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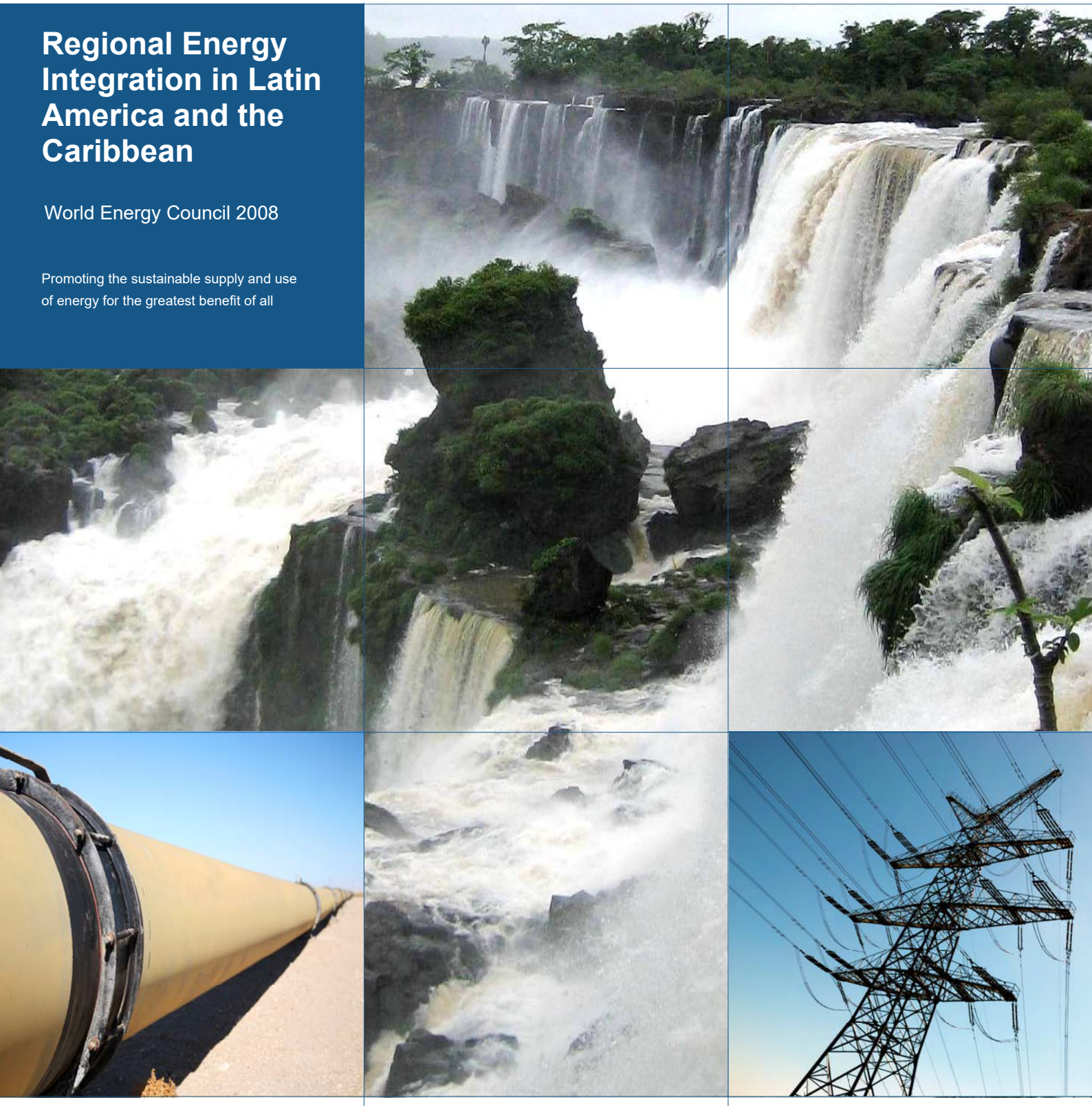
Regional Energy Integration in Latin America and the Caribbean

World Energy Council 2008

Promoting the sustainable supply and use of energy for the greatest benefit of all



Regional Energy Integration in Latin America and the Caribbean

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Foreword

"The author owns the foreword but the afterword belongs to the reader" Nietzsche - 1877

This report is produced within the framework of the regional Work Programme of the World Energy Council.

Following the conclusions and recommendations of the 19th World Energy Congress in Sydney, Australia, the WEC Chairman, André Caillé, emphasised the role of the WEC Regional Programmes, especially those of Latin America and the Caribbean, with a view to promote the sustainable supply and use of energy for the greater benefit of all Latin American and Caribbean citizens.

I am proud to present the WEC's report **'Regional Energy Integration in Latin America and the Caribbean'**. This region has huge energy resources within reach at low cost, and the opportunity of capitalizing on them is an important comparative advantage.

Integration of the countries' energy resources is a step towards a closer social and economic integration of the region and its further integration in the global economy.

I would like to thank the World Energy Council, especially the Director of Programmes, Elena Nekhaev, for her tireless advice and encouragement whilst the Study was being carried out.

I would also like to thank the Steering Committee, the Director of the Study, the Institute of Economy, Federal University of Rio de Janeiro - IE-UFRJ, Brazil and the CEARE, University of Buenos Aires for their arduous work.

Norberto de Franco Medeiros
WEC vice Chair for Latin America and the Caribbean
Chair WEC Brazilian Committee

1. Introduction

Energy supplies will need to double in the next forty years to meet global energy requirements. This task may seem too difficult but there are sufficient energy resources in the world to meet this demand.

The major challenge will be to access energy resources and transport the services from the production site to where most needs are concentrated.

Over the next few decades, fossil fuels will continue to provide most of the primary energy requirements. Proper management of greenhouse gas emissions and climate change threat will also be necessary.

Higher energy prices will be a key element for dealing with this twofold challenge of achieving growth and curbing climate change. Higher prices will push global development towards energy efficiency and will attract higher levels of capital investment in infrastructure. Heavy public and private investment in Research and Development of clean and more efficient technologies will also be necessary.

Governments should set clear regulations for global energy trade, as well as a stable price for carbon that can clearly be understood by markets and investors. Government engagement in this and other areas must be encouraged; while at the same time co-operation and integration are essential between the different regions of the world and between public and private sectors. These sectors will have different responsibilities and activities.

It is a myth to think that the task of meeting world energy requirements, while mitigating climate change, will be too costly.

With higher levels of co-operation and investment, as well as clearer regulations for energy trade, we can build a sustainable future for energy.

This report includes the analysis of forty major studies on Latin American and the Caribbean Integration (Annex I), of which thirteen studies (Annex II) were selected and examined in depth.

After this introduction, chapter 2 addresses the institutional organisation of the region in order to integrate the various energy markets.

Chapter 3 indicates that the region has multiple energy resources and analyses the energy scenario of one region that, after a period of crisis, resumed growth. Forecasts for each political bloc are given (Central America, Andean countries, Southern Cone) and in the case of Brazil, it was decided to divide it into North and South Brazil. An analysis was made for the current status and 2018 forecasts for the different energy sources: coal, natural gas, oil and electricity by country in each political bloc. In the Caribbean, Trinidad & Tobago was selected as an example.

Chapter 4 addresses the institutional and regulatory organisation of each bloc and each country. The taxation and rates used vary from country to country (Annex II).

Regional energy will be integrated mainly by interconnecting power systems and natural gas pipelines in order to enjoy scale economies, cut costs and increase the reliability of the national energy systems.

Chapter 5 discusses existing gas and electricity projects relating to energy integration.

Chapter 6 shows price formation for the gas and electricity exchanges.

Chapter 7 points out that it is fundamental to adopt policies for reducing the economic asymmetries in the field of physical infrastructure and combining regulatory and institutional systems. It also presents the possibility of implementing the economic mechanism, the Multilateral Regional Security Reservoir (MRSR).

Chapter 8 provides the conclusions of the study.

2. Energy Integration of Latin America and the Caribbean

During the second half of 20th century, Latin American economic and social integration was boosted by the creation of regional organisations to promote regional trade. It was hoped that industrialisation of countries in the region would accelerate and, as a result, Latin America would achieve a more balanced slot in the global economy.

1960 saw the creation of Latin American Free Trade Association (LAFTA) in South America, and the Central American Common Market (CACM) for Central American countries[1]. In 1980, LAFTA was substituted by the Latin American Integration Association (LAIA)[2], and, subsequently, sub-regional blocs of the Andean Community of Nations (ACN)[3] between Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela[4], and the Southern Cone Common Market (Mercosur)[5] between Argentina, Brazil, Paraguay and Uruguay. Although, in recent years, there have been movements and connections between both blocs[6], the identification of the traditional sub-regions – ACN and Mercosur – continues to be a valid geopolitical category on questions relating to regional integration.

In 1993, in Tegucigalpa, Honduras, the CACM countries and Panama created the Central American Integration System (CAIS). In the energy area, the countries in this region have the Central American Electrification Council (CEAC), which addresses the regional electricity market (MER), and the Central American Inter-Governmental Hydrocarbons Co-operation Committee (CCHAC). In 2005, in Cancun, Mexico, the Central American countries, with Mexico, Colombia and the Dominican Republic, set up the Mesoamerican Energy Integration Program (MEIP).

In 2000, the Initiative for Integration of South American Regional Infrastructure (IIRSA)[7] was launched at a meeting in Brasilia, Brazil.

In 2004, in Cuzco, Peru, the South American countries[8] decided to form the South American Community of Nations (SACN), now called the Union of South American Nations (Unasur)[9] to promote communication, energy and physical integration.

[1] LAFTA was created by the Montevideo Treaty, Uruguay, 18 February 1960. CACM created under the Managua Treaty, Nicaragua, 1960.
[2] LAIA created by the Montevideo Treaty, Uruguay, 12 August 1980.
[3] ACN, originally known as Andean Pact or Andean Group, created under the Cartagena Agreement, Colombia, on 26 May 1969.
[4] Venezuela joined ACN in 1973 and on 22 April 2006 officially withdrew from the Cartagena Agreement, Colombia, and therefore from the Andean Community.
[5] Mercosur was founded on 26 March 1991 under the Treaty of Asunción, Paraguay.
[6] Bolivia and Chile (1996), Peru (2003), Colombia and Ecuador (2004) became associate States of the Mercosur. Argentina, Brazil, Uruguay and Paraguay are ACN associates.
[7] Member countries of IIRSA are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela.
[8] The Cuzco Declaration, Peru, 2004, was signed by Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela.
[9] In 2007, the name South American Community of Nations was changed to Union of South American Nations (USAN).

Figure 1
Sub-regional blocs: Mercosur, Andean Community of Nations (CAN) and Central American Integration System (CAIS)
Source: World Energy Council

Unasur

Table 1 shows a comparison between the Unasur bloc, different existing blocs and the largest countries in the world. (see page 7)

The sub-regional blocs created financial organisations. In 1970 ACN created the Andean Development Corporation (CAF), a multi-purpose bank and agency for encouraging development and Andean integration. The River Plate Basin Financial Development Fund (FONPLATA) in Mercosur and the Central American Bank for Economic Integration (CABEI) in Central America are similar. The Inter-American Development Bank (IDB) and World Bank remain the main financial promoters of the regional energy integration.

The results achieved by the sub-regional focus (Mercosur, ACN, and Central America) were beneficial. Sub-regional trade made a strong quantitative leap, having created various opportunities to articulate sub-regional markets, including the energy sector. The weak link between existing national infrastructures, especially in the energy area, remains the major obstacle against strengthening regional economic integration. This situation curbs the growth of regional trade and

Table 1

Comparison with other blocs and countries

Source: CIA World Factbook 2004, IMF WEO Database, 2003

1 – NAFTA Member

2 – Unasur Member

Entity	Area km²	Population	GDP US$ million	GDP per capita US$	Member countries
Unasur	17,715,335	366,669,975	4,224,903	10,996	12
NAFTA	21,588,638	445,335,091	15,857,000	35,491	3
European Union	3,977,487	456,285,839	11,064,752	24,249	27
ASEAN	4,400,000	553,900,000	2,172	5,541	10
Large countries	**Area km²**	**Population**	**GDP US$ million**	**GDP per capita US$**	**Political divisions**
India	3,287,590	1,065,070,607	3,033,000	2,900	34
China	9,596,960	1,298,847,624	6,449,000	5,000	33
USA[1]	9,631,418	293,027,571	10,990,000	37,800	50
Canada[1]	9,984,670	32,507,874	958,700	29,800	13
Russia	17,075,200	143,782,338	1,282,000	8,900	89
Brazil[2]	8,514,876	188,181,069	1,803,000	9,108	27

hinders the consolidation of the regional economic integration process.

The purpose of this study is to propose alternative solutions for the integration process in the electricity and natural gas markets. Energy integration is a process that also covers primary factors other than energy.

The purpose of this study is to propose alternative solutions for the integration process in the electricity and natural gas markets.

Geographic proximity is a relevant factor for projects that integrate the natural gas and electricity infrastructure. In the this study, the traditional geopolitical blocs - Central America, Andean countries, Southern Cone - were considered, but in the case of Brazil, it was decided to divide the country in two sub-regions - South-Brazil and North-Brazil. This division is necessary because the domestic integration process of Brazilian regional energy markets adopts different time frames. In South Brazil the integration is considerably advanced, but in North Brazil, the Amazon region in the national energy system is still incomplete.

Figure 2 on page 8 illustrates the geographical division used. It also shows a diagram of the integration zones under analysis. As suggested, some zones are relatively well-developed (continuous lines) while others are underway or in the planning stage (broken lines). The connection between the Brazilian Amazon region and the Amazon region of the other ACN countries is only an outline.

The transport logistics infrastructure available in the vast region covering the Southern Cone, South Brazil and the southern part of ACN allows relatively strong energy flows between the countries in the region. A similar situation occurs between the countries in the northern part of ACN and between the countries in the Central American Isthmus. In the other regions several projects are in progress or being structured to create favourable conditions for energy flows. Barriers, especially regulatory and institutional, have been drawbacks to the development of such projects.

Figure 2

Energy sub-regions and inter-regional integration zones

Source: World Energy Council

The institutional and regulatory organisation of natural gas and electricity markets, particularly the regulatory aspect, boosts regional trade. It was found that these regional energy trade barriers are still high, with the exception of the Central American region.

Despite such drawbacks, the conclusion is that there are significant mid-term prospects open to regional energy trade. Various integration projects are underway and will help boost energy flows between the regions in the study and others studied for the same purpose.

Consequently, integration of the energy markets with this possible advantage is strategic for the countries in the region. The fast growth of China and India, Middle East disputes and the need to minimise greenhouse gas emissions have transformed the international energy market.

This situation opens a vast window of opportunity for the region to use energy resource as an effective link to the global economy.

3. Energy Scenario

After a long period in crisis, Latin America and the Caribbean stimulated re-development. The strong demand from Asia for commodities, the core of the LAC exports, opens positive prospects for sustained growth by the regional economies.

A number of projects are in progress or being structured to create favourable conditions for the energy flows between the five regions in the study. This study identifies energy integration projects and examines the expected impacts on energy demand.

In 2006, energy consumption in the five regions was 2.8 million kbep (3.6 million kbep including Mexico). Brazil had the highest consumption (48% of the total), followed by the Andean countries (23%), the Southern Cone (20%), Central America (6%) and the Caribbean (3%).

In all countries the share of petroleum and its by-products in the energy mix is 50% (on average). In the Central American countries and Paraguay, biomass, basically firewood, still plays a major role in energy consumption (40% of the energy mix). Natural gas is hardly used in Venezuela and

Table 2
Energy Consumption 2006
Source: OLADE (LAEO)

Country	Population	GDP	GDP per capita	Final Energy Consumption	Consumption per Capita	Energy Intensity
	10^3 inhab.	10^6 US$	US$/inhab.	10^3 Boe	Boe/inhab.	Boe/10^3US$
CENTRAL AMERICA	**40,804**	**85,107**	**2,086**	**168,003**	**4.12**	**1.97**
Costa Rica	4,399	21,029	4,780	24,049	5.47	1.14
El Salvador	6,991	15,248	2,181	23,961	3.43	1.57
Guatemala	13,018	20,969	1,611	53,938	4.14	2.57
Honduras	7,518	7,615	1,013	24,675	3.28	3.24
Nicaragua	5,594	4,772	853	18,570	3.32	3.89
Panama	3,284	15,474	4,712	22,809	6.95	1.47
CARIBBEAN	**1,311**	**13,801**	**10,527**	**79,015**	**12.77**	**5.73**
Trinidad & Tobago	1,311	13,801	10,527	79,015	12.77	5.73
ANDEAN COMMUNITY	**125,187**	**354,387**	**2,831**	**668,692**	**5.34**	**1.89**
Bolivia	9,627	10,194	1,059	26,613	2.76	2.61
Colombia	46,772	105,574	2,257	169,014	3.61	1.6
Ecuador	13,408	21,320	1,590	60,132	4.48	2.82
Peru	28,349	70,662	2,493	86,612	3.06	1.23
Venezuela	27,031	146,638	5,425	326,320	12.07	2.23
BRAZIL	**190,127**	**764,552**	**4,021**	**1,355,368**	**7.13**	**1.77**
SOUTHERN CONE	**62,250**	**467,744**	**7,168**	**566,101**	**8.68**	**1.21**
Argentina	38,971	340,316	8,733	361,886	9.29	1.06
Chile	16,436	96,533	5,873	159,151	9.68	1.65
Paraguay	6,365	8,391	1,318	26,674	4.19	3.18
Uruguay	3,478	22,504	6,470	18,390	5.29	0.82
TOTAL	**422,679**	**1,685,591**	**3,988**	**2,837,180**	**6.71**	**1.68**
Mexico	107,537	665,522	6,189	800,331	7.44	1.20
TOTAL + Mexico	**530,216**	**2,351,113**	**4,434**	**3,637,511**	**6.86**	**1.55**

Figure 3
Per capita energy consumption 2005
Source: OLADE (LAEO)

especially in Argentina (50% of the mix). Coal is not significant in the region, and the countries that most use it are Colombia and Brazil (6% and 7%).

In 2006, Brazil produced 46% of the world's ethanol.

In Brazil the use of biofuels has risen sharply in recent decades and their share in the energy matrix should grow in the near future because of increasing demands from the transport sector. In 2006, Brazil produced 46% of the world's ethanol and the share of flex-fuel vehicles manufactured in the country was 65%. The indicators selected for the Latin American and Caribbean countries in this study for the year 2006 are summarised in Table 2. Energy consumption per capita by the countries in the region is still low, although Latin America has abundant energy resources. (Figure 3 above)

The region accounts for 11% of world reserves of oil and 5% natural gas. Venezuela is the Latin American country with the largest quantity of oil (77 billion barrels) and natural gas reserves (4.6 trillion m^3). After Mexico, Venezuela is also the main oil producer (3.1 million barrels a day in 2005), while Argentina heads the list of natural gas producers (51.5 billion m^3 in 2005). Argentina and Bolivia are the main natural gas exporters in South America.

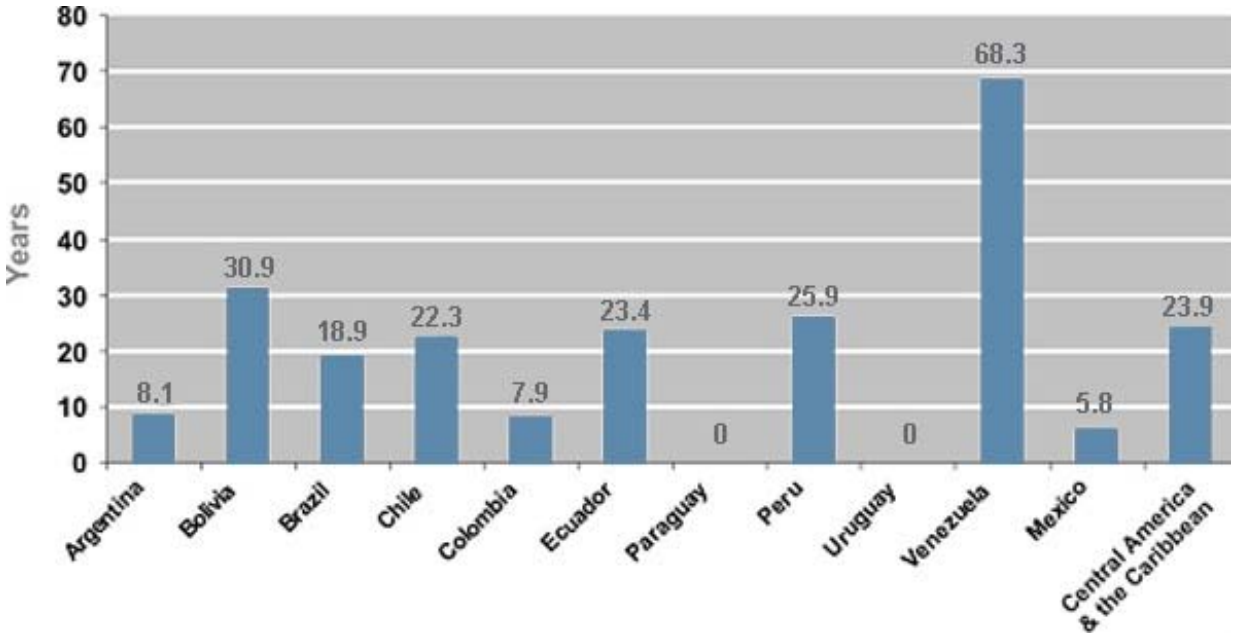
Brazil has great potential due to oil and gas reserves discovered off the Southeast Brazilian coast. Brazil is the second largest ethanol producer in the world, using sugarcane as feedstock, which is extremely productive and efficient. The oil reserves/production ratios in the region can be seen in Graph 1.

