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" World Bank Strategy for the Natural Gas Sector in LAC "

by

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WORLD BANK STRATEGY FOR THE NATURAL GAS SECTOR IN LAC¹

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WORLD BANK STRATEGY FOR THE NATURAL GAS SECTOR IN LATIN AMERICA

EXECUTIVE SUMMARY

Introduction

1. The purpose of this paper is to propose a Natural Gas (NG) strategy in the Latin American region aimed at eliminating policy, legal and regulatory barriers that currently inhibit the use of this fuel, consistent with the policy objective of achieving a reliable and economic energy supply mix. In order to do this, it is necessary to examine the potential role of NG in the energy balance taking into account its availability and economic importance relative to other fuels; and to analyze the issues which have constrained the NG sector development in the past and evaluate the strategic options available to the countries in the region (maps) for overcoming the obstacles and developing the sector.

Conclusions and Recommendations

2. There are large proved natural gas reserves in LAC and, even larger potential reserves to be found. Even though preliminary indications point out that the economic supply costs of NG are competitive with substitute fuels, the contribution of NG to energy requirements in LAC is below its economic potential. While natural gas is beginning to play an important role in satisfying the energy requirements in 9 countries (Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, Peru, Trinidad and Tobago and Venezuela), its increased use would require the implementation of several new projects in field development, transmission and distribution not only in these countries but in other countries where NG plays a negligible role such as Ecuador, Uruguay and Paraguay. These investments required by these projects will provide opportunities for: (i) the private sector to participate; (ii) the public sector to reduce public investment and raise fiscal revenues; and (iii) the Bank with new lending opportunities.

3. The development of the natural gas subsector should be given the same emphasis as power and petroleum in the Bank energy strategy. This is the central conclusion of this study. This sector offers the Bank a wide ranging policy dialogue with Governments on some of the major issues which constrain economic development in Latin America in terms of a more efficient use of resources, promotion of private sector participation, improving the balance of trade, macroeconomic adjustment and environmental improvement. Natural gas can contribute in this direction because it : (i) is a potentially low cost energy source which can displace exportable fuels or generate import savings with a positive impact on public sector investments, deficit and debt; (ii) could be exported and is generally accompanied in its production by high value petroleum liquids; (iii) provides opportunities to promote trade liberalization; (iv) can help private sector involvement thus reducing the relative size of the public sector and fostering competition; and (v) is a clean and efficient fuel.

4. The proposed Bank strategy in the natural gas sector should be underpinned by a continuous policy dialogue on broad issues on trade, labor legislation and taxation, and by more focused energy sector issues dealing with least cost sector development, legislation, pricing policies, regulatory functions and organization, institutional development and the environment. In addition to energy sector studies, the Bank should provide assistance in specific areas : petroleum/natural gas legislation, investment legislation for promotion of private sector participation, sectoral interrelationships (i.e. gas use in power, industry, commerce, household, intersectoral pricing relationships), natural gas cost and tariff studies and sector regulations. Lending operations should be tailored to strengthen deregulation of the sector, promote the private sector, restructure public enterprises, and rationalize Government sector policies (regulatory, pricing, environmental, etc.). The proposed Bank strategy should be disseminated to all staff, regional organizations and borrowers.

5. The Governments in LAC play an important role in the gas sector, being the policy makers, regulators and in some cases the sole shareholder in natural gas public enterprises. The natural gas sector is dominated by public enterprises that manage production, transmission and distribution. Except in three countries, the private sector is playing an important role in the exploration and production of natural gas and a minor role in transmission and distribution activities. In these countries, the Bank effort should be oriented to further private sector involvement and reduce Government intervention and public sector involvement through adequate legislation, contracts and regulations and appropriate energy pricing policies. In most other countries, where natural gas is under strong Government control, the Bank strategy should seek, on the one hand, a Government commitment to move towards private sector involvement in the sector and, on the other, the necessary legal and regulatory changes to implement the opening of the sector to private investors.

6. Regarding the Bank's resources, the LAC region in the Bank has been able to field missions in the past to carry out energy sector studies (Brazil and Argentina). The teams consisted of Bank staff who provided the intellectual leadership, complemented by local and international consultants. In both cases, an experienced gas consultant addressed the issues of costs, tariffs, regulations, and exploration/production contracts. Since the completion of this work, a Gas Unit in the Bank has been staffed with special experts, providing assistance supported with external consultants to carry out studies on gas regulations, tariffs, contractual issues and gas sector development. In the case of three ongoing lending operations, the required gas expertise came from outside consultants and Bank staff. Based on these experiences, the Bank's regional staff with support from outside consultants and the Gas Unit should be able to meet the work requirements foreseen for the near future in the gas subsector.

Issues

7. The major issues facing the natural gas sector are : the poorly defined role of natural gas in energy and power sector policy and strategy, the lack of a clear legal and contractual status for natural gas, the unclear roles of the public and private sector companies, the lack of a rational and predictable intersectoral energy pricing policy, the weakness of public companies and the

inadequate government institutional capacity to develop policies and regulate the sector. The objective of a country's energy strategy is to provide the economy with a least cost and reliable energy supply mix. The energy strategy in many LAC countries is usually not explicit about the role of natural gas in meeting this objective and consequently does not provide an adequate policy environment and proper economically efficient incentives to encourage investments in the sector.

8. While production and other upstream operations resemble the petroleum sector, transmission and distribution of natural gas are public activities that operate like power utilities. As a result the legal and contractual status of natural gas is poorly understood by the LAC countries. Risk petroleum contracts, for instance, do not include adequate provisions for natural gas pricing and marketing.

9. The main reason why natural gas penetration in the energy markets has been slow is the government's control over pricing of petroleum products, coal and electricity. In Venezuela, the industrial consumer pays the equivalent of US\$ 1.38/bbl for natural gas; in Brazil, 1.92; and in Colombia 3.84, far below the prices of competing fuels. But these low prices also are a strong disincentive to the private and public sector to develop or expand gas infrastructure.

10. The existing institutional structure is generally inadequate to encourage development of natural gas. In some cases, responsibility for the sector is divided among several agencies, some of which have conflicting interests. In addition to being the policy maker and regulator, the government may also be the sole shareholder in the gas company. As a result, companies operate with severe limits on their autonomy due to constraining labor laws, energy pricing policies and interference by other government agencies.

11. Finally, interregional gas trade has been slow to develop mainly because of the conflicting policy objectives of fuel import substitution and of trade liberalization (required for gas imports). Presently, the energy strategy of Latin-American countries lacks a regional focus, but with the severe constraints on public investment foreseen, expansion of natural gas trade should be important within and outside the region.

Economic Benefits

12. The macroeconomic benefits from increased use of low cost natural gas include the reduction in the cost of energy to the country; improvement in the balance of payments due to import savings and/or export revenue increases and reduction of public sector debt (when the private sector participates). An analysis made for Argentina shows that the cost of energy to the economy could be reduced by about US\$ 700-900 million (1987 US\$) over the period 1987-2000 due to the lower cost of locally produced natural gas as compared to the cost of the replaced fuels. The balance of trade would improve by US\$ 130-530 million over the same period because of the exports of the released fuels replaced by natural gas.

13. The microeconomic benefits stem from the convenience and environmental benefits of natural gas and its lower economic cost than competitive fuels. As

a result, one conclusion is that even if the economic cost of natural gas and the competing fuels were the same, the user benefits from expanding the energy supply with natural gas would be larger than expanding it without natural gas. The other conclusion is that, if rational energy pricing policies are in place, the lower economic cost of natural gas would translate into lower end-user prices for energy which would expand demand, providing the economy with additional benefits.

Strategic Options

14. The energy strategy should aim at establishing an environment of open competition and equal opportunities for public and private companies in all areas of exploration, production, transportation and marketing of natural gas, while ensuring the national interest is protected with a minimum of regulations and controls. Government policy decisions should be limited to : developing a national energy policy and strategy, setting the legal/contractual requirements for public and private enterprises and promoting investments in natural gas development. The regulatory agency should be responsible for approving tariffs for natural gas sale based on agreed and transparent criteria reflecting full economic costs, including incentive payments for risk taking and adequate returns on capital regulating access and transport tariffs of pipelines, ensuring public safety and monitoring performance by public sector entities.

15. While the public sector enterprises should have full technical, administrative and financial autonomy, the role of the private sector in natural gas sector development should be well defined. In particular the private investor should have the right to sell gas to third parties and the right to build and own pipelines. There should be a clear definition of the right by producers to export gas and special terms that would encourage development of marginal fields.

16. Foreign private sector involvement in natural gas development can only be encouraged if a solution is found to the problem of securing payments in convertible currencies if natural gas is used for domestic consumption. There are many avenues which could be explored such as commodity payments (crude or fuel oil) or even barter deals. Innovative financing arrangements could also be found through joint ventures, public debt purchases by private investors, advance gas or gas liquids purchase contracts, sales of shares of gas utilities to the public, limited and non-recourse financing and end-users participation in infrastructure construction.

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WORLD BANK STRATEGY FOR THE NATURAL GAS SECTOR IN LATIN AMERICA

I. INTRODUCTION

1.1 An adequate supply of reliable and low cost energy is essential if the LAC countries' goals for economic recovery and development are to be realized in the 1990s. Most countries have had to import petroleum products to meet domestic and industrial energy needs and have invested vast sums to develop hydroelectric and crude oil resources. These expenditures have strained public sector financial resources, aggravated budget deficits and increased the external debt burden of most LAC countries. But natural gas (NG), which is available in commercial quantities in ten LAC countries, has been effectively developed in only four. Natural gas, an environmentally clean fuel, can replace most of the liquid fuels consumed in the residential/commercial, industrial and power sectors. It can replace electricity for cooking and water heating and consequently reduce liquid fuel imports, and/or release fuels for export. Should international energy prices remain high, the economic burdens imposed by the present energy mix will become even more onerous, making low cost natural gas an increasingly important component in the energy balance.

1.2 Several obstacles have impeded natural gas development and market penetration. Lack of an energy policy which do not discriminate against natural gas; lack of technical capability to develop the resource; lack of legal, contractual and commercial frameworks, which would encourage investment; arbitrary

pricing structures which subsidize competing fuels, and lack of a proper institutional framework have all played a role in slowing sector growth. If natural gas is to reach its full potential, these barriers must be eliminated. A sound natural gas sector policy must include an adequate legal, fiscal, regulatory, contractual and institutional framework which will encourage development, properly allocate resources, encourage private sector participation and ensure the financial integrity of the sector.

1.3 Given its role in financing development projects and sector strengthening in Developing Countries, the World Bank could play an important role in sector development in Latin America but thus far its involvement in the sector has been limited. The Bank's guidelines presently applied to natural gas sector lending¹ (see references) deal in great detail with the exploration and development of natural gas as well as the required infrastructure for its transport and distribution. In most cases these account for the larger portion of the investment, and the economic and institutional issues involved are more similar to power sector issues than those related to oil development projects. The purpose of this paper is to propose a natural gas strategy aimed at eliminating policy, legal and regulatory barriers that discourage the development and use of this fuel, consistent with the policy objective of achieving a reliable and economic energy supply mix. First it

is necessary to determine the potential role of NG in the energy balance, then the technical, economic and institutional factors which have hindered the use of natural gas; to identify the strategic options the LAC region--and each country--has for overcoming the obstacles and developing the sector; and to recommend a natural gas strategy which the World Bank could adopt to encourage appropriate sector development in LAC.

1.4 Commercial quantities of natural gas have been discovered from Mexico to Tierra del Fuego so there are both national and regional prospects for sector development. The countries with exploitable reserves include Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Trinidad and Tobago, and Venezuela (Maps). Uruguay, Paraguay, as well as the Central American countries, have no known indigenous gas resources but they are strategically located to import natural gas. Therefore, their roles in regional developments is examined. At present, the only international pipeline is between Bolivia and Argentina but other regional pipelines have been proposed. There is significant development potential in the Southern Cone region (Argentina, Brazil, Chile and Bolivia) as well as other regions.

