An Energy Overview of Bolivia

General Information

Bolivia, the fifth largest South American country (slightly less than three times the size of Montana), is one of the two land-locked countries in South America and has a climate that ranges from humid and tropical to cold and semi-arid. Bolivia shares borders with Brazil to the North and Northeast, Paraguay to the Southeast, Argentina and Chile to the South, and Peru to the West. There are nine administrative regions (called 'departamentos') in Bolivia; these are shown in Figure 1. The capital city, La Paz, is located in the west central part of the country and has a population of about 800,000. The land area of Bolivia is approximately 1.1 million square kilometers and the population is estimated at 8.3 million as of mid-1991; Bolivia has a low population density of 7.5 people per square kilometer and an annual growth rate of about 2.3%.

Bolivia is a very ethnically diverse nation; the population is 30% Mestizo, 30% Quenchua, 25% Aymara, and 15% Caucasian. There are three official languages -- Spanish and two Amer-Indian languages, Aymara and Quenchua. Bolivia is one of the poorest countries in South America, with a per-capita income of less than $950. Bolivia's currency, the Boliviano ($B), has an exchange rate (as of August 2003) of about 7.68 $B per U.S. dollar (i.e., 1 Boliviano equals about U.S. $0.13). Bolivia's GDP (based on purchasing power parity) is $21.4 billion, which ranks it 99th among 212 countries and territories.

Bolivia is a founding member of the World Trade Organization, a member of the International Monetary Fund (IMF) and the Latin American Energy Organization (OLADE). In addition, Bolivia is a member of the Southern Cone Common Market (Mercosur), along with Argentina, Paraguay and Uruguay. Bolivia has shown a willingness to pursue genuine changes in fiscal policy, including private investment in the energy privatization program, as well as environmental clean-up, pursuing judicial reform, and an anti-corruption campaign.

Figure 1: Administrative Regions of Bolivia

Source: map courtesy of and copyright by FOTW Flags of the World

Energy Policy and Regulation

Several different regulatory agencies have oversight responsibility for energy in Bolivia. The regulatory system for hydrocarbons is divided between upstream and downstream sectors. The Ministry of Hydrocarbons sets policy for upstream operations and oversees enforcement. The Office of the Hydrocarbons Superintendent is responsible for the downstream sector. The Superintendent of Electricity has oversight responsibility for the electricity sector.

Prices for domestic natural gas are set by the government, while those for export are dictated by the market. Companies gain access to the natural gas transportation system through concessions, and firms are not awarded exclusivity grants to geographic areas. The Office of the Hydrocarbons Superintendent has the authority to solicit new concessions. Companies enter the natural gas distribution market through concessions, after receiving approval of the local governments involved. Geographic exclusivity is given with distribution rights.

In 1994, the government passed the Electricity Law which unbundled the state-owned electricity company Empresa Nacional de Electricidad S.A. (ENDE) into its generation, distribution, and transmission components. It also set limits on market power for electric generators so that no company operating on the national electric transmission grid can control more than 35% of total installed capacity. The Electricity Law separated

responsibility for generation, transmission, and distribution such that no company can operate in more than one of the sectors. These restrictions do not apply to companies outside of the national grid. The law gave the Superintendent of Electricity oversight responsibility for the electricity industry. With the Electricity Law, competition has gradually been phased in, resulting in lower electricity costs. Under Bolivia's Capitalization Law of 1994 (see Privatization Status section, below), 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. The Capitalization Law will become critical in 2008 when all utilities will be subject under the Electricity Law to the marginal cost pricing system.

In 1999, a new law, the Ley Corazon Law 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.

Energy Summary

Bolivia, with its large oil and natural gas potential, is becoming an increasingly important link in South American energy trade. With many new natural gas fields being discovered and the construction of the Bolivia-Brazil pipeline, Bolivia is on its way to becoming a key center for energy resources for Central and South America. An historical summary of Bolivia's Total Primary Energy Production (TPEP) and Consumption (TPEC) is shown in Table 1.

Table 1: Bolivia's TPEP and TPEC, 1990-2001
(in Quads)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TPEP	0.17	0.17	0.18	0.17	0.18	0.20	0.20	0.20	0.21	0.19	0.22	0.26
TPEC	0.09	0.09	0.10	0.10	0.11	0.12	0.12	0.13	0.13	0.14	0.16	0.16

note: 1 Quad = 1 quadrillion Btu
Source: DOE/EIA

Oil

Exploration and Reserves

Oil is a small component of Bolivia's hydrocarbon mix when compared to natural gas, but the country has seen great improvement in its oil reserves since 1998. The Bolivian government placed proven reserves in January 2001 at 440.5 million barrels, up from 396.5 million barrels in 2000 and 151.9 million barrels in 1999. The government

estimates the level of proved, probable and possible reserves at 1.783 billion barrels, a five-fold increase over 1999 estimates. Reserve levels are expected to continue to climb as recent exploration and production (E&P) efforts, principally by Brazil's Petrobras and the Bolivian hydrocarbons company Andina, yield results.