In Ecuador, Venezuela, Bolivia and Peru, it exceeds 130 years, but in Argentina it is only 10 years. Total production attributed to the Caribbean is summarised in the production by Trinidad & Tobago, which liquefies its natural gas and exports practically the entire production to the American market. Graph 2 shows these ratios.

Graph 1

Oil Reserves / Production Ratios 2005

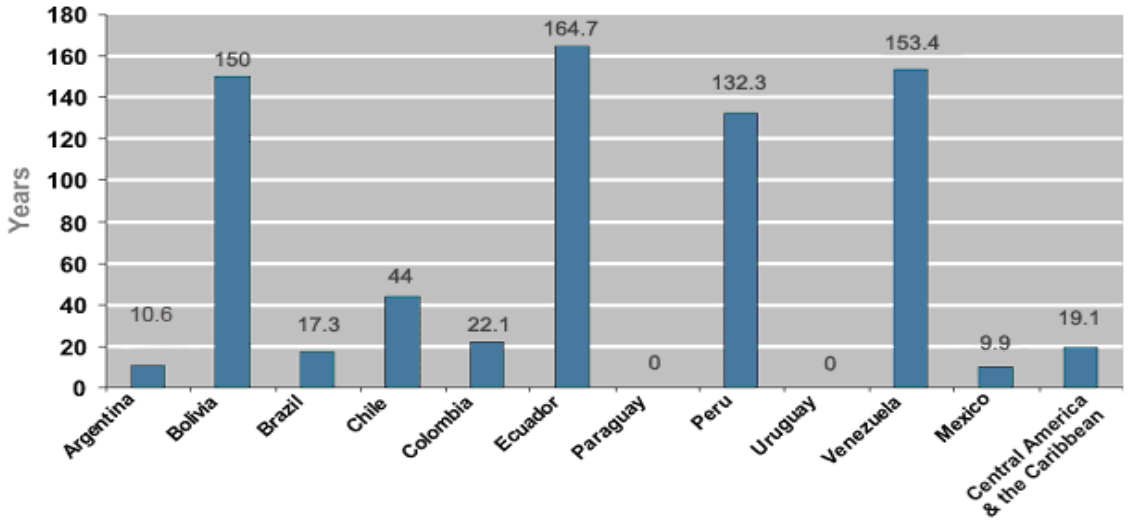
Source: IEA/DOE and British Petroleum



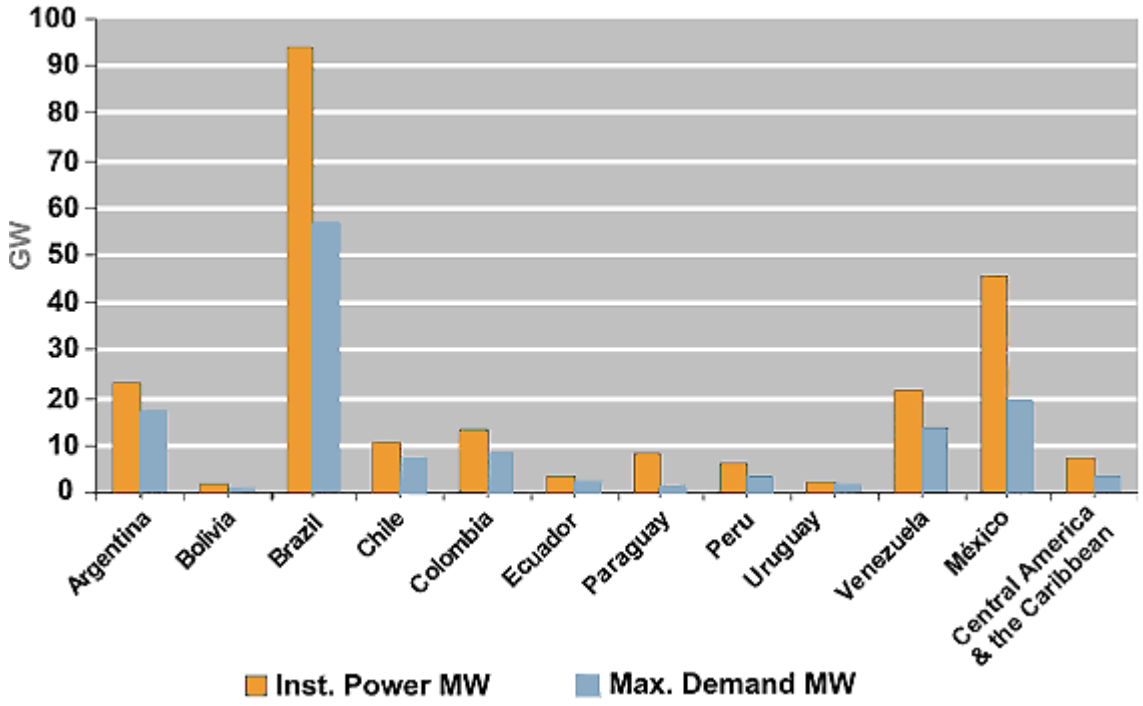
Graph 2

Natural Gas Reserves / Production Ratio 2005

Source: IEA/DOE and British Petroleum



Graph 3
Capacity and Maximum Electricity Demand 2005
Source: DIER and DOE



Water potential is extremely important, with estimated 659.5 GW in Latin America and the Caribbean, and only a small portion is used, leaving huge possibilities for building new hydropower plants. In 2005, Brazil had an installed capacity of almost 93.2 GW and maximum demand of 56 GW, the highest in the region. It is followed by Argentina (with 23.3 GW installed capacity and 17.3 GW maximum demand) and by Venezuela (with 21.3 GW of installed capacity and 13.8 GW maximum demand). Graph 3 shows the installed capacity and maximum demand by the countries in the region.

Most of the unexploited hydropower potential is in the Amazon, but there is an ever-growing concern with biodiversity. On the other hand, the largest identified natural gas reserves are concentrated in ACN countries, especially Venezuela, Bolivia and Peru, and heavy investments are required to bring these energy resources to the consumption centres in other Latin American countries

It has been established that all the Latin American countries have a power surplus in relation to maximum demands. These countries are essentially self-sufficient and also have power surpluses that could be used in the integration process as the interconnection infrastructure expands. Brazil is the major hydropower supplier in the region, where 84% of electricity produced is from this source. The other countries have more balanced thermal and hydropower capacities. The nuclear supply is insignificant in the region where only three countries produce from this source (Argentina, Brazil and Mexico) and in none of them more than 5% of the total power generation.

3.1 Central America

Countries comprising the region of the Central American Isthmus are Guatemala, Costa Rica, Panama, Honduras, El Salvador and Nicaragua.

Guatemala has the highest energy consumption in the region. All countries heavily depend on petroleum and by-product imports: Nicaragua (44%), Panama (66%), Costa Rica (52%), El Salvador (21%), Honduras (50%) and Guatemala (42%). Except for Costa Rica and Panama, the other countries use considerable quantities of

Table 3
Natural Gas Demand Forecasts Central America and Mexico (10^6 m^3 / day)
Source: IDB

Year	CA Isthmus	Mexico Potential	CA Isthmus+Mexico
1	8.78		8.78
2	9.81		9.81
3	10.54	3.00	13.54
4	11.78	6.00	17.78
5	13.19	10.00	23.19
6	14.48	16.00	30.48
7	16.17	20.00	36.17
10	19.22	20.00	39.22
15	24.35	20.00	44.35

biomass. Coal and natural gas are not used in the region. Honduras and Costa Rica (6%) and (19%) respectively use hydropower.

3.1.1 Natural Gas

The region does not have natural gas but it may be introduced in the future due to the growing demand for electricity. Potential volumes for the use of natural gas in Central America are calculated by adding the volumes allocated to industry and vehicle gas to the demand for electricity generation.

The amount of natural gas to be used by Mexico in the future is important for defining the quantity of gas to be used in the entire area of Central America.

The demand forecasts for Central America, plus the potential demand of Mexico, are shown in Table 3.

3.1.2 Electricity

Electricity demand forecasts for each Central American country can be seen in Table 4.

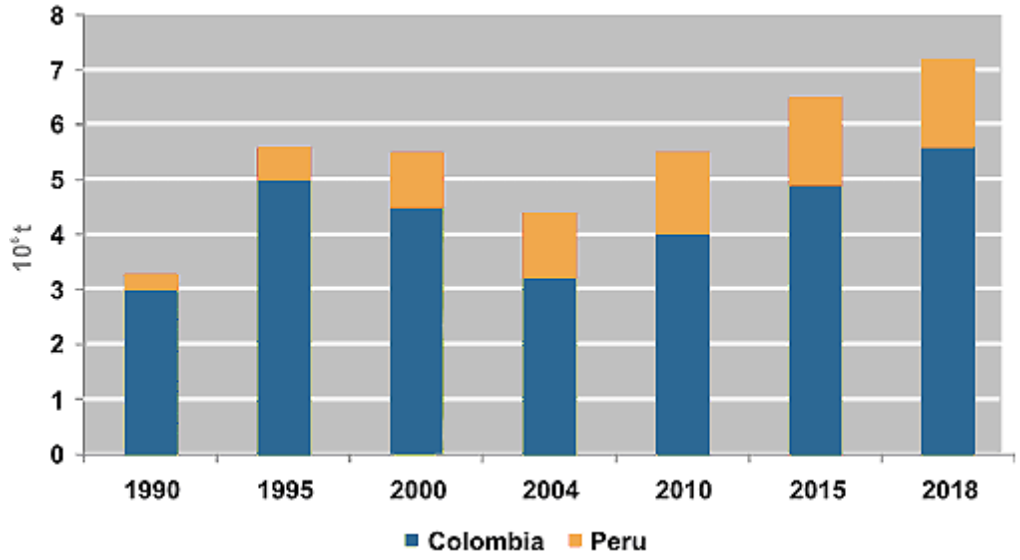
3.2 The Caribbean

In the Caribbean, Trinidad & Tobago is the major producer, having developed and marketed its abundant natural gas reserves. Trinidad & Tobago was the first in the region to seize the opportunity of natural gas deployment. 2018 forecasts for Trinidad & Tobago can be found in Annex IV.

Table 4
Electricity Demand Forecast – Central America (GWh)
Source: GTPIR

Year	GU	ES	HO	NI	CR	PA	Total
2006	7 185	4 866	6 321	2 896	8 594	5 752	**35 614**
2010	8 825	5 693	7 575	3 460	10 506	6 907	**42 966**
2013	10 174	6 404	8 662	3 896	12 234	7 920	**49 290**
2015	11 135	6 926	9 438	4 217	13 575	8 692	**53 983**
2018	12 676	7 791	10 669	4 765	15 882	10 006	**61 789**
2020	13 775	8 427	11 505	5 204	17 643	11 003	**67 557**
% growth	4.8%	4.0%	4.4%	4.3%	5.3%	4.7%	**4.7%**

Graph 4
Coal Demand – Colombia and Peru, Forecast from 2010
Source: OLADE (LAEO)



3.3. Andean Countries

At present, only four of the six Andean countries are members of ACN (Bolivia, Colombia, Ecuador and Peru). Chile is not an ACN member and Venezuela withdrew to join the Mercosur. In this study, Chile was considered part of the Southern Cone and Venezuela as belonging to the Andean bloc.

3.3.1 Coal

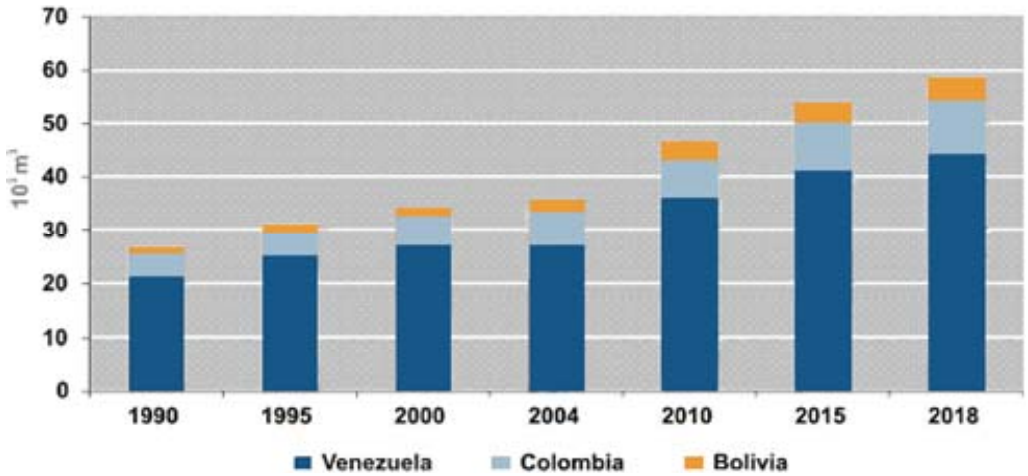
Regional coal consumption is concentrated in Colombia and Peru (13% of South American total). A slight increase in consumption of this fuel is expected in Peru and a higher increase in Colombia, as shown in Graph 4.

The largest reserves in the region are in Colombia, Peru and Venezuela, accounting for 41% of the total South American reserves.

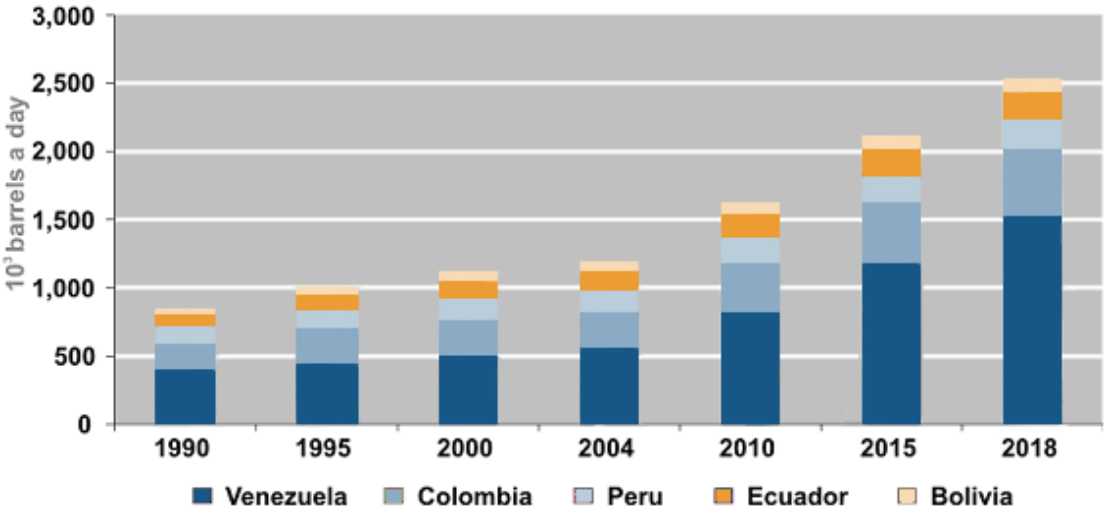
3.3.2 Natural Gas

Regional natural gas consumption was 37% of the region's total energy consumption in 2004, but annual growth was slow.

Graph 5
Natural Gas Demand in CAN, Forecast from 2010
Source: OLADE (LAEO)



Graph 6
Oil Demand in CAN, Forecast from 2010
Source: WEC



Venezuela, with significant gas reserves, produces less gas than it consumes. Peru and Bolivia also have reserves. Bolivia is a major exporter and Peru largely consumes what it produces. Colombia exports natural gas but may start importing in the future. Ecuador consumes what it produces but reserves would permit possible future exports. Venezuela may become a major exporter. Graph 5 shows consumption forecasts for the main ACN member countries.

3.3.3 Petroleum

The region accounts for almost 27% of South American consumption. Regional oil consumption has been on the increase, especially in Venezuela, which also has the largest reserves. All ACN countries have oil reserves. Bolivia produces what it consumes. Colombia has smaller production than consumption, with proven reserves sufficient for another six years. Ecuador, as an oil exporter, should encourage exploration in order to prevent importation. In Peru, consumption exceeds mid-term production and, if the country fails to find new reserves it may have to start importing. Venezuela, with large reserves, will continue to export. Graph 6 shows consumption forecasts for the ACN countries.

3.3.4 Electricity

Regional electricity consumption increased 30% between 1994 and 2004 to reach the 168 TWh mark. In 2007, 25% of the installed capacity in South America was in ACN, with 40% of this in Venezuela. Demand in ACN has been rising by 3.3% a year. Regional generation is diverse, namely: hydropower, coal, gas, oil for thermal generation, and alternative sources such as wind or solar energy. Table 5 shows the installed capacity in each ACN member country.

Forecast growth in electricity consumption by the countries in the region is presented in Graph 7. The expected increase in thermal power generation will also lead to oil, natural gas and coal consumption increasing in Venezuela and Peru. New hydropower plants and alternative sources will also be used to meet this expected increase.

Table 5
Installed Capacity
Source: IEA/DOE

Country	Total (GW)	Hydropower (%)	Thermal (%)
Bolivia	1.4	35	65
Colombia	13.7	65	34
Ecuador	3.5	50	50
Peru	6.0	51	49
Venezuela	20.6	61	39
Total	**45.0**	**59**	**41**

Graph 7
Electricity Demand – Peru and Venezuela, Bolivia, Colombia and Ecuador, Forecast from 2010
Source: OlLADE (LAEO)/WEC

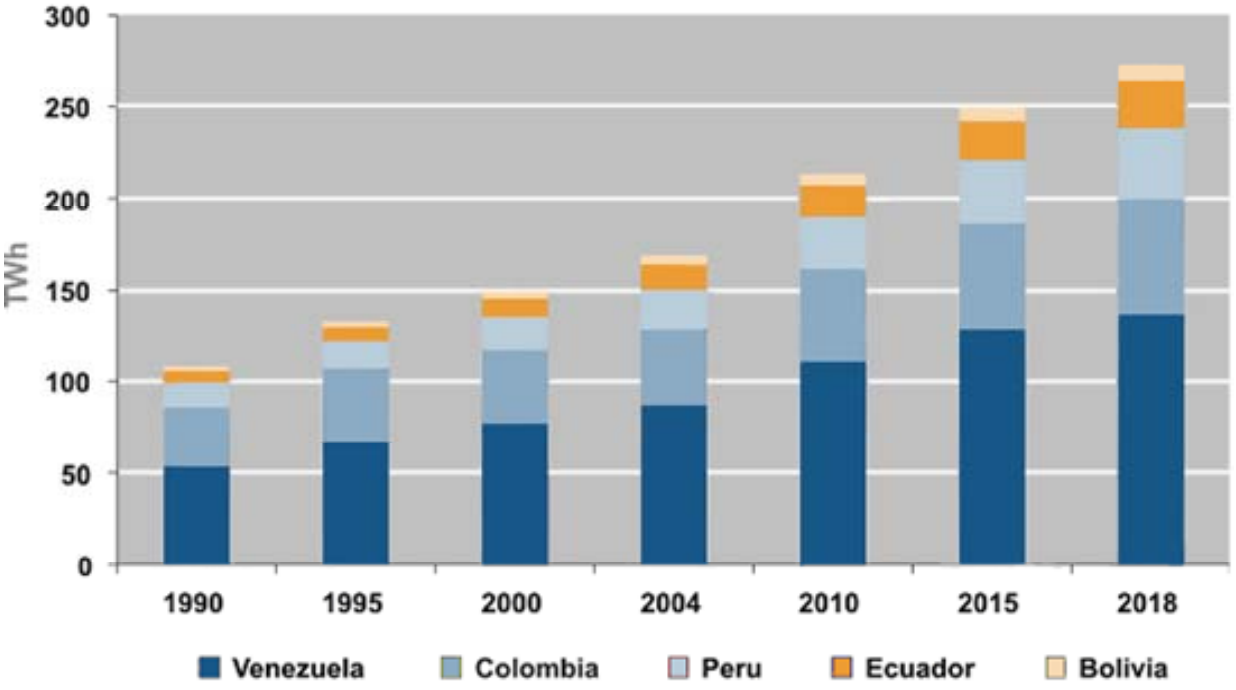


Table 6

Energy Data 2005-2006

Source: EPE (Energy Research Company)

1 - Includes gas liquids (NGL).
2 - Includes "measured", "indicated" and "inferred" reserves of coal and peat.
3 - Hydropower potential already inventoried.
4 - It includes coke from metallurgy coal.
5 - Variations between the years 2005 and 2006.
6 - Units are: bbl = barrel; bbl/day= barrel per day; boe= barrel oil equivalent; boe/day = barrel oil equivalent per day.

