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BUSINESS SCHOOL RESEARCH PAPER

ECONOMIC EVALUATION FOR THE
BOLIVIA - BRAZIL PIPELINE

by

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*A research paper submitted in fulfillment of the requirements for 3 credits,
GRADUATE INDEPENDENT RESEARCH PROJECT Fall Term 1996,
Professor Gautam Kaul, Faculty Supervisor.*

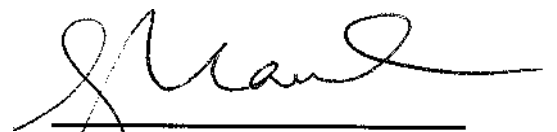
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Faculty Comments

This project is excellent in its conception and the enormous implications it has for Brazil and Bolivia, as well as the entities participating in it.

Henrique has been able to carry out a very good financial analysis, but the project's "writing" part is disappointing. I am also a little concerned about the lack of theoretical detail.

But then I am evaluating this as almost a PhD level document because Henrique is an outstanding student.



Signature of Faculty Supervisor

Professor of Finance

Title

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1. Introduction:

This paper's purpose is to assess the economic feasibility for a Natural Gas Pipeline linking Bolivia to Brazil through the stand point of one of the project's equity-holder who is the BTB group. The pipeline construction is expected to begin by early 1997 and by the summer of 1996, some of the Bolivia - Brazil financing/economic details were still being analyzed by equity-holders and debt-holders.

The pipeline's prospective equity-holders are Tenneco Energy, British Gas, B.H.P (these three companies formed the BTB group) the Brazilian State Owned Oil Company (Petrobras), Enron and the Bolivian State Owned Oil Company (YPFB). Both the Bolivian and Brazilian governments have already changed their national laws and authorized international energy companies to explore economically the transportation of Natural Gas within their countries.

For a long time Brazil has been searching for alternative sources of energy that would be able to complement its current energy portfolio - mostly composed by hydroelectric energy. Although Sao Paulo, the fourth biggest city in the world, is currently being able to serve its energy demand, many energy experts forecast that if Brazil keeps its growth pace, there will be a run-out of energy by the turn of the century. New hydroelectric power plants do not look attractive anymore because in addition to its high initial investment and environment hazards, the Brazilian topology's limitations does not allow many more plants. Specialists say that Natural Gas energy is the best

solution . It is acclaimed to be a cheaper, cleaner and environmental friendlier energy alternative for the country.

The first study for a Natural Gas Pipeline between Brazil to Bolivia is dated from 30 years ago. Since then, specialists and Brazilian politicians are calling the country's attention for the project's urgency. Nevertheless for a long time Brazilian and Bolivian laws did not allow private companies, specially international ones, to transport Natural Gas inside the country. Additionally, the world economic crisis during the late 70's and 80's postponed all big investments plan for the next century.

The first step towards the construction of the pipeline took place in 1994 when the just elected Brazilian president Fernando Henrique Cardoso ruled the end of the State Monopoly in Transporting Natural Gas. From that moment on, private companies, national and international, were allowed, with some constraints, to economically explore the transport of Natural Gas in Brazil. At that point; energy companies as Enron, Tenneco Energy, B.H.P. and British Gas started to study proposals that would transform this project into reality. By August 1995 B.H.P, Tenneco Energy and British Gas - which had formed the BTB Joint Venture - were chosen by Petrobras as the players at the Brazilian side of the pipeline. YPF chose Enron as the player at the Bolivian side.

During the summer of 1996 I had the opportunity to work for Tenneco Energy with the Bolivia- Brazil Pipeline Project. My job was to analyze the economic model already developed and evaluate the assumptions considered to build it. Most of the information used at this paper were obtained during this professional experience. No books or articles were used as references for this paper. Considering that the project terms

Rio de Janeiro and Belo Horizonte (around 9 million and 6 million inhabitants respectively). These four Brazilian cities accounts for approximately 23% of the Brazilian population.

In an overall the pipeline will provide gas to seven Brazilian states: Mato Grosso do Sul, Sao Paulo, Rio de Janeiro, Minas Gerais, Parana, Santa Catarina and Rio Grande do Sul. These states represent 75% of Gross National Product (\$ 420 billion), 82% of industrial output (\$183 billion) and 71% of the country's energy consumption - all figures from 1994.