Bolivia's bidding process for oil exploration licenses is a two-step process. The first step requires companies to nominate areas to be included in the auction. These areas are then put up for sale. Firms can bid on an area up for auction, regardless of whether or not they nominated the area. Interested parties have until August 15th of that year to submit their bids, which includes an initial exploration commitment.

Interest in E&P licenses has been declining every year since Bolivia began soliciting bids in 1997. The first year saw the awarding of 16 blocks, then the number fell to eight in 1998, five in 1999, and two in 2000. The only bidder in 1999 was Argentina's Pluspetrol. Petrogas Energy and Matpetrol were each awarded one block in 2000. Interest in the 2001 licenses has been better than in 1999 or 2000 with blocks in the northwest and southern parts of the sub-Andean region, areas that are largely unexplored, attracting the most interest. Some 1.87 million hectares have been nominated for auction in 2001.

A reason for the drop-off in interest in oil exploration is the restrictions the government places on its licensing agreements. Potential bidders have been trying to persuade the Bolivian government to revise its licensing practices. Current rules stipulate licensees must drill exploratory wells at a ratio of 1 well per 25,000 hectares, and have four years to bring successful wells into production. Companies are urging the government to relax its controls and give producers more freedom to drill in response to market conditions.

Production and Consumption

In 2000, Bolivia consumed an estimated 40,000 barrels per day (b/d) of oil, while producing 38,900 b/d. According to the Ministry of Mines and Energy, most crude oil production in Bolivia is for domestic consumption except for a relatively small amount, which is exported to Chile through the Sica-Sica-Arica pipeline. Bolivia has become practically self sufficient in oil except for diesel oil, which is imported. An historical summary of petroleum production and consumption in Bolivia is shown in Table 2.

Table 2: Petroleum Production and Consumption in Bolivia, 1990-2001 (in thousand b/d)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Production (total)*	26	26	28	29	30	34	37	37	43	43	40	44
Production (Crude Oil only)	21	21	21	22	23	28	30	29	35	32	30	34
Consumption	25	26	26	27	30	33	35	36	40	43	48	49

* includes crude oil, natural gas plant liquids, other liquids, and refinery processing gain
Source: DOE/EIA

Refineries and Downstream Processing

Total refinery capacity for Bolivia is 47,888 b/d, coming almost entirely from the country's two main refineries: Cochabamba (26,000 b/d) and Santa Cruz (19,000 b/d). Actual refinery output is less than 40,000 b/d, leaving open the potential to refine liquid by-products from natural gas production, and export the refined products to regional markets. It is estimated that the export of petroleum derivatives could total $80 to $100 million per year.

In December 1999, Petrobras purchased 70% of the Cochabamba and Santa Cruz refineries, while Argentina's Perez Companc also holds a significant interest in both refineries.

An historical summary of Bolivia's output of refined petroleum products by fuel type is shown in Table 3.

Table 3: Output of Refined Petroleum Products in Bolivia, 1990-2000 (in thousands of b/d)

Refined Product	Production Rate										
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Motor Gasoline	9	9	11	11	11	8	10	10	11	10	11
Jet Fuel	2	2	2	2	2	2	3	3	3	3	3
Kerosene	1	1	1	1	1	1	1	1	1	1	1
Distillate Fuel Oil	0	0	1	7	8	7	8	8	8	8	8
Residual Fuel Oil	7	8	7	0	1	1	1	0	1	1	0
Liquefied Petroleum Gases	1	2	1	2	7	5	2	2	2	2	1
Lubricants	0	0	0	0	0	0	0	0	0	0	0
Other *	1	1	1	1	1	9	14	13	14	16	12
Total Output	**22**	**22**	**23**	**23**	**30**	**33**	**37**	**36**	**39**	**39**	**36**
Refinery Fuel and Loss	0	0	0	0	0	1	1	1	1	2	1

* includes asphalt, coke, napthas, paraffin wax, and petrochemical feedstocks

note: production rates shown as "0" (underlined) actually mean "less than 500 b/d"
components may not add to total due to rounding
Source: DOE/EIA

Natural Gas

Exploration and Reserves

Bolivia has South America's second largest reserves of natural gas, after Venezuela. The Bolivian government's January 2001 estimates for proven and probable reserves are 46.83 trillion cubic feet (tcf), up 45% from the 2000 forecast. The January 2001 forecast shows a five-fold increase over 1999 estimates, and are seven times higher than those from 1997. By including possible reserves in the estimate of natural gas reserves, that estimate increases to 70.0 tcf. Some 85% of Bolivia's gas comes from the southern region of Tarija. This region contains the important gas fields of San Alberto, San Antonio, Itau and Margarita, each with estimated reserves in excess of 5.0 tcf.