Proven Reserves	Unit[5]	2005	2006	% 06/05[6]
Oil	10^9 bbl	11.8	12.2	3.5
Natural Gas[1]	10^9 m^3	306.4	347.9	13.5
Coal[2]	10^9 t	32.3	32.3	0.0
Hydropower Potential[3]	GW	260.1	260.1	0.0
Primary Energy Production	**Unit[5]**	**2005**	**2006**	**% 06/05[6]**
Total Production of Primary Energy	10^6 toe	200.5	211.5	5.5
Oil Production	10^3 bbl/day	1,690.3	1,780.7	5.3
Natural Gas Production	10^6 m^3/day	48.5	48.5	0.0
Coal Production	10^6 t	6.3	5.9	-6.0
Electric Power Generation	TWh	402.9	417.4	3.6
Energy Imports and Exports	**Unit[5]**	**2005**	**2006**	**% 06/05[6]**
Total Energy Imports	10^6 toe	58.2	58.3	0.2
Petroleum and by-products	10^3 bbl/day	566.5	592.6	4.6
Natural Gas	10^6 m^3/day	24.7	26.8	8.8
Coal[4]	10^6 t	15.4	14.9	-3.5
Electricity	TWh	39.2	41.4	5.7
Total Energy Exports	10^6 toe	29.1	35.1	20.7
Petroleum and by-products	10^3 bbl/day	538.2	643.1	19.5

3.4 Brazil

Brazil is considered to be a region within South America because of its geographic dimensions and, for the purpose of this study, it is divided into two sub-regions: North (North and Northeast) and South (Midwest, South and Southeast). The overview of the Brazilian energy sector is given in Table 6.

By the end of last century, the energy transport infrastructure between Brazil and its neighbours was still in the early stages with only small border connections with Argentina, Uruguay, Paraguay and Venezuela. The situation began to change in the 1990s with the construction of larger power interconnections with Argentina and gas pipelines with Argentina and Bolivia. These projects coincided with the interconnection of the two Brazilian electricity sub-markets: North-Northeast and Midwest-South-Southeast. There are border hydropower plants e.g. Acaray, from 1965. Itaipu Bi-national with 14,000 MW was commissioned in the 1980s.

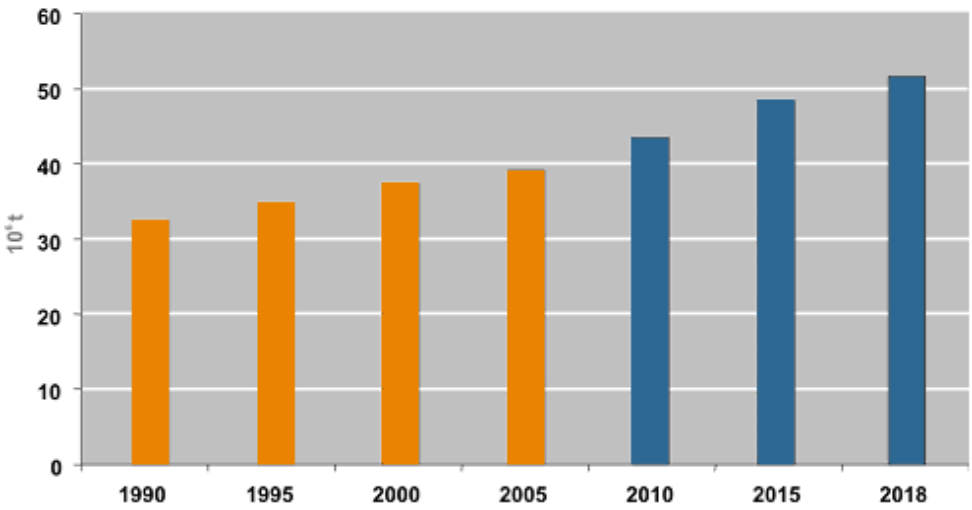
3.4.1 Coal

Coal has a small share in the Brazilian energy mix. The country has a large reserve of steam coal, but imports metallurgical coal. Growth forecasts for coal use are given in Graph 8.

Graph 8

Coal Demand in Brazil, Forecast from 2010

Source: EPE



3.4.2 Natural Gas

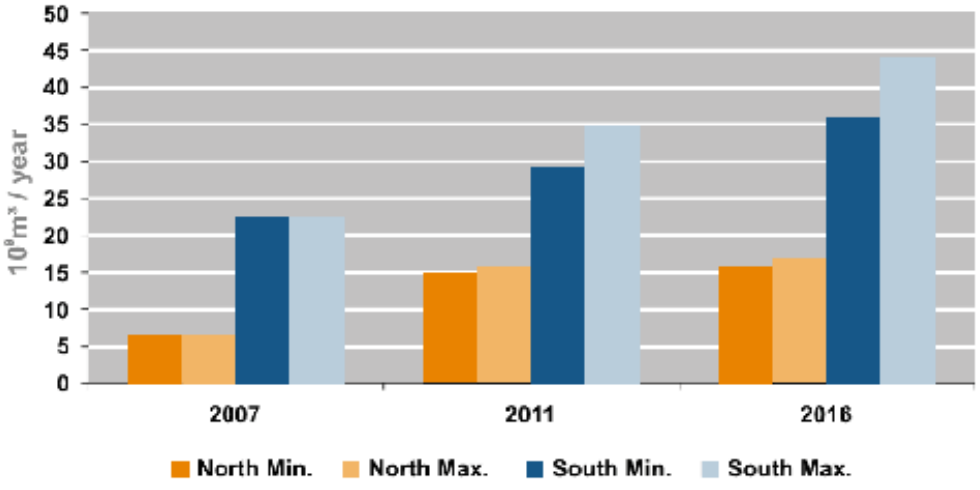
Consumption of this source of energy has grown by 100% in the past five years. The considerable availability of natural gas in countries neighbouring ACN, the reasonable domestic availability, high energy efficiency and relatively low price resulted in this fuel being used widely in Brazilian industry. Although Brazilian proven reserves remain modest, probable reserves are promising, principally those on the continental shelf.

North Brazil will continue to import natural gas, mainly from Bolivia and possibly Peru. Hydrocarbon exploration activities in South Brazil provide optimistic expectations for new reserves of natural gas off the coast from Espirito Santo to Santa Catarina. Natural gas consumption forecasts for the country are shown in figure 9.

Graph 9

Forecast of Natural Gas Consumption in Brazil by sub-region

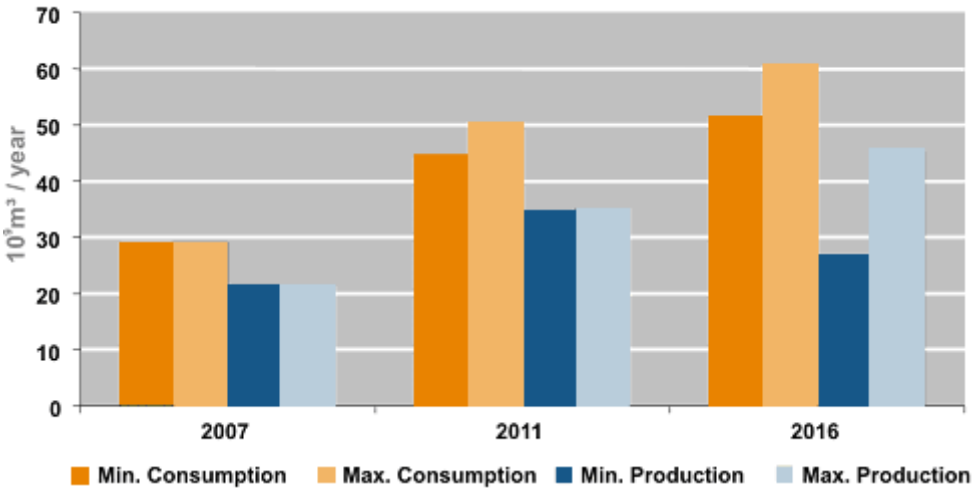
Source: EPE



Graph 10

Forecast of Natural Gas Consumption and Production in Brazil

Source: EPE



3.4.3 Petroleum

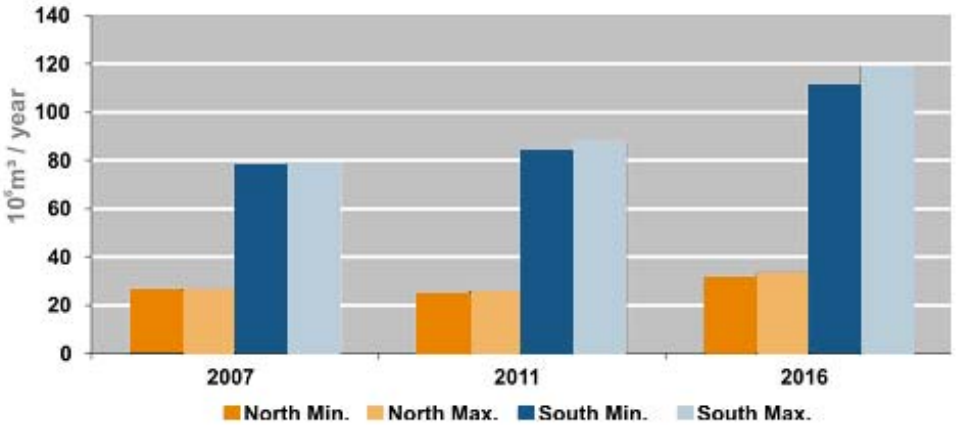
Oil consumption in Brazil has been increasing at a rate of 2.5% p.a. The country has become self-sufficient and, with new exploration possibilities, there is an expectation of large reserves, especially in the pre-salt layer in Santos Basin. In the future Brazil might become an oil exporter. Consumption in the regions in Brazil is forecast in Graph 11.

Graph 12 shows forecasts for oil consumption and production in Brazil (million m^3 p.a.).

Graph 11

Forecast of Oil Consumption and Production in Brazil by region

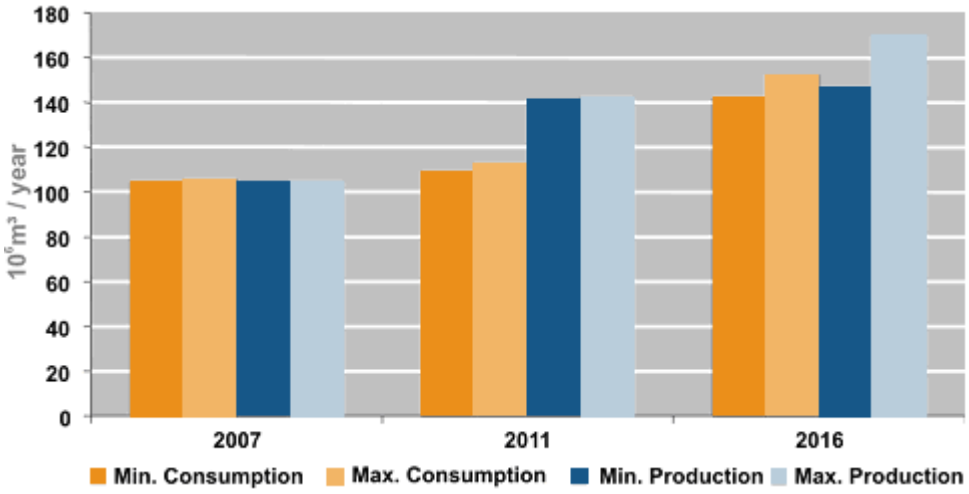
Source: EPE



Graph 12

Forecast of Oil Consumption and Production in Brazil

Source: EPE



3.4.4 Electricity

Over the last ten years growth in electricity consumption in Brazil has been restricted due to the power crisis at the start of the century. In 2005, Brazil had 93.2 MW installed capacity, including the Brazilian share of Itaipu, and has produced 402.9 TWh, 84% of which is hydropower. Growing demand and installed capacity of electricity is shown in Table 7 and Graph 13.

Table 7

Growth Rates %

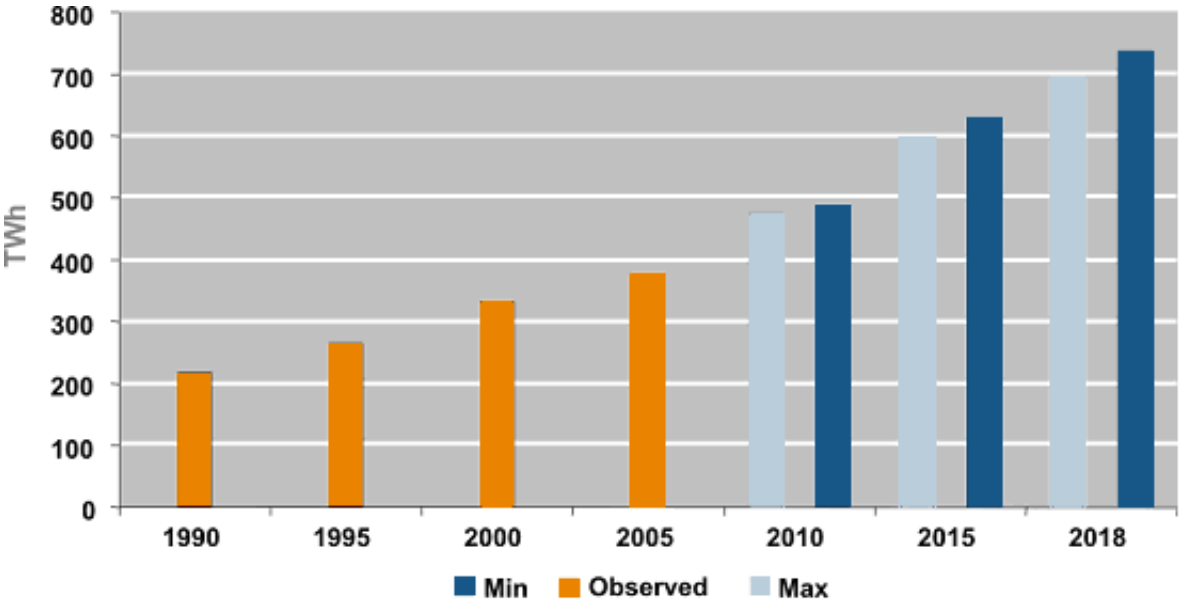
Source: OLADE (LAEO)

Period	Demand growth	Installed Capacity	
	% (year)	Basic (%)	Alternative (%)
2005-2010	4.0	4.2	5.0
2010-2015	4.8	3.8	4.8
2015-2018	5.0	3.1	3.7
2005-2018	4.5	3.58	4.6

Graph 13

Electricity Consumption in Brazil (TWh), Forecast from 2010

Source: EPE



Brazil will continue to build hydropower plants, complemented by thermal plants using natural gas, coal and those burning sugarcane bagasse. It will also have higher nuclear capacity and more alternative energy sources. Table 8 shows forecasts of final energy consumption in Brazil until 2030.

Table 8

Forecast of Final Energy Consumption (ktep)

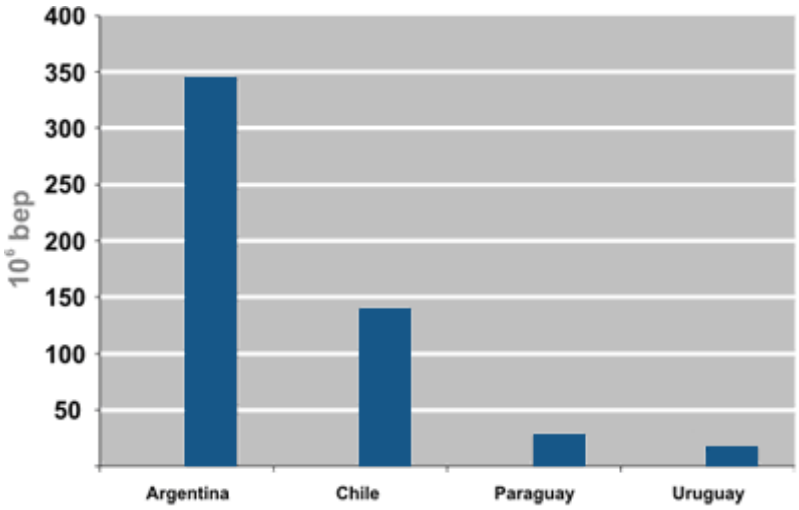
Source: EPE

	2005	2010	2020	2030	% p.a. 2005-2030
SCENARIO (mean)	**165,044**	**206,149**	**288,663**	**402,821**	**3.6**
Petroleum by-products	66,875	81,784	109,593	150,613	3.3
Electricity	31,103	40,346	58,618	85,325	4.1
Sugarcane products	20,046	25,087	39,240	60,289	4.5
Natural gas	9,411	13,756	22,259	32,645	5.1
Coal	9,938	14,338	22,850	26,349	4.0
Firewood & charcoal	22,367	22,792	22,811	25,174	0.5
Biodiesel	-	2,115	4,019	9,715	7.9
Other	5,304	5,932	9,274	12,711	3.6

Graph 14

Demand for Primary Energy in the Southern Cone (kbep p.a.)

Source: Olade (LAEO)



3.5 Southern Cone

The Southern Cone comprises Argentina, Chile, Paraguay and Uruguay. The largest consumer of primary energy in the region is Argentina, while Uruguay and Paraguay have similar consumption to that of the Central American countries.

The percentage of petroleum and by-products in the energy mix of Uruguay is 51%, in Chile 43%, Argentina 37% and 14% in Paraguay. Hydropower is significant in Paraguay (62%) and Uruguay (33%), while natural gas is essential in Argentina (49%) and Uruguay (16%). Primary energy demand per country is presented in Graph 14.

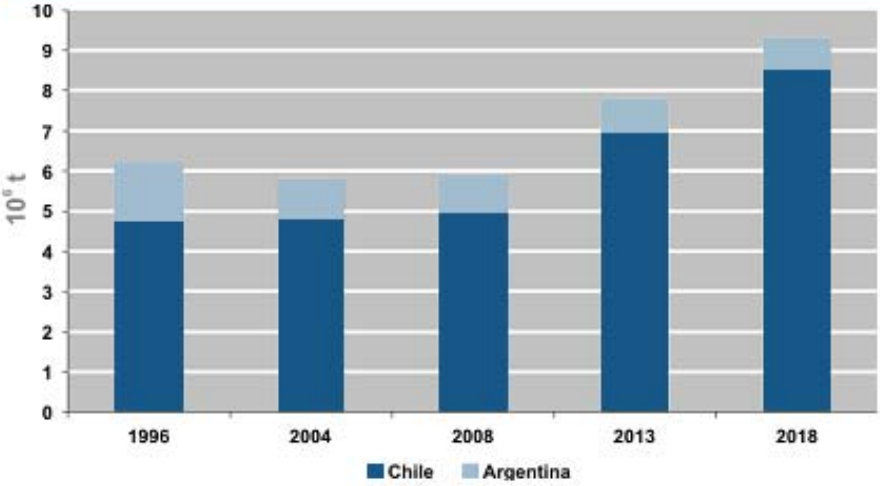
3.5.1 Coal

Chile and Argentina both have coal reserves. Chile uses coal in thermal plants, 90% of coal is imported from Australia, Indonesia and Colombia. Argentina uses local coal in steelmaking and to a lesser extent in supplementing hydropower generation. Demand forecast in Chile and Argentina is displayed in Graph 15.

