



Latin America's Energy Future

Roger Tissot

**Inter-American
Development Bank**

Infrastructure and
Environment
Department

DISCUSSION PAPER

No. IDB-DP-252

December 2012

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December 2012

<http://www.iadb.org>

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OPTIONAL: Type address for correspondence

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Abstract¹

This working paper presents a survey of the changes in Latin America's energy consumption over the last 30 years, before considering the trends that will affect the region in the coming decades. It highlights several important issues, including the growing demand for oil, which has prompted a resurgence of resource nationalism and the revitalization of national oil companies in the region. Regional oil policy has also been boosted by the growth of China, which is now a major player in the Latin American energy sector, as both consumer and financier. Natural gas consumption has also grown in recent years, and the discovery of large non-conventional gas reserves will also alter the energy landscape. Overall, the paper concludes that Latin America has adequate resources to meet its rising energy needs. The challenge for national governments, however, is to find a balance of sources that best provides energy security, meets growing demand, is environmentally sustainable, and can be developed at a competitive cost. For the region with the cleanest energy matrix in the world, the paper recommends that national governments focus on developing renewable resources in order to avoid a greater reliance on fossil fuels.

¹ "Latin America's Energy Future" by Roger Tissot for the Inter-American Development Bank and the Inter-American Dialogue Energy Working Paper Series.

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Introduction

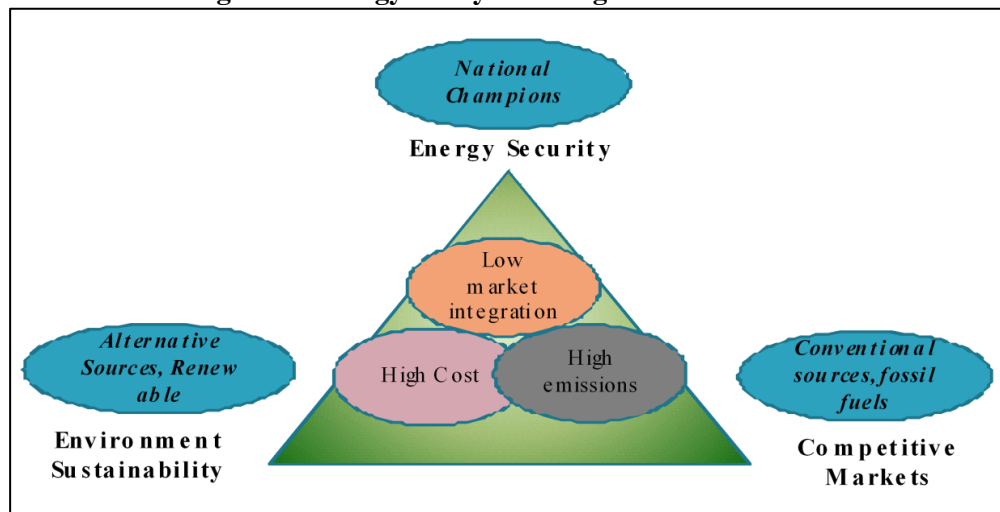
Energy is central to economic growth and social development. However, as more energy is consumed, additional pressure is put on the environment. “The provision of adequate and reliable energy services at an affordable cost, in a secure and environmentally benign manner, and in conformity with social and economic development needs is an essential element of sustainable development.”² What energy to use is an essential policy question with far-reaching political, economic, and environmental consequences?

Energy policy tries to address energy choices, but trade-offs are necessary. Focusing on a single priority could lead to solutions that are not viable in the long term. For example, if energy security is the priority, the government may opt for creation of state-owned hydrocarbon or electricity companies. The mandate of those companies would be to supply the local market at a low cost. However, lack of competition would result in economic inefficiencies, inefficient allocation of resources, and poor financial outcomes.

On the other hand, if the government’s priority is to implement market solutions, the outcome could be a dynamic private sector focus on investments with short payout periods and lower upfront capital requirements. Preference would be given to low-cost sources, such as coal or simple cycle gas-power generation units.

If the objective were to promote environmental sustainability and reduce Co2 emissions, the government would have to consider solutions, for example in electricity generation, that are currently costly, requiring government subsidies to level the playing field between renewable and conventional sources.

Figure 1: Energy Policy Challenges and Trade Offs

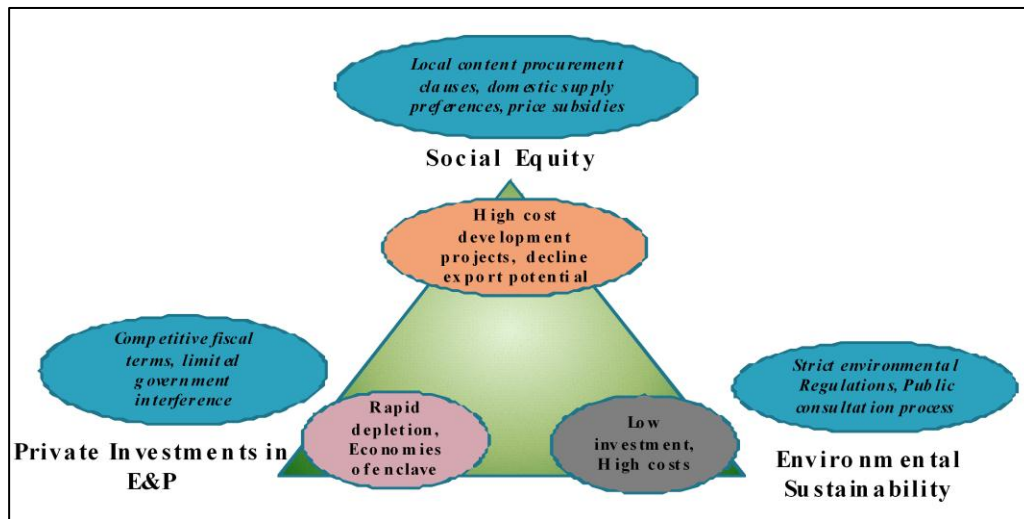


Source: Author’s own

² “Energy Indicators for Sustainable Development: Country Studies on Brazil, Cuba, Lithuania, Mexico, Russian Federation, Slovakia and Thailand,” United Nations, 2007

Energy policy is also affected by a country's resource endowment. Countries with generous hydrocarbon resources often have a difficult time transforming those resources into long-term, sustainable, and equitable social development. The challenge for those countries is to find the right balance among governments' needs to finance development, environmental and social sustainability, and investors' expectations about production and rates of return.

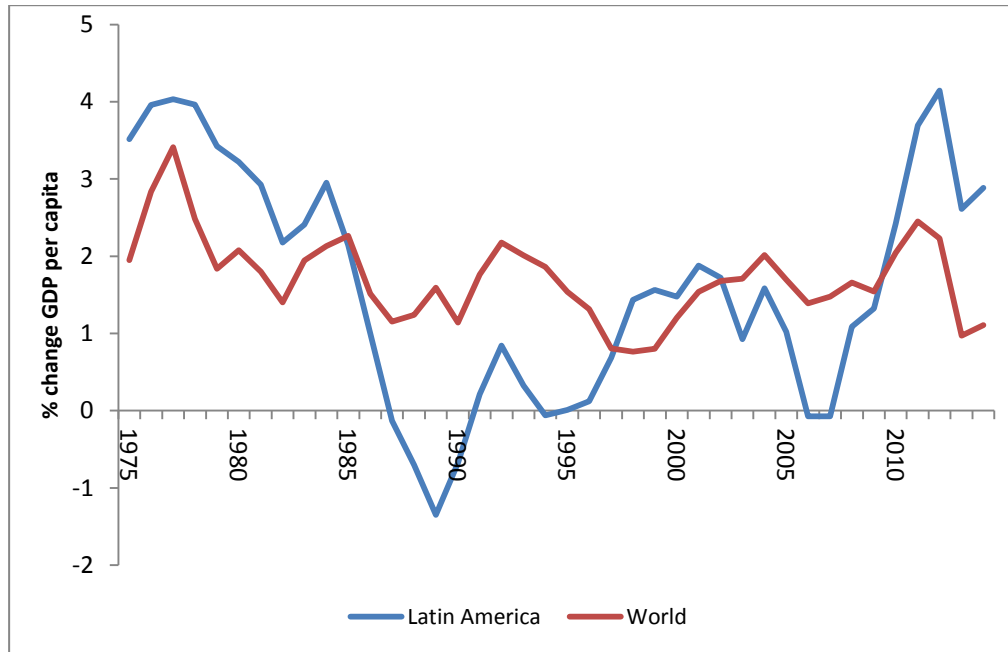
Figure 2: The Challenge of Trade Offs for Resource Rich Countries



Source: Author's own

In 1960, Latin America accounted for 6 percent of the world economy. In 2009, that share increased to 7.2 percent. In other words, after 50 years, the region's contribution to the world economy had grown by only 1.2 percent. However, in the last decade, the region's GDP growth has outperformed world GDP per capita by at least 1.5 points.

Figure 3: GDP per Capita, Latin America, World



Source: World Bank and author's own calculations

Latin America has emerged as one of the most successful economies in the world, driven by the rapid increase in commodity prices but also by the implementation, in most countries, of sound economic policies. Still, this success has brought challenges:

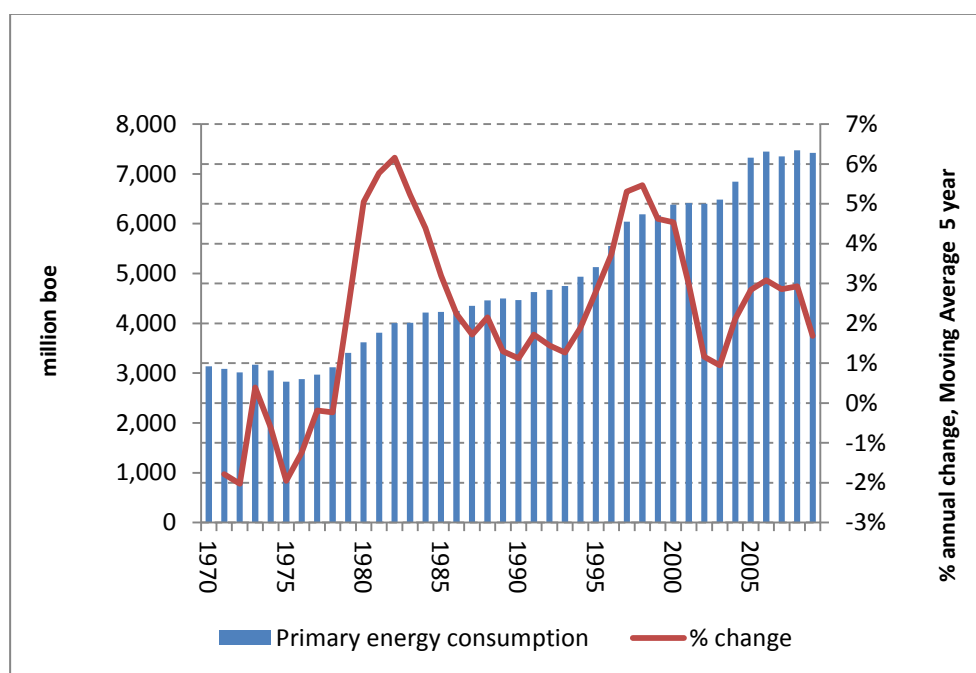
- Growing opposition from environmental groups and local communities to oil and mining developments;
- Rapid appreciation of local currencies, leading to a process of de-industrialization; and
- Excessive dependency on commodities for export revenues.

This document examines the challenges that Latin America faces in meeting its energy needs and the energy policy options.

Latin America's primary energy demand

Primary energy demand² in Latin America has more than doubled in the last forty years, but the rate of growth has not been constant. Energy demand grew rapidly in the 1970s, a period that coincided with strong levels of economic activity and fast expansion of the electricity grid. The rate of growth declined in the late 1980s and 1990s when the debt crisis sent the region into a deep recession and a slow recovery. Improved energy efficiency also lowered the growth rate of consumption. Use of conventional energy sources (hydrocarbons, electricity) expanded rapidly while demand for traditional resources (wood, animal waste) declined. In the last decade, overall energy consumption has increased at a rate of 3 percent per year, again fueled by strong levels of economic activity.

Figure 4: Latin America's Primary Energy Consumption



Source: ECLAC

The share of fossil fuels in Latin America's primary energy mix over the last forty years has not changed substantially,³ accounting for 74 percent of primary energy needs. However, in 1970, the picture was different. Oil met 61 percent of those needs while coal and natural gas combined accounted for 13

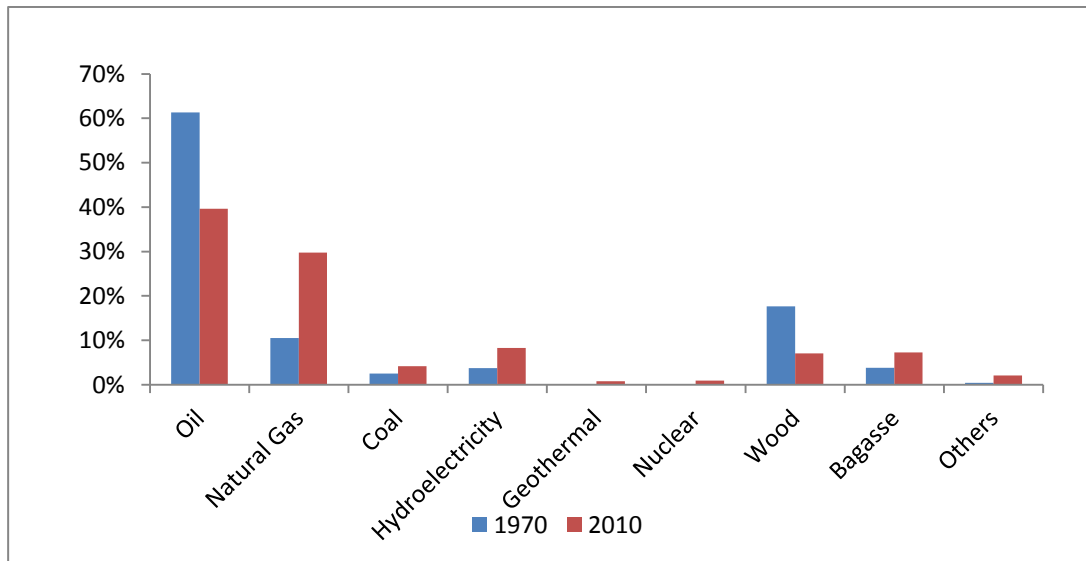
² Primary energy sources are those obtained directly from nature, such as hydroelectricity, wind, solar, wood and vegetable fuels, or those from extraction, such as oil, natural gas, coal, and geothermal. Source: CEPAL database.

³ Primary energy consumption = Energy production – Exports + Imports + change in inventories from all primary sources: oil, natural gas, coal, hydroelectricity, geothermal, wood, bagasse, nuclear, renewable. Source: CEPAL data.

percent of the energy mix. By 2010, oil’s share was less than 40 percent while natural gas accounted for 30 percent. Coal’s share in the energy mix saw a modest increase.