The maps (attached) show projected gas transmission lines to be built. Except for the Santa Cruz-Sao Paulo, Argentina/Chile, Cuzco-Lima and Buenos Aires/Montevideo transmission pipelines, the other projected lines would only be justified if larger reserves are confirmed and markets expanded. This study does not focus on liquid hydrocarbons such as LPG and condensates which are extracted from natural gas.

1.5 The study is presented in five parts. First, the growth of the energy sector in LAC is reviewed and the impact of increased natural gas use on factors such as economic growth; foreign exchange balances; and public sector deficits is examined. Second, bottlenecks which have slowed the use of natural gas are analyzed. Third, the costs and benefits of using more natural gas are evaluated for selected countries where natural gas could play a significant role. Fourth, the strategic options for sector development are reviewed. Finally, based on these analyses a World Bank strategy to assist the LAC countries in developing the sector is proposed.

IMPORTANCE OF NATURAL GAS IN LATIN AMERICA

LARGE PROVED RESERVES:

6300 BILLION M3 REPRESENTING 6.5% OF WORLD RESERVES

HIGH PRESENT LEVEL OF SUPPLY:

EQUIVALENT TO 75 YEARS AT PRESENT RATE OF CONSUMPTION.

YET SUPPLY LEVEL COULD BE THREE TIMES THAT MUCH BECAUSE:

INDUSTRY STANDARDS REQUIRE RESERVES TO ENSURE ONLY 20 YEARS SUPPLY.

RELATIVELY LITTLE EXPLORATION AND DEVELOPMENT ACTIVITY

THE REGION HAS ONLY ONE EXPLORATORY WELL PER 1000 KM² OF SEDIMENTARY BASIN VERSUS

80 IN THE USA,

10 IN THE USSR AND CANADA; AND

6 IN WESTERN EUROPE.

REMAINING RESERVES ARE ESTIMATED TO BE:

17-20000 BILLION M3, I.E., TRIPLE THE PRESENT PROVED RESERVES LEVEL.

II. THE ENERGY SECTOR IN LATIN AMERICA

Energy and the Economy

2.1 In LAC, energy consumption and economic growth have grown side by side. When GDP grows energy consumption tends to grow as well. However, the energy curve is generally above the GDP curve, indicating that when incomes fall, energy consumption also declines but less so, because of previous investment by users in equipment and appliances. On the other hand, when GDP increases energy consumption grows faster. The LAC economies generally grew faster during the 1970s (5.0%) than during the 1980s (1.5%), and in both periods the pace of energy consumption was faster, 6.3% and 2.8%, respectively.

2.2 The relatively rapid growth of energy consumption conceals important differences in the demand for the different fuels. Not all fuel uses grow at the same rate. Several factors affect fuel demand in different manners: relative prices, convenience, ease of use in consumption, availability, strategic considerations, environmental concerns, level of development, etc. The most important reasons why natural gas is favored above all other fuels, is its convenience and price. Perhaps the reason why NG has not played a more important role in the past is because policy, legal and regulatory deficiencies have not permitted the availability of NG to final users.

2.3 The two oil price shocks of 1973 and 1979, and the precipitous price decline in 1986 lead to several changes in energy consumption patterns. The immediate effects on the oil importing countries of the price increases were inflationary pressures and balance of payment problems. This led many of them to implement energy conservation and diversification policies designed to reduce domestic dependence on foreign oil. Several Governments delayed to pass on the oil price increases to users, opting to subsidize consumption through deficit financing and foreign borrowing. Other countries did pass on the price increases while fostering development of domestic energy supplies, but did so with little regard to relative prices and opportunity costs. The policies were based more on strategic considerations. Thus, after many years of inefficient pricing and diversification policies, many countries in the region are now facing the consequences in the form of higher inflation, lower consumption and investment levels, balance of payment problems and inefficient energy use.

2.4 The oil exporting countries (Venezuela, Mexico and Ecuador), on the other hand, began huge public investment programs during the period of high oil prices, with little, if any, regard to efficiency considerations. During the succeeding period of weak international prices and rising interest rates, while the importing countries had a lower import bill and lower inflationary pressures, the exporting countries had to meet rising domestic and foreign expenditures with lower oil export revenue.

2.5 Given the commanding role of the energy sector in the economy, the drastic changes in the international

price of oil led to some important indirect effects in other parts of the economy. The deterioration in the terms of trade, the plunge in borrowing power, the decline in public expenditure and the mounting social and political pressures lead to a drive towards efficiency. Although the decade of the 1980s was the lost decade (as commonly called), where little, if any, per capita economic growth occurred in LAC, it was also a decade when the first steps were taken toward improving energy policies. Several Governments in the region began implementing rational energy pricing policies, promoting sounder management practices, searching for investment efficiency and encouraging private sector participation.

Sectoral Energy Demand

2.6 Industry and transport are the largest users of energy, each one accounting for about 38% of consumption in 1987, while the residential/commercial sector accounts for 23%. The rate of growth of industrial demand was 7.9% from 1971 to 1980, and 3.0% from 1980 to 1987. This meant that its share increased from 35% in 1971 to 38% in 1987. This sector, as one would expect, is more sensitive to economic conditions. Thus, the apparent income elasticity of industrial consumption was 1.6 and 2, for both periods respectively, higher than most of the other sectors. Residential/commercial energy consumption grew at 6.7% per annum in the former period, and 3.6% during the later. The rate of growth in the transport sector, on the other hand, was the lowest, growing at 6.0% and 2.1%, respectively. (See Table 1).

2.7 During the 1980's power sector nuclear generation grew at a fast pace in LAC (17.8% annually) because

	1971	1975	1980	1985	1986	1987	Rates of Growth		Elasticities	
							71-80	80-87	71-80	80-87
By Fuels	124877	167673	228120	250896	260084	272838	6.9%	2.6%	1.4	1.7
Coal	5038	6150	8695	12544	12304	13087	6.3%	6.0%	1.3	4.0
Oil	98463	129136	167002	167834	176131	181916	6.0%	1.2%	1.2	0.8
Natural Gas	9729	15882	26237	36181	35206	39494	11.7%	6.0%	2.3	4.0
Hydro/Other	11647	16505	26186	34337	36443	38341	9.4%	5.6%	1.9	3.7
By Sectors	120651	161856	219195	242352	251235	265553	6.9%	2.8%	1.4	1.8
Industry	42286	59136	84131	96775	97911	103491	7.9%	3.0%	1.6	2.0
Transport	51728	68848	87317	90058	95294	100725	6.0%	2.1%	1.2	1.4
Res./Comm.	26637	33872	47747	55519	58030	61337	6.7%	3.6%	1.3	2.4
NG by Sectors	14683	22804	36073	48631	48124	47400				
Industry	7750	13261	22588	30372	28772	26942	12.6%	2.5%	2.5	1.7
Transport				3	18	17		136.6%		N.A.
Res./Comm.	1980	2621	3649	5806	6416	5986	7.0%	7.3%	1.4	4.9
Power	4953	6922	9836	12450	12918	14555	7.9%	5.8%	1.6	3.8
Total GDP										
1986 US\$	523759	665735	812234	845590	878544	901650	5.0%	1.5%		

Table 1: Energy Consumption in LAC, Million tons of Oil Equivalent (MTOE)

it started at a very low level (See Table 2). Coal generation maintained a rapid growth rate of 12.8% p.a. All of the electricity generation from other fuels was in the single digit range: hydroelectricity at 5.8%, natural gas at 4.7% and oil at 3.8%. However, the hydro share of

in 1971 to 65% in 1987 due to a higher growth rate in in 71-80 period. Oil, on the other hand, experienced a steady decline from 32% of total electricity generation in 1971 to 24% in 1987. Natural gas stayed basically constant around 9%

Generation by Fuels	1971	1975	1980	1985	1986	1987	Rates of Growth	
							71-80	80-87
Coal	4949	4030	7023	13515	17062	16321	4.0%	12.8%
Oil	52398	66090	96430	96887	112130	124968	7.0%	3.8%
Natural Gas	14616	19091	30146	37601	38284	41547	8.4%	4.7%
Nuclear		2517	2340	8866	5835	7365	-1.4%	17.8%
Hydro/Other	88963	133496	222288	313452	323055	330091	10.7%	5.8%
Total Generation	160926	221194	351204	456806	479304	503971	9.1%	5.3%

Table 2: Fuels Used in Electricity Generation (GWh)

generation still increased from 55%

of total electricity generation during the period.

III. CHANGES IN THE ROLE OF NATURAL GAS 1970-1987 AND PROSPECTS FOR THE YEAR 2000.

Natural Gas Reserves

3.1 The natural gas reserves of Latin America have grown considerably since 1970. Thanks to discoveries in Mexico, Argentina, Bolivia, Colombia, Trinidad and Chile, and recent additional discoveries in Venezuela, Brazil and Peru, a number of major gas regions are emerging in Latin America. With more than 6300 billion m³ of proved reserves, the region has 6.5% of the total world reserves but markets only 4% of the world's production. The reserves of the region in 1987 were sufficient to meet current production for 75 years compared with the acceptable industry standard of 15 to 20 years. With such high level reserves, the region appears to have considerable scope for expanding gas use. Ultimate remaining natural gas resources have been estimated² at about 17-20,000 billion m³, i.e. more than 3 times the present level of proved reserves. The large potential in the region has not been matched by exploratory drilling. Only one exploratory well has been drilled per 1000 km² of sedimentary basin, compared to 80 wells in the USA, 10 in the USSR and Canada, and 6 in Western Europe.

Growth of Natural Gas Demand

3.2 Based on IEA³ energy data statistics, natural gas use has outpaced overall energy consumption. While final energy consumption in the region grew at an average annual rate of 5.0% over the 1971-1987 period, natural gas consumption grew at 8.5% per year. The growth in each consuming sector mirrors this pattern. In the

residential/commercial sector energy use grew 5.2% per year while natural gas use increased 8.1% per year; industrial energy use increased 5.8% annually and natural gas, 9.1%; primary energy used for power generation grew 6.9% annually and natural gas, 7.6%. As a result, the natural gas share of the combined markets grew from 18% in 1971 to 22% in 1986. The status of the natural gas sector in each of the producing countries is described in Annex 2.

Interfuel Substitution

3.3 The overall growth of energy consumption conceals the very important pattern of interfuel substitution which occurred as a result of the two oil price shocks during the early 1970's and 1980's. As shown in Table 3, except for alcohol which has a specialized market in Brazil, in markets where the fuel is used directly, natural gas use increased more rapidly than either coal or electricity, indicating that when consumers make the energy selection decision they are increasingly selecting natural gas over coal and electricity.

3.4 While country by country experience may differ somewhat, natural gas has tended to displace LPG and kerosene in the residential/commercial sector, fuel oil and coal in the industrial sector, and coal and fuel oil in the electric power sector. Given the cost and convenience advantages of natural gas, it is expected that this substitution process will continue to underpin the growth of natural gas demand in the region.

	1971	1973	1975	1977	1979	1980	1982	1984	1986	1987
DIRECTLY CONSUMED:										
ELECTRICITY (ALL SOURCES)	100	119	137	159	191	204	219	244	268	281
NATURAL GAS*	100	131	137	159	207	219	251	276	291	314
COAL*	100	106	124	143	160	165	170	208	237	249
ALCOHOL	100	137	172	283	991	1237	1638	2791	3650	N.A.
CONSUMED FOR POWER GENERATION:										
HYDRO/NUCLEAR ELECTR.	100	125	153	187	230	253	283	334	374	386
NATURAL GAS (ELECTRICITY)	100	118	140	146	195	199	219	234	261	294
COAL (ELECTRICITY)	100	98	83	105	129	137	166	209	274	283
FUEL OIL (ELECTRICITY)	100	115	137	165	185	205	202	212	200	N.A.
DIESEL (ELECTRICITY)	100	114	174	182	233	242	201	171	140	N.A.
ALL PRIMARY ENERGY	100	120	132	148	172	180	187	193	206	217

* For all uses including as fuel for electric power generation.

Source: International Energy Statistics (1989)

TABLE 3. Interfuel Substitution in LAC

Demand Outlook for Natural Gas to 2000

3.5 An estimate⁴ of the potential market for natural gas and the demand by the year 2000 has been made for each country based on a simple model which correlates energy demand by market sector with economic growth. World Bank GDP growth projections were used and it has been assumed the countries would be able to continue gas sector development as in the previous decade (Table 4).