In addition to the pipeline trunk line, there will be built 16 compressor stations, with four 4500 HP compressors in each station. Between Corumba and Canoas, there will be 29 city gates.

The pipeline is expected to be concluded in two phases. The construction of the main pipeline trunk line from Bolivia to Sao Paulo in 1997 will comprise Phase I, while Phase II will comprise the construction of the southern pipeline from Sao Paulo to Rio Grande do Sul which will be completed in 1999.

3. Cash Inflow:

3.1 Short Term:

The Bolivia - Brazil pipeline will be financing by equity-holders and debt-holders. The project will be highly leveraged once total funds required are \$ 2.248 Billions and debt represents 75.6% of this amount.

Two entities were created to own and control the project as equity-holders. They are the Brazilian Gas Transportation Company and the Bolivian Gas Transportation Company. As already mentioned; Tenneco Energy International (US), along with the B.H.P. (Australia) and British Gas (UK) formed the BTB Joint Venture. This group was selected by Petrobras as partner of the pipeline at the Brazilian side. Petrobras holds 55% of ownership at the Brazilian side while BTB holds 25% (8.33% for each one of the three Joint Venture partners). The other 20% of ownership at the Brazilian side is divided between Enron and YPFB. At the Bolivian side, Enron was selected by YPFB as a partner. YPFB holds 51% of ownership at the Bolivia side while Enron holds 34%. The other 15% is divided between Petrobras and the BTB consortium. These six companies/organizations are expected to be the only equity-holders for the pipeline (*Exhibit 2*).

Although the Project is owned by two separate legal entities, financing will be on a unified basis. The major debt-holders are ECA, World Bank, JADB, Japanese Eximbank, Banco Nacional de Desenvolvimento (BNDES), CAF and other smaller entities. These entities are entitled to be Senior Debt-holders and will represent 55.6% of the total \$2,247 Billion funds required for the project. Additionally, Investors and Petrobras sub-loans will be part of the debt structure (representing 11.1% of the total funds required) and will be called Junior Debt holders.

The Financial assumptions used to calculate the interest and commitment fee costs are as follows:

Table 1.1

Sources	Total Debt (US\$'000)	Amortization Method	Upfront fee	Interest Rate	Commitment Fee
Senior Debt					
ECA	279,079	Level Prin.	0.0%	7.00%	0.50%
World Bank	307,805	Mortgage	0.0%	7.00%	0.50%
IADB	307,805	Level Prin.	0.0%	7.00%	0.75%
JExim/BNDS/CA F/Others	354,363	Mortgage	0.0%	7.00%	0.50%
Total Senior Debt	1,249,051				
Junior Debt					
Investors Sub Loan	138,090	Level Prin.		15.00%	0.00%
Petrobras Sub Loan	111,720	Level Prin.		15.00%	0.00%
Total Junior Debt	249,810				
Overrun Sub Loans					
Petrobras Overrun Sub Loan	200,000	Bullet		5.00%	0.00%
Total Overrun Sub Loans	200,000				
Equity					
Petrobras	74,480				
Tenneco Energy	11,523				
BHP	11,523				
British Gas	11,523				
YPFB	34,527				
Enron	23,018				
Total Equity	166,540				
Total Funding	2,248,491				

3.2 Long Term:

The Project will serve primarily industrial, commercial, residential, transportation, and electric power generation markets. These markets will be initially served with gas from Bolivia per the terms and conditions of the Natural Gas Purchase Contract from February 17, 1993. This Contract signed between Petrobras and the other pipeline equity

holders (Enron, YPFB, and BTB group) defines the volume and price of natural gas transported for the next twenty years through the pipeline. The Gas Contract certifies that reserves in Bolivia that are not required for domestic consumption would be dedicated to the Project in preference to all other possible uses in accordance with the contract. Any demand for gas in Brazil beyond the volumes stipulated in the Gas Contract must be satisfied from outside Bolivia unless sufficient additional reserves (new fields or certified reserves in the existing fields dedicated to the Project) have been developed and are deliverable within Bolivia beyond those necessary to meet the Gas Contract commitment. The Contract also assumes that in case YPFB is privatized all its obligations go to its successors. The price, volumes and revenues defined in this Take-or-Pay contract are as defined below:

Table 1.2

Year	Base Tariff (\$/MM Btu)	Contract Volumes ('000 CM/Day)	Revenues	Year	Base Tariff (\$/MM Btu)	Contract Volumes '000 CM/Day)	Revenues
1996	1.21	0	0	2007	0.28	18,080	5,062
1997	1.22	0	0	2008	0.29	18,080	5,243
1998	1.22	0	0	2009	1.29	18,080	23,323
1999	1.23	9,040	11,119	2010	1.3	18,080	23,504
2000	1.24	10,328	12,807	2011	1.31	18,081	23,686
2001	1.24	11,622	14,411	2012	1.31	18,082	23,687
2002	1.20	12,914	15,497	2013	1.32	18,083	23,870
2003	1.25	14,205	17,756	2014	1.33	18,084	24,052
2004	1.26	15,497	19,526	2015	1.33	18,085	24,053
2005	1.27	16,788	21,321	2016	1.34	18,086	24,235
2006	1.27	18,080	22,962	2017	1.35	18,087	24,417
				2018	1.35	18,088	24,419

In an effort to verify the gas demand in Brazil, and to minimize the risk of bad terms agreements in the Gas Contract, Petrobras conducted a market research in Brazil. This research was based on an extensive survey in each of the six states of which the pipeline traversed. The analysis concluded that the market assumptions used in the solicitation were valid and justified the development of the pipeline project. The table below illustrates the results:

Table 1.3

<u>Volume (MM) CM/day</u>	1998	2000	2001	2002	2003	2004	2005	
<u>Low Case Demand for Gas</u>								
Volumes	8.0	9.1	10.3	11.4	12.6	13.7	14.9	16
<u>Base Incremental Demand for Gas</u>								
Sao Paulo	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
Rio de Janeiro	2.9	3.5	3.9	3.9	3.9	3.9	3.9	
Minas Gerais	0.8	1.2	1.4	1.6	1.8	2.0	2.2	
Mato Grosso do Sul	0.4	1.0	1.4	1.8	2.2	2.6	3.0	
Parana	0.6	0.8	0.9	1.0	1.1	1.2	1.3	
Santa Catarina	2.3	2.5	2.7	2.9	2.9	2.9	2.9	
Rio Grande do Sul	0.4	0.6	0.8	1.0	1.2	1.4	1.5	
Total Demand for Gas	21.4	24.6	27.1	29.2	31.1	33.0	34.8	
Less Domestic Supply	(8.8)	(8.5)	(8.5)	(8.6)	(9.0)	(8.6)	(8.4)	
Total Market for Pipeline	12.6	16.1	18.6	20.6	22.1	24.4	26.4	
<u>High Case Incremental Demand for Gas</u>								
Base Case Market for Pipeline	12.6	16.1	18.6	20.6	22.1	24.4	26.4	
Power Markets in Sao Paulo	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Power Markets in Rio de Janeiro		2.0	2.0	2.0	2.0	2.0	2.0	
<u>Total Market for Pipeline</u>	14.6	20.1	22.6	24.6	26.1	28.4	30.4	

In the event that YPFB fails to tender enough gas to meet the requirements of the transportation contracts, YPFB will be responsible for paying the monthly capacity payment to the Gas Companies based on the volume shortfall. In the event that Petrobras fails to purchase enough gas to meet the requirements of the transportation contracts, Petrobras will be responsible for paying the monthly capacity payment to the Gas

Companies based on the volume shortfall. In the event that YPFB or Petrobras is capitalized, all transportation contract obligations will be assumed by their successors.

4. Cash Outflow:

4.1 Short Term - Initial Investment Requirements:

At the short term, the major costs expected are related with the construction of the pipeline and other utilities. The overall construction cost expected for each segment of the pipeline and the year of these expenses are as follow (US\$'000):

Table 1.4

Segment	1996	1997	1998	Total	Total Esc¹
I. Rio Grande/Corumba	36,624	183,120	146,496	366,240	389,730
2. Corumba/Campaigns	87,071	435,396	348,244	870,610	926,449
3. Campaigns/Araucaris	21,833	109,165	87,332	218,330	232,333
4. Araucaris/Florianopolis	12,130	60,647	48,518	121,295	129,075
5. Florianopolis/Criciuma	7,610	38,047	30,437	76,094	80,975
6. Criciuma/Canoas	8,595	42,974	34,379	85,949	91,461
Total	173,853	869,259	695,407	1,738,518	1,850,023

Additionally, other small investments are expected during the 3 first years of the pipeline construction. They are:

¹ Escalated numbers consider a US inflation rate of 3.5% per year.