Graph 15

Coal Demand in Southern Cone, Forecast from 2008

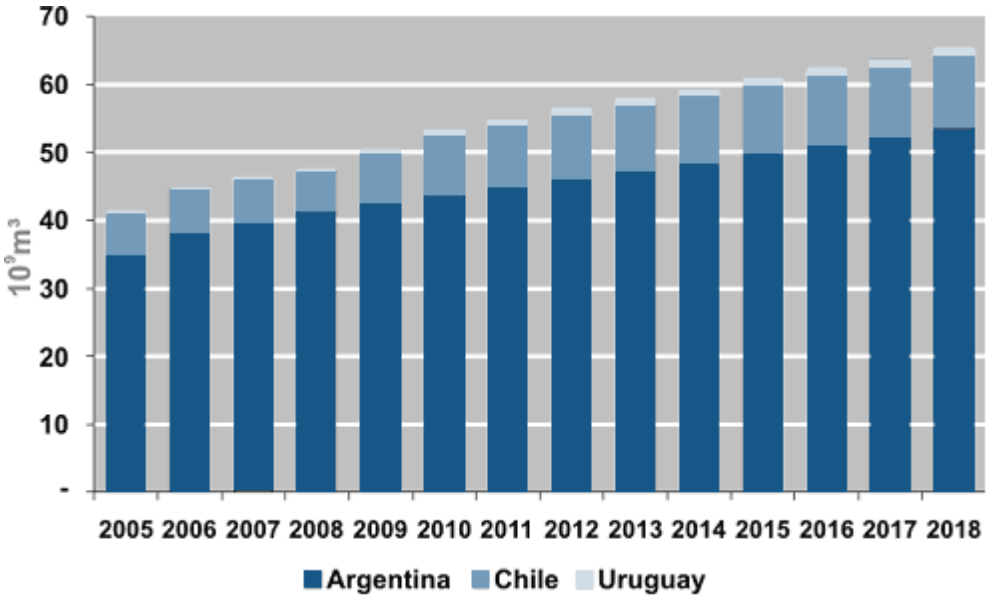
Source: Olade (LAEO)



Graph 16

Forecasts Demand for Natural Gas in the Southern Cone

Source: WEC, based on data from the Energy Board (Argentina)/CNE (Chile)



3.5.2 Natural Gas

Argentina is the major natural gas producer in the region, exporting to Chile, Uruguay and Brazil. The region is currently in a crisis due to gas supply problems in Argentina. Chile is considering importing LPG. Bolivia has to increase current production to supply the natural gas demand by the Southern Cone and Brazil. Regional forecasts of higher consumption are exhibited in Graph 16.

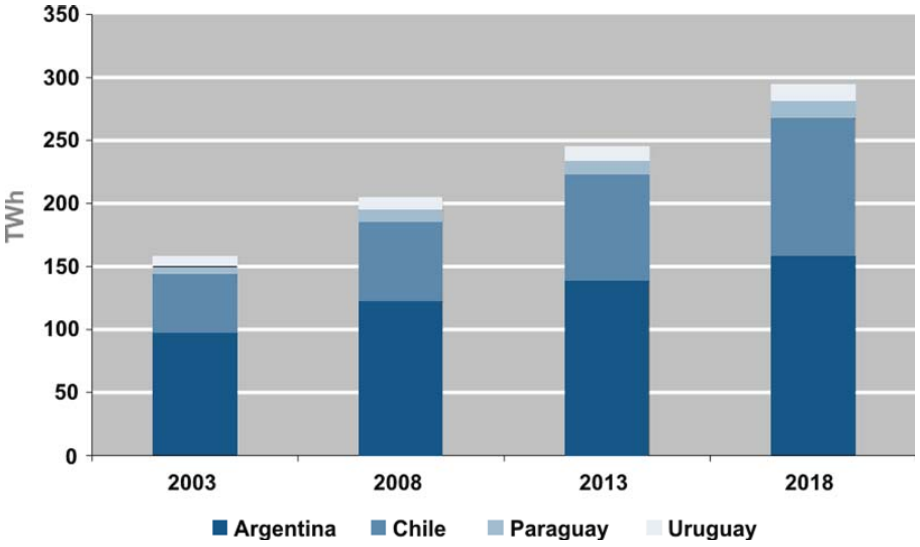
3.5.3 Petroleum

The largest oil reserves in the Southern Cone are to be found in Argentina. No oil is produced in Uruguay and Paraguay while oil production in Chile is small. Chile imports oil from Argentina, Brazil, Nigeria and Peru. Forecasts in Graph 17 show that with an increase in demand Chile, Uruguay and Paraguay will have to import oil from another region, since the Argentinean reserves shall be used internally.

Graph 17

Oil Demand in Southern Cone, Forecast from 2008

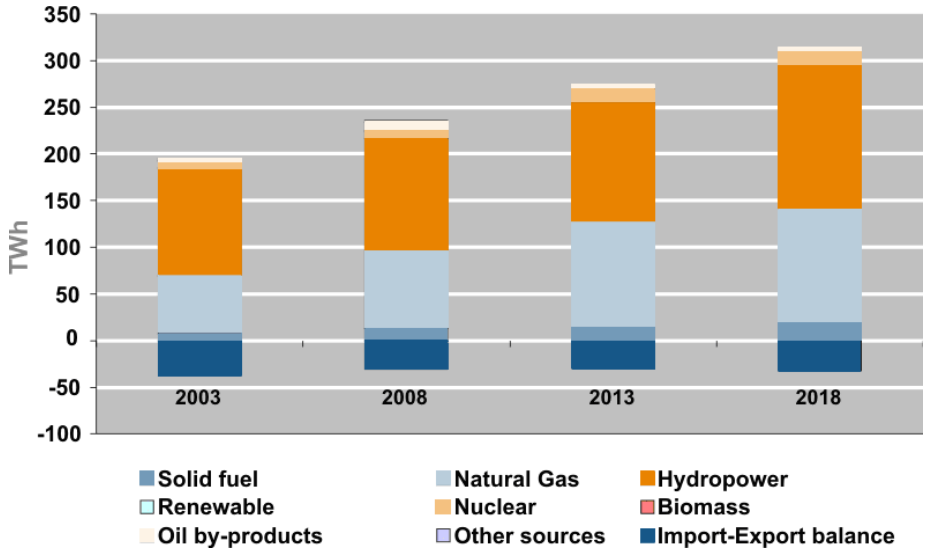
Source: OLADE (LAEO)



Graph 18

Electricity Supply in the Southern Cone, per source, Forecast from 2008

Source: OLADE (LAEO)



3.5.4 Electricity

In 2003 consumption in the Southern Cone was 158 TWh. Argentina (61%), Chile (29%), Uruguay (5%) and Paraguay (4%). Electricity supply and demand in the Southern Cone is shown in Graphs 18 and 19.

Expected energy growth rates in the studied regions – Central America, Andean countries, Brazil and the Southern Cone are consolidated in Tables 9, 10, 11 and 12.

Aggregate electricity consumption will reach 1,340.4 TWh by 2018 (Table 9). Expected annual growth rates in the five regions are not so different, between 3.3% and 5.1%. It is estimated that North Brazil will have a higher growth rate in consumption, and that the two Brazilian macro-regions together will account for more than 50% of the total regional consumption.

Graph 19

Electricity Demand in Countries in the Southern Cone, Forecasts from 2008

Source: OLADE (LAEO)

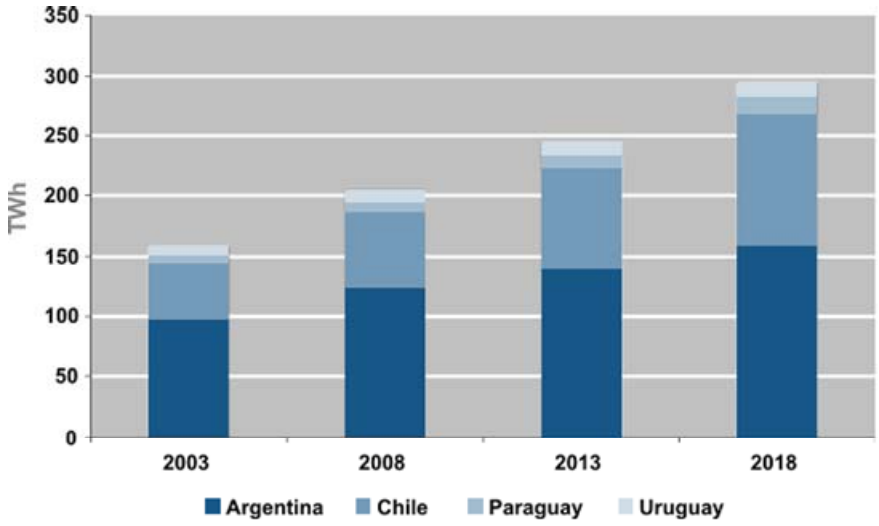


Table 9
Electricity Demand Forecast (TWh)
Source: WEC

	2008	2013	2018
CA Isthmus	39.0	49.1	61.8
Southern Cone	201.9	242.3	291.3
ACN	197.0	234.6	272.7
North Brazil	89.2	116.3	156.5
South Brazil	346.0	440.1	558.0
Total	**873.1**	**1082.4**	**1340.4**

In the case of natural gas, consumption is expected to rise at a much faster rate, between 3.5% and 13% a year. By 2015, total daily consumption by the five macro-regions could reach 165.7 million m³. The Southern Cone will continue to have the highest consumption of natural gas, but the strongly growing demand in the other Brazilian macro-regions should bring them closer to Southern Cone consumption. It is worth mentioning that the studies suggest a sharp rise in natural gas consumption in the Central American Isthmus. Table 10 shows the expected performance.

Expected annual growth rates of coal (2.3%) and petroleum (3.4%) consumption are much lower than those for electricity (4.4%) and natural gas (5.7%). Tables 11 and 12 show the forecasts of the coal and petroleum demand per bloc.

Table 10
Natural Gas Demand Forecasts (10^6 m^3)
Source: WEC, CAN data 2004

	2006	2010	2015
CA Isthmus	3.20	4.81	7.02
Southern Cone	44.2	52.0	59.9
ACN	35.5	46.5	53.8
North Brazil	5.3	15.2	16.0
South Brazil	12.7	24.1	29.0
Total	**100.9**	**142.7**	**165.7**

Table 11
Coal Demand Forecasts (t)
Source: WEC, Brazilian data 2005

	2004	2013	2018
Southern Cone	5.8	7.8	9.2
ACN	4.4	6.1	7.2
Brazil	39.1	46.4	51.6
Total	**49.3**	**60.2**	**68.0**

Table 12
Oil Demand Forecast (10^3 m^3)
Source: WEC

	2008	2013	2018
Southern Cone	48.0	54.0	61.5
ACN	77.0	89.9	104.9
North Brazil	26.1	27.9	35.4
South Brazil	53.4	63.2	84.9
Total	**204.5**	**235.0**	**286.6**

3.6 Fossil Fuel Emissions

When compared to other countries in the world, as figure 4 shows, the region produces lower fossil fuel emissions, and shall continue doing so due to clean sources that will be used to meet the energy demand growth.

Figure 4
Fossil Fuel Emissions
Source: Embrapa/IEA

	ton/inhab	ton/km^2		ton/inhab	ton/km^2
USA	20.14	710	Europe	7.93	472
Canada	19.24	69	China	4.07	555
Australia	20.24	53	World	4.37	209
Holland	16.44	6,493	Latin America	3.1	71
Germany	10.24	2,365	Brazil	1.9	42
Japan	9.65	3,256	Africa	1.2	34

Table 13

Growth of per capita income (% p.a.)

Source: IPEA, A. Maddison "The World Economy & Historical Statistics", OECD

Countries	1820-1900	1900-1950	1950-1960	1960-1980	1980-2005	1990-2005
Brazil	0.06	2.25	4.22	4.47	0.31	0.85
Argentina	0.94	1.19	1.09	1.97	(0.22)	1.48
Chile	n. d.	(0.31)	1.23	1.43	2.70	3.76
Mexico	0.47	1.10	2.92	3.51	0.58	1.53

3.7 GDP Growth

Table 13 shows historical data for some of the main countries in the region but the economies of these countries, with the exception of Chile, were less dynamic in a more recently.

However, the price of the region's exportable commodities and fast economic growth of large importing countries such as China and India, helped the region to recover, creating positive prospects for a period of sustainable growth.

Forecasts for final energy consumption by source can be found in Annex V, e.g. Natural solid fuels, natural gas, crude oil, hydropower, other renewable sources, nuclear energy, biomass, petroleum by-products etc, per country in Latin America and the Caribbean.

The average growth rates forecasts of the GDP for the region are given in Table 14.

Table 14

GDP growth forecasts (% p.a.)

Source: OLADE (LAEO)

Period	Growth Rate
2005-2010	4.8
2010-2015	4.5
2015-2020	4.5

4. Institutional Regulatory Organisation

Principal aspects of regulatory frameworks and institutional arrangements of gas and electricity for each country in the four regions – Central America, the Andean countries, Brazil, and the Southern Cone - are described in detail below. The existing tariff system is shown in Annex III.

4.1 Central America

Institutionally, Central American countries have different strategies for formulating policies and regulating their energy sectors. There is always a political aspect: ministries are involved and the Administration is responsible for drawing up the national energy policy with the support of specialised technical bureaux.

In the hydrocarbon sub-sector, the rules and regulations governing upstream activities – even when insignificant or non-existent – have been assigned to specialise technical bureaux (Hydrocarbon Bureaux) attached to the respective ministries. In most countries, they are also responsible for the price and tariff policy, and supervising the quality of fuel supply services (downstream).

Although all the countries have bodies that are self-sufficient or do not depend on the Administration for regulating public services, only Costa Rica has included the hydrocarbon sub-sector in the jurisdiction of its regulatory agency (ARESEP). Honduras has, since September 2006, divided the duties of the Petroleum Technical Unit among the different technical units of the Administrative Committee for Buying, Selling and Trading of Petroleum and its By-products (CAP) which, in turn, directly signs exclusivity contracts for buying and selling hydrocarbons. Reforms in Nicaragua in 2007 gave rise to the Ministry of Energy and Mines again taking over many hydrocarbon regulations, as well as supervision and inspection duties that the Nicaraguan Energy Institute had been managing.

In El Salvador, Guatemala and Panama, the enforcement authority of the fuel supply regime is the same Hydrocarbon Board that is part of the ministerial organisation chart. According to the El Salvador's Gas Bill, activities related to the supply of natural gas are also directly regulated by the Ministry of Economy.

In short, there is only a small market in the sub-sector's hydrocarbon framework, especially with reference to network supply.

All Central American countries have special bodies within the electricity sector in charge of regulating the electric power supply:

- Public Utilities Commission (Belize);
- Regulatory Authority for Public Services (Costa Rica);
- Superintendence of Electricity and Telecommunications (El Salvador);
- National Electricity Commission (Guatemala);
- National Energy Commission (Honduras);
- Nicaraguan Energy Institute (Nicaragua); and
- National Authority for Public Services (Panama).

Central American countries have regulations for the exploration and production of hydrocarbons, as well as for hydrocarbon trade and supply, but in view of the lack of a natural gas market there are no specific regulations for the services corresponding to this sub-sector.

4.1.1 Natural Gas

Central American countries have regulations for the exploration and production of hydrocarbons, as well as for hydrocarbon trade and supply, but in view of the lack of a natural gas market there are no specific regulations for the services corresponding to this sub-sector. In some cases, the hydrocarbon laws refer to natural gas, but always in relation to general exploration and production activities.

Only El Salvador (which has a project for the construction of an LNG re-gasification plant) has a Natural Gas Bill for regulating reception, storage, re-gasification, transport, distribution and marketing natural gas. This initiative assumes that the activities will be accomplished by the private sector which would be granted the following authorisations: construction and operation of storage plants; construction and operation of natural gas service stations for vehicles; garages to convert vehicles to natural gas; and modular gas transport. Authority would also include concessions for gas transport by pipelines, for the distribution of gas through networks, for licences granted to authorisation and concession holders to operate their facilities, and export permits.

According to the project, natural gas imports will only require the prior registration of the importer. A gas export authorisation is subject to continuing domestic supply. The regulatory framework is wide in the sense of encouraging competition in the future natural gas industry (for example, transport and distribution activities are divided), although it provides for the possibility that both concessions are granted to the same corporation if this should be a requirement for new projects. Various regulatory aspects will be determined by regulations, such as the characteristics of the tariff regime (“stamp” or distance transport tariff). Tariff revision is foreseen to be undertaken every four years, and so are other circumstances under which an extraordinary revision can be requested.

At a regional level, a study is now underway to develop a strategy for the introduction of natural gas in the Isthmus. This study includes a proposal for a Framework Agreement to regulate the future regional gas market. The conclusions of the study and the project for the Framework Agreement will be available shortly, after publication by the Inter-American Development Bank.

Basically, the study recommends sanctioning a minimum of common regulation for the six countries of the Isthmus and for the other participants in the project (Mexico and Colombia); this is to be achieved through a framework agreement or treaty for the promotion of the development of the infrastructure and the regulation of international gas transactions that will use this infrastructure. According to the agenda of the Framework Agreement, the countries are committed to endeavour sanctioning the specific national regulatory frameworks for natural gas that are compatible with the basic principles defined in the Framework Agreement.

Institutionally, the project recommends the creation of at least three regional entities:

- a **Governing Board** comprising a representative for each country with jurisdiction over the formulation of the gas integration policy to be put in charge of facilitating the fulfilment of the commitments undertaken by the participating states for realising the project;
- a **Regulator** with regulatory and normative power to be in charge of controlling and supervising the enforcement of the common rules governing the regional natural gas market; and
- a **Regional Transport Operator** to be the technical body in charge of the regional dispatch of natural gas.

Unlike the case of electricity for which there was already an organised market within each country at the time of the creation of the regional market, natural gas - a new industry - has more flexibility to determine the organisation of the industry and its regulatory framework, both at regional and local level.

4.1.2 Electricity

In the electricity sector, it is important to stress that Central American countries already have a Framework Agreement for the regulation of regional electricity exchanges.

On 30 December 1996, the governments of Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama signed the Framework Agreement on the Central American Electricity Market related to the project for the interconnection of national markets through the Sepia Line (the project is being implemented).

The main characteristic of the **Regional Electricity Market (MER)** is that it is considered to be a seventh market coexisting with the national markets. Harmonising national regulations is planned than a regulatory unification.

The objective of the MER Framework Agreement is *"the gradual formation and development of a regional competitive Electricity Market. (…) based on reciprocal non-discriminatory treatment that will contribute to the sustainable development of the region within a framework of respect for, and protection of, the environment"* (Section 1).

Besides establishing the rights and obligations of the parties, the MER Framework Agreement is designed:

- to establish the necessary conditions for the growth of the MER which should supply the electricity required for the economic and social development of Central American countries in a sustainable way;
- to encourage a greater and more competitive private participation in the electricity sector;

- to encourage the interconnection infrastructure necessary for the development of the MER;
- to create the conditions necessary for contributing to an acceptable quality, reliability and safety of the electricity supply in the region;
- to enforce objective, transparent and non-discriminatory rules to regulate the operation of the MER and the relationships between the agents, as well as creating suitable regional entities to achieve these aims;
- to pave the way for the benefits derived from the MER to reach all the inhabitants of the countries of the region.

The **MER Framework Agreement** is based on the following principles: **competition** (freedom in the development of service rendering based on objective, transparent and non-discriminatory rules); **gradualness** (provisions for the progressive evolution of MER through the incorporation of new participants, the progressive increase in co-ordinated operation (the development of interconnection networks and the strengthening of regional bodies); and **reciprocity** (right of each State to apply to other States the same rules and regulations that the State applies temporarily according to the gradualness principle).

The Regional Electricity Market is defined as "*the place where regional electricity buying and selling transactions are performed between market agents*". It is foreseen that the MER will evolve gradually towards a wider, more open and more competitive situation, in accordance with the development of a regional and national infrastructure.

MER transactions include:

- **short-term exchanges** arising from an energy dispatch based on regional economic criteria; and
- **mid and long-term contracts**.

MER Agents comprise all the agents from national wholesale markets recognised as such by the legislation of each country: electricity generation, transmission, distribution and marketing companies, as well as major consumers. If the country's legislation allows one company to carry out two or more activities that company must create separate business units allowing a clear identification of the costs of each activity.

The MER Framework Agreement provides – among others - the following guarantees to the Agents:

- the right to buy and sell electricity freely, without discrimination;
- free access to regional and national transmission networks;
- exemption from electricity transit, import and export taxes that discriminate between market transactions.

The Framework Agreement commits the governments to endeavour to develop the MER into increasingly competitive stages. They will perform joint assessments at least every two years

based on recommendations made by the regional regulator.