3.6 Demand is projected to grow from 47.4 MTOE in 1986 to 130 MTOE by the year 2000. Natural gas will still only provide 19% of the combined residential/commercial, industrial and power sector markets, actually a decrease from the 22% market penetration achieved in 1986. On the other hand, natural gas consumption would be only 37 % of the potential market. Consequently, there appears to be a large scope for the countries to promote greater

economic use of natural gas vis a vis other fuels and electricity.

Natural Gas Supply Prospects by the year 2000

3.7 All the countries considered in this study have large natural gas reserves relative to current consumption rates. As shown by Table 5, the reserves life, based on 1987 consumption ranged between a low of 32 years for Colombia to a high of 121 years for Venezuela with an average of 75 years for all countries. However, adequate reserves do not necessarily guarantee that supplies will be economic to ensure development of the sector. The reserves must be developed when required and the natural gas must be distributed to consumers at competitive prices. In some countries the reserves may not be well located to serve important markets economically. A case in point is Chile's reserves in Tierra del Fuego which cannot be

NATURAL GAS DEMAND BY THE YEAR 2000
AND POTENTIAL MARKET
CONSUMPTION (MTOE) AND SHARE (%)

Country	Residential			Industrial			Power			Total		
	Pot.*	Dem.	%	Pot.	Dem.	%	Pot.	Dem.	%	Pot.	Dem.	%
Argentina	11.3	8.5	60	8.3	7.8	72	6.8	6.8	24	26.4	23.1	43
Bolivia	0.6	0.05	5	0.8	0.8	85	1.0	0.1	12	2.4	0.9	34
Brazil	19.5	0.4	1	46.0	6.7	9	15.1	-	-	80.6	7.1	6
Chile	0.9	0.3	19	1.9	0.1	3	0.6	-	-	3.4	0.4	8
Colombia	2.4	0.3	5	5.5	2.8	40	4.9	4.9	22	12.8	8.0	23
Mexico	27.4	2.4	7	77.8	42.7	49	60.4	4.6	6	165.6	49.7	25
Peru	1.8	0.05	2	2.4	0.7	21	1.4	0.3	5	5.6	1.05	9
T & T	-	-	-	6.2	6.2	93	1.8	1.8	98	8.0	8.0	94
Venezuela	4.7	0.5	6	25.6	25.6	80	18.2	5.6	11	48.5	32.1	35
Total	68.6	12.5	11	174.5	93.8	42	110.2	24.1	7	353.3	130.4	19

* Market which could potentially be satisfied by natural gas.

Note: The percentage is the percent of the sector market which is estimated to be met with natural gas, not the potential market for natural gas.

Source: Reference 4

TABLE 4. Natural Gas Demand by the Year 2000 and Potential Market Consumption and Share

economically transported to the major markets in the Santiago area. A more detailed study of the reserves that takes into account the distribution, size of reserves and geographical location with respect to the major markets would be required to establish the economic reserve.

Natural Gas Potential for Development

3.8 The estimated economic cost⁵ of natural gas delivered to industrial consumers in 1990 is \$0.58/MMBtu in Venezuela; \$1.13/MMBtu in Argentina; and \$1.34/MMBtu in Brazil, whereas the international price of heavy fuel oil is \$2.00-\$2.50/MMBtu (based on an oil price of \$15-19/bbl). The cost of gas depends on whether it is associated with oil (lower cost), i.e., Brazil and

Mexico, non-associated (higher cost), i.e., Bolivia and Colombia or a mix, i.e., Argentina and Venezuela. Given the lower economic cost of associated and non-associated natural gas as compared to the fuels it can replace, the prospects for developing additional supplies are good, despite the uncertainty of oil prices.

3.9 The data on gas reserves were obtained either from the official agency in each country or from studies conducted by internationally known consultants.⁶ Estimates of additional reserves (Annual Additions in Table 5) yet to be discovered were based on historical correlations of reserve additions. The international oil and gas companies will step up their exploration efforts and the rate of reserve additions could be

**NATURAL GAS SUPPLY REQUIREMENTS,
RESERVES LEVEL (BCM)* AND LIFE (YEARS)**

Country	Supply (BCM)		Reserves (BCM)		Reserves/Supply Ratio=Life.Years		
	1987	2000	Annual	1987	2000	1987	2000
Argentina(1)	20.7	31.2	15.2	682	542	33	17
Bolivia (2)	2.4	3.5	2.9	144	143	41	41
Bolivia(3)	2.4	5.9	2.9	144	128	41	22
Brazil	3.2	11.7	10.8	106	107	33	9(4)
Chile	0.2	0.5	1.4	142	156	710	312(7)
Colombia	3.4	10.7	3.0	109	56	32	5(4)
Mexico	27.4	73.4	88.0	2166	2655	79	36
Peru	0.7	1.3	15.4	24	211	34(5)	162(6)
T & T	4.9	11.5	5.9	297	267	61	23
Venezuela	21.8	61.1	217.4	2646	4933	121	81
Total	84.7	215.6	360.0	6316	9266	75	43

* Billion cubic meters of natural gas.

1. This case assumes imports from Bolivia would continue beyond 1992 but does not include possible exports to either Brazil or Chile.
2. This case includes present exports to Argentina but not to Brazil.
3. This case assumes equal volumes of exports to Argentina and Brazil.
4. This level of life of reserves is not considered adequate by industry standards.
5. Does not include Camisea gas field.
6. Includes Camisea reserves.
7. Methanol exports included.

TABLE 5. Natural Gas Supply Requirements, Reserves Level and Life

much higher than is projected in this paper if the incentives (see Section IV) they receive are improved. The projected supply includes gas which is flared, reinjected or used in petroleum production and refineries. As shown in Table 5, in 2000 the average reserve life for all the countries would be 43 years. The reserve life will still be very high only in Chile, Peru, Venezuela and Mexico and these countries should, in addition to maximizing internal use of gas, evaluate other options such as exports. On the other hand, Brazil and Colombia may find their reserve life is very short. It will behoove them to increase incentives

to develop natural gas and to consider imports. However, in light of the huge potential market in LAC countries (Table 4), and the strong likelihood that natural gas use will be expanded, all of the countries should develop a strategy to expand their natural gas reserves to maintain a life of at least 20 years by encouraging investment by the private sector.

MAJOR ISSUES FACING THE NATURAL GAS SECTOR

- O NATURAL GAS ROLE IN THE VARIOUS COUNTRY ENERGY POLICIES IS NOT CLEAR**
 - O PRODUCTION AND OTHER UPSTREAM OPERATIONS RESEMBLE THE PETROLEUM SECTOR BUT TRANSMISSION AND DISTRIBUTION ARE PUBLIC UTILITY ACTIVITIES SO THE LEGAL STATUS IS POORLY DEFINED;**
 - O POTENTIAL ROLE IN MEETING COUNTRY'S ENERGY NEEDS NOT USUALLY WELL APPRECIATED;**
 - O NATURAL GAS ROLE IN INTERREGIONAL TRADE NOT PROPERLY ASSESSED;**
 - O ROLE OF THE PRIVATE SECTOR IS NOT CLEARLY DEFINED;**
 - O PETROLEUM LAW AND CONTRACTS OFTEN DO NOT SPECIFY TERMS AND CONDITIONS FOR NATURAL GAS DEVELOPMENT;**
 - O PRICING OF NATURAL GAS IN RELATION TO COMPETING FUELS AND ELECTRICITY IS NOT PREDICTABLE;**
 - O REGULATORY AGENCIES LACK LEGAL FOUNDATION AND TECHNICAL CAPACITY TO MONITOR CONTRACTS AND PUBLIC SAFETY AND ENVIRONMENTAL STANDARDS.**
 - O PUBLIC SECTOR ENTERPRISES LACK TECHNICAL, ADMINISTRATIVE AND FINANCIAL AUTONOMY;**
 - O PUBLIC SECTOR ENTERPRISES LACK FLEXIBILITY TO ENTER JOINT VENTURES WITH PRIVATE SECTOR COMPANIES OR SELL SHARES TO THE PUBLIC.**
-

IV. ISSUES WHICH HAVE CONSTRAINED THE NATURAL GAS SECTOR DEVELOPMENT

Government View of Natural Gas In Energy Sector Planning

4.1 In LAC the natural gas sector has traditionally been treated as an adjunct to the oil sector because natural gas is produced either in association with oil (associated gas) or separately as free (non-associated) gas. While upstream operations such as exploration, production and processing are similar to oil operations and have a similar legal and contractual framework, downstream operations such as transportation and distribution to consumers, are much more like utility operations in the power sector. In particular, transportation and distribution imply common carrier utility-type regulations under terms of a concession (franchise) to provide natural gas services to consumers in a geographically defined area.

4.2 In LAC natural gas is, except for the Bolivian exports to Argentina, a non-tradeable commodity much like electricity, and sector development is principally driven by local consumers' demand. However, natural gas competes with practically all other forms of energy, including electricity. Even in the transport sector compressed natural gas (CNG) competes with gasoline and diesel. Because of these complex interrelationships with other energy sources, the natural gas sector does not appear to have a well defined status in most Latin American countries. It is generally dealt with as a subsector of the petroleum sector and is not integrated into the national energy plans as a separate sector, such as electricity.

4.3 The policy objective of a rational energy strategy is to promote the provision of the least cost and reliable energy supply for the country. Given its low economic cost in most LAC countries, natural gas should play a well defined and important role in this strategy. The development of natural gas resources promotes diversification of the energy sources and reduces the country's dependence on oil products. However, most countries have failed to internalize all economic, social and environmental costs of competing energy sources and have not taken into account the true cost of capital required for competing projects. The energy strategy is usually not explicit about the role of natural gas in meeting the country's energy needs and does not incorporate the policies which will encourage private investment in the sector.

Legal and Contractual Constraints

4.4 Petroleum legislation and risk contracts generally treat natural gas as crude oil. But, as there often is no developed market for the gas, the terms and conditions under which natural gas would be developed and produced are not specifically defined. As a result, risk petroleum contracts do not include provisions for natural gas pricing and marketing. They are usually left to be negotiated after gas is discovered but in the meantime the local natural gas market is not being developed because the reserves have not been developed. In addition the risk exploration/production contracts do not include provisions for the downstream activities including transport, export and marketing of natural gas.

4.5 On the other hand, even if the contract does specify a natural gas price at the wellhead or the city gate, it may not provide the investors a return on investments commensurate with the risks they have taken. Finally, and equally importantly, since natural gas is a non-tradeable commodity, international private investors may not have an incentive to develop gas reserves for the local market if the legislation does not allow for some direct or indirect convertibility of revenues into foreign exchange. In some countries (Brazil, Mexico and Venezuela), the private sector is restricted from having any role in natural gas development.

Regulatory Constraints

4.6 The Government's control over the pricing policy for petroleum products, coal and electricity has had the greatest impact in slowing natural gas penetration in the energy markets. The prices for these fuels which are competitive with natural gas, are usually subsidized and as a result the netback value of NG at the wellhead may be well below its economic cost. This is also generally true for consumers' natural gas prices which may be below both the opportunity value of competing fuels in a gas short country and the long run marginal cost of natural gas in a gas surplus country. In Venezuela, the industrial consumer paid the equivalent of \$1.38/BBL for natural gas; in Brazil, \$1.92/BBL; and in Colombia, \$3.84/BBL, far below world prices in January 1990. Industrial fuel prices are listed in Annex 1.

4.7 Some countries have partially deregulated natural gas and petroleum product prices in order to stimulate competition. However, in several LAC countries petroleum product prices

remain below international prices and the price structure is highly distorted. Electricity tariffs also are often set well below the long run marginal cost. Long term price stability is essential to attract private investment to the public utility sector but investors cannot predict, with any degree of certainty, what prices and tariffs the Government may put in place. As a result they cannot plan their long term investments in the natural gas sector. Bureaucratic delays and "red tape" often delay government approval of price increases. This "regulatory lag", particularly in an inflationary economies, erodes the financial viability of regulated public utilities thus creating another disincentive for private investment.