Table 1.5

Other uses	Total (US\$'000)
Interest During Construction	156,077
Value Added Taxes - Construction	100.000
Development Cost	45,000
Transaction Cost	30,000
ECA Exposure Fee (9.89%)	27,601
Debt Service Reserve Fund	25,347
Commitment Fee	9,444
Working Capital	5,000
Total Other uses	398,468

The total investment required during the construction years considers the sum of the totals from Tables 1.4 and 1.5. The total sum of these two values will be \$2.3 Billions, matching with the funds expected to be raised (*Exhibit 3*).

4.2 Long Term:

At the long term, starting in 1998 and until the end of 2018 - when the Gas Contract ends - the economic model for the pipeline project considers yearly operational costs. The present value for these costs is evaluated in approximately \$ 408 million. The average yearly operational cost is \$ 22.5 million, which already considers an yearly capital cost increase of 14%.

The operational cost is composed mainly by maintenance and operation of the pipeline.

5. Project's Risks:

There are two major categories of problems, very closely related, affecting the BTB project - commercial and political. In summary, these problems are related with the negotiation process of distributing the investment risk among all the players; BTB, Enron, Petrobras, YPFB, Brazilian State Governors and Federal government. All these negotiations are very time demanding.

Bureaucrats in Brazil, some from inside Petrobras, are saying the pipeline project is not the best economic solution for the energy problem in the country. Based on that position, many opposition leaders are holding up the required approval process in Congress to establish legislation governing the transportation and commercialization of natural gas in Brazil.

As a consequence of that BTB is confronted by some legislative uncertainties in Brazil and is pushing Petrobras for further negotiations in order to reduce the project risks. These negotiations are very time consuming and are ongoing and include all parties.

Additionally, there are some risks the gas reserve levels in Bolivia will not be enough for the Brazilian market.

A team from the BTB group is in place in Brazil to monitor developments and negotiations. Indications have been made that no major breakthroughs are expected through the end of 1996. Although the Brazilian and Bolivian governments have announced this project as a top priority, it is still uncertain what it means to the overall time frame.

6. Cash Flow Analysis:

The table bellow considers the major finds for the economic analysis of the Pipeline. It was assumed a WACC of 15%. This value considers both the historical business risk and the risk premium related with constructing in emerging economies such as Brazil and Bolivia - which might add some economic and political uncertainties to the project. The cash flow streams can be better observed in Exhibits 4, 5 and 6.

Table 1.6

•000	Consolidated :		Brazil:		Bolivia :	
	<i>Return</i>	<i>NPV@ 15%</i>	<i>Return</i>	<i>NPV@15%</i>	<i>Return</i>	<i>NPV@15%</i>
BTB	18.14%	\$19,740	18.25%	\$19,039	16.66%	\$701
ENRON	17.35%	\$10,063	18.25%	\$6,093	16.66%	\$3,971
PETROBRAS	6.15%	(\$321,408)	13.84%	(\$22,782)	5.74%	(\$20,279)
YPFB	18.43%	\$23,167	18.25%	\$9,139	18.57%	\$14,028

All values are nominal for a 20 year project.

7. Conclusion:

For the BTB group stand point, the Pipeline project brings positive NPV. Using a WACC of 15%, the BTB group will be able to collect around \$ 20 million as profit in present value (to be divided among the Joint Venture Players). The Consolidated project overall IRR is 13.23%, as can be observed in Exhibit 6. For the BTB group and considering its share of the cash-flow, the IRR is 18.14%.

The major equity-holders beneficiaries from this project are the BTB group and YPF. On the other hand, Petrobras will have a negative NPV if it goes ahead with the pipeline (around \$ 321 million).

As a major consequence of Petrobras's negative results the initial construction is delayed. Assuming no further space for negotiations among the pipeline players, the Brazilian government is still studying the nation needs for the pipeline and if such investment is really required.