In accordance with the MER Framework Agreement, the following regional organisations have been created:

- **Regional Electric Interconnection Commission (CRIE)**: it is the MER regulating agency which must ensure the fulfilment of the Framework Agreement and secure the development and the consolidation of the market. It has legal capacity and legal status under international public law and it has to establish its headquarters in a Central American country. Its members include a Commissioner for each country, appointed by government for a 5-year term. Its administrative and technical structure is determined according to the needs. The CRIE is empowered to issue regulations on the operation of the MER, to take measures to guarantee competition and non-discrimination conditions, to impose sanctions and to solve conflicts between the Agents. Its activity is backed by a regulation and supervision charge. The CRIE is economically and functionally independent and has technical expertise.
- **The Regional Operating Agency (EOR)** is in charge of regional electricity operation and dispatch according to economic, safety, quality and reliability criteria. Operational functions are performed in co-ordination with the national dispatch bodies. The EOR has legal capacity and a legal status under international public law and is domiciled in a Central American country. It is administered by a Board of Directors comprising two directors for each party appointed by each government upon a proposal by the Agents for a 5-year term. The EOR is in charge of the business management of transactions among Agents. It is responsible for the formulation of the indicative expansion plan of regional generation and transmission and backs – by supplying information - the MER evolution processes. The resources to run it will basically ensue from charges on operational service of the system approved by the CRIE. The EOR is economically and functionally independent and has technical expertise.
- **The Grid Proprietor (EPR)** is the company in charge of the design, development, financing, construction, and upkeep of the first regional transmission system called ‘SIEPAC Line’. According to the Framework Agreement, the EPR is governed by private law and is domiciled in a Central American country. For its constitution, it was decided that each country would appoint a government agency to participate in EPR, which could be of public capital or have private participation. No member can have controlling interest in the company. Besides, according to the legal procedures in each country, by the Agreement the EPR were given the respective authorisations to build and exploit the first regional interconnection system for an extendable 30-year period. Regional transmission companies will not be able to generate electric power or carry out distribution or trading activities and cannot be major consumers.

Table 15

Summary of the Institutional Structures in the Energy Sector

Source: WEC

Country	Energy Exchange	Natural Gas	Electricity	Electricity Market Regulator
Costa Rica	Deficit – Hydrocarbons import	No	Generation: private participation Transmission and distribution: Costa Rica Energy Institute (ICE). Trade: exclusive Expansion decisions: by the State.	ARESEP
El Salvador	Deficit – Hydrocarbons import	LNG Project	Generation: private companies and some state-owned companies.. Distribution: mostly private. Expansion decisions: by the market	SIGET
Guatemala	Deficit – Exports crude but imports of refined products	No	Generation: hydropower by the State and thermal by private companies. Transmission: totally state-owned. Expansion decisions: by the state.	CNEE
Honduras	Deficit – Hydrocarbons import	No	National Energy Utility (ENEE) operates in the three segments. Private participation is allowed, except for transmission. Expansion decisions: by the State.	CNE
Nicaragua	Deficit – Hydrocarbons import	No	The State operates in the three segments. Private participation is important in distribution and is forbidden for transmission (fully operated by state-owned ENTRESA). Expansion decisions: by the state.	INE
Panama	Deficit – Hydrocarbons import	Project from Colombia	Generation and distribution are in private hands. State-owned Panamanian Transmission Company (ETESA) controls transmission. Expansion decisions: by the state.	ANASEP

Moreover, the Second Protocol created the MER Board of Directors, comprising a representative of each State with jurisdiction on the formulation of the electricity integration policy of their country in relation to the MER.

In event of settlement of disputes the following was stipulated:

i. Disputes between the national Agents, the System Operator and the market, the Regional Operating Entity, and regulators of the parties that are not settled by negotiation shall be submitted to the CRIE to settle the issue as a friendly counsellor through conciliation or as arbitrator. In all cases the decision is final and binding.

ii. Disputes between the governments with reference to the interpretation and application of the Agreement: if they cannot be settled by direct negotiation through diplomatic channels within a six-month term, the governments may, through specific agreement, submit them to a conciliation procedure through the CRIE and, failing that, to an ad hoc arbitration tribunal whose arbitrators shall be appointed upon agreement of the parties. The arbitration tribunal will take decisions based on International Law principles and adopt its own procedure.

At a regulatory and institutional level, the electricity sector in Central America's sub-regions experienced great progress in the integration process.

4.2. Andean Countries

4.2.1 Natural Gas

In all Andean countries, except for Venezuela, major reforms have taken place since the nineties, impacting on the institutional structure and the regulatory framework of the natural gas sector. In general, these reforms led to a reformulation of the State's role and allowed the private sector to act as entrepreneurs; the State continued to be policy-maker and regulator.

In the upstream, the natural gas prospecting and extraction regulations were altered mainly to attract foreign risk capital, thereby increasing available reserves. Thus, most countries created several incentives to attract foreign investment, such as reduction of taxes and of royalty percentages, extension of the concession terms, a greater participation in production and freedom to export by eliminating the domestic market supply obligation.

Bolivia

Bolivia has had two entirely different legal systems. The first, in effect from April 1996 to April 2005 was based on incentive concessions to the private sector in order to attract foreign investment for the Bolivian hydrocarbon sector. The State no longer acted directly in the segment, assuming the role of supervisor. The second, introduced in May 2005, determined the nationalisation of all hydrocarbons and a return to the former role of the State. In the majority of cases it acted through the **Yacimientos Petrolíferos Fiscales Bolivianos (YPFB)** in all the oil and natural gas chain segments.

The first system was based on the Hydrocarbons Act (Law no. 1689) which defined a new regulatory framework for the Bolivian gas sector, establishing the ways/models of development of the natural gas industry as well as the characteristics of the regulatory entity and market regulation mechanisms. The gas chain was unbundled and mixed partnerships occurred in each of the different stages.

YPFB stopped direct natural gas exploitation and extraction; these activities are now carried out exclusively by private companies through risk contracts shared with the state-owned oil company. Moreover, 50% of the exploitation areas were transferred to private initiative while the other 50% remained under the control of YPFB. The 1996 legislation also determined the division of the regions in the country with hydrocarbon potential into eight geological provinces totalling an area of 45,000 square kilometres.

The transport of hydrocarbons and distribution of natural gas through grids that used to be under the monopoly of YPFB became the object of administrative concessions for a limited period. The Transredes Company which operated the Bolivian part of the GasBol became the concessionaire of transport services.

As a result of the in-depth reform of the Bolivian natural gas sector, 38 foreign oil companies started operations in the country during the second half of the nineties. Even though Law 1690 had been successful in attracting companies to the upstream, tax income failed to follow the production increase because royalties were cut from 50% to 18%.

Furthermore, the natural gas export prices to Brazil and to Argentina were established at levels below those on the international market.[10]

This situation unleashed a social crusade to recover the property rights to the country's natural resources. This crusade reached its peak with a national referendum on changes in the regulatory framework. A new Hydrocarbons Law was passed in 2005, but became effective only in 2006. The new decree established a period of 180 days for the shared risk contracts signed with foreign oil companies operating in the country to be adapted to the new legislation.[11] Companies that decided to continue to operate in Bolivia had their stock control transferred to the YPFB. Foreign companies would become "service providers" while the Bolivian State would compensate them for the loss of their local subsidiaries control. Neither amount nor term for this payment were stipulated in the decree and will have to be negotiated case-by-case.

Furthermore, decree 3058 increased the income tax on hydrocarbons paid by the private companies to 32% (IDH). Since they are also obliged to pay 18% of their royalties besides other taxes, the new decree raises the tax burden on oil and natural gas extraction in Bolivia to 82% of the value of production on the larger fields with a production above 100 million cubic feet/day. The new Hydrocarbons Law also imposed limits on volume as well as on price for marketing these resources. The domestic market became the main priority and private wholesalers were eliminated from the trading chain.

The purpose of the new Law is to increase the revenue of the Bolivian State by giving back to YPFB control over the country's natural resources privatised during the second half of the nineties. However, the decree lacks complementary regulations, and the uncertainty of foreign companies due to the unilateral breach of contracts

[10] In the case of Brazil, for example, prices in contracts signed between YPFB and Petrobras were set to be those at the entrance of the GasBol in Rio Grande. The initial price corresponded to a supply of as much as 16 million m³/day at US$0.95 per million of BTU for the first year of the contract. This amount could be progressively increased during the 20 following years, until it reached US$1.06 per million BTU. Additionally, prices could be adjusted every six months, based on a basket of petroleum by-products (reference prices of low quality fuel oil), and was subject to revisions every five years. The price for volumes over 16 million m³/day was fixed at US$1.20 per million BTU.

[11] For instance, the new contract signed by Petrobras and the YPFB in 2006 determined that: (i) Petrobras continues responsible for the operation of the fields of San Alberto and San Antonio; (ii) the YPFB is responsible for marketing the hydrocarbons produced; (iii) the total value of the production at wellhead is divided as follows: 50% paid to the Bolivian state as royalties, participation and IDH. From the remaining 50%, Petrobras has the right to recover its costs, including the investments made and operational and depreciation costs. The remaining amounts are divided between the YPFB and Petrobras in accordance with a chart, previously agreed upon, whose main determinants are production level, depreciation rate, prices, volumes produced and taxes collected. If the company makes new investments, these will also be included in costs recoverable by the company; (iv) the term of the contract was increased to 30 years; and (v) current assets still belong to Petrobras. At the end of the contract, these assets will pass into the hands of the YPFB. Materials and equipment directly linked to exploitation and production activities that have been acquired after the contract has been signed will become the property of the YPFB after they have been totally amortised (Petrobras, August 2006).

generated, at least initially, a standstill in the Bolivian natural gas sector.[12]

YPFB was not prepared to carry out all the duties that were assigned to it through the nationalisation decree. An example is that the company, due to the elimination of private wholesalers from the distribution chain, became the country's only distributor and wholesale importer. This led to a generalised lack of fuel supply which obliged the government to partially recant. A decree authorising the YPFB to sign contracts with wholesalers was issued to guarantee the country's supply, at least temporarily.

The main administrator of the Bolivian natural gas sector is the **Ministry of Economic Development (MDE)** to which the Vice-Ministry of Energy and Hydrocarbons is subordinated. They are in charge of proposing, drawing up and enforcing the sector policy, as well as of fostering investments in the hydrocarbons sector and of leading the process of assigning prospecting and production areas.

Also subordinated to the MDE is the **Sector Regulation System (Sirese)** created in October 1994 to regulate, control, and supervise the activities of the hydrocarbon sector. These functions are performed through the **Superintendence of Hydrocarbons (SH)** linked to it. This unit, also created in October 1994, is in charge of regulating, controlling and supervising activities related to concessions, prospecting and production licenses, the transport of natural gas and liquid hydrocarbons, besides the domestic trading of refined petroleum products and natural gas with the purpose of avoiding monopolistic practices. Highlights among its responsibilities are their task of inspecting the construction and operation of gas pipelines and of equipment used by the natural gas industry; setting price caps for marketing natural gas on the domestic market; setting rates for transporting gas through pipelines; and inspecting the natural gas distribution grid.

YPFB, as representative of the Bolivian State and owner of all the hydrocarbons produced in the country, resumed their trading activities. They began to draw up conditions and to stipulate volumes and prices for the domestic market, as well as for export and industrialisation.

Colombia

The first law for oil and natural gas exploitation in Colombia includes a Legislative Decree proclaimed in 1974. It established that the exploratory risk was exclusive to the private sector and that, in case commercially viable fields were discovered, the investments necessary for their development would be equally shared by Ecopetrol and the companies associated to it. 20% of the royalties would be due to the State.

In 1994, new changes were made in the natural gas segment which had until then been an Ecopetrol state-owned monopoly with a vertically integrated structure. After the proclamation of the Public Services Law a reorganisation of the gas

[12] The fact that the wording of the new contracts to which the foreign companies must migrate has not been defined, hampers any progress in the negotiations. The manner in which the new IDH will be charged was also not defined.

supply was started. Ecopetrol was obliged to sell all its shares in local distribution companies to private companies and the gas chain became segmented into production, transportation and distribution activities. Gas also started to be traded on the wholesale market.

With the discovery of large natural gas fields, especially Cuisiana, the construction of the transport infrastructure gained momentum in the domestic market. The construction of gas pipelines to supply Bogota, Cali and Medellin led, in 1997, to the creation of the state-owned company Ecogas as a decentralised entity of the State. Ecogas operates, maintains, and exploits its own gas pipelines and those of third parties in which case an availability tax is paid. When Ecogas was founded, all the gas pipelines and availability contracts which until then had been operated by Ecopetrol were transferred to the new company. Thus, natural gas transport was no longer a monopoly of Ecopetrol. Access to the gas pipelines was freed and transport was unbundled since Ecopetrol also sold its shares in Promigas, the main domestic natural gas transportation company.

In 2000, the Colombian government decided to introduce new modifications in the contract system in force, mainly in the upstream. They wanted to attract more risk capital to oil and natural gas prospecting and extraction activities, to extend reserves and to increase production capacity. Specifically, regarding natural gas, the private companies acting in the country complained mostly about the high taxes and the high costs due to the conflict generated by the occupation of part of the national territory by guerrillas. Due to these factors and the low vertical integration of private companies, Colombian gas became less competitive on the international market.

Between 2000 and 2002, even though 64 new hydrocarbon exploration contracts had been signed in Colombia – a record for the country - results were discouraging. Only some small fields were discovered. As oil production increased, their reserves decreased about 6% during that period. Natural gas reserves also showed a marked decline due to the re-evaluation of the proven reserves of large fields discovered in the second half of the nineties. Concerned regarding the possibility of becoming a net importer of hydrocarbons in the Medium-term, the Colombian government decided to totally restructure its hydrocarbon sector and to this end promulgated, Decree Law 1760 in 2003.

In order to render Ecopetrol more competitive, it would no longer act simultaneously as regulator and Oil Company, devoting itself only to the industrial and commercial activities in the oil and gas chains owned by the State. A new agency, the Hydrocarbon National Agency (ANH) linked to the Ministry of Mines and Energy (MME) took over the role of administrating and regulating the Colombian hydrocarbon resources.

Another important change introduced by Decree 1760 refers to the nature of the hydrocarbons exploration contracts. The association model was abandoned in favour of another that foresees the payment of royalties, taxes, and rights associated to three different stages and separates the activities that compose the upstream of the oil and

gas chain: prospecting, evaluation, and extraction. As a result, Colombian State participated on an average with between 50% and 60% in the revenues from natural gas production

Today, the **Ministry of Mines and Energy (MME)** are the Colombian Legislative power for the natural gas industry. They are responsible for drawing up the sector policies, defining the criteria for hydrocarbon production, and setting natural gas wellhead prices.

ANH, subordinated to the MME, but with financial and budgetary autonomy is the agency in charge to regulating, managing and auctioning the use of Colombian hydrocarbon resources.

The **Mining and Energy Planning Unit (UPME)** founded in 1993 and also subordinated to the MME, is the agency responsible for the integrated planning of the sector, resolving the energy requirements of the population, and defining the short, medium and long term sector plans. It has administrative and budgetary autonomy.

The Energy and Gas Regulation Commission (CREG) founded in 1994 and linked to the MME is the agency that regulates all the aspects related to natural-gas transport, distribution and trading. Its task is to establish the methodology of the tariff calculation and to issue the corresponding resolutions.[13]

The Superintendence of Public Services (SSPD) created in 1994 is linked to the Ministry of Economic Development and is in charge of inspecting and controlling all the companies that provide public services to households, including those of natural gas. Its operations cover supervision of the flow of natural gas through the pipelines system until delivery in order to assure service quality and avoid economic damage.

Ecuador

Ecuador does not have a truly legal framework for natural gas. There are some guidelines related to gas production in fields that may be operated by private companies. If companies involved in hydrocarbon prospecting and exploration discover commercially viable fields in their contract area they may freely sign additional contracts for natural gas exploration.

Besides being responsible for the entire natural gas trade, Petroecuador also operates in the production, transport and distribution segments.

The Ministry of Energy and Mines (MEM) is the main agency responsible for defining policy. The Hydrocarbon National Direction ensures they regulate and control the performance of the sector.

Peru

Until the early nineties, there existed no regulatory framework for natural gas in Peru. The first law, the Hydrocarbons Act (Law 26221), was passed in

[13] The CREG may also prohibit natural gas export in the following cases: (i) whenever there are users in the country whose physical and financial infrastructure allows the gas supply, but whose demand is not being met; (ii) when the estimated reserves are inferior to six years; (iii) when there are transitory restrictions to the fuel supply or transport.

1993. It abolished Petroperu's monopoly in the activities that comprise the downstream of the oil and natural gas chain and created several incentives for private companies that operated in the upstream in order to increase the foreign investments in this segment.[14] Conditions for the performance in the transport, distribution and trading of hydrocarbons were made flexible by a number of measures such as the elimination of the obligation to ensure domestic market supply and the freeing of profit repatriation.

In 2000, to continue opening the hydrocarbon sector to foreign investments, the Hydrocarbon Update Law was passed. It focused on the upstream stages. Thanks to it, the demands for companies operating in the exploration stages were reduced and their concession terms were extended. Three years later, modifications to the royalties' calculation methodology were made, reducing the percentages charged. From a level of between 15% and 35%, the royalties now dropped to between 5% and 20% and took the companies' production levels into consideration.

The legislation dealing specifically with natural gas also underwent several changes as of 2003, before the imminent coming on stream of the Camisea field. Initially, companies active in production were obliged to ensure the domestic market supply for a permanent 20-year time frame and in June 2005 this was decreed, which paved the way to facilitating natural gas exports.

Currently, the sector is segmented vertically; transporters as well as distributors must give free access to the transport capacity of their systems whenever there is availability regarding the contracted demand.

Since Petroperu went private in the second half of the nineties (1990), prospecting and extracting natural gas is controlled by foreign companies under licensed contracts with the State; there are several contract models including operation and risk participation, but auctions predominate. Producers may dispose integrally of their gas production thus assuring free competition.

Thus, they may negotiate supply contracts with transporters, distributors and major users directly. Through the General Hydrocarbon Administration, the Energy and Mines Department (MEM) is the main legislative body responsible for normative and legal questions related to the entire chain of oil and natural gas. It can propose and evaluate policies and grant licenses and concessions for hydrocarbon exploitation in the country.

The Higher Bureau of Investment in Energy (Osinerg) was founded in 1996 and is part of the Supervision System of Investments in Energy linked to the MEM. It includes a regulatory entity in charge of compliance with the legal and technical provisions related to hydrocarbon sector activities, thus ensuring the quality and the efficiency of the services rendered by concessionaires to end-users. Through the Energy Regulatory Commission, the Osinerg is also responsible for setting rates charged by distributors to end-users who do not contract their supply independently.

[14] Petroperu was the owner of all oil refineries.

Venezuela

Until the end of the nineties, Venezuela did not have a specific legislation for the natural gas segment. This evidences the little importance they given to gas until recently. The Hydrocarbon Organic Gas Law which provided a legal framework for the industry was only promulgated in 1999. The following year, the National Gas Entity (Enagas) was created.

The Ministry of Energy and Oil (MEP) is the main legislative body of the hydrocarbon sector. It is responsible for defining the regulatory framework and setting tariffs based on information provided by Enagas.[15]

Enagas is linked to the Ministry of Energy and Oil but has functional autonomy. It is in charge of facilitating the sector's development at all stages of the natural-gas activities. Enagas is also in charge of regulating gas transport, distribution and trade.

The PDVSA Gas company, founded in January 1998, focussing on prospecting and extraction of non-associated gas, as well as on the extraction and processing of Natural Gas Liquids (NLG). The company is also active in natural gas transport, trade and distribution. It has the monopoly in the first two stages of the downstream operations.

CVP administrates all business matters involving PDVSA and national or foreign oil companies. It is also responsible for financing all operations linked to the energy infrastructure.

Since 2006, all private companies in Venezuela operate in the oil and gas sector based on a system called 'Mixed Companies' in which the government maintains a share above 50% of the capital. By their statutes, these companies are obliged to reinvest a portion of their gross turnover in the development of the region where they operate. The State has the right to a share equivalent to a minimum of 50% of the gross revenues from the oil activity. The Mixed Companies may not trade either oil or natural gas even if they extracted and own the resources. Trading is a State monopoly exercised through PDVSA or its subsidiaries.

Based on the above, it can be concluded that in two Andean countries, Colombia and Peru, private sector plays the main role in the development of the natural gas industry. In other two nations, Bolivia and Venezuela, the State is still the main actor. Finally, in Ecuador, due to the weakness of its natural gas industry, institutional and regulatory frameworks are not yet in place, as shown in Table 16.