Wood also played a far more prominent role in 1970; it was the second most important energy source after oil, accounting for 17 percent of the energy mix. It now represents around 7 percent. During the same period of time, hydroelectricity’s share more than doubled to 8 percent while the share of energy from sugar cane increased to 7 percent, from 4 percent. Non-fossil fuels, excluding hydroelectricity, make up a modest 4 percent of the region’s energy mix. This includes nuclear, geothermal, wind, and solar sources.

Figure 5: Latin America's Primary Energy Matrix



Source: ECLAC

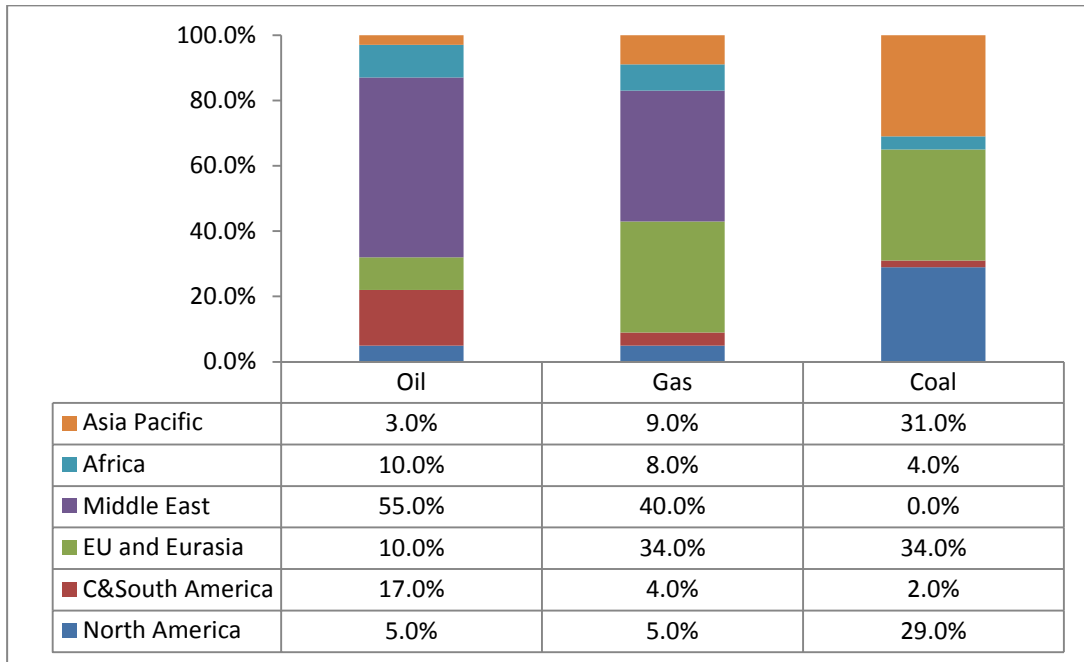
Primary energy sources are used in three key areas:

- the transportation sector, which consumes the bulk of the oil transformed by refineries;
- electricity generation which, in addition to hydroelectricity, uses coal, gas, fuel oil, nuclear, geothermal, wind, and solar to generate electricity; and
- consumption by industrial and residential sectors.

Latin America’s Energy Resources

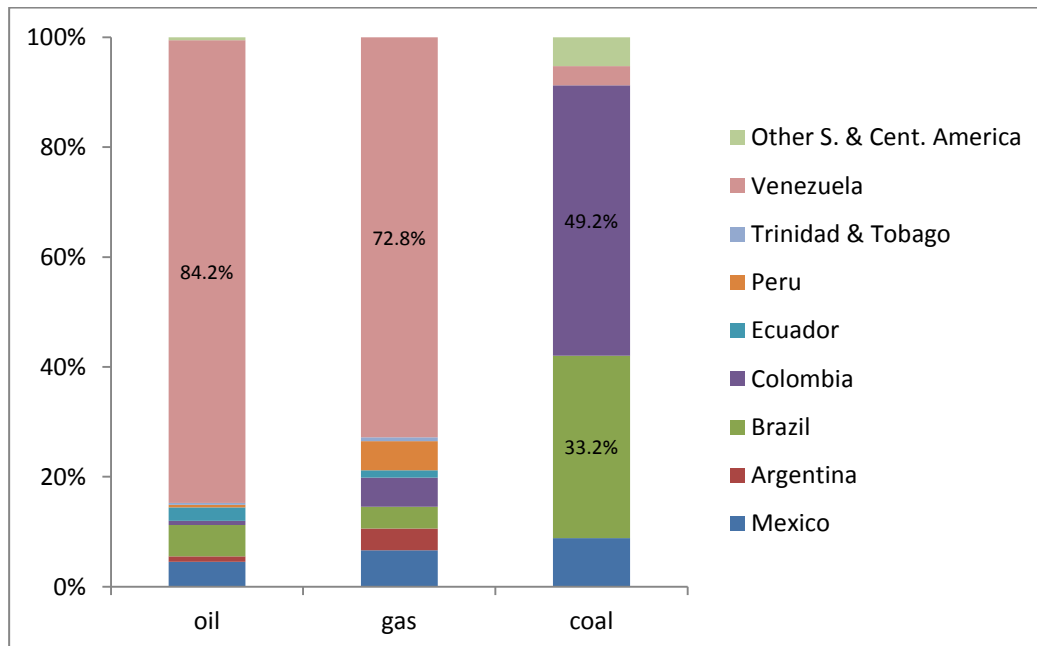
Latin America is home to the second largest reserves of oil outside the Middle East. The region’s natural gas and coal reserves are, however, not as large. Fossil fuels are not distributed equally in Latin America. Oil and gas reserves are concentrated in Venezuela while most coal reserves are located in Colombia and Brazil.

Figure 6: World Fossil Fuel Share of Reserves by Region



Source: BP energy statistics

Figure 7: Latin American Fossil Fuel Reserves: Share by Country



Source: BP energy statistics

The hydroelectricity potential of Latin America is vast. Information from INTPOW, Norway's renewable resources nonprofit, indicates that Latin America has enough hydroelectricity potential to meet demand for the foreseeable future. However, it is unlikely the region will develop all those resources. Hydroelectric potential is concentrated in few countries—notably Brazil, Colombia, Ecuador, and Peru—and in areas that are difficult to access.

Large hydroelectric projects, preferred since they benefit from economies of scale, are drawing increased opposition from environmental groups and local communities. Their approval processes are lengthy and confrontational. Despite this, large projects are planned in Argentina, Brazil, Chile, Colombia, Ecuador, and Peru. One of the more controversial is the 11.2 gigawatt (GW) Belo Monte project in Brazil's Amazon region. Opposition to Chile's US\$10 billion HidroAysén project is also strong. That project calls for building five dams on the Baker and Pascua rivers in southern Chile's Aysén Region.

Latin America's non-renewable resources, excluding hydroelectricity, account for a modest 2 percent of the electricity mix. From the options available, wind power—with its mature technology and declining costs—offers perhaps the best chance for greater development. In fact, wind generation is calculated at around US\$60 per megawatt hour (MWh) in Mexico, one of the least expensive rates in the world. Average wind power costs in Brazil are also competitive at around US\$83 MWh. As with other resources, the potential of wind power generation is unequally distributed in Latin America. Mexico and Argentina have attractive wind base potential.

Wind power's key advantage is its ability to complement hydroelectricity generation since the generation of each is independent from the other. To fully benefit from wind power, however, Latin America must develop regional trade and exchange mechanisms.

Biomass is already an important source of power generation in Brazil, Colombia, and Central America. Its growth is influenced by sugar mills' ability to expand production and by changes in sugar prices. A prohibition against burning field trash and other regulations could further encourage the use of sugar cane residues for power generation.

Despite its great potential, geothermal energy remains mostly unused in Latin America. The region's geothermal potential could be as high as 125 terawatt hours (TWh), many times its current 11 TWh capacity. Most of that potential is concentrated in Central America, Mexico, and Chile. Human resources, regulatory and financial uncertainty, and lack of access to technology have slowed its development.

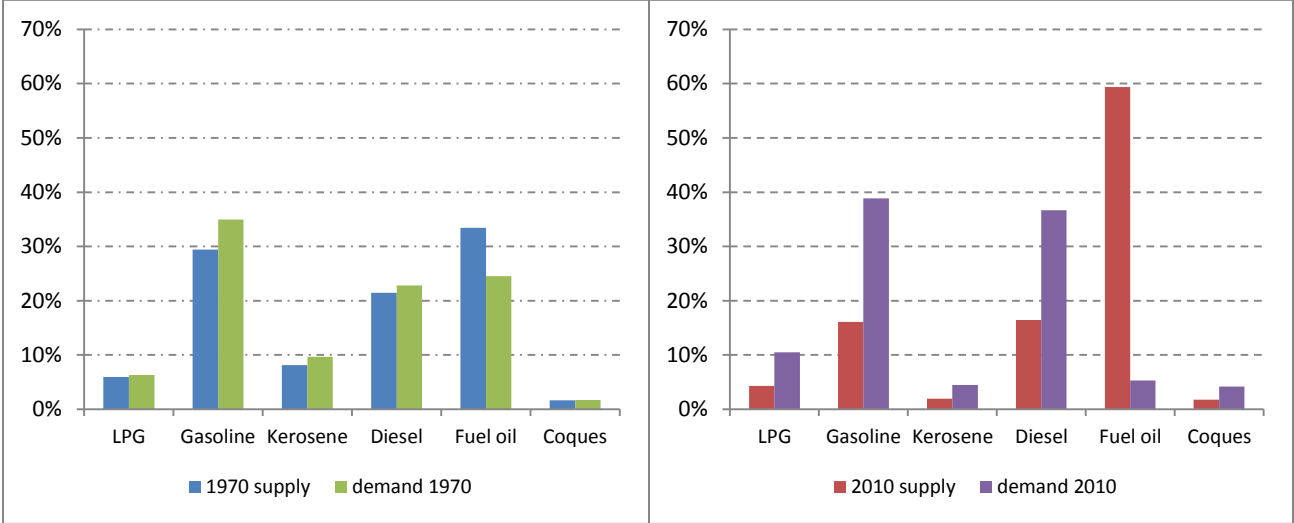
Solar power also offers strong potential, particularly in Mexico, Peru, Brazil, and Argentina, but it remains largely unexploited. Generation costs estimated at US\$150 to US\$200 MWh are solar power's main barrier. The expense of connecting to the grid is another challenge. Despite this, several governments include solar power in their renewable energy strategies. The most important of these initiatives is in Argentina, where the San Juan I 1.2 MW project requires an investment of US\$10 million. The project is part of a

national strategy to generate up to 8 percent of the country’s electricity from renewable sources; the government has offered tax incentives to attract private investors. In 2010, state company Enarsa launched its first tender for 1,000 MW of power through renewable sources. Six photovoltaic energy projects, totaling 20 MW, were awarded.

Petroleum Product Demand in Latin America

Oil is transformed into a number of products, the most important of which are liquid petroleum gas (LPG), gasoline, kerosene, diesel, fuel oil, and residues (petroleum coke). The following graphs show how significantly Latin America’s gasoline and diesel deficit has increased in the last forty years (although the region shows a large surplus of low-value fuel oil, traditionally used for power generation). In recent years, natural gas has replaced fuel oil for power generation.

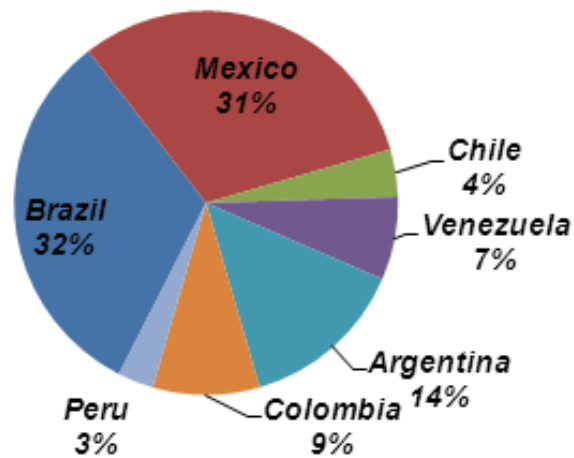
Figure 8: Latin American Oil Supply and Demand, 1970; 2010



Source: OLADE - SIEE Database

The surge in demand for gasoline and diesel comes in tandem with the rapid expansion of Latin America’s vehicle fleet. There are approximately 65 million motor vehicles in Latin America, concentrated in three markets: Brazil (21 million), Mexico (20 million) and Argentina (9 million). With a population near 400 million and a large unsatisfied demand for vehicles, Latin America has become the world’s fastest-growing vehicle market. In five years the fleet has grown 50 percent, to 169 cars per 1,000 habitants, from 113 cars per 1000 habitants. The booming demand for vehicles is expected to continue in the near future.

Figure 9: Distribution of Latin American Vehicle Fleet in 2009



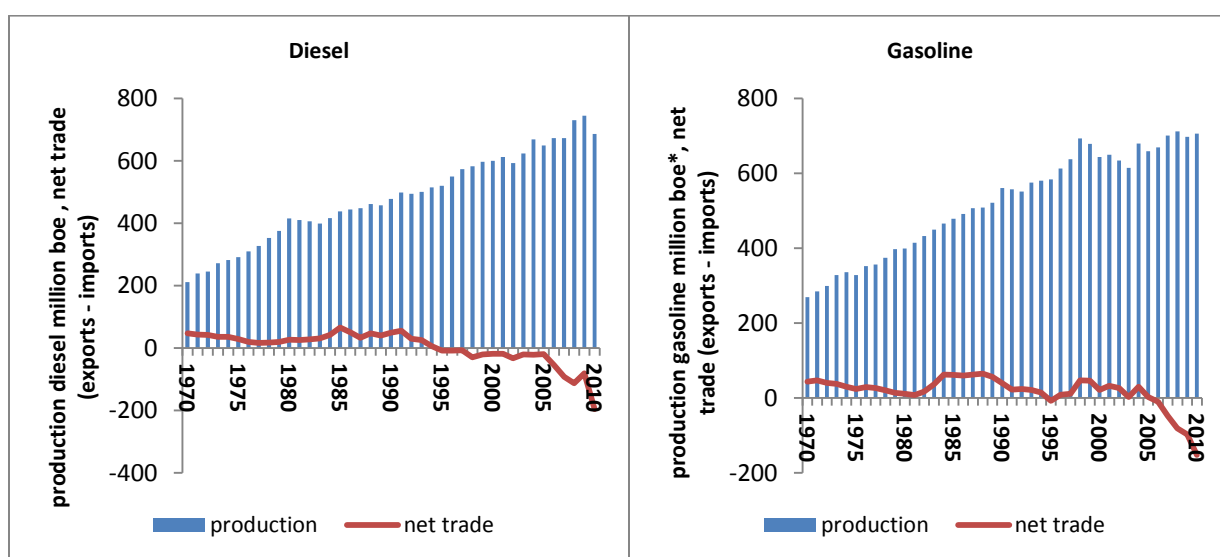
Source: BBVA Latin America automobile industry

After a decade of fast economic growth, declining unemployment, and improved income distribution, Latin America's large, emerging middle class can afford cars for the first time. GDP per capita, now approximately US\$7,000, is expected to exceed US\$10,000 in the next three years. At those levels, vehicle demand tends to grow exponentially. With currencies appreciating, the cost of imported vehicles is declining. At the same time, relatively low inflation has prompted banks to offer attractive vehicle-purchase options. Nearly 80 percent of the region's population lives in urban centers, but infrastructure deficits leave most Latin American countries without viable mass transportation systems, such as trains and subways, making motor vehicles the preferred mode of travel.