The foreign companies most active in the natural gas industry are Petrobras, TotalFinaElf, BP Amoco, British Gas, ExxonMobil, and Repsol YPF. The 50% partial privatization of two E&P units and the transport unit belonging to the former state-owned hydrocarbons company, Yacimientos Petroliferos Fiscales Bolivianos (YPFB), for over $830 million in December 1996 breathed new life into the hydrocarbons sector. Andina, which is 50% owned by Repsol YPF and 50% owned by Bolivian pension funds, and Chaco (BP Amoco 30%, Bridas 20%, Bolivian pension funds 50%) were formed out of the spin-off of YPFB. Both Andina and Chaco hold significant reserves of natural gas.

Much of Bolivia's major natural gas discoveries have come since 1998. Unfortunately, very little of these resources have been tapped due to limited markets within Bolivia. The country has a very small domestic natural gas market that is incapable of absorbing much of the country's output. Close to 50% of Bolivia's gas, the associated (wet) gas, is re-injected, flared, or vented. Forecasts for the next 20 years show that Bolivia will only be able to absorb 20% of the country's gas reserves. Potential export markets for Bolivian natural gas include Brazil, Argentina, Chile, Paraguay, Uruguay and the United States. Of these, Brazil is Bolivia's only major export market. Bolivia also exports limited quantities to Argentina. With Bolivia sitting on so much untapped reserves with limited potential markets, there is little incentive to invest in further exploration. This could prove detrimental to the country’s long-term energy future.

Production and Consumption

According to 2001 Utility Data Institute (UDI) energy data, Bolivia's installed capacity for energy generation via natural gas is reported at 575 megawatts (MWe), which represents 57% of total generation. The majority of natural gas was consumed by the industrial sector, while household consumption of natural gas is expected to increase. An historical summary of Bolivia's natural gas production and consumption is shown in Table 4.

Table 4: Natural Gas Production and Consumption in Bolivia, 1990-2001
(in trillion cubic feet)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	0.107	0.104	0.110	0.103	0.105	0.113	0.109	0.112	0.107	0.087	0.117	0.143
Consumption	0.030	0.026	0.032	0.030	0.035	0.043	0.037	0.047	0.031	0.032	0.044	0.041

note: "dry" gas means gas with condensates removed
Source: DOE/EIA

The 20-year export gas sales agreement, signed between YPFB and Brazil's Petrobras, gives preferential treatment to the natural gas Petrobras produces from its wells in Bolivia. Petrobras was able to secure these favorable terms in exchange for financing $2.15 billion to construct the Bolivia-to-Brazil pipeline, when other sources were hesitant to get involved. These preferential terms have since been renegotiated, but natural gas from Petrobras' wells in Bolivia still has the right to first access ahead of others. The company has a stake in eight of Bolivia's natural gas fields and holds nearly one-third of Bolivia's gas.

There is potential for expanding gas exports to Argentina. Experts predict that by 2010, Argentine consumption will exceed its domestic production levels. Bolivia currently exports small quantities of gas to its southern neighbor. Beyond exports to Brazil and Argentina, there are discussions underway to export natural gas to the United States. Pacific LNG, a consortium headed by Repsol YPF (and includes BP Amoco and British Gas), wants to export 28 million cubic feet (mcf/d) of gas to California. The plan calls for transport via a 510- to 560-mile pipeline from southeastern Bolivia to ports on the Chilean or Peruvian coast. The gas would then be liquefied and shipped in LNG tankers to Baja California via Mexico, where it would enter the U.S. pipeline network, destined primarily for San Diego. The cost of the plan is estimated at $2.5 billion. This export proposal has the added benefit of being able to supply Mexico as well, which is experiencing a short-term shortage of natural gas.

The LNG export scheme has since attracted more attention with Chevron, Shell, and ExxonMobil all having expressed interest in participating. An alternative transportation route calls for natural gas to flow to Brazilian or Argentine ports on the Atlantic and from there on to the United States. This route will double or triple the project's distance, but offers the opportunity to supply new markets in Brazil or Argentina. Transporting through Brazil would necessitate expanding the Bolivia-to-Brazil pipeline, while a 1,300-mile pipeline would be needed to move the gas through Argentina.

LPG and Other Downstream Gas-to-Liquids Processing

Bolivia produces 317,000 tons per year (t/yr) of liquefied petroleum gas (LPG). Approximately 83% (or 263,000 t/yr) of the LPG is produced as a co-product of natural gas production. Chaco, formerly part of state-owned YPFB and now a BP Amoco subsidiary, produces almost 40% (or 104,000 t/yr) of LPG as a co-product of natural gas production. Andina, Maxus, and Perez Companc together produced 143,000 t/yr of co-product LPG in Bolivia. The remainder of the LPG output comes from Bolivia's two

refineries. Demand for LPG varies widely by region in Bolivia. Three-quarters of Bolivia's LPG demand comes from the major cities of La Paz, Cochacamba, and Santa Cruz.

LPG production is expected to increase in response to the forecasted increase in Bolivia's natural gas production. LPG production from natural gas is expected to rise from 275,000 t/yr to 700,000 t/yr by 2005.

Bolivia could be exporting 500,000 t/yr of LPG by 2005, but it faces the challenge from Argentina's plan to increase its own LPG exports; the Mega Project is an Argentine plan to export 370,000 t/yr to Brazil beginning in October 2000. GTL Bolivia is in the process of selecting a location for a gas-to-liquids project that could eventually produce 50,000 b/d of refined petroleum products, and southern Bolivia is the likely site. Initial production goals are for 10,000 b/d. Cost estimates run from $350 million for a 10,000 b/d plant to $1 billion if the plant's capacity is expanded to 50,000 b/d. Completion is scheduled for 2004 or the early part of 2005. Output from the plant will go to satisfy domestic demand as well as for export; Bolivia's refineries presently produce 7,000-8,000 b/d of diesel for domestic use, which only meets half of demand, with the rest coming from imports.

Coal

Bolivia has minor coal reserves of poor quality. Recoverable reserves are estimated at approximately one million short tons of anthracite and bituminous coal. An historical summary of coal production and consumption in Bolivia is shown in Table 5.

Table 5: Coal Production and Consumption in Bolivia, 1990-2001
(in millions of short tons)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	0	0	0	0	0	0	0	0	0	0	0	0
Anthracite	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
Bituminous	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
Lignite	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
Consumption	0	0	0	0	0	0	0	0	0	0	0	0

n/a - not applicable
Source: DOE/EIA

Hydroelectric and Other Renewable Energy

Hydroelectric Power

There are two great river systems in Bolivia, the Amazon and the Paraguay/Parana. Bolivia has a vast amount of unexploited hydroelectric resources, estimated at nearly 39,000 MWe, of which about 34,000 MWe is in the Amazon region.

Virtually all of Bolivia's hydroelectric generating capacity is owned by three companies: Compañía Boliviana de Energía Eléctrica (COBEE), which is now 100% owned by the U.S. power company NRG Energy, Hidroelectrica Boliviana S.A., now a subsidiary of U.S.-based Tenaska Inc., and Empresa Electrica Corani S.A., which is owned by U.S.-based Duke Energy. A summary of existing hydroelectric power plants in Bolivia is shown in Table 6.

Table 6: Hydroelectric Power Plants in Bolivia (5 MWe and Greater)

Hydroelectric Facility	Owner	Location		Capacity (MWe)
		River	Departamento	
Santa Isabel	Empresa Electrica Corani S.A.	Málaga	Cochabamba	72
Corani	Empresa Electrica Corani S.A.	Málaga	Cochabamba	54
Yanicachi Norte	Hidroelectrica Boliviana S.A.	Unduavi	La Paz	50
La Chojlla	Hidroelectrica Boliviana S.A.	Taquesi	La Paz	35
Huaji	COBEE	Zongo	La Paz	29
Cahua	COBEE	Zongo	La Paz	27
Harca	COBEE	Zongo	La Paz	26
Churuaqui	COBEE	Zongo	La Paz	25
Cuticucho	COBEE	Zongo	La Paz	21
Santa Rosa	COBEE	Zongo	La Paz	12
Kilpani	Empresa Electrica Valle Hermosa	n/a	n/a	11
Sainani	COBEE	Zongo	La Paz	10
Zongo	COBEE	Zongo	La Paz	10
Tiquimani	COBEE	Zongo	La Paz	9
San Jacinto Asj	Agrupacion San Jacinto	Tolomosa	Tarija	8
Kanata	Synergia S.A.	n/a	Cochabamba	7
Botijlaca	COBEE	Zongo	La Paz	7
Carabuco	COBEE	Miguillas	La Paz	6
Choquetanga	COBEE	Miguillas	La Paz	6

Landara	Empresa Electrica Valle Hermosa	n/a	n/a	6
Hydroelectric Facility	**Owner**	**River**	**Departamento**	**Capacity (MWe)**
		Location		

n/a - not available
Source: Platts UDI; NRG Energy

Within the next decade, Bolivia is expected to nearly more than double its hydroelectric generating capacity. A summary of Bolivia's planned hydroelectric projects is shown in Table 7.

Table 7: Hydroelectric Power Plants Planned or Under Construction in Bolivia (5 MWe and greater)

Hydroelectric Facility	Owner	River	Capacity (MWe)	Status
Miguillas	COBEE	Miguillas	160	Planned
Misicuni	Empresa Misicuni	Misicuni	120	Planned
Cambari	Comision Regional Rio Bermejo	Tarija	102	Planned
San José Corani	Empresa Electrica Corani S.A.	Málaga	84	Planned
Sacaba	Empresa Electrica Corani S.A.	n/a	6	Planned

n/a - not available
Sources: Platts UDI

Other Renewables

Another source of Bolivia's electricity, in addition to hydropower, is electricity from biomass and solar power. In 1999, Bolivia produced approximately 0.1 billion kilowatt-hours (kWh) of electricity from renewable energy sources other than hydroelectric. Solar power is being harnessed in some isolated mountain villages where 2,000 photovoltaic systems are in operation. In Riberalta, a city of 60,000 near the Brazilian border, nutshells from Brazil are being used as a feedstock for a 1 MWe plant.

Energy Transmission Infrastructure

Natural Gas Pipelines

Bolivia teamed up with Brazil to construct the 1,452-mile Bolivia-to-Brazil gas pipeline to transport gas from Rio Grande, in Bolivia, to Sao Paulo, Brazil. An extension connects the pipeline to Porto Alegre, in southern Brazil. The $2.15 billion pipeline was finished in July 1999. Petrobras oversees the Brazilian part of the pipeline and owns an equity stake

in the Bolivian section. In total, Petrobras owns 42.6% of the entire pipeline. Other firms with a stake in the pipeline include BTB, a consortium that includes British Gas and El Paso (21%), Transredes (20%), Shell (7%), Enron (7%), and Gaspart (3%).

The pipeline is currently running at just one-third its 1.07 billion cubic feet per day (bcf/d) capacity, but demand for natural gas in Brazil is expected to climb rapidly to fuel the many gas-fired power plants currently under construction in the country. As a result, Brazil is requesting the pipeline reach its full capacity by 2003, a full year ahead of schedule. This is the second time in two years that Brazil has asked that the maximum flow date to be moved up. In 2000, the target date for reaching full capacity was moved up from 2005 to 2004. Brazil is also expected to seek a one-third increase in the pipeline's capacity to 1.43 bcf/d. An increase in the pipeline's capacity beyond 1.07 bcf/d would require an expansion of the pipeline.

Gas Oriente Boliviano, a consortium made up of Enron, Shell, and Transredes, is near completion of a 390-mile natural gas pipeline that will connect San Miguel, Bolivia to Cuiaba, Brazil. The pipeline will be an extension of the Bolivia-to-Brazil pipeline. The pipeline will have a capacity of 710 million cubic feet per day (mcf/d) and natural gas from the pipeline will go to fuel an existing 480 MWe gas-fired power plant in Cuiaba. The project has generated controversy as the pipeline's route runs through the environmentally-sensitive Chiquitano Forest.

Discussions surrounding other alternatives to supply Brazil with natural gas are underway, including a second Bolivia-Brazil pipeline, which would connect the southern parts of both countries. One option on a new Bolivia-to-Brazil pipeline would run the pipeline through Paraguay or Argentina to also service those markets. The route through Paraguay is a pipeline from Villamontes in the Tarija region of Southern Bolivia through Paraguay to southern Brazil.

Petrobras wants to build an extension from the Bolivia-to-Brazil gas pipeline to supply the Brazilian capital of Brasilia. The extension would run 512 miles and would have a capacity of 158.9 mcf/d. The construction of a gas-fired power plant would be needed to make the project economically feasible.

Besides exports to Brazil, Bolivia has also made a deal to supply natural gas to Argentina. Pluspetrol of Argentina planned to begin pumping 14.1 mcf/d of gas from its fields in the Madrejones block in October 2001 to supply power plants in Northern Argentina. The pipeline is linked to an existing pipeline in Argentina that is controlled by Refinor, an Argentinian refinery. Pipeline volume is scheduled to rise in January 2002 to 42.4 mcf/d and 98.9 mcf/d by January 2003. By 2005-2006, exports should hit 176.6 mcf/d.

Electricity Transmission

Electricity is distributed in Bolivia through the national grid, Sistema Interconectado Nacional (SIN), and a few small, independent systems. 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. 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. SIN was privatized in 1997 and is now owned by Empresa Transportadora de Electricidad (TDE), which is a subsidiary of Spain's Union Fenosa. A diagram of SIN's electricity grid is shown in Figure 2.

Figure 2: Electricity Grid of Bolivia

(Click on Image to View a Much Larger Version)
Source: SIN

Two of Bolivia's provincial systems are Servicios Electricos Tarija S.A. (SETAR) and Servicios Electricos de Potosi (SEPSA). SETAR serves 40,000 customers in the southern region of Tarija and is not connected to the national power grid. The state-owned company has a capacity of 20.25 MWe generated from hydroelectric and thermal plants. SEPSA services 23,500 customers in southern Bolivia.

The government has been trying to increase electrification through the National Rural Electrification Program (Proner). The program’s goal was to provide electric service to 28% of the country’s rural areas by the end of 2001. Another step toward greater rates of electrification was the decision by the Superintendent of Electricity to approve transmission company Empresa Transportadora de Electricidad's (TDE) proposal to

construct two transmission lines and substations to connect then to the grid. The transmission lines are between Santivanez and Sucre, and Sucre and Punutuma.

Electricity

Installed Capacity

There has been a large increase in Bolivia's electricity generating capacity over the past decade, and almost all of this increase has been with thermo-electric power plants. Back in 1990, slightly more than half of Bolivia's electric power was generated with thermal-electric power plants; by the end of the 1990s, that ratio had grown to about two-thirds. An historical summary of electricity generating capacity in Bolivia is shown in Table 8.