[15] Gas prices in the so-called delivery centres are "regionally set through an administrative mechanism that tries to simulate the market behaviour by calculating the value of the fuel for a specific application (for example, reinsertion to increase the oil production), taking into consideration not only the marginal costs of long term production, transport and distribution, but also the balance between long-term supply and demand". (LAEO, 2004)

Table 16
Synthesis of the Legal Framework of the Natural Gas Industry
Source: WEC

Country	Prospecting and Production	Transport	Distribution
Bolivia	The state retains the ownership of the hydrocarbons. YPFB drafts the concession contracts and associates with companies where it has majority holding and control of operations.	YPFB monopoly	YPFB and temporary concessions divided in geographic areas with exclusivity. Prices regulated by the Government.
Colombia	Through contracts. Ecopetrol enters into partnership with private companies with a minority stake (30%)	Controlled by two companies (Ecogas and Prolmgas)	Concessions divided in geographic areas with exclusivity. Government regulated prices.
Ecuador	The state retains total control of the upstream plants, but activities are carried-out by private companies.	Controlled by Petroecuador.	Concessions divided in geographic areas with exclusivity
Peru	The state retains the ownership of the hydrocarbons. This right is licensed to the private sector by contracts negotiated by Petroperu.	Licence and service contracts.	License and service contracts divided in geographic areas with exclusivity
Venezuela	Private companies may participate mainly in non-associated natural gas, always associated with PDVSA, which has majority holding and control of operations.	Monopoly of PDVSA Gas or of its subsidiaries.	PDVSA Gas and concessions divided in geographic areas with exclusivity. Government regulated prices.

4.2.2 Electricity

At the beginning of the nineties, the electricity system of the Andean countries was in a critical situation, caused by the lack of resources to guarantee the necessary investments to increase the supply and assure the upkeep of the existing infrastructure. Due to this situation, several Andean countries began reorganisation of their electricity systems. In general, they tried to separate the State's roles, in order to allow the private sector to act as entrepreneur and foster investments while the government was restricted to the role of policy maker and regulator. In Peru, Bolivia and Ecuador regulation agencies were created, but linked to the Ministries. In Colombia an independent regulatory agency was created, supervised by the government, while the task of defining policies was assigned to the Administration. Only Venezuela did not make any substantial change to the structure of its electric system.

As a result of implemented changes, the Andean countries, except for Venezuela, adopted some ways to trade energy with the obligatory participation by market players. Generally, that meant the creation of wholesale electricity markets. The common motivation was to create competition in the electricity system in order to improve an infrastructure that could not meet the growing demand for electricity, and to attract foreign investments and allow expansion of the installed capacity.

The fact that all the countries in the region suffered hydropower shortages due to the high reliance on hydraulic sources to meet the domestic demand led them to encourage a more comprehensive energy integration that would improve the reliability of supply. A fundamental step in this direction was taken in 2002, with the approval of ACN Decision

536. Through this "General Framework for the Sub-regional Interconnection of Electricity Systems and Electricity Intra-community Exchange", a juridical communitarian framework was established to facilitate the development of the energy sector among the member countries.[16] Besides, conditions were created to offer incentives to the development of an infrastructure based on the common use of the transmission networks. The purpose was a transmission network built, preferably using the "built-operate-transfer" model, to operate a co-ordinated economic dispatch since both would belong to a single regional transmission system.[17]

Among the fundamental rules for international transactions among member countries, established since Decision 536 the highlights are:

- **No price discrimination between national and foreign markets and no subsidies**, tariffs or any other kind of restrictions to the intra-communitarian trade of energy should be created;
- **Free access to international interconnected lines** is guaranteed.
- **Free contracting** is allowed among the agents of the electricity market of the countries, provided the contracts are signed in agreement with the legislation and the frameworks in force in each country. No restrictions can be imposed, aside from those already stipulated in the contracts for national markets;
- **Short-term international electricity transactions are compulsory.** They are not subject to surpluses and limited only by the capacity of the international links.
- **Revenue** that may arise from congestion charges of an international link **shall not be credited to their owners.**
- **Electricity prices at both ends of the intra-communitarian interconnections** arising from physical flows determined by co-ordinated "economic dispatches" serve as a **basis for setting the value of short-term international electricity transactions**.

[16] The agreements that enable the harmonisation of the regulatory frameworks in the Andean Region have as main background the Meeting of Cartagena de Indias, Colombia, in September 2001, in which the Agreement for the Interconnection of the Electricity System and the International Energy Interchange was signed. The agreements made within the framework established by the Ministries of Mines and Energy and the regulatory entities of the Andean countries were translated into ANC Decision 536.

17 As it requires supra-national co-ordination of the decision and construction planning process of the transmission nets, as well as of the international unions, the Andean Committee of Standard Bureaus was created, backed by Decision 536 and Regulatory Agencies of Electricity Services. The performance of this bureau is centred on two working groups: The Working Group of Electricity Service Regulatory Bureaus, created in June 2003, is responsible for formulating proposals that allow making progress in the standard marks of the harmonisation process necessary for the implementation of the sub-regional interconnection of the electric systems and the electricity intra-communitarian interchange. The Working Group of Planner Organisms of Electricity Services created in January 2004, is in charge of drawing up proposals that (i) assure the co-ordinated action of the energy and electricity entities of the Member Countries, (ii) permit access to information and (iii) guarantee co-ordinated planning of projects for regional integration.

Since then there has been progress in the development of regulatory frameworks of the Andean countries, especially concerning standard and commercial aspects which enabled them to take the first steps towards a major interconnection of the national electric systems to improve efficiency and cut the costs. In 2003 Colombia and Ecuador, for example, harmonised the regulatory frameworks of their respective electric power sectors, resulting in the interconnection and the synchronised operation of the national electricity systems of both countries. There are also interconnection lines between Colombia and Venezuela, as well as between Peru and Ecuador. Several other projects are being executed or planned.

It should be mentioned that expansion of international interconnections in the Andean region, besides providing quality benefits mainly related to higher reliability of supply, also produces several quantitative benefits that translate into greater economic efficiency. This arises from decreased use of non-renewable fuels and then replacement by better use of the existing generating capacity and, principally, from a better use of the water stored in the reservoirs of three countries: Ecuador, Peru and Colombia. These interconnections also allow the use of idle infrastructure and make better use of other assets e.g. thermal generation, which at present is not used in Colombia, could be essential for the “Central de Paute” in Ecuador that causes high volatility in the domestic prices.

Bolivia

The regulatory framework of the Bolivian electricity sector is based on five instruments:

1. **The Law of Electricity promulgated in 1994;**
2. **the Law of Sector Regulation of 1994;**
3. **the Rule of Transmission Quality established in July 1997;**
4. **the Rule of Operation of the Electric Market (ROME); and**
5. **the Rule of Prices and Tariffs.**

The last two were approved in 2001. ROME deals with concessions, licenses, use of public property, electric power services, quality of supply and application of sanctions and penalties. In order to operate in the sector, only a license from the **Superintendence of Electricity (SUPERELE)** is required.

The main Organisation of the Bolivian electricity sector is the **Ministry of Public Works (MOP)** to which the **Vice-Ministry of Alternative Energies and Electricity (VEEA)** is subordinated. The VEEA is in charge of proposing, preparing and enforcing policies, as well as facilitating investments in the hydrocarbon and energy sectors.

The National Committee of Load Dispatch, subordinated to the VEEA, was created to administrate the Wholesale Electricity Market and co-ordinate electric power generation, transmission and marketing at a minimum cost to the STI in order to assure reliability of supply in every area of

the country. Every six months, this Committee draws up a Program for Medium-term Operation which is used as reference for determining the expansion needs of the transmission system, as well as for defining regulations and obligatory procedures for the agents working in the Market.

Another important Organisation of the Bolivian electric power sector is the **Sector Regulation System (SIRESE)** linked to the Ministry of Economic Development. Founded in October 1994, it is responsible for regulating, controlling and supervising public services, including electricity and is achieved through its Electricity Superintendence. The SIRESE is also in charge of supervising the performance of the CNDC.

The Electricity Act determines that the expansion of transmission installations is the responsibility of users requesting an increase of supply; and they must agree with the financing or a payment to the transmission company. The expansions require the approval of the SUPERELE through a respective transmission license. Such licenses may also be granted on request by an interested party or by public tender when there are competing bidding requests or in the case of projects identified by the State.

To incorporate new installations in the STI which are paid for by all the participants in the Wholesale Electricity Market, a report from the CNDC is necessary, stating that they are beneficial to the system; they must also be approved by the SUPERELE.

The Bolivian wholesale electricity market, which is where energy, power and ancillary services transactions are performed, is based on a contracts market where there is free price agreement between sellers and buyers and on a spot market where prices are controlled. Only consumers with a demand equal to or above 1MW are considered Non-Regulated Consumers and are permitted to negotiate freely with the generating companies.

Colombia

During the fifties, the Colombian Electricity Market became completely state-owned. This situation continued until the beginning of the nineties when there was electric power rationing throughout the whole country. This was caused by administrative, operational and financial deficiencies in the electricity companies operations, which had accumulated over the years. At that point, a restructuring process began in the Colombian electric sector. The first decree to this end (Decree No. 700) was issued at the beginning of 1992. Among other measures, it defined the rules for the entry of private investors into the generation activity. In 1994, a new regulatory framework for the sector was promulgated through the Electricity Act which introduced free competition in the sector and imposed limits to the vertical integration of the electricity companies.[18] Trading was incorporated in generation, transmission and distribution operations, giving rise to a wholesale electricity market.

[18] For example, no company could have more than 25% installed generation capacity, trade activity on the national interconnected system, and distribution activity. Additionally, no generating company could have over 25% of the share capital of a distribution company.

In this market, the regulatory framework divides users into two categories: regulated and non-regulated, and free. The first are subject to uniform contracts and to the tariffs established by the State through a general tariff formula. The second may negotiate a bilateral contract with the energy trader and the prices of sales are free to be agreed upon between the parties.

The main regulatory agency of the electricity industry is the Ministry of Energy and Mines (MEM). It is not only responsible for establishing policies, but also for regulating, planning and co-ordinating activities related to the electricity services.

The **Mining and Energy Planning Unit (UPME)**, founded in 1993, is also subordinated to the MME and is responsible for the integrated, indicative planning of the sector, for determining the energy requirements of the population, and defining short-medium- and long-term plans, including expansion decisions. It has budgetary and administrative autonomy.[19]

The **Gas and Energy Regulatory Commission (CREG)** created in 1994, and linked to the MME, regulates all aspects related to the supply of electric power as public services. It establishes tariff calculation methodology and defines corresponding resolutions. It also assures free competition and prevents market power abuse in the supply of the public electricity utility.

The Superintendence of Public Services (SSPD), also created in 1994, is linked to the Ministry of Economic Development and is responsible for inspecting and controlling all companies that provide domestic public services. It is also responsible for supervising the CREG.

Expansion planning of all the international links is the responsibility of the UPME which performs this task in partnership with the planning departments of the country members of ACN and those countries with which Colombia has regulatory market integration.

Ecuador

The Ecuadorian electricity sector was reformed in the second half of the nineties to replace a structure centred on companies that controlled total electric power activity. These reforms gave rise to a system based on competition with benefits to clients by providing improved prices and services. The most important change took place in October 1996, with the establishment of the Electricity Sector System Act (LRSE) where electricity sector activities were divided into three components: generation, transmission and distribution. A Wholesale Electricity Market was created. However, the main actors in the Ecuadorian electricity system are still the state-owned companies, at present constituted as limited companies. Although LRSE established free access to the distribution and transmission systems, it also gave a legal monopoly of

[19] To prepare the Transmission Expansion Plan which is updated annually and has a horizon of at least 10 years, the UPME is supported by a Transmission Planning Advisory Committee (CAPT), integrated by companies that work in all the segments of the electric chain as well as by major consumers.

transmission in Ecuador at a national level to the state-owned Transelectric S.A.

The regulatory framework, like the other Andean countries, divided the users into two categories: regulated and non-regulated, and free. The first are subject to state standards, while the second, which are those with demands equal to or over 1MW, may negotiate their energy needs freely with the generating companies.

The Ministry of Mines and Energy (MEM) is the main agency responsible for determining the rules for economic dispatch. MEM regulates the performance of the Wholesale Electricity Market, ensures that legislation is observed and rules on concessions. It also establishes the basis for regulated tariff calculation and ensures enforcement.

The National Centre for Energy Control (CENACE), integrated as generation, transmission and distribution companies and major consumers, is responsible for technical and economic management of energy through the National Interconnected System in order to guarantee precise operation. It is also responsible for the administration of transactions in the Wholesale Energy Market.

Peru

The Ministry of Energy and Mines (MEM) is the main agency of the Peruvian Legislative power for energy issues, responsible for planning of the transmission system of SEIN and of international links. It is also a task of MEM to promote private investment.

MEM acts through the General Directorate for Electricity, which is the body in charge of proposing and issuing the standards for electricity generation, transmission, distribution and trade; signing electric power concession contracts; and granting electricity generation concessions. It also draws a Referential Electricity Plan, which guides all the investments of the sector. The General Directorate for Electricity is also responsible for the coordination of the planning processes with the planning agencies of the ACN countries.

The Higher Energy Investment Organisation (Osinerg), created in December 1996 as part of the Energy Investment Supervisor System, operates in the framework of MEM. It includes a regulatory body that operates as inspector of local and technical actions related to the electricity sector, to supervise the quality and efficiency of the services provided to the users by the concessionary companies. Osinerg is also responsible, through the **Energy Regulatory Commission (CREG)**, for defining tariffs imposed by distributors on the end users, who do not contract their supply in an independent way.

Peru already has a **Committee of the Economic Operation of the System (COES)**, integrating the companies in generation and transmission of the interconnected system, with the purpose of guaranteeing trade at minimum cost and the settlement of transactions on the Wholesale Electricity Market. This covers transactions of all clients with a demand below 1MW. Clients with

demand equal to or over 1MW are free to pursue their supply.

Legal framework establishes that the transmission may be operated both by national and foreign companies. Only in situations where the plants may affect State assets and/or which require an obligatory supply, is it necessary for a concession. In other situations, transmission may be operated freely, as long as it complies with technical environmental rules and National Cultural Heritage.

Generators or customers requiring electric transmission lines or substations other than those constituting the transmission system, pay for them (called Secondary Transmission Systems) according to the criteria defined by Osinerg. They pay a toll, equivalent to 100% of the mean annual cost of the secondary market, to supply or obtain energy from the main system.

Venezuela

The Venezuelan electricity sector has, since the end of the nineties begun a reform process which, however, did not result in a well-defined policy. Reforms began in September 1999, when the Electric Sector & Organisation Law (Law No. 36791) was passed and thus established the basis for the creation of the Wholesale Electric Market by segmenting and unbundling generation, transmission and distribution companies to guarantee free access to energy transport and distribution activities. In December 2001, this legislation was complemented by the Electricity Service Organisation Law which specified the creation of a **National Electricity Commission (CNEE)**.

The start of the Venezuelan energy wholesale market was delayed a number of times. Only in December 2006, with the approval of Decree No. 5026, the **National Electricity System Management Centre (CNG)** was it created. It is responsible for controlling, supervising and co-ordinating the integrated operations of generation and transmission resources that comprise the National Electricity System. The CNG is also responsible for administration of the Electricity Wholesale Market.

In 2007 Venezuelan Government, through a Decree, determined the nationalisation and reorganisation of the national electricity sector. The new law, although stipulating that the electricity sector is to be state-owned, does not alter regulations regarding energy generation, transmission, distribution and trade; these continue to be the subject of the Electricity Service Organisation Law. The government's intention is to concentrate the entire electricity sector in a new corporation, the **Corporation Electrical National S.A. (CORPORELEC)** linked to the **Ministry of Oil and Energy (MENPET)**.

CORPORELEC will be a state-owned company in charge of generation, transmission, distribution and trade of electricity load and energy and will be responsible for the centralised operation of the National Electric System. The Federal Government will retain 75% of its stock, while the Petróleos de Venezuela S.A. (PDVSA) will own the remaining 25%. All shares in the Venezuelan public electricity

Table 17

Summary of Institutional Structures and Regulatory Frameworks of Electricity Markets

Source: Inter-American Development Bank, "Energy Integration in the Andean Pact", June 2002

Notes: Bolivia – National Committee for Load Dispatch (CNDC). **Colombia** – Energy & Gas Regulation Committee (CREG): National Operation Council (CON): National Planning Department (DNP) and Superintendence of Household Public Utilities (SSPD). **Ecuador**: National Electricity Council (CONELEC) and National Energy Control Centre (CENACE). **Peru:** National Energy Council (CNE); General Electricity Board (DGE) and Energy Tariff Committee (CTE). **Venezuela:** National Electricity Committee (CNEE) and National Management Centre (CNG)

Basic Functions	Bolivia	Colombia	Ecuador	Peru	Venezuela
Definition of the sector's policy	Electricity Superintendence	MME	CONELEC, CONAM & CENACE	CNE	MENPET
Regulatory supervision	Electricity Superintendence	MME, MH & DNP	CONELEC	CNE	MENPET
Technical rules and regulations	Electricity Superintendence	CREG	CONELEC & CENACE	DGE	CNEE
Operational rules and regulations	Electricity Superintendence	CREG & CNO	CENACE	DEG	CNG
Tariff definition and approval	Electricity Superintendence	CREG	CONELEC	CTE	CNEE & MENPET
Concessions authorisations	Electricity Superintendence	MME, MH & DNP	COMOSEL	DGE	MENPET
Competition supervision	Electricity Superintendence	SSPD		DGE	CNEE
Expansion plans	Electricity Superintendence	UPME & agents	CONELEC	CNE	CNEE & CNG
Service quality	CNDC	CREG	CONELEC	CNE	CNEE

companies will be transferred to CORPORELEC of which they will be subsidiaries. A three-year period has been defined for the implementation.[20]

Currently, the remuneration to companies in the transport segment is based on Decree No. 368 which established rules for tariff definition in the electricity sector. It stipulates that the remuneration of electric power service companies will be calculated according to the fixed investment method, where a company has the right to profit based on the Mean Liquid Assets each year and a part of the working capital of the company. For the specific case of transmission, the profit was established at 4%, in accordance with guidelines set by the regulator.

MENPET is the main regulatory agency of the Venezuelan electricity sector, responsible for the definition of policies as well as for the operational

[20] The state-owned companies that will be grouped in the CORPORELEC at the moment of its creation are: CV G Electrificación del Caroní S.A. (Edelca), C.A. Energía Eléctrica de Venezuela (Enelven) and its subsidiaries. C.A. de Administración y Fomento Eléctrico Nacional (CADAFE) and its subsidiaries, C.A. La Electricidad de Caracas (ELECAR), C.A. Energía Eléctrica de la Costa Oriental (ENELCO), Energía Eléctrica de Barquisimeto (ENELBAR), Sistema Eléctrico do Estado de Nueva Sparta (SENECA), C.A. Luz y Fuerza Eléctrica de Puerto Cabello (CALIFE), Electricidad de Ciudad Bolívar (ELEBOL).

framework. High voltage international exchanges are subject to its approval.

MENPET operates in the electricity sector through the Energy Vice-Minister's Office. This unit is in charge of administrating the sector by formulating policies, and planning and controlling electric power services as a whole. It also defines regulatory policies and is in charge of concessions in transmission and distribution, as well as concession permits.

The activities of MENPET are carried out by several agencies. CNEE, the main one and created in 1992, functions as regulator, supervisor, inspector and controller of the activities in electric services. Even though it is linked to MENPET, the Commission has administrative and budgetary autonomy. Amongst other responsibilities, it is also responsible for setting prices and tariffs in the electric sector, defining technical and operational parameters for transmission and distribution activities, establishing management rules for the electric system, and defining the rules and general follow-up of the operations.

Quality of service is controlled by the **Bureau for the Operation of the Interconnected System (OPSIS)** which like CNEE is linked to MENPET but has functional autonomy. It is responsible for promoting the development of the electricity sector, guaranteeing competition and regulating transport, distribution and electricity trade activities.

Administration of the Wholesale Electricity Market, as well as control and co-ordination of the integrated operations of generation and transmission of the National Electric System is in charge of CNG. It is state-owned, established as a limited company, and also linked to MENPET.

Lastly, MENPET is also backed by the **Foundation for the Economic Development (FUNDELEC)**, created in 1992 to give technical support to several agencies of the Venezuelan Executive for the electricity sector. Its purpose is to guarantee the rationalisation and consolidate the regulatory activities of the State regarding electricity service provision and use.