In face of so many uncertainties, and additional risks, the pipeline's equity holders are re-analyzing the project's expected returns and the impact of these new risks on the returns. The social cost for Petrobras related with the pipeline is too high. The pipeline consortium need to review the distribution of returns among the payers in order to make this project a reality.

EXHIBITS

EXHIBIT 1

STRUCTURE OF THE BOLIVIA - BRAZIL PIPELINE



SEGMENT

PIPE SIZE

Diameter Length
(Inches) Miles

1 - Rio Grande/Corumba

:32 350

2 - Corumba/Campinas

:32 771

3 - Campinas/Araucaris

:24 267

4 - Araucaris/Florianopolis

:20 163

5 - Florianopolis/Criciuma

: 18 101

6 - Criciuma/Canoas

:16 155

TOTAL

: 1,807

EXHIBIT 2

SHAREHOLDERS OWNERSHIP

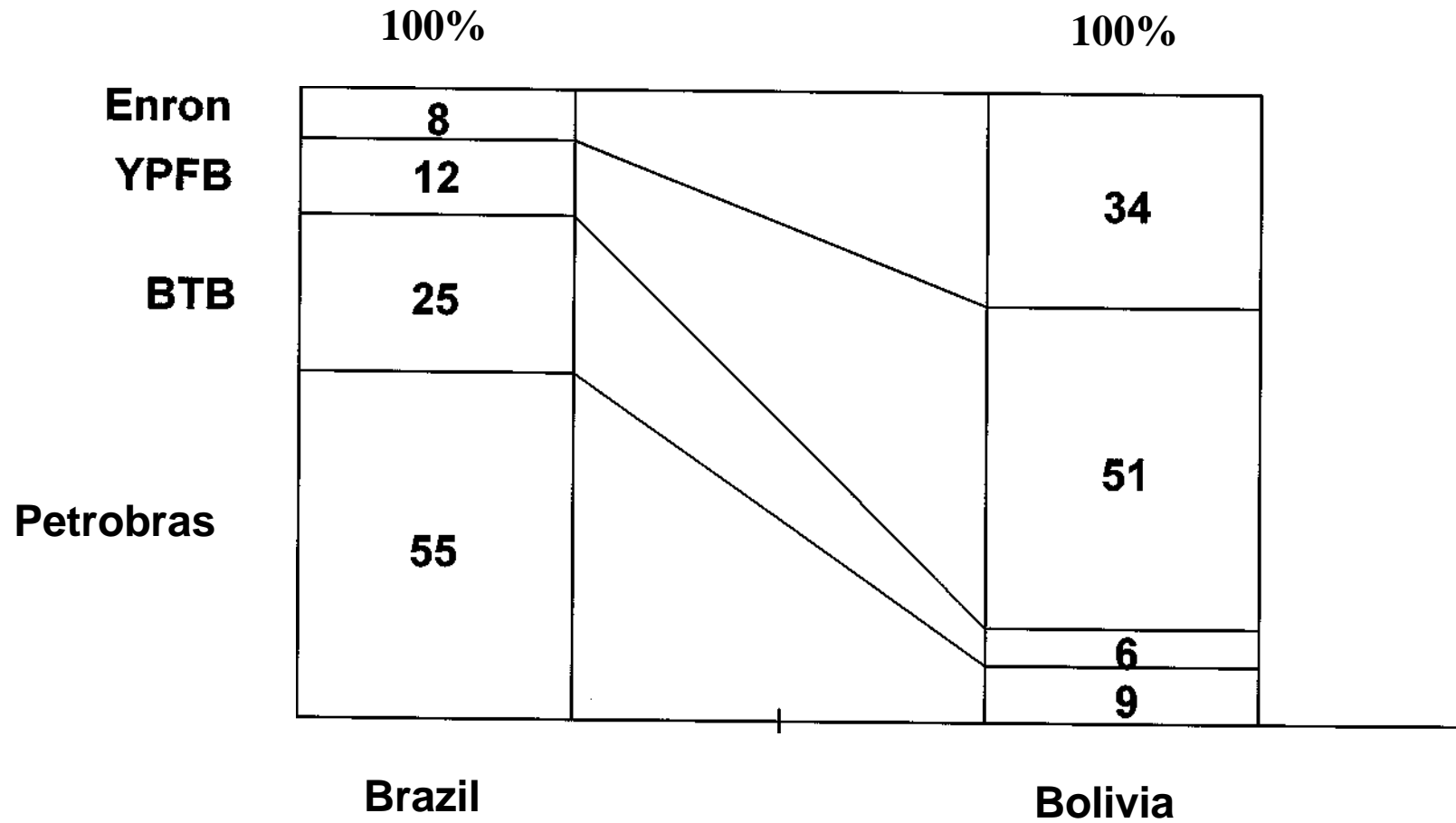
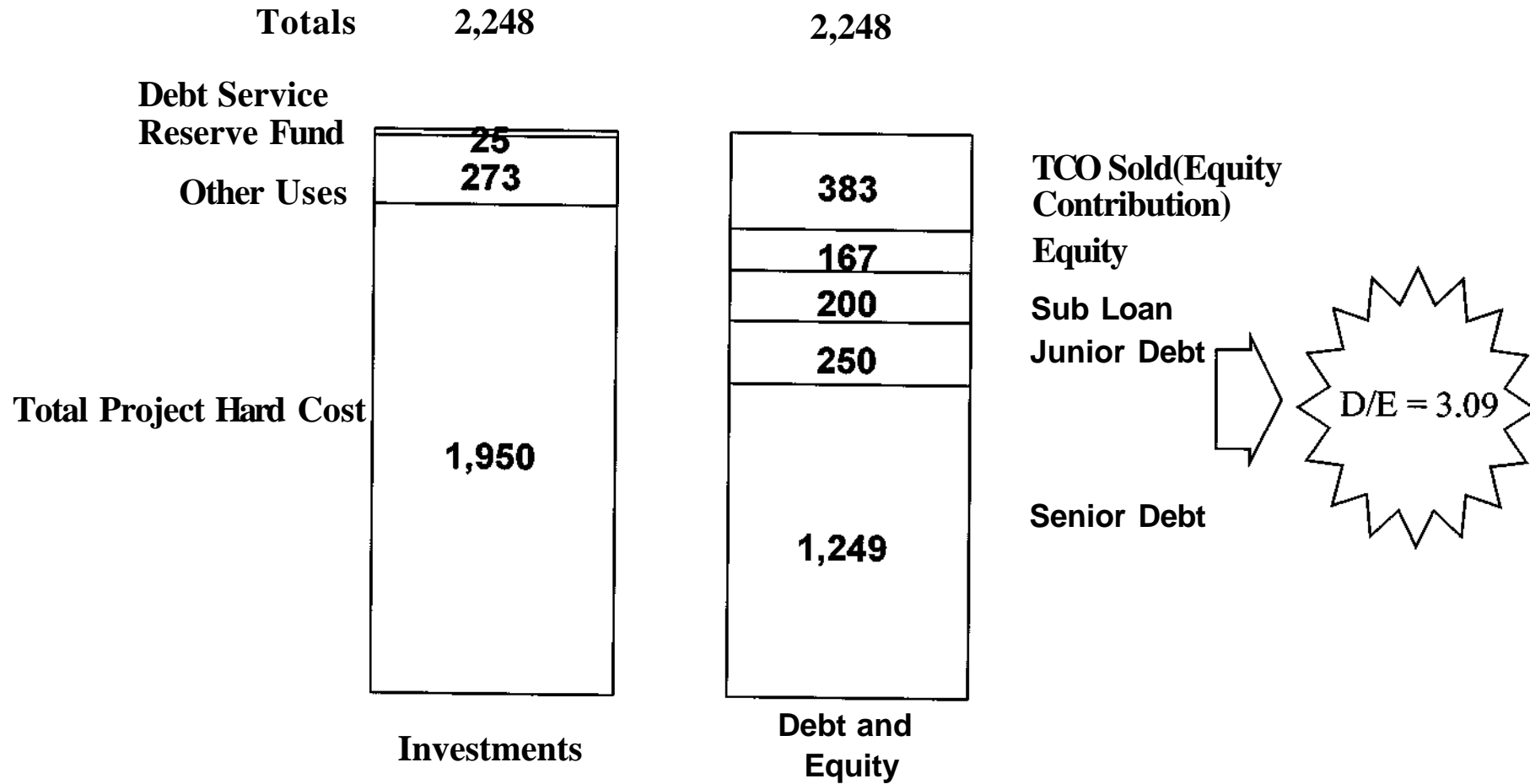


