

Case Study From



Gas Monetization in Bolivia¹

Bolivia is on its way to be the first natural gas hub in Southern Cone, with probable reserves of 47 tcf and exports to Brazil, Argentina, and Paraguay. Recent aggressive exploration efforts in the southern and eastern parts of the country have been so successful that Bolivia's gas reserves are now second only to those of Venezuela in South America. Discoveries have outpaced low domestic demand. Gas-fired power generation capacity is 489 MWs (55% of total). Only 55% of the population has access to electricity with 80% of the rural population without electricity, but the demand is increasing at

10% a year. Currently, about half of Bolivia's gas production is re-injected, flared, or vented rather than marketed. Most of the gas produced is exported to Brazil via the 1,432-mile Bolivia-to-Brazil pipeline. Exports to Argentina have been suspended due to Argentina's increased production. During 1998, 85% of gas was consumed by the industrial sector, and plans to increase household consumption were initiated.

- *What is the best strategy for Bolivia to monetize its gas resources?*
- *Should Bolivia use gas to expand energy to its impoverished population? If so, how?*
- *Should Bolivia export more gas, or gas-fired power, to its neighboring countries?*

Background

With a GDP per capita of around \$1,000, Bolivia is one of the poorest countries in Latin



America. About two-thirds of the population is poor, with low levels of education, health and nutrition. Bolivia's 8.3 million people live in a landlocked territory of 1.1 million km². Population density is low at 8 people per km². The urban population has been growing at 4.3% a year considerably faster than the national average of 1.9% for the past 10 years. The exchange rate (November 2002) is 7.40 Boliviano per U.S. dollar. The 2002 GDP was estimated at \$7.4 billion. Bolivia has been relatively successful in maintaining price stability; inflation peaked above 12% in 1995 and has since decreased to less than 7%.

Bolivia has a segmented society, with insufficient investment, weak institutional capacity, and entrenched vested interests hampering the private sector. Nevertheless, private investment has grown at about 10% a year since 1992, but the country remains heavily dependent on foreign assistance to finance development projects. At the end of 1998, the government owed \$4.3 billion to its foreign creditors. Foreign direct investment (FDI) for 1999 and 2000 was about

¹ This case study was prepared using publicly available information.

\$1 billion and \$500, respectively. FDI was \$500 million in 2002, with increasing activity in the oil and gas sectors as the driving force.

Energy Sector

According to the EIA, Bolivia is relatively self sufficient in oil, consuming an estimated 43,000 barrels per day (b/d), slightly equal to what it produced (around 43,800 b/d) in 2001. There is no coal production or consumption. The country has developed significant gas potential in recent years. Proved gas reserves are estimated at more than 24 tcf, although the potential is expected to be as high as 52 tcf. But consumption is very limited with only 44 bcf a year. Bolivia exports about 99 bcf of natural gas a year.

In 1999, the country generated about 3.6 billion kWh of electricity, 57% of which was thermal and 42% of which was hydropower. Consumption of electricity in Bolivia from hydroelectric and other renewable sources accounted for over 348 Million kWh of installed capacity for electric generation in 2001, which represents 35% of total generation. The share of thermal generation has grown rapidly in recent years. There are four major generation companies in Bolivia: Guaracachi, Valle Hermosa, Corani and Cobee. The national grid, the SIN, accounts for the vast majority of Bolivia's installed electric capacity and power generation. Currently, Bolivia has no international grid interconnections. However, in December 2000, construction on the first export facility was inaugurated. A joint venture between Duke Energy and Petrobras will build two new power plants, one on each side of the Bolivia-Brazil border.