4.3 Brazil

In the early nineties, the Brazilian economy faced a major crisis. The import substitution strategy adopted in the fifties no longer improved economic development. The government decided to radically change its strategy for growth, initiating these changes by opening the Brazilian economy. The new strategy focused on productivity and efficiency instead of the past focus on filling gaps in the input-output matrix. The macroeconomic stabilisation programme launched in 1994 assumed that the extremely unfavourable fiscal situation prevented state-owned companies from acquiring the financial muscle to develop the energy system. This context opened the window for constitutional amendments allowing freeing and privatising the energy system.

In spite of strong pressure exerted by nationalists, Congress approved a legislation that removed the constitutional monopoly on the hydrocarbons market from Petrobras and the constitutional ownership monopoly on hydropower plants from Brazilians. The **National Bank for Development**

(BNDES) took radical privatisation measures in a field where it was easier to make this move: the electric power sector. For the hydrocarbons market, a far more complicated political issue, an incremental approach was adopted.

4.3.1 Natural Gas

The privatisation of Petrobras faced fierce opposition. Unlike the electric power companies, Petrobras had a track record of technical and financial efficiency confirmed by international awards. Privatising the company would create a de facto private monopoly and the alternative of unbundling the company into several small companies was likely to cause inefficiencies. An incremental approach was adopted for freeing the hydrocarbons market (de Oliveira, 1996).

In 1997, the **Brazilian petroleum regulatory agency (ANP)** was created to regulate the market. To open the Brazilian market, Petrobras was encouraged to develop its operations internationally, e.g. by swapping Brazilian shares in the Brazilian market with shares in international companies elsewhere. State-owned companies with gas distribution networks were privatised in São Paulo and Rio de Janeiro. Although natural gas prices for end-consumers continue to be regulated at state (local) level[21], oil prices have not been subject to government approval since 2002.

Nevertheless, Petrobras still dominates the hydrocarbons market. The company has the logistics needed to transport, store, import and export petroleum, petroleum products and natural gas. National hydrocarbons, as well as their import and export, are controlled by Petrobras which has minority shares in all city-gas distribution companies, except for those in the states of Rio de Janeiro and São Paulo. However, Petrobras dominance is likely to fade gradually. The company currently produces 92% of national petroleum, but develops 74% of the new oil fields, exploring only 52% of the blocks licensed by the ANP.[22]

Companies have to pay an initial bonus if they acquire the right to explore a block[23], and a tax on land use while searching for or producing hydrocarbons. When hydrocarbons production starts, they pay royalties and, occasionally, when their fields are very productive, a proportion of their revenues.[24]

The supply of natural gas is in its infancy. The network of trunk pipelines required to transport gas from producing areas to the city gates, and the network of pipelines needed to reach consumers, are as yet underdeveloped. Only in the metropolitan areas of São Paulo and Rio are a fair number of consumers supplied with natural gas. Natural gas transport to the city gates is regulated

[21] The Brazilian constitution gives to the states the authority to regulate city-gas distribution to end-consumers.

[22] Hydrocarbon resources are the property of the Federal Government, but subject to exploitation under licensing conditions imposed by the ANP. The 9th licensing round took place in 2007.

[23] Winners must buy a stipulated minimum amount of their materials and services in Brazil.

[24] See ANNEX 3.

Table 18

Summary of the Regulatory Structure of the Natural Gas Industry

Source: WEC

Notes:

(a) CNPE – National Energy Policy Council; MME – Ministry of Mines & Energy.

(b) Petrobras – Petróleo Brasileiro S.A.

(c) Art. 177 of the Brazilian Constitution (CRFB): The following are a monopoly of the Federation: I – exploration and exploitation of oil, natural gas and other liquid hydrocarbons; II – refining of domestic and foreign oil; III – import and export of the resulting basic products and by-products; IV – maritime transport of national crude oil and of basic petroleum by-products produced in Brazil, as well as the transport by pipeline of crude oil, its by-products, and of natural gas. The Federation may outsource exploration and extraction of oil, natural gas and oil refining, as well as she importation and transport of oil and natural gas to state-owned and private corporations.

(d) Art. 25 of the CRFB: The States are in charge of exploiting local city gas services directly or by means of a concession.

Structure	Industry Policy: CNPE[a]; MME[a]
Exploration and Production (Union Monopoly)[c] • Exploration and exploitation concessions with state[b] or private companies granted by ANP, within the framework of Law 9478/97. Free gas prices.	**Regulator** • ANP - Brazilian regulatory agency for Petroleum, Natural Gas and Biofuels.
Transport (Union Monopoly)[c] • Authorisation granted by ANP with state[b] or private companies, within the framework of Law 9478/97. Open access.	• ANP is in charge of regulation, contracts and control of the economic activities of the petroleum, natural gas and bio-fuel industry.
Distribution • Gas pipeline distribution system (Individual States Monopoly)[d] operated by state or private companies and subject to the regulation of the States Agencies.	• State Regulatory Agencies [d] (Regulation of local city gas services) • Brazilian regulatory agency for petroleum, natural gas and biofuels – ANP. (Regulation of

by the ANP. Distribution companies are regulated by state agencies under monopolistic license contracts signed with state governments. Their rates to end-consumers are similar to those charged by electric power distribution companies (price cap).

Both oil and trunk natural gas pipelines are dominated by Petrobras. Rates for the use of pipelines are bilaterally negotiated between owners and users, ANP acting as mediator whenever no agreement is reached. There is a sole rate for the Bolivia-Brazil pipeline (postal regime), while the other pipelines have rates set according to the distance between the gas inflow into and outflow from the pipeline.

Gas imported from Bolivia is priced at the city gates in accordance with a contract signed by Petrobras with Bolivian suppliers, and the prices passed on to Brazilian consumers.[25] National natural gas prices at the city gates are free, but prices charged by Petrobras aim at rapidly increasing the share of natural gas in the energy balance. The gas bubble from take-or-pay contracts prompted this policy with Bolivian suppliers that were unable to find the expected demand in the electric power system. The governments support this policy by offering tax incentives to consumers.

[25] The contract has a base price in US$ that is reviewed every three months to be in line with fuel oil prices on the international market and inflation in America.

4.3.2 Electricity

The privatisation of electric power companies was relatively easy to implement (de Oliveira, 1996). BNDES up-front loans in state governments smoothed the progress of their companies' privatisation[26]. Private companies largely control distribution (a market share of 88%). Nevertheless, power generation continues to be dominated by state-owned companies (a market share of 67%), most of them under federal control.

In the North, Eletronorte and CHESF (state-owned companies) are major suppliers to the interconnected grid, but the region is a net importer of electric power. In the South, Itaipú (a bi-national company shared by Brazil and Paraguay) has dispatch priority to the interconnected grid, but several private and state-owned companies compete for the supply to distribution companies and free consumers. Gas-fired thermal power plants are few in the north, but relevant in the south. Coal-fired power plants and nuclear power plants are situated in the south. Management of the hydro reservoirs is crucial for the reliability of the interconnected grid.

BNDES privatised the distribution companies based on the price-cap system adopted in the reform undertaken in England and Wales for setting rates for consumers (Surrey, 1996). Non-controllable costs (e.g., wholesale electricity prices and taxes) of distribution companies are passed directly on to rates, but controllable costs (e.g., investments and personnel) are indexed to inflation, minus an "X" factor that reflects forecasted rises in productivity. The base line of the rates is reviewed every five years (along with the "X" factor) to allow a fair rate of return on controllable costs.[27] These regulations work relatively well, despite initial discontent among consumers and distribution companies.[28]

To monitor the electric power industry, the Congress passed a law creating an **independent regulatory electricity agency (ANEEL)** and a **non-profit civil association of power companies (ONS - National Electric System Operator)** was created to operate the grid and co-ordinate the competitive dispatch of the reformed electric power market. A **Wholesale Electricity Market Administration (CCEE)** clears financial flows among generators, distribution companies and consumers.

Electric Power companies were required to divide their bulk power transmission operations. Transmission-line concessions are offered by ANEEL at public auctions where the winner is

[26] Macroeconomic stabilisation put in evidence the extremely bad financial situation of the states.

[27] A special rate review can be requested if unusual circumstances prevented the distribution company from earning the expected fair return on their investments.

[28] Consumers were unhappy with the general price index chosen for the annual tariffs review. This index is largely influenced by the Real exchange rate and the Real suffered large devaluations in 1999 and 2002. Distribution companies did not like that they could not automatically pass on their non-controllable costs, nor did they like the regulator's decision to use a *reference* distribution company for their first five-year tariff review. The Real's value rose substantially between 2005 and 2006, diminishing both consumer and distribution companies discontent with the price-cap tariff system.

awarded a long-term contract stipulating a price indexed to inflation, but has to guarantee availability standards to avoid financial fines. The ONS operates the grid using a cost-plus basis[29] passed down on to generators and consumers.

Privatisation and liberalisation generation proved far more complicated.[30] Electric power sector officials strongly opposed both, arguing that central co-ordination of the water flow is essential for the efficient economic dispatch of the Brazilian hydro-dominated power system.[31] Moreover, they forecast the underdevelopment of the untapped hydropower potential because thermal power projects would gain substantial competitive advantage in a liberalised electric power market.[32] Eventually, the Government decided to continue its privatisation policy, but to protect hydropower plants from the hydrological risk.

Large consumers and distribution companies have to buy their power using bilateral contracts or the spot market, which clears differences between contracts and actual generation (or consumption). Four regional spot prices (south, southeast/centre-west, northeast and north) are calculated by the ONS, using the same set of computer models employed to manage the hydro-reservoirs in the traditional monopolistic institutional arrangement.[33]

A **financial mechanism (MRE)** guarantees each hydropower plant a volume of electric power (called assured energy) that can be sold to consumers regardless of real power generation.[34] As in the traditional monopolistic arrangement, thermal power plants are expected to stay idle when hydrology is favourable (flexibility) or to declare a 'must run' for their dispatch (inflexibility). Most of the time, flexible thermal plants buy cheap hydropower (below the fuel cost) on the spot market to honour their contracts.

The inflexibility of thermal plants reduces the reliability of the Brazilian power system during unfavourable hydrological periods such as that experienced between 1999 and 2001. Aiming to solve this problem, the current government radically changed the wholesale power market. The concept of assured energy was extended to thermal plants and their fuel costs were passed on to captive consumers. Their capacity factors are,

[29] Grid rates are calculated by summing up the transmission-line costs and the grid operational costs of ONS.

[30] Cement producers, dams and transmission line constructors, and hydro-turbine producers have a major interest in the construction of hydropower plants.

[31] The set of models employed for the co-ordinated monopolistic dispatch of the power system was used to estimate the power output of an "uncoordinated dispatch" (i.e., market competition). These studies suggested that competition could cause a loss of 30% of generating capacity due to spilled water and other operational inefficiencies (Santos, 1996).

[32] These power plants have a lower capital cost and can exploit the large availability of low- cost hydropower in the hydrological favourable periods to also reduce their fuel cost.

[33] These power plants have a lower capital cost and can exploit the large availability of low- cost hydropower in the hydrological favourable periods to also reduce their fuel cost.

[34] The Energy Reallocation Mechanism (Portuguese acronym MRE) provides financial compensation for the differences between actual generation and the *assured* energy of the electric power plants. The *assured* energy (like the guaranteed energy of the monopolistic past) of the electric power system is calculated according to the set of dispatching models, assuming future scenarios of natural energy flows to the hydro dams.

Table 19
Summary of Institutional Structure of the Electricity Market

Source: WEC

Notes:

(a) CNPE – National Energy Policy Council; MME – Ministry of Mines & Energy; ANEEL – National Electricity Agency; ONS – National Electricity System Operator; CCEE – Chamber of Commerce for Electricity; SEN (MME) – Energy Secretariat of MME; EPE – Energy Research Company; CMSE – Committee for Monitoring the Electricity Sector; CADE – Administration Council in Defence of Competition.

(b) Eletrobras – Centrais Elétricas Brasileiras S.A. (federal state holding company - GTDC). CEMIG – Companhia Energética de Minas Gerais S.A.; COPEL – Companhia Paranaense de Energia. CEEE – Companhia Estadual de Energia Elétrica (RS). CELESC – Centrais Elétricas de Santa Catarina S.A. and others.

(c) Tariff definition and approval for monopolies sectors T&D.

Basics Duties	Institution[(a)]	Structure
Definition of industry policy	▪ CNPE ▪ MME	**Generation** ▪ Competition ▪ Deregulation ▪ Private and State(b) participation **Transmission** ▪ Monopoly ▪ Regulation ▪ Private and State(b) participation **Distribution** ▪ Monopoly ▪ Regulation ▪ Private and State(b) participation **Commercialisation** ▪ Competition ▪ Trade ▪ Deregulation ▪ Private and State(b) participation
Supervision of regulatory action	▪ ANEEL	
Authorisation of concessions	▪ ANEEL	
Quality of service	▪ ANEEL	
Tariff[(c)]	▪ ANEEL	
Supervision of competition	▪ ANEEL ▪ CADE	
Expansion planning	▪ Energy Secretariat (MME) ▪ EPE	
Energy Trade	▪ CCEE	
Operational rules and dispatching (interconnect system)	▪ ONS	
Monitoring	▪ CMSE	

however, reduced according to their expected dispatch by the ONS.[35]

Distribution companies are not permitted to sell electric power to free consumers[36] and must contract the officially declared forecast power consumption of their captive consumers. Free consumers still contract their energy supply in a free market, but distribution companies must contract power in a regulated market.[37] Existing electric power plants are classified as sellers of old power and those under construction as sellers of new power. The government adopted these concepts in order to encourage investors to

[35] Thermal plants avoid the hydrological risk, but larger capital cost.

[36] Consumers are classified into two groups: captive (below a demand of 3MW) and free (a demand of 3MW or more). Free consumers may sign bilateral contracts with generators, but captive consumers must accept that distribution companies sign bilateral contracts on their behalf.

[37] Free consumers have to pay a tariff, set by ANEEL, to transport power through grids of distribution companies.

develop new electric power plants without moving the old power supply to its opportunity cost.[38]

Old and new energy can be sold to free consumers at bilaterally negotiated prices. If sold on the regulated market they must be offered at public auctions organised by a new company, the **Energy Research Company, (Portuguese acronym EPE)**. EPE specifies the amount of electric power which has to be contracted, as well as the group of hydropower plants that may participate in the auctions (approved by the MME and conducted by the ANEEL). Old and new electric power is offered to distribution companies at separate auctions. While new power is offered for long-term firm contract (30 years), old power is offered for shorter-term contracts.[39]

Old power auctions are organised to achieve prices below those of new power auctions. To reduce the market risk of distribution companies, they are allowed unilaterally to cut up to 4% of the volume of power purchased through their old power contracts whenever their consumers do not use their official forecast of consumption.[40] In practice, old energy is sold on a market where there is likely to be a supply surplus.

[38] The impact of power prices in the inflation index is still a very sensitive macroeconomic issue.
[39] Prices are indexed to inflation.
[40] To further reduce their market risk, distribution companies can pass on to the rates paid by captive consumers up to 3% of the contracted but not-consumed power.

4.4 Southern Cone

4.4.1 Natural Gas

In the Southern Cone, Argentina has a mature market for natural gas whose surpluses during the nineties were supplied to its neighbours, Chile, Uruguay and Brazil. The development of the Argentine gas sector since the privatisation of the natural gas system in 1992 was accompanied by a significant evolution of institutional and regulatory organisation.

Chile and Uruguay have a regulatory framework for their imports of natural gas from Argentina.

Paraguay lacks natural gas and depends on LPG imports; therefore there are no specific regulations for the sector.

Argentina

The upstream sector is a competitive segment ruled by a Hydrocarbons Law. It is not considered a “public service”, but an “activity of general interest”. The **National Secretariat of Energy** is the enforcing authority of Law 17 319 in the national territory. In the provinces, local energy authorities enforce this Law.

Until the beginning of the nineties, Yacimientos Petrolíferos Fiscales S.E. –YPF and its contractors had a state monopoly on the exploitation of hydrocarbons. Gas del Estado S.E. (a state-owned company that monopolised gas supply in the entire national territory) had priority in gas purchases. In 1989, it was decided to deregulate upstream, to

make crude oil freely available to the domestic and foreign market, to gradually progress free hydrocarbon prices, and review concession contracts. At present, all operators are private (Repsol-YPF S.A. concentrates 40% of the market).

Gas prices have theoretically been free since 1993, although the economic crisis at the beginning of 2000 led to a price freeze. They are being gradually updated through agreements between the government and producers.

In December 1992, the national government privatised gas transport and public distribution services which, until then, had been wholly provided by Gas del Estado S.E. The national territory was divided into two transport areas and nine distribution areas. Transport and distribution licences for each area were granted an initial 35-year term, with the possibility of renewing it for 10 more years.

A law for a regulatory natural gas framework and privatisation of Gas del Estado, was introduced in 1992, with a view to providing guidelines applicable to natural gas carriers, distributors, traders, storage agents and consumers signing direct contracts with producers. The principle of open access to transport and distribution networks was adopted. Vertical integration of the different segments of the industry was restricted. Carriers were prohibited to trade in gas, except for their own consumption or for the gas necessary to keep the systems running. No producer, storage agent, distributor, trader or consumer contracting directly with producers could have a controlling interest in a company authorised to operate as a carrier. Likewise, no producer, storage agent, carrier or trader could have a controlling interest in a distribution company. However, a decree, described in the following section, modified this restriction, allowing distributors to have a controlling interest in the gas trade business.

The same law created a **Gas Regulator Agency (ENARGAS)**, authorised to act as a self-sufficient entity. This Agency currently operates within the scope of the **Ministry of Federal Planning**, Public Investment and Services, which is in charge of regulating transport and distribution services in the entire national territory. ENARGAS started operations in 1993, and is a regulatory entity (enacting the various regulations that control activities in the gas sector). It is also in charge of ensuring that all stakeholders comply with these regulations and administrates the relevant legal system (ENARGAS is the judge in all settlements of conflicts within the industry).

End-user tariffs are set by ENARGAS according to a price-cap or maximum tariff system, and include the price of gas, as well as the transportation and distribution rates. The price of gas is transferred to the final tariffs by pass-through. The regulator revises transport and distribution margins every five years. The Law had created a tariff-adjusting mechanism through the application of an adjustment index in the international market, but the 2002 Law of Economic Emergency cancelled this adjustment.

The regulatory framework of the natural gas industry established in 1992 was seriously affected by the economic emergency measures introduced by the Argentine government at the beginning of 2002, and by measures taken since 2004 when the economic crisis became an energy crisis.

The main modifications to the regulatory framework were:

(i) temporary freezing of gas prices and tariffs, and prohibition to apply price-indexing mechanisms;

(ii) introduction of a new investment system in the infrastructure;

(iii) founding an Electronic Gas Market;

(iv) unbundling of major users; and

(v) export restrictions.

(i) In 2002, the Law of Public Emergency and New Exchange System abolished the fixed exchange parity system of 1 peso = 1 American dollar that had been in force since March 1991. The tariffs of public services were 'converted to pesos' at the rates as of January 2002, and the application of any price-indexing mechanism was prohibited. In the case of natural gas transport and distribution, the exchange reform altered the relationship between the income of licensees and the operation, maintenance and expansion costs of their services. The cancellation of tariff updating methodologies affected the economic and financial equations of the contracts. In view of this situation, the Emergency Law authorised the government to renegotiate public services contracts, including gas transport and distribution licences. In 2007, the renegotiation of gas licences still continued.

(ii) The economic and financial crisis led private investors to stop funding the expansion of gas transport and distribution systems. Decree 180/04 established trust funds with the exclusive objective of financing transport and distribution infrastructure works. According to their rules and regulations, each expansion programme is financed through a specific fund, comprising:

(1) tariff charges payable by users of transport and distribution services;

(2) the resources obtained from special credit programmes of national and international organisation; and

(3) specific contributions from direct beneficiaries.

The creation of trust funds involved two major changes in the industry. Investment decisions were no longer taken by the market agents in line with state planning (the Ministry of Planning regulates the constitution and functioning of the trust and decides what works are eligible to be performed under the aegis of this system). The discrimination between new investments in the infrastructure (whose profitability makes them viable) and investments already made by the present licensees, whose profit declined due to the tariff delay, was introduced. The governmental goal is to give priority to new projects.

(iii) Decree 180/04 established an **Electronic Gas Market (Spanish acronym MEG)** whose main duties are the co-ordination and centralisation of all commercial transactions associated to the spot (daily) gas market and to the secondary transportation and distribution market. The main objective for the creation of MEG is to guarantee the transparency of the dispatch and to generate the necessary information flow for prices to be the result of a free interaction between supply and demand.