EXHIBIT 3

CAPITAL STRUCTURE - CONSOLIDATED

(MM\$)



15 YEAR CASH FLOW - BRAZIL

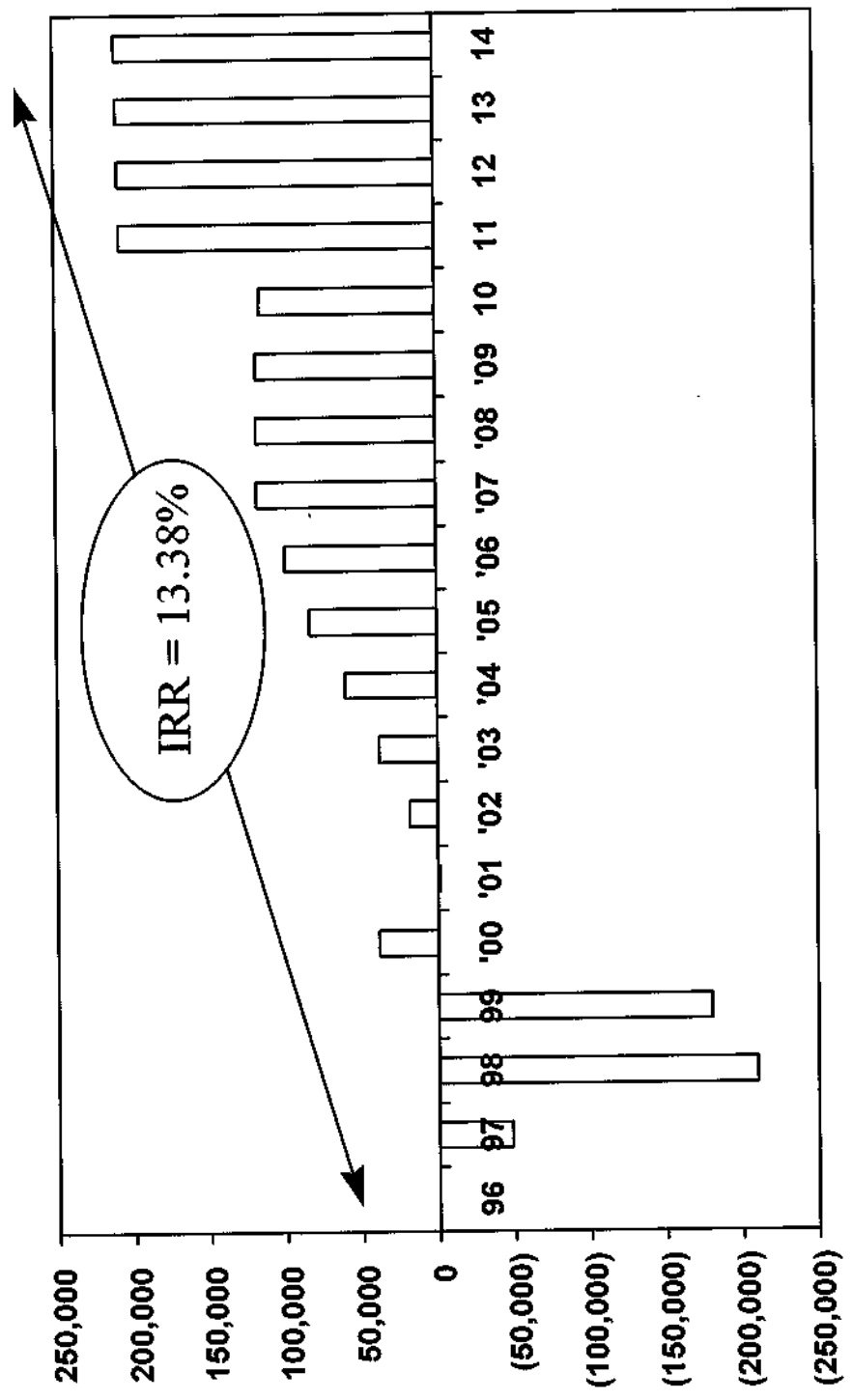