4.8 In those countries where natural gas transmission pipelines exist, common carrier regulations setting rules for access, conditions of service and transportation charges have not been established. In addition, the regulating agency does not properly monitor the investors' performance in meeting public service obligations and adhering to design and construction standards, public safety rules and environmental guidelines.

Institutional Constraints

4.9 The existing institutional structure is generally inadequate to encourage development of natural gas or to allocate properly the limited institutional resources which are available for that purpose. In some cases responsibility for the natural gas sector may be divided among several agencies so the same agency is not responsible for both policy making and regulation. In this case the role of each must be clearly defined and adequate resources provided for both functions. In

addition to being the policy maker and regulator, the Government may also be the sole shareholder in the public gas company. This raises the potential for conflicts of interest and the need for an independent regulatory body is heightened. In addition to the lack of defined responsibilities, Government institutions also suffer from a lack of an appropriate organization to deal with the sector and a shortage of qualified staff to carry out the policy planning and regulatory functions. The roles the Government could play are discussed in Section VI.

4.10 In addition to the inadequate institutional structure, there is overlapping of responsibilities since the public sector enterprise may also perform duties which should be handled by the Government. For example the public enterprises may be promoting exploration to the private sector; negotiating risk contracts; and monitoring private contractor's performance contracts. They may also regulate design and construction of gas processing installations, pipelines and distribution networks.

Public Sector Enterprise Lack of Autonomy and Accountability

4.11 If the Government acts as policy maker, regulator and shareholder of a publicly owned gas enterprise, the latter operates with severe limits on its autonomy. The labor laws deny the gas enterprise the administrative autonomy to fix salaries or to hire and fire employees. Energy pricing policies which set consumer prices below the economic value of natural gas erodes the financial viability of the company. Financing plans, dividend policies and capital structure must be approved by other government agencies so the enterprise lacks

financial autonomy. There is no guarantee that the enterprise would receive a rate of return which would allow it to internally finance a large share of its investments, thus increasing the power of the treasury to control growth. This lack of autonomy, with all the risks inherent in political control of an enterprise, when coupled with the normal business risks and uncertainty of oil prices leads to capital premiums and, ultimately to higher consumer prices.

4.12 A number of other legal or policy requirements may impinge on the public enterprise's autonomy. It may be required to subsidize local industries or provide natural gas to other state agencies at less than the opportunity cost. There are no performance targets by which the principal shareholder (the government) can judge the performance of the public enterprise. The public entity may not be able to enter into joint ventures with private sector companies or sell shares to the public.

Lack of an Effective Planning Structure for Natural Gas

4.13 The institutional structure of the energy sector in most IAC countries has evolved to meet national needs. The government involvement in each sub-sector has developed independently because interactions between them were very limited. As a result, the electricity and petroleum sectors have received most of the attention but few countries have established a clear-cut assignment of responsibility for natural gas development and utilization. Historically natural gas has been treated as a by-product of crude oil production and governments have been willing to delegate all

responsibilities for its development to the national oil company. Unfortunately, the national oil company policies are usually established by petroleum-oriented managers who consider natural gas only as a means of maximizing oil production and once their needs are met, natural gas development becomes a drain on their limited capital which could generate a higher rate of crude oil production, though at lower rates of return. Many national petroleum companies in LAC countries -- and other parts of the world -- have not always been as diligent as they might in optimizing economically natural gas use, and massive volumes have been flared and wasted.

4.14 Planning for crude oil is relatively simple: produce as much as possible and sell at world market prices. Because of oil's impact on the national economy responsibility for sector development was centralized at the highest government level. On the other hand it is more difficult to plan natural gas development. If gas and its derived products, could be exported, natural gas would be commercially equivalent to crude oil, except there is no world market price and no OPEC production quotas. So long as the market is assured and the project is economically viable, the gas should be produced and exported. On the other hand, if the gas is to be sold in the internal market, an integrated supply and demand program, often involving several Government ministries as well as provincial and local governments, must be developed.

4.15 The institutional structure of the natural gas sub-sector must be geared to deal with all aspects of production, transportation and marketing. This entails a three pronged approach to provide the legal

and technical underpinning for an effective system.

- o Legislation. The hydrocarbon laws which were adopted by many of the LAC countries in the 1970s gave little, if any, attention to natural gas. Specific natural gas legislation is required to define the legal basis for regulation of production and pricing; the scope of responsibilities of government agencies; and the interrelationship with other energy and commercial laws.
- o Regulation. The legislation must be implemented in a set of regulations which will be used by the responsible government authorities to establish rules for production and transportation; for price and tariff regulation; and rules for quality of service and protection of the public health and safety.
- o Operating standards. Operating companies must establish engineering standards for building and operating pipelines and other facilities.

Political Uncertainties

4.16 Price stability is a keystone for the healthy development of public utilities such as electric power and natural gas distribution companies. The highly leveraged debt/equity ratios and low financing costs which are characteristic of public utilities can be maintained only if investors can have reasonable assurance that debt service ratios will be met and financial integrity will be sustained. But prices are more often set on the basis of political, rather than economic,

considerations. This results in misallocation of resources, cross-subsidization and abrupt price changes when government policies -- or governments -- change.

4.17 High inflation coupled with inadequate pricing policies has severely eroded utility earnings and investor confidence. Price indexing, asset revaluation and other techniques which are intended to offset inflation have been considered but none has been completely effective in maintaining investor confidence.

4.18 The pricing structure can be somewhat insulated from the political arena by placing responsibility for tariffs with an independent regulatory agency which sets tariffs on the basis of economic principles. Wellhead gas prices may conceivably be vulnerable to political influences but the downstream investor could be protected by "purchased gas adjustment clauses" or other provisions to pass-on higher wellhead prices to the end user.

Interregional Trade

4.19 In terms of the development of a natural gas market, Latin America is about the stage Europe was 30 years ago: very large potential markets for natural gas in Argentina, Brazil, Venezuela and Mexico, and strategically well located natural gas reserves in countries such as Argentina, Bolivia, Peru, Venezuela and Colombia. In addition, the USA will remain well into the twenty first century a large potential market⁷ for natural gas. LAC are becoming more and more conscious of the need to think "more regionally" in terms of their energy needs. Already several binational projects exist in petroleum and electricity production. Bolivia has a proven

track record in exporting natural gas to Argentina for the last 13 years with another 12 years before contract expiration and is also finalizing an arrangement to export gas based electricity to Brazil in 1992. Interregional natural gas trade has been slow to materialize in the most promising southern cone area (Table 4) represented by the most important natural gas market in Brazil and to a smaller extent by Uruguay and Chile (Santiago) and large reserves in Bolivia and Argentina which could be delivered economically to those markets. In addition to the major issues facing the development of natural gas in each LAC country discussed above, the major obstacle to a rapid expansion of natural gas trade in the region has been the basic conflict between fuel import substitution policies followed until recently by all countries in the region and trade liberalization policies that would promote a more regional oriented energy policy approach by the various countries. In addition transmission of gas over long distances requires large volumes and rapid build-up, calling for integrated demand and supply planning. The Bank has a very important role to play as a catalyst for interregional gas trade projects. Already the Bank has been involved in the Bolivia-Argentina natural gas pipeline and the pipeline/power project between Bolivia and Brazil. The following table lists one probable scenario for interregional gas trade (Million m³/year) in the southern cone countries by the year 2000:

<u>Importers</u>	<u>Exporters</u>		
	<u>Argentina</u>	<u>Bolivia</u>	<u>Total</u>
Argentina	---	2200	2200
Brazil	1100	1100	2200
Chile	365	---	365
Uruguay	365	---	365
Total	<u>1830</u>	<u>3300</u>	<u>5130</u>

The southern cone countries will thus constitute the most dynamic natural gas market in the next 20 years; but in the long term, the giant Peruvian natural gas reserves would be tapped to supplement the Brazilian natural gas market requirements as well as exports in the form of LNG to the USA. The Venezuelan enormous gas reserves would underpin a major development of the local natural gas

market and exports to Colombia but also justify an LNG export project oriented to the US market. Already Venezuela is searching for private partners for this scheme despite that it would require an amendment of the present legislation to allow involvement of foreign partners (Maps). Finally, Central American countries could be supplied by both an LNG based scheme (possibly connected with that planned by Venezuela) but also through a pipeline system connecting Mexico to the north and Colombia with Venezuela to the south. The Central American LNG supply scheme would not be unrealistic in light of similar schemes already in place between Algeria (LNG exporter) and countries with no gas infrastructure such as Greece, Turkey and Portugal.

V. MACROECONOMIC BENEFITS OF NATURAL GAS USE

Macroeconomic Benefits of Increasing Natural Gas Use

5.1 The macroeconomic impact of increasing natural gas supplies is very important. First, there is the improvement in the balance of trade for an oil importing country from substituting higher-cost fuel imports by cheaper domestic natural gas, and for an oil exporting country from releasing for exports high priced oil products from the substitution by cheaper natural gas. Second, distribution of natural gas increases the potential for private sector participation, increasing the overall investment level and reduces strains on public finances. The investment needed to build the delivery facilities would increase public debt, unless private capital is attracted. Third, natural gas increases public sector revenue, because the long run marginal cost of natural gas is lower than the opportunity costs of the substitute fuels. Fourth, natural gas contributes to the diversification of the energy economy, reducing the dependency risk of a sudden curtailment of supplies and of sudden international price changes. The macroeconomic effects of increased natural gas use on two natural gas producing countries, Colombia and Argentina, and one country which could import natural gas, Uruguay, have been assessed in detail under the following Bank crude oil price (US\$ 1987 per BBL) scenario: 13.1 (1988), 14.7 (1989), 16.0 (1990), 16.4 (1991), 16.8 (1992), 17.1 (1993), 17.3 (1994), 17.5 (1995), and 21.0 (2000).⁸

Argentina

5.2 Two different pricing scenarios were considered in the analysis. Under the first, the subsidized price scenario, it was assumed that the price structure of 1987 for different energy forms would be retained. That is, the prices would be kept at levels lower than international. Under the second scenario, the efficient prices scenario, prices would gradually be adjusted to international levels. Under the subsidized prices scenario the overall cost of energy to the economy during the 1987-2000 period would be reduced by approximately \$900 million (1987 \$) and \$680 million under the efficient price scenario compared with a baseline scenario assuming no investments are made in gas development during the period. The savings would derive from the lower cost of locally produced natural gas as compared to the cost of the fuels it replaced. Gas infrastructure development would require investing \$1.6 billion under the efficient price scenario during the 1987-2000 period. Assuming that US\$1.4 billion would be public sector expenditures, taxes could be increased and the public sector budget could be improved by about \$450 million. Assuming that 15% of the investments would be externally financed, Argentina's external debt would increase from US\$ 238 million under the efficient price scenario to US\$ 382 million under the subsidized price scenario during the period. The impact on the balance of trade would be positive under either scenario because the petroleum products which would be replaced by natural gas would be exported. Under the

subsidized scenario the balance of trade would improve by \$130 million but under the efficient price scenario it would improve by \$530 million over the period.

Colombia

5.3 In view of the more limited potential for natural gas development, unless additional gas reserves are proved up, the macroeconomic benefits are limited. The benefits were evaluated for a limited development strategy which would provide for limited additional investment in the sector. The cost of energy for the economy for the 1987-2000 period would be reduced by about \$135 million compared to a baseline scenario assuming no further investments in gas development, due to the lower cost of natural gas as compared to the cost of the fuels it replaced. The sector investment was estimated to be \$980 million. Assuming that US\$ 830 million would be public, the budget deficit would increase significantly given the limited margin for increasing taxes. On the other hand, external debt would increase by US\$ 150 million under the assumption that 15% of investment would be externally financed. However, since private investors already participate in the sector, a portion of the capital may be provided by them, substituting for public capital. The trade balance would be favorably impacted by the increased export of petroleum products which natural gas would replace generating an additional \$280 million over the period.