(iv) Since 2005, a Resolution issued by the Secretariat of Energy has forced Major Users (basically industries and thermal plants) to stop using distributors and to sign gas sale contracts directly with producers or traders.

(v) Since 2004, as a result of the natural gas supply crisis, the Secretariat of Energy has enacted a number of resolutions that restrict exports. These measures have seriously affected Chile, which depended greatly on Argentine gas imports.

Chile

The **National Energy Commission (NEC)**, created by Decree Law of 1978, is a decentralised government agency whose main duty is to develop and co-ordinate the necessary plans, policies and rules for the smooth operation and the development of the country's energy sector.

NEC is directly responsible to the President of the Republic. Legal and administrative operations are performed through the Ministry of Mining. NEC is administrated by a Board of Directors comprising the ministries of Mining, Economy, Finance and National Defence, as well as the Secretary General of the Presidency, and the Planning and Co-operation Bureau. The highest authority in this Council is the presiding Minister of the National Energy Commission, a position currently held by the office holder of the Ministry of Mining.

The natural gas industry developed in a deregulated environment, favouring private investment, and contracts between parties govern transactions.

According to the Chilean legal framework, economic activity in this industry is conducted in the following three areas:

(i) production;
(ii) transport; and
(iii) distribution.

(i) The Chilean Constitution stipulates that the resources are the property of the State which can exercise the power of exploiting them through the **National Petroleum Company (ENAP)**, administrative concessions, or **Special Oil Operating Contracts (CEOP)**, which is the concept most widely used in recent years.

Most of the gas consumed in Chile is imported from Argentine producing companies. Gas integration between Chile and Argentina took place within the framework of the bi-national Integration Protocol on "Rules regulating gas interconnection and natural

gas supply between the Argentine Republic and the Republic of Chile", signed in 1995 within the LAADI.

During the 2004 crisis, the legal institutional framework of gas exchange between Argentina and Chile was unable to solve the situation facing both countries as a result of shortages in the Argentine natural gas system. A diplomatic conflict occurred between the two countries, and the public sector voiced many complaints; however, no solution to the underlying issue was reached.

The Chilean government argued that Argentina had breached existing agreements; restrictions on exports would discriminate between Chilean and Argentine consumers, and it would be impossible to abide by the export contracts previously authorised through a corresponding administrative act.

The Argentine government justified the legality of the interruptions based on the priority assigned to domestic supply by Argentine regulations, whose validity was expressly ensured in the bilateral agreements. It blamed private producers for not having taken measures necessary to ensure supply to the domestic market and their export commitments.

The price of natural gas was set by means of a free contractual agreement between Argentine producers and Chilean customers (distributors, thermal plants and industries). These are long-term contracts, with the traditional price clauses: a basic price for gas, with minimum and maximum values, and general updates associated with gas oil, WTI and PPI, which in some cases are currently negotiated and modified in order to ensure supply.

(ii) The transport segment is mostly in private hands, with ENAP, a state-owned company, being one of the players. Transport concession is granted for a certain period and authorises the concession holder to provide the service from point of reception to point of delivery, and to build, maintain and operate the system. There are no exclusive or monopoly conditions. New concessions may be granted for routes that had been previously granted to other concession holders.

Transport is subject to the non-discriminatory open access principle with reference to capacities available in the system. The regulation requires that all new transport capacity should be offered publicly. To offer transport capacity or to expand their current facilities, transporters are obliged to make a public offer (open season) of their existing or future transport capacity. Within this public offer process, the load centres present their needs and these are translated into a volume of transport demand, which the carrier assesses in relation to his investments. Based on this economic assessment, he may or may not make an offer. The offer consists of the same type of contract as of all other clients, but a new tariff can be higher or equal to the existing rate, but never lower since the carrier must balance the lower tariff with the rest of his contracts for the same delivery area.

Transport tariffs are included in contracts between the parties. No special types of tariffs are determined. Each gas pipeline has a transport tariff in line with its investments.

(iii) Distribution services are rendered by the companies with respective concessions located in different geographical areas of the country. The manner in which concessions are granted and their exclusivity are characteristics identical to those of transport services.

Distribution charges are freely agreed upon by the gas companies, although they are somewhat restricted by the State which intervenes when behaviour contrary to free competition is evident. For such intervention, proof must be provided that benefits in the tariff structure established by the concession holder exceed certain fair criteria. Prices awarded to gas correspond at most to the annual average of the gas purchase contracts to supply the five largest industries in the concession area at the connection point of the distribution system.

Once the tariff for a certain sector has been established, any discrimination between consumers of the same type is prohibited. All tariff alterations must be published officially.

Regulations do not restrict vertical integration of the different segments of the industry, nor of the participating proprietors.

As a consequence of a shortage of regulations, the legal body for the protection of the various interests of clients and companies is the Antimonopoly Commission, particularly on issues that are considered critical. Transporters and distributors have organised their businesses so as to avoid conflicts with that Commission. All issues linked to prices, readjustments and conflict resolutions are contained in the contracts.

Paraguay

Paraguay has no sector authority, nor a specific regulatory framework for the sector. The energy policy is administrated by the Ministry of Communications and Public Works through the Vice-Minister of Mines and Energy.

In order to diversify the energy mix, the Paraguayan government has created the **Natural Gas Co-ordinating and Promoting Commission (COMIGAS)**, whose aim is to study, promote and develop regional energy integration projects related to production, transport and distribution of natural gas. One of the tasks performed by COMIGAS was drawing up a regulatory framework embracing all activities of the natural gas industry.

In 2002, the Gas Pipeline Transport Act established the conditions for granting concessions for gas transport service directly to the interested applicant. It also provided guidelines for the structure, duties of the regulator, established a tariff system and the rights and obligations of the concession holder.

There are still no specific regulations for distribution; they will initially be issued through the Act of Concessions of Public Works and Services.

The following shall also apply to natural-gas projects:

- A law that approves the Partial Scope Agreement for the Supply of Natural Gas from the Republic of Bolivia to the Republic of Paraguay (customs protection and non-customs protection).
- A Hydrocarbons Law that regulates prospecting, extraction and exploitation activities.
- A law that creates Petróleos Paraguayos - Petropar and its charter.
- A law that creates the National Electricity Administration (ANDE) as a self-sufficient body and its charter, which refers to the generation of electricity associated to the gas project.
- A law that draws up a New Tax System, and Law no. 60/90, referring to a tax incentive scheme for investment by national and foreign investors.
- A law on environmental impact and Law no. 1561/00 that creates the National Environment System.

Paraguay is one of the nations that signed the "Memorandum of understanding related to gas exchanges and gas integration between the Mercosur member States", approved by a Resolution in 1999.

Uruguay

The **Ministry of Industry, Energy and Mines (MIEM)** is responsible for the national hydrocarbons energy policy through its **National Energy Administration (DNE)**. The Hydrocarbons Law assigns the regulation of the sector's activities to the government.

The Uruguayan energy sector features major State participation. In 1931, the **National Administration of Fuels, Alcohol and Portland (ANCAP)** was founded. The Hydrocarbons Act empowered ANCAP to carry out directly or through third parties all activities and business transactions of the hydrocarbons industry.

Legalisation founded a law for the **regulatory agency for energy and water (URSEA)** as an independent body of the government, with auditing duties on import, transport, storage and distribution of natural gas by networks. URSEA ensures that the specific sector rules are fulfilled and creates regulations relating to the quality and safety of products, services and facilities, including the implementation of rules ensuring free access to the networks.

Transport is a public service concession. Its tariff is set through contracts and was regulated for transport capacities of up to 5MMm^3/d. Transport concessions have a minimum 15-year term.

Table 20
Summary of the Regulatory Structure of the Natural Gas Industry
Source: WEC

Country	Exploration and production	Transport	Distribution
Argentina	Exploration permits and exploitation concessions granted by the local authorities within the framework of Law 17 319. Free availability of extracted hydrocarbons. Free gas prices, and temporarily agreed upon between producers The State. Priority of domestic supply.	Licences to operate the two transport systems: North and South. Public service regulated by ENARGAS, which establishes maximum tariffs. Open access.	Nine exclusive distribution areas operated by private companies and subject to the regulation of ENARGAS, which establishes maximum tariffs for the end user. Price-cap tariff regime.
Chile	Exploitation by state-owned ENAP, directly or through contracts with private companies. Relies on Argentine gas exports.	Private holders of concessions. Open access. Tariffs determined by contract.	Private concession holders without geographical exclusiveness. Tariffs freely agreed upon between the parties. Free competition control. No restrictions to vertical integration.
Paraguay	No natural gas supply. LPG imports.	No transport infrastructure.	No distribution infrastructure.
Uruguay	MIEM authorises. State-owned ANCAP controls the sector. Relies on imports from Argentina.	Concession holder of the transport service: ANCAP in Gasoducto del Litoral and 20% in Cruz del Sur. Remaining 80% is privately held.	Two distribution concessions in private hands. URSEA regulates the quality and the reliability of the supply.

The government nominated ANCAP as the transporter of the Uruguayan section of the *Gasoducto del Litoral* for a term of 30 years from the date it comes on stream.

The *Gasoducto Cruz del Sur S.A.* (20% ANCAP and 80% private producers), was granted the construction and exploration rights of the transport system by public tender.

Distribution services are a public service concession and were granted to two companies: GASEBA (for the city of Montevideo) and CONECTA (for the rest of the Uruguayan territory, including the city of Paysandu). The following is worth mentioning among its major features: assured open non-discriminatory access; distribution tariffs adjusted according to international efficiency and investment indices; the distributors have priority in the expansion of their gas pipelines network. The structure of the final consumer tariff includes the price of gas, transport and distribution.

In 2004, the Regulations for the Supply and Vehicle Use of Compressed Natural Gas approved by URSEA came into force. However, the constraints on Argentine natural gas exports to Uruguay undermined the development of the sector.

At international level, Uruguay signed agreements for the supply of Argentine natural gas in 1991 and 1996. In 1999, Uruguay was one of the signatories of a Memorandum of Understanding related to gas exchange and gas integration between the

countries of the Mercosur. In 2005, Uruguay was involved in the working group that drew up a proposal for a juridical and institutional framework for the creation of a Southern Gas Pipelines Network.

4.4.2 Electricity

The Southern Cone was where the first market opening and liberalisation reforms of the electric sector structure over the last decades were introduced, replacing organisations based on vertical integration and on state monopolies by a vertical and horizontal unbundling of the industry. Electricity markets were established both at wholesale and retail level and state companies were privatised.

Initial organisational reforms took place in Chile at the beginning of the eighties, followed by Argentina in the early nineties. Both countries divided their electricity industry vertically and horizontally, created wholesale markets, fostered the liberalisation of the retail market for major users, and privatised state assets. They were the first to do this and in general followed the English model of the late eighties[41], although with relatively significant differences in design and implementation. Chile and Argentina's organisational models turned out to be successful in attracting domestic and international private capital.

In Chile, the reform continued over the two decades after it began: the transport segment was separated – it had been linked to generation – with a view to increasing transparency and competition in the setting of supply prices.

In Argentina, after the success of the model in the formative years, there was evidence that some regulatory issues should be the objects of "second generation" reforms in order to optimise investment in the generation and transport segments. After a long economic recession during which there was a failed attempt in 2001 by the Congress to introduce reforms that would increase the market mechanisms in the electricity sector, an economic crisis gave rise to a transition period starting in 2002 within the framework of the Economic Emergency Law. This, together with the withdrawal of the flow of private capital for investment in electricity generation in developing countries[42] at the end of the nineties, led to stagnation of investment and to difficulties in meeting the high demand growth. Since 2003, the State is reprising the role of developer and investor – without excluding private investment – to achieve a capacity expansion in generation and transport.

Towards the end of the nineties, Uruguay, although it continued to have an integrated state monopoly under the National Administration of Power Plants and Electricity Transmission (TEP) – also introduced an accounts division by segment of the electricity chain. I.e. generation, transport and distribution; implemented a wholesale market;

[41] Britain's plan to privatise the electricity industry in England and Wales was announced in 1988. The new organisational structure began to come into effect in 1990. (Armstrong, Cowan & Vickers – Regulatory Reform, Economic Analysis and British Experience. The MIT Press, London. 1994.)

[42] See World Bank, IEA, Deloitte Touche Tohmatsu Emerging Markets Group.

opened the demand of its largest users to competition and admitted free private initiative for new generation and transport projects.

On the other hand, Paraguay did not reform its electricity system. It is still monopolised by the State Company ANDE, which provides generation, transmission and distribution services throughout the country.

Landmarks in regulatory evolution in each of these countries are listed below.

Argentina

The energy reform of the nineties abolished state planning. Economic markets ruled investments, a policy that turned out to be effective while there were growth prospects for domestic and foreign demand due to the interconnection with Brazil.

The 1992 reform introduced a vertical and horizontal division of the electricity sector, unbundling generation, transport and distribution activities, and included major users. It also introduced the concept of trade and restrictions for cross-control in more than one business segment. It founded the **National Electric Regulator Agency (ENRE)**, the **Wholesale Electricity Administrator Company (CAMMESA)**, and established basic rules for the operation of this market.

At present, the State controls 24% of the installed generating capacity[43] and some distribution concessions within the jurisdiction of the provinces[44]. Transport is carried out through concessions to private agents[45]. Independent transporters under technical licence of the transport concession holder carry out transport network expansions. Facilities for the international electricity trade are built, operated and maintained by holders of cross-border transport concessions.

The level of competition reached in the wholesale electricity market is satisfactory and has a low concentration of supply. The major share in private generation is in the hands of the ENDESA group (Spain), i.e., 15% of the total. Next in line is the local business group SADESA, with 14% of shares. Altogether, 20 business groups participate in the market offer with 43 generation plants. In 2006, 45% of the generation was in the hands of generators belonging to international investors, 29% pertained to local private investors, and 26% to state-owned generators.

The rationale of the operation of the energy market, with annual natural gas contracts including a “take or pay” clause in support of short-term incremental costs of thermal generation, is based on an increasing dispatch, after optimising hydro availability, to minimise total cost. Generators

[43] 2006 data, considering the unified electricity market. The state administrates the trade of energy delivered by bi-national projects (Yacyretá and Salto Grande) through EBISA and by the nuclear power stations through the NASA.

[44] The federal political organisation of Argentina continues to have jurisdiction over the segment of electricity distribution to the provinces. The so-called metropolitan region, which concentrates 40% of the demand in Argentina, is under the national jurisdiction in a special statutory scheme since the distribution network covers the Federal Capital and various surrounding towns of the Province of Buenos Aires.

[45] Except for the Trunk Line Carrier of the region of Comahue which belongs to the provinces of Neuquén and Rio Negro.

declare their costs according to seasonal periods, based on which they compete for the dispatch. Mean short-term incremental cost of thermal generation sets the market price; with an additional conventional compensation per power dispatched fixed by state regulation, as a fix signal for the payment of the capacity made available on the market in the long term and a whole set of items that constitute the remuneration of the short-term reserves of the system. There is an optional fixed-term contract and a daily spot market.

Transport and distribution are considered public services and are governed by long-term concessions, with regulation of quality and tariffs under state control for five-year periods. For these segments, defined as natural monopolies, "management" periods were also fixed every ten years, at the end of which public tender as an additional mechanism to foster efficient management offers the principal block of the company's shares.

In transport, a single company has the concession for the extra high voltage system (500kV). Seven transport companies for high voltage hold the concession for the regional networks which link extra high voltage networks with distributors in the provinces.

The control of competition and prevention of market power abuse by major traders was originally conferred on the **National Regulatory Electricity Board (ENRE)**. This was later included in the jurisdiction of the **National Commission for the Defence of Competition (CNDC)**, with the proviso that decisions had to be preceded by a technical report issued by ENRE.

Due to the 2001/2002 economic crisis, and in view of the restrictions in the natural gas supply as well as fears of the effect of rapidly increasing prices, market restrictions were imposed and various forms of initiatives, interventions, subsidies and state financing were promoted. New institutional forms and ways for capacity extension not yet fully consolidated consist of **Public-Private associations (Spanish acronym PPP)** and incipient new planning. The production crisis strengthened the domestic supply priority over export commitments.

The Secretariat of Energy which reports to the **Ministry of Federal Planning Public Investment and Services (MPFIPS)** issues the policy for the industry, as well as the rules and regulations for the **Wholesale Electricity Market (MEM).** The State is playing a more active role in expansion decisions and is resuming its planning, financing and implementation role.

State supervision is carried out through the ENRE, in compliance with the regulatory framework in force. ENRE is also responsible for regulating and controlling tariffs and the quality of transport and distribution, solving conflicts between key players in the power sector, and preventing anti-competitive behaviour.

The electricity market is operated and administrated by the **Electric Wholesale Market Administration Company (CAMMESA)** wherein generators, carriers, distributors and major users

participate under the supervision of the Secretariat of Energy.

Since Argentina is politically a federal country, the provinces participate in organising and expanding the electricity system through a Federal Energy Council which acts as consultant to the Secretariat of Energy and takes an active part in the plans for the expansion of transport capacity.

Chile

Electricity reform begun in Chile in 1982 (General Electricity Utilities Act), stipulated a vertical and horizontal unbundling, a market system, and the introduction of competition and private initiative. The aim was to achieve a reliable unit and economically efficient energy supply, and to ensure sustainable development.

The segments into which the sector was divided were generation (including high voltage transport), distribution and free customers (major users). The system based its dynamics and technological renovation on price signals as promoters of investment and efficient management; state supervision continued for reviewing private planning to meet domestic supply requirements.

The electricity market is regulated by the **National Energy Commission (NEC)**, which draws up energy plans and policies, analyses supply and demand, as well as price structure and level. Major generators and transmitters are in charge of dispatch (Economic Load Dispatch Centre - CEDC) in all electricity systems in the country.

The market is concentrated both in the **Interconnected System of the Great North (SING)** and in the **Central Interconnected System (SIC)**, with four investor companies participating actively in decisions to expand the generation system.

By 2004 (Law 19 940) regulatory changes were introduced to resolve some pending issues:
a) reliability of electricity systems, and
b) transparency and independence of transmission in relation to generation.
Transport was separated from generation, and regulated tariffs were set for transmission.

In 2005 (Law 20 018), partly due to the restrictions to the natural gas supply from Argentina, new regulations were introduced to ensure supply and strengthen the co-ordination of the system through a greater participation in demand, planning and decisions in the market.

Tariffs for end-users with capacity below 2 MW are regulated. The node price is determined every six months and is based on an estimate of the forecast mid-term incremental costs of the system. The distribution margin is regulated by the “efficient company” scheme. Transmission endeavours to send out clear signals for suitable locations of generation plants.

At present, the activities of the Chilean electricity sector are totally under private control. The State is in charge of the supervision of the sector, policy making, regulation and control.

The state institutions governing the Chilean electricity sector are:

- the Ministry of Economy and Energy (MEE) which determines the energy policy of the country;
- the National Energy Commission (NEC), which is the price regulator and market supervisor;
- the Electricity and Fuels Superintendence (EFC), which audits technical aspects and service quality, emphasising the regulated markets and the control of compliance with legal provisions;
- the Controller and Resolving Committee (FCR), in charge of investigations and charges for unfair competition;
- and finally, the Economic Load Dispatch Centre (CDEC) is the wholesale electricity market operator, including generation and transport.

Paraguay

Paraguay is the only South American country that has not introduced any opening and liberalisation reforms in the electricity sector. Unbundling of activities is not forecast in the country's electricity sector structure. It has not changed the structure of its state-owned, vertically integrated company, ANDE, which supplies the domestic market and effects small cross-border exchanges with some Argentine towns. **ANDE, the National Electricity Administration**, founded in 1948 through the nationalisation of a formerly private company, has acted as a self-sufficient official body since 1964.

The Ministry of Public Works and Communications (MOPC) is currently in charge of the energy policy through the Vice-Minister of Energy and Mines.

ANDE performs regulatory duties such as co-ordinating the electricity sector development, regulating the service, and proposing tariffs. ANDE's commercial management is in charge of all distribution and trade activities, but there are regional agencies whose level of autonomy is very low and which are greatly centralised. *Compañía Luz y Fuerza S.A.* is a private concession holder that distributes electricity in the city of Villarica.

Paraguay owns 50% of the Itaipu Bi-national company it shares with Brazil, and 50% of Yacyretá Bi-national company shared with Argentina. Both entities are independent bi-national companies governed by special treaties signed with the respective countries.

Paraguay's generation assets produce more than ten times the demand of its domestic market, and this makes it the main electricity exporter of Latin America. Due to its small domestic demand and the heavy concentration of its production capacity in the two large bi-national ventures with Brazil and Argentina respectively, regulatory changes based on competition in a wholesale market are impossible. Initiