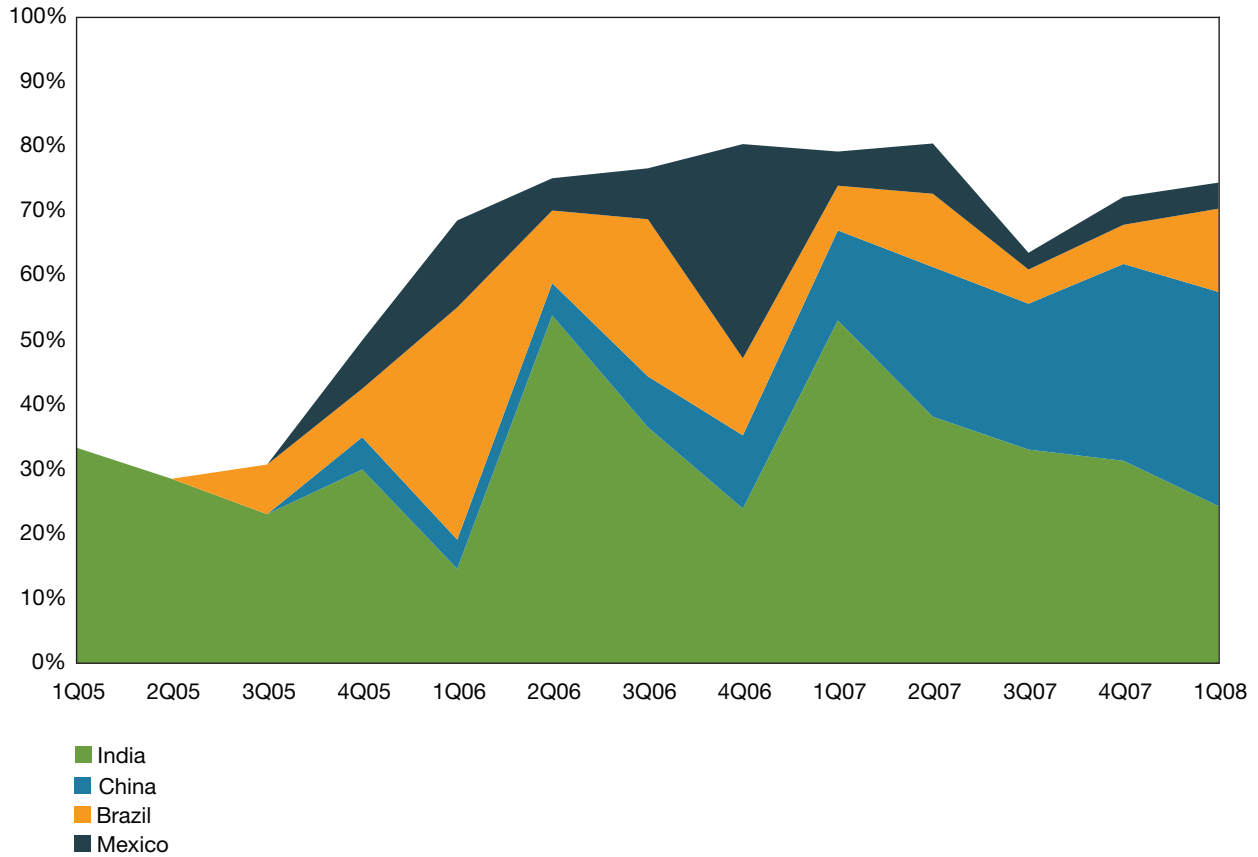
Latin America is among the world leaders today in hosting CDM projects. Along with Asia, the two regions together account for more than 95% of all projects globally. In Latin America, Brazil and Mexico stand out as regional leaders, hosting a majority of all projects in the region and together accounting for almost one-fifth of all projects globally. In addition to the CDM sector, LAC and Asia are also involved in the creation and implementation of projects designed for the voluntary carbon market. Asia is also by far the world's leader in terms of the number of voluntary offset projects hosted, with over 40% of the global total. Latin America, though active, garnered just about 8% of global voluntary offset projects in 2007. While Asia is the leading region for hosting carbon projects worldwide, Latin America is a distant second and has considerable room for growth.