Fossil Fuel Reserves, Production and Consumption in Bolivia (2001)

	Proved Reserves	Production	Consumption
Oil	55 million t. (440 million b.)	2.2 MT/yr (43,800 b/d)	2.2 MT/yr (43,000 b/d)
Natural Gas	680 bcm (24 tcf)	4.1 bcm/yr (400 MMcf/d)	1.3 bcm/yr (121 MMcf/d)
Coal	1 million short tons	None	None

Sources: Energy Information Administration, BP World Energy

Energy Sector Reform

Over the past 10 years, the Bolivian government has introduced many effective policy developments in the energy sector. Since the industry has been in the hands of state-owned Yacimientos Petroliferos Fiscales Bolivianos (YPFB), a series of legislative and structural reforms has transformed the energy sector from state-ownership to a predominantly private-run industry. In 1991, the government introduced new hydrocarbon codes, and passed the Hydrocarbon Law in 1996. In early 1998, the government signed a memorandum of understanding with Peru for the proposed construction of a 418-km pipeline to export liquid gas products. In 1999, the Ley Corazon, or the "Heart Law," was instituted to promote the development of power plants by foreign investors to generate and export electricity abroad. The intent is to promote development of cross-border electricity and hydrocarbon projects. This law, in combination with a bill drafted to create tax-exempt areas for energy export projects, is intended to encourage companies to build gas-fired electricity generation capacity for export markets.

Private foreign investment, driven by privatization and the prospect of supplying the region's largest and most rapidly developing energy consumer, Brazil, has transformed Bolivia's oil and gas industry. Until recently, the missing link has been a sufficiently large market to justify the hundreds of millions of dollars required to explore and develop the country's hydrocarbon potential.

The government enacted the Electricity Law in 1994 to bring market reforms to the utility sector. Competition has gradually been phased in, resulting in lower electricity costs. The Superintendence of Electricity has replaced the Direccion Nacional de Electricidad, the regulatory agency responsible for setting electric rates. Under the Capitalization Law, the government forfeits management control for five years or until the amount of investor capital is exhausted. The government shares the profits, and overall increases are made in the value of the company. In 2008, due to competition, Capitalization Law will become critical when all utilities will be subject to the marginal cost pricing system.

Natural Gas

Bolivia has been producing natural gas since the 1960s, mostly for export to Argentina. The domestic demand has more than doubled between the late 1980s and the late 1990s but the country still had plenty of extra production for exports. The following table provides an historical summary of Bolivia's natural gas production and consumption.

Natural Gas Production and Consumption in Bolivia, 1987-2001 (in bcf)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	110	110	110	110	110	110	110	110	110	110	110	110	73	110	146
Consumption	14	19	26	30	26	32	30	35	43	37	47	31	32	44	

Source: BP World Energy, EIA

Aggressive exploration efforts in recent years have led to many large discoveries, with several fields over 5 tcf. Blocks containing significant gas reserves include Block 20 (Tarija West), San Antonio and San Alberto, El Dorado, and Caipipendi. Caipipendi contains what is currently the largest field, Margarita, which holds over 13 tcf, according to some estimates. There is now concern that additional export infrastructure will be needed if natural gas exploration is to take advantage of its full potential. Exports to Argentina ended in 1999, the same year that exports to Brazil began. Bolivia had exported about \$100 million worth of natural gas to Argentina until August 1999, when flow on that pipeline was reserved to transport the natural gas to the Brazilian market. The domestic gas market is small, and while it is expected to grow, the other countries will remain the key markets for the Bolivian gas.

Gas Exports

The Bolivia-to-Brazil (BTB) pipeline, tapping Bolivia's Rio Grande sources, came on stream in July 1999. Currently, Petrobras has 9% interest in the Bolivian side of the pipeline but 51% controlling interest on the Brazilian side. The project began in 1996 and cost \$2.1 billion. It serves Sao Paulo, Brazil, and an extension southward to Porto Alegre in Brazil is planned. The completed pipeline covers 3,000 km (1,900 miles). The pipeline is not operating at its 1.06 billion cubic feet per day (bcf/d) capacity, which is not expected to be reached until 2003 at the earliest. Brazil's economic slowdown in the wake of the January 1999 currency devaluation suppressed energy demand growth, causing plans for new gas-fired power plants in Brazil to be shelved. The power plants had been expected to be the major customers of the Bolivian gas

Bolivia's San Alberto and San Antonio fields began exports to Brazil in January 2001. The gas travels through an existing pipeline, connecting to the BTB pipeline. The Superintendence of Hydrocarbons is considering whether to agree to have Petrobras construct a new gas pipeline along this route, allowing Petrobras to transport gas from the San Alberto and San Antonio fields that it operates in partnership with Repsol-YPF and TotalFinaElf. The new pipeline would require an investment of \$300 million, which would be invested equally by the three firms. The pipeline could be completed by the end of 2002.

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pipeline is being considered which would stretch from Villamontes in the Tarija region through Paraguay to southern Brazil. Several hundred miles of pipeline line would run south of the BTB pipeline and serve several small cities in southern Brazil. Brazil's state oil company, Petrobras, has the preference to place its gas on the BTB line first, making it difficult for other producers to ship significant volumes. But, recently the ANP, petroleum regulatory agency in Brazil, allowed BG to use BTB for more than 70 MMcf/d until the end of 2003 despite opposition from Petrobras.

The joint owners of Transredes and RD/Shell, have begun construction of a \$560-million, 160-mile, 18-inch pipeline extending from the main BTB pipeline at San Miguel, Bolivia, to a new gas-fired power plant in the Brazilian city of Cuiaba. Transredes is planning to spend an additional \$300 million to construct a gathering network of 500 miles of pipelines to bring gas from the various fields to a collection center located in Rio Grande.

Proposed Pipeline Projects

Type of pipeline	Destination	Length (km)	Cost (\$ million)
Gas	Cuiaba - Brasil	610	195
Oil	Ilo - Peru	420	175
Gas	Asuncion - Paraguay	829	182

Source: Bolivian Vice Ministry of Energy and Hydrocarbons

In July 2001, Bolivia's largest gas producers, Repsol-YPF, BG, and BP, decided to form a Pacific liquefied natural gas (LNG) export consortium in hopes of delivering Bolivian gas to the U.S. market. The project could involve constructing a 430-mile pipeline from Bolivia's Margarita field to a port in northern Chile, where a two-train liquefaction plant would be built. The gas could then be shipped to a regasification plant in northern Mexico, and piped to northern Mexican and U.S. destinations. The entire project would cost an estimated \$6-\$7 billion.

Petrobras' commercial gas company, Gaspetro, plans to expand domestic sales volume to about 80 million cubic meters per day (MMcm/d) by 2007 (about 2.8 bcf/d), up from 12 MMcm/d (3.4 bcf/d) currently. By 2007, Brazil will consume 70 to 80 MMcm/d (2-2.8 bcf/d) of gas from Bolivia and produce around 40 MMcm/d (1.1 bcf/d).

To carry out these expansions, five companies (Comgas, SCgas, Sulgas, Compagas and Msgas) plan to invest \$45 million over the next two years. Five natural gas distribution companies located along the Bolivia-Brazil gas pipeline are planning to install 1,400 km of distribution pipelines. At the end of 1998, in the five states through which the gas pipeline will pass, the network of existing distribution pipeline consisted of 2,300 km. The table above presents the pipeline projects proposed by the Bolivian Vice Ministry of Energy and hydrocarbons.

Environmental issues with gas pipelines

Environmental groups oppose the construction of the second natural gas pipeline from Bolivia to Matto Grosso do Sul in western Brazil. These actions have prompted the U.S. Overseas Private Investment Corporation (OPIC) to vote over the objections of the environmentalists on providing funding of \$200 million for the \$570-million project. Environmental NGOs, including Friends of the Earth, World Wildlife Fund, and Amazon Watch, are concerned with the route of the pipeline. The pipeline, which has already been constructed by Enron, passes through an area made up of both wetlands and dry tropical forests. Shortly after this decision to fund the project, OPIC approved new stricter environmental guidelines. When OPIC votes on the pipeline loan, environmentalists are expected to protest, insisting that the agency is violating its own rules.

The construction of another \$120-million gas pipeline between Bolivia and Brazil through the Chiquitano Forest is also under fire from environmentalists who claim the forest is one of the last intact dry tropical forests in the world. This 610-kilometer San Miguel-Cuiaba pipeline will transport 2.5 MMcm/d of gas (0.71 bcf/d). Local environmental groups claim that the project's environmental impact assessment was insufficient and was prepared in exchange for money. These environmental groups, as well as city governments, civic committees and three provincial environmental forums have declared their opposition to pipeline construction and are demanding an alternate route.

Electricity

The national grid (*Sistema Interconectado Nacional*, or SIN) accounts for the vast majority of Bolivia's installed electric capacity and power generation. Historically, Bolivia depended on hydro, which accounted for more than 60% of installed capacity even in the late 1980s. This has changed throughout the 1990s as more gas-fired units have been built. Currently, about 33% of the installed capacity is hydroelectric and 67% is thermal (see table below).

Installed Electricity Generation Capacity in Bolivia, 1987-2001 (Gigawatts, GW)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hydroelectric	0.30	0.30	0.31	0.31	0.31	0.31	0.31	0.31	0.29	0.31	0.31	0.31	0.34	0.34	0.39
Thermal	0.17	0.30	0.30	0.33	0.39	0.39	0.39	0.45	0.50	0.50	0.50	0.66	0.70	0.70	0.94
Total Capacity	0.47	0.61	0.61	0.63	0.70	0.70	0.70	0.76	0.79	0.80	0.80	0.97	1.04	1.04	1.34

Source: EIA

Domestic demand for electricity has been increasing by an estimated 10% per year. Yet, only 55% of the population has access to electricity. In order to meet this demand, capacity has to increase. In 1998, SIN accounted for 80% of installed capacity, 88% of the generation, and 89% of all consumption. SIN serves five of Bolivia's nine regions and connects the major cities; as of 2001 its system consisted of 536 kilometers of 230 kilovolt (kV) lines, 863 kilometers of 115 kV lines, and 100 kilometers of 69 kV lines. In 1998, SIN accounted for 80% of Bolivia's installed capacity, 88% of the country's generated power, and 89% of all the electricity consumed in the nation. At the beginning of 1998, SIN's installed capacity was 671 MW, with an average demand of 605 MW; incremental additions of capacity increased SIN's overall installed capacity to 690 MW at the end of 1998. The trend of decreasing dependence on hydro can also be seen in the table below with historical figures on generation and consumption.

Electricity Generation and Consumption in Bolivia, 1987-2001 (TWh)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Net Generation	1.5	1.9	2.0	2.1	2.3	2.5	2.5	2.5	3.1	3.2	3.2	3.5	3.6	3.6	3.9
Hydroelectric	1.1	1.2	1.2	1.2	1.4	1.3	1.4	1.4	1.4	1.5	1.4	1.4	1.5	1.5	1.9
Thermal	0.4	0.6	0.7	0.9	0.9	1.1	1.1	1.1	1.6	1.7	1.7	2.0	2.1	2.1	2.0
Net Consumption	1.4	1.8	1.9	2.0	2.2	2.3	2.3	2.4	2.9	2.9	2.9	3.2	3.4	3.4	3.6

Source: EIA

Due to its large generating potential, Bolivia is currently analyzing several projects to export electricity to supply unmet demand in Brazil. The government estimates that if the ability to export electricity to Brazil is fully utilized, Bolivia could expect to earn as much as \$800 to \$900 million in annual export revenues. Bolivia is also working on creating electricity export accords with both Peru and Chile. This has led to the promotion or establishment of "duty free zones" along the Bolivia-Brazil border as an incentive for firms to construct power plants in these areas. Any import, transportation, or value-added taxes (VAT) would be waived for plants constructed there. The only taxes they would have to pay would be on the profits themselves, basically a 12.5% tax on profit remittance.

There are four major private electricity generation companies in Bolivia, all of which have been controlled or operated by foreign investors since 1995. Demand for electricity has been rising for the past two decades. The estimated annual growth rate through 2004 is 5 to 6%. As a result, Bolivia will require an estimated total investment of \$3 billion to \$8 billion.

Bolivia's 10-year Expansion Plan foresees a market growth for energy of 5% a year in the period 1999 to 2004. According to the Bolivian government, electricity generation, transmission, and distribution companies needed to invest \$295.6 million by the end of 2001 in order to cover the increase in demand and improve the quality of service or risk losing their investment. The projected consumption per person for 2004 is estimated at 1,950 kWh.

Investment Environment

In order for Bolivia to meet its goal of becoming a major supplier of energy, nearly \$700 million of investment is needed by 2005 to develop its oil and gas reserves, build pipelines, and construct power plants. As of 1998, about \$285 million of this investment was in place (see table below).

Capital Formation Investment in Bolivia's Hydrocarbon Sector (1998-2005) (in billion dollars)

	Committed	Projected	Total
Privatized Companies	118	125	243
Exploration/Development	78	220	297
Pipeline to Brazil	62	0	62
Pipeline to Peru	0	25	25

Source: U.S. Department of Energy

The Ministry for Economic Development is being pushed for new legislation for a tax moratorium on capital goods imports for export projects, such as natural gas and electricity. In early 1999, the Bolivian Congress approved a law establishing eleven corridors designed to attract foreign investment and promote the export of natural gas and electricity to neighboring countries under 40-year concessions. The Ley Corazon or "Heart Law" allows the operation of export facilities within 30 miles (50 km) of the border by foreign companies. Previously, the Constitution prevented foreign entities from owning property in these corridors. The majority of these corridors are located along the border with Brazil.

The Bolivian government had earmarked \$601 million for public investment projects in 1998 (mostly social infrastructure investment). Total public investment in 1998 was set to rise by 11% compared to 1997. The government forecasts Bolivia will be able to draw about \$11 billion worth of investment over the next five years, of which about \$7 billion will come from

private sources. For growth of foreign investment in Bolivia, one of the government's most urgent priorities is upgrading the road system. The road system is about 52,000 km, with less than 5% paved, about 70% dirt, and the rest gravel. More than 500 km of road is the goal set by the government to be under private concession by 2002.

Developments in the energy sector have moved farther and faster than predicted three years ago. Regional companies, such as Argentina's YPF, Pluspetrol, Perez Companc, and Petrobras, have competed fiercely for a position in Bolivia against leading world oil companies, such as Amoco, TotalFinaElf, ExxonMobil, Repsol, among others. The result has been new investment averaging over \$600 million annually -- two-thirds of total FDI, helping Bolivia to have the highest GDP growth rate in the region. This spending has mainly been targeted at new exploration to prove gas reserves for export to Brazil.

However, just as producers are successfully positioning themselves to deliver projected supply, concern has been raised about a potential lack of Brazilian demand. Brazil's recent economic woes, coupled with a 40% currency devaluation, led to decreased demand estimates at the beginning of this year and questioned Brazil's ability to absorb all of Bolivia's potential output.

Privatization and FDI in Bolivia, which reached \$872 million in 1998 (670% over the 1993 total), remained strong through 2001. It is expected that temporary monopolies in electricity, oil and gas will expire around this time, but the lure of open markets will likely not be enough to sustain inflows of FDI beyond 2001. The government is also interested in privatizing the natural gas distribution lines. The objective of the privatization is to increment the distribution service. There are distribution systems in several cities. Some of them belong to YPFB and others are mixed enterprises.

Bolivian officials predict an investment boom based on a survey of private investors' plans for 1999 through 2005. The government says total investment, private and public, is set to double over the next five years, to a total of \$13.2 billion. The government envisages that the private sector will supply some \$9.2 billion (70%), of which around \$7.7 billion will be FDI. Most of the total is earmarked for hydrocarbons (44%), followed by mining (11%), electricity (10%), telecom (7%), industry and agriculture (6%), and construction (5%).

Sources:

EIA Country Analysis Brief, <http://www.eia.doe.gov/emeu/cabs/bolivia.html>

The Oil & Gas Journal, various issues (searched via the web site, www.ogj.pennnet.com/home.cfm)

Superintendence of Hydrocarbons, <http://www.superhid.gov.bo/>