EXHIBIT 5

15 YEAR CASH FLOW - BOLIVIA

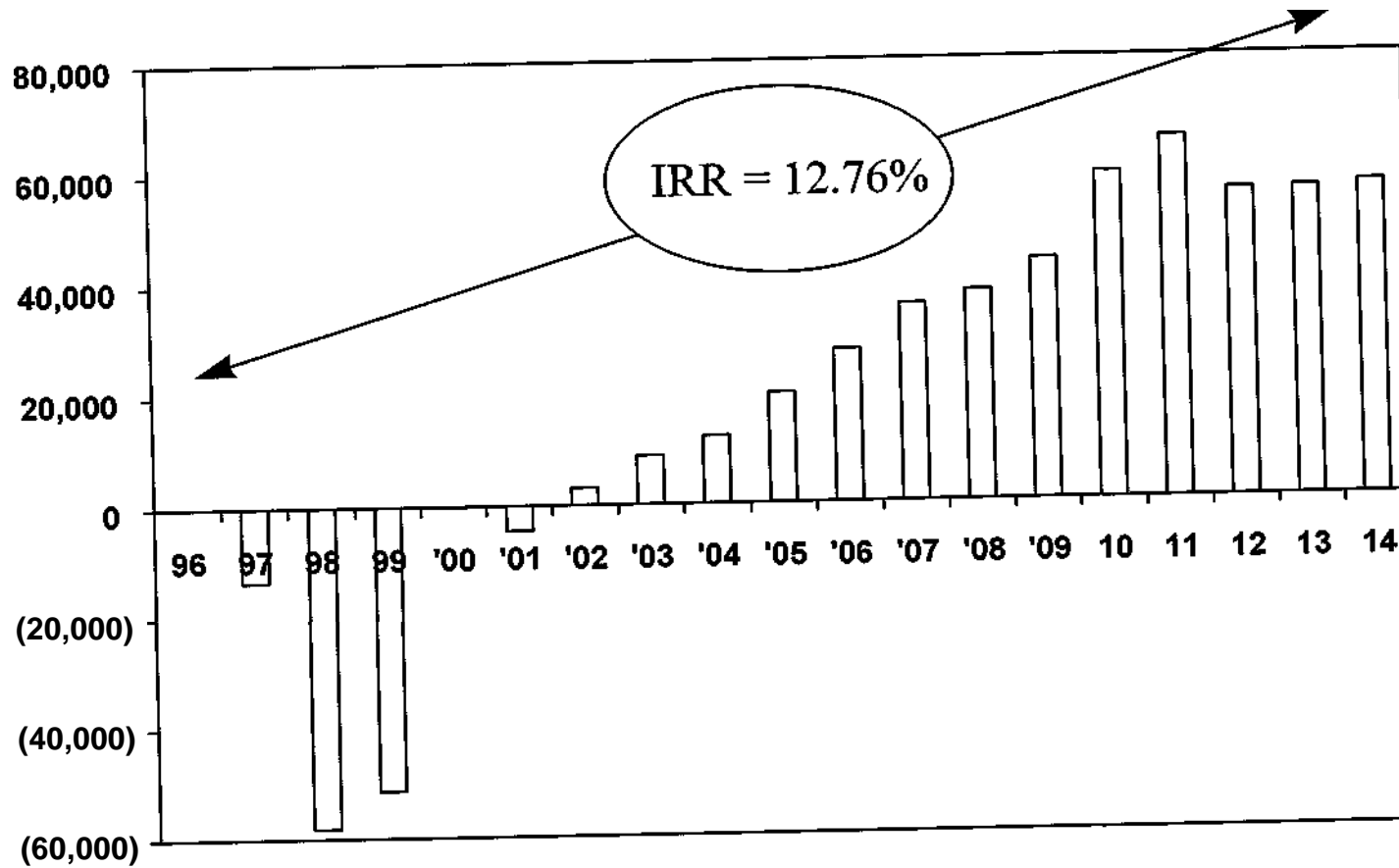


EXHIBIT 6

15 YEAR CASH FLOW - CONSOLIDATED

