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# INCLUSIVE GREEN **GROWTH** in Latin America and the Caribbean

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**The findings, interpretations, and conclusions expressed in this report do not necessarily reflect the views of the Executive Directors of the World Bank or the governments they represent.**

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**1.**

**OVERVIEW**

**LATIN AMERICA AND  
THE CARIBBEAN AS A  
LEARNING LAB FOR  
INCLUSIVE GREEN  
GROWTH**



Amazon rainforest - Victor Soares ABr





**Since the last Rio Conference on Sustainable Development, the Latin America and Caribbean Region (LAC) has served as the world’s laboratory for inclusive green growth.**

- *From the lowest carbon energy matrix of the developing world to the first regional catastrophic risk insurance facility...*
- *From Payments for Environmental Services to the frontiers of sustainable cattle ranching...*
- *From community-driven slum upgrading to the world’s most extensive use of Bus Rapid Transit...*

These innovations are clean, efficient, resilient and socially inclusive—the elixir of inclusive green growth. For two decades, LAC has been a creative spark and a source of knowledge for the rest of the world on how to green a growing economy.

**Converting these sparks of innovation into mainstream policies and widespread practices is the challenge that lies ahead for the LAC region.** Green policies that support economic growth leverage clean technologies, efficient processes, and climate-resilient investments. For these policies and investments to endure over time they must benefit all of the region’s people. This means they must be inclusive, providing affordable access and services to all communities and segments of society. Moreover, complementary green policies and investments are needed on both sides of LAC’s growth ledger: consumption and production—namely, the consumption of infrastructure and urban services, and the productivity of rural areas.<sup>1</sup>

### **1.1 CONSUMING GREEN – LAC’S URBAN AND INFRASTRUCTURE SERVICES**

**Infrastructure and urban services are drivers of economic growth and define the quality of life for over 80 percent of LAC’s population.** They also contribute to pollution, through the emission of greenhouse gases (GHGs) as well as local particulates. Each sector of infrastructure and urban services has unique goals related to achieving inclusive green growth over the next 20 years. These are determined by such factors as the current performance and investment levels of the sector; its contributions to local pollution versus global emissions; and the availability and affordability of each sector’s services over time.

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<sup>1</sup> Although the production of infrastructure services generates negative externalities, we place the green agenda for infrastructure and urban services in the consumption basket because their production is driven by consumer demand.





The matrix below summarizes the main objectives for the key areas of urban development and infrastructure services as they relate to inclusive green growth.

**Urban and Infrastructure Services –Key Objectives for Inclusive Green Growth**

	Urban Development	Energy	Urban Transport	Water Supply & Sanitation
Clean	Expand urban services without increasing pollution & emissions	An affordable but low carbon composition of technology and fuel mix in generation capacity.	Manage demand for automobiles, and promote non-motorized modes that are low-emission.	Expand sanitation coverage and share of sewage that is treated.
Efficient	Redefine city design and shift incentives toward greater density.	Increase efficiency in production, supply and use of energy.	Strengthen public transport w/ financially sustainable networks & competitive services.	Manage water as a scarce natural resource, reducing water losses.
Resilient	Reduce vulnerability of urban assets and services to natural disasters and climate change impacts.	Increase system resilience, for instance by interconnecting systems to spread hydrological risk.	Engineer transit systems for greater resilience to natural disasters.	Increase resilience of water services to anticipate and respond to droughts and floods.
Inclusive	Expand household services to slums and poor communities.	Provide universal access at affordable prices.	Strengthen public transport to promote inclusion and access.	Provide universal urban household connections with regular availability & high quality service.

**In achieving these goals, LAC will confront a broad suite of green challenges in the arenas of urban development and infrastructure services, including:**

- One of the most urbanized regions in the world
- The fastest growing motorization rates in the world, at 4.5 percent per year
- High levels of sprawl caused, in particular, by the region’s secondary cities
- Increasing exposure of coastal cities to natural disasters
- An incomplete agenda of access to urban services, such as water, sanitation and solid waste
- A shifting energy matrix that will begin to move away from its hydro-power base over the next 20 years
- Habits of production and consumption which rely on subsidies, many of which are regressive.

**Embedded in those challenges is the recognition that current levels of infrastructure investment throughout the region are not sufficient to meet growth demands.** As the region moves to expand its commitment to urban service provision, the forms of technology, pricing structure for consumers and the institutional arrangements that define the operating efficiency

of the service providers will jointly determine how green and inclusive LAC’s infrastructure and urban services will be over the next 20 years.

## 1.2 PRODUCING GREEN – LAC’S NATURAL RESOURCES AND RURAL SERVICES

**The sustainability of LAC’s growth will depend upon its commitment to protecting and strengthening its unique natural assets.** The very advantages that LAC’s natural endowment provides—rich water resources, fertile land, and unparalleled biodiversity—are under threat from the spread of inefficient land use and deforestation, as well as fragile and changing water resources. The rural agenda is also closely bound to the challenges of social inclusion due to the region’s large indigenous population and the related fact that about half of the region’s poor live in rural areas.

The matrix below summarizes the main inclusive green growth objectives for LAC’s natural resources and rural services:

### Natural Resources and Rural Services –Key Objectives for Inclusive Green Growth

	Agriculture & Land Use	Water Resource Management	Rural Transport & Access to Markets
Clean	Green agriculture by reducing (and reversing) deforestation.	Expand the treatment of human, industrial, and agricultural contamination of water resources.	Reduce local environmental and social footprint, including the induced effects of transport infrastructure construction and operations.
Efficient	Adopt widespread efficient agriculture practices. Maintain trajectory of high output growth without expansion of the environmental footprint from production.	Adopt economic incentives to induce efficient allocation and use of resources.	Reduce GHG emissions by moving toward more efficient modes and practices of freight transport.
Resilient	Maintain productivity in the face of changing climatic conditions—while reducing GHG emissions.	Include climate impacts on hydrology in water resource pricing and planning.	Engineer transport assets according to changing requirements for resilience, particularly in flood prone areas.
Inclusive	Focus on smallholder competitiveness, including logistics/ access to markets.	Include local communities in water resource management decisions as well as Payment for Environmental Services schemes.	Include local communities in investment & operations decisions; and focus on expanded access—including transport services & logistics—for rural communities.

**The challenges that surround LAC’s natural resources and rural communities include, among others:**

- Continued encroachment on the Amazon, the world’s largest carbon sink and the source of moisture and hydrology for much of the region



- Increases in agricultural production in some areas that have come at the cost of environmental damage—such as deforestation and increased pollution
- Water resources made vulnerable by climate change and unsustainable use, and the impact on hydrology
- Rural communities that remain unconnected to basic services and removed from market access
- Regional dependence on trucks for the transportation of goods—including long-haul movements linking rural production centers to markets. Outside of Brazil, the road sector’s share of transport movements is over 90 percent.

**There is no single path to inclusive green growth for the LAC region.** There is no single set of market failures—such as the inability of markets to value the long-run costs of CO<sub>2</sub> emissions—that circumscribes the full range of the region’s challenges to environmental and social sustainability. Likewise, there is no single government failure—such as regulatory incapacity—that, if satisfied, would reverse all trends. It will take far more than one change of incentives, one transformational investment or technology, one type of regulation, or one behavioral change to improve the quality of life of all of LAC’s citizens while preserving its unique natural endowment.

**However, many of the answers lie within LAC’s experiences.** There are powerful—and in many cases locally grown—antidotes to these ailments. The policy levers and targeted investments that have been deployed across LAC to release economic growth, crowd-in the poorest and most vulnerable segments of society, and protect environmental assets address both infrastructure and urban services as well as and rural productivity and natural resources.

Below are some specific achievements and innovations in the greening of LAC’s urban development and infrastructure sectors since the last Rio Summit:

- *Recognition of the Need for a Compact and Efficient Urban Footprint:* Densification subsidies to attract people to the city center and revitalize stagnant urban economies are now being utilized in many cities in LAC, such as Mexico City, Lima, and Rio de Janeiro. The fuller use of fiscal and market-based tools—from dual tax rates to Tradable Development Rights—will help to expand and deepen the trend toward policy-driven densification.
- *Expansion of Basic Urban Services:* Between 2001 and 2008, an additional 63 million people in LAC were covered by solid waste services, increasing the coverage rate for collection from 81 to 93 percent. Although sewerage connectivity rates have just about kept up with population growth, pockets of the region have led the world in innovative approaches to water and sanitation service expansion and finance. Several secondary cities in Colombia have created mixed-capital companies (*empresas*



*mixtas*) that marry public financing with private sector efficiency, while large public utilities—such as Medellín’s multi-utility and São Paulo’s state water and sanitation company—have brought transparency to their finances and corporate rigor to their operations. Chile and Barbados have leveraged the resources of domestic and foreign pension funds in financing water supply and treatment.

- *Public Transport and the Alternatives to Automobiles:* As LAC undergoes rapid growth in automobile ownership—4.5 percent per year—it has also led the developing world in the conceptualization and implementation of alternative mass transit systems, particularly Bus Rapid Transit Systems (BRTs). From the world’s first BRT put in place in Curitiba, the concept has spread and matured throughout the region, to other urban centers of Brazil, to Bogota and Lima, then Mexico City, Santiago, and the secondary cities of Colombia and Mexico. When these systems are integrated into densification policies, housing and basic service expansion plans, and when they succeed in providing faster alternatives to driving, they serve to reduce congestion and emissions while improving a city’s competitiveness and vitality.
- *Expansion of Low Carbon Electricity Generation:* Electricity generation in LAC more than doubled between 1990 and 2009, growing at over 4 percent per year. And though the generation mix has evolved over these 20 years, hydroelectricity remains the most important source of baseload power with natural gas expanding steadily. The share of natural gas in the region increased from 10 percent in 1990 to 21 percent in 2009. With oil and diesel declining in importance, generation growth in LAC has thus had a lower carbon footprint than in other regions. With energy growth booming and dam-building becoming more complex and costly, the low emitting portions of LAC’s energy matrix will be under stress in the coming decades. Nonetheless, the region has demonstrated that it can introduce combined cycle gas plants, geothermal, micro-hydro, and even wind into its grids. It has built complex and successful auctioning systems for hydropower in Brazil and Peru to finance expansion of that baseload. With greater integration of grids, demand side management, and carefully priced incentives for renewables, LAC’s generation mix may yet continue to lead the world in the low carbon production of electricity.

LAC’s rural access and resource management areas have benefitted from green innovations and inclusive approaches that may be expanded in the years to come:

- *The Greening of Transport Networks and Rural Access:* As LAC has grown as a trading region over the last 20 years, several governments have struggled to confront the environmental and social pressures from expanding transport networks. The region has innovated in several areas that may yet curb the unbridled growth of road traffic, pollution, and induced impacts on land use and vulnerable communities—both through the multi-modal movement of freight and greener road transport systems.



Argentina has expanded the use of its portion of the Paraná-Paraguay waterways system for the transportation of soy and other bulk commodities through an innovative tolling system that self-finances the dredging and maintenance of the rivers. Brazil, in turn, is pursuing a “green trucking” strategy to improve efficiency of its cargo haulage industry, reduce petroleum usage, and curb pollution from trucking. For the entire hemisphere, the expansion of the Panama Canal will bring post-Panamax vessels and introduce greater scale economies in shipping. This will lead to pressure for increased efficiency in in-land transport networks so that fewer hub ports can compete for the larger vessels. Outside of Brazil, approximately 90 percent of the region’s freight is hauled over roads, measured in Ton-kilometers. Addressing this imbalance by growing rail, coastal shipping and waterway movements will be a key ingredient in the sustainable future of LAC’s transport system.

- *Effective Management of Water Resources:* Rio 1992 affirmed that top-down management of water resources had proven ineffective and should give way to a participatory approach, involving users, planners, and policy makers at all levels. This water governance agenda has been embraced by many LAC countries and helped them improve their institutional and legal frameworks for water management—notably by developing river-basin management approaches with significant stakeholder participation. In addition, the adoption of economic incentives to induce more efficient allocation and use has become more prevalent and LAC countries have led the way in developing such new instruments as payments for environmental services. Users of water resources, such as Buenos Aires and Bogota, are now investing heavily—in the order of \$12 billion—to clean up their river basins by financing infrastructure, working with industries to become cleaner, and developing new management approaches.
- *Extending LAC’s Successes with Sustainable Agriculture:* The most important pillar of a strategy to reduce the environmental footprint of LAC’s agriculture has been the preservation of existing forest cover and the encouragement of reforestation with native species where feasible. LAC has led the way in using direct payments for forest conservation, with national programs in place in several countries and Brazilian states. Costa Rica led the way in 1997, establishing its *Pago por Servicios Ambientales* (PSA) program, which pays land users to conserve existing forest in priority areas or reforest their land. Substantial progress on this is critical for lowering the trajectory of emissions, conserving biodiversity, and reducing erosion. Success will depend largely on discouraging unsustainable livestock production, eliminating harmful policies, implementing forest protection policies such as protected areas, and supporting projects to encourage protection such as payments for environmental services.

**The following sections of this paper provide a more detailed review of the sectoral objectives, challenges, and way forward in making LAC’s growth greener and more inclusive.** It looks back over the achievements of the demand sectors of urban development and infrastructure services—energy, urban transport, and water and sanitation—as well as natural resources and rural development since Rio 1992. It highlights the achievements in those areas, and the ability of those accomplishments to establish a robust path for the region to inclusive green growth.









**2.**

**INCLUSIVE GREEN  
GROWTH**

**URBAN AND  
INFRASTRUCTURE  
SERVICES**







Infrastructure and urban services are drivers of economic growth and define the quality of life for over 80 percent of LAC's population. These services also contribute to pollution, through the emission of GHGs as well as local particulates. Each sector of infrastructure and urban services has unique goals related to achieving inclusive green growth over the next 20 years. These are determined by such factors as the current performance and investment levels of the sector; its contributions to local pollution versus global emissions; and the availability and affordability of each sector's services over time.

The following sections explore, using a sector by sector approach, (i) inclusive green growth objectives, (ii) progress since Rio 1992, (iii) opportunities and constraints on the path to inclusive green growth, and (iv) a way forward. Section 2.1 reviews cities in LAC's evolution, and the green dimensions of urban planning. The next three sections look at aspects of consumption in more detail: Section 2.2 reviews the energy sector, Section 2.3 looks at urban water and sanitation services, and Section 2.4 considers urban transport.

## 2.1 LAC'S URBAN EVOLUTION

LAC is one of the most urbanized regions in the world. As of 2008, 81 percent of the population lived in urban centers and the percentage is expected to rise further as the less urbanized Central American countries catch up with the rest of the region. Rapid urbanization, coupled with the financial crises of the 1980s and 1990s, hampered the capacity to provide infrastructure and services to the growing urban population. This resulted in a lack of serviced land and affordable shelter, and inequality in income and access to basic urban infrastructure. These conditions were made worse by urban sprawl, pollution, and vulnerability to natural disasters.

The region's expected growth and the continuing trends toward sprawl bring new challenges to urban planning in LAC. A green urban strategy's key elements in LAC must be based on: (i) compact cities to reduce emissions and ecological footprints, (ii) good management to improve resource efficiency, and (iii) solid plans to understand and prepare for the potential outcomes associated with natural hazards as well as the expected negative consequences of climate change.

### Green objectives

Green growth for LAC cities means clean, efficient, resilient, and inclusive growth. To achieve this:

- Urban infrastructure needs to expand to accommodate the expected urban growth with far less pollution and greenhouse gas (GHG) emissions, more efficient natural resource use, and reduced urban vulnerability to natural disasters and climate change.



- Strategies for promoting growth must include elements of city shape and density/compactness, efficiency of the urban sectors—buildings, energy (see Section 2.2), water and sanitation (see Section 2.3), waste management—and comprehensive long-term planning.

## Progress in the last two decades

There has been considerable progress in LAC in terms of innovative and participatory solutions for green city management. Many of these achievements, however, are highly variable across countries and have not reached low-income populations.

Over the last 10 years, solid waste management in LAC has improved markedly. Between 2001 and 2008, an additional 63 million people were covered by solid waste services, increasing the coverage rate for collection from 81 to 93 percent.<sup>2</sup> Despite promising gains, however, more than half of the solid waste is inadequately disposed in rivers and waterways (this is discussed in more detail in Section 2.3 and Section 3.2).<sup>3</sup>

Recycling is still limited and remains an important opportunity. Less than three percent of solid waste generated in LAC cities is separated at the source and recycled.<sup>4</sup> This situation is improving in some cities; for instance, in Mexico City and Santiago, 10 and 11 percent, respectively, of waste is reportedly recycled.

The region has substantially increased its population's access to potable water and sanitation. On sanitation, most of LAC's urban population is served but wastewater treatment remains a major issue. On average, less than half of the wastewater is treated, and that rate is lower in many cities (these issues are discussed in more detail in Section 2.3). Failure to treat wastewater can be especially problematic owing to the health problems that can occur. Water services are embedded in the urban fabric and should be integrated into urban planning. Spatial development patterns have an important influence on water services. The density of development determines the extent of water distribution and collection networks; cities characterized by high levels of sprawl require more kilometers of pipe and generally higher pumping costs, affecting investment and operating costs. The extent to which rainwater can naturally infiltrate into the soil, or be temporally stored in natural basins such as ponds or wetland, determines the requirements for drainage pipes and pumping stations. Cities that preserve open spaces and/or take measures to temporarily store storm water peak flows can significantly reduce storm water management costs. At the same time,

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2 IDB (2011). *Relatorio da Avaliacao Regional ad Gestao de Residuos Solidos Urbanos na America Latina e Caribe*, 2010

3 Sustainable Cities of the XXI, Initiative: IDB Special Program. Washington: IDB, Inter-American Development Bank (IDB), 2010.

4 Op Cit (2011).

they can weave water into the urban fabric by making water bodies part of the urban landscape. Often, however, too little consideration is given to water issues in urban planning, leaving water utilities to simply respond to urban dynamics rather than proactively influence development to enhance inclusive green growth.

Many Latin American cities have successfully set up extensive public transport systems, notably the rapid bus transport systems. However, little success seems to have been achieved in terms of behavioral changes and use of private car transportation (this is discussed in more detail in Section 2.4).

The prevalence of informality and sprawl is a challenge and ubiquitous feature of most LAC cities and makes plans for preserving green space difficult. Most cities show provisions to protect green spaces but these policies are not always successful as the demand for low income housing leads to encroachment into marginal lands.

With more than half of LAC's large cities in low coastal zones, the vulnerability to floods is quite severe. Few cities have included planning to adapt to imminent disasters.

## Opportunities and constraints

LAC is well positioned to lead inclusive green growth initiatives in the urban sphere and has been the laboratory of many of urban innovations in the last decades.

LAC has the opportunity to use several market based tools for compact and mixed development and to promote land-use regulation for limiting urban sprawl and protecting green spaces including: transferable development rights (TDRs), additional transferable rights (ADRs), dual tax rates, and other instruments that encourage densification in urban areas and avoid the encroachment of urban development in rural areas or sprawl of urban development. Densification subsidies to attract people to the city center and revitalize a dead town are common in many cities in Latin America (for instance, Mexico City, Lima, and Rio de Janeiro).

In Brazil, urban agglomerations experiencing the highest population growths as of 2000 also registered higher levels of sprawl (see Figure 1). This presents an opportunity for small and medium-sized urban areas in Brazil to avoid replicating the growth patterns of larger cities. They can instead structure their urban development policies in an integrated manner to optimize the provision of infrastructure services, reducing their ecological footprint and vulnerability.<sup>5</sup>

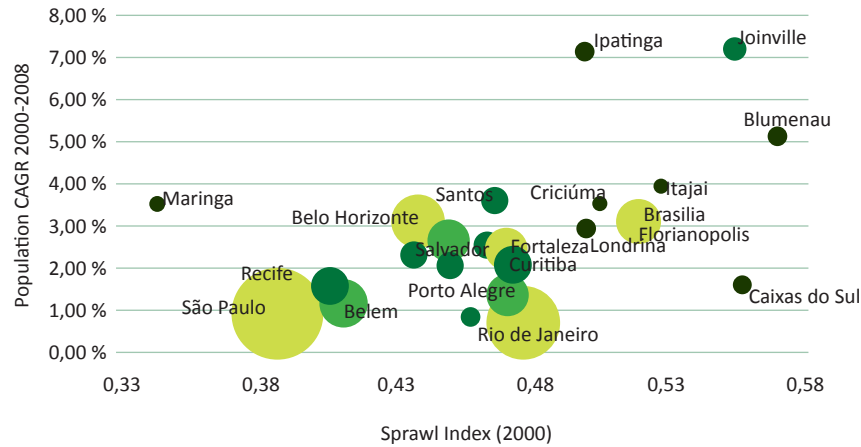
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5 Medium-sized cities have grown rapidly, particularly during the 1980s when their rate of growth was higher than the rate for the major cities, as well as that for the urban population as a whole. In the 1990s, a number of these cities began to encounter some of the same types of problems that LAC's larger cities had been dealing with, such as problems related to the development of infrastructure and the delivery of municipal services.





**Figure 1: Brazil: Urban Sprawl Is Greater in Rapidly Growing Cities**



Source: Adapted from Ojima, A. and Hogan D (2009).<sup>6</sup>

LAC leads in transit-oriented development to reduce congestion and pollution. Some notable examples are the bus rapid transit systems (BRTs) in Curitiba, Santiago, Bogota, São Paulo and many others (see Section 2.4 for more details). Designed in the late 1960s to early 70s, the Curitiba plan integrates land use and transport using a mix of incentives and controls applied to land-use planning.

In most LAC metropolises, local or federal governments, as well as the private sector, recognize the potential of revitalizing inner urban areas. Three principal approaches have been used to recycle existing built-in areas according to their original use and new land-use possibilities: (i) creating new recreation and cultural attractions, (ii) regenerating existing residential areas, and (iii) brown-field development.

To increase resilience to climate change, LAC cities need to mainstream climate change and disaster-risk management into urban development planning, and prepare action plans for adapting to climate change. Public and private awareness and strategies have improved significantly, as has the use of early warning systems. Countries have begun to build the analytical capacity to predict or forecast an event’s probability, take preparatory measures in case of accidents, and strengthen insurance mechanisms to respond quickly to the aftermath. Regional coordination for disaster-risk management has also advanced to promote information and experience sharing across vulnerable

6 In chapter “Urban Sprawl and Environmental Risks in Brazilian Urban Agglomerations: Challenges for Sustainability”, in de Sherbiniin, A., A. Rahman, A. Barbieri, J.C. Fotso, and Y. Zhu (eds.). 2009. *Urban Population-Environment Dynamics in the Developing World: Case Studies and Lessons Learned*. Paris: Committee for International Cooperation in National Research in Demography (CICRED).

countries. For example, Mexico and Cuba are implementing a three-year regional project on climate change adaptation. Coordination is also improving at the city level. Perhaps most significant, LAC has pioneered the use of innovative insurance instruments such as Catastrophe Bonds.

Given the large number of households living in informal settlements in LAC cities, social programs are needed to better integrate these settlements while avoiding new slum generation. The road toward an inclusive city necessarily involves higher integration of informal settlements into the urban fabric. In the past decade, a number of successful programs—based on holistic approaches to slum upgrading—have emerged. In Medellin, for example, urban integral projects were introduced in the densest and poorest neighborhoods of the city. This new generation of slum upgrading projects has incorporated institutional and community participation components in new infrastructure and public-space investments to achieve greater ownership and generate a sense of belonging.

## Way forward

Motivating cities to adopt cleaner, more efficient, more resilient, and more inclusive urban development requires a holistic view of the urban ecosystem. Considering possible synergies between sectors is critical for managing resources more efficiently. But it also involves a higher level of horizontal coordination (for instance, between transport and planning secretaries) and vertical coordination (for instance, between national and sub-national housing agencies).

One challenging aspect of urban management in LAC cities involves the allocation of responsibilities for service provision at the local level. Clarification of roles and coordination between relevant actors is essential to ensure adequate and efficient management of the cities.

Cities must reduce their vulnerability to natural disaster and climate change, particularly in fragile informal settlements. This will require a shift from an emergency response policy to a disaster risk management approach.

Of course, developing urban infrastructure requires financing, and this is a challenge (especially for small and medium-size cities). While public private partnerships (PPPs) are increasingly welcome in most LAC cities, transfers and grants from higher levels of government will continue to be needed to finance the new urban infrastructure that is required.

## 2.2 ENERGY

Developing the energy sector is critical for the LAC region's economic growth in coming decades. Economic and social development in the region since Rio 1992 has been supported by widespread electrification that has greatly increased the provision of electricity services to households,



commerce, and industry. Over the next 20 years, the electric power supply will need to expand to meet growing demands. But how the production and use of electricity develops will have broad ramifications for the diverse economies of the region. The challenge is to satisfy the considerable energy needs in a clean, efficient, resilient and inclusive manner.

## Green objectives

The energy sector must be efficient at the minimally feasible economic cost and must avoid the waste of resources. It must be inclusive to provide universal access and sustainable to meet energy needs with minimal harm to the environment. Lastly, it must be resilient to climatic, economic, and technological challenges. The key issues in the coming years will be the appropriate balance in the composition of the technology and the fuel mix of the generation capacity.

## Progress in the last two decades

Electricity generation in LAC has grown steadily over the last two decades, with output more than doubling between 1990 and 2009. That is equivalent to an average annual growth of four percent. The electrical generation mix has evolved over these 20 years, with oil (diesel and fuel oil) and hydroelectricity contributing less (but with hydroelectricity remaining the most important source) and natural gas contributing more. But with its vast endowment of hydropower, generation growth has had a lower carbon footprint than in other regions. The share of natural gas in the region increased from 10 percent in 1990 to 21 percent in 2009. The countries with the highest share of natural gas in the generation mix are Trinidad and Tobago (99 percent), Bolivia (58 percent), Mexico (53 percent), and Argentina (51 percent). The share of electricity production from nuclear power and coal has historically been low and has remained steady since 1990.

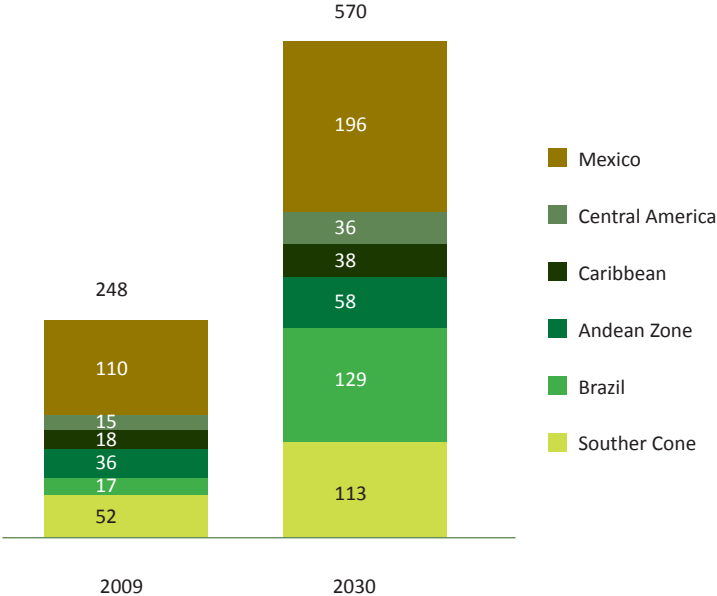
## Opportunities and constraints

The region's demand for electricity will almost double in the next two decades. The key issues in the coming years will be the appropriate balance in the composition of the technology and in the fuel mix of the generation capacity. Composition should be diversified to promote energy security and lessen the environmental impact. Some of the instruments available to diversify the energy matrix and cut global emissions are: greater use of hydropower, natural gas, and non-hydroelectric-renewable resources; more regional energy integration (for both electricity and gas); and specific efficiency improvements on the supply and demand sides. Additionally, many LAC countries need more dynamic participation of both the public and private sectors and reforms to the regulatory, contracting, and licensing processes.

Fortunately, the LAC region already has the least carbon-intensive electricity sector of any region in the world. This is a consequence of the high share of hydroelectricity, particularly in Brazil, Colombia, Paraguay, and Venezuela. However, the carbon intensity of the power sector has been rising owing to the increasing share of fossil fuels (including natural gas), and this trend is expected to continue.

According to a World Bank report, under moderate economic growth scenarios, CO2 emissions from electricity generation in LAC would more than double between 2009 and 2030 as a result of a decline in the share of hydroelectricity and an increase in fossil fuels, driven by natural gas. As show in Figure 2, such a supply scenario shows that, in 2009, about 260 million metric tons of CO2 were emitted into the atmosphere and by 2030, emissions would reach nearly 570 million metric tons of CO2.

**Figure 2: Scenario CO2 Emissions, Latin America and the Caribbean**



Source: Yopez, A. Johnson, T. and Andres, L.A. (2011), "Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean", World Bank, *Directions in Development*.

To lower the expected emission trajectory other cleaner sources of energy must be optimized. After hydro, wind appears to be the renewable energy resource with the largest potential. Solar electricity generation—mainly concentrated solar thermal power—will require breakthroughs to reduce costs if it is to contribute significantly in the next 20 years to grid-supplied electricity in LAC. Biomass, particularly residues from the sugar industry, provides a significant amount of electricity in Brazil but its future role and potential requires greater investigation in terms of identifying suitable and economically feasible locations and processes.





Interregional trade would allow countries to diversify their sources of power generation and enjoy the gains from trade associated with specialization from the most efficient producers. Moreover, a regional approach could reduce GHG emissions as a result of a larger share of renewables in the regional generation mix. Enhancing regional integration will require overcoming institutional, political, and legal constraints; a key requirement for more regional integration is a regulatory and institutional framework that allows contract enforcement.

Of all the options for meeting future electricity supply, energy-efficiency measures are almost always the least expensive. Supply-side interventions address inefficiencies, power losses as well as national energy-efficiency resource standards (utility energy-saving targets); energy codes for new buildings; appliance standards; programs to promote comprehensive energy retrofits to existing buildings; and energy-efficiency labeling. Reducing subsidies on fossil fuels remains a high priority and can unleash multiple benefits—economic, environmental, and social if accompanied by better targeted transfers.

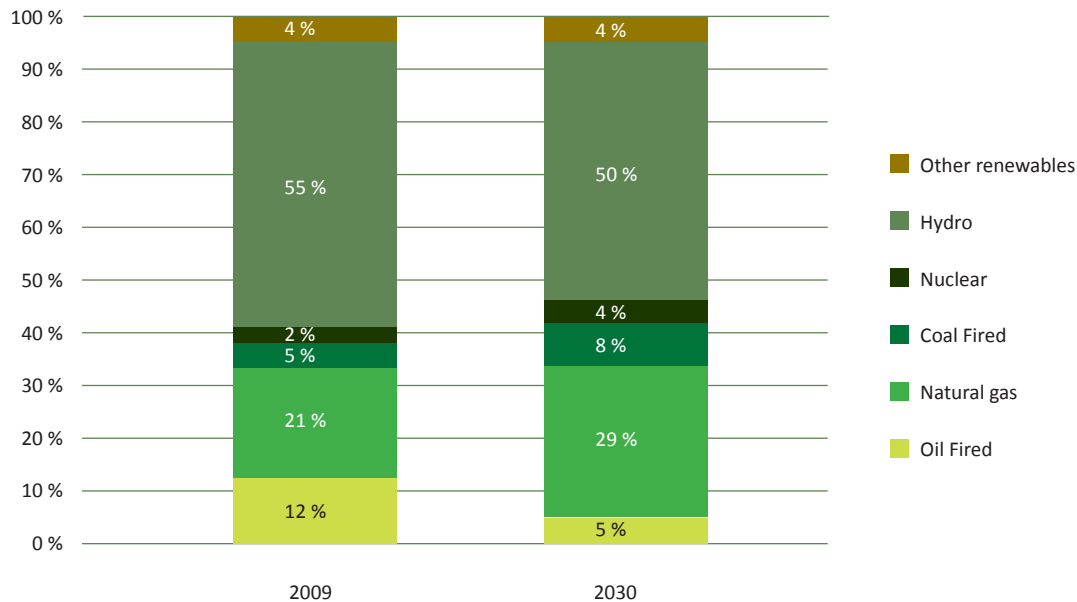
LAC has relatively high electricity access rates compared to other developing regions. For example, Africa’s average electricity access rate is 40 percent and the global average is 78 percent, but LAC’s access rate was 93 percent in 2008. There are, however, large disparities in access rates both between and within countries. Even in countries with high overall access rates, there can be a startling disparity between urban and rural access rates. Grid extension is the natural way to spread access in countries with a developed electricity transmission network. But for countries with limited power infrastructures, and for isolated communities, solar photovoltaic systems, together with micro-hydro and wind, can play important roles in providing least-cost electricity access.

## The way forward

Energy security—in the context of diversification of the generation technology mix and environmental sustainability—demands an assessment of future trends in the role of natural gas, hydropower, and other clean and low-carbon electricity supplies relative to petroleum and coal. It also requires assessing what policies and regulatory regimes would help promote low-carbon development.

Under a baseline scenario for the region for 2030, most new generating capacity would be met by hydropower and natural gas (see Figure 3). To tap the region’s extensive hydro resources, most countries will need to change their regulatory policies to enable such investments under a more stringent financial scenario and also tough environmental and social constraints. A large increase in the use of natural-gas power generation is also planned for years to come. Realizing the expansion of natural-gas-fired generating capacity will require more regional cooperation in building pipelines and negotiating bilateral gas contracts since natural gas resources are not evenly distributed throughout the region.

**Figure 3: Region-Wide Electricity Generation Mix, 2009–2030**



Source: Yepez, A. Johnson, T. and Andres, L.A. (2011), “Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean”, World Bank, *Directions in Development*.

Some alternatives could reduce the amount of new thermal-generating capacity needed in LAC over the next 20 years. Perhaps more important, these alternatives can help produce a more diversified and stable power sector, and many options have lower costs than traditional power-generation solutions.

On the fiscal side, subsidies will have to be cut to allow electricity tariffs to reflect the true market value of electricity. This would contribute on all fronts as fiscal resources can be better channeled to other social needs while the required generation capacity and CO<sub>2</sub> emissions would be less.

Disparities in access rates are great both between and within countries, especially in electricity access. Prospects for higher penetration rates hinge on the extent of individual LAC countries’ transmission capacity. Thus a major challenge is to find ways to promote universal access using clean, efficient, and resilient technologies—that is, how to be green and inclusive.

To meet the investment requirements (including the increase in hydro- and natural-gas-generated power) many LAC countries will need more dynamic private sector participation, to attract the requirement investment, as well as reforms to the regulatory framework and to contracting, and licensing processes.



## 2.3 WATER AND SANITATION SERVICES

Although about 85 percent of the LAC urban population is connected to a water system, the quality of service provided by many water utilities in terms of continuity, pressure, and water quality is relatively poor and most water utilities struggle with financial sustainability. Wastewater management and environmental degradation in LAC is also widespread, with less than half of wastewater properly treated and disposed. This in turn results in widespread degradation of rivers, lakes, and coastal zones and has health impacts (discussed in more detail in Section 3.2). Finally, owing to overall income inequality in LAC, certain populations, particularly in rural and peri-urban slum areas, continue to lack access to adequate water and sanitation.

LAC's generally solid and sustained economic growth offers the opportunity to invest in environmental improvement—particularly wastewater collection and treatment—and in more effective urban flood control and drainage defenses. Moreover, the goals of a healthy water supply and good sanitation are achievable for most LAC countries within a generation—if they make the right decisions on institutional reforms and investments now.

### Green objectives

Water supply and sanitation, and protection of waterways, are integral parts of the inclusive green growth agenda in LAC given their importance for human health, economic development, and environmental sustainability. The key green goals are:

- Efficient and inclusive water services delivered at reasonable rates for everyone.
- Clean and environmentally sound water services that manage water as a scarce natural resource and incorporate water into the urban fabric.
- Resilient water services that can anticipate and respond to droughts and floods without significantly compromising service quality.

To achieve the goals of efficient, inclusive, clean, and resilient water services, LAC governments must sustain and deepen their institutional reform agendas for the water sector and forge stronger links with environmental, water resource, and urban management efforts.

### Progress in the last two decades

LAC has made good progress since Rio 1992 in improving service coverage but those rates have stopped climbing in recent years and much remains to be done to boost efficiency and inclusiveness. Achieving the objectives of clean and resilient water services has just begun in most LAC countries and is intimately linked with the overall efficiency of water services.

Many countries in LAC have experimented with water sector reforms since the mid-1990s, including separating policy-making, regulatory, and service functions, as well as decentralizing services and forming PPPs. In most countries, however, the reform agenda is unfinished and not yet consolidated; governments must continue to experiment and reform to achieve a truly sustainable sector.

## Opportunities and constraints

Despite LAC's progress since Rio 1992, major problems remain. One of the 2015 Millennium Development Goals (MDGs) is to reduce by half the gap in basic water and sanitation coverage. The overall levels of access to improved water supply and sanitation in the region are encouraging, especially given the rapid urbanization and economic shocks of the last two decades. Nevertheless, about 32 million people (mainly in rural areas) lack access to safe water; some 123 million people lack access to sanitation; less than half of urban wastewater is currently treated; and many water utilities provide low levels of service (in terms of continuity, pressure, and water quality), and are struggling financially.

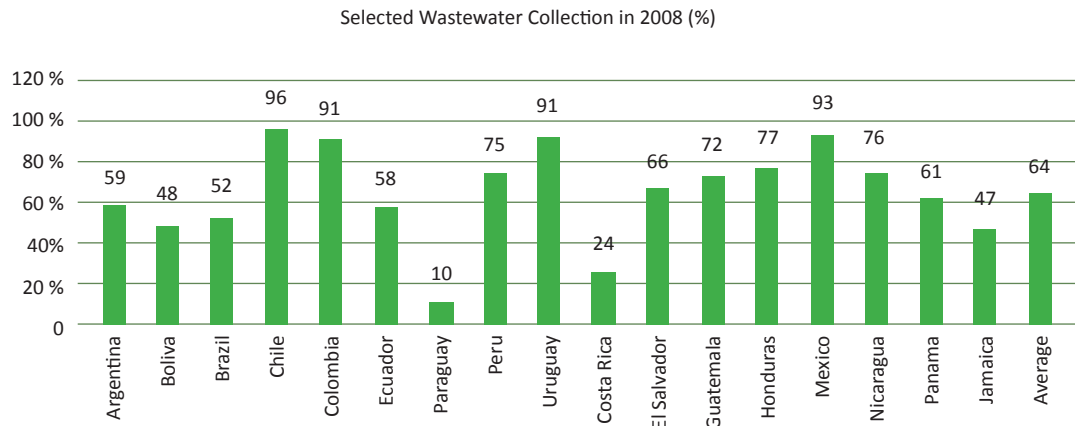
The low levels of service typically result from a combination of inefficient water utilities and inadequate investments. Although the LAC region has some world-class water utilities, most are under-performing in operational and financial terms (for instance, non-revenue water, collection ratios, operating ratios, and profitability). The causes vary from cases to case, but most LAC countries are still in the process of reforming their water sectors and crafting the right policies on tariffs, regulation, industry structure, financial arrangements and the distribution of subsidies.

The widespread pollution of natural water bodies has had a severe ecological impact in the region. The LAC countries currently “collect” and treat less than half their wastewater. Collection, treatment, and disposal of wastewater, and accompanying bio-solids, are expensive and most LAC countries have yet to address them (see Figure 4). Most have not yet fully invested in wastewater collection networks and actual treatment levels are below 50 percent, except in Chile and Uruguay.





**Figure 4: Wastewater Collection in Latin America and the Caribbean**



Source: ABDIB-Position paper for 2012 World Water Forum

Wastewater management is the next decade’s challenge for the region’s middle-income countries. Almost every middle-income country has ambitious and costly programs to rapidly expand wastewater collection and treatment. Most of the mega-cities of the region have already initiated wastewater programs and are expanding collection systems and building new treatment plants.

The higher incidence of floods and droughts in the last few decades—and evidence increasingly suggesting that climate patterns in the region are becoming more extreme—threatens the reliability of water services. Dealing with water scarcity and drought is now an imperative in most LAC cities. Fortunately, a new array of tools to deal with scarcity issues is emerging and becoming more economically viable. These tools range from standard conservation measures to developing new alternative sources such as desalination, reclaimed water, and rainwater harvesting, but implementing these requires additional resources.

The general thrust of reforms since Rio 1992 has been on separating policy-making, regulatory, and service entities, and ensuring that each entity has adequate capacity and authority to undertake its tasks. This reform agenda remains unfinished. Ultimately, the effectiveness of sector policies—such as investment subsidies and tariffs, regulations, and environmental standards—can be judged by whether water services are provided efficiently and inclusively, which is still not the case for many LAC countries. Key reforms in some of the larger countries illustrate the variety of experiences:

- **Argentina’s** experience with privatizing water services was unsuccessful, and it returned to a public-service delivery model. In the 1990s, as part of a broader national privatization policy, many cities (notably Buenos Aires) signed long-term concession contracts and, by the early 2000s, around 70 percent of the urban population

received services from a private water company. Following the economic crisis of the early 2000s, nearly all the major concession contracts collapsed and service is now provided primarily by public companies.

- **Brazil's** water sector is characterized by large state-wide water companies and with accelerating use of PPPs. Responsibility for sector policy and water resource management are handled by different agencies, and in 1998, responsibility for water services was devolved from the state to municipalities. There are now 27 state water companies and about 580 municipal water utilities. In addition, there are 14 state regulatory agencies, whose authority and capacity vary considerably. An increasing number of public water companies are entering into PPPs, particularly to provide wastewater services requiring large investments.
- **Chile** is unique in the region in managing to create a strong policy and regulatory context that has enabled private companies to take over service responsibility. The key to Chile's early success was creating a functioning policy and regulatory framework that emphasized self-financing, accountability, and government support when needed. Chile also has a well-targeted and structured tariff policy for low-income households, which does not undermine the financial stability of the water utility. The introduction of the private sector after 1998 helped attract new waves of investment to finance wastewater treatment and upgrade water and sewerage infrastructure. Chile's industry structure is characterized by relatively large regional companies, which are able to provide economies of scale and simplify regulation.
- **Colombia**, like Chile, created strong regulatory agencies to oversee the sector for economic regulation. National sector policy and planning is provided by the housing ministry. Since 1992, water services have been decentralized to the 1,119 municipalities, and in 1994 a public service law required municipalities to use specialized water operators, including private companies. The result has been a wide range of institutional models, including public water companies in Bogota, Medellin, and Cali and concession contracts with mixed public-private ownership in Cartagena and Barranquilla. Colombia also has a unique tiered water tariff system whereby upper-income households pay more for water services, and thereby cross-subsidize lower-income households. Although this works well in some cities, in many of the smaller and poorer ones cross-subsidies are insufficient and municipal governments are unable or unwilling to provide the necessary subsidies to water companies.

These brief country profiles highlight the richness of experience in the region and the diversity of approaches. Nevertheless, future reform efforts will require:



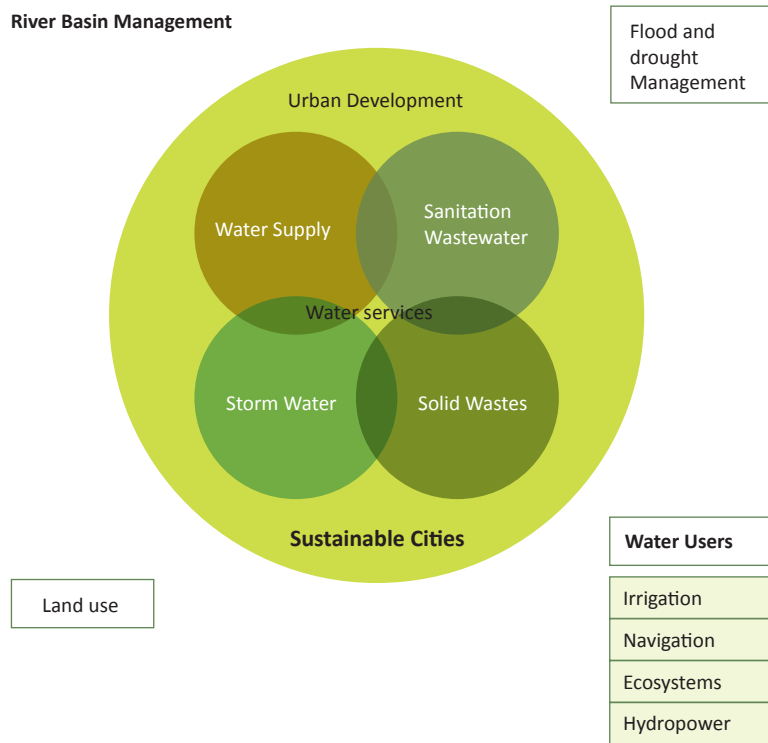
- **Policy commitment**—Governments must be committed to ensuring the appropriate mix of policies to ensure adequate levels of investment and service quality, and to constantly adjusting the policy matrix as needed.
- **Industry structure and decentralization**—Since Rio 1992, there has been a region-wide movement towards decentralizing services, typically through constitutional reform. It has often deprived many water companies of sufficient economies of scale to drive down prices and cross-subsidize users. Decentralization also complicated water service regulation as specialized agencies typically cannot provide enough attention to small municipalities.
- **Cost recovery**—the three primary source of funds for water services—tariffs, taxes, and transfers—must be sufficient to cover actual costs or water services cannot be sustainable over the long term. Efficient water utilities can reduce costs by making smart investment decisions and cutting operational expenses; likewise, an efficient water utility with a strong and stable cash flow can attract lower-cost financing.

While privatization was the rallying cry of sector reforms in the 1990s, experience has been less than satisfying—with only Chile fully adopting a functioning system based on private companies. In the rest of the region, countries have had a wide range of generally successful or emerging experiences with PPPs. The rationale and selection of an appropriate PPP option will vary depending on the specific context. But some of the more common objectives are: higher levels of management expertise to improve efficiency; more transparency and consistency in service delivery; and, where appropriate, equity or debt financing to facilitate investment.

## The way forward

Water supply, sanitation, and urban drainage are but one component of a broader hydrological and institutional environment. The concept of integrated urban water management has been coined to help capture a city's relationship with the broader water resource context, but in close connection with urban development dynamics and the city's urban water services. The approach (Figure 5) and its successful adoption will be central to achieving the green growth goals of clean, efficient, inclusive, and resilient water services. The World Bank has an "Integrated Urban Water Management" initiative that works with LAC cities to identify and share good practice.

**Figure 5: Concept of Integrated Urban Water Management**



Source: World Bank

The quality of a city’s water services hinges on the broader water resource management framework: urban water supply typically constitutes 20–30 percent of a country’s water usage, and water resource allocations and rights are fundamental to ensuring a reliable source of water. Flooding at the regional level often has a profound impact on urban drainage. Drainage of storm water in urban areas can be hindered by high water levels in receiving rivers; similarly, rivers can overtop or burst through flood control embankments and cause urban flooding. Typically, regional or national water resource management agencies are responsible for allocating water uses and for regional hydraulic infrastructure, river management, and integrated water management.

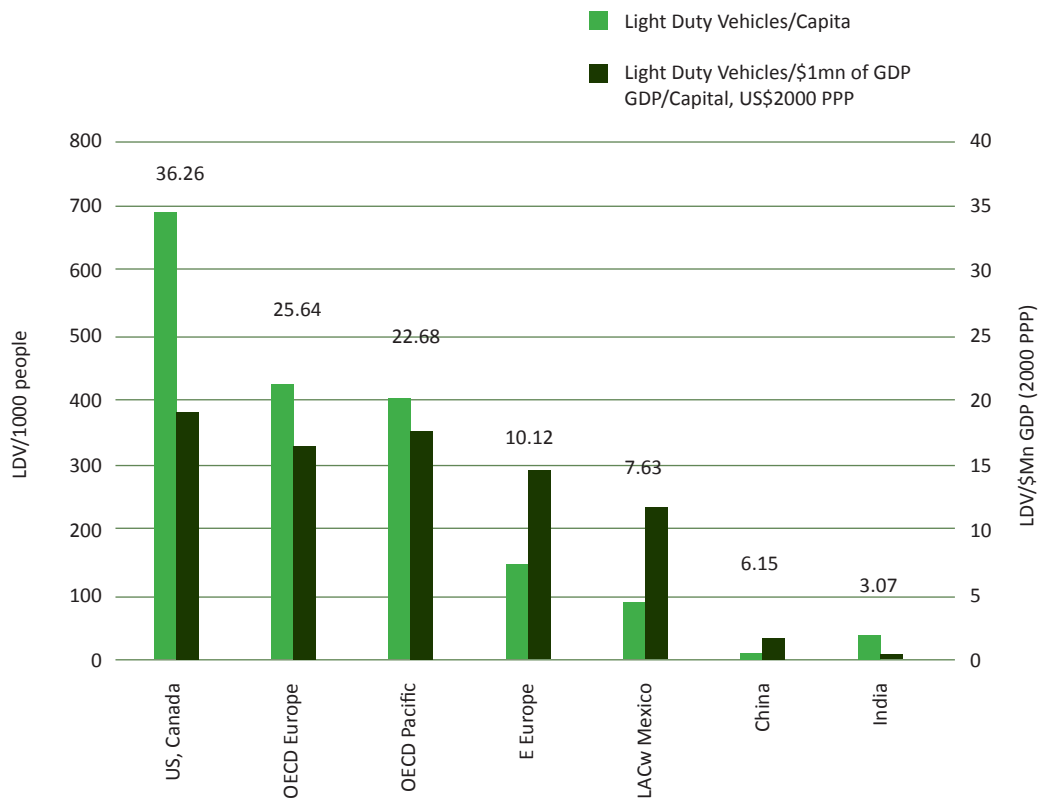
Water utilities and their municipal governments must coordinate with water resource and environmental management institutions, and be active participants in policy making, to ensure that their interests are protected and water is managed in a sustainable manner. However, as discussed in more detail in Section 3.2, many of the water and environmental management regimes in LAC suffer multiple shortcomings and are still evolving.



## 2.4 URBAN TRANSPORT

Increasing demand for urban passenger and freight transport—resulting from rapid economic growth and rising urban populations—is straining the transport systems of cities in the region. On the one hand, severe overcrowding in overstretched public transport networks makes trips less reliable and comfortable. On the other hand, rising incomes are expanding the vehicle feet and the growing number of private vehicles imposes a disproportionately higher cost on society. As Figure 6 shows, LAC already has amongst the highest motorization rates of outside the OECD. Latin America had a per capita ownership of light duty vehicles of 86 vehicles per 1,000 people—mostly private cars, SUVs, and light trucks.<sup>7</sup> Even though China and India have much larger populations, the per capita auto ownership is very low and even the absolute numbers of LDVs in those two giants are still well below the number in LAC.

**Figure 6: Light Duty Vehicle Ownership vs. Income and Population, 2005**



Source: IEA MoMo Database (IEA, personal communication, 2009).

Notes: 10-20 percent of these light duty vehicles are commercial vans or pickups. GDP/Capita in USD \$1,000 (2000 PPP) shown above each region.

<sup>7</sup> LAC has high auto ownership in comparison to the Middle East and Africa, not shown in the table, although some oil rich nations in both regions have higher car ownership.



How LAC transport systems evolve will play a critical role in defining the economic and environmental future of its cities. Fortunately, there is a convergence among the agendas of the transport system's financial, economic, environmental, and social sustainability—an economically efficient urban transport system will also most likely be clean, efficient, and resilient.

## Green objectives

The green objectives for transport are to:

- Manage the challenge of auto demand, which not only threatens to overwhelm cities with congestion but imposes a major environmental impact in terms of carbon and local emissions, safety, and impact on public space.
- Strengthen public transport by creating financially-sustainable networks that offer competitive service quality while minimizing the social and environmental footprint of public transport.
- Promote and support non-motorized modes, which provide a life-line to the poor and are also truly zero-emission.

## Progress in last two decades

LAC has led the developing world in adopting innovative modern practices to address its transport challenge; improvements in the quality of public transport supply over the last two decades have been transformational.

The greatest gains have come from developing bus rapid transit (BRT) systems. These systems have mainstreamed bus-based mass transit by offering high capacity and high service at relatively low costs. In the process, they have also transformed the business model underlying public transport operations in the region—yielding substantial safety and environmental benefits. Although Curitiba in Brazil has operated a BRT system since the 1970s, the concept gained popularity quickly after the successful deployment of the TransMilenio system in Bogota in the mid-1990s. Today the Bogota system carries 1.7 million passengers a day with a capacity that compares favorably with the high-density rail markets in the world and with speeds that compare favorably with rail.

The success of TranMilenio, and a similar system in Quito soon after, led to an explosion of BRT systems, initially across LAC and increasingly globally. The World Bank has supported BRT programs in Colombia, Mexico, and Peru, and systems have been (or are being) developed in Argentina, Brazil, Ecuador, Guatemala, and Uruguay. While the manner in which the BRT concept has been adapted in local contexts has met with varying degrees of success, BRT has been the most



important innovation in public transport developed, perfected, and mainstreamed in LAC over the last two decades.

Important advances have also been made in deploying rail-based systems, particularly in the largest metropolitan regions of Brazil. Both Rio and São Paulo have transformed century-old suburban rail services into modern high-capacity systems with metro-like frequency and capacity. Both metropolitan areas are also building extensive metro rail systems, using PPPs.

Many cities have also addressed the challenge of integrating different modes of transport to reduce inconvenience and delays. Systems not integrated physically—through high-quality transfer terminals—and operationally—through coordinated schedules—drive away passengers of choice and impose a burden on captive users. Having to pay separately for each mode, which remains common, compounds the inconvenience. And for the poor, who live in the suburbs and are the most likely to make transfers, the multiple fares are unaffordable.

Important successes in integration have been establishing unified ticketing systems, or Bilete Unicos, in São Paulo and Rio de Janeiro. Developing high-quality transfer terminals, such as Bras and Luz in São Paulo, or the Moreno terminal in Buenos Aires, also improved integration and efficiency. But perhaps the most notable experiment has been Santiago de Chile's TranSantiago project; TranSantiago called for a complete transformation of the public transport system from one of generally informal service provision to an integrated city- and system-wide network more typical of an advanced country. Even the passenger payment and transfer systems were integrated via a SmartCard system. While the launch of TranSantiago was beset by some start-up problems, the Government reacted immediately to address them and today the new public transport system is considered one of the best in Latin America. The transformation laid the blueprint for seamless, citywide public transport coverage owing to the integration, via SmartCard, with the metro. Most buses are modern, air conditioned, Euro3 standard (environmentally cleaner), with uniformed drivers trained to provide quality service to riders. Moreover, poor residents can take multi-leg trips from often distant neighborhoods to the central business district while paying only once.

## Opportunities and constraints

The core of the challenge is to keep travel times reasonable, and travel as affordable, comfortable and convenient as possible. This is no easy task, particularly in the big cities where congestion is a chronic problem.

A key problem in the region is that investment in the cities' public transport infrastructure lags far behind needs and potential. Part of the problem is the high cost of modern mass public transport systems: the latest phase of Bogota's high-quality BRT, for instance, cost more than \$15 million per kilometer. While this is substantial, it is but a fraction of the cost of new underground metro construction—costs in São Paulo exceeding \$300 million per kilometer are not atypical.

Not only do many LAC countries have limited fiscal space, the problems are even more severe at sub-national levels.

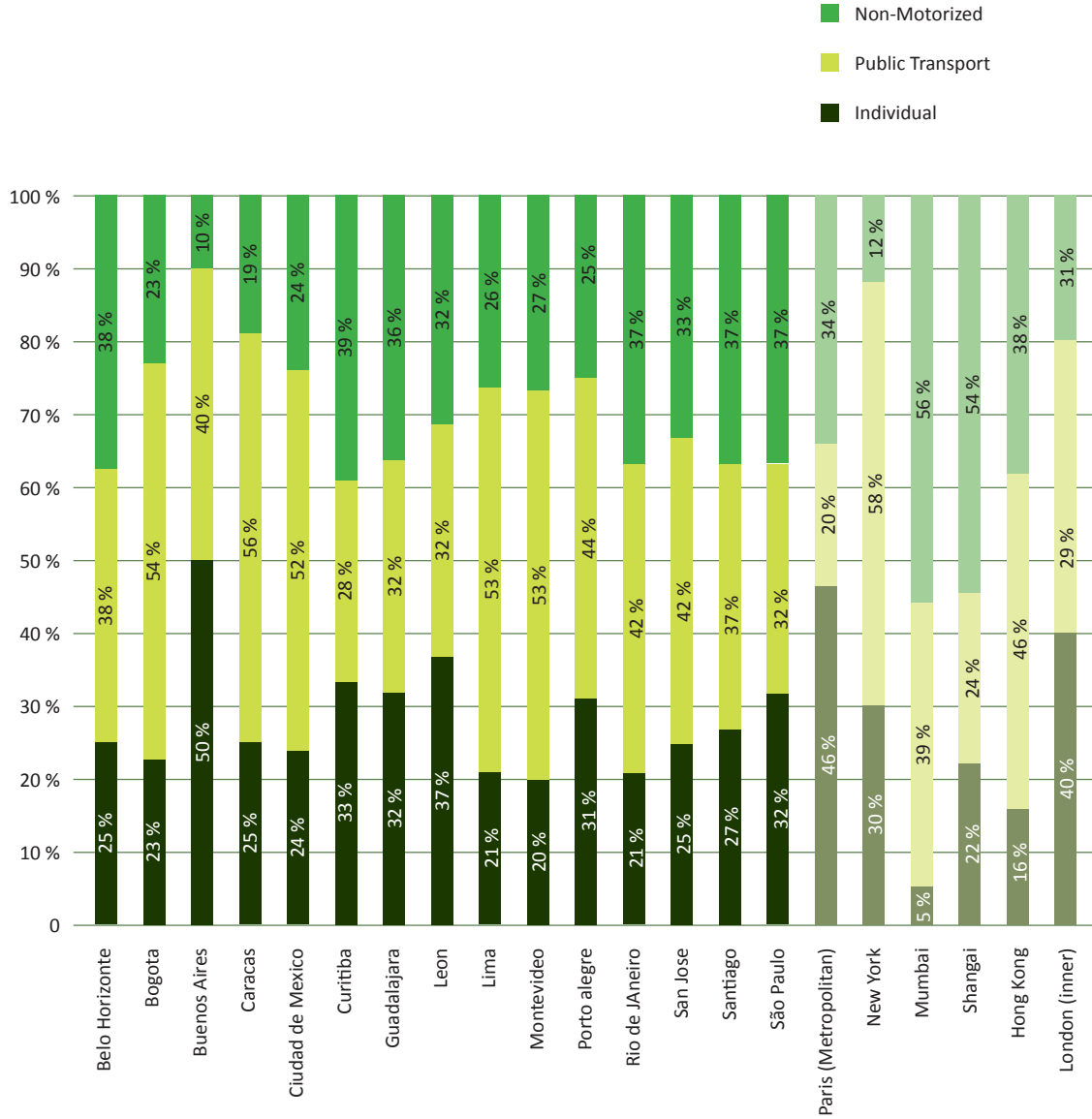
Cost recovery is often a stated objective, but it is regressive in its impact and requires compensating subsidies for the poor. Economic logic suggests that as long as the city has resources (or can raise them) and can assure that subsidies are being directed to service improvements for passengers, some level of subsidy for public transport can be justified because of the public benefits it generates and the potential to reduce auto trips that impose negative externalities. In practice, to balance economic and social sustainability, several cities have set fares for cost recovery to ensure economic sustainability and offer demand-side subsidies for the poor to ensure access and equity. Achieving these dual goals, however, is not easy as it is hard to accurately identify the poorest and ensure that subsidy schemes are not abused. The result has often been either lower fares that require large public subsidies or a strategy of higher (more sustainable) fares that cover costs but risk pricing out the poor and rationing usage. This tension extends to operations. Santiago was designed to be financially self-sustaining and this contributed to its start-up problems; in retrospect, the system had too few buses, owing to budgetary constraints, which led to severe overcrowding. In Bogota, people complain about overcrowding even in off-peak period, but if TransMilenio uses more buses, it risks running a deficit.

Despite these concerns, one of the most celebrated benefits of modern BRT systems has been their higher environmental performance, and greater comfort and reliability relative to old buses. BRT systems also offer opportunities to upgrade fleets to achieve lower carbon emissions. But these technologies come at nontrivial incremental costs, which have the potential of unfairly burdening the poor.

Similarly, enhancing the quality and quantity of non-motorized vehicles (notably cycling and walking) would be valuable. These modes have the potential to reduce congestion and add to the quality of life but they are dependent on city geography, incomes, safety, climate, and culture. Even in the biggest cities in the LAC region, walking accounts for about a third of all trips—these trips are critical for keeping the transport systems operating and sustainable, and retaining the walking mode share of overall trips must be a core element of any transport strategy for cities in the region (Figure 7 shows modes shares from a selection of world cities).



Figure 7: Recent Mode Shares from a Selection of World Cities



Source: The World Bank

As to cycling, many LAC cities in the last decade have begun recognizing the central role it can play in improving the performance and sustainability of transport networks. Several cities (including Bogota, Buenos Aires, Rio de Janeiro, São Paulo, and Santiago) have tried to promote cycling and improve related facilities in the city. To achieve transformational change, this requires combining investments in infrastructure and facilities with activities that spur a change in attitudes about cycling.

## The way forward

As incomes rise, more and more trips in the LAC region will be made using cars, causing unacceptable levels of congestion, unless the built and pricing environments specifically motivate people otherwise. In this context, many are concerned that by not reflecting external costs imposed on society, auto ownership is artificially cheap, reinforcing a tendency to over-use automobiles. Economic theory strongly supports charging drivers for the cost that driving imposes on society. Economic agents (drivers) are known to over-consume when what they pay does not reflect the actual costs borne by the rest of society—the costs of climate change, pollution, and delays attributable to congestion. In this situation, a “Pigovian tax”<sup>8</sup> can help align individual incentives and costs with the broader impacts on society. Estimates suggest that a charge explicitly pricing congestion, and reflecting the impact of autos on safety, local pollution, or emissions, would add about \$2.28 per mile of car use in an US urban setting.

In this context, a ladder of choices is available to authorities for implementing meaningful demand-management measures in metropolitan regions. Among the alternatives are:

- High-occupancy vehicle (HOV) incentive schemes for a strategic network of roads—This strategy restricts specific lanes of a section of road to vehicles with several passengers (usually a minimum of two or three people), providing an incentive to drivers to consider alternatives to driving alone to enjoy a congestion-free ride.
- Charges on vehicle ownership and use—Governments can use a range of instruments to increase the costs of vehicle ownerships and use to reflect the total costs autos impose on the city. Surcharges on fuel can be effective and in most of LAC, the basic mechanism to impose fuel surcharges is already in place.
- Parking management—All private vehicle trips start and end with parking spots making parking a potentially powerful tool to manage urban demand. While transport planners and city leaders have a tendency to be sympathetic to those looking for parking, parking restrictions and charges have a virtuous demand management impact on traffic. By restricting parking in cities, enforcing those restrictions, and charging appropriately for available parking, cities can simulate congestion charges at relatively low political and transaction costs.

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8 A Pigovian tax is a tax imposed on individuals or firms whose actions have negative social consequences. The tax corresponds to the social burden imposed by the action, so that the total “cost” to the individual (or company) reflects the costs they impose on society. A Pigovian tax equal to the negative externality (or burden imposed on society) is thought to correct the market outcome back to efficiency. A typical example of such a tax would be charging polluters for air or water pollution emissions.





- Restricting and charging for access—Charging trip-makers explicitly for the congestion they contribute to—so-called congestion charges—is the most direct way to address congestion problems.

In sum, integrated city planning and, especially, addressing the “automobility” issue directly to maximize the use of non-motorized transport, is essential to improving the urban transport system in LAC. In their absence, the impacts of supply enhancements in other modes could be limited. The experience in LAC, and more broadly, suggests that addressing transport congestion in dense urban settings, at the relatively high-income level many big Latin American cities are already at, is difficult, perhaps impossible, without a deliberate strategy to manage automobile demand. And as incomes continue to rise, this problem will only worsen.



**3.**

**INCLUSIVE GREEN  
GROWTH**

**NATURAL RESOURCES  
AND RURAL SERVICES**



Herdsmen cross Xingu River in Para state - Antonio Cruz ABr





The sustainability of LAC's growth will depend upon its commitment to protecting and strengthening its unique natural assets. The very advantages that LAC's natural endowment provides—rich water resources, fertile land, and unparalleled biodiversity—are under threat from the spread of inefficient land use and deforestation, as well as fragile and changing water resources. The rural agenda is also closely bound to the challenges of social inclusion due to the region's large indigenous population and the related fact that about half of the region's poor live in rural areas.

The following sections explore, using a sector by sector approach, (i) inclusive green growth objectives, (ii) progress since Rio 1992, (iii) opportunities and constraints on the path to green growth, and (iv) a way forward. Section 3.1 explores rural transport, looking at green issues of market access and connectivity. Section 3.2 reviews water resource management and Section 3.3 reflects on the agriculture sector.

### 3.1 RURAL MARKET ACCESS

Demand for freight transport and access to markets has increased substantially owing to brisk economic growth in recent years. Increasing connectivity and access to markets also leads to more socially inclusive growth: rural roads contributed to poverty reduction by promoting integration, connectivity, mobility and access to basic social services. Rural roads enhance the social inclusion of the rural population, especially in connecting poor rural communities to cities at the district level.

The LAC region has a relatively costly and environmentally unfriendly road mode that dominates freight transport. Trucks carry most freight, with limited use of rail and waterways. The region also suffers from high logistics costs (50–100 percent above OECD countries) owing to: a wide range of stakeholders and lack of coordination among them; insufficient integration of supply chains; a backlog of quality infrastructure inherited from years of underinvestment and a focus on roads; and poor integration of transport modes with a heavy reliance on roads. It has a reputation as the world's last frontier—both environmentally, because of its rich but endangered biodiversity and socially, with its variety of indigenous people living traditional lifestyles. The natural environment provides the main social safety net for the rural poor and helps limit malnutrition and massive urban migration. The rural economy is also where almost half of LAC's exports come from (food, live animals and raw materials).



## Green objectives

The main environmental and social challenges to market access in LAC fall under three categories:

- Minimizing the local environmental and social footprint and the induced effects of transport infrastructure construction and operations. Much of the transport work in the region has shifted from being based solely on engineering aspects of roads to incorporate mitigation of negative social and environmental impacts.
- Ensuring inclusive and efficient infrastructure. The most innovative market access projects, especially in rural areas, support sustainable development efforts that are inclusive and ensure the participation of affected communities. Projects are also expanding access to basic services and complementing efforts to reduce poverty through universal education and health coverage, even in the most remote areas.
- Responding to the climate change challenge agenda, both in terms of mitigation and adaptation. While relatively little of the climate change mitigation and adaptation considerations have been incorporated into the market access agenda to date, it has attracted more attention in the past few years in light of the increasing number of climate events.

## Progress in last two decades

LAC has made good progress in integrating the green agenda to its market access efforts. This has included:

- Integrating safeguards to mainstream good environmental and social practices. Obtaining environmental licenses for road work, for instance, causes long delays and often environmental agencies lacked the capacity to identify, monitor, and supervise the environmental implications of road projects. Safeguards have been created to institutionalize environmental and social considerations in transport project implementation.
- Integrating conservation efforts and minimizing the local footprint. Ensuring the harmonious development of infrastructure projects in environmentally sensitive areas remains a challenge. One promising approach is the development of land-use planning tools that support the design of a landscape that integrates road development with biodiversity conservation, and with forest restoration principles. Market access projects in LAC have been increasingly enriched by proactive approaches to protect the environment (see Box 1).



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### Box 1: Payments for Environmental Services in Honduras

The area surrounding the San Lorenzo-Olanchito road in Honduras contains 80-90 percent of the world's remaining population of the critically endangered Honduran Emerald hummingbird. In 2005, a protected area was established—known as the Polingo Reserve—but was not considered large enough to maintain a viable long term population of the hummingbird. As a result, efforts were made to put the remaining sizeable patches of thorn forest under effective, long-term conservation. This would occur through a system of “payments for environmental services” (PES) if Aguan Valley landowners agreed to maintain their remaining parcels of thorn forest intact. This program was the first of its kind in Honduras, and it is expected to lead to the long-term, on-the-ground conservation of a sufficiently large area of thorn forest to ensure the survival of the Emerald hummingbird and other unique biodiversity in the Aguan Valley. To further assure implementation of the PES system, the project included a legally binding commitment on advance conservation measures to be implemented as a condition for disbursing road improvement funds.

- Improving construction methods. Although improved construction methods and stronger environmental monitoring—such as slope stabilization and catchment draining management—are essential for improving construction methods, more progress is needed. Brazil's experience with performance-based rehabilitation and maintenance contracts has led to the introduction of various innovations in road construction, including milling road materials, which has important positive environmental effects in wasting less material.
- Building local capacity, integrating community concerns, and addressing cultural sensitivities. Market access projects continue to support efforts to build local capacity to integrate community concerns and address cultural sensitivities and issues that may affect indigenous communities. A participatory framework that stresses equitable access to decision-making empowerment (for peasants, Indians, women and youth) has become an established element of good practice in rural roads projects. This approach has empowered communities and enhanced their integration with society as a whole.
- Creating jobs. Rural road maintenance in LAC generate the most jobs of all infrastructure investments analyzed to date—25,000–50,000 annualized positions for \$100 million of expenditures. Resources for such activities are also relatively easy to mobilize in an environment where there are few long-term infrastructure plans with “shovel-ready” projects. Highway construction creates about 1,000 annualized positions for \$100 million of expenditure (see Box 2).

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### Box 2: Job Creation in Peru Rural Roads Project

In a Peru roads program, the authorities decided to support microenterprises for road maintenance activities. In 2011 alone, 697 local governments contracted 744 microenterprises and generated 5,132 jobs for the local communities. To date, rural roads that were rehabilitated up to 12 years ago—which are under routine maintenance by micro enterprises—remain in good condition.



## Opportunities and constraints

Inadequate connectivity still constrains growth in the region, and increasing the efficiency of the transport sector remains critical. The LAC region's logistics costs, as a share of GDP, are in the 17–28 percent range, compared with OECD targets of 8–10 percent. To some degree these high costs reflect the region's heavy reliance on the export of bulk commodities. But it also suggests that enhanced transport-sector efficiency translates directly into enhanced competitiveness of the related primary economic sectors.

The transport sector is the fastest growing source of carbon emissions in the LAC region. For example, in Brazil, transport was responsible for roughly 30 percent of all energy consumed and CO<sub>2</sub> emissions in 2007, with road-based modes contributing more than 90 percent of this amount.<sup>9</sup> Opportunities to reduce the carbon intensity of the freight sector can be grouped into three broad strategies:

- Facilitating a shift from freight to more fuel-efficient modes. Road based transport (trucking) is the most carbon-intensive freight mode and the goal should be to develop an integrated multi-modal transport sector to facilitate a shift away from trucks
- Increasing the fuel efficiency of existing modes. Owing to the distributed and fragmented nature of trucking, trucks account for the vast majority of all freight vehicles and vehicle kilometers (except for air transport). The challenge is to identify and deploy strategies to reduce fuel-use in the trucking sector. Reducing the fuel-intensity of the trucking sector is thus strongly linked with reducing local pollutants. Conversely, many actions taken to “clean” diesel fuel by lowering sulfur levels may also have synergistic effects on the fuel efficiency of truck fleets.
- Reducing unnecessary vehicle kilometers traveled without constraining economic growth.

The imperative to “green” LAC's freight sector is important in itself. However, the objectives of “greening” are closely related to business, local, and national economic and environmental exigencies. And in this convergence of opportunities lies an important change to generate truly inclusive green growth. An integrated, properly maintained multi-modal transport system that facilitates modal shift and operational efficiency lowers both emissions and costs, and enhances safety outcomes. Similarly, enhanced fuel-economy is not only important from a carbon-emissions perspective; the transport industry has a strong incentive to improve fuel economy for economic reasons as fuel is one of the largest components of truck operating costs.

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<sup>9</sup> This is based on the 2008 National Energy Balance (Brazilian Ministry of Mines and Energy). The road transport sector accounts for a larger share of total energy consumption and CO<sub>2</sub> emissions than most countries because of the energy production matrix emphasizing hydroelectric power.

Success will depend on addressing historical and institutional constraints:

- The multi-modal constraint—When available and competitive, modes such as rail and waterway can often be much more cost-effective than trucking. But LAC remains more dependent on road transport.
- The fuel-efficiency constraint in a fragmented sector dominated by private sector activity—While the case for more fuel-efficient freight activity is clear, and technical choices are available, the structure of the industry poses a major constraint. Freight activity is principally a private sector activity, with truckers and rail and barge carriers operating in a market environment. Moreover, a number of them are entrepreneurs and individual owner-operators running small business that carefully prioritize capital investments. Thus, there is a need to find market-friendly ways to promote the efficient use of a modernized fleet in a highly fragmented industry and to find light-touch initiatives consistent with market principles.
- The aggregate demand constraint. Ultimately, as these efficiency challenges are successfully met, it may become important to consider viable ways to decouple what has been a historically strong correlation between economic growth and freight demand.

## The way forward

The LAC region requires a holistic approach to its market access and inter-urban transport challenges. It needs to develop a comprehensive strategy for the sector focusing on three areas:

- A key requirement of a green-growth agenda is infrastructure. It can influence positively environmental performance by making available cost-effective and convenient alternatives, quality roads, and the right use of materials and construction methods. First, the availability of cost-effective and convenient alternatives can help divert traffic off trucks onto more energy efficient modes such as rail and inland waterways. Second, the quality of road infrastructure has important implications for truck speeds and, consequently, energy efficiency. And finally, infrastructure building in itself is an energy-intensive activity; hence, the appropriate use of materials and construction methods can have an important impact on energy use during infrastructure development.
- Modernized regulatory and pricing systems can also have an important influence on the green-growth agenda. LAC governments can influence modal choices, costs, contractual arrangements, and levels of economic activity by changing the regulatory environment in which transport carriers operate. But developing an appropriate regulatory regime remains a work in progress in the region. The ideal regulatory



structure should provide a level playing field, transparency, and incentives for investment and should account specifically for market failures (for instance, charges that reflect the external costs of different modes). Prices should reflect the actual costs (including infrastructure development costs and environmental impacts) and the incentives of tax policy should be aligned with broader green-growth tools.

- Improving the fuel efficiency of the existing truck fleets is critical. The key is to give truck owners and transport users the incentives to measure and lower their fuel footprint and to turn average into good operators by inducing a culture of continuous improvement. The opportunity exists to create a voluntary partnership-based program. International experience suggests that market structure and relationships between shippers, carriers, and technology vendors offer important opportunities for collaborative and voluntary programs to reduce the environmental impact of the industry. A variety of examples of good practice are evident in LAC countries. The best fleets have already adopted much of the latest technologies, management practices, and training to maximize fuel efficiency. Evidence also suggests that in some cases shippers can induce carriers with whom they contract to increase their focus on fuel efficiency. In some cases, LAC governments have also instituted programs to mainstream good maintenance and environmental practice. Nonetheless, the challenge is to institutionalize the still-fragmented set of initiatives and achievements to attain fleet-wide improvements in a sector in which the government has a relatively minor role.

### 3.2 WATER RESOURCE MANAGEMENT

Water is an essential ingredient for sustaining development and economic growth over the long term. It is needed to feed populations, keep growing cities healthy, and maintain the competitiveness of industries. And water's effective development and management are critical for clean, efficient, resilient, and inclusive growth. Though LAC has one of the highest per capita endowments of fresh water in the world,<sup>10</sup> geography, pollution, and inequality impose severe limits on access to clean water. Throughout much of the region, river basins and aquatic habitats serve as receptacles for the disposal of waste, mining, and industrial effluents. As the region advances to high- and middle-income status, pressures on its water resources will continue to grow.

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10 The region is home to four of the world's largest rivers: the Amazon, Paraná, Orinoco, and Magdalena. It also has some of the world's larger lakes including Maracaibo in Venezuela, Titicaca in Peru and Bolivia, and Poopo in Bolivia. Twenty percent of global runoff comes from the Amazon Basin alone.

## Green objectives

The overall green goals for the water sector are to make it clean, efficient, resilient, and inclusive, and they are tightly linked. Achieving these goals will require LAC countries to:

- Address human, industrial, and agricultural contamination of water resources.
- Effectively manage and allocate water resources given water's essential importance for many sectors.
- Ensure more efficient water service and use through well-run utilities, the right incentives, and technological innovation (as discussed in Section 2.3).
- Adapt effectively to climate variability and change.

## Progress in last two decades

Rio 1992 affirmed that top-down management of water resources had proven ineffective and should give way to a participatory approach, involving users, planners, and policy makers at all levels. This water governance agenda has been embraced by many LAC countries and helped them improve their institutional and legal frameworks for water management—notably by developing river-basin management approaches with significant stakeholder participation. In addition, the adoption of economic incentives to induce more efficient allocation and use has become more prevalent and LAC countries have led the way in developing such new instruments as payments for environmental services, in recognition of the environmental dimension of good water management.

While much has been done, many challenges remain. As the region continues on its growth path, it needs to deal with issues of water scarcity and climate-induced variability by building on its knowledge and experience of recent years and ensuring that water resource development and management proceed in a clean, efficient, resilient, and inclusive manner. But the region has laid a good foundation for advancing further and managing water resources for inclusive green growth.

## Opportunities and constraints

Despite LAC's generous water endowment, large sub-regions are faced with water scarcity, which is now worsened by climate change. These sub-regions include the Northeast of Brazil, parts of Bolivia, Chile, and Peru, Mexico and several Caribbean islands. Not surprisingly, the arid and semi-arid regions are often the poorest.





Compounding the scarcity owing to lack of water resources is man-made scarcity in the form of pollution. Cities such as Buenos Aires and Bogotá have polluted their water bodies to the extent that they are unusable. They are now investing heavily—in the order of \$12 billion—to clean up their river basins by financing infrastructure, working with industries to become cleaner, and developing new management approaches. When Quito began polluting its groundwater resources, it was forced to look to supplement its supply from Amazonian river basins.

Industrial contamination is also a challenge, especially around such larger cities as Bogotá, Buenos Aires, Mexico City, and São Paulo. Efforts to address industrial pollution of water bodies must continue if cities are to grow in a more sustainable and healthy manner. This is especially important for those cities that rely on groundwater since clean-up is so expensive; indeed, a groundwater aquifer is typically lost once it is contaminated and alternative resources are often prohibitively expensive.

Even some relatively sparsely populated areas suffer poor water quality. Semi-arid regions, such as the state of Ceará in Brazil—that used to focus its efforts on increasing water supplies—is now experiencing eutrophication of its reservoirs, owing to sewage from many small towns along the rivers. It is pursuing solutions to this challenge as it addresses the water quantity issue.

While point-source pollution as it is encountered in cities and industries can be addressed with strong political will and massive investments, non-point-source pollution from agriculture remains a challenge, as described in Box 3.

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**Box 3: Lake Nicaragua and Non-Point Source Pollution**

Non-point-source pollution from agriculture—from sediment runoff and agrochemicals—degrades water quality in large Latin American watersheds. A case in point is the second largest lake in the region, Lake Nicaragua, also known as Lake Cocibolca. It is a major freshwater resource in Central America and the second largest lake in Latin America. The watershed is a major site for agricultural output and one of Nicaragua’s main tourist attractions. Loss of forest cover and the resulting soil erosion, combined with large sediment loads and other environmental problems stemming from agrochemicals and wastewater flows, have drastically reduced water quality and the navigability of the lake and the potential for future tourism development.

A recent World Bank study has estimated that by combining such measures as reforestation in areas with the steepest slopes, adopting conservation tillage, and improving pasture management, it is technically feasible to reduce sediment flows by more than 80 percent, and to lower the associated flows of nitrogen by more than 18 percent and phosphorus by more 46 percent. The search for solutions will require concerted efforts by Nicaragua and Costa Rica to address multiple pollution sources and ensure sustainable use of this critical freshwater source for Central America.

Mining is a fast-growing challenge to the clean dimension of green growth in LAC’s water resources sector. The region is experiencing a mining boom that is bringing much needed financial inflows to countries and helping them grow, create jobs, and reduce poverty. But this bonanza is also having important impacts on water quality. Water contamination is not just a problem around mining sites; it is also extending many kilometers downstream and affecting water use for human consumption and agriculture (see Box 4 for an example from Colombia). For the region to enjoy

the full benefits of increased global demand for its mining products, it must address this issue—for example, through environmental legislation related to mining concessions.

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**Box 4: Colombia, the Gold Boom, and Water Pollution**

Colombia is the world's leading producer of gold and other precious metals and during the period 2003-11, it produced more than 330 tons of gold and exported some 40 tons. While Colombian gold production confers economic benefits, it also imposes environmental and social costs, as mercury pollution from gold mining regions affects air quality and drinking water, as well as fisheries and agriculture in downstream areas, carrying serious health impacts.

A recent World Bank study on the impacts of gold mining in Colombia estimates that it may be necessary to develop redistribution schemes for royalties to be paid to downstream areas that bear the high costs of pollution and receive few or no benefits from mining production. These would enable part of the proceeds from mining to be invested in healthcare, education, and the water supply sector in the downstream areas to help limit mercury exposure and reduce its adverse impacts on the affected vulnerable populations.

Difficult trade-offs need to be made in allocating water to different sectors. Irrigation, for example, requires large amounts of water, which may then not be available for hydropower, as in Chile. Similarly, the city of São Paulo draws water not only from its own basins but seeks to import water from out of state. The municipality of Quito continues to expand its water search from the Amazon basins through inter-basin transfers. And Brazil is just about to finish the São Francisco inter-basin transfer, which seeks to reallocate water from the São Francisco basin to various other basins in Northeastern Brazilian states.

Allocation decisions have financial, economic, social, and environmental dimensions. As countries travel on greener growth paths, trade-offs will concern key issues like energy. Cleaner energy, which implies more hydro development, may in turn affect sensitive Amazonian ecosystems in various LAC countries.

LAC is one of the few regions in the world with the potential to augment global food production (see Section 3.3 for more on agriculture). Various countries in the region—for instance, Argentina, Brazil, the Dominican Republic, and Peru—are actively seeking to expand their irrigated areas. Argentina and Brazil are also looking to increase their cattle ranching. Although this is welcome from a global perspective, it will mean further stress on existing water resources. For example, the Brazilian Cerrado is the starting point for five of the largest Brazilian river basins. Expanding the agricultural frontier further into the Cerrado will therefore not only affect the Cerrado region itself, but also the water resources and the services they provide all across Brazil.

The need for efficient water use among sectors is well-documented. Many LAC countries have focused on improving the performance standards of their water utilities, decreasing unaccounted-for-water, and introducing tariff structures that induce water saving while preserving access to water for basic needs. Enhancing water use efficiency—through economic incentives, peer pressure, new models of PPPs, and technological innovation—will be crucial for meeting LAC's growing water demands. Many new approaches are being used but, unfortunately, many large and



megacities are continuing to expand their water imports from outside their basins (for instance, Mexico City, Quito, São Paulo, and Tegucigalpa) and agriculture still lacks the incentives to use water more efficiently.

From an inclusive green growth perspective, two issues are key: (i) whether funds should be diverted to more infrastructure when demand management could save water at a fraction of the cost, thus liberating funding for other societal purposes; and (ii) the need to address the impact on allocative efficiency and trade-offs. Clearly these issues constitute a major challenge for the region, especially in light of the effects of climate change.

## The way forward

Going forward, a multi-sectoral approach for WRM will be essential. As the LAC region embarks on developing more hydropower, changes in precipitation patterns must be considered. When formulating incentives for expanding agriculture, both flood and drought management and appropriate technological approaches must be considered.

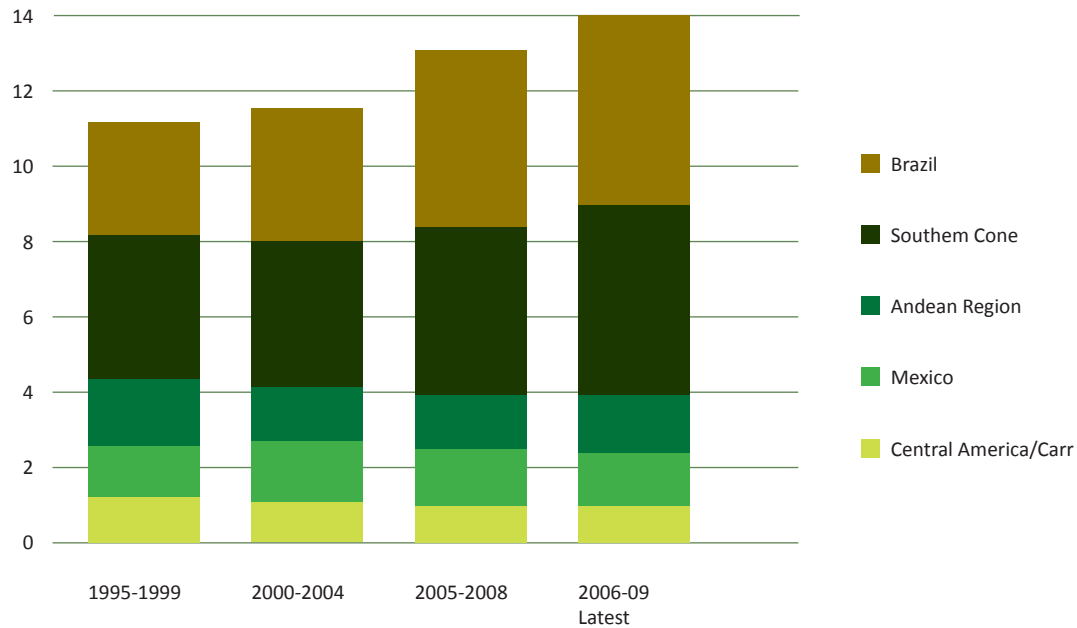
The region also needs to find the right balance between strengthening WRM management structures and disaster-risk management and to make them truly complementary.

As the region aims to continue on its growth path, lifting even more people out of poverty, it is vital to build on the collective knowledge and experience acquired in the past years and ensure that water resource development and management take place in a clean, efficient, inclusive, and resilient manner for the benefit of future generations. This will mean developing and building on existing economic incentives, continuing and adapting river basin management approaches, and focusing more on allocation issues.

### 3.3 AGRICULTURE

LAC is a global agricultural powerhouse. Since Rio 1992, the region's share of global food exports has increased dramatically, led by Brazil and Argentina. Poverty in the region has also fallen substantially over the 2000s, although the downtrend has been interrupted in recent years by the financial and food price crises.

**Figure 9: LAC Agricultural Exports Share of World Agricultural Exports**



Over the next 40 years, LAC will need to almost double production of grains and meats.<sup>11</sup> It must do so in a way that sustains the natural resource base on which agriculture depends, eliminates negative external costs imposed on others, helps meet global goals for reducing emissions of GHGs, increases resistance to climate variability and eventual climate change, and continues to reduce poverty in rural areas.

## Green objectives

To stay on its trajectory of high output growth and poverty reduction without increasing its environmental footprint, agriculture in LAC must become more efficient, generate fewer off-site impacts, be more inclusive, and more resilient. Most importantly, it must become more “climate smart,” to maintain productivity in the face of changing climatic conditions while at the same time reducing GHG emissions. Climate change is likely to have major impacts on productivity and it will require substantial adaptation by farmers. Overall, the region is well equipped to tackle this challenge.

<sup>11</sup> “Forces shaping present and future agricultural trends in Latin America and the Caribbean: Alternative Scenarios”, Simla Tokgoz, Prapti Bhandary, Mark Rosengrant. 30 April 2012, International Food Policy Research Institute for the World Bank, LCSSD.



## Progress in last two decades

Deforestation is the most important obstacle to greening agriculture. Fortunately, many LAC countries have jettisoned the most egregious policies that encouraged it and some notable successes have been achieved in recent years (notably in Costa Rica, Uruguay, Brazil and Mexico). Countries in LAC have experimented with innovative approaches to reversing deforestation and protecting forest land, including through payments for conservation.

## Opportunities and constraints

LAC's high potential for scaling up its agricultural output owes to its natural endowments, particularly the key inputs of land and water. Of the approximately 446 million hectares of land worldwide potentially suitable for sustainable expansion of cultivated area, about 28 percent are in LAC (more than in any other region except Africa), but part of this land is forested and includes dry forests such as cerrado in Brazil. LAC's potential is even more pronounced if accessibility is factored in: the region has 36 percent of the 263 million hectares of land suitable for expansion worldwide that is within six hours travel time to the closest market. On a per capita basis, LAC has the highest endowment of renewable water resources among developing regions, although some sub-regions face higher than average scarcity.

LAC's relatively high levels of technology and human capital are another important factor contributing to its potential to increase production. This gives it the capacity not only to ramp up production, but also to transfer knowledge to other regions, notably Africa. Perhaps the leader in advances in production technology is Brazil, where technology developed mainly by the public research institute EMBRAPA transformed the Cerrado (a Savannah-like biome) into a highly productive area through improved crop varieties and environmentally-friendly soil management practices (that is, no- or low-tillage production) but of course this comes at the cost of loss biodiversity in the Cerrado). Furthermore, the region is well positioned to respond efficiently to higher prices because of its incentive framework, perhaps the least distorted in the world.

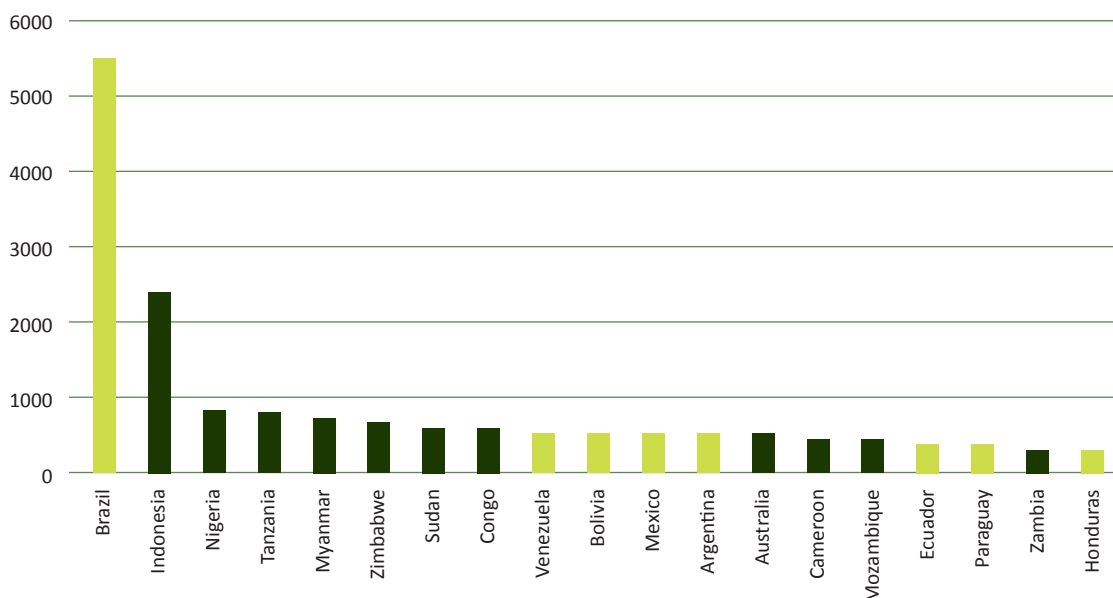
Despite this potential for growth, of LAC's economic sectors agriculture is likely to suffer the most direct and largest impact from changes in temperature and precipitation. Simple adaptation strategies such as improved crop varieties, changes in sowing dates, and modest irrigation can dampen the yield shocks to a significant degree for some crops, and improving irrigated production technologies can control emissions of methane, a potent GHG.

Agriculture's carbon footprint, which is shaped by deforestation, livestock production, and unsustainable production practices, must be reduced. More so than in other regions, land-use change—mainly deforestation and forest degradation—has been the major contributor to GHG emissions in LAC. Deforestation is the most important obstacle to the greening of agriculture. While Brazil, which possesses by far the largest forest, has lost the greatest area, the phenomenon



of deforestation in the region is widespread (see Figure 10). Fortunately, many LAC countries have abandoned the most egregious policies that encouraged it and have experimented with innovative approaches to reverse deforestation and protect forestland.

**Figure 10: Gross Forest Loss in Hectares, 1990–2010**



The LAC region must also preserve its great biodiversity.<sup>12</sup> Much of the stress on ecosystem biodiversity until now has been caused by human encroachment on sensitive areas. Looking forward, biodiversity will be increasingly threatened by climate change, which is likely to drastically affect the survival of species as breeding times and distributions of some species shift.

### The way forward

The most important pillar of a strategy to reduce the environmental footprint of agriculture is to preserve existing forest cover and encourage reforestation with native species where feasible. Substantial progress on this is critical for lowering the trajectory of emissions, conserving biodiversity, and reducing erosion. Success will depend largely on discouraging unsustainable livestock production, eliminating harmful policies, implementing forest protection policies such as protected areas, and supporting projects to encourage protection such as payments for environmental services. LAC has led the way in using direct payments for forest conservation,

<sup>12</sup> Of the world’s ten most biodiverse countries, five are in LAC: Brazil, Colombia, Ecuador, Mexico and Peru.



with national programs in place in several countries and Brazilian states. Costa Rica led the way in 1997, establishing its Pago por servicios Ambientales (PSA) program, which pays land users who conserve existing forest in priority areas or reforest their land.

A second pillar of the greening strategy is to make agricultural production and distribution technology more efficient and climate smart. Designing more sustainable livestock systems, especially for cattle, can make the single biggest contribution to reducing greenhouse gas emissions (see Box 5).

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**Box 5: Colombia's Sustainable Cattle Ranching**

Colombia is implementing sustainable cattle ranching based on silvopastoral systems, where leguminous trees are planted in pasture land. This is a successful cattle-ranching-intensification program, which leads to higher carrying capacity and more profitability per hectare but with the environmental and social value of converting grazing land to forest. Implemented in five project areas, in strategic ecosystems, this multi-stakeholder initiative has expanded production, enhanced natural capital protection, increased carbon sequestration, and cut methane and nitrous oxide emissions.

Integrating ICT in agricultural activities can help farmers improve agricultural productivity and market efficiency and reduce post harvest and distribution losses. Using mobile technology, farmers are able to access weather information for better planting and pest management decisions. Market information systems can help farmers decide when and where to sell, reducing the risk of selling in a saturated marketplace. And ICT applications can also improve farmers' ability to meet quality-control standards and improve sanitary management at the farm and country level (see Box 6).

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**Box 6: Uruguay uses ICT to Control Foot and Mouth**

A notable example is the livestock tagging program in Uruguay to control foot and mouth disease. The program provides government officials and cattle farmers with tags, readers, and internet-connected software that allow them to track the precise location of animals on farm and in the market. The system also allows the tracing of the spread of infectious diseases and the implementation of targeted eradication and quarantining efforts. Indeed, Uruguay is now free of foot and mouth disease and is becoming a model for effective animal health surveillance.

Mainstreaming climate-smart agriculture will require developing an ecological agricultural inputs industry. Ecological agricultural inputs include any organic agricultural inputs used to enhance crop production that do not hurt the ecosystem, such as organic fertilizers, microbial organisms, and organic pesticides to substitute for chemical inputs, to reduce GHG emissions and the energy intensity of production. Ecological inputs may have overall positive effects on production systems (that is, soil and water quality).

A third pillar of the greening strategy is to manage water resources more efficiently for irrigation and other agricultural production systems, and to expand hydroelectric energy as part of national low-carbon growth strategies. Ensuring that new hydro energy programs also include irrigation would enhance agriculture's adaptation capacity.

The fourth and final pillar of the greening strategy is to improve regional and global agriculture trade systems to respond to future impacts of climate change on global food production. Global markets must remain open and facilitate agricultural trade for two reasons: (i) patterns of comparative advantage in food production will change and, as they change, moving food from countries that produce it efficiently to food-deficit countries will require trade patterns different from current ones, and (ii) on a year-to-year basis, the expectation of greater variability in weather will create short-term local shocks to food supply that will require rapid adjustment of food trade to avoid shortages.





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