Latin America and the Caribbean lag behind Asia in terms of CDM projects and voluntary carbon projects implemented and in the pipeline. This was not always the case. During the first year of the Clean Development

Mechanism, from November 2004 to November 2005, 39 CDM projects were developed worldwide. Latin American projects accounted for 18 of these, including the first two to be registered, and three of the first five. It was a promising start for the region in terms of the beginning of an era in sustainable development. Today, Asia hosts more than 65% of all CDM projects in the world, while Latin America hosts about 30%. This is almost entirely due to the burgeoning economies of China and India, which account for the vast majority of projects in Asia. Moreover, while certain advantages are inherent to each region, Asia has arguably pushed more forcefully and has taken advantage of more opportunities to ensure its primacy in the sector.

One reason for investors to look to implement carbon offset and CDM projects in Latin America and the Caribbean, however, is the general treatment of climate change at the national level in many countries. Of the countries that were analyzed in this study, Mexico has recently released its Climate Change 2008 to 2012 roadmap; the Brazilian government declared 2007 the "National Clean Development Year"; Colombia is gearing up to develop a National Climate Change Policy; and Chile in the past two years has created a Ministry of Environment and a Ministry of Energy, each of which lend institutional support for the implementation of carbon projects. This open support for projects to help mitigate the effects of climate change is an indication of the seriousness with which national governments are treating the issue and the extent to which they plan to address it in the context of sustainable development. The region is rich in natural resources that can be utilized for the implementation of carbon projects. It is a growing

**Chart 1.0i Percent of Global CDM Projects in the Pipeline**



Source: UNFCCC

agricultural powerhouse and thus could become an important source for certain renewable energy projects that rely upon biomass for production. The region is also rich in forests, which are disappearing in record numbers. Protecting these resources represents a great opportunity for investors looking to develop carbon offset projects.

Today, hydroelectric projects represent one of the most common types of CDM projects in the hemisphere, while forestry projects are among the most numerous in the voluntary sector. Of the five countries in the region that this study analyzed, hydroelectricity projects are the most common or the second most common type of project in four of them. In places like Brazil, Chile, Colombia and Honduras, this is a reflection of the ample fluvial resources that exist in these countries. At the same time, however, hydroelectric projects are subject to climate change risks. A severe drought in Brazil in 2001 played a role in the virtual breakdown of hydroelectricity as rivers dried up, contributing to a 1.5% reduction in GDP. Looking ahead, helping countries in the region to

diversify their energy matrices — as well as their carbon portfolios — could help them to avoid climate change-related risk. Forestry projects in the voluntary sector are found throughout the region and, in many cases, reach isolated areas where CDM projects do not generally exist. This type of project’s promise for the region is that it can be implemented almost anywhere, and has already shown that it can contribute significantly to sustainable development.

Several countries in the region are taking innovative steps to augment their involvement in, and treatment of, the carbon market. In Chile, the government has begun to make a serious commitment to the diversification of the country’s energy matrix. Included in this effort is a mandate that 15% of the new energy capacity in the country come from renewable energy sources. Furthermore, the state is encouraging green building and energy-efficient construction. Mexico’s Secretariat of the Environment and Natural Resources (SEMARNAT) has worked with the Centro Mario Molina and BANCOMEXT to create the Mexican Carbon Fund (FOMECAR), which is designed to support activities related to emissions

reduction. FOMECAR's goal is to increase Mexico's participation as a host country within the CDM. The National Development Bank of Brazil has begun a Clean Development Program that launched two closed-investment mutual funds to support projects that can generate certified emissions reductions (CERs). Such undertakings indicate that the region's approach to carbon markets is becoming more robust.

### Gaps Preventing the Wider Adoption of Carbon Markets in LAC

Carbon projects, whether as part of the regulated or voluntary market, face myriad challenges in their implementation. For the Americas, one of the most fundamental challenges vis-à-vis its competition with Asia to implement projects that it cannot offer the same number of emissions reductions to investors for the simple reason that its energy matrix is less heavily geared toward traditional fossil fuels than are China's and India's. While this is an inherent disadvantage for the region, there are other disadvantages in policy, financing, and institutions that can be smoothed out or overcome in order to better the prospects for carbon markets in the region.

#### Lack of Policy Initiatives

The extent to which governments take an active role in promoting carbon projects is strongly correlated to the success that these countries have had in the carbon market. The Brazilian government declared 2007 the "National Clean Development Year," which included at its launch a protocol signed by 15 government bodies to take action to reduce greenhouse gas emissions through the use of CDM projects. This type of action by a national government is a clear instance of leading by example. In Mexico, SEMARNAT created FOMECAR to increase the country's participation as a host country within the CDM framework and to gain further benefits in the form of foreign investment and technology transfer. Chile's National Commission on the Environment (CONAMA) created a strategy to support sectors where CDM projects need to be developed, including recommending specific technologies or procedures for potential CDM projects. These proactive policy initiatives have helped to build and sustain lively carbon markets in several countries.