Uruguay

5.4 Uruguay is a potential natural gas importer. The macroeconomic benefits would accrue from replacing more expensive imported petroleum products or indigenous biomass fuels

with cheaper natural gas. The macroeconomic effects under the same two scenarios were estimated. Under the first, "High" scenario, imported natural gas would replace both fuel oil and biomass (largely firewood) as an industrial fuel. Under the second (Low) scenario it would replace only fuel oil. Under the High scenario the natural gas imported over the 1992 - 2000 period would cost \$155 million while the fuels it replaced would have cost \$215 million i.e., cost savings of US\$ 60 million. Under the Low scenario natural gas imports would be lower and the cost savings would be about US\$ 20 million. It was assumed the project could be externally financed to the level of 70%, so there would be a public sector debt increase of \$80 million under the High scenario and \$70 million under the Low scenario.

Natural Gas Pricing Policies Affect Benefits

5.5 As previously discussed (para. 4.4), private investors are reluctant to invest in gas exploration or development because in most LAC countries neither the risk contracts nor the hydrocarbon legislation specify how the wellhead price for natural gas will be determined. Therefore the producer has no basis to assess the potential economic return. Even in countries where pricing formulas have been tried they have often proved counterproductive and actually been a disincentive for drilling. For example, in Colombia the field price is indexed to the export price of fuel oil but without reflecting the real economic value of gas. When fuel oil prices were high in the early 1980s private companies were eager to invest in exploration in gas prone provinces. However, prices now (before the Gulf crisis) do not reflect the economic value of gas,

have not attracted new investors and the gas provinces are not being developed. A similar problem occurred in Argentina where, at one time, the price of gas was set as low as 14% of the crude oil price. The negotiated price approach has been used in Brazil to set a reasonable price for gas after it was discovered in the search for oil.

5.6 Subsidization of alternative fuels has also been a strong deterrent to natural gas development. In the early 1980s retail energy prices were heavily subsidized in most countries. Declining oil prices in the mid 1980's mitigated subsidies to some extent but they still exist in several countries. The prices of electricity and LPG, fuels which compete directly with natural gas in

the residential market, continue to be subsidized on the grounds that they provide a social benefit to low income consumers. This leads to the economically absurd situation of a country paying hard currency for imported LPG which it sells at less than the CIF price. It is difficult for natural gas to compete with subsidized fuels unless it also is subsidized. The economic cost of distributing natural gas exceeds the delivered price of subsidized LPG and consumers have no incentive to switch to natural gas, particularly if they must pay an initial connection charge for the service.

VI. STRATEGIC OPTIONS FOR NATURAL GAS SECTOR DEVELOPMENT

Elements of a Sound Policy

6.1 The key components of a sound national energy policy have been presented in many Bank papers and other publications but few have addressed the role that natural gas could play and the manner in which the policy should integrate the natural gas sector. As previously discussed, natural gas has generally been treated as a petroleum by-product. However, natural gas is to be developed to maximize national benefits, the Government agencies responsibilities must be clearly defined. The specific functions of the Government are discussed below.

6.2 Development policies for natural gas must be founded on sound technical and economic criteria. The policies should be supported by adequate information and statistical services to monitor the effect of policies on the sector and the national economy. The policies should recognize the need for an economic regulatory structure. The regulatory agency must have a solid legal foundation and a clearly stated mission with the scope of its responsibilities defined within the legislation.

Government Role in Developing Energy Policies

6.3 The Government's energy plan should aim at establishing an environment of open competition and equal opportunity in all aspects of exploration, production, transportation and marketing of natural gas, while ensuring that the national interest is protected with a minimum of regulations and controls. The Government should limit its role

to setting the general parameters for the rational development of the sector and regulating its operation. Some state enterprises would yield to the Government the current regulatory duties they now perform. The Government should retain its role as policy maker and regulator and strengthen the Government agency responsible for the sector by establishing a strong legal foundation and providing adequate human, financial and logistical resources.

6.4 The Government policy decisions should be limited to :

- o Developing a national energy strategy which fully considers the economic, social and environmental benefits of natural gas, and the advantages of competition and private sector participation.
- o Setting the legal regulatory requirements for public enterprises based on commercial criteria.
- o Promoting exploration/production, transmission and distribution activities by private concerns, and negotiating risk contracts with these entities.
- o Establishing reasonable ad-valorem taxes on petroleum products and natural gas to capture a share of the economic rent and encourage energy conservation, while maintaining incentives.

6.5 The Government should recognize the significant differences between

oil and gas activities which require it to include specific and detailed provisions for natural gas development in the petroleum risk contracts with private companies. The contracts should provide:

- o Private companies to freely dispose of a share of gas production for export;
- o Adequate guidelines for pricing exports of natural gas;
- o The basis for pricing natural gas delivered at the city gate, considering prices of substitute fuels in areas with established gas markets;
- o Concrete criteria for market-price determination in areas with no previous gas markets and a potential demand, to offer attractive return for developing domestic reserves.

6.6 Finally the Government should use the fiscal system to collect part of the economic rent as income tax since this approach provides more incentives to the private company to invest than high royalties which are skimmed off the top of the private companies gross revenues.

Government Regulatory Role

6.7 The Government regulatory role in the natural gas sector would consist of:

- o Monitoring implementation of natural gas regulations relating to conditions of service;
- o Approving tariffs for the sale of natural gas to residential, commercial, industrial, transportation and electric power generation consumers;

- o Regulating access to transmission pipelines and transportation tariffs;
- o Monitoring compliance of all companies, including public sector enterprises, with their risk contracts commitments;
- o Reach an agreement with the state enterprise on performance targets which would reflect profitability and productivity, i.e. measure the real performance on the basis of the parameters under the state enterprise's control; and periodically evaluate and reward/penalize performance of the state enterprise based on the meeting of agreed performance targets; and
- o Issuing and enforcing standards for the design and construction of oil and gas installations and pipelines to ensure safety and environmental protection from hydrocarbon related activities.

Government Role as a Shareholder of Gas Companies

6.8 The public sector enterprises should have full technical, administrative and financial autonomy, thus limiting the role of the Government to that of a shareholder ensuring accountability. In this capacity, the Government would:

- o Appoint qualified public and private representatives to a board of directors which would include members with the experience and stature needed for the job.

6.9 State sector enterprises should be encouraged to enter into joint

ventures with private companies, sell stock to private shareholders in the stock market, and act only as a last resource, when no acceptable private sector options exist.

Private Sector Role

6.10 Production agreements with private companies to develop and market natural gas should provide the private investor:

- o The right to sell gas to third parties;
- o The right to build pipelines under conditions specified in the production agreement;
- o A clear definition of what constitutes gas reserves for domestic requirements and gas reserves for exports.
- o Guidelines on free disposal of gas production and pricing (para.6.5).

6.11 A clear definition of what constitutes a commercial gas discovery should be provided to the private company. It should also be allowed sufficient time to appraise the discovery and the markets and time to construct the transportation and distribution facilities. The time before reversion should be longer than for an oil discovery in order to make it possible to earn a reasonable return on investment.

6.12 The private company should be able to negotiate the inclusion of special contractual terms that encourage development of marginal but economically attractive gas fields.

Options for Financing Sector Development

6.13 In the past much of the sector financing was obtained from government sources. Restrictions on oil and gas development contracts discouraged private investors and there was no incentive for private investors to put money into downstream operations. There are some indications this may be changing to some extent. The new policies in Argentina and Colombia are designed to expand private participation in upstream activities. However, the downstream activities are still largely financed by the public sector.

6.14 If government-owned companies continue to own and operate the downstream pipelines and distribution networks, the investment funds will have to come from public sector financing. The company can generate investment funds internally only if its tariffs are properly structured. It must avoid the pitfalls of the electric utility industry which has been forced to sell electricity at less than cost and then rely on government funds for expansion (sometimes even for operations).

6.15 The private sector may be encouraged to invest in gas if the incentive framework, particularly prices, is adequate and the appropriate investment tools are available. However, a number of problems must be recognized by the government when establishing rules for private investment. These are discussed below and some specific proposals to promote private sector participation as a partner and as a cofinancier of natural gas development and distribution projects are presented in this section.

Convertibility of Local Currency Earnings

6.16 With few exceptions around the world, when natural gas is discovered

by a privately owned international oil and gas company it is destined for the local market. If the local market is well established -- the only established markets in the LAC countries are in Argentina, Colombia, Venezuela and Mexico--the company will be paid for the gas in local currency. If the company cannot repatriate its profits as hard currency it has little incentive to make further hard currency investments. The Government could agree to pay for the gas at the wellhead in hard currency at a price equal to the netback value, that is the opportunity value minus delivery costs, of the fuels the gas would displace. This is the case in Brazil where Petrobras pays Shell Pecten the equivalent of fuel oil prices based on Rotterdam prices. There are similar pricing arrangements in Colombia and Argentina where prices have been negotiated but not necessarily based on the price of substitutable fuels.

Payments in Crude or Fuel Oil or Barter

6.17 When foreign exchange markets are not freed, a possible solution to the hard currency shortages would be for the producer to receive payment for the gas in the form of crude oil or fuel oil which is displaced by the use of gas and which could be exported at world prices. Of course, this would be feasible only in countries which are net petroleum exporters. Even in exporting countries this approach should be used with caution. There is always the risk that a country could become an importer within the contract period. Barter arrangements might be useful, but certainly not as attractive to investors. In Bolivia, international oil companies have accepted oil field materials and equipment produced in a neighboring country as payment for oil and gas

which they delivered to the Government. These materials were in turn exported by the private companies who were paid in hard currency. Similar innovative barter deals involving exportable commodities could be found on a case-by-case basis. These are however qualitatively inferior to hard currency and oil products payments.

6.18 Payment for the gas with natural gas liquids (NGLs) extracted from the gas is also feasible. Most of the natural gas produced in LAC contains economically recoverable quantities of hydrocarbon liquids, mainly LPG and condensates. The Government could authorize the investor to export some or all of those liquids as a form of payment for the gas delivered to the local market. International oil and gas companies have made such proposals to the governments of Bolivia and Argentina. As an added incentive they also offered the option of financing gas-fueled electric generating stations which would be amortized through the export and sale of natural gas liquids.

Joint-Ventures

6.19 Private international companies have expressed some interest in participating in downstream activities such as trunk gas pipeline transmission and urban distribution networks. In Colombia a consortium of local private companies, including the gas producer, has suggested joining with the government-owned oil company to finance and build the north-south gas pipeline. In Argentina a foreign company built and operated a major gas transmission pipeline for a number of years. However, foreign investment is often tied to use of goods manufactured in the country which provides the financing. Many of the gas user

countries can manufacture high-pressure transmission line pipe as well as pipe suitable for urban networks, and some local manufacturers have shown an interest in participating in the construction and operations of the gas transmission and distribution system. On the other hand, compressors which constitute the second largest cost component, are usually imported. Consequently, the tendency in LAC is to have local companies involved in the construction and operation of transmission and distribution systems, sometimes in a joint venture arrangement with international groups.

6.20 The joint venture concept offers many advantages to both the Government and the foreign companies. The Government partner would bring the know-how in the local conditions for construction, operation and the finance of its share of the project. This would streamline project management and speed project completion. Ultimately it would lead to more efficient operations. The private partner would bring outside expertise and private capital thereby improving efficiency and reducing the public sector investment and debt. The primary question in this type of venture is whether the share of the economic rent the Government allows the private partner to retain will provide a sufficient incentive to participate. Equally importantly, is the economic rent sufficient to provide both the Government and the partner a reasonable return on their investment? In these types of ventures, the private participant probably will require a guaranteed gas purchase price for part or all of the contract period. The World Bank could play an important role not only by providing cofinancing and attracting others to cofinance but also as a catalyst for the private

sector involvement. It is important to note that there is an opportunity to develop many types of Government/private partner arrangements. Given the nature of regional projects to be considered, specific arrangements could be developed taking into account the needs for financing; the extent of Government participation; the impact of the project on the country's macroeconomy; the expected rate of return; and foreign investors' requirements.

6.21 Liquefied natural gas (LNG) projects provide opportunities for private sector participation. Their main benefit is the generation of hard currency. LNG projects, however, require multi-billion dollar investments in field development, processing, transmission and liquefaction plus the cost of LNG tankers. LNG projects are technically complex and require the experience and know-how of the international oil companies as well as their capital. They are not generally highly profitable. These projects would require financing from bilateral and multilateral agencies as well as commercial banks. In certain cases when requested by the project partners, the Bank could play an important role as a facilitator and cofinancier in these projects: In some LAC countries; e.g. in Venezuela and Trinidad and Tobago in the short term and Peru in the longer term.

Advance Purchase Contracts

6.22 Advance purchase contract financing is well suited to natural gas field development. Investors guarantee long term sales of natural gas and/or natural gas liquids to consumers in return for a future payments. A down-payment is included to help finance the drilling and

field development costs. This type of arrangement was proposed in 1983 by a group of French banks against oil to be recovered from a secondary oil recovery project in Peru. The French oil company, Total, would have provided the technical guarantee by managing directly the operations on behalf of the Petroperu, the national Peruvian oil company.

Public Debt Purchase by Private Investors

6.23 This method of attracting private investment would be available in countries where natural gas activities are mainly controlled by the government-owned companies. Private investors would purchase the public debt and gain an equity position through a debt for equity swap.

Sales of Shares of Gas Utilities to the Public

6.24 Since transportation and distribution of natural gas are public service activities closely akin to activities of electric utilities there is a large scope for equity ownership of the gas companies by the general public. The Government should foster a climate of investor confidence. First, if a Government-owned company has a monopoly on gas supply, it should open-up the sector for private sector participation, while securing the long term availability of natural gas at commercial prices. If the gas supply is not monopolized by the government, the government should encourage further development by the private sector. Investors must be assured of an opportunity to earn a reasonable rate of return on its fixed assets if the public is to have confidence in the financial viability of these companies.

Limited and Non-recourse Financing

6.25 Non-recourse financing can be effective in financing a well-defined project such as an LNG export scheme. As described in OMS 3.82, the potential for non-recourse financing depends on whether the project can be structured to protect its cash flow adequately, e.g., through the use of sales contracts, throughput agreements and/or trust accounts; to minimize the risk of non-performance through the presence of an experienced and reliable operator and contractor; and whether an environment exists or can be created in which political and convertibility risks are deemed acceptable. Financing natural gas projects "off balance sheet" with exportable liquid products can make them attractive to investors and governments which cannot mobilize private financial resources on the basis of their own credit standing, but may be able to do so for enclave projects. Such an arrangement has been proposed to finance the Bolivia-Brazil gas pipeline/power project. The Bank is considering financing a portion of the cost.

End Users Participation

6.26 End users such as power generation companies, petrochemical manufacturers, industry or residential users cooperatives could purchase natural gas at the wellhead and build, or partially finance, the transmission pipeline required. While this possibility has been considered in Argentina, it raises legal questions about its feasibility when a Government-owned entity has a monopoly on gas transport. This type of arrangement also raises policy questions about guaranteeing gas reserves to fulfill the long term contract.

IMPORTANCE OF GAS SECTOR IN BANK COUNTRY STRATEGY

BANK INVOLVEMENT IN THE NATURAL GAS SECTOR SHOULD SUPPORT THE MAJOR POLICY OBJECTIVES IN THE REGION;

- (I) EFFICIENT USE OF RESOURCES: NATURAL GAS IS GENERALLY A LOW ECONOMIC COST ENERGY SOURCE WHICH CAN DISPLACE EXPORTABLE FUELS OR GENERATE IMPORT SAVINGS WITH A POSITIVE IMPACT ON PUBLIC SECTOR INVESTMENTS, DEFICIT AND DEBT; REDUCES INVESTMENT REQUIREMENTS OF POWER SECTOR WHEN USED AS A PRIMARY ENERGY SOURCE.**
 - (II) PROMOTION OF EXPORTS: NATURAL GAS COULD BE DIRECTLY EXPORTED AS LIQUEFIED NATURAL GAS (LNG) OR AS A GAS AND ALSO INDIRECTLY EXPORTED IN THE FORM OF FERTILIZERS AND PETROCHEMICALS. DEPENDING ON ITS COMPOSITION, IN SOME COUNTRIES PRODUCTION OF NATURAL GAS IS ACCOMPANIED BY HIGH VALUE EXPORTABLE PETROLEUM LIQUIDS SUCH AS CONDENSATE AND LPG;**
 - (III) MACROECONOMIC ADJUSTMENT: THE NATURAL GAS SECTOR PROVIDES OPPORTUNITIES TO PROMOTE TRADE LIBERALIZATION THROUGH EXPORTS OF GAS AND DERIVED PRODUCTS BY BOTH PRIVATE AND PUBLIC ENTITIES AND ENCOURAGES THE COUNTRIES TO ELIMINATE TRADE BARRIERS AND PROTECTION OF LOCAL INDUSTRIES SUPPLYING EQUIPMENTS, MATERIALS AND SERVICES; AND**
 - (IV) ENVIRONMENTAL IMPROVEMENT: NATURAL GAS IS A CLEAN BURNING FUEL WHICH IS HIGHLY CONVENIENT AND ECONOMIC FOR RESIDENTIAL COMMERCIAL AND INDUSTRIAL USERS DISPLACING MORE POLLUTING FUELS SUCH AS HIGH-SULPHUR OIL AND COAL. IT IS A VERY EFFICIENT FUEL FOR POWER GENERATION.**
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VII. A PROPOSED STRATEGY FOR THE BANK

Bank Activities in the LAC Natural Gas Sector

7.1 The Bank has only recently become involved in lending to the natural gas sector in LAC but it has participated in a number of energy studies. In the early 1980's the Bank, in cooperation with UNDP, carried out many energy assessment studies under the ESMAP program. In Latin America, the energy sectors in Bolivia, Chile, Colombia, Costa Rica, Ecuador, Haiti, Honduras, Jamaica, Paraguay, Peru, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago and more recently the Dominican Republic were analyzed. An energy strategy study in Guatemala is to be completed by ESMAP soon. In addition to the above studies, the LAC region will soon issue two important energy sector studies on Argentina and Brazil. Finally a trust fund financed gas market study was carried out in Peru. No energy sector reviews are currently available for Mexico, Venezuela and Uruguay. Unfortunately, except for the Argentina and Brazil studies, none analyzed natural gas markets potential, reserves, production, transportation and distribution in any depth. The very important issues of sector investment programs, the long run marginal cost of gas and its netback value for different uses, the institutional and regulatory framework, pricing policies, the need for restructuring of public enterprises and private sector involvement in the sector received scant attention.

7.2 As part of its ongoing lending operations, the Bank is financing a Gas Utilization and Technical Assistance project in Argentina; a Gas Recycling Project (Vuelta Grande) in Bolivia; a Natural Gas Distribution Project in the State of

Sao Paulo, Brazil and is preparing two major projects: one, a major Gas Pipeline and Power Generation Project in Bolivia and the other, an Energy Transportation Project in Brazil. These projects involve investments upstream (gathering and processing facilities) as well as downstream (transmission pipelines and distribution networks). These projects promote the expansion of natural gas supply; foster the implementation of an efficient pricing policy for petroleum fuels and natural gas; and promote an action program for the efficient use of energy. The projects also aim to improve the efficiency of the public sector energy enterprises by restructuring them and promoting private sector involvement.

Potential for Natural Gas Projects

7.3 There is a large potential market for natural gas in Latin America, principally in: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Trinidad and Tobago, Uruguay and Venezuela. If these potential markets are to be developed, a large number of projects will have to be undertaken to develop the gas and provide the delivery infrastructure. Potential projects include projects in exploration promotion to attract investments by the private sector, gas field development, gas pipeline transportation and distribution, gas-fueled electric power generation, compressed natural gas use as a fuel for road transportation, regional exports of natural gas and LNG exports. These projects offer a wide scope for policy dialogue with the above mentioned countries and a good base for a lending program in the gas sector.

A Proposed Bank Approach to Promote Natural Gas in LAC

7.4 In all energy sector studies carried out by the Bank natural gas should be treated in a similar manner to power, petroleum products and other sources of energy, receiving the same in-depth analyses, even in those countries which would have to import natural gas. The analyses should consider the resource base of natural gas and whether it is associated or non-associated gas. Non-associated gas can be developed and produced as long as it is economically feasible but the rate of development of associated gas is closely linked to the oil production rate. A special effort should be made to ascertain the potential resource base in light of the investment plans to explore and develop hydrocarbons.

7.5 Since natural gas competes with other energy sources in a wide variety of uses, market studies and demand forecast require specialized analytical methods and an iterative procedure. The long-term demand should be based on income and price variables, as well as the cross-elasticities with other fuels. Forecasts of substitute fuel prices should consider their relative long run marginal costs of supply. As previously pointed out, the cost of natural gas is usually less than the cost of the substitute fuels in the residential, commercial, industrial, power and transportation markets.

7.6 In assessing projects, the environmental benefits of natural gas should be explicitly evaluated. While it is difficult to quantify the air quality improvements in terms of health benefits and other social gains, they should not be neglected. Natural gas is clean-burning and power plant emissions can be significantly reduced. When natural

gas substitute for gasoline and diesel in the transport sector, tailpipe emissions are greatly reduced. In crowded urban centers such as Mexico City and Sao Paulo natural gas-powered transit buses could significantly cut pollution.

Bank Interactions with Host Governments

7.7 In several LAC countries, the planning ministries and other government agencies are not fully aware of the potential benefits of natural gas development. An initial step should be to make them aware of the role of natural gas and the importance of attracting the private sector, through dissemination of information and promotion of dialogue with potential private investors.

7.8 Government agencies should be encouraged to utilize the analytical tools and methods developed by the Bank and other organizations for the analyses of natural gas resources, markets and costs. The Gas Utilization Study methodology⁹ is a sound basis for initiating sector reviews. Based on these studies the government should establish a sector development program which determines provisions for private sector participation, identifies specific projects for exploration, development, transportation and marketing of natural gas.

7.9 The Bank could provide technical assistance to government agencies in organizing and implementing the appropriate institutional structure. The first requirement is to establish the legal foundation for regulation of the sector. As discussed in Section 4.4, the existing hydrocarbon law may not adequately address natural gas development, particularly the downstream activities and the laws governing issuance of franchises to

distribute gas in local regions may be required. A set of regulations for implementing the legislation will be needed. The staffing requirements and training needs for the staff responsible for sector planning and regulation must be defined.

Priorities for Bank Operations in the Gas Sector in the 1990s

7.10 Bank involvement in the natural gas sector should support its major policy objectives in the region. It could lead to more efficient use of resources, promotion of exports, improvement of trade balances, reduction of public debt and improvement of the environment.

7.11 The Bank can promote the rationalization of the energy market in LAC. Indigenous energy resources could be used more efficiently if the Bank promotes the provision of lower cost supplies of NG. Natural gas is a high quality fuel, along with electricity and LPG. It is clean and easy to use and is a fuel of choice for users. This means that the willingness to pay by users for natural gas should normally be higher than for petroleum fuels. Thus, even if the costs of natural gas and the competing fuels were the same, the benefits from expanding energy supply with natural gas would be greater than expanding it with alternative fuels (higher consumer surplus). If the lower economic costs of natural gas is considered the expansion of supply with natural gas would lead to savings. Furthermore, if rational energy pricing policies are in place, the lower economic cost of natural gas would be reflected in a lower end-user price for energy which would inter alia expand demand and provide the economy with larger consumer benefits.

7.12 Exports should be promoted when it is economically viable to do so.

Natural gas could be directly exported as LNG or natural gas, and indirectly exported in the form of fertilizers and petrochemicals, if these prospects are economically viable. Increased natural gas production could also increase the production of exportable high value liquids such as condensate and LPG.

7.13 The macroeconomics of the country would be improved. Trade relations would be liberalized through exports of natural gas and derived products; trade barriers would be reduced through development of regional projects; and special rules which protect inefficient local industries which supply equipment, materials and services to the natural gas industry would be eliminated.

7.14 Consequently, natural gas in the energy strategy in LAC is a resource to be seriously considered. The first step should be to pursue a wide ranging dialogue with the LAC Governments on the major issues which constrain its development.

Techniques and Instruments for Bank Assistance to LAC Countries

7.15 Energy sector studies can serve as the first step in establishing communications between the Bank and countries which have a potential to develop economically their natural gas sector. The energy sector work should follow the pattern set for the studies recently carried out in Argentina and Brazil which provided an in-depth analysis of issues in the gas sector and provided a broad range of recommendations. Issues to be considered should include the government policy involving trade, labor and taxation as well as the energy sector issues discussed in Section IV.

