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Energy Challenges in Latin America

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Abstract
Co-edited by Peter Hakim, President Emeritus, Inter-American Dialogue and Genaro Arriagada, Non-Resident Senior Fellow, Inter-American Dialogue, this issue examines energy as a priority issue for nearly all Latin American and Caribbean countries and considers its impact on regional integration and both foreign and domestic policy. Articles present opportunities and challenges facing the region, as well as recommendations for addressing the energy issue in Latin America in a strategic, constructive and effective manner.

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Energy Challenges in the Americas

MIAMI CONSORTIUM
FOR LATIN AMERICAN AND CARIBBEAN STUDIES

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IN THIS ISSUE

Hemisphere

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Cover Image:
Ribeirao das Lajes dike with its forest bordering the reservoir, an example of Light S.A.'s reforestation program. Light, a subsidiary in Brazil of the French company EDF (Électricité de France), distributes electricity to 80% of the State of Rio de Janeiro and implements environmental protection programs. ANTONIO SCORZA/AFP/Getty Images.

FROM THE EDITOR

Dear Hemisphere readers:

The energy situation in the Americas, not to say the world, is changing rapidly. Developments in the Middle East continue to surprise us daily. Contrary to popular belief, however, the principal US oil suppliers are countries not in the Middle East or Africa, but rather the Western Hemisphere: Venezuela and Mexico.

China and India are increasing their energy demands faster than most analysts predicted and are assiduously courting suppliers for the long haul. The energy market has become a seller's market and is likely to continue to be one in the coming years. Latin America's oil and gas reserves, as well as the region's hydroelectric potential and relatively low overall consumption, put most of the countries in this region in an enviable position when facing their energy future. The landscape, however, is rapidly changing.

Traditional Latin American energy powerhouses are seeing a rapid decline in their energy production (Mexico), while new oil (Brazil) and gas (Bolivia) reserves are being discovered in places impossible to reach with available technology until very recently. Despite great technological advances, the recent oil spill in the Gulf of Mexico showed the world how fragile the ecological balance can be and the consequences of accidents, whether manmade or natural.

The increasing double threat of global warming and climate change has introduced new variables to the energy equation. Price is no longer the only factor driving the search for alternative energy sources. Protecting the right to a clean environment for future generations is another very important determinant.

This year we have devoted our annual issue of Hemisphere to the problem of Energy Challenges in the Americas. I would like to thank my colleagues and friends from the Inter-American Dialogue Energy Task Force for agreeing to join forces with LACC to produce this volume.

In addition to the pieces authored by the Inter-American Dialogue Energy Task Force members we have included commentaries by two FIU faculty members and one graduate student. Some authors address broad themes; others focus on specific issues, regions or countries. As usual the idea is not to give you, the reader, an exhaustive view, but to invite you to explore the issues from new comparative and cross-disciplinary perspectives.

With this issue of Hemisphere LACC begins a longer debate on energy in the Americas. This year's Journalists and Editors Workshop on Latin America and the Caribbean, LACC's traditional yearly gathering of media professionals covering Latin America and the Caribbean, will be devoted to discussing different aspects of this topic. Some of the issues we will address include opportunities and challenges from the perspectives of the haves and have-nots, those posed by the new global and regional geopolitics of energy, and the diminishing costs of alternative energy sources.

Many people have contributed to this issue of Hemisphere and I am grateful to them all. In addition to the Dialogue's Energy Task Force members I would like to thank Peter Hakim, Chris Cote and Alexis Arthur from the Inter-American Dialogue, and Liesl Picard, Andreina Fernández and Alisa Newman from LACC.

Thank you,

Cristina Eguizábal
Director
Latin American and Caribbean Center
Florida International University

FROM THE GUEST EDITORS

Dear readers:

The fact that energy has become a priority issue for nearly all Latin American nations was our central motivation for establishing the Inter-American Dialogue's Energy Policy Group. This assertion needs no explanation; energy is a critical element in every country's thinking about and planning for its future. Energy has become a key factor affecting the pace and success of regional integration processes and is shaping the foreign policies and domestic choices of many Latin American countries.

Moreover, the problems associated with energy are subject to rapid change. They must be tracked and analyzed on a regular basis. In the past year, we have witnessed wide swings in the price of energy. Latin American countries are giving renewed attention to nuclear power; Brazil has taken major steps to prepare for the exploitation of newly found petroleum deposits and is building the world's third largest dam; and poor management is leading to declining oil production in Mexico and Venezuela, the region's largest exporters.

In country after country, energy has emerged as a central political issue. Politics and ideology (as much as calculations of national interest) are shaping and constraining energy decisions, and government choices about energy are affecting the national politics and foreign policies of many nations. In the absence of new discoveries, Mexico's oil reserves are rapidly being depleted; yet, it is politically risky for any Mexican government to consider allowing foreign investment into the petroleum sector. Venezuela's regional influence depends heavily on its ability to assist the resource-poor countries of Central America and the Caribbean to meet their energy needs. Protests and demonstrations, which forced Bolivia to rescind essential price increases in natural gas, have weakened the government of Evo Morales. Even Chevron's court battles in Ecuador are as much about politics as they are about the environment.

Decisions about energy production and use in any one Latin American country affect the economies and politics of many other nations. Brazil's largest city, São Paulo, depends on natural gas exports from Bolivia, while the Bolivian economy relies on Brazilian purchases. Argentina has a similar link to Bolivia. Chile depends on natural gas imports from its neighbors Peru, Argentina and Bolivia but cannot fully count on a reliable supply. It is planning to turn to much higher priced LNG imports and perhaps develop a nuclear energy capacity.

We are pleased to have this opportunity to showcase the initial work of the Energy Policy Group, which was launched in 2009 with the cooperation and support of the Inter-American Development Bank. The group's approximately 20 participants include energy experts and political and economic analysts, who meet to discuss the most important energy policy challenges confronting the region's governments, offer balanced analysis of issues and choices, and develop ideas and approaches for addressing them in constructive ways. Many of the articles in this issue of Hemisphere were prepared by members of the group during its first year of operation. The Dialogue also publishes the Latin America Energy Advisor, a highly regarded weekly newsletter that offers up-to-date information and timely analysis of hemispheric energy issues.

We very much hope that you enjoy this issue of Hemisphere and find the conclusions and recommendations that have emerged from the Dialogue's policy group to be instructive and useful. We owe a debt of gratitude to FIU's Latin American and Caribbean Center and its director, Cristina Eguizábal, for giving us this opportunity to present the group's work. We would also like to acknowledge and thank Alexis Arthur and Chris Cote of the Dialogue staff for the editing and other contributions they made to assembling this issue. It would not have been possible without their help.

Sincerely,

Peter Hakim
President Emeritus
Inter-American Dialogue

Genaro Arriagada
Non-Resident Senior Fellow
Inter-American Dialogue

Leading Energy Policy Issues in Latin America

By Genaro Arriagada

Energy is a leading world concern. A fundamental factor in determining the might and weight of nations is the skill with which they handle energy policy. Tensions among states are increasingly linked to the security of energy supplies, prices and transportation. In this context, analyses from the viewpoint of politics and strategic and power considerations among states gain new importance in addressing energy issues.

Compared to other world regions, Latin America's energy mix reveals special circumstances, challenges, problems and policies. The table illustrates the percentage of total consumption by energy source and region.

Latin America is an area rich in oil, hydroelectric power and gas, with enormous reserves and production that exceeds consumption, making it a net energy exporter. By contrast, the share of coal and nuclear energy in the mix is very small.

Since energy policy should be based on the use of all sources rather than a single one, a view of the overall energy mix is fundamental to discussing and formulating long-term policy. Environmental concern about greenhouse gas emissions has given new momentum to once-controversial energy sources, such as dams and nuclear power plants. Such considerations should not obscure economic factors essential to growth, for the cleanest energy sources—wind and solar—are among the most expensive. A purely economic logic favors investment in coal, which is the cheapest source but also the most polluting.

Energy Mix 2009

	Oil	Gas	Coal	Nuclear	Hydro	Total
North America	38.5	27.6	20.0	8.0	5. 9	100.0
South & Central America	45.5	21.5	4.0	0.8	28.2	100.0
Europe-Eurasia	33.0	34.4	16.5	9.5	6.6	100.0
Middle East	51.0	47.2	1.4	0.0	0.4	100.0
Africa	40.0	23.4	29.7	0.8	6.1	100.0
Asia-Pacific	29.1	10.8	51.9	3.0	5.2	100.0
World Total	34.8	23.8	29.3	5.5	6.6	100.0

Source: BP Statistical Review of World Energy, 2010.

Between now and 2030—assuming that energy consumption rises 60%, the mix remains clean, and the increase in energy costs is minor—Latin America should set the following general energy policy goals: (1) maintain the current share of hydroelectric power; (2) slightly reduce the oil share; (3) maintain the natural gas share; (4) reduce the coal share; (5) reduce the role of traditional biomass, especially if associated with extreme poverty; (6) maintain or, ideally, increase the nuclear energy share; and (7) increase the Non-Conventional Renewable Energy (NCRE) contribution to 10-15% of the mix.

Analysis of Energy Sources

Having set the general framework, it is important to analyze the different components of the energy grid. These are at varying degrees of development, pose distinct problems and opportunities, and should be addressed through different policies.

Oil. Excluding the Middle East, Latin America is the region where oil makes the largest contribution to the fuel pool, even more than in the "oil-addicted" United States. South and Central America, the Caribbean and Mexico together account for 15.8% of proven reserves and 12.8% of world production, which compares favorably to their 8.8% share of consumption.

Recently, however, highly favorable conditions have given way to uncertainty due to stagnating, even declining production in most of

Itaipu's Brazilian General Director, Jorge Miguel Samek, speaks to journalists about the controversial hydroelectric dam, which is co-owned by Paraguay and Brazil, during a press conference at the São Paulo State Industry Federation (FIESP) headquarters in São Paulo, Brazil, on May 27, 2009. Photo: Mauricio Lima/AFP/Getty Images.

South America and Mexico. The Mexican state underfunds the oil sector, and oil reforms approved by the Mexican Congress are seen as too limited. In Venezuela, too, the oil situation is deteriorating rapidly.

Brazil, in contrast, has emerged as a success story when it comes to oil exploration and production. In 1997 it accounted for two-thirds of South America's crude imports, but by 2009 it was self-sufficient in energy and ready to join the exclusive club of oil-exporting countries. Its results are so favorable that by the end of the decade it will probably overtake Venezuela and Mexico as the hemisphere's leading producer. In Brazil, an active state policy coexists with a company, Petrobras, which combines the features of state-owned and private enterprise within a regulatory framework that allows it to avoid the dilemmas of overly liberal policies or unyielding statism.

Outside of Brazil, Latin America's oil future is under threat unless there is an effort to increase sector efficiency, particularly in Mexico, Argentina, Venezuela and Ecuador.

Natural gas. The contribution of gas to the regional energy mix is close to the world average: 22.2% compared to a global average of 23.7%. When it comes to reserves and production, however, gas is less satisfactory than oil. Latin America owns 4.1% of proven reserves and production matches consumption, 6.3% of the world total. Venezuela and Bolivia have immense reserves but sector development is lagging. Brazil, Peru and Trinidad & Tobago have more successfully managed their gas sectors.

The South American liquefied natural gas (LNG) market started in 2008 following the announcement of plans to build at least seven regasification plants. This strengthened the overall regional energy situation but weakened integration efforts. A more optimistic way to view the relationship between LNG and integration is to say that classic gas integration—via pipelines—is on the way out, but the door has opened for integration on the basis of LNG, with close cooperation between neighboring countries: Chile and Peru, Brazil and Argentina.

Coal. This will continue to be the fastest-growing fuel and its share in the Latin American mix —a low one-seventh of the world average—is likely to increase, driven by low costs and difficulties in developing hydroelectric and nuclear energy. The role of coal is small and limited to Brazil, Chile and Colombia, which account for 85% of regional consumption. At the same time, however, Central and South America represent the world area where coal consumption is growing the fastest. This increase will tend to muddy a comparatively clean energy mix.

Hydroelectric power. Latin America, South America in particular, is the world's richest hydroelectric region, with 22% of the global total for this resource and four times the world average. However, opposition by environmental groups to new dams has led to conflicts in Chile, Brazil, Guatemala, Mexico, Honduras, El Salvador, Peru and other countries. Such confrontations pit environmentalists, native communities and large international NGOs opposed to dams (and nuclear energy or even oil development) against large corporations, governments and multilateral lenders that support development based on such factors as cost and security or clean energy concerns. Proponents argue that nuclear power is a sustainable option for a continent that has decided to halt hydroelectric development and should not rely on coal.

Nuclear energy. Nuclear energy comprises 6% of the world energy

Itaipu's Paraguayan General Director, Carlos Mateo Balmelli. Photo: Mauricio Lima/AFP/Getty Images.

mix, but in Latin America it accounts for less than 1%. Since 2006, governments have espoused the necessity of developing this sector given such factors as climate change, high oil prices, and dwindling reserves and production. Brazil and Argentina have announced new nuclear plants, the debate in Mexico is growing more strident, and Uruguay has set up a bipartisan commission to review the issue. Chile may soon become the fourth Latin American country to integrate nuclear energy into the mix. In Venezuela, the Chávez administration has been flirting with nuclear energy that uses Russian and Iranian technology.

Traditional biomass. The oldest form of energy is traditional biomass for heating, lighting and cooking. Its use is often associated with extreme poverty, and some 100 million Latin Americans rely on traditional biomass to meet their basic energy needs. Firewood, the most characteristic use of biomass, is hard to quantify, but it accounts for a very high share of the mix in the poor nations of Central America and the Caribbean. Yet, firewood could be used rationally in countries with vast forests, the technology to process farm waste, and thoughtful forest management plans. One of the Millennium Development Goals is to give the poor, who otherwise have only traditional biomass, access to modern energy sources.

Non-Conventional Renewable Energy. This includes run-of-river hydroelectric plants, wind, solar, geothermal, and non-traditional biomass such as sugar cane, corn-based and cellulosic ethanol. While they currently contribute only 2% of the Latin American mix, these sources are critical to addressing climate change and will be a focal point of future debate. Clean to varying degrees, some of these sources have non-trivial negative effects. Worldwide use of non-conventional renewable energy has been rising rapidly but its overall contribution remains scant. In general, its development hinges on subsidy policies that poor and even middle-income economies, such as those of Latin America, cannot afford to any significant extent. Still, there have been success stories with some forms of renewable energy in individual countries.

Non-conventional hydrocarbons. The hemisphere holds remarkable possibilities for development of "non-conventional" or "tough" hydrocarbons, including Canada's tar sands or the ultra heavy oils of Venezuela's Orinoco Basin, which could total as much as double the reserves of Saudi Arabia. The technical and financial issues in developing these resources are enormous and the environmental impact is also being questioned, particularly with regard to tar sands. Interestingly, high-profile observers note that the distinction between conventional and non-conventional oil is irrelevant since at the end of the day, any oil that markets can integrate in terms of cost and price is conventional. In this sense, the ultra heavy oils of the Orinoco have better prospects than Canada's tar sands.

Energy Regions in the Hemisphere

Specific local circumstances and issues call for different policies, making it most expedient to view the hemisphere as not one zone but three: Central America and the Caribbean; South America; and North America, including Mexico, the United States and Canada.

Central America and the Caribbean encompass 23 nations with an energy deficit. Only Guatemala and Cuba produce some oil, although not enough to meet domestic demand. Oil accounts for more than 70% of the energy mix in many of these nations. They possess limited refining capacities, compounding dependence. The Central American and Caribbean

zone also has virtually no gas, except for Trinidad and Tobago, home to a significant exportable surplus. Countries in this area possess modest hydroelectric resources and no access to nuclear energy in the foreseeable future.

Energy is one of the bottlenecks to growth in Central America and the Caribbean. Oil becomes an instrument of policy whenever a strong imbalance of power emerges between a country with a surfeit of the resource and another that needs it urgently. A state may prevail over another in such a situation, reinforced by subsidized prices or soft financing terms. Within the hemisphere, this zone is the most likely to experience such relationships.

South America, in contrast, is rich in energy resources. Exportable oil surpluses are significant and proven reserves very high. Venezuela, Bolivia and Peru have vast gas reserves and Brazil has recently reported major discoveries. The hydroelectric potential is enormous.

Major differences underlie this scenario. Chile and Uruguay are weakest, with large energy shortfalls. Paraguay compensates its shortcomings with the enormous flow of electricity from large dams on its borders with Brazil and Argentina. All other countries show positive balances but their prospects differ. Brazil exemplifies successful policy management while Venezuela, Argentina and Ecuador face declining production and deteriorating energy sectors.

Latin America is the leading oil exporter to the United States. The US has a strong energy deficit, in contrast to Mexico and Canada, both with excess production. But in Mexico, too, as we have noted, energy production is on the decline. In fact, North America is the region of the world where the reserves-to-production ratio is lowest.

Experience shows that energy security comes from a diversification of the energy mix.

The disparities among these three zones create both challenges and opportunities for energy partnerships.

Security, Integration and Geopolitics

Energy security is an elusive concept. At its most basic it requires an uninterrupted flow of energy at a reasonable price.

While cuts in supply are the foremost threat to security, responsibility for them varies. Many cuts occur for reasons beyond the fault or control of states or companies, although cutting or threatening to cut the energy supply may be used as an instrument of political pressure. Security can also be threatened when a relatively more powerful country sets an unfair price—either too high (if it is a supplier) or too low (if it is a consumer), thus affecting a weaker nation. Cartels may distort prices and, more seriously, put conditions on supply.

Because of oil's fungible nature, its use for political purposes is limited. Exports to one country that are diverted to another will simply be replaced with other exports. The main concern is whether the reduction of one source can limit the global supply. Natural gas is different, as about 70% of the gas supply does not trade on the open market. Prices and quantities are fixed in long-term contracts between countries joined by a pipeline, creating strict, reciprocal dependence between exporter and importer. The LNG market resembles the oil market with the restriction that it requires consumers to build regasification plants.

Experience shows that higher levels of energy security come not from autarchy but from diversification of the energy mix. Security through diversification and leverage of economic benefits are among the factors that drive integration. The leading forms of energy integration are linkages through gas pipelines and power grids, but development of either in Latin America is nascent at best. In the case of natural gas, progress has been hobbled by political or geopolitical factors.

Nations such as China or India, whose greatest concern is to secure the energy supplies their growth plans require, are increasingly active in Latin America. As a result, the geopolitical energy equation must consider not just large producers, but also and most especially large overseas importers and their investments in the area.

Prospects for energy security would benefit greatly from a regional accord or convention designed to guarantee that energy supplies will not be arbitrarily cut by signatory states. This may not be easy to achieve.

Geopolitically, the presence of extra-continental powers in the region as well as tensions between countries in the hemisphere should be watched. Examples include: (1) any vacuum created by the suspension or reduction of projects or promises made to countries and governments by Venezuela, whose oil slump may make fulfillment impossible; (2) how the United States will address eventual export declines by Mexico and Venezuela; and (3) tension between Brazil and Bolivia over natural gas, not only as related to Brazilian investments in Bolivia, but also to those arising from Brazil's shift from deficit to self-sufficiency and even to exporting.

Savings, Prices and Public Corporations

Any energy policy must consider three fundamental elements: efficiency, public corporations and energy prices.

Energy efficiency is a priority objective of a consistent policy. Nearly all Latin American countries have the ability to reduce consumption at a reasonable cost using measures within reach of institutions and individuals. Energy efficiency can yield a remarkably high economic return and makes a significant contribution toward addressing climate change.

The largest players in the Latin American energy arena, especially as pertains to oil and gas, are National Oil Companies (NOCs). Many types of NOCs exist, varying by corporate governance systems and relations with the state, the private sector and society. These models are differentiated by the way NOCs address rent take (production sharing or concession-based contracts); whether private participation exists (in exploration and production, or in company ownership); how and by whom the company is governed; and the sector's price policy. Brazil's Petrobras and Venezuela's PDVSA are examples of NOCs that address these issues in divergent ways. NOCs are likely to continue to dominate the oil industry, especially in Mexico and South America, and the quality of their performance is a central energy policy issue in Latin America.

The study of pricing and subsidy policies is an issue of special concern, as in Latin America these can be an obstacle to consistent energy policies. They interfere with efficiency, discourage investment, distort demand, do not always favor the poorest and are a disincentive to integration.

Subsidies, first cousins of pricing, tend to be high in Latin America. Venezuela, for instance, has some of the world's lowest gasoline prices at enormous public cost. Subsidies in Venezuela and Ecuador represent 8.3% and 6.7% of GDP, respectively. In some cases, subsidies are high and lack transparency. Their cost and financing are unclear and they sometimes benefit the affluent sectors of society. At the same time, many non-conventional renewable energy sources are costly and can only be developed if supported by subsidies. This forces a discussion within a broad perspective about the advisability of investing in non-conventional renewable energy without impacting global economic growth or diverting funds from other areas, especially social needs.

Latin America and Climate Change

Energy's golden era of fossil fuels is coming to an end. Humankind has agreed that such a system is unsustainable and must be stopped due to high levels of carbon dioxide emissions and their contribution to climate change.

Latin America is not a large contributor to greenhouse gas emissions. The region adds a mere 6% to the world total, thanks to low levels of industrial output and public transportation emissions and the weight of hydroelectric power in the energy mix. The region's greatest potential contribution to climate change is deforestation.

Regional energy policies have already begun to address the climate change challenge. Important initiatives include hydroelectric power and increased energy efficiency. Nuclear energy too cannot be ignored. The controversies over its development, mostly political (nuclear weapon proliferation) and safety-related (risk of accident) cannot obscure the fact that it is a clean source of energy in terms of greenhouse gas emissions.

To the above policies—whether any or all are adopted—one must add the fundamental role to be played by non-conventional renewable energy for its contribution to reducing carbon dioxide emissions and fossil fuel dependence. In general, non-conventional renewable energy is expensive and hard to develop without subsidy support. Production costs have declined significantly in recent years, however, and there is active discussion about international financing tools that could make it accessible to countries with lower relative development. Latin American countries should continue their efforts to invest in non-conventional renewable energy and develop new, more accessible technologies. They should do so with caution, however, ensuring that development does not create a heavy subsidy burden or pronounced energy price increases. ■

Genaro Arriagada is a non-resident senior fellow at the Inter-American Dialogue.

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INTER-AMERICAN DIALOGUE'S
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Inside This Issue

Energy Conflicts: A Growing Concern in Latin America

By Patricia I. Vásquez

Protesters burning Christmas decorations in La Paz during a December 30, 2010 Gasolinazo protest against a decree by Bolivian President Evo Morales to remove fuel subsidies. Photo by James Brunker/Latin Content/Getty Images.

The past decade has witnessed a proliferation of energy projects in Latin America. Many have been central to the domestic economic development plans of governments; others have been efforts to expand much-delayed regional energy cooperation or consolidate a particular political agenda across borders. As oil, gas and hydroelectricity developments have multiplied, so have conflicts brought on by the negative political, social, environmental and/or economic externalities these projects have generated.

While the dynamics of the conflicts vary, the disputes at national and local levels share two underlying triggers: first, Latin America's deep-rooted economic inequality and the marginalization of certain societal groups; and second, weak state management of the revenue from extractive industries. The region succeeded in reducing inequality levels in the last decade through

improved education and increased transfers to the poor. The quality of the education the poor receive, however, remains lower than that attained by the top 10% of the population, and redistribution is minimal.

Persistent social and economic differences in spite of increased natural resource revenues in producing countries create frustration among the population and are at the heart of energy-related conflicts in Latin America. These conflicts can be regional, national or local. Regional conflicts may be geopolitical; in other words, related to the use of energy, particularly oil, as a tool for building political alliances across borders, or border conflicts related to unresolved, long-term geographical frictions that hinder energy cooperation between nations. At the national level, disputes stem from revenue conflicts or clashes over the distribution of natural resource revenues among different ethnic or economic groups. Local conflicts, in turn, emerge from disputes within the boundaries of areas under oil, gas or hydroelectricity development.

Revenue and local conflicts in particular build on historical economic inequalities, especially those affecting ethnic minorities, in addition to weak institutional frameworks and incomplete implementation of the rule of law. If not addressed properly and in a timely manner, these disputes may prove a challenge for economic development models based on extractive industries and threaten the stability of democratic governments.

Geopolitical Conflicts

Countries with large hydrocarbon reserves sometimes leverage their abundant resources to exert political pressure on governments dependent on energy imports. In other situations, they may use the wealth they accumulate through exports to push broader political or ideological agendas. Russia, in its handling of gas supplies to its European customers, fueled a geopolitical conflict.

In Latin America, Venezuelan President Hugo Chávez has used his country's ample oil and gas reserves—80.5 billion barrels of proven oil and 149 trillion cubic feet of natural gas—to craft energy cooperation initiatives that have gained political allies. The specter of supply interruption hangs over those who do not share his ideology. Chávez, a strong critic of the United States, has also used his country's hydrocarbon might to challenge opposition political views.

Border Conflicts

The most challenging border conflict in the region is between Bolivia and Chile and traces its origin to more than century ago. Since the War of the Pacific in the 1880s, when Chile took away Bolivia's access to the Pacific Ocean and left it landlocked, Bolivians have maintained a historic claim for return of the coastline. That grievance resurfaced in 2002 in the form of massive popular opposition in Bolivia to proposals to export gas from new reserves through a Chilean port. Violent uprisings left dozens dead and ousted two presidents—Gonzalo Sánchez de Lozada in 2003 and his successor, Carlos Mesa, in 2005—in what became known as the "Gas War."

When the private consortium project to export Bolivia's gas fell through, the companies turned to Peru instead. Had the original export venture succeeded, it would have turned Bolivia, South America's poorest country, into the region's first exporter of liquid natural gas (LNG). Instead, that privilege is enjoyed by Peru, which became Latin America's first LNG exporter in 2010.

Revenue Conflicts

Estimates of Bolivia's proven natural gas reserves increased from roughly 4.3 trillion cubic feet (tcf) in 2000 to 27 tcf in 2009. Bolivia has since been immersed in a long period of political instability as opposing groups struggle to control gas resources. This struggle has highlighted Bolivia's persistent class and ethnic differences: The relatively small percentage of the population of Spanish descent, which controls the gas-rich southeastern provinces of Tarija, Santa Cruz and Cochabamba, has squared off against the majority indigenous population in the country's western highlands. Underlying these differences are historical economic inequalities, as revenues from the eastern energy-producing departments have usually failed to improve the living standards of the poor in the rest of the country.

In March 1990, a nationwide march organized by the indigenous population —Marcha por el Territorio y la Dignidad (March for Territory and Dignity)— precipitated a series of laws that increased recognition of indigenous peoples' rights and their participation in the country's political life. Most important among them was the Law of Popular Participation, which aimed to decentralize state power by transferring political and administrative control – and 20% of the national budget – to local municipalities.

The ascendancy of indigenous President Evo Morales in 2006,

which marked the first time Bolivia's majority indigenous population has held political power, can be traced to the push for inclusion that gained momentum throughout the 1990s. Morales also sought economic power through greater control of the profitable gas revenues in Bolivia's southeastern states. Rather than acting as a balancing force, however, his election deepened the divide between the rich eastern lowlands and the poor western highlands. Morales set out to mandate a redistribution of some 30% of gas revenues to pay for social programs for retirees, public school students and other groups in the western states. The move weakened the autonomy movement, but many governance inefficiencies continue to create popular discontent. Clientelism, rent-seeking practices and corruption persist, particularly within the state-owned oil company (Yacimientos Petrolíferos Fiscales de Bolivia, or YPFB). Most important, thriving gas revenues, which went from $620 million in 2004 to $3.2 billion in 2008 (more as a function of price than increased investments), have failed to improve the livelihood of most poor Bolivians.

Morales is trying to reach a balance between the gas industry and growing discontent among indigenous groups who have yet to enjoy the benefits of oil and gas projects in their territories. Pushing forward with hydrocarbon development could erode Morales's indigenous support, open the way to increased confrontation from his own constituency and lead to the development of local conflicts.

Local Conflicts

With conventional oil reserves becoming harder to tap around the world, a new and largely undeveloped hydrocarbons frontier in the heart of the Amazon has attracted the interest of governments and oil and gas producers. Similarly, attempts by Latin American governments to promote regional energy integration and cooperation have resulted in several new hydroelectric projects, again mostly in the Amazon, as part of the South American Regional Infrastructure Integration Initiative (IIRSA). The growing emergence of oil, gas and hydroelectric projects in areas inhabited by indigenous communities that are now more effectively voicing their grievances has spawned a proliferation of local conflicts.

Protesters demonstrated against the construction of the Belo Monte Dam in Brazil in front of the Brazilian Permanent Mission to the United Nations on April 28, 2010 in New York City. Photo by Ben Hider/Getty Images.

Energy-related local conflicts are arguably the most difficult to solve because of the variety of actors involved, the complexity of the issues that need resolution and the intricacy of the applicable legal framework. The potential for such conflicts to spread depends on several triggers:

1. *The environmental and social standards of the company involved in the energy projects*. In the past decade, Latin America has seen a proliferation of small oil and gas companies as well as large national oil companies (NOCs), some of which observe less stringent social and environmental safeguards than the big majors.
2. *The local community's level of radicalization and opposition to the energy project*. Indigenous movements have radicalized their actions and gained more sophisticated negotiating skills across Latin America in the past two decades. The extent of opposition and radicalization may depend on various factors, among them local culture, the historical relationship between the community and extractive industries, and NGO involvement.
3. *The availability of institutional mechanisms to mediate conflicts*. Latin American countries often lack well-functioning institutions with the capacity to effectively mediate conflicts. An exception to this rule is the Peruvian Ombudsman's Office, which holds a high degree of legitimacy among all stakeholders and has succeeded in de-escalating conflicts. Local NGOs usually have lower success rates in mediating energy-related conflicts.
4. *The extent of law enforcement*. A constant source of energy conflicts is laws that are overlooked or improperly applied, or an abundance of overlapping rules that

make them confusing and inoperative. Combined with government failure to comply with international legal standards, such as those imposed by the ILO 169 Convention and the UN Declaration of the Rights of Indigenous Peoples, ineffective law enforcement could lead populations affected by energy development to resort to violence to seek answers to their problems.

5. *The existence of old grievances or a history of negative externalities related to energy projects*. In areas with a history of social or environmental damage from previous energy projects, local inhabitants tend to more actively oppose similar new developments. Such communities also tend to be more radicalized. The best example is the widespread opposition to new dams in light of the deep scars left by similar projects in the past.
6. *The level and nature of involvement of international non-governmental organizations in the conflict*. International NGOs have grown in power and sophistication over the last 20 years and are particularly active in the Amazon. They play a fundamental role in supporting communities in their negotiations with companies and governments, but have also been accused of contributing to the escalation of some conflicts by imposing agendas that do not fully represent the demands of local communities.
7. *The degree to which companies and governments comply with previous agreements with local communities*. A government's or company's failure to comply with a previous commitment to a community leaves locals feeling betrayed and is often a source of conflict. Trust that is eroded is difficult to rebuild. Communities often protest the breach of contract with force or violence.

Frequently underlying these seven elements are the historic economic disadvantage and social and political exclusion of the affected population. In many cases, indigenous communities find themselves suddenly negotiating with large oil corporations for access to basic education. Quasi-isolated and forgotten groups see these negotiations as their only chance to draw attention to their living conditions and improve their livelihood, or at least gain access to basic services. When the outcome of the negotiations is perceived to be unfair, communities affected by energy projects may resort to protests and sometimes violence to express their dissatisfaction. Conflict in these circumstances may become an instrument for forcing some kind of a solution to old grievances. Increased coordination over shared grievances by indigenous groups at the international, national and regional levels often exacerbates the conflicts. Unless properly addressed, discontent over historical injustices could build and become a source of democratic destabilization. The deadly confrontations in the Peruvian Amazon city of Bagua in 2009 offered a glimpse of this threat.

Potential Political Repercussions

There are four types of energy-related conflicts in Latin America: geopolitical and border conflicts at the regional level; revenue conflicts at the national level; and local conflicts with the potential to reach national importance unless properly addressed. Geopolitical and border conflicts normally receive the most attention from the general public and the media. Revenue and local conflicts, however, carry a greater risk of destabilizing the region by building on largely unresolved inequalities, weak governance and the increasing radicalization of the indigenous movement.

Expanded energy projects are necessary for economic growth in Latin America, where installed hydroelectric capacity remains very low and large oil and gas reserves await development. At the same time, the infrastructure required for such projects constitutes a tremendous risk factor, as most of the still-untapped oil and water sources are in environmentally and socially sensitive areas.

These social and environmental fragilities, combined with the dire economic reality and historical marginalization of the communities affected by energy development, generate gradually more conflictive situations. Unless addressed rapidly and properly, these conflicts could pose important challenges to Latin America's political stability and the region's prospects for economic growth. ■

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Latin America's Nuclear Future

By Jorge Zanelli Iglesias

What are the challenges and opportunities for nuclear power in Latin America? Will nuclear energy continue to be a marginal player in electric generation in the region (2% vs. 15% worldwide)? Are the drivers to revive the nuclear industry elsewhere in the world going to be observed here as well?

Nuclear Power: World Outlook

As of 2010, 436 nuclear reactors generated about 15% of the world's electricity. Hydraulic power, the other major low-emissions energy source, provided nearly 20%. But while hydraulic power is constrained by the availability of large rivers and depends on climate, nuclear power still has considerable room for growth. After a modest start in the 1950s and exponential growth in the 60s, the nuclear industry stagnated for 30 years in the western world, primarily as a result of the increase in interest rates caused by the 1973 oil crisis.

During the stagnation period, the nuclear industry developed progressively simpler, safer and more robust reactors. Streamlined procedures improved performance, helped boost load factors from 60% to 90%, and extended service life by about 30%. Since the first reactor that produced enough power for four light bulbs in 1951, the technology has come a long way. Nowadays, the nuclear industry is probably the safest (fewer accidents per MW generated); most reliable (load factors above 90%); economically attractive, even including decommissioning and waste management (comparable with coal-burning); and environmentally friendly (tiny CO_2 footprint) energy source.

The last decade has witnessed a revival of the nuclear industry driven by increasing demand for energy. In a context of uncertainty in oil prices and supplies, especially in the emerging economies, and concerns over greenhouse gas emissions, the supply security of nuclear power has made it more attractive. This has led to a rebound in construction, especially in East Asia, and prompted several European governments to revise their nuclear policies. China and India plan to increase their nuclear capacity by some 100,000 megawatts by 2020, and the US

Nuclear Regulatory Commission has received applications for 30 new nuclear reactors to go online in the next decade.

A new concern is global warming, presumably an effect of burning fossil fuels, which in a few decades returns to the atmosphere the CO_2 that was captured by plants over several hundred million years. Even some environmentalists formerly opposed to nuclear power advocate the use of nuclear technology to eliminate fossil fuels from electric generation worldwide. If the growing trend is maintained, nuclear power could be generating more than 20% of the world's electricity in 20 years.

Latin America's Nuclear Countries

Argentina and Brazil, like other world powers after World War II, developed nuclear energy as an outgrowth of military programs in the 1950s. Nuclear programs in these South American countries were sparked by the hegemonic ambitions of the authoritarian, nationalistic governments headed by strongmen Juan Domingo Perón and Getúlio Vargas, respectively. In the 1970s, military regimes in both countries covertly attempted to develop missiles and to master the complete nuclear fuel cycle. Although their civilian nuclear industries did not require it, both succeeded in controlling the heavy water enrichment and production cycle. Nuclear electricity was essentially a cover for military programs rather than a true attempt to secure the energy supply. With the return to democracy, both Argentina and Brazil abandoned their military goals, developing civilian nuclear power programs that have safely and reliably delivered 935MWe and 1,900MWe to their respective grids.

Mexico, in contrast, never started a military nuclear effort. In the early 1960s the government concluded that, at prevailing uranium prices, it made sense to sell oil abroad and import nuclear fuel rather than burn oil to produce electricity. This led to the construction of the Laguna Verde Plant in 1988, which has successfully provided some 1,330MWe to the Mexican economy.

The 5,300 MW of nuclear generation in these three countries covers about 5% of their internal demand and accounts for 2% of Latin American electricity generation. Argentina and Brazil are completing construction of third reactors (Atucha II and Angra III, respectively). Mexico is expanding the capacity of its Laguna Verde facility by 20% and is considering construction of eight new reactors as part of plans to reduce its carbon footprint. This vigorous growth, which could triple output by 2025, has wide political support, a big change from the opposition the original plant encountered in the1980s.

New Concerns, New Players

In recent years, several Latin American governments have expressed interest in starting new nuclear programs. Apart from Cuba, however, where efforts in this direction were started and then aborted, no new programs have been launched since the 1980s. After so many unfulfilled announcements, and the abundance of hydraulic and fossil fuel resources in the region, those claims can reasonably be dismissed as sheer advertising for image-building, without a serious commitment.

Brazil, Venezuela, Mexico, Colombia, Peru, Ecuador and Bolivia are rich in fossil fuels; Brazil has vast untapped hydroelectric potential; Paraguay exports five times the electricity it consumes; and, until recently, Argentina had a natural gas surplus. Such abundance makes nuclear energy unattractive as a short- or medium-term option. However, as economic growth forces up demand and fuel prices, as CO_2 emissions become increasingly objectionable and eventually taxed, and fewer rivers remain untapped, burning fossil fuels for electric generation will become uneconomical, unpopular and unethical. Sooner or later, Latin American economies will have to look for alternatives that can provide base-load electricity safely, reliably, affordably and sustainably to replace today's primary sources: hydropower, coal and gas. Renewables – wind, solar and geothermal – are intermittent, considerably more expensive and less reliable than the standard primary sources and, contrary to standard opinion, not as environmentally friendly with current technology. Scale is also an issue: It takes around 20,000 acres of wind turbines to match the output of a standard coal-burning plant. As energy–storing technology evolves, some nonconventional alternatives should play an important role in the future matrix, but which ones and when remain open questions. Since the only certain fact about the future is the growing need for energy, countries with limited energy resources that could jeopardize their economic future would be wise to invest in a proven technology such as nuclear, which could deliver energy to the required scale at a reasonable cost and in reasonable time.

Chile and Uruguay are seriously considering nuclear power as an alternative. These two countries are net energy importers, with limited fossil fuel deposits and little room for growth in hydropower. They seem the most likely candidates to join the regional nuclear club.

Reaching this goal, however, is a complex affair for any nation, hinging on unpredictable factors and internal and external political barriers that must be overcome.

Challenges and Opportunities

Countries that intend to start civilian nuclear power programs must not only have the financial resources to invest in the technology, but must also be technologically sophisticated and institutionally mature, with the necessary legal and regulatory government agencies. These nations should also have a safety culture that goes beyond having enough manpower to operate nuclear reactors, a regulatory body and a minimal technological network to support the nuclear industry. They must have the human resources trained for high standards of safety and rigor.

Civilian nuclear power programs require broad social consensus. Both imaginary fears and legitimate concerns about nuclear energy must be addressed, and the long-term commitments cannot be overlooked. The first power that nuclear reactors generate brings with it irradiated fuel containing high-activity, long half-life radionuclides that must be kept in isolation for several centuries. Although this is not technologically difficult to do, it underscores the fact that starting a nuclear power program requires having answers to questions that might arise a hundred years down the road. In participatory democracies, this requires a high level of public consensus and governments that guarantee transparency, thoroughness and best practices through competent, rigorous, independent and fully empowered regulatory agencies.

Nuclear countries must also satisfy the international community with a clear commitment to peace. All Latin American and Caribbean countries have ratified the Tlatelolco and Nuclear Non-Proliferation treaties, but recent ambiguous statements by Brazilian authorities with regard to the legitimacy of the military use of nuclear energy have cast a shadow over the civilian nature of that country's program. Venezuela's plans to join Iran's nuclear efforts have also raised concerns in the international community. Although there are no signs that Venezuela has the technological knowhow or the intention to become a rogue state like North Korea, it is still a matter of concern that Venezuela, Brazil and Argentina have yet to endorse the Additional Safeguards Protocol to allow unimpeded nuclear inspections.

Recurring international concerns about terrorist groups getting hold of fissile material to make weapons, or spent fuel and other radioactive material to produce "dirty bombs," are exaggerated given the enormous technological difficulties involved in building a working nuclear bomb and the inefficiency of a dirty bomb as terrorist propaganda.

Regional integration is probably the key to ensuring viable, robust and transparent nuclear programs. International cooperation could help newcomers establish their regulatory infrastructures. The industry could benefit from an extensive network of advanced technology providers, with training and certification of operators and inspectors carried out at regional centers. Integration could also provide assurances to all stakeholders of compliance with non-proliferation agreements and avoidance of the military use of nuclear power, similar to the ABAAC agreement between Argentina and Brazil for the enrichment of uranium. Electrical integration of the region, like the SIEPAC project in Central America or similar efforts in the Southern Cone, would make the grids more stable, economically efficient and robust under local or seasonal climate fluctuations. Finally, an integrated Latin American nuclear energy effort could play a role similar to that of EURATOM, which started the European economic integration that gave rise to the EEC 40 years later.

The recent earthquake and tsunami that struck Japan have raised legitimate concerns about the safety of the nuclear industry. The accident at the Fukushima power plant prompted antinuclear voices demanding the suspension of new reactor construction and possibly reducing existing nuclear generation. Although it is too soon to tell whether human responsibilities contributed to the magnitude of the accident, the lessons learned from this experience will be incorporated into the next generation of nuclear reactors, significantly improving the safety and reliability of the nuclear industry, in an evolution similar to that of the aviation industry. The nuclear industry will certainly suffer in the short term as governments and investors revise their plans and the technology absorbs the lessons learned. As the dust settles in a scenario of increasing energy demands, however, renewed growth can be expected. The image of nuclear energy will suffer in the eyes of the public, but its safety record will not change much from its historical level, keeping it one of the safest and most environmentally friendly forms of electric generation. ■

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What Climate Change Means for Latin America

By Paul Isbell

Compared to the US or China, each of which contributes 20% of the world's annual greenhouse gas emissions, Latin America accounts for a mere 10%. Agriculture (a major source of methane) and deforestation account for nearly two-thirds of the region's greenhouse gases.

Latin America's position in the energy and climate change landscape generates unique strategic policy choices. Like Africa, Latin America has contributed relatively little to climate change, but the region is set to absorb more than its fair share of the environmental and geopolitical consequences of the problem, leading to a range of strategic incentives and disincentives that require more than mere replication of the policy responses elsewhere.

Latin America is particularly vulnerable to climate change due to its geography. Much of Mexico and Central America lies within the hurricane belt, which now operates with greater force and volatility as a result of global warming. Latin America's low-lying coastal zones, which include many of the region's largest urban areas, will come under threat from warming-induced rising sea levels. In addition, much of South America's agriculture and urban activity depends on water flowing from the Andean glaciers, which are now in retreat. This threatens the sustainability of the region's populations and economies and, in particular, its main low-carbon energy source – hydroelectric power.

How such environmental instability will interact with ongoing geopolitical frictions and heightened instability in different parts of the region is far from clear. Climate change is poised to impact Latin America just as many of the region's economies are breaking away from a traditional cyclical dependency on the world's core developed economies. The region's economies are slowly but surely diversifying their domestic production, internal demand, and external trade and financial linkages. Brazil in

particular is emerging as a pioneer in energy and climate policy. At the same time, however, the region remains vulnerable to traditional maladies – from the oil curse to the debt trap – that typically interact destructively with the sources and impacts of human-induced climate change.

Compared to the United States or China, each of which contributes more than 20% of the world's annual greenhouse gas emissions, Latin America's impact is a mere 10%. In per capita terms, these figures correspond to more than 23 metric tons per person in the US, compared to just over 10 metric tons in Latin America. This is down from more than 13 metric tons 20 years ago.

Furthermore, Latin America's carbon footprint has a distinctive structure and obeys a different dynamic than in other parts of the world. While CO_2 emissions from energy use make up nearly two-thirds of global greenhouse gas released from all sources, in Latin America they account for less than a third. Instead, agriculture (a major source of methane) and changes in land use patterns, including livestock-driven deforestation, account for nearly two-thirds of the greenhouse gases the region produces.

If we removed all greenhouse gas contributions stemming from changes in land use patterns, the region's share would drop to around 6% (around 5 metric tons per capita). The US contribution in relative terms would remain at more than 20% (22 metric tons per capita). But if we discounted all non-energy related greenhouse gas emissions, Latin America's contribution would fall even further, to between 3 and 4% of the global total (compared to 19% from the US), around four to five metric tons per capita. This is in line with Chinese per capita energy-induced CO_2 emissions.

What this emissions profile should tell policymakers about Latin America is that energy consumption there is less dirty (in climate terms) than in most other parts of the world. Although Latin America is still more dependent on petroleum, which comprises 44% of its energy mix compared to 35% in the world as a whole, it is less dependent on coal (4% compared to a global average of 24%). Coal is by far the energy source that emits the most CO_2. In its place, Latin America relies on large-scale hydroelectric power for approximately 25% of the region's primary energy mix. In Brazil, the figure is 75%, an even greater electricity share than France's fabled nuclear power, while in Paraguay hydropower approaches 100% of the electricity mix.

For policymakers, the battle against deforestation is even more important than decarbonization of the energy economy in Latin America. This is particularly true in Brazil, where biofuels add even more low-carbon energy – 25% of all transportation fuels – on top of hydroelectricity. But while Brazil's energy economy is relatively clean in terms of carbon emissions, its economy accounts for much of the significantly higher level of greenhouse gas emissions in the region in total.

To some observers, all of this suggests that the push toward a post-fossil fuel energy future is less urgent in Latin America than in other parts of the world. On the one hand, given the low level of CO_2 emissions stemming from energy across the region, even if Latin America completely decarbonizes its energy economy it will make little difference to the rate of global greenhouse gas accumulation in the atmosphere (the key in this regard resides in the US and in China). The expansion of livestock agriculture, on the other hand, which leads to both increased methane emissions and forest clearing-induced CO_2 accumulation, significantly contributes to global warming. Efforts to halt deforestation in developing countries, such as the REDD+ program, have been recognized by the international climate change community as critical elements in the fight against global warming. Unfortunately, while Latin America has improved on the land-use front, its traditionally low energy-induced carbon dioxide emissions have increased significantly in recent years, even if from a low base.

Some Latin American countries may see little strategic gain in undertaking the arduous and costly effort of deploying low-carbon energies to reduce global emissions in time to avoid the worst manifestations of climate change. Yet many of the same countries have much to gain from significant efforts to pursue low-carbon energy deployment, simply because such a commitment is often the best way to garner financing for the costly mitigation efforts and even more expensive climate adaptation they will soon need. Even without the threat of climate change, many Latin American countries would see strategic benefits from displacing imported, high-priced fossil fuels with domestic renewable and other low-carbon energy sources, reducing direct energy costs and freeing themselves from potentially destabilizing dependence on unstable and unreliable sources. ■

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Central America's Energy Challenges

By Cristina Eguizábal

Of the three poorest countries in the Americas, two are in Central America. With the exception of Costa Rica and Panama, poverty rates are high and inequality is profound. Central American countries spend much of their resources on imported hydrocarbons despite the fact that the region's main source of energy for household use remains firewood. This is even true of Belize and Guatemala, the region's only oil producers. As a result, the seven small economies of the region suffer when oil prices are high, as was the case in 2008.

Hydroelectricity, administered by the state through public utilities and transmission companies, has dominated electricity generation in the region. In the 1990s, economic liberalization and privatization reached the energy markets and attracted foreign investors to develop new power plants. Investors preferred thermal (diesel-powered) plants as they were less costly and faster to build than hydropower plants, let alone river dams. In the 1980s, approximately 75% of the region's energy came from hydroelectric dams; that percentage has since dropped to less than 50%. In 2009, according to ECLAC, 47.5% of electricity in Central America was generated by hydraulic power, 37.3% came from oil, 7.9% was geothermal, 4.4% was generated by sugar cane, 1.8% came from coal and 1% was wind-powered. Of that total, 60.8% of electricity was generated from renewable sources. As a result, the region's energy matrix looks fairly diversified, although much work remains to be done for the countries to reach energy output levels capable of maintaining economic growth and lifting their

Guatemalan woman carrying a load of firewood from the slopes of the mountain to her home. In the Quiche region, more than 90 percent of families rely on firewood for cooking.

Windmill farm on the shores of Lake Nicaragua. The Concepción Volcano on Ometepe Island dominates the background.

populations up from poverty while reducing the proportion of hydrocarbon-generated electricity.

Energy profiles vary among Central American countries: 95% of Costa Rica's energy production comes from renewable sources (mostly river dams), while in Nicaragua the figure is 26.6%. In El Salvador, Guatemala, Panama and Honduras the proportion of renewable energy is around 50%. All of the countries in the region need to expand their power-generating capacity quickly to extend the electrical grid to rural areas and complete the electrification of their territory. Out of a total of 40 million people living in Central America, approximately 10 million do not have electricity in their homes and almost 20 million still use firewood for cooking. The challenge confronting Central American countries is their need to reduce reliance on traditional biomass sources of energy –e.g., firewood—which are not only big polluters but also contribute to the region's rapid deforestation. It is imperative to build renewable energy-generating capacity while reducing emissions of greenhouse-effect gases.

Central America's hydroelectric potential is far from exhausted. Big dams are not only costly in financial terms, however; by dramatically changing the social and ecological systems of an entire region, they can also become costly politically. The Brazilian conglomerate Quieroz-Galvão-Electrobras is building a new dam, Tumarín, in Nicaragua's South Atlantic Autonomous region. The dam will revert to public property after 30 years, but the communities that surround Tumarín –which claim they were not consulted about the project—and environmentalist groups allege that it will negatively impact the entire Río Grande de Matagalpa watershed.

The Chalillo hydropower project in Belize provides another example. Since 2005, Belize Sugar Industries (BSI) has been working on a plant that runs on both oil and sugar cane bagasse (92% renewable). It will produce 30 megawatts of power, of which 25 megawatts, representing 20% of Belize's national grid, are to be sold directly to the state-owned Belize Electricity Limited. The remaining five will be for use at the BSI factory.

Other renewable public-private partnerships in energy projects include wind parks in Costa Rica (Plantas Eólicas de Costa Rica) and Nicaragua (Amayo I and II), which are already operational, and Cerro de Hula in Honduras, still under construction. El Salvador is Central America's larger producer of geothermal energy. Two plants in Ahuachapán and Berlín generate approximately one-quarter of the country's total output.

At the other end of the continuum are small-scale renewable energy initiatives that allow poor rural populations to avoid the need for fixed lines. There are no reliable data on the spread of off-grid renewable energy on a small scale, but a large number of these systems are being installed. Small solar projects, underground biogas chambers and "mini" hydroelectric dams deliver electricity at a price that even the poor can afford and are sufficient to power cell phones, fans and high-efficiency light bulbs. These initiatives will not replace the need for the more reliable electricity delivery systems necessary to power major appliances such as refrigerators, but until that happens, they will make life easier for millions of people, particularly poor women and children.

The most ambitious energy initiative involves not power generation but power efficiency, by linking the power grids of Panama, Costa Rica, Nicaragua, Honduras, El Salvador and Guatemala. After 20 years of discussion, Central American governments finally began construction of the Central American Interconnection System (SIEPAC) in 2006; the interconnection of Panama and Costa Rica became operational on October 25, 2010. As part of the Puebla Panama development initiative (which includes Colombia as well), the Regional Electrical Market plans to complement SIEPAC with electrical interconnections between Guatemala and Mexico, Guatemala and Belize, and Panama and Colombia. Supporters of the project argue that the interconnection of the nations' electrical transmission grids will optimize shared use of hydroelectricity, reduce operating costs and create a large enough market to attract foreign investment in power generation and transmission systems. Some critics fear that SIEPAC will facilitate electricity exports to Mexico and Colombia but not expand access in Central America, and others voice concerns about the associated environmental and social costs of large hydropower facilities. Supporters and critics alike stress the weakness of the region's regulatory environment at all levels, national and regional.

Central American countries must expand their electricity generation considerably in the coming years. To do so responsibly, they need to establish a truly diverse energy pattern based on financial and environmental sustainability. ■

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Why the United States and Cuba Collaborate
(and What Could Happen If They Don't)

By Jorge Piñón

If Cuba's suspected but yet undiscovered hydrocarbon reserves are proven real, it will take between three and five years to develop them fully. Production volumes would have to reach more than 200,000 barrels per day to have the same positive economic impact currently derived from foreign oil subsidies. If this occurs, significant revenues from oil, natural gas and sugarcane ethanol would integrate Cuba into global and regional markets within the next five years.

International oil companies such as Spain's Repsol, Norway's Statoil Norsk Hydro and Brazil's Petrobras are actively exploring Cuba's Gulf of Mexico waters. Cuban authorities have invited United States oil companies to participate in developing the island's offshore oil and natural gas resources, but US law does not allow this. Although US oil, oil equipment and service companies have the capital, technology and operational know-how to explore, produce and refine Cuba's potential reserves in a safe and responsible manner, the almost five-decade old unilateral political and economic embargo keeps them on the sidelines.

Cuba currently relies on heavily subsidized oil from Venezuela for two-thirds of its petroleum needs. This supply contributes to the Cuban government's ability to maintain a politically antagonistic and belligerent position towards the US.

The collapse of the Soviet Union in 1991 made Cuba aware of the political and economic risks and consequences of depending on a single source of imported oil. Only when Cuba diversifies suppliers and develops its offshore hydrocarbon resources, estimated by the United States Geological Survey at 5.5 million barrels of oil and 9.8 trillion cubic feet of natural gas, will it have the economic independence to consider political and economic reforms. It is in the US interest to develop a new policy toward the island based on constructive engagement to support the emergence of a Cuban state in which Cubans themselves can determine the political and economic future of their country through democratic means.

Cuba is about to embark on an 18-month oil exploration drilling program to validate the presence of recoverable hydrocarbon reserves. US support of such endeavors would be beneficial in the framework of a constructive engagement policy.

The Deepwater Horizon drilling semi-submersible incident and the resulting catastrophic oil spill demonstrate the urgency of developing a policy of energy and environmental cooperation between the United States and Cuba. As Cuba develops its deepwater oil and natural gas potential, the possible consequences of a spill call for proactive planning by both countries to minimize or avoid an environmental disaster.

To respond effectively to an oil-related marine accident, any company operating in Cuba would require immediate access to US oil services companies for the near-instant technology and know-how needed to halt and limit damage to the marine environment. Obviously, the establishment of working relations between the US and Cuba in the area of marine environmental protection would assist enormously in the contingency planning and cooperation necessary for an early and effective response to an oil spill.

The United States and Cuba are already parties to a number of multilateral oil pollution agreements, such as the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL) and the 1983 Convention for the protection and Development of the Marine Environment in the Wider Caribbean Region (Cartagena Convention). Both agreements address prevention of pollution of the marine environment by ships from operational or accidental causes. The 1990 International Convention on Oil Pollution Preparedness, Response and Cooperation also offers a precedent for cooperation. The convention is designed to encourage and facilitate international cooperation and mutual assistance in preparing for and responding to major oil pollution incidents. Signatory

nations are tasked with developing and maintaining adequate capabilities to deal with such an emergency. In the case of Cuba and the United States, the capabilities must be transnational, as there is no barrier to the movement of oil from one country's waters to another's. The United States, therefore, must develop appropriate regulatory and procedural frameworks for the free movement of equipment, personnel and expertise between the two countries as part of any oil spill response.

The 1980 Agreement of Cooperation between the United States and Mexico Regarding Pollution of the Marine Environment by Discharges of Hydrocarbons and Other Hazardous Substances (MEXUS Plan) provides the foundation for a similar protocol with Cuba. This would include the establishment of joint response teams, coordinating roles, rapid incident notification mechanisms, joint operations centers and communication procedures, along with regular exercises and meetings. The United States government, irrespective of the current embargo, has the power to license the sale, lease or loan of emergency relief and reconstruction equipment and the travel of expert personnel to Cuba following an oil spill.

Cuba's long-term energy challenges will be a consequence of its future economic growth and rising standard of living within a market environment. This anticipated growth will depend largely on the development of a competitively priced, readily available and environmentally sound long-term energy plan. Cuban energy policy should embrace energy conservation, modernization of the energy infrastructure, and balance in sourcing oil/gas supplies and renewable energy sources that protect the island's environment. The country would benefit from the guidance of a variety of partners, including the United States. ■

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Challenges of Designing an Optimal Petroleum Fiscal Model in Latin America

By Roger Tissot

The ability to replace hydrocarbon reserves is influenced by the level of investment in exploration activities. Governments have two options for conducting exploration activity: 1) investing in exploration activities directly; or 2) asking private companies to make the investments.

In the first case, the ability of the entity – usually the National Oil Company (NOC) – to make investments depends on the skill level of the country's workforce, the government's financial capabilities, its aversion to risk, and the level of financial and strategic independence of the NOC from other government authorities.

Political authorities tend to be risk averse and would prefer to use scarce financial resources for projects aimed at improving social conditions or economic development. Their investment preferences are also influenced by political ideology and the preferences of their constituencies.

The NOC has to compete with other government authorities for the funding to make its investments. The more dependent on NOC revenues the government is, the less independence will be granted to the NOC. In this case, the NOC is more likely to be risk averse, focus most investments on sustaining production from existing wells, and implement only modest exploration activities in the most prospective areas.

Sometimes NOCs manage to achieve a high level of independence from the government despite being their main source of cash. The sustainability of NOC "independence" depends upon three factors: 1) its ability to meet the government's financial needs; 2) its capacity to produce and replace reserves efficiently; and 3) endorsement of NOC strategic activities by top-level political authorities. If these conditions are not met, the result is often a cash-starved and risk-averse NOC unable to carry out exploration alone.

The other option is for governments to offer the rights for developing the resource via concessions to international oil companies (IOCs), or to partner with them in exchange for a share of production or profits. The option selected depends on the government's choice of petroleum fiscal models.

The different "families" of models represent legal contracts or agreements covering rights granted over a period of time and for an agreed level of activity. The difference between these systems mostly involves the mechanics of risk and reward sharing between the contractor and the government. Fiscal models can be more or less progressive depending on when the rents are captured: the later the payment is required, the more progressive the system is.

The main challenge in the design of optimal fiscal system is to achieve alignment of different and sometimes diverging objectives between the government and the IOC. The government's primary objective is to maximize the value of its petroleum resources while attracting sufficient interest from IOCs to invest in E&P activities. IOCs in turn seek to ensure that the rate of return on the capital employed is consistent with the project's risk and with the strategic objectives of the corporation.

Latin American Experience

Latin America has been a fertile ground for petroleum fiscal models. Whether the region's policies are open or closed usually obeys shifts in the political pendulum from populism to economic orthodoxy. In the 1990s, therefore, Latin America adopted market-oriented models, reduced government take, ended NOC monopolies and, in some cases, privatized them. The private sector response was positive, resulting in rapid growth of reserves and production. Most of the fiscal models, however, failed to respond to the steep price increases. That failure coincided with the rise of new populist regimes that relied on resource nationalism as

a key component of their political platforms.

Since this most recent "turn to the left," Latin America has faced two very different paths with regard to oil policy. The first favors state corporatism and maximization of rents even at the cost of investments and additional reserves. This is the case of Venezuela, Bolivia, Ecuador and, to a certain degree, Brazil and Argentina. The second path advocates strengthening market-oriented models, resulting in a boom in investments in Colombia, Peru and, to a lesser extent, Trinidad & Tobago.

Oil Reserves and Production

Figure 1 shows the evolution of petroleum reserves in Latin America from the 1990s through 2009. Reserves increased modestly (0.7% on average) from 1990 to 2005, followed by a drastic jump since then.

Figure 2 shows the change in oil reserves in the main oil-producing countries of Latin America between 2004 and 2009. Venezuela explains most of the jump in reserves over the last few years. This is not "new oil" but rather a change in the definition of already recorded reserves from the heavy crude oil Orinoco fields. Brazil has increased its reserves almost constantly in the last two decades, due in part to more active exploration efforts by Petrobras, the Brazilian NOC, and IOCs since the opening of the sector a decade ago. Brazil has also captured international headlines since 2008 due to huge discoveries of pre-salt oil, described as a "game changer" for Brazil's petroleum outlook. The country is expected to become an important oil exporter in the next decade.

Latin America's oil production peaked at 10.65 million b/d in 2005. Since then, production has

Figure 1

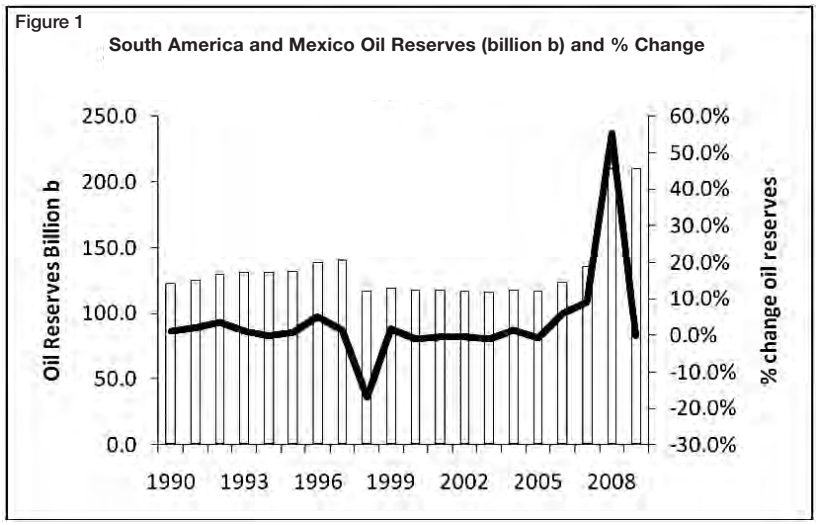


Figure 2

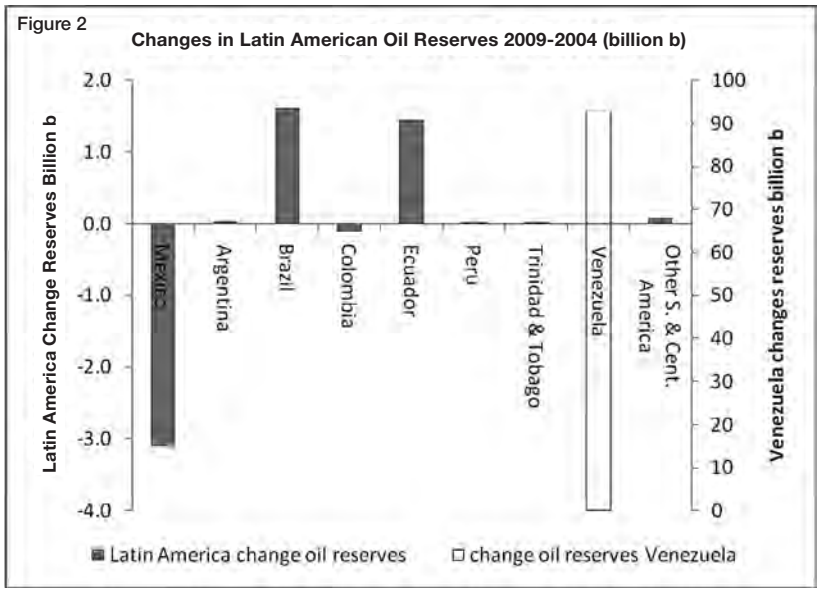
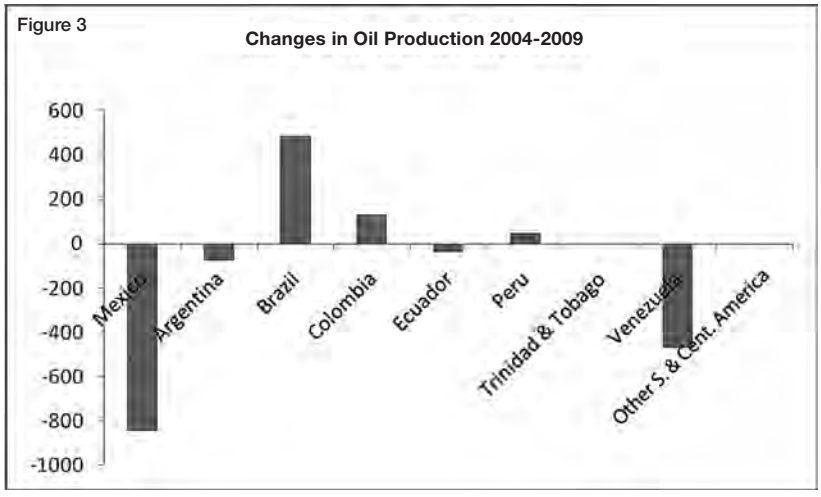


Figure 3



slowly declined to less than 10 million b/d. Average production changes since 2005 on a country basis show Mexico with the biggest decline, followed by Venezuela, Argentina and Ecuador. Gains were made in Brazil, Colombia and Peru.

Petroleum Policy Outlook

According to a recent report by the Fitch Rating agency, capital expenditures by the largest five Latin American NOCs could reach US$550 bn in the next five years. Coinciding with the ambitious expansion plans is a deterioration of fiscal balances in the region due to increased spending caused by the fiscal stimulus in 2009 and natural disasters during the 2010 rainy season.

Countries that were seen as "business friendly" have become victims of their own success. Access to land is becoming more expensive and governments have imposed higher taxes and royalties and/or stricter qualifying requirements for IOCs. Resource-nationalist countries have experienced a drastic decline in production and, in some cases, reserves. The economic sustainability of these countries is tied to new investments. There is uncertainty about local NOCs' abilities to meet the investment challenge, while foreign investors would expect a reward attractive enough to compensate for political and fiscal risks.

In the last decade, some countries have successfully increased their hydrocarbon reserves, with high rents for governments, increased investment and attractive rates of return for investors. It would be tempting to "copy" the fiscal models of successful countries, but a successful fiscal model must reflect the political, social and economic characteristics of the host country. In some countries, allowing concessions to IOCs may be seen as highly offensive, for historical reasons. In others, the need to secure new reserves to postpone the need to import oil is a sufficient incentive to grant IOCs attractive fiscal conditions.

The main challenge in Latin America is to design petroleum fiscal models that are flexible enough to incorporate price volatility and political change and stable enough to allow private investors to focus on long-term development. ■

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Petrobras: The Unique Structure behind Latin America's Best Performing Oil Company

Genaro Arriagada and Chris Cote

Brazil's oil and gas giant Petrobras stands among the world's most successful businesses, admired by the public as well as by private and state-owned national and transnational oil companies. Petrobras today is active in 23 countries in the exploration, production, refining, distribution and sale of oil, gas and energy, as well as petrochemicals, biofuels and electricity.

Latin America's most successful oil company owes its success at least in part to Brazil's condition as an oil-poor country with a government that does not see it as a cash cow. Unlike the other state-owned powerhouses in the region, Mexico's PEMEX and Venezuela's PDVSA, Petrobras grew gradually on a reputation for efficiency, ensuring crucial funding from government and other sources. The recent discovery of pre-salt oil now presents the company with the opportunity to exploit immense new reserves.

Petrobras headquarters, Rio de Janeiro, Brazil.

A Remarkable Success

After recovering quickly from the recent financial crisis, Petrobras is considered the world's eighth largest corporation and is often described as Latin America's best-managed company.

Brazil's oil and natural gas production are rising: Oil production is projected to increase by 60% by

2014 and 130% by 2020 (compared to 2008). Natural gas production is estimated to increase by 100 and 245%, respectively. Company reports estimate that in 2014 Petrobras will produce 3 million barrels of oil per day and 623,000 barrels of oil equivalent (boe) in natural gas.

Petrobras's investment is enormous. Its 2010-2014 Business Plan calls for an investment of $224 billion (some $45 billion per year), more than five times the investment level of PDVSA, according to independent estimates.

Petrobras's efficiency compares exceedingly well to oil companies of similar size, although accurate comparisons are difficult as most similar sized national oil companies (NOCs) —the majority in the Persian Gulf—do not provide audited figures. Industry analysts believe that Petrobras vastly outperforms all of them. Petrobras also ranks exceptionally high when compared with the supermajors.

Statists vs. Free Enterprisers

The history of Petrobras is rife with tension, largely between those who wanted a fully state-owned enterprise ("statists") and those who envisioned Petrobras as a private company ("free enterprisers"). The Brazilian government cemented Petrobras's status as a state institution with several laws between the 1940s and 1960s, and the Federal Constitution of 1988, which enacted a state monopoly over all aspects of the hydrocarbons industry, put Petrobras firmly in state hands.

After several unsuccessful attempts in the early 1990s, reform proponents finally had some success under the presidency of Fernando Henrique Cardoso. A 1995 Constitutional amendment authorized the federal government "to outsource oil and gas activities under state monopoly to private or government-owned companies."

Two years later, Congress set a new industry framework segregating Petrobras's business and regulatory roles. Petrobras kept the former while the latter was transferred to a new National Petroleum Agency (ANP), effective in January 1998. The interaction between Petrobras and the ANP is among the keys to understanding the success of Brazil's oil policy.

The ANP's ample powers include the awarding of exploration and production bids for oil, natural gas and other liquid fuel concessions; approving the import, export and transportation of natural gas, oil and its derivatives; and playing a regulatory, oversight and dispute-settlement role in substantive cases. While maintaining a state monopoly on oil and gas, Brazil grants exploration and production concessions to Petrobras, private companies and joint efforts. In January 2002, the country also deregulated imports, exports and prices.

A Very Special Government Corporation

The recurring conflict between statists and free enterprisers, which has never been fully resolved, is fundamental to understanding how Petrobras became a sui generis national oil company. Petrobras has dual status as a government corporation with a crucial role in Brazilian growth and as a dividend-paying private company.

Private involvement in Petrobras would not have been possible without a legal framework guaranteeing government control. Brazil shares with many other countries a nationalistic concern about oil resources, especially with regard to selling into foreign hands. Rather than risk denationalization of the industry, Law 9478 of 1997 ensured that private shareholders had practically no non-economic rights, especially over management function, by separating stock into voting common shares and non-voting preferred shares. It also required state ownership of 50%-plus-one of voting shares. A complementary 1999 law extended the possibility of stock ownership to foreign companies and individuals. Foreign-owned stock now exceeds the share in private Brazilian hands.

State Business

A nine-member board of directors heads Petrobras. Seven members are government-appointed, one represents non-government minority common shareholders, and another is elected by preferred shareholders. The board is made up of cabinet-level officials (President Dilma Rousseff was previously a member), former military officials and academics, all with close or direct ruling party ties. One responsibility of the CEO is to propose a slate of six general managers for board approval or rejection. Along with the CEO, these general managers make up the executive board that runs the company. All board members except the CEO have had at least 30 years of experience in Petrobras.

Petrobras works closely with Congress and the administration. State oversight is exercised through legislative approval of multi-year plans that establish general company goals and budgetary and investment guidelines. The plan helps entrench in law a medium-term budget timeframe free from Finance Ministry fiat. Petrobras operational, economic and government policy are harmonized through executive approval of a Global Expense Program.

Oil drilling platform off the coast of Brazil.

Private Investment and Oversight

Private ownership in Petrobras has expanded dramatically in the last decade. The number of shareholders grew by 153,000 between 2000 and 2008, and today one million individuals hold shares in Petrobras-related securities.

Privatization proponents often claim that companies are more efficient and profitable in private hands. Petrobras has performed outstandingly in state hands while keeping the private sector in the role of a mere investor. Placing stock in private hands, however, had a fundamental effect on efficiency. It made Petrobras subject to the same oversight standards that apply to private multinationals, including the Sarbanes-Oxley Act, with audits and oversight conducted by a securities commission. The presence of private shareholders also serves as a check on government attempts to milk NOCs for cash.

Opportunities and Challenges in Pre-Salt

When the pre-salt oil reserves—estimated to contain 50 billion boe—were discovered off Brazil's southeast coast in 2006 and 2007, the Lula administration quickly moved to bring the oil under more direct state control. The government passed four laws in 2010 that effectively limit foreign participation and guarantee Petrobras a majority hand in production.

The first law created a new, state-owned company, Pré-Sal Petróleo S.A. (PPSA), to manage pre-salt production sharing contracts entered into by the Ministry of Mines and Energy. The second authorized the government to cede Petrobras exploration and production rights to the equivalent of 5 billion boe in the pre-salt in exchange for a company share package whose value is set by law. The third made Petrobras the sole operator of pre-salt projects and gave it a 30% minimum stake in each. Finally, the fourth law created a social fund that will invest pre-salt profits in education, anti-poverty initiatives, the environment, science and technology.

This legislation—especially Petrobras's required operatorship in each project—presents an enormous opportunity to increase production levels over the next decade, but it also demands of Petrobras a high level of capitalization, skilled labor and management, technical expertise and efficiency. While Petrobras is widely considered to be capable and experienced enough to tackle the pre-salt, the amount of new production projects coming online will test the company's human resource capacity and could undermine the sound management and organization that have brought it success up to this point. Critics of greater state control over the pre-salt are also concerned about the loss of competition and resulting inefficiencies that may arise.