Some countries in the region, however — even those that have had relative success within the carbon market arena — have had particular trouble with gaps in policy. In Honduras, for example, convoluted procedural standards that vary among government offices create uncertainty that can deter developers and investors. Brazil has faced certain issues as well, including the undefined fiscal status

of CDM projects. Policy initiatives must be not only proactive, but also consistently applied throughout a country. Ensuring that this is the case not only makes the processes of project proposal and implementation less cumbersome for developers and investors, it also speeds up the project-development process and lowers transaction costs.

*The extent to which governments take an active role in promoting carbon projects is strongly correlated to the success that these countries have had in the carbon market.*

#### Access to Financing

Among the most challenging aspects of project design and implementation in the Americas is project financing. This is especially true in smaller countries with less investor confidence and also for smaller projects.

Several countries are better placed than others to help project developers access financing. Because of institutional parameters set out in countries like Brazil, Chile, and Mexico, project proposals are more easily channeled so that the best projects are consistently given precedence over those that might need more work. In countries like Brazil and Mexico, where investors are more likely to look for opportunities, institutional and policy benefits play an important role in attracting financing.

However, lack of financing for small projects continues to hamper growth efforts throughout the region, especially in smaller countries such as Honduras. Projects that are smaller in terms of emissions credits produced are not necessarily small in terms of the impact they can have on sustainable development. But because these projects do not provide the same return on investment as larger projects, investors are often unwilling to pursue them, just as lending institutions may be. Even when lending institutions do provide funding, the rural nature of smaller projects often affects the speed with which they can be completed, due to infrastructural limitations. In this context, Garten Rothkopf found that financing opportunities are often limited to one round and, should construction run over the expected budget, project developers are forced to seek additional financing elsewhere.

#### Institutional Gaps and Inefficiencies

The institutionalization of standards and norms relating to the carbon market is another area that helps to guide

project developers and channel projects through a set system on their way from project design to implementation. Brazil, for example, was one of the first in the region to establish an institution, the Inter-Ministerial Commission on Climate Change (CIMGC), to coordinate discussions on climate change issues and integrate the discussions into government policies. Today, CIMGC is composed of nine ministries that are responsible for approving project activities eligible for CDM as well as creating additional eligibility criteria beyond those rules established under the Kyoto Protocol. Similarly, Mexico's Inter-Ministerial Commission for Climate Change (CICC) and its Secretariat of the Environment and Natural Resources (SEMARNAT) both work to channel the efforts of diverse stakeholders toward concerted efforts to develop carbon projects for the sake of sustainable development.

In Honduras, institutional delays created by long periods for completing feasibility studies and the lengthy project-approval process act to drive up transaction costs which are already prohibitive in many cases. In the course of this study, Garten Rothkopf identified one privately-financed hydroelectric project in the country that had to wait three years just to complete the permit process to begin construction. In Chile, the designated authority, CONAMA, requires project developers to ask for a separate Letter of Approval (LoA) for any new information that is added during the course of project design and implementation. This makes the project approval process much more time consuming and drives up transaction costs for all parties involved.

## Recommendations

Though countries in the Americas vary to a large extent in terms of the potential for their participation in the carbon market, four pillars will help each country to become as robust as possible in the field. In order for carbon markets to continue growing in Latin America, the IDB must play a leading role to support these pillars by lending financial support, heightening building capacity in the region, and helping countries to design and implement institutional programs to streamline and enhance their carbon sector.

### I. Establishing the Potential for Carbon Markets

The key to understanding the process of emissions mitigation is an all-encompassing view of national emissions portfolios. Fully comprehending the contours of national emissions on a sector-by-sector basis can aid local and international institutions in bringing about the most appropriate emissions-mitigation and sustainable-development projects for each country. In Latin

America's case, taking stock of individual country endowments may result in a more nuanced approach to project development and could help to identify specific potential emissions mitigation projects in each country. As the IDB has already accomplished an inventory of its own corporate greenhouse gases as part of its Carbon Neutral Initiative, it can translate this knowledge through capacity building in the region to help government institutions understand how to inventory emissions. This, in turn, will help countries identify emissions-mitigation projects that may have been overlooked up to this point.