7.16 Energy sector studies in Mexico and Venezuela should be given

**PROPOSED BANK STRATEGY IN NATURAL GAS SECTOR
POLICY DIALOGUE THROUGH SECTOR WORK**

- o **ISSUES THAT SHOULD BE DISCUSSED WITH THE GOVERNMENT INCLUDE POLICY ON TRADE, LABOR LEGISLATION AND TAXATION.**
- o **ISSUES THAT SHOULD BE DISCUSSED WITHIN THE FRAMEWORK OF ENERGY SECTOR STUDIES INCLUDE POWER, NATURAL GAS, PETROLEUM AND OTHER FUELS LEGISLATION, PRICING POLICY, REGULATORY FUNCTIONS AND ORGANIZATION, INSTITUTIONAL SET UP AND ENVIRONMENT.**
- o **ENERGY SECTOR STUDIES IN MEXICO AND VENEZUELA MAY BE NEEDED.**
- o **ENERGY SECTOR STUDIES IN BOLIVIA, COLOMBIA, ECUADOR, PERU, TRINIDAD AND URUGUAY SHOULD BE UPDATED.**
- o **THE STUDIES SHOULD FOCUS ON SPECIFIC AREAS WHERE THE GOVERNMENTS NEED HELP: NATURAL GAS COST AND TARIFF STUDIES, COMMON CARRIER REGULATIONS, AMENDMENT TO PETROLEUM LEGISLATION, AMENDMENT TO INVESTMENT LEGISLATION FOR PROMOTION OF PRIVATE SECTOR, ORGANIZATION AND MANAGEMENT OF REGULATORY AGENCY.**

POLICY IMPLEMENTATION THROUGH BANK LOANS

- o **GAS SECTOR LOANS SHOULD INCLUDE CONDITIONS FOR DEREGULATION, LEGISLATION CHANGES FOR PROMOTING PRIVATE SECTOR INVESTMENTS, RESTRUCTURING OF PUBLIC ENTERPRISES, STRENGTHENING OF GOVERNMENT POLICY AND REGULATORY ROLE AND ENVIRONMENTAL POLICY.**
- o **PUBLIC SECTOR ENTERPRISE RESTRUCTURING OR ADJUSTMENT LOANS WOULD ALSO BE OTHER VEHICLES TO EFFECT THE ABOVE POLICY CHANGES.**
- o **NATURAL GAS SECTOR INVESTMENT LOANS SHOULD ENCOURAGE PARTICIPATION OF THE PRIVATE COMPANIES.**
- o **BANK LOANS THROUGH INNOVATIVE MECHANISMS TO SUPPORT EXPANSION OF PRIVATE SECTOR INVESTMENTS AND PERMANENCE OF GOVERNMENT POLICY REFORMS.**

POLICY SUPPORT THROUGH INFORMATION DISSEMINATION

- o **EXCHANGE IDEAS ON PROPOSED STRATEGY WITH STAFF OF THE DIFFERENT REGIONS OF THE BANK AND PRE.**
 - o **EXCHANGE EXPERIENCE WITH REGIONAL ORGANIZATIONS (ARPEL, OLADE) THROUGH CONFERENCES.**
 - o **DISSEMINATE INFORMATION ON THE NATURAL GAS SECTOR TO BORROWERS.**
 - o **COOPERATE WITH REGIONAL ORGANIZATIONS ON NATURAL GAS STUDIES.**
-

priority since the Bank has recently reestablished lending programs with Mexico in the power sector and has opened a dialogue with Venezuela relating to power sector development.

7.17 The Bank should also consider updating energy sector studies in countries where energy assessment studies have been carried out such as Bolivia, Chile, Colombia, Ecuador, Peru, Trinidad & Tobago and Uruguay. Particular attention should be given to natural gas.

7.18 The Bank should be prepared to assist the Governments in carrying out the specific studies which will have been identified and recommended by the energy sector studies. These may include natural gas marginal cost and tariff studies; preparation of common carrier regulations for gas transmission pipelines; development of organizational and staffing plans for the Government agency responsible for the natural gas sector.

7.19 The Bank lending program can be an appropriate mechanism to follow up the recommendations of the energy sector studies. Gas sector investment loans should be considered for certain countries to achieve policy changes in: (i) deregulation of the oil/gas sector including elimination of price controls on natural gas and competitive fuels, establishing a competitive market for crude oil and petroleum products, liberalizing trade and eliminating barriers to entry in the sector; (ii) petroleum legislation which would provide incentives to the private sector to invest in both upstream and downstream activities in the natural gas sector; (iii) legal framework under which the public enterprises in the oil/gas sector operate; (iv) the Government management of the oil/gas sector to strengthen its capacity as a policy maker and regulator; and (v) environment policy guidelines for oil and gas operations.

7.20 Public sector restructuring loans would also be an appropriate vehicle for initiating a dialogue on all of these issues. Since the Bank cannot undertake all issues under one operation, an appropriate strategy, which takes into account the comparative advantage of Bank financing vehicles, must be devised for each country.

7.21 There are numerous projects in Latin America which would need financing in the future. Given the credit situation of most of the Bank's borrowers in Latin America, natural gas projects could be conceptualized as enclave projects with limited or full recourse financing or any other type of arrangement so that the Bank would truly be the source of last resort financing. Investment and adjustment loans in the natural gas sector should be conditioned to ensure that the policy changes to foster private sector participation and a reduction of public sector control are permanent. There is a lag time between the implementation of policy changes and the realization of the benefits. The borrower may need financing to bridge this gap and compensate for distortions created by past policies. A good example is the problem of disposing of the fuel oil which is substituted by natural gas. Bank loans would also encourage the private sector to participate in joint ventures or negotiate special financing arrangements. After the Government has agreed to a significant involvement of private companies in the NG sector, Bank should continue its support to ensure that the new policies become permanent. The Bank could either support the private sector (credit lines) or provide adjustment loans to the Government to stay the course over the long term.

7.22 Dissemination and exchange of information with other regional

groups within the Bank can play a key role in encouraging sector development. The Bank strategy in the natural gas sector in Latin America would be disseminated to the other regions and the experiences of the other groups could be reviewed.

7.23 The program for dissemination and exchange of information with regional agencies in LAC should be expanded. The Bank should promote closer cooperation with regional organizations such as ARPEL and OLADE to: (i) exchange information on experience in the natural gas sector; (ii) promote joint projects such as the natural gas study financed with Italian government funds or the soon to be initiated study on the environmental impact of oil/gas operations; and (iii) organize regional conferences to address decision makers in the oil/gas sector in Latin America on the major issues in the sector. ARPEL and OLADE could provide an excellent forum for member countries and companies to exchange regional experiences on policy issues and the need to harmonize them in order to expand regional gas trade.

7.24 The Bank should also address the concerns of the private sector trade and professional associations in each country which provide technical and commercial leadership

for the oil and gas industry. These usually include the engineering and industrial lobbies as well as the local private and international private oil and gas companies.

7.25 The LAC region in the Bank has been able to field missions in the past to carry out energy sector studies (Brazil and Argentina). The teams consisted of Bank staff who provided the intellectual leadership, complemented by local and international consultants. In both cases, an experienced gas consultant addressed the issues of costs, tariffs, regulations, and exploration/production contracts. Since the completion of this work, a Gas Unit in the Bank has been staffed with special experts, providing assistance supported with external consultants to carry out studies on gas regulations, tariffs, contractual issues and gas sector development. In the case of three ongoing lending operations, the required gas expertise came from outside consultants and Bank staff. Based on these experiences, we estimate the Bank's regional staff with support from outside consultants and the Gas Unit should be able to meet the requirements foreseen for the near future.

INDUSTRIAL ENERGY PRICES
January 1990

	NATURAL GAS <u>US\$/MMBTU</u>	RESIDUAL ----- <u>US\$/BBL</u>	FUEL OIL ----- <u>US\$/MMBTU</u>	ELECTRICITY ----- <u>US\$/KWH</u> <u>US\$/MMBTU</u>	
Argentina	1.66	10.08	1.76	0.008	2.38
Bolivia	1.82	34.38	6.00	0.056	15.25
Bra_il	0.32	3.78	0.66	0.010	2.97
Colombia	0.64	14.78	2.58	0.051	14.85
Chile	0.57	17.88	3.12	0.051	14.85
Mexico	2.55	9.34	1.63	0.041	11.88
Venezuela	0.23	1.43	0.25	0.010	2.97

Source: OLADE

STATUS OF THE NATURAL GAS SECTOR IN LAC COUNTRIES

Introduction

1. Although commercially exploitable natural gas reserves have been discovered in ten LAC countries, the extent of sector development varies greatly, primarily because of the availability of other energy resources or failure to recognize its benefits. Some countries which have abundant resources, such as Argentina, have a well developed infrastructure and are now entering the market expansion phase. Others, like Brazil have made little effort to date but plan to accelerate sector development. The availability of gas, the existing infrastructure and the commercial structure of the sector in each country are provided below. The larger existing pipelines and those which are under consideration are shown in Maps 1 and 2.

Argentina

2. Argentina's gas industry has a history of more than 30 years and is one of the most extensively developed gas industries outside North America and Europe. The proved reserves are more than adequate to meet current needs and at present consumption levels the R/P ratio is 33 years. Buenos Aires, the principal market center, is connected to the largest producing fields in the Andean foothills and Tierra del Fuego by a network of transmission pipelines. More than 3 million customers are served by a 50,000 km network of transmission and distribution pipelines. Two government owned companies, YPF and Gas del Estado, have controlled gas production and marketing but recently efforts have been made to shift distribution to municipal governments or private

investors. Natural gas is imported from Bolivia and projects to export gas to Chile and Brazil are under consideration.

Brazil

3. Brazil's natural gas sector is newer and somewhat less developed than Argentina's. Proved reserves currently provide a reserve to production ratio (R/P) ratio of 33 years. About half the gas is associated with oil but recent discoveries off-shore and in the Amazon Basin have greatly boosted non-associated reserves. PETROBRAS, the national oil company which has the monopoly to transport natural gas, operates five unconnected pipeline systems along the Atlantic coast which deliver gas from the fields to local industrial users. The existing urban distribution networks in Sao Paulo and Rio de Janeiro, which are operated by public sector enterprises, are being expanded and new networks are planned for Belo Horizonte and other cities. Negotiations are ongoing to import electric power, fertilizer and other products derived from natural gas from Bolivia and gas from Argentina.

Chile

4. Chile's known gas resources are relatively small and are confined to associated gas produced from oil fields in Tierra del Fuego. The gas is used locally for residential fuel and as feedstock to produce methanol for export. Gas has been discovered offshore several hundred kilometers south of Santiago but the reserves are not considered commercially exploitable at this time. There are

ongoing discussions to import natural gas to Santiago from Argentina's Western gas fields.

Peru

5. Natural gas resources in Peru increased dramatically with the discovery in the mid-1980s of the very large deposits in the Camisea region in southeast Peru. The reserves may exceed 300 billion cubic meters (BCM) which is equals almost two-thirds of Argentina's proved reserves. Several plans have been proposed to build a pipeline to Lima where the gas could be used locally for power generation and industrial applications or exported as liquefied natural gas (LNG).

Bolivia

6. A large portion of Bolivia's proved natural gas reserves of approximately 125 BCM contain a high percentage of natural gas liquids (LPG and condensate) which have a high market value. The liquids are extracted before the gas is used for power generation in the Santa Cruz region and as industrial fuel in other regions. YPF, the government-owned oil company is responsible for most of the gas production but a private company operates the field which supplies the gas exported to Argentina. A YPF affiliate, YABOG, operates the pipeline and the urban distribution network in Santa Cruz. The 1200 km Altiplano pipeline, extending from Santa Cruz to La Paz now connects the largest producing fields in the south with the principal cities. The urban distribution network in Santa Cruz is being expanded and others are being established in La Paz, Cochabamba and the other large cities. Bolivia has exported gas to Argentina since the mid-1970s and negotiations continue to extend the contract beyond the April 1991 expiration date.