Table 8: Installed Electricity Generation Capacity in Bolivia, 1990-2001 (in thousands of MWe)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Hydroelectric	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.33	0.36	0.40	0.38
Nuclear	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Geothermal/Solar/ Wind/Biomass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Conventional Thermal	0.33	0.39	0.39	0.39	0.45	0.50	0.50	0.50	0.66	0.70	0.94	0.95
Total Capacity	**0.63**	**0.70**	**0.70**	**0.70**	**0.76**	**0.80**	**0.80**	**0.81**	**0.99**	**1.06**	**1.35**	**1.33**

n/a - not applicable
note: components may not add to total due to rounding
Source: DOE/EIA

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 MWe, with an average demand of 605 MWe; incremental additions of capacity increased SIN's overall installed capacity to 690 MWe at the end of 1998.

Generation and Consumption

Bolivia's consumption of electricity grew by 70% during the 1990s. Most of this increase was met by new thermal-electric power plants, with a smaller contribution from hydroelectric power and other renewable energy sources. The estimated annual growth rate through 2004 is 5 to 6%. An historical summary of electricity generation and consumption in Bolivia is shown in Table 9.

Table 9: Electricity Generation and Consumption in Bolivia, 1990-2001 (in billion kWh)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Net Generation	2.1	2.3	2.3	2.4	2.8	3.0	3.1	3.1	3.5	3.8	3.8	3.9
hydroelectric	*1.2*	*1.4*	*1.3*	*1.4*	*1.4*	*1.4*	*1.5*	*1.4*	*1.5*	*1.8*	*2.0*	*2.1*
nuclear	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
geothermal/solar/wind	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
conventional thermal	*0.9*	*0.9*	*0.9*	*1.0*	*1.3*	*1.6*	*1.6*	*1.7*	*2.0*	*1.9*	*1.8*	*1.7*
Net Consumption	2.0	2.2	2.2	2.3	2.6	2.8	2.9	2.9	3.3	3.5	3.6	3.6
Imports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

generation components may not add to total due to rounding
Source: DOE/EIA

Industry Overview

There are four major electricity generating companies in Bolivia, all of which have been controlled or operated by foreign (mostly U.S.) investors since 1995 when ENDE was split into three parts. COBEE is now entirely owned by NRG Energy (a subsidiary of Xcel Energy), while in April 2000, Duke Energy purchased Dominion Energy's stake in Empresa Electrica Corani S.A., which for the moment owns the two largest capacity hydroelectric power plants in the country. Also, in 1997, Tenaska had acquired a majority stake in Hydroelectrica Boliviana, which is recently brought online two hydroelectric projects near La Paz that generate a total of 86 MWe of electricity. Table 10 shows an historical summary of the electricity generating companies in Bolivia.

Table 10: Electricity Generation Companies in Bolivia

Generating Company	Owner	Annual Generation (in million kWh)					
		1997	1998	1999	2000	2001	2002
Empresa Electrica Corani S.A.	Duke Energy	688.0	611.0	743.7	768.8	846.6	838.7
Empresa Electrica Guaricachi S.A.	Energy Initiatives; GPU International	830.4	939.9	1,078.1	921.4	837.6	862.1
Empresa Valle Hermosa S.A.	Constellation Energy	692.2	853.3	636.3	576.8	137.9	163.0
COBEE	NRG Energy	853.6	865.6	941.6	1,066.8	1,184.8	1,122.8
Rio Eléctrico S.A.	n/a	63.9	59.0	57.7	56.3	71.0	69.3
Compañía Eléctrica Central Bulo Bulo	Petrolera Chaco S.A.				78.1	418.3	486.5
Hidroelectrica	Tenaska		2.1	6.6	6.9	7.0	136.8

Boliviana S.A.							
Synergia S.A.	n/a			11.0	22.7	26.3	18.2
Genergys	n/a						11.6

n/a - not applicable
Source: Bolivia Superintendencia de Electricidad

Bolivia doesn't have any very large thermal-electric power plants; the largest one is the six-unit Guaracachi gas turbine facility in eastern Bolivia. A summary of conventional thermal-electric generating plants in Bolivia is shown in Table 11.

Table 11: Thermal-Electric Power Plants in Bolivia (15 MWe and Greater)

Power Plant	Owner	Location		Fuel	Capacity (MWe)
		City	Departamento		
Conventional Gas Turbine Power Plants					
Guaracachi	Empresa Electrica Guaricachi S.A.	Santa Cruz	Santa Cruz	Natural Gas	249
Carrasco	Empresa Valle Hermosa S.A.	Carrasco	Cochabamba	Natural Gas	112
Bulo Bulo	Compañía Eléctrica Central Bulo Bulo	Carrasco	Cochabamba	Natural Gas	87
Valle Hermosa	Empresa Valle Hermosa S.A.	n/a	Cochabamba	Natural Gas	19
Kenko	COBEE	Kenko	La Paz	Natural Gas	18
Karachipampa	Empresa Electrica Guaracachi S.A.	Potosí	Potosí	Natural Gas	14
Internal Combustion Power Plants					
Aranjuez	Empresa Electrica Guaracachi S.A.	Sucre	Chuquisaca	Oil	32

n/a - not available
Sources: Platts UDI; Bolivia Comite Nacional de Despacho de Carga

Environmental Activities

The shift in the country's population from the mountains to the tropical areas is straining the country's natural resources. Soil erosion resulting from overgrazing, slash and burn agricultural practices, and the clearing of forests is a serious concern. It also serves to worsen floods and landslides. Water pollution puts supplies for drinking and irrigation at risk.

Growing environmental concern has led Bolivia to join international environmental agreements, including being a party to Conventions on Biodiversity, Climate Change, Endangered Species, Tropical Timber 83, Tropical Timber 94, Law of the Sea, Nuclear Test Ban, and Wetlands. The government has signed, but not ratified, agreements on environmental modification, desertification, marine dumping, marine life conservation, ozone layer protection, and hazardous wastes.

The two government agencies with oversight responsibility for environmental matters are the Ministry of Sustainable Development and the National Office of Wildlife, National Parks, Hunting, and Fishing.

Environmental groups are opposing the construction of an extension to the Bolivia-to-Brazil pipeline through the environmentally-sensitive Chiquitano Forest, claiming the forest is one of the last intact dry tropical forests in the world. Gas Oriente Boliviano, a consortium made up of Enron, Shell, and Transredes, is near completion of a 390-mile natural gas extension that will connect San Miquel, Bolivia to Cuiba, Brazil. The World Wildlife Fund, Amazon Watch, and Friends of the Earth claim that Gas Oriente Boliviano has failed to control erosion, water and air pollution, illegal hunting and unauthorized access to the route that runs alongside the pipeline.

Pressure from environmental groups has influenced the U.S. Overseas Private Investment Corporation (OPIC) to set stricter environmental standards for the Cuiaba project and require independent environmental and social monitoring. OPIC commissioned an environmental impact study that resulted in a re-routing of 30% of the pipeline to avoid the most pristine areas of the forest. The organization further went on to establish a web site for the project to show its commitment to tough environmental standards and to promote open debate about the benefits of the pipeline. Companies involved in the project are contributing $20 million toward preservation of the Chiquitano Forest.

Environmental groups are calling for the Inter-American Development Bank (IDB) to stop funding pipelines in Bolivia because of the environmental damage allegedly already done to the Chiquitano Forest. The groups claim a broken pipeline owned by Transredes spilled 10,000 barrels of gasoline and crude into the Desaguadero River, in the basin of Lake Titicaca, in February 2000.

An historical summary of CO_2 emissions from fossil fuel use in Bolivia is shown in Table 12.

Table 12: Fossil Fuel-related Carbon Dioxide Emissions in Bolivia, 1990-2001 (in millions of tonnes of carbon)

Component	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CO_2 from coal	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO_2 from natural gas	0.49	0.43	0.75	0.91	1.17	0.89	0.79	0.95	0.70	0.66	0.80	0.88
CO_2 from petroleum	0.89	0.91	0.94	0.93	1.04	1.18	1.18	1.21	1.35	1.70	1.70	1.74
Total CO_2 from all fossil fuels	**1.38**	**1.34**	**1.69**	**1.84**	**2.21**	**2.07**	**1.97**	**2.16**	**2.05**	**2.35**	**2.50**	**2.62**

n/a - not applicable
Source: DOE/EIA

Privatization Status

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.

Bolivia adopted a so-called "capitalization" program in 1994 as a means of privatizing government-owned companies such as utilities. The Capitalization Law of March 1994 was specifically aimed at Bolivia's six major public companies: YPFB (hydrocarbons), ENDE (electricity), ENFE (railways), LAB (national airline), ENAF (smelters) and ENTEL (telecommunications). The program was set up so that the investor who is awarded with one of the companies (via an international public tender) will only be granted 50% of the company's shares, with the other 50% of the shares reserved for the Bolivian people via private pension funds handled by international trustees. However, full administrative control will be granted to the private investor, guaranteed through the Capitalization Law, a capitalization contract and an administration contract.

The privatization of YPFB began in 1994 and called for the company to be split into two upstream companies, a transport company, a refining company, and several service companies. Half of the equity in the two E&P companies was sold to BP Amoco and Repsol YPF in 1996 for $571 million. Transredes, an Enron/Royal Dutch/Shell joint venture, bought the natural gas transport operations of YPFB for $263.5 million. The partial sale of YPFB left it with storage facilities and multi-purpose pipelines, gas distribution grids, liquid petroleum gas (LPG) bottling plants, service stations, airport fuel terminals, and refineries. In October 1999 the government struck a deal with labor unions opposed to the sell-off that involved transferring some of YPFB's assets to employees. The employee-owned company, Empresa Laboral Petrolera (ELP), took over 33 service stations, 6 storage facilities, 4 bottling plants and about 13% of YPFB's refining capacity.