### Program Ideas

#### • National Greenhouse Gas Inventories Project:

Undertake a thorough inventory of national greenhouse gas emissions by sector throughout the region, including those from deforestation, in order to highlight troubling trends as well as to identify the potential for new types of emissions-mitigation projects.

#### • Private Sector Carbon Footprint Initiative:

Promote private sector emissions accounting through the bank's own efforts as part of the Carbon Neutral Initiative and tie private carbon mitigation efforts regionwide to local offset projects in order to establish a link between local corporate efforts to reduce emissions and sustainable-development projects to generate offsets.

### II. Streamlining Institutional Structures and Procedures

Central coordinating bodies for the Clean Development Mechanism (CDM), referred to as Designated National Authorities (DNAs), already exist as important central institutions for the promotion and approval of carbon projects in many countries in the region. These institutions often play a key role in helping project developers design and implement the best projects possible. In many cases, however, these institutions also create a certain amount of institutional inertia, prolonging the project development process and upping transaction costs for all parties involved. In order to streamline the project approval process, legal and procedural gaps need to be addressed so that fewer projects do not fall through the cracks.

These DNAs only address the process of CDM project development. In order to facilitate broader participation, individual governments can create a single central coordinating body for any project seeking carbon credits, in the voluntary sector as well as the CDM. Doing so would ensure that each country properly utilizes all the carbon assets available, not just those that are the largest and seem the most lucrative. Such institutions could also help to facilitate an increase in the number of voluntary projects in a relatively short time span, as the voluntary market is unregulated and does not have to contend with

the inefficiencies associated with policy, financial, or institutional gaps. This would help the region to become more active and more innovative in the market and could help in terms of development on a very local level.

#### Program Ideas

- **Institutional Capacity Building Plan:** Identify legislative and procedural gaps that concern the implementation of carbon projects by interviewing project developers, and build government capacity to fill them by increasing technical support throughout the project-development and -implementation phases.
- **Carbon Project Clearinghouse Program:** Centralize all matters regarding CDM and voluntary carbon offset project proposals to give project developers a single place to submit their applications for any project that they want to pursue, no matter the size or type, ensuring that small projects that do not qualify for the CDM are not thrown out but instead incorporated into the voluntary market.

### III. Promoting Specific Types of Carbon Projects

Many countries have already begun initiatives to harness the potential for renewable energy. Developing a plan for the implementation and use of a renewable energy sector is especially important for smaller countries in the region, which generally do not have sufficient alternatives to traditional fossil fuels when confronted with drastic oil price fluctuations. This can lead to considerable economic hardship. Pursuing renewable energy projects beyond the hydroelectric sector will help countries to become less dependent upon foreign oil through the diversification of energy matrices and will also work to reduce national emissions portfolios.

At the same time, there is a tremendous opportunity in Latin America for carbon-offset projects in the forestry sector. Deforestation is rampant in the region: From 1990 through 2005, it accounted for over 60% of global primary forest loss. Central America has the highest rate of deforestation of any region in the world over the past 15 years, with Honduras leading the way. Today, there are a number of forestry projects that are CDM-certified or registered in the voluntary market. Some pay communities to plant trees in previously forested areas, while others take a more holistic approach that emphasizes land management and sustainable agriculture in the context of the replanting of indigenous tree species. Given the staggering rate of deforestation in certain areas of the region and the sustainable development benefits that can be gained, there is today huge latent potential for the promotion of such a sector.

#### Program Ideas

- **Renewable Energy Projects for the CDM Program:** Map national endowments for various types of clean energy, and promote the implementation of renewable energy projects by offering preferential financing to private sector project developers.
- **National Forest Protection Program:** Work with governments to map national deforestation, implement capacity-building measures to educate communities in those areas in long-term sustainable land-use management, and finance initial replanting and avoided-deforestation projects, which can then compensate communities in the long-term through the sale of voluntary carbon offsets.

### IV. Improving Access to Financing

Lack of financing is one of the key hurdles inhibiting the growth for the carbon sector throughout the region. Some national institutions have addressed this shortcoming. The Brazilian National Development Bank (BNDES) and the Mexican Carbon Fund (FOMECAR), for example, have instituted programs to support emissions-mitigation projects. These types of institutions play an important role in expanding the scope of projects suitable for the carbon market and act as useful examples of how relatively well-endowed countries can go one step further to support market development. Most countries in the Americas, however, do not have the resources necessary to fund such institutional programs. The ability of countries to fund carbon projects will be increasingly important, as it will act to build investor confidence and to foment interest from project developers seeking to implement new projects.

#### Program Ideas

- **Public-Private Partnership Working Group:** Match interested private project developers with potential public-works projects throughout the hemisphere that can be utilized to generate offsets, such as innovative, low-emissions public transportation or landfill gas projects.
- **Latin American Carbon Fund:** Create a trust fund to obtain future flows of certified emissions reductions (CERs) on behalf of participants, in return for up-front project finance support.
- **Latin American Carbon Market Plan:** Increase the number of bank-sponsored clean energy projects by providing additional early-stage project development financing as well as technical support to validate project designs and certify emissions reductions that result from these projects.

## Endnotes Section 1

- 1 International Energy Agency. "Energy Balance of Non-OECD Countries – 2008 Edition." International Energy Agency. 2008. 30 Oct. 2008 <[http://www.iaea.org/textbase/publications/free\\_new\\_Desc.asp?PUBS\\_ID=1078](http://www.iaea.org/textbase/publications/free_new_Desc.asp?PUBS_ID=1078)>.
- 2 Operador Nacional do Sistema Eléctrico (ONS), "Dados Relevantes 2006." 5 Apr. 2008. 9 Sept. 2008 <[http://www.ons.org.br/biblioteca\\_virtual/publicacoes\\_operacao\\_sin.aspx](http://www.ons.org.br/biblioteca_virtual/publicacoes_operacao_sin.aspx)>.
- 3 Intergovernmental Panel on Climate Change (IPCC). "Climate Change and Water." UNEP and WMO. June 2008. 30 Oct 2008 <<http://www.ipcc.ch/pdf/technical-papers/climate-change-water-en.pdf>>.
- 4 OLADE. "Sistema de Información Económica Energética." OLADE. Nov. 2007. 1 Sept. 2008 <<http://www.olade.org/documentos2/plegablecifras-2006.pdf>>.
- 5 Renner, Michael, Sean Sweeney, and Jill Kubit. "Green Jobs: Towards Sustainable Work in a Low-Carbon World." UNEP. Sept 2008. 31 Jan. 2009 <[http://www.unep.org/labour\\_environment/PDFs/Greenjobs/UNEP-Green-Jobs-Report.pdf](http://www.unep.org/labour_environment/PDFs/Greenjobs/UNEP-Green-Jobs-Report.pdf)>.
- 6 OLADE. "Sistema de Información Económica Energética." OLADE. Nov. 2007. 1 Sept. 2008 <<http://www.olade.org/documentos2/plegablecifras-2006.pdf>>.
- 7 REN21. "Renewables 2007 – Global Status Report." REN21. 2008. 20 Apr. 2008 <[http://www.ren21.net/pdf/RE2007\\_Global\\_Status\\_Report.pdf](http://www.ren21.net/pdf/RE2007_Global_Status_Report.pdf)>.
- 8 Sustainable Energy Finance Initiative and New Energy Finance. "Global Trends in Sustainable Energy Investment 2008 – Dataset." UNEP. 2008. 5 Sept. 2008 <[http://sefi.unep.org/fileadmin/media/sefi/docs/publications/data\\_2008.pdf](http://sefi.unep.org/fileadmin/media/sefi/docs/publications/data_2008.pdf)>.
- 9 REN21. "Renewables 2007 – Global Status Report." REN21. 2008. 20 Apr. 2008 <[http://www.ren21.net/pdf/RE2007\\_Global\\_Status\\_Report.pdf](http://www.ren21.net/pdf/RE2007_Global_Status_Report.pdf)>.
- 10 New Energy Finance. "NEF Desktop 3.0." 10 Sept. 2008 <<http://www.newenergymatters.com>>.
- 11 REN21. "Renewables 2007 – Global Status Report." REN21. 2008. 20 Apr. 2008 <[http://www.ren21.net/pdf/RE2007\\_Global\\_Status\\_Report.pdf](http://www.ren21.net/pdf/RE2007_Global_Status_Report.pdf)>.
- 12 International Geothermal Association. "Installed Generating Capacity." 29 July 2008. 1 Sept. 2008 <<http://iga.igg.cnr.it/geoworld/geoworld.php?sub=elgen>>.