Colombia

7. Colombia's gas reserves could meet present requirements for 32 years. Non-associated gas from the Guajira fields off the north coast near Barranquilla comprise about three-quarters of the total. A high pressure pipeline delivers the Guajira gas to consumers along the coast including distribution companies in Barranquilla, Cartagena and other cities. Deliveries from nearby fields to Bogota started in late 1989 and a distribution network is being built to serve initially the low income consumers in the south of the city. ECOPETROL, the national oil company, is a shareholder in numerous mixed public/private ownership companies which transport and distribute natural gas. Texaco, which operates the Guajira field, is the largest gas producer. The gas is bought in the field by ECOPETROL; transported by PROMIGAS, a mixed company; and resold to industrial consumers or to distribution companies at the city gate. A plan to build the 500 km Gasoducto Central from the north coast to Bogota has been postponed pending proof of additional reserves in Guajira.

Venezuela

8. Venezuela has reserves to provide an R/P ratio of over 100 years, but most of the gas is associated with oil so, at present, gas production is affected by OPEC quotas. Large non-associated gas reserves have been discovered offshore recently. The transmission infrastructure is well developed but may require expansion in the next three years. Gas produced in the Anaco region is shipped south to the industrial complex at Puerto Ordaz; north to Puerto La Cruz; and west to the Caracas region. The gas produced in the Lake Maracaibo region is used locally or shipped to north to the power plants and refineries near the

coast. The pipeline networks connect most of the large consuming centers but the east and west systems are not interconnected. CORPOVEN, a subsidiary of PdVSA, the government-owned oil company, produces and transports 70% of the gas. Other PdVSA subsidiaries produce and market some gas and small quantities are sold at retail by private companies. LAGOVEN, a PdVSA subsidiary is discussing a project to export LNG which would utilize the non-associated offshore gas and probably would be jointly financed by private companies.

Mexico

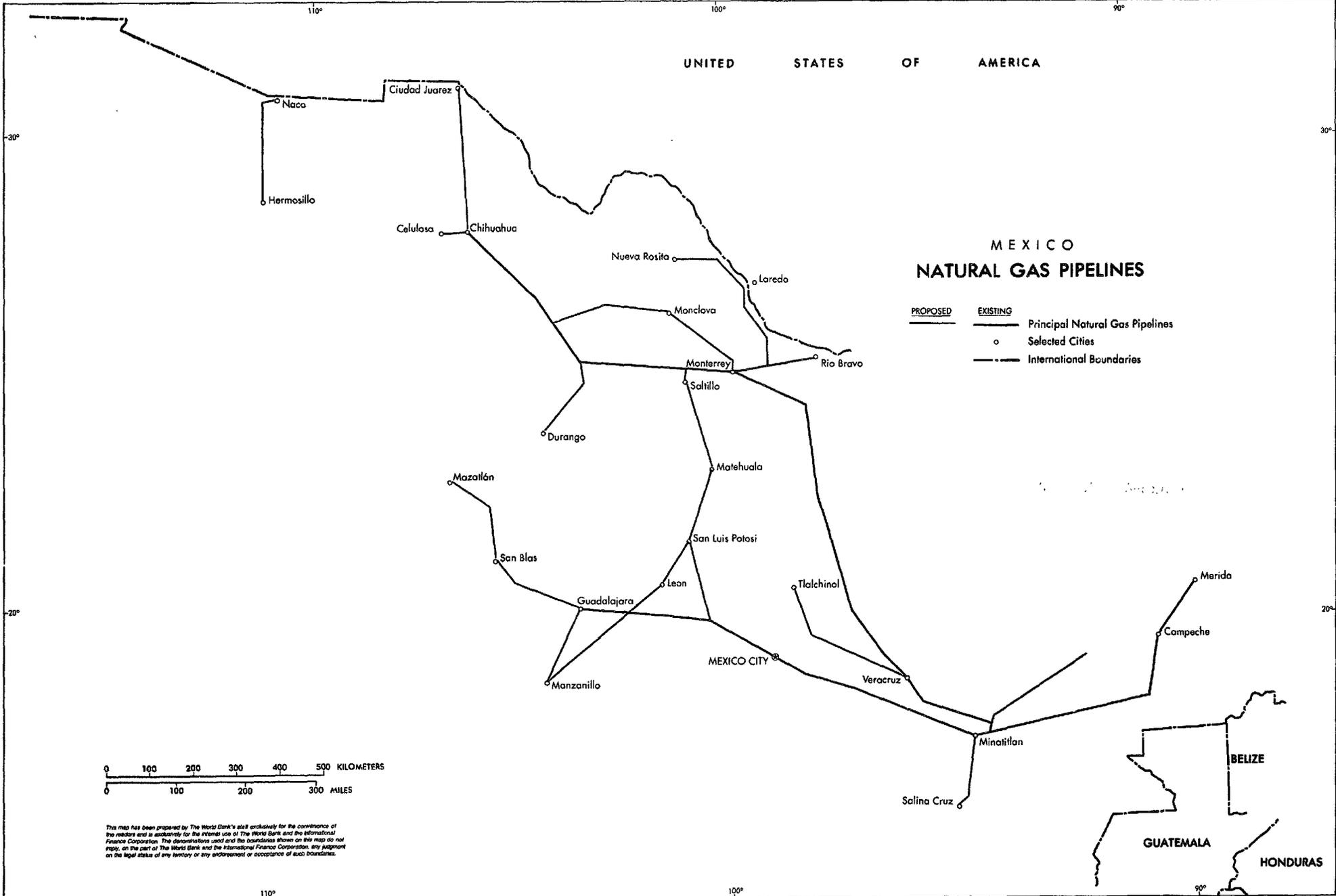
9. Mexico's natural gas reserves, which are largely associated with crude oil, total approximately 2,000 BCM, second only to Venezuela in Latin America. Production has declined in the recent past as oil production dropped, but at present production rates the R/P ratio is 61 years. PEMEX, the national oil company which produces and markets all of the natural gas has constructed an extensive pipeline network from the producing fields to the principal markets. A decade ago Mexico built a large capacity pipeline to the U.S. border and exported gas to U.S. markets for a short time. However, no gas has been exported since 1984 and although it has been suggested from time-to-time, it is not likely exports will be resumed in the near future.

Trinidad and Tobago

10. Although the country has large proved and potential gas reserves, and export projects were proposed in the mid-1970s, the pace of development has been limited by the ability to use natural gas locally. The total proved reserves are 490 billion CM, equivalent to more than 60 years consumption. More than 60% of the reserves are non-associated but the larger portion of the 8 billion CM produced annually is associated gas. Natural gas development policy is set by the Ministry of Energy which also regulates conservation, safety and environmental practices. Associated gas is produced by TRINTOC, AMOCO and other oil producers and is delivered to the petrochemical complex at Port Lisas via a pipeline. Some gas is used for power generation and steel production but the principal use is to convert it to exportable products such as fertilizer and methanol. The government-owned National Gas Company is developing a project to recover natural gas liquids for export and TRINTOC is evaluating a 2200 ton per day methanol project at Point Fortin. The offshore non-associated gas reserves could be a source of liquified natural gas exports to the United States.

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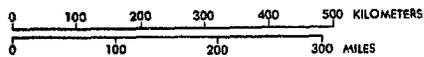
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UNITED STATES OF AMERICA

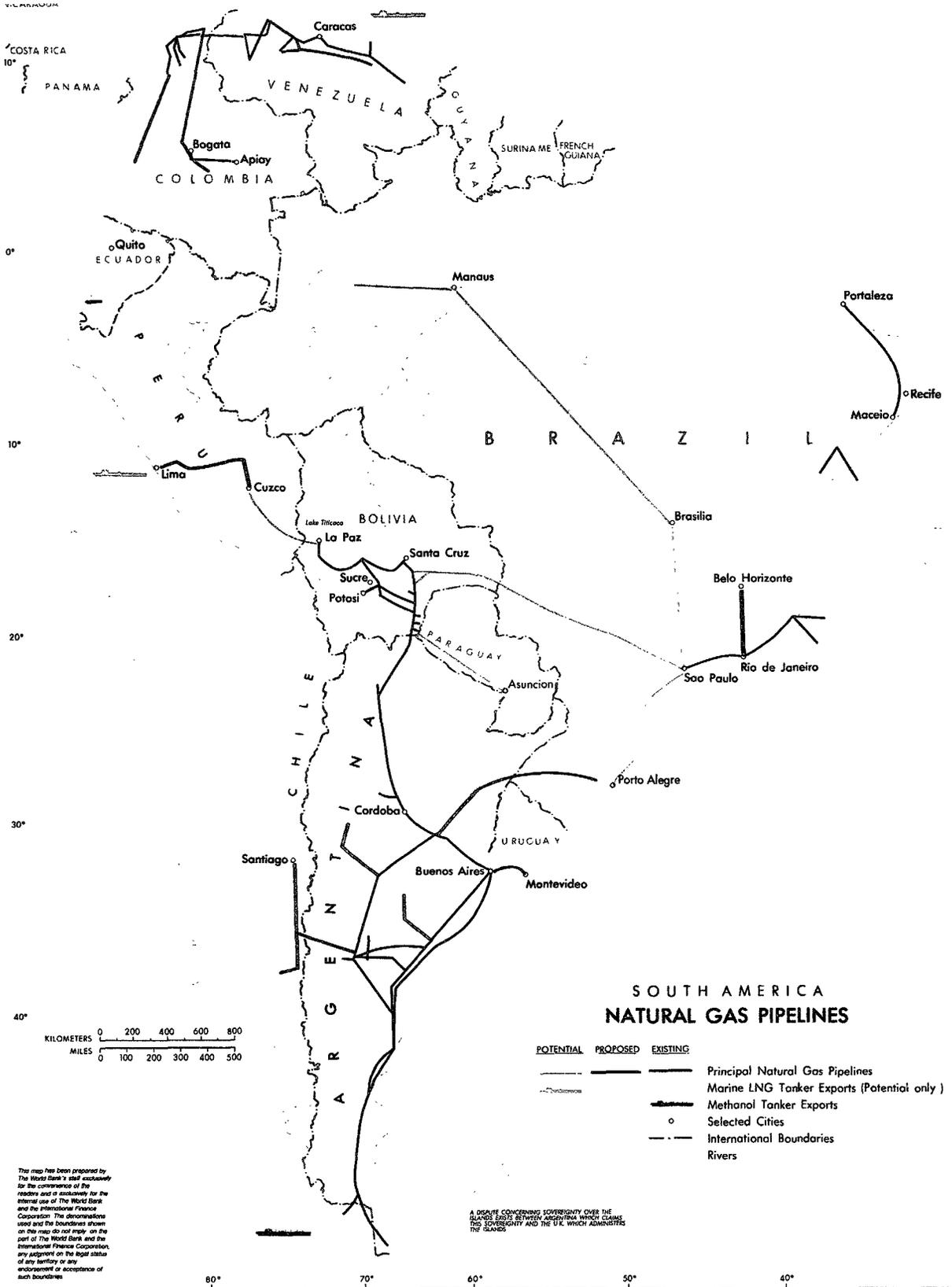
MEXICO NATURAL GAS PIPELINES

- | | | |
|-----------------|-----------------|---------------------------------|
| <u>PROPOSED</u> | <u>EXISTING</u> | Principal Natural Gas Pipelines |
| ○ | ○ | Selected Cities |
| --- | --- | International Boundaries |



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BELIZE
GUATEMALA
HONDURAS



SOUTH AMERICA NATURAL GAS PIPELINES

- | POTENTIAL | PROPOSED | EXISTING | |
|-----------|----------|----------|--|
| | | | Principal Natural Gas Pipelines |
| | | | Marine LNG Tanker Exports (Potential only) |
| | | | Methanol Tanker Exports |
| | | | Selected Cities |
| | | | International Boundaries |
| | | | Rivers |

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A DISPUTE CONCERNING SOVEREIGNTY OVER THE ISLANDS EAST BETWEEN ARGENTINA WHICH CLAIMS THIS SOVEREIGNTY AND THE U.K. WHICH ADMINISTERS THE ISLANDS

80° 70° 60° 50° 40°