At the same time vehicle demand is surging, production of diesel and gasoline is stagnating. The resulting need for more oil imports poses a challenge to the region's balance of payments. Latin America pays high prices to import high-value-added products, which are then sold at subsidized prices in the domestic market. Energy subsidies cost Ecuador approximately US\$5 billion per year, Mexico US\$10 billion per year, and Venezuela up to US\$20 billion per year, according to the IEA.⁴

⁴ Source: IEA World Energy Outlook 2011.

Figure 10: Production and Net Trade of Diesel and Gasoline in Latin America



Source: OLADE SIEE database and own calculations (*boe – barrels of oil equivalent)

Exposing local populations to the elevated prices of imported oil products carries political risks. Measures to reduce subsidies often result in social unrest. Household income is affected as the costs of cooking, heating, lighting, and transportation increase. There is also an indirect impact as distribution companies pass their increased costs on to consumers, pushing up prices on food and other products. An International Monetary Fund study found that a US\$0.25 jump in the price of a liter of oil in Latin America represents a 3.8 percent decline in household income.⁵ Subsidies have proven an inefficient mechanism for protecting the poor since they allow leakages into wealthier social groups, resulting in higher demand volumes and increasing the burden to governments' accounts.

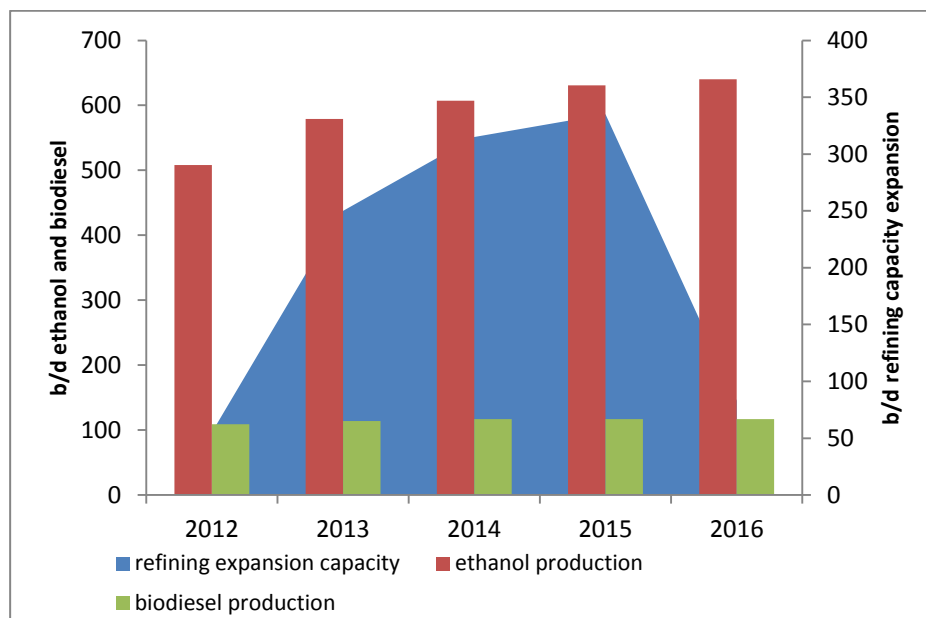
Latin America's response to the rising demand for oil products is expansion of its refining capacity. The IEA forecasts a capacity increase of 1 million barrels per day (b/d) in refining products in Latin America over the next five years, mostly in Brazil. Expanded capacity is seen as a way to replace imports and adapt local refineries to changing supplies of crudes, from light to heavy and extra heavy ones. It also allows the supply of refining products made locally to meet stricter environmental standards, including lower sulphur content and no lead. The proposed expansion projects are led by the region's national oil companies (NOCs), since the refining sector is highly concentrated in state hands in Latin America, directly or in partnership with Chinese and other Asian companies. For example, Chinese National Petroleum Company is collaborating in PDVSA and PetroEcuador's US\$13 billion Pacific Refinery in Ecuador. PDVSA also signed a memorandum of understanding with engineering giant Hyundai for the financing of an engineering,

⁵ Javier Arze del Granado, David Coady, and Robert Gillingham, "The Unequal Benefits of Fuel Subsidies: A Review of evidence for developing countries" (working paper, International Monetary Fund, September 2010).

procurement, and construction (EPC) contract on the US\$2.9 billion Batalla de Santa Inés refinery project in Venezuela’s Barinas state.

Asian companies have also established refining units in the Caribbean. One example is PetroChina’s purchase of Valero assets in Aruba. Moreover, as perhaps forced by its internal cash-flow limitations, PDVSA seems to be abandoning some of its refining investments in the Americas, Chinese companies appear to be eager to substitute them.

Figure 11: Latin America's Refining Expansion and Biofuel Production



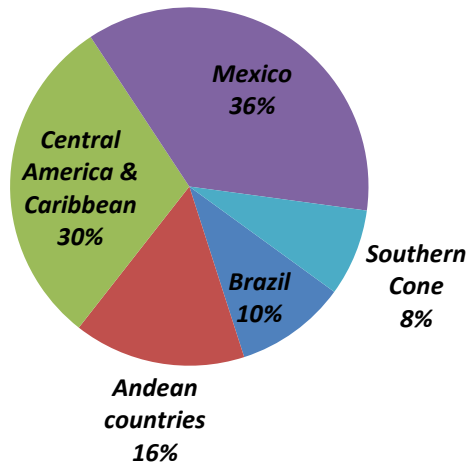
Source: IEA world energy outlook

Mexico has proposed a new US\$11 billion refinery with a processing capacity of 250,000 b/d in the state of Hidalgo. It would reduce the need for imports by 34 percent. During the campaign for the presidency of Mexico, the leftist candidate from the PRD, Andrés Manuel Lopez Obrador, proposed a more aggressive expansion, with construction of as many as five new refineries. The election was later won by PRI candidate Enrique Peña Nieto. The economic logic of refinery expansion in Mexico has been questioned by analysts since excess capacity in the United States allows access to products or refineries at a lower cost.

Expansion in Latin American is likely to meet strong competition from US exports to the region. US demand for oil products remains negative due to a sluggish and uncertain economic recovery and consumers’ preference for smaller, energy-efficient vehicles. As oil demand stagnates in North America, private refineries will actively pursue export opportunities into the booming Latin American market. Increased labor productivity in the last few years and a weaker US dollar also make it competitive for the United States to export. With annual volume of 450,000 b/d, Latin America represents 53 percent of US

refining exports. Mexico and Central America together account for 66 percent of all US exports to Latin America.

Figure 12: US Exports of Refined Products to Latin America 2010

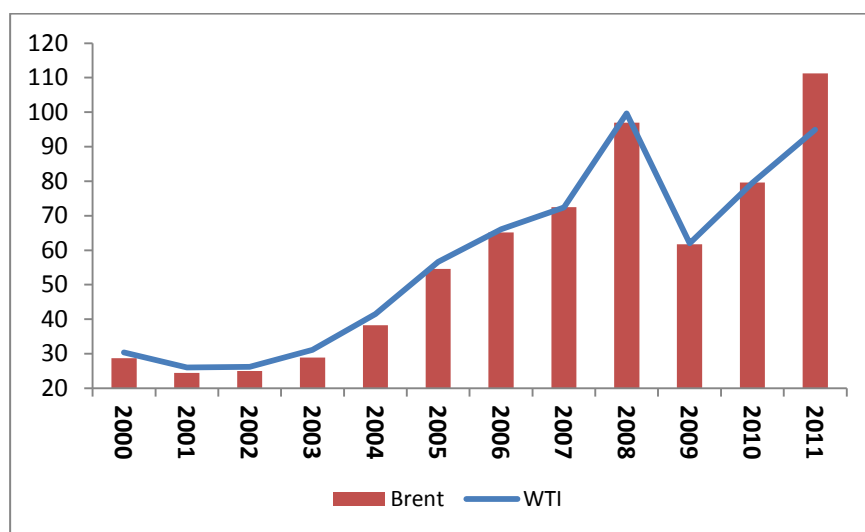


Source: US Department of Energy

A decade of petroleum policies

The last decade started with very low oil prices, but these rose rapidly as the global economy recovered from the short-lived recession of 2001. Prices reached historic highs in 2008 and again in 2011. The drastic fluctuations had profound geopolitical impact, not just in Latin America but globally. In Latin America, price surges prompted: i) the ascendancy of resource nationalism; ii) the revitalization of national oil companies; and iii) the development of new geopolitical alliances.

Figure 13: Oil Prices in USD/b Yearly Average



Source: US Department of Energy

i) The ascendancy of resource nationalism

Resource nationalism can be defined as the effort by resource-rich nations to shift political and economic control of their energy and mining sectors from foreign and private interests to domestic and state-controlled companies.⁶

Contrary to previous oil shocks, the price surge that started in 2004 was seen as structural and likely to continue in the long term. Growing demand for oil products from industrializing economies, coupled with the decline of conventional petroleum reserves, encouraged governments to extract more rents from petroleum resources. This coincided with the ascendancy of populist regimes, particularly in Venezuela, which used petroleum wealth as a tool to project geopolitical influence and to replace market liberalization policies adopted in the previous decade. The new policies centered on government control of strategic assets. Venezuela and like-minded countries also used resource nationalism to consolidate political power through “nationalizations” and government spending aimed at reducing poverty.

The recent wave differs from those of the past.⁷ Previous nationalizations were often promoted by a local technical elite supported by a nationalist administration or by a military regime with industrialization ambitions. Today “nationalizations” are the work of populist leaders with a mercantilist focus that prioritizes rent maximization.

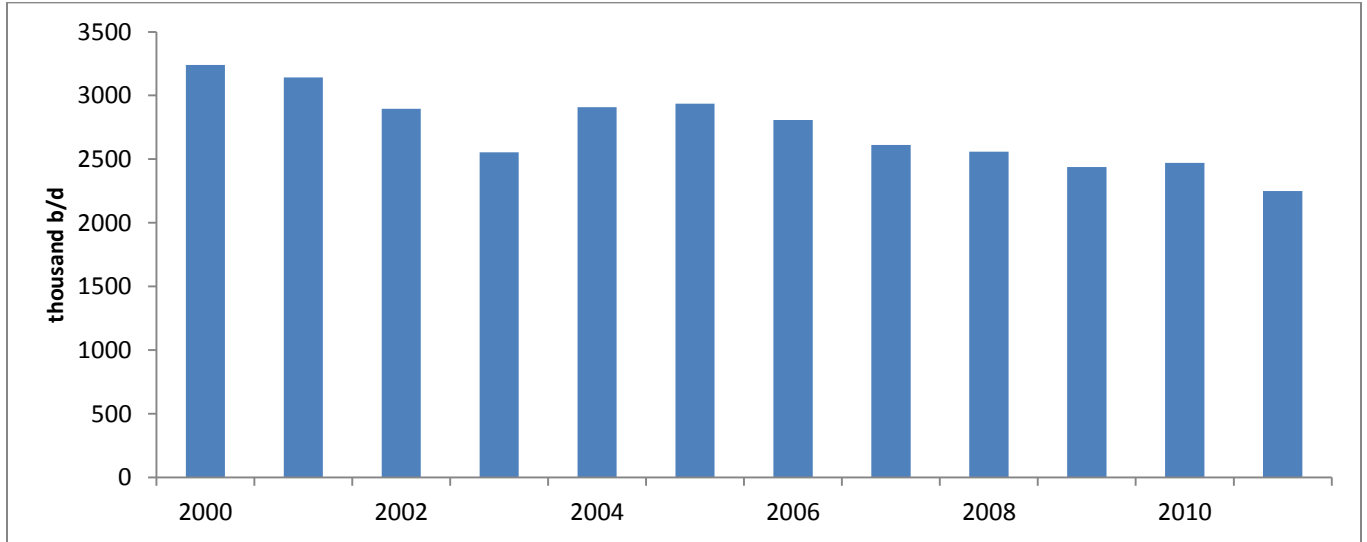
In Venezuela, President Hugo Chávez “nationalized” an industry that had been nationalized in 1976 then reopened by the Carlos Andrés Pérez government in the 1990s. Chávez’s “nationalization” did not

⁶ Ian Bremmer and Robert Johnston, “The Rise and Fall of Resource Nationalism,” *Survival*, (2009) 51:2, 149-158.

⁷ Latin America’s petroleum nationalization started in Mexico in 1936. The first national oil company was created in Argentina in 1922.

close the door to foreign investments. However, it guaranteed PDVSA's role as the operator and majority shareholder of all oil projects in the country. Since then Venezuela's oil production has steadily declined.

Figure 14: Venezuela's Oil Production



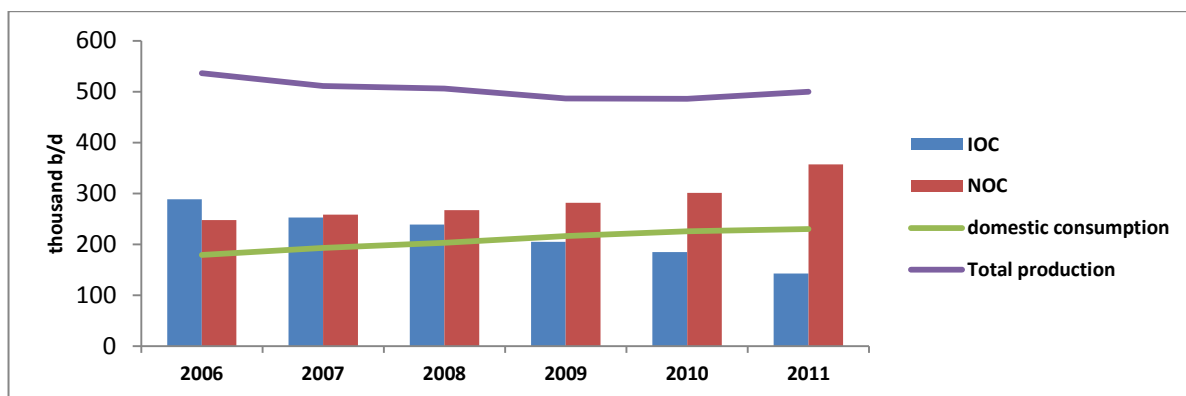
Source: Argus Latam Energy

Resource nationalism in Ecuador and Bolivia also focused on rent extraction from foreign companies rather than closure of the sector to foreign investors. Both countries achieved higher rents but at the cost of declining investments, production, and reserves. Confrontations in Ecuador led several foreign companies to cancel contracts and withdraw their exploration and production activities from the country. While private companies' output declined, output from the two state-owned companies, PetroEcuador and PetroAmazonas,⁸ increased. Overall, Ecuador's production has stagnated around 500,000 b/d.