These obstacles notwithstanding, Petrobras is well positioned to take on the pre-salt projects. Its investment is on the rise, and capital inflows are increasing from foreign and domestic sources. The technical challenges are surmountable and will give the company greater experience in ultra-deepwater fields, cementing its position as the most successful and experienced deepwater driller. Brazil is already self-sufficient in oil production and consumption. When all of the pre-salt projects come online—probably around 2020—Petrobras should become a major oil exporter. ■

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Argentina's Energy Pricing Challenges

By Pablo Fernández-Lamela

Argentina's most immediate energy challenge is pricing—a situation it has in common to varying degrees with many other Latin American countries. Since 2002, the Argentine government has capped the price of oil, gas and electricity substantially below market levels. The result has been a sharp drop in energy investments, rising consumer demand and growing subsidies. The government has taken some measures to address the situation but the central problem persists: To attract investment, reduce wasteful consumption and increase hydrocarbon reserves, Argentina needs to let markets determine most energy prices.

For the past two decades, Argentina has been a net energy exporter, but low prices, declining production and rising domestic demand have brought the country close to becoming a net energy importer. Oil output decreased by 27% between 1998 and 2010, and gas production has declined by 10% since 2004. Oil exports dropped by 64% from 2001 to 2009; gas exports plummeted by 88% from 2004 to 2009. Proven reserves of oil declined 22% in the last 10 years and gas reserves have fallen by 55%.

In the 1990s, Argentina shifted its heavily state-managed energy sector to private ownership and introduced a series of other energy-related reforms. State oil, gas and electricity companies were mostly

privatized and new policies and regulations promoted foreign investment in energy companies. Production of oil, gas and electricity went up, while costs per unit came down. Argentina became an energy exporter.

Since the country's 2001-2002 economic collapse, the Argentine government has kept energy prices artificially low. The price of oil is 70% of its international reference price. Gas and electricity prices have fared worse at only 20% and 30% of international references. Sustaining low consumer prices (which leads to inefficiently high use) requires the government to subsidize imports during months of elevated demand, with major fiscal consequences. During the first three quarters of 2010, the Argentine government spent approximately $4.5 billion on energy subsidies, or about 1.3% of GDP. From 2002 to 2009, oil and gas subsidies cost the Argentine government $55 billion. Energy subsidies have also been a source of friction in Argentina's external relations; for example, high domestic usage allowed the Argentine government to halt exports of natural gas to its neighbor, Chile.

Raising energy prices is an extraordinarily sensitive political matter in Argentina, as it is in many other Latin American countries, but it is essential for the health of the energy sector and for the country's longer-term development. Without higher prices, neither foreign nor domestic investment will be available for energy exploration or production, and subsidies will continue to drain Argentina's fiscal resources. ■

Pablo Fernández-Lamela is a Master of Public Administration candidate at Harvard University's John F. Kennedy School of Government.

Energy Consumption: Challenges and Opportunities of Urbanization

By Heidi Jane Smith

Latin America and the Caribbean is the most urbanized region in the developing world. Of the mega cities with populations of five million or more, eight are located in this region, and the World Bank estimates this number to increase to 15 by 2030. Faced with the challenges of rapid urbanization, a number of cities have developed innovative ways to deal with increased waste, air pollution and the rising cost of energy. The transportation systems, sanitation sites and waste-to-energy models developed in Latin American cities have been replicated around the world.

When the southern Brazilian city of Curitiba began growing rapidly in the 1960s, Mayor Jaime Lerner and his planning team restructured the city's traffic flow to reduce cars in the downtown area. Curitiba lacked the funding for a subway system, so the team designed a system of express lanes to speed buses through traffic. The system saves around 27 million auto trips annually and approximately 27 million liters of fuel. As a result, Curitiba uses 30% less fuel per capita than any other Brazilian city of its size and has one of the lowest rates of air pollution in the country. Curitiba residents spend only about 10% of their income on travel, much less than the national average, ensuring accessibility for low-income residents.

Bogotá replicated much of Curitiba's transportation ideas when it created its own rapid transit bus system, the TransMilenio. Project development received unprecedented sub-national financing from the Inter-American Development Bank. Former Mayor Enrique Peñalosa, who presided over the initial project, is now advising other cities interested in building rapid transit bus programs of their own.

A metropolitan giant of 20 million inhabitants, São Paulo has used international cooperation from the EU and US to provide clean technologies around the city. Its waste-to-energy plants reduce approximately three million tons of municipal waste every year. By using a thermal treatment to decompose the garbage, these plants generate approximately 750,000 tons of fuel oil. The decomposition processes within landfills create anaerobic molecules that are absorbed into the atmosphere as H_2O instead of greenhouse gases. With more than 13 million tons of CO_2-equivalent savings, waste-to-energy technologies are of particular interest for climate change policymakers.

Monterrey's sanitation system was in the spotlight when Secretary of State Hillary Clinton visited this northern Mexican city in March 2009. The project is operated by a public-private partnership between Bioelectrical Monterrey, S.A. de C.V., the government of Nuevo León state, and the System for the Handling and Processing of Organic Waste (SIMEPRODE), a decentralized government agency. The renewable energy project has the capacity to capture 12 MW of electricity per day, sufficient to generate overnight public lighting for seven municipalities. According to SIMEPRODE, the plant has generated more than 400,000 MWh of power and avoided 85,000 tons of greenhouse gas emissions, or 1,800,000 tons of CO_2. The effect is equivalent to planting 970 hectares of forest.

Around the world, the rapid growth of cities is exacerbating global warming, with as much as 78% of total greenhouse gas emissions generated in urban areas. This transformation has enormous implications from an energy and climate perspective: Buildings alone account for up to 40% of the energy consumption of some countries, urban development patterns affect emissions from transportation, and solid waste and sanitation systems are significant sources of greenhouse gases. In some cases, however, the pressures of urbanization have provoked a response from cities to reduce greenhouse gas emissions. As the Latin American cases above illustrate, how cities develop and respond to energy challenges today will have an indelible impact on the world's carbon footprint in the future. ■

Heidi Jane Smith is a PhD candidate in Public Administration at Florida International University.

PetroCaribe: Welcome Relief for an Energy-Poor Region

By Chris Cote

The international price of oil has an enormous impact on the economies of the energy-poor countries of Central America and the Caribbean, nearly all of which are substantial importers of fossil fuels. Venezuela has been the region's lone source of relief from the skyrocketing prices of recent years. It created PetroCaribe in June 2005 to help Central American and Caribbean governments finance their oil imports.

Today, PetroCaribe, which is managed by Venezuela's national oil company, PDVSA, serves 17 of the 24 Central America and Caribbean countries, excluding Barbados, El Salvador, Panama, and Trinidad & Tobago (the region's only energy exporter). Although questions have been raised about PDVSA's reporting, the Venezuelan oil company's own figures show PetroCaribe supplied the region with approximately 160,000 barrels per day on average from 2007 through 2009. This amounted to nearly 20% of Central America's and the Caribbean's oil supply—although half of the total went to Cuba.

The recipient countries benefit most from PetroCaribe's special financing. As the price of petroleum increases, so does the amount PetroCaribe is prepared to finance. The terms become particularly generous when the price of oil is above $40 per barrel, which will likely be the case for some time into the future. The scheme is an intelligent one: the higher the price of oil, the greater Central America and the Caribbean's need for help, but rising prices also expand Venezuela's capacity to assist. When prices are low, Venezuela cannot help much, but the region also requires less assistance.

Venezuelan President Hugo Chávez and Cuban Acting President Raúl Castro on December 21, 2007, in Cienfuegos, Cuba, at the fourth summit of PetroCaribe, an initiative created by Venezuela to provide oil to Caribbean neighbors at preferential prices. Photo: Adalberto Roque/ AFP/Getty Images.

Besides financing oil purchases, PetroCaribe has promised to contribute to the cost of developing and repairing refineries and other infrastructure. So far, repair of the Cienfuegos refinery in Cuba is the only project that has been completed. Plans call for building or repairing some 20 refineries in the next 10 years. Petrocaribe has also pledged to contribute to a food security fund for Central America and the Caribbean when oil prices exceed $100 a barrel.

PetroCaribe has been a constructive way for Venezuela to gain political influence. Venezuela has been criticized for seeking political advantage from its support of PetroCaribe, but this is an objective of almost all foreign aid, regardless of the source. Moreover, Venezuela has gained a measure of good will across the Caribbean and Central America as a result of its PetroCaribe mechanism.

The longer-term prospects of PetroCaribe are uncertain. Despite high prices, the Venezuelan oil industry is deteriorating. PDVSA's oil production has fallen by approximately one-third since 1997 (from 3.30 to 2.20 mbd). Exports fared even worse; due to rising domestic demand, Venezuela's shipments abroad dropped by one-half (from 2.90 to 1.50 mbd). There is no question that PetroCaribe has become more costly to Venezuela, with shipments from PDVSA through PetroCaribe continuing to rise as a share of total oil exports. In response, Venezuela appears to be tightening the terms of its PetroCaribe sales. ■

Chris Cote is a program assistant for economics at the Inter-American Dialogue, where he specializes in energy and Brazil-related issues.

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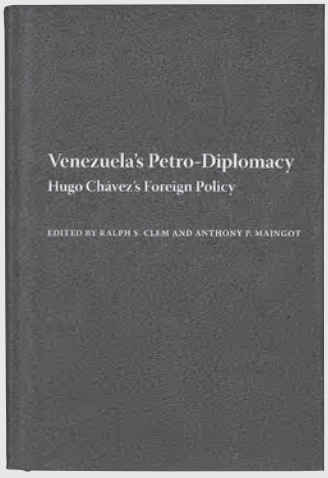
- Collaborating with organizations, scholars and practitioners throughout the hemisphere
- Contributing to the Comprehensive Approach for Probabilistic Risk Assessment (CAPRA) Initiative in the Latin America and Caribbean region, supported by the World Bank, the Inter-American Development Bank and the United Nations

For more information, please contact the Latin American and Caribbean Center (LACC) at Florida International University at **(305) 348-2894** or visit **http://casgroup.fiu.edu/drr**



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Venezuela's Petro-Diplomacy
Hugo Chávez's Foreign Policy

Edited by Ralph S. Clem and Anthony P. Maingot

Over the last decade, Venezuela has exerted an influence on the Western Hemisphere and global international relations well beyond what one might expect from a country of 26.5 million people. Since coming to power in 1999, President Hugo Chávez has used the windfall of high oil prices to remake Venezuela internally along the model of twenty-first-century socialism and, even more audaciously, to rewrite global relations by directly challenging U.S. influence. While revenue from petroleum exports has swelled national coffers and allowed the expansion of public programs and aid to foreign countries, bolstering Chávez's popularity at home and abroad, the volatility of petroleum prices and the neglect of other export industries have the potential to render the regime's power tenuous.

Foreword by Cristina Eguizábal, Director, Latin American and Caribbean Center, Florida International University.

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