Near the end of 2000, the government once again put provincial electricity system SETAR up for sale. Privatization was first tried in 1997, but a lack of interest caused the government to reconsider. The government is also trying to dispose of 10 wholesale fuel distributors, despite opposition from retailers.

Economic Situation

In 2000, the Bolivian economy grew two percent, a slight improvement over the one percent rise in 1999, but well short of the government's goal of GDP growth in the 4 to 4.5% range. The 1990s saw steady economic gains with yearly GDP growth averaging about four percent thanks to market-oriented reforms. In the second half of the 1990s the government sold off state-owned companies in the railroad, telephone, airline, electricity, and oil industries.

Bolivia has been relatively successful in maintaining price stability. Inflation during 2000 was 3.41%, much lower than expected, and a far cry from the hyper-inflation Bolivia experienced in the mid-80s when inflation peaked at 11,700 in 1985. An historical summary of some of Bolivia's macroeconomic indicators is shown in Table 13.

Table 13: Bolivia's Macroeconomic Indicators, 1990-98

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
GDP Growth, percent	4.4	5.0	1.8	4.0	4.2	3.7	4.0	4.2	5.2	0.4	2.4
Inflation, percent	18.0	14.5	10.5	9.3	8.5	12.6	7.1	6.7	4.4	3.1	3.4
Exchange Rate, B$/US$	3.4	3.8	4.1	4.5	4.7	4.9	5.2	5.3	5.7	6.0	6.4

n/a - not available
Sources: Latin America Today; Boliviabiz.com; Bolivianet.com, Banco Central de Bolivia

Foreign direct investment in Bolivia declined 25% in 2000 to $750 million, partly because companies completed the capitalization of their projects. Some 44% was in the hydrocarbons sector, and 42% was in the service sector.

In an attempt to speed up economic growth in the country, the government began a drive to improve private sector liquidity, hastened construction of major infrastructure projects, and instituted job creation plans in April 2000. It has maintained tight monetary policy and in 1999, it renegotiated terms with the IMF to allow its fiscal deficit to climb from 3.7% to 4%. The IMF declared Bolivia eligible for a new debt reduction plan and received a further $854 million in debt relief.

Trade and Investment

Regional oil companies, such as Argentina's YPF, Pluspetrol and Perez Companc, and Petrobras, have competed fiercely for a position in the new market against leading world oil companies, such as Amoco, Total, Exxon, Mobil, Repsol, and Elf, among others. The result has been new investment averaging over U.S. $600 million annually -- two-thirds of Bolivia's total foreign direct investment -- which is helping keep the nation at the top of the regional GDP growth rate. This spending mainly has been targeted at new exploration to prove gas reserves for export to Brazil.

By the middle of 1999, 88% of the FDI capitalization promises will be satisfied. Some companies, particularly those in the energy industry, will likely continue to spend well beyond their original investment targets, but this may not fully compensate for the fall in privatization proceeds. Consequently, attracting fresh foreign inflows (if for the sole reason of financial stability) is a top government priority.

Bolivian officials predict an investment boom based on a survey of private investors' plans for 1999 through 2005. Although the responses were incomplete, authorities have embraced the results. The government now says total investment, private and public, is set to double over the next five years, to a total of $13.2 billion. Of the total $13.2 billion, the Ministry 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%), telecoms (7%), industry and agriculture (6%), and construction (5%).

Recent gas discoveries have increased the viability of building a second gas pipeline to Brazil, while the San Cristobal project should provide a large boost to investment in mining. Indeed, the EIU believes that these two industries alone should ensure that FDI flows remain at historic levels at least through 2001.

Predicted capital formation investment in Bolivia's hydrocarbon sector (for 1998-2005) is shown in Table 14.

Table 14: Capital Formation Investment in Bolivia's Hydrocarbon Sector (1998-2005)
(in billion B$)

	Committed	Projected	Total
Privatized Companies	835	880	1,715
Exploration/Development	548	1,550	2,098
Pipeline to Brazil	435	0	435
Pipeline to Peru	0	175	175

Source: The Economist Intelligence Unit, Ltd.

In order for Bolivia to meet its goal of becoming a major supplier of energy, nearly B$5 billion of investment is needed by 2005 to develop its oil and gas reserves, build pipelines, and construct power plants. As of 1998, about B$2 billion of this investment was reached.

Bolivia's 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 kilometers) 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.

To encourage further development and in recognition of the country's reforms the international financial community has reduced the size of Bolivia's international debt. In 1998, Bolivia's public debt totaled a net present value of B$450 million, which accounts for 80% of the reduction made by the Paris Club of creditor nations (an amount equal to about 13% of Bolivia's outstanding debt in 1997). Bolivia was the second country (and first Latin American country) to be approved in conjunction with the World Bank/IMF Highly Indebted Poor Countries Program.

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