PetroEcuador's 2012 budget of US\$3.7 billion includes US\$528 million for exploration and production (E&P) activities. To shore up E&P, the government recently added to its service contract a flat fee of US\$35 to US\$58 per barrel of oil produced. Although some companies have responded to the government invitation, the production outlook remains uncertain.

⁸ PetroEcuador's E&P division was eventually transformed into a separate oil company to focus exclusively on the operation of assets taken from international oil companies (IOCs).

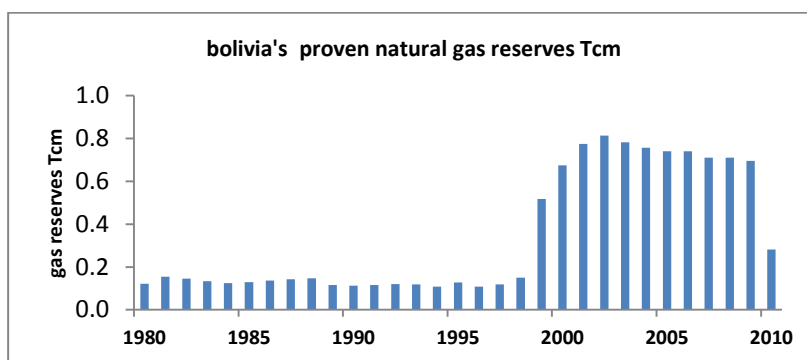
Figure 15: Ecuador's Oil Production and Consumption: International Oil Companies (IOC) and National Oil Company (NOC)



Source: Asociación de la Industria Hidrocarburifera del Ecuador (AIHE)

Bolivia was supposed to become South America's natural gas hub in the 1990s, supplying Southern Cone countries. Following a decade of investments, Bolivia's gas reserves rose significantly. However, by 2004, they started to decline.

Figure 16: Bolivia's Proven Natural Gas Reserves



Source: BP Energy Statistics

Companies may have been too optimistic about their reserve assessments. It appears that companies also reduced their exploration efforts, while increasing production, in order to recuperate investments as soon as possible, anticipating a new wave of nationalizations. Evo Morales' "nationalization" on May 1, 2006, re-created national oil company YPF in Bolivia and imposed additional taxes and royalties on private operators. A combination of higher prices on Bolivian gas exports to its neighbors, increasing oil prices,⁹ and a bigger government take boosted government revenues to more than US\$1.5 billion in 2007, from

⁹ Bolivia gas price exports to Brazil are tied to a basket of oil products.

US\$284 million in 2004.¹⁰ However, by 2010, Bolivia had lost nearly half its gas reserves, or approximately 4 percent of the country's GDP.¹¹ In 2011, government incentives to E&P companies brought new exploration commitments and foreign oil company production and discoveries.

Brazilians would like to compare their soft resource nationalism to Norway's model of conservationism. However, as is too often the case when significant oil discoveries are made, Brazil's newfound oil wealth exposes the policy challenges of an emerging economic power.

In 1994, Brazil became one of the latest countries to open its petroleum sector to foreign participation. Energy reforms attracted foreign investments, but their most important effect was the transformation of Petrobras into a successful oil company in terms of revenue, production, and reserve additions. In 2007, Petrobras and its partners made one of the world's largest oil discoveries in the last twenty years: the Tupi (now Lula) field in the Santos Basin.

The discovery sparked an intense political debate, which resulted in a change in Brazil's regulatory environment. Instead of allowing oil companies to develop the resource through a competitive market system, the government excluded the pre-salt area from the concession, preferring a production-sharing agreement with Petrobras. By granting Petrobras privileged access to the country's reserves and changing the fiscal model, Brazil opted for a rent maximization strategy that is likely to slow development of Brazil's resources. In fact, instead of benefitting from the exploration efforts of competing companies, the development will be limited by Petrobras' capabilities.

Brazil's new oil potential is perceived as an opportunity to promote industrialization by increasing the linkages between oil activities and the local economy. The government implemented an ambitious program that requires oil companies to use local suppliers for a percentage of their services. However, due to the size and complexity of Petrobras' projects, local-content rules are expected to cause delays and increase costs. Achieving both, Petrobras' ambitious corporate goals and those of the government is proving difficult.

The government would like to use oil revenues to solve Brazil's infrastructure and social deficiencies. A new allocation of revenues from oil royalties has been proposed. The shift, modifying the revenue distribution among federal, state, and municipal governments, has created a firestorm between oil-rich states, like Rio de Janeiro, and poor states. Although the idea of regional equalization of revenues is a good one, little social development can be expected if revenues from oil production are distributed to states and municipalities that lack proper management and good governance.

The Brazilian government also struggles to find the right balance between environmental protection and far-reaching infrastructure developments. Environmental regulations are strict and the approval process

¹⁰ Brent Z. Kaup, "A neoliberal nationalization? The constraints of natural gas led development in Bolivia," *Latin American Perspectives* (2010) 37:123, p. 129.

¹¹ Assumes an average export price of US\$7 mm btu. Bolivia's GDP is approx US\$22 billion.

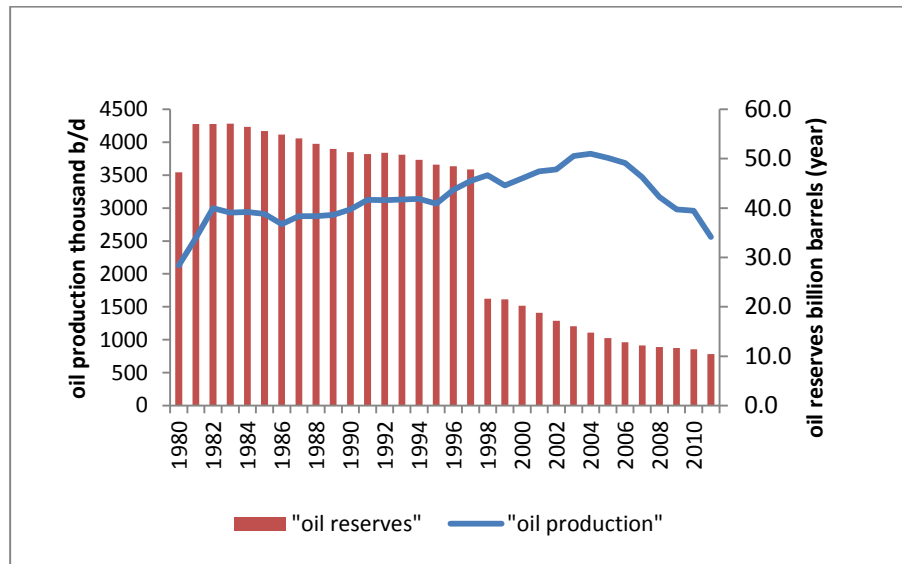
slow. As demonstrated by Chevron's recent oil spill, however, this offers a false sense of security about the environmental impact of large oil projects. Despite what is often perceived as an over-reaction by local authorities and politicians, the Chevron incident exposed the inadequacy of the country's risk-mitigation strategies when it came to handling massive deep-water oil developments.

In the coming decade, Brazil is expected to become the fifth largest economy in the world, surpassing the United Kingdom and France. Its large and diversified manufacturing sector is coping with the rapid currency appreciation that resulted from a massive influx of foreign capital. As oil production and exports increase, Brazil's currency will be under even greater pressure. Moreover, Petrobras' impact on the balance of payments and fiscal revenue will continue to increase and, with it, politicians' desire to influence the energy company's decisions. Those tensions were already obvious with the 2011-2015 investment plan. The plan proposed a more ambitious investment program for refining infrastructure, anticipating a demand boom in Brazil and seeking to make the country an exporter of "value-added refining products"—even though the market preferred that Petrobras focus on what maximizes value from its exploration and production activities.

Brazil is well positioned to continue its successful economic progress, but resource nationalism could carry a notable cost. In fact, Brazil would need to decide if it wants to use oil as a source of rents or as an input to fuel a diversified and growing economy. If the answer is the first one, its conservationist policies may be adequate, but the cost is likely to be a less dynamic economy. If Brazil follows the second option, the best policy would be to further open its hydrocarbon sector to market competition.

What happened to Mexico's oil industry in 1936 is often described as a "classical nationalization" since it led to the expulsion of foreign oil companies and the creation of a national oil company, PEMEX, with a monopoly control over all activities related to the hydrocarbon value chain. The nationalization also became a symbol of national pride, often manipulated by the political elites. Now, after 75 years of government control and a decade of collapsing reserves and production, Mexico is slowly opening its industry.

Figure 17: Mexican Oil Production and Reserves

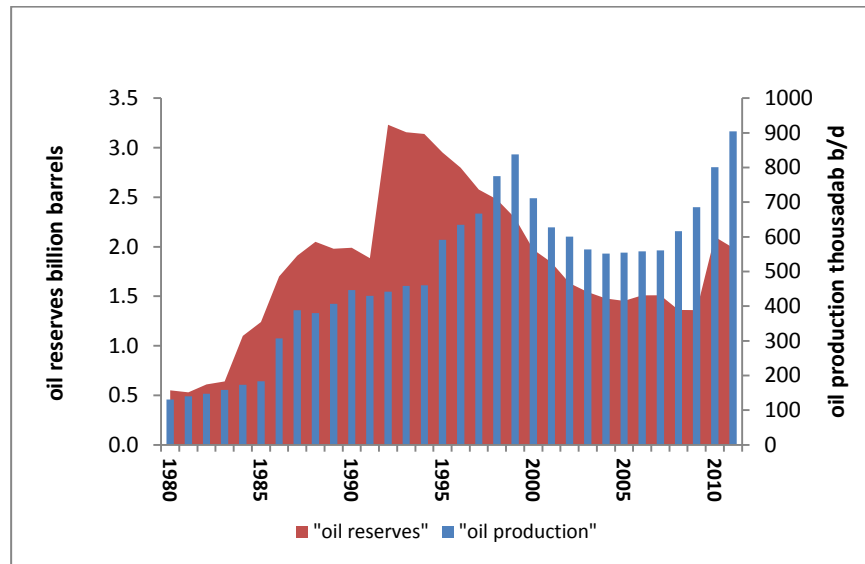


Source: BP energy statistics

In 2008, the government proposed a series of reforms aimed at increasing investments in upstream activities. In 2011, the first bidding round of “incentive projects” was offered—with lukewarm results. Political parties PAN and PRI seem to agree on the need to open further upstream activities to private capital, but two reforms are necessary if Mexico is to become a preferred upstream destination again. First, the Mexican economy must end its “oil rent addiction” by ensuring that its expenses can be covered through taxes on income generated by overall economic activities. PEMEX should be taxed as any normal petroleum company. This would force the company to manage its budget more rationally and provide performance indicators that can be benchmarked against peers. Second, Mexico should allow private companies to invest in oil exploration and production through a simple tax and royalty concession model. Constitutional limitations currently prevent this, but perhaps it is time for Mexicans to address constitutional reform. After all, constitutions are living documents that need to reflect the political aspirations and desires of society. All reforms proposed by Mexican legislators now occur at the margin of “what is possible under the Constitution.”

With a more flexible petroleum model, Mexico could expect a boom in hydrocarbon investments. Its proximity to the United States, its vast oil and natural gas reserve potential, its legal framework offering investors the necessary tools to protect their activities, and the presence of an experienced work force should make Mexico the preferred destination for any oil company.

Figure 18: Colombian Oil Production and Reserves



Source: BP Energy Statistics

Colombia offers one of the most interesting petroleum stories in Latin America, a scenario where, over the last decade, resource nationalism played a role by its absence. It was assumed that Colombia would become a net oil importer after the drastic decline of oil reserves and production in the 1990s and the low levels of exploration. However, today Colombia produces around 900,000 b/d and is Latin America's third largest oil supplier to the United States.

A combination of very low oil prices, high security risks, and unattractive fiscal terms ended private investment in Colombia's oil sector in the late 1990s. Ecopetrol's limited investment capabilities were not sufficient to reverse the drastic decline in production and reserves. By 2004, Colombia embarked on drastic industry reform that had at its center the implementation of a modern tax/royalty concession model. The government's share of revenues was significantly reduced, making Colombia one of the most attractive locations for private company investment.

Management of the concessions was entrusted to a new regulatory body, the National Hydrocarbon Agency (ANH), and Ecopetrol was required to compete on a level playing field with private competitors. To ensure financial independence from the government budget, the government sold up to 10 percent of Ecopetrol shares. This was not a privatization process but, rather, a clever mechanism allowing ordinary citizens to gain ownership of the company for a modest fee. Strict restrictions were imposed on the re-sale of the shares to avoid concentration of the company in a few private hands.

The reforms transformed the petroleum sector. Hundreds of companies are now exploring and producing oil in Colombia (although most production remains concentrated in few companies). Ecopetrol accounts for 40 percent of the output.

The rapid transformation of Colombia's oil sector has not come without challenges. Transportation capacity is now a major bottleneck, although completion of major pipeline projects should ease that. Indeed, transportation capacity is expected to double from 1.1 million b/d in 2011 to 2.2 million b/d by 2016. In addition to the Caribbean coast, the traditional transport destination, projects are being studied to transport oil to the Pacific coast, with the Asian market as the destination.¹²

Meanwhile, there has been growing friction between local communities and private operators. The communities expect to benefit from the petroleum boom via employment opportunities and investments in social development, putting pressure on local operators. As exploration expands further into the jungle, there are tensions with indigenous communities opposed to encroachment on their territories; these are also areas where guerrilla presence remains strong. Finally, organized labor wants all oil companies operating in Colombia to offer the same benefits as Ecopetrol.

Unlike previous periods when Ecopetrol acted as a local intermediary between foreign operators and local communities, a larger number of companies now operate alone. Many are small companies with limited budgets. Some have been better than others at managing a corporate social responsibility portfolio.

Colombia's objective is to produce 1 million b/d. That important milestone likely can be achieved, but it will be difficult to maintain that level of production long term. Existing oil reserves (2 billion barrels) put Colombia's reserves-to-production ratio at 5.5 years. With an average of 197 million barrels per year discovered in the last decade, Colombia will have to find much more oil to avoid becoming a net oil importer toward the end of the decade. Unfortunately, the most attractive areas for exploration—the Llanos and the Amazon—carry the greatest social, environmental, and security challenges.

ii) The revival of national oil companies

During the 1990s, the outlook for NOCs was grim. Years of bloated workforces, combative unions, limited budgets, over taxation, and financially expensive subsidies for petroleum products sold to the domestic market were taking a toll. With low prices and costly exploration, companies were unable to carry new investments. The prevailing belief at the time was that the industry would perform better if governments sold state-owned companies to private owners.

The situation reversed a decade later, but the outlook for NOCs in Latin America varies greatly. Two basic models have evolved in the region. One is the political NOC. Its main characteristic is a lack of independence from the central authority. Often used as a tool for political propaganda, it is hindered by objectives unrelated to oil. PDVSA is the best example.

¹² Currently oil companies in Putumayo can use the OTA pipeline, which connects the Putumayo fields to the Pacific coast in the department of Narino.

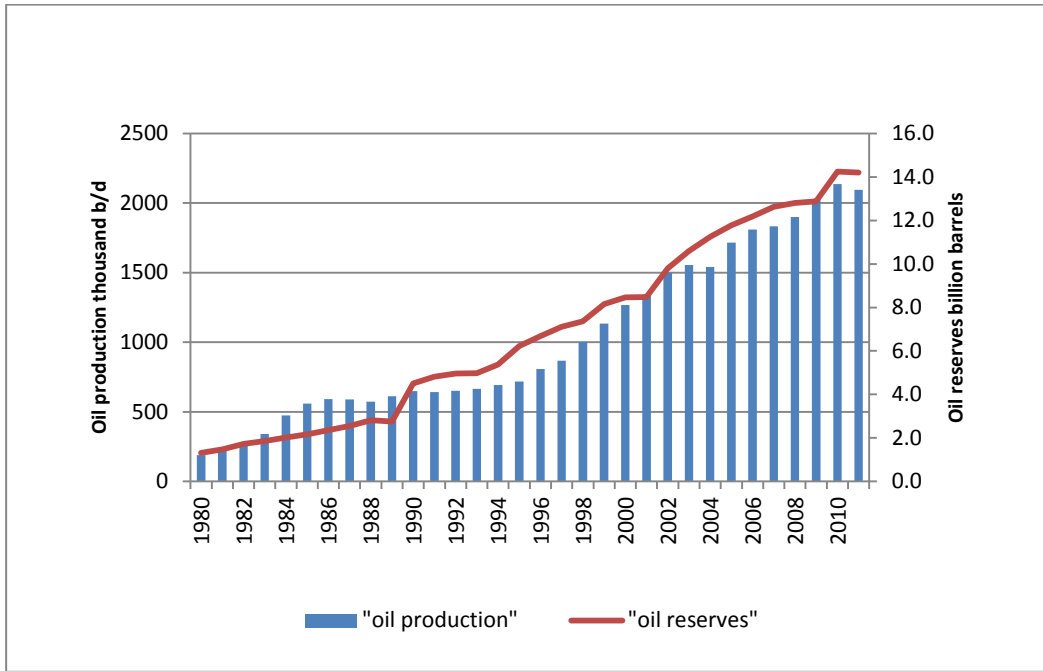
Governments in Ecuador and Bolivia revived their NOCs by capturing assets from private operators and by increasing their government take. Ideological sympathies with the Chávez administration led, with varying degrees of success, to efforts to develop joint projects. However, pragmatism and a survival instinct in the face of declining reserves and production seemed to emerge in these two countries. Both governments are modestly improving terms for private investment in E&P activities.

Following its privatization, Petroperu struggled to remain relevant. The company, lacking the political support to return to upstream activities, was forced to compete for low margins in downstream business. Under President Ollanta Humala, the company has received sufficient political support to return to its upstream activities. The model the Humala administration seems to favor is Petrobras. To date there have been no heavy-handed expropriation or nationalizations. However, the possibility of returning assets to Petroperu exists, particularly if private companies reduce exploration as their concessions come to an end. This would boost Petroperu's ability to expand its exploration activity but erode oil companies' confidence about expanding investment in the country.

The second model can be described as the entrepreneurial NOC. In this case, the company secures a higher degree of financial independence from the government, its investment decisions are based on profitability, and there is a high level of transparency regarding the company's operations. Traditional examples of the Latin American entrepreneurial NOCs are Petrobras and Ecopetrol.

The challenge for these two companies is to find the right balance between their profit-maximization interests and those of the government, which often include hard-to-quantify social development objectives. An extreme case of a corporate NOC that disregarded the political priorities of its shareholder was the old PDVSA, which was accused of caring more about long-term expansion than the country's social needs. The recent history of Venezuela and PDVSA shows that too much misalignment of government and company objectives can lead to dramatic corrections.

Figure 19: Brazilian Oil Production and Reserves



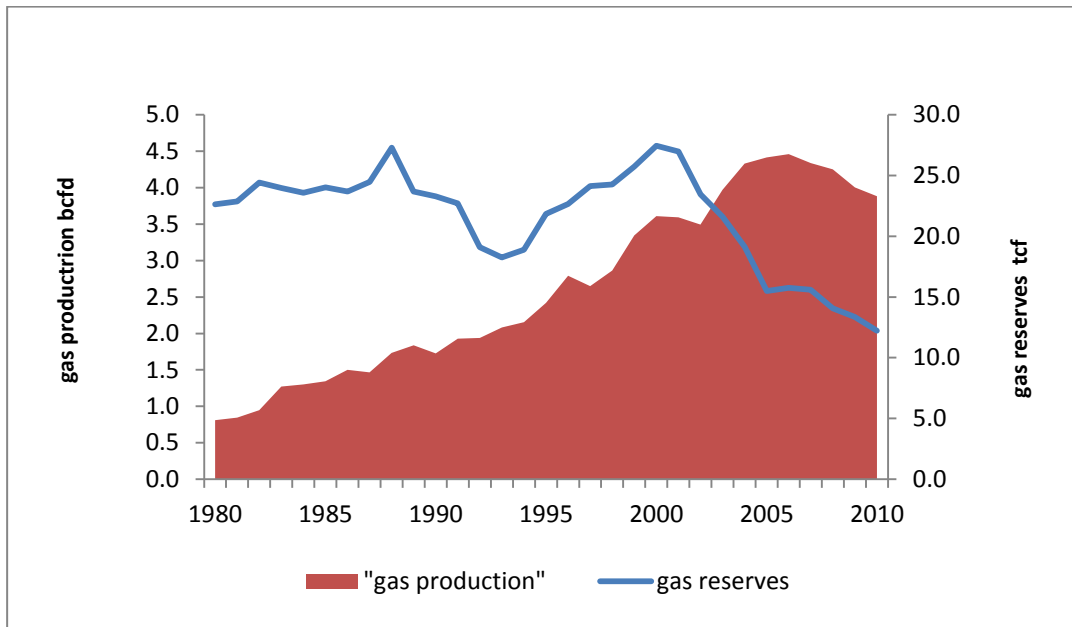
Source: BP Energy Statistics

Argentina nationalized Repsol’s share of YPF in April 2012, adding a new chapter to two decades of misguided energy policies. YPF, a highly bureaucratic and inefficient NOC, was transformed into a publicly traded company in 1992. Between 1993 and 1999, it emerged as a dynamic oil company with regional ambitions. However, in a speedy deal in 1999, Repsol purchased the majority of YPF shares.

During the deregulation period, Argentina attracted a large number of investments and became a net exporter of oil and natural gas. The industry was concentrated in few foreign companies. Following the economic crisis of 2001, the government of Nestor Kirchner reversed most of the market-oriented policies of the Menem administration. The government imposed price controls, taxes on exports, and volume restrictions at the same time it implemented generous subsidies to final consumers. Kirchner’s pro-growth strategies and government spending, fueled by high prices on soy exports, brought a booming demand for energy while investments in exploration and development collapsed.

The government’s first response to the collapse in hydrocarbon reserves and production was denial. It then began to import piped natural gas from Bolivia and shipped LNG from Trinidad Tobago and Qatar. The result was a significant increase in costs and a burden on government finances.

Figure 20: Argentina Gas Reserves and Production



Source: BP energy statistics

To reverse the situation, the government launched a “gas plus program”¹³ promoting exploration and production of non-conventional sources (shale and tight gas). With a potential of more than 700 trillion cubic feet (Tcf) of technically recoverable reserves, Argentina is one of the three largest sources of shale gas in the world. From the perspective of exploration activity, the program was successful. More than fifty projects were approved, representing investment of approximately US\$4.2 billion. Producers expressed interest since it allowed them to negotiate market prices with industrial buyers. Provinces also liked the program because revenues from royalty payments increase when prices are higher.

Despite these positive developments, when confronted with an energy trade deficit of more than US\$9 billion in 2011, the government opted to nationalize YPF assets. The justification was Repsol’s failure to invest in the country. The government, in fact, accused Repsol of taking most of its profits out of Argentina. The government seems to have ignored that, in 2007, it suggested that Repsol finance the acquisition of 14 percent of the company by the Petersen Group, owned by the Eskenazi family, who were close friends of the Kirchners. Repsol’s incentive to repatriate profits was, thus, driven by its desire to secure loan repayment from the Petersen Group. Repsol’s fate was perhaps set in November 2011 when the company announced the discovery of Vaca Muerta, Argentina’s largest shale gas reservoir and possibly one of the largest in the world.

Contrary to recent nationalizations, Argentina’s main motivation was not to capture rents or to assert national sovereignty over the country’s natural resources. The government seemed to be focusing on the

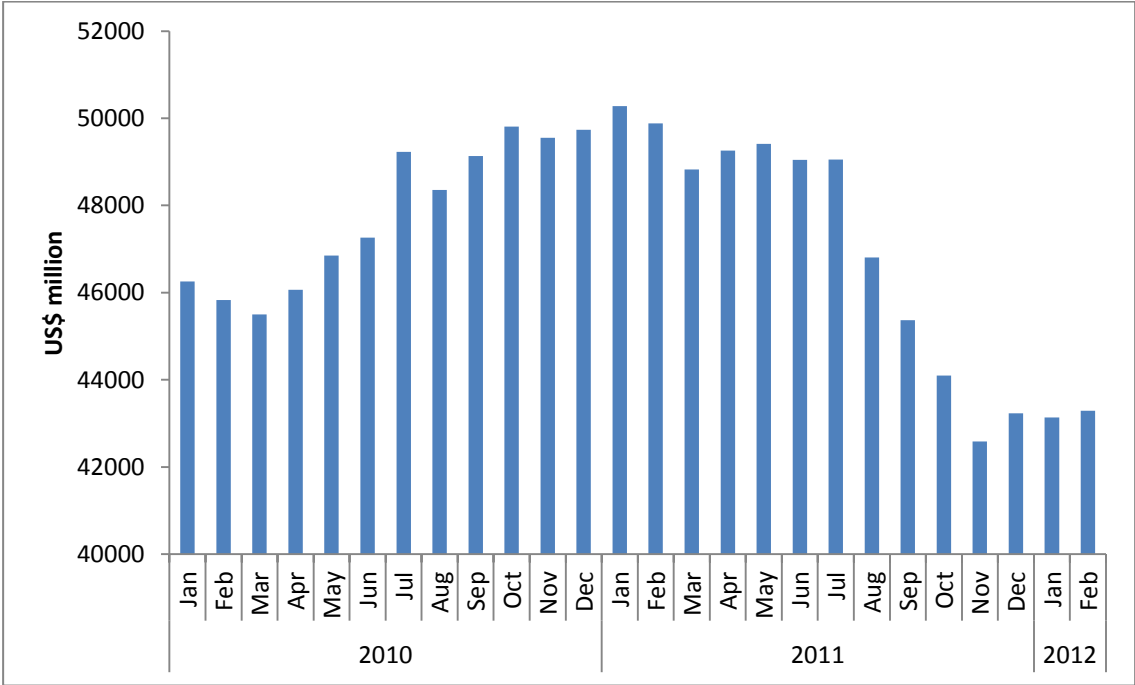
¹³ The program was extended to oil and refining activities.

short term, seeking to delay a potential balance-of-payments crisis. Since nationalization, the government has been inviting other oil companies to jointly develop Argentina’s vast gas resource potential.

However, the government is gambling with the country’s energy future. In fact, in May 2012 Repsol cancelled its supply contract of LNG to Argentina. According to press reports, new suppliers could be found but at very high price of around US\$17 mcf.

If YPF fails to reverse the production decline, Argentina will face a growing energy trade deficit or severely curtail demand, depending on how Argentina’s NOC evolves. Will YPF be a political NOC, following the steps of PDVSA? Or could it emulate the successes of Petrobras and Ecopetrol? The results of other nationalizations in Argentina, such as the airline industry, do not instill confidence about the government’s ability to foster a successful entrepreneurial NOC.

Figure 21: Foreign Reserves (excluding gold)



Source: Institute of International Finances (IIF)

iii) The development of new geopolitical alliances

One of the key features of Latin America’s recent economic ascendancy is the perceived decline of the United States as the ultimate power broker in the region. A number of publications have examined that recently.¹⁴ As the United States retreated, new players, notably China, became increasingly relevant.

¹⁴ For example see Hal Weitzman, *Latin Lessons: How South America Stopped Listening to the United States and Started Prospering* (Chicago: John Wiley & Sons, 2012).

China is a significant investor in Latin America's hydrocarbon sector. According to a recent study by the Inter-American Dialogue,⁵ Chinese banks have loaned approximately US\$75 billion to Latin America since 2005. That surpasses loans from the World Bank, the Inter-American Development Bank, and the US Export-Import Bank combined. An important source of financing, China is also a key direct investor.

China involvement in Latin American hydrocarbon activities takes two forms. One is as a traditional oil company, operating directly when permitted or as a partner in joint ventures. China also secures oil supplies via loans-for-oil. The Inter-American Dialogue estimated that China will receive 1.5 billion barrels of oil for its loans to Brazil, Ecuador, and Venezuela. For non-creditworthy countries such as Argentina, Ecuador, or Venezuela, these loans have provided essential access to the capital needed to finance investments.

In the 1990s, no country would have dared to call for nationalization or expropriation of assets held by foreign companies. In fact, governments advertised their support for mechanisms to reduce investors' risks. That is no longer the case. Hugo Chávez mocked the risk caused by the expropriation of U.S. interests in the Orinoco belt, suggesting that Chinese companies would be happy to replace them. The Chinese alternative became a common theme of populist leaders during the recent wave of expropriations and nationalizations.

However, Chinese companies have shown that their assessments of investment opportunities are, like those of any private company, based on careful evaluation of risks and opportunities. Chinese companies may not be burdened by the transparency and anti-corruption rules governing U.S. companies, but Chinese companies are as careful as any foreign investor at protecting their investments.

The challenge facing future oil production in Latin America

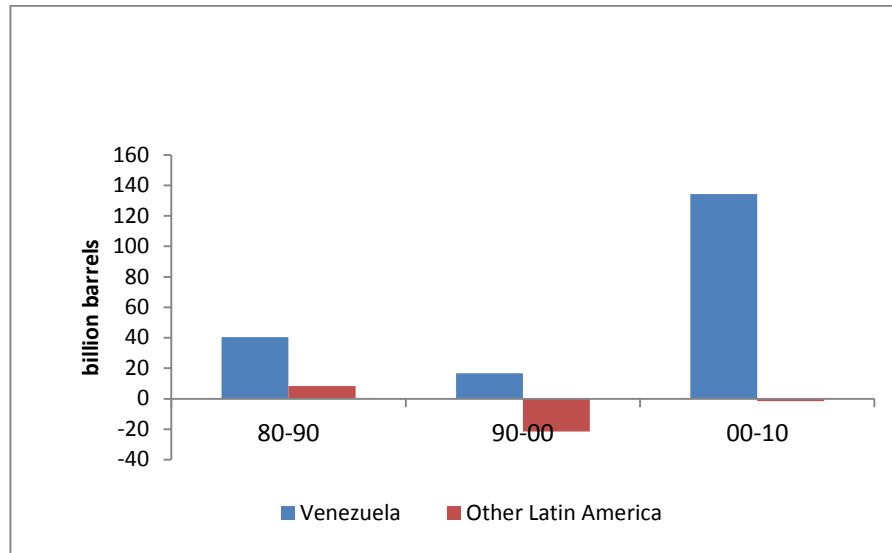
Substantial investment throughout the petroleum value chain is required if Latin America is to meet its growing demand for oil products. According to the IEA, Latin America would need to invest nearly US\$3.5 trillion in total energy infrastructure between 2011 and 2035 and approximately US\$1.9 trillion in the oil sector alone. OPEC forecasts that Latin America's refining sector alone needs more than US\$100 billion in investment over the next 25 years.¹⁶⁶

As shown in the following graph, despite recent discoveries in Brazil, most growth in petroleum reserves will come from the addition of heavy crude oil from Venezuela. That means any long-term oil production outlook will be profoundly impacted by that country's energy policy and political developments.

⁵ Kevin P. Gallagher, Amos Irwin, Katherine Koleski, "The New Banks in Town: Chinese Finance in Latin America"(Inter-American Dialogue Working Paper, 2012).

¹⁶ Source: OPEC World Oil Outlook 2011.

Figure 22: Change in Oil Reserves by Period, Venezuela and Latin America



Source: BP Energy Statistics and author's own calculations

Instead of devising a mechanism to ensure maximum extraction of rents and participation by only the most technically competent companies, the Chávez administration invited companies based purely on geopolitical interests. Preference was given to companies from China, Russia, and other developing nations.

PDVSA has ambitious production goals, planning to increase output to 4.15 million b/d by 2015. However, an average 40 percent per year rise in government spending since 2008 has forced the Venezuelan NOC to borrow heavily, pushing its debt level up 138 percent between 2008 and 2011. The company's ability to meet its ambitious expansion plans remains in doubt. IEA expects Venezuela to produce around 3.9 million b/d by 2035, of which 2.3 million b/d would be unconventional extra heavy crude.

Chávez's poor health and the proximity of the presidential elections leaves Venezuela's political outlook uncertain. The country's economic situation is delicate as it enters what can be characterized as the third phase of macroeconomic populism: "In Phase 3 of macroeconomic populism, pervasive shortages, extreme acceleration of inflation, and an obvious foreign exchange gap lead to capital flight and demonetization of the economy. The budget deficit deteriorates violently because of a steep decline in tax collection and increasing subsidy costs. The government attempts to stabilize by cutting subsidies and by a real depreciation. Real wages fall massively, and policies become unstable. It becomes clear that the government is in a desperate situation."¹⁸ As past populist experiences show, and Dornbusch and Edwards described in their paper, the following phase brings a drastic economic adjustment under a new government.

¹⁸ Rudiger Dornbusch and Sebastian Edwards, *The Macroeconomics of Populism* (Chicago: University of Chicago Press, 1991), 11.

Recent efforts by PDVSA and its partners suggest a modest improvement in oil production. However, unless the country addresses its mounting macroeconomic imbalances and reverses its anti-investment policies, the full potential of its vast oil reserves is not likely to be achieved.

Other sources of oil include Brazil's offshore deep-water reserves and, pending successful exploration outcomes, those of Guyana and Suriname. Oil production could also be expanded in Mexico with reforms in the petroleum sector.

Like oil, Latin America's natural gas production will depend not only on geology but also political and regulatory developments. Argentina and Mexico both have vast non-conventional gas reserves. However, their development comes with unattractive economic terms, regulatory restrictions, and political risk.

Biofuel developments

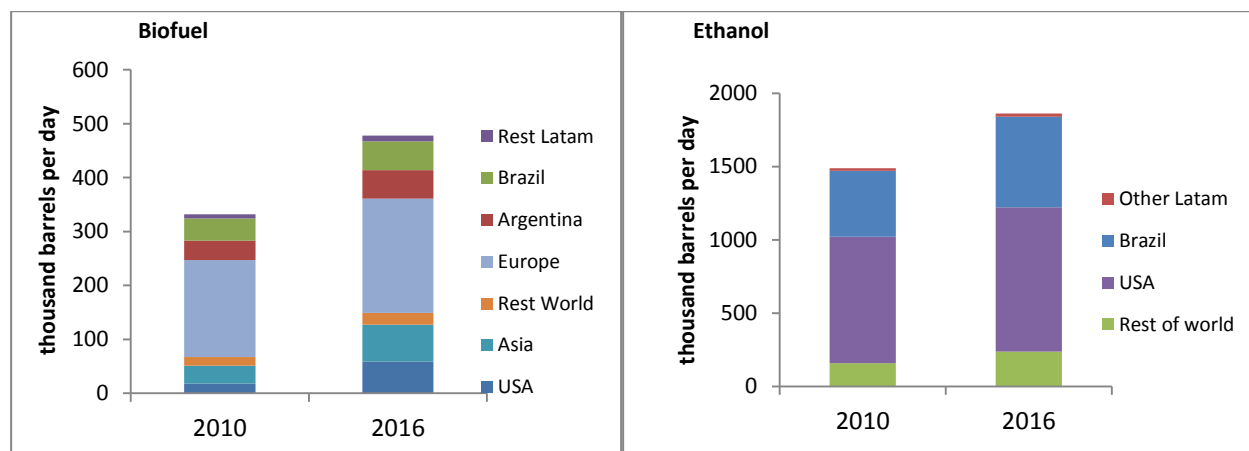
Latin America is in an advantageous position to develop a biofuel industry thanks to good soil, suitable climate, available land, and low labor costs.¹⁹ Balances of payments are expected to improve through the replacement of costly oil imports with local biofuels; ethanol already is used as substitute for up to 20 percent of Brazil's oil imports. A biofuels industry also opens the door to lucrative exports to markets in North America, Europe, and Asia, diversifying the export base of producer countries. The biofuel industry brings employment to rural areas. Finally, use of biofuels is believed to contribute to the reduction of CO₂ emissions (although there is not yet consensus on this assertion). It is, therefore, not surprising that biofuel production has grown rapidly in Latin America, with Brazil leading the expansion.

In 2010, the world's ethanol production was close to 1.5 million b/d, with Latin America contributing around 31 percent of that. Brazil accounted for 96 percent of the region's ethanol output. Colombia and Paraguay have rapidly growing ethanol industries; Mexico, Central America, and other South American countries are at differing stages of development. Biodiesel output has grown fast in Argentina and Brazil with soy as the main input, while Colombia uses oil from African palm trees. Most countries have legislation that mandates blending of biofuels as a mechanism to promote the development of a domestic market.

IEA forecasts that Latin America's production of ethanol will increase to 640,000 b/d, or 34 percent of the world's total, by 2016. Biodiesel output is expected to reach 478,000 b/d with Latin America boosting its output to 117,000 b/d, from 85,000 b/d—although its global share will not increase as output from Asia is forecasted to expand further.

¹⁹ Rainer Janssen and Dominik Damian Rutz, "Sustainability of biofuels in Latin America: Risks and opportunities," *Energy Policy Journal*, 39:10, 5717-5725, January 2011.

Figure 23: World Ethanol and Biofuel Production Forecasts; 2010 - 2016



Source: IEA World Energy Outlook

Ethanol and biodiesel industries in Latin America have not been free of controversy. The main criticism centers on the threat of deforestation in the Amazon region and destruction of the Cerrado, Brazil’s savannas. However, most of the deforestation in the Amazon comes from cattle ranching, subsistence farming, and illegal logging. Large infrastructure projects such as roads, hydroelectric dams, and electricity transmission lines also increase deforestation. The Amazon is not suitable for sugar cane production. However, the region could be indirectly affected as cattle ranchers sell their land in other areas, such as the Cerrado, for use as sugar mills—then expand their activities into the Amazon. This issue is more relevant to the rapid expansion in the Cerrado of biodiesel producers using soy beans.

In Colombia, criticism has surfaced over human rights abuses associated with land expropriation by African palm producers. Colombia’s biodiesel industry is concentrated in the Urabá, a rainforest area close to Panama and inhabited by Afro-Colombians. Human rights activists have denounced the presence of paramilitary forces that dislocate peasants from land that is then used by African palm growers. The industry also appears to have little concern for the long-term environmental impact that occurs when a tropical rainforest is turned into a large monoculture plantation.

As food prices spiked in 2008, the biofuel industry was also accused of contributing to global hunger because of concerns that food crops were being replaced with biofuel crops, driving up food prices. But factors contributing to food price inflation are numerous. Demand for food is expected to grow rapidly as a result of the wealth impact of a larger middle class in emerging economies. At the same time, agriculture expansion could be blocked by i) expanding urban areas and suburban sprawls; ii) climate change; iii) growth of national parks; and iv) production of biofuels.

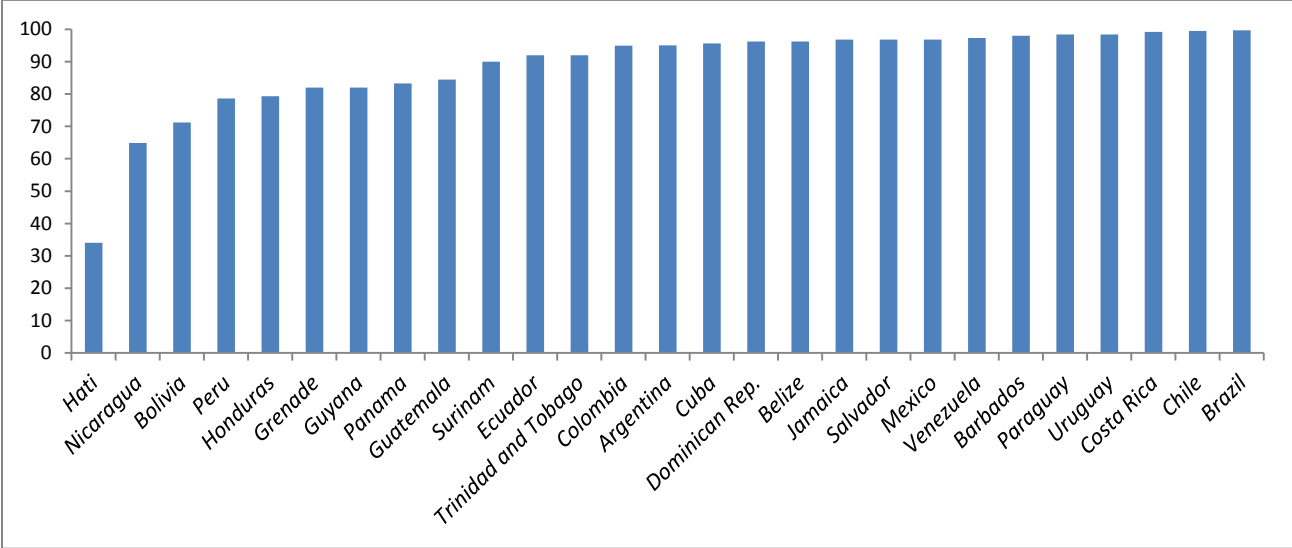
Electricity developments in Latin America

The structure of the electricity sector in Latin America has changed in the last thirty years. After World War II, the sector expanded rapidly with vertically integrated state-owned utilities. The expansion was based on large projects overshooting demand requirements. Government access to lending allowed investments in mega hydroelectric projects. However, utilities’ financial situations deteriorated rapidly when inflation eroded their revenues and governments were reluctant to increase tariffs. The external debt crisis worsened the situation, weakening ability of the utilities to invest in new capacity and severely deteriorating the quality of the service.

In 1982, Chile became the first country to deregulate and privatize electricity. The following decade most of the region moved to adopt structures that ranged from complete market competition to state control. As occurred in the petroleum sector, we are now seeing a tendency toward “re-nationalization” of the electricity sector. Venezuela nationalized its previously privatized electric utilities in 2007 and, at the time of this writing, Bolivia had announced nationalization of its electricity grid.

Electricity coverage in Latin America has increased significantly in the last forty years. In the case of Brazil, coverage in 1970s was less than 50 percent; by 2010, Brazil had achieved more than 90 percent coverage. But there remain significant differences in coverage levels among countries. Haiti has the lowest level (34 percent) while Brazil has the highest (99.6 percent). Coverage is near 100 percent in urban centers, yet there are still up to 34 million people in Latin America without access to electricity. Peru has the largest population without access: 6.5 million people.

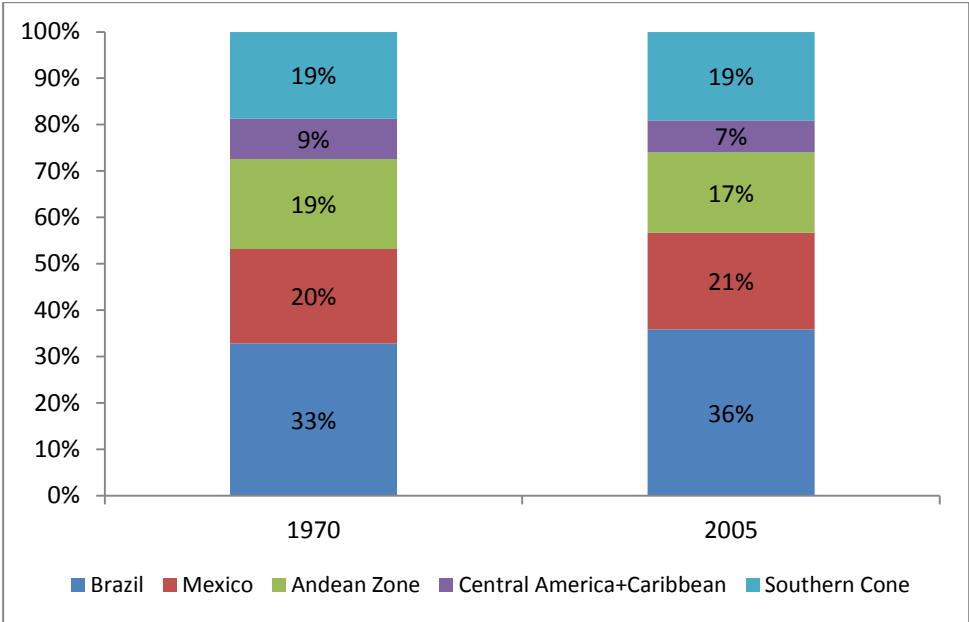
Figure 24: Electricity Coverage, Percentage of Population



Source: Ariel Yepes et al., Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean. World Bank, 2010.

If progress has been achieved with coverage, the same cannot be said for losses linked to transmission and distribution of electricity. Latin America’s loss level averages 16.7 percent of total output, twice the world average. A high level of loss carries significant cost for the region’s economies. In fact, if distribution losses could be reduced to the levels of the best performers in the region over the next 20 years, annual electricity savings from distribution improvements alone could reduce demand by about 78 TWh (6 percent of the incremental demand of 1,325 TWh) by 2030.²⁰ Venezuela has the highest average level of losses (27 percent) while Chile has the lowest (6 percent) in Latin America. Most of the electricity generation is concentrated in two countries: Brazil and Mexico combined produce 57 percent of the region’s electricity.

Figure 25: Latin America's Electricity Generation by Country/Region 1970 - 2005



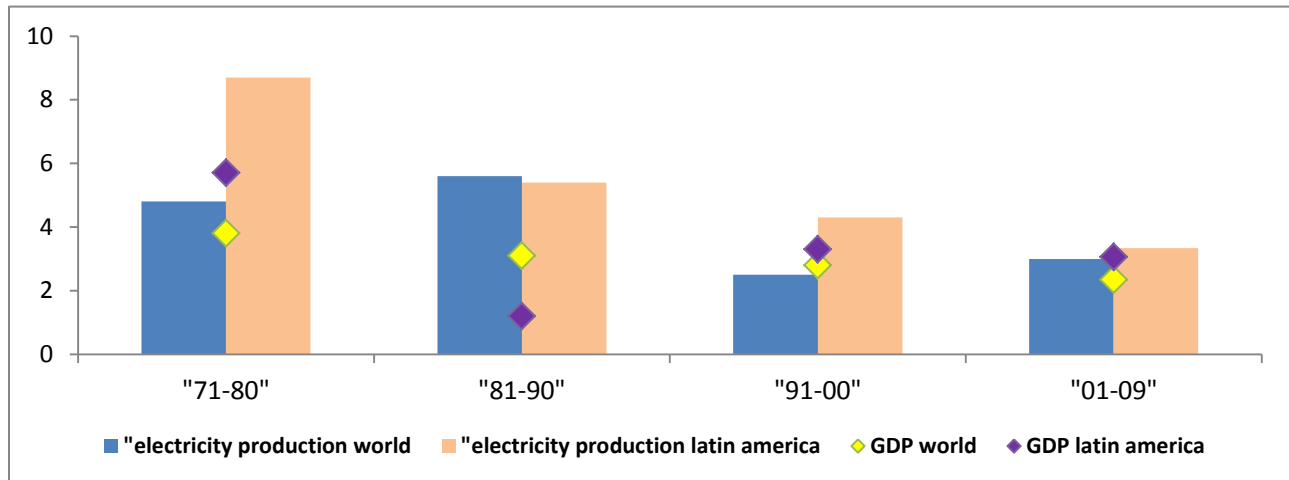
Source: OLADE SIEE database

Electricity generation

Since 1970, Latin America’s electricity production has increased an average 5.6 percent per year. That exceeds global electricity-generation growth, which averaged 4.2 percent annually during the same period. However, Latin America’s growth rate has not been consistent.

²⁰ Rigoberto Ariel Yépez-García, Todd M. Johnson, and Luis Alberto Andrés, *Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean*, (Washington, D.C.: The World Bank, 2011).

Figure 26: World and Latin American Electricity Production and GDP Growth

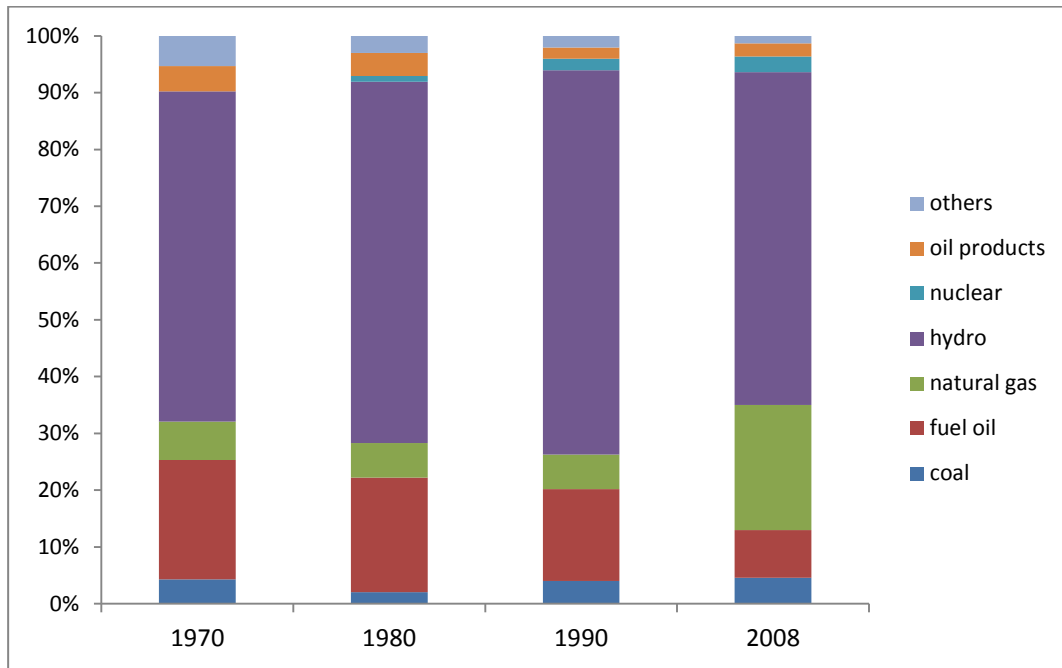


Source: Based on Ariel Yepes et al., Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean. World Bank 2010

Electricity's fast growth, above 8 percent, coincided with the economic expansion of 5.7 percent and rapid industrialization in the 1970's. In the 1980s, the world's electricity production grew faster than that of Latin America where, during that period, economies were undergoing the economic impact of the debt crisis. The region's GDP growth averaged 1.2 percent per year, below the global 3.1 percent growth rate. The 1990s saw an economic recovery in Latin American and resumed growth in electricity generation—surpassing world production rates. In the last decade Latin America's electricity production and GDP have expanded at higher rates than the world average; electricity rose by 3.3 percent and GDP by 3.1 percent per year.

Latin America has the cleanest electricity mix in the world, as measured by greenhouse gas emissions, thanks to the prominence of hydroelectricity. However, the structure of the electricity generation varies significantly by country or group of countries. The Caribbean and Central America—except Costa Rica—rely mostly on oil products for power generation. Mexico has greater diversity of sources powering electricity, with gas playing a key role, followed by oil products and coal. Hydroelectricity dominates in Brazil and the Andean Zone. In the Southern Cone, hydroelectricity is also the most important source of electricity, followed by natural gas.

Figure 27: Latin America's Electricity Generation by Source



Source: OLADE SIEE Database

The use of natural gas for electricity generation has expanded rapidly in the last decade and now accounts for 22 percent of Latin America's electricity mix. Fuel oil as a feedstock for electricity generation, on the other hand, has declined from 21 percent in 1970 to 8 percent in 2008.

Market deregulation, liberalization, and privatization of the electricity and hydrocarbon sectors have encouraged the use of gas in power generation. New technologies such as combined cycle and gas-fired cogeneration allowed private investors to invest in gas-fired power projects that required lower levels of upfront investment yet offered shorter payout periods.

This expansion occurred mostly in Brazil, Mexico, and the Southern Cone. In Mexico and Chile, gas-fired electricity generation also addressed growing concern about the health effects of coal-fired electricity generation, particularly near urban centers such as Mexico City and Santiago. In Brazil, the government of Fernando Henrique Cardoso set an objective: to use natural gas for at least 10 percent of electricity generation. The move came in reaction to the nation's dependency on hydroelectricity, which was vulnerable to changing weather patterns. Similar concern existed in Colombia.

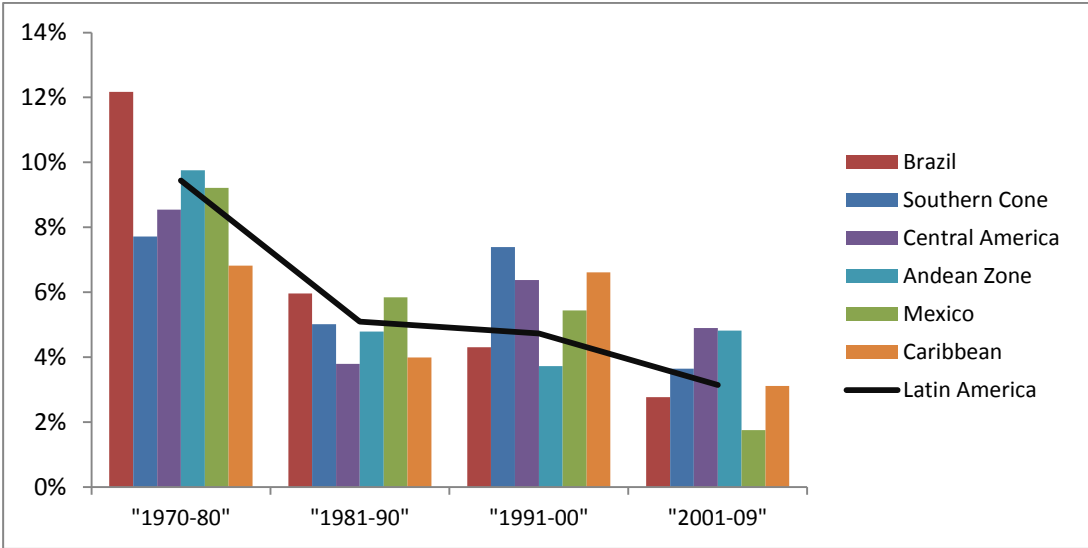
Chile's enthusiasm for gas-fired electricity generation was unusual given that, unlike other countries, it lacked domestic supplies. Bolivia was the most economical source of natural gas, but acquiring it carried political risk since Bolivia still claimed access to Chile's Pacific coast. So Chile opted for imports from Argentina to meet its rapidly growing demand for electricity. However, that made Chile vulnerable when

Argentina severely curtailed exports. Chile has since diversified its suppliers, importing LNG while expanding the use of coal and hydroelectricity. Chile is also considering investments in nuclear generation.

Electricity consumption

In Latin America, Brazil had the fastest growth in electricity use in the 1970’s but that rate has been declining fast in the last two decades. Mexico electricity use also experienced a sharp decline in the last decade. On the other hand, electricity use in the Andean region, Central America and the Caribbean increased but a lower rate than in the 1990’s.

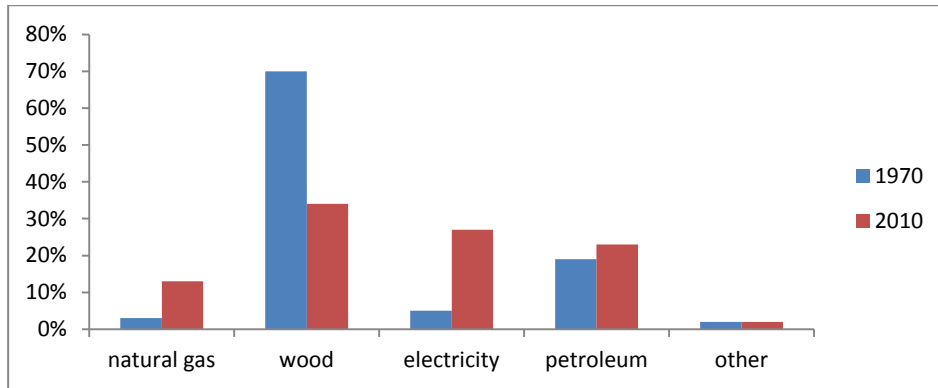
Figure 28: Growth in Latin American Electricity Consumption 1970 - 2009



Source: OLADE SIEE Database

In 1970, residential energy use made up 32 percent of total energy demand in Latin America. Forty years later, this had declined to 16 percent as a result of increased energy efficiency. Wood met 70 percent of residential energy needs in 1970; it is now around 30 percent. Use of wood for energy correlates to income levels: wood is the fuel of choice for the poor. Wood is also an inefficient energy source that carries both high health care costs, particularly for children, and high environmental costs due to deforestation. During the four decades in which the use of wood declined, the use of conventional energy sources (natural gas, oil products, and electricity) increased.

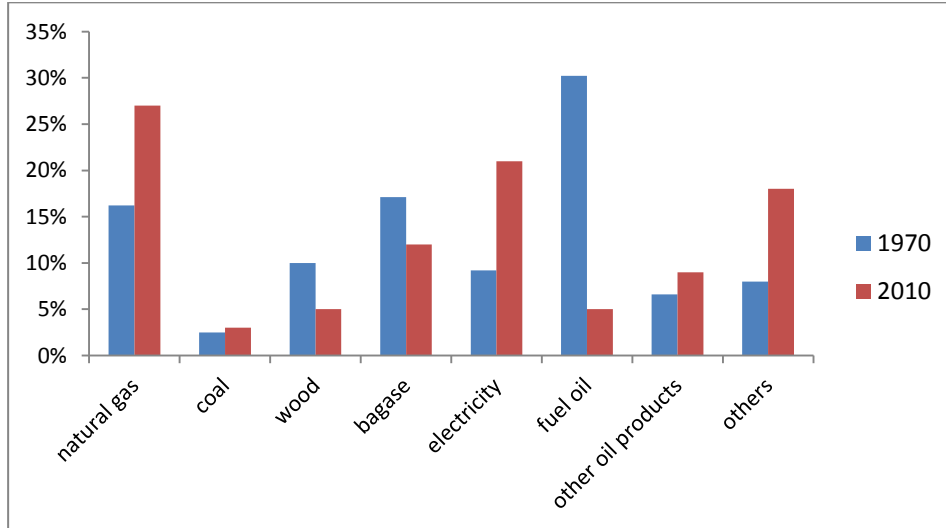
Figure 29: Latin America Residential Energy Consumption 1970 - 2010



Source: OLADE SIEE Database

Industrial activities account for 34 percent of total energy use in Latin America. Industrial demand has seen a rapid expansion since 1970, averaging 6 percent growth per year. That demand has been coupled with a shift toward natural gas and electricity and away from fuel oil, wood, and sugar cane.

Figure 30: Latin American Industrial Energy 1970 - 2010



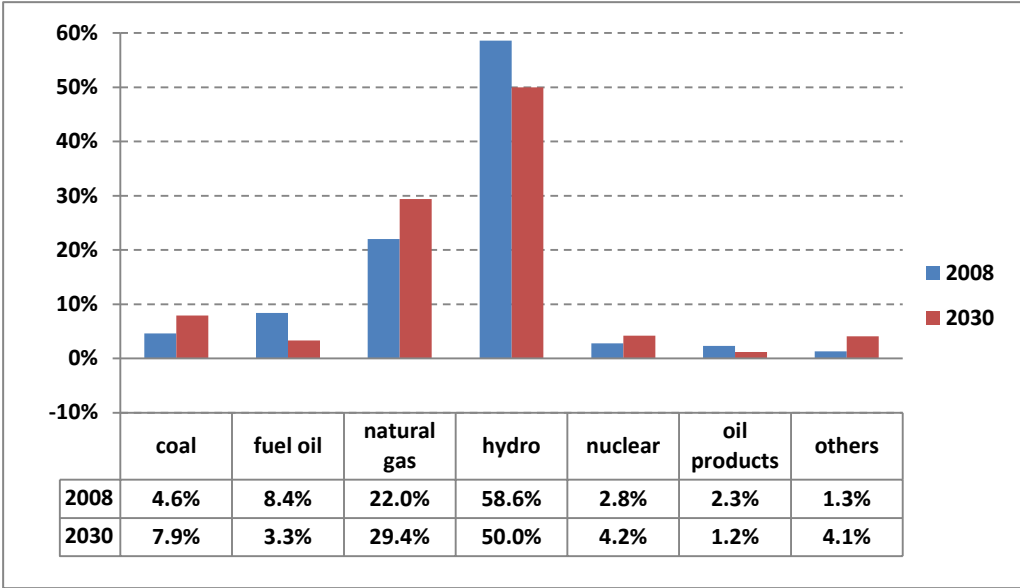
Source: OLADE SIEE database

The outlook for electricity demand

According to IEA forecasts, world electricity consumption is expected to increase 72 percent between 2009 and 2035, with Latin America’s electricity consumption growing 75 percent, or about 2.9 percent per year. A recent World Bank publication offered detailed forecasts of electricity demand growth in Latin America.

It assumed average GDP growth of 3 percent for all countries until 2030, with Latin America’s demand for electricity expected to grow at a higher 3.7 percent per year. By 2030, consumption was forecasted to be around 2500 TWh, nearly double current consumption. The fastest growing markets were expected to be Central America and Brazil. The growth in demand for electricity in the Andean and Southern Cone countries was expected to decline, at the same time Mexico could see the highest growth rate jump, to 3.4 percent from 1.8 percent in the current decade.

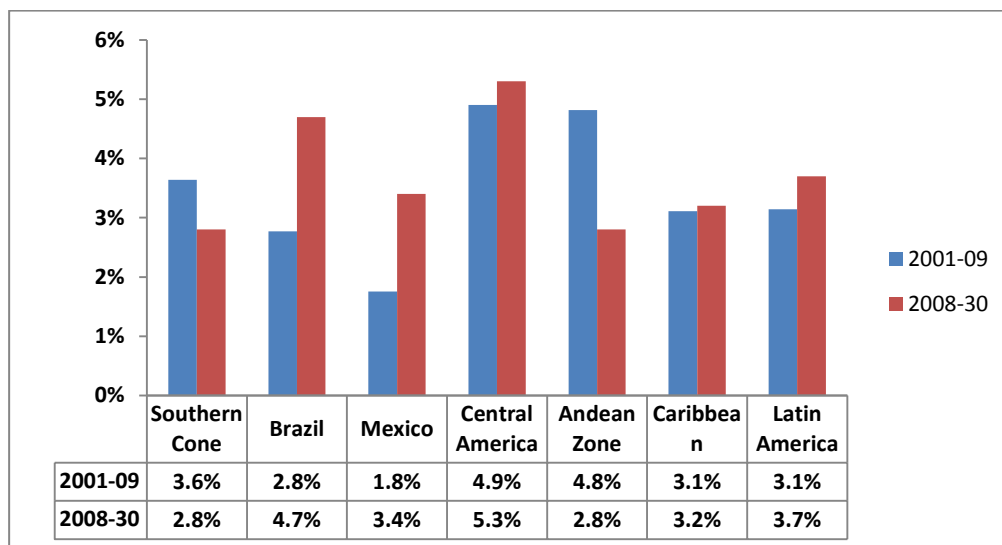
Figure 31: Electricity in Latin America’s Generation Mix



Source: Based on Ariel Yepes et al., Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean. World Bank 2010

Hydroelectricity will continue to be the most important source of electricity generation, although its contribution to the electricity mix will continue to decline. Latin America’s dependency on fossil fuels for electricity generation, meanwhile, will increase.

Figure 32: Latin American Electricity Demand, Change Per Year



Source: Source: Based on Ariel Yepes et al., Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean. World Bank 2010

Natural gas will be an important component in the region’s electricity generation. And coal will continue to play a greater role, reversing a decline that began in the 1970s. Coal will account for an 8 percent share of the electricity-generation mix in 2030, up from 4.6 percent today. Consequently, Co2 emissions in Latin America are expected to rise from 244 million metric tons in 2008 to 569 million metric tons by 2030.

The share claimed by clean energy sources, including nuclear and renewable sources, will increase but their overall contribution to the total electricity generation mix will remain modest. Fuel oil and oil products for use in generating electricity will be displaced by gas power generation.

Conclusion: meeting the energy challenges

Latin America has adequate resources to meet its energy needs. However, its challenge is to find the balance of sources that best provides energy security, meets growing demand, is environmentally sustainable, and can be developed at a competitive cost. The World Bank study provides an electricity mix forecast that reveals continued dependency on hydroelectricity but with natural gas taking a more relevant role. Because of limitations imposed on hydroelectric development, Latin America will have to significantly increase the share of other renewable sources in order to avoid greater dependency on fossil fuel for electricity generation. However, a more significant role for these sources in the electricity mix implies higher electricity costs for consumers and/or more expensive subsidies by governments.

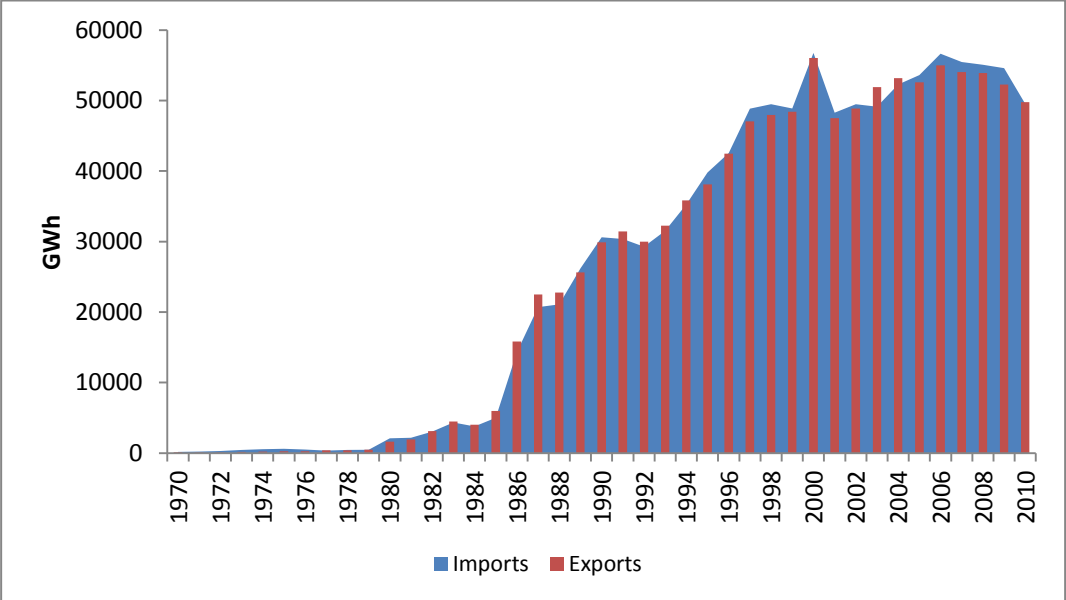
The region is also seeing rapidly growing demand for oil products by the booming transportation sector. Latin America’s oil production peaked in 2005 at 10.7 million b/d then constantly declined until

2009. Since then, production has slowly recovered. Still, Latin America’s demand for oil is expected to surpass production by 2025. In order to meet that growing demand and retain export potential, the region is going to need significant investment in exploration. However, rent-seeking policies have resulted in expropriation, nationalization, and changes in contractual terms, negatively affecting investment.

In addition to supply side considerations, it is important to note the role played by energy policies, as well as the benefits of regional energy integration. A regional electricity market would reduce generation costs at the country level since consumers benefit from access to other countries’ larger and low-cost generation facilities. Economies of scale could also be achieved, with larger projects based on expanded regional (rather than national) electricity demand. Meanwhile, instead of allocating capital to develop smaller and costly generation units, a regional electricity market would free that capital for other purposes. Regional energy trade also reduces the need for costly domestic reserve requirements and enhances supply security by maximizing potential complementarities from different sources (occurrence of different sources at different periods of the year reducing the need for backup generation). Finally, trade increases market competition by diversifying sources of supply.

Trade in Latin America’s electricity sector has developed gradually with a focus on connecting supply nodes to meet seasonal demand. Earlier collaborations, such as between Paraguay and Brazil, were based on government-to-government agreements establishing prices and volumes. Currently there are three key regional trade zones: i) Brazil-Southern Cone; ii) the Andean Zone (Colombia-Ecuador and Venezuela); and iii) Mexico-Central America. Electricity trade in the region increased in the 1980s but, since 2004, it has declined as countries opt to secure their needs internally.

Figure 33: Latin America's Electricity Trade



Source: OLADE SIEE database

Development of an integrated electricity market has not been a priority, although it was often presented as a long-term objective. Colombia's "Connecting the Americas 2022" proposal during the Summit of the Americas in Cartagena in April 2012 may spark increased interest, but implementing a regional energy market could be daunting. The first challenge will be Latin America's spectrum of regulatory models, from the market-oriented ones in Chile and El Salvador to the vertically integrated state-owned utilities in Costa Rica and Venezuela. Countries are reluctant to give up control over their regulatory agencies.

Creation of an EU-style regulatory authority could be the solution for the region. However, that option does not seem politically feasible in the short or medium term. In fact, after attempts to develop a market-oriented institutional framework, the energy sectors remained vulnerable to the new political priorities of subsequent administrations. Without a regional regulatory authority, the system would have great difficulty in coordinating prices, tariffs, and access. Despite these difficulties, important milestones have been achieved. Construction of a transmission grid between Mexico and Central America and Colombia and Panama, for example, is a first step toward a Latin American electricity market

Market integration should not be limited to electricity. Gains can be achieved through development of a regional natural gas market, too. Gas reserves are not distributed equally throughout the region, and the importance of gas in the energy mix varies greatly by country.

In recent years, Latin America opted for "virtual gas integration" using LNG instead of pipelines. The LNG option provides higher levels of security since importing countries can diversify their sources of supply. However, LNG dependency came at a cost: Importing countries had to pay higher prices, which are often tied to oil price variations. Still, LNG imports are expected to become more competitive and could challenge, for example, Peru's ambitious LNG exports and development of its petrochemical industry. The "shale gas revolution" in the United States caused prices to collapse. Gas producers are now looking for new markets with better rates of return.

In the last decade Latin America has benefitted from exceptionally favorable macroeconomic conditions and from the lessons learned from previous crises. The region sits at the crossroad of sustainable economic growth and another bust. In its favor, Latin America has sounder macroeconomic policies (with the notable exceptions of Venezuela and Argentina), democratically elected administrations, and an emerging middle class. Working against it, the region is still marked by poor productivity, an increasing dependency on commodities, a process of de-industrialization, and high levels of corruption and income inequality.

The investment required and the technical complexity of developing vast energy potential requires the participation of public and private actors. The last two decades have demonstrated that one economic

model alone will not answer the challenges ahead. The so-called Washington Consensus favored private actors in the development of the energy sector, at the cost of declining rents for governments. The resource nationalist developments of the last decade have brought more rents to governments but at the cost of new investments. Moving forward, Latin America will need to find a pragmatic approach in which market forces are the main driver of private investments but private actors' behavior is strictly supervised through strong regulations and regulators.

Latin America's challenge over the next two decades is not one of resources but, rather, one of institutions. The region must develop institutions that "maintain productive dynamism and generate resilience to external shocks."²¹ And rather than modeled on foreign experiences, those institutions must reflect the local characteristics of each country.

²¹ Dani Rodrik, *One Economics, Many Recipes: Globalization, Institutions and Economic Growth* (Princeton, N.J.: Princeton University Press, 2007).

Bibliography

- Altamonte, Hugo, Nelson Correa, Diego Rivas, and Giovanni Stumpo. “La Dinámica del Consumo Energético Industrial en América Latina y Sus Implicaciones para un Desarrollo Sostenible.” CEPAL. Dec. 2011.
- Argus LatAm Energy at <http://www.argusmedia.com/Petroleum/Crude/Argus-LatAm-Energy> “Balance Preliminar de las Economías de América Latina y el Caribe.” CEPAL. Santiago, Chile. 2011.
- Bremmer, Ian and Robert Johnston. “The Rise and Fall of Resource Nationalism.” *Survival*, (2009) Vol. 51, No. 2: 149-158.
- Delgado, José Luis García and Juan Carlos Jiménez. “Energía y Regulación en Iberoamérica.” *ARAIE*: Thomson Civitas Edition. 2008.
- Del Granado, Javier Arze, David Coady, and Robert Gillingham. “The Unequal Benefits of Fuel Subsidies: A Review of Evidence for Developing Countries.” International Monetary Fund. Sept. 2010.
- “Desarrollo Sostenible: Medio Ambiente, Cambio Climático y Energía: Oportunidad para el Dialogo y la Cooperación entre Europa y América Latina y el Caribe.” Banco Interamericano de Desarrollo. Mar. 2008.
- Dornbusch, Rudiger and Sebastian Edwards. “The Macroeconomics of Populism.” University of Chicago Press. 1991.
- “Electric Power Intelligence Series: Outlook 2012.” *Business Americas*. Oct. 2011.
- “Energy Indicators for Sustainable Development: Country studies on Brazil, Cuba, Lithuania, Mexico, Russian Federation, Slovakia and Thailand.” International Atomic Energy Agency. United Nations, Department of Economic and Social Affairs. Feb. 2007.
- “Energy Outlook 2010.” International Energy Agency. 2010.
- “Energy Outlook 2011.” International Energy Agency. 2011.
- Fishlow, Albert. José Antonio Ocampo & Jaime Ros, Editors. “Recent Commodity Price Boom and Latin American Growth: More than New Bottles for an Old Wine?” *Oxford University Press*. 2010.
- Foss, Michelle Michot. “The Outlook for US Gas Prices in 2020: Henry Hub at \$3 or \$10?” Oxford Institute of Energy Studies. Dec. 2011.
- Gallagher, Kevin P., Amos Irwin, and Katherine Koleski. “The New Banks in Town: Chinese Finance in Latin America.” Inter-American Dialogue, Working Paper. 2012.
- Gallaher, Kevin P., Amos Irwin, and Katherine Koleski. “The New Bank in Town: Chinese Finance in Latin America.” Inter-American Dialogue. Feb. 2012.
- Janssen, Rainer and Dominik Damian Rutz. “Sustainability of Biofuels in Latin America: Risks

- and Opportunities.” *Energy Policy Journal*, (Jan. 2011) Vol. 39, No. 10: 5717-5725.
- Kaup, Brent Z. “A Neoliberal Nationalization? The Constraint of a Natural Gas Led Development in Bolivia.” *Latin American Perspectives*. 2010.
- “Medium Term Oil and Gas Markets 2011.” International Energy Agency. 2011.
- “Mercados Energéticos en America Latina.” FIESP/OLADE. 2010.
- “Peruvian Hydrocarbons: A Sector ripe for Investments.” Oil and Gas Intelligence Series: *Business Americas*. Dec. 2011.
- “Resource Revolution: Meeting the World’s Energy, Materials, Food, and Water Needs.” McKinsey & Company. Nov. 2011.
- Rodrik, Dani. “One Economics, Many Recipes: Globalization, Institutions and Economic Growth.” Princeton University Press. 2007.
- Weitzman, Hal. “Latin Lessons: How South America Stopped Listening to the United States and Started Prospering.” John Wiley & Sons: Chicago. 2012.
- “World Hydroelectric Potential.” INTPOW, Norwegian Renewable Energy Partners. 2009.
- “World Oil Outlook.” OPEC. 2011.
- Yepez-Garcia, Rigoberto Ariel, Todd M. Johnson, and Luis Alberto Andres. “Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean.” The World Bank. 2011.