- 13 Global Wind Energy Council. "Global Wind 2007 Report – Second Edition." May 2008. 1 Sept. 2008 <[http://www.gwec.net/fileadmin/documents/test2/gwec-08-update\\_FINAL.pdf](http://www.gwec.net/fileadmin/documents/test2/gwec-08-update_FINAL.pdf)>.
- 14 REN21. "Renewables 2007 – Global Status Report." REN21. 2008. 20 Apr. 2008 <[http://www.ren21.net/pdf/RE2007\\_Global\\_Status\\_Report.pdf](http://www.ren21.net/pdf/RE2007_Global_Status_Report.pdf)>.
- 15 REN21. "Renewables 2007 – Global Status Report." REN21. 2008. 20 Apr. 2008 <[http://www.ren21.net/pdf/RE2007\\_Global\\_Status\\_Report.pdf](http://www.ren21.net/pdf/RE2007_Global_Status_Report.pdf)>.
- 16 Fay, Marianne and Mary Morrison. "Infrastructure in Latin America and the Caribbean: Recent Developments and Key Challenges." The World Bank. 2007. 3 Jan. 2008 <<http://www.iadb.org/sds/conferences/infrastructure/WB-IDB%20Infrastructure%20in%20Latin%20America.pdf>>.
- 17 AMDEE. "Perspectiva del Mercado." Primer Encuentro Internacional para el Fomento de las Energías Renovables en el Estado de Oaxaca. 29 Feb and 1 Mar 2008. 10 Apr 2008 <<http://www.oaxacaenergialimpia.com.mx/bloque02/10.ppt>>.
- 18 Sonntag-O'Brien, Virginia and Eric Usher. "Mobilising Finance for Renewable Energies – Thematic Background Paper." International Conference for Renewable Energies, Bonn 2004. Jan. 2004. 9 Jan. 2008 <<http://www.uneptie.org/energy/act/fin/docs/TBP05-Financing.pdf>>.
- 19 New Energy Finance. "New Energy Finance Desktop 3.0." New Energy Matters. 7 Sept. 2008 <<http://www.newenergymatters.com>>.
- 20 Jannuzzi, Gilberto De Martino. "Public Interest Research and Development: Electricity Sector Reforms and the Effects in Energy R&D Activities." International Energy Initiative – Latin America. Energy Discussion Paper No. 2.62-01/03. Apr. 2003. 23 Jan. 2008 <<http://www.iei-la.org/documents/RellE12-62-01-03.pdf>>.
- 21 Maize U.S. #2 Yellow, USDA; Soy Oil FOB Argentina, USDA FAS; Palm Oil CIF Rotterdam, Malaysian Palm Oil Board
- 22 Roig-Franzia, Manuel. "A Culinary and Cultural Staple in Crisis." The Washington Post. 27 Jan. 2007. <[http://www.washingtonpost.com/wp-dyn/content/article/2007/01/26/AR2007012601896\\_pf.html](http://www.washingtonpost.com/wp-dyn/content/article/2007/01/26/AR2007012601896_pf.html)>.
- 23 International Energy Agency. "Biofuels for Transport: An International Perspective." Paris, 2004.
- 24 New Energy Finance, statistical database, accessed 05 Sept. 2008.
- 25 N.a. "Chile slashes taxes on biofuels to avoid social and health crisis." Biopact. 18 May 2007. <<http://biopact.com/2007/05/chile-slashes-taxes-on-biofuels-to.html>>.
- 26 "Oportunidades y riesgos de la bioenergía." Comisión Económica para América Latina y el Caribe (ECLAC). Centro de Prensa. 07 May 2007. <<http://www.eclac.cl/cgi-bin/getProd.asp?xml=/prensa/noticias/comunicados/6/28506/P28506.xml&xsl=/preNSA/tpl/p6f.xsl&base=/prensa/tpl/top-bottom.xsl>>.
- 27 New Energy Finance, accessed 01 Oct. 2008.
- 28 Mesquita, Mauricio. "IRSA Economic Fundamentals." IADB. N.d. Aug. 2006.
- 29 Rozas Balbontín, Patricio. Powerpoint presentation. CEPAL. APEC 3rd Senior Officials' Meeting and Related Meetings: Seminar on Best Practices in Regulation and Promotion of Efficiency in Transport Infrastructure Facilities. Lima, Perú. 15–16 Aug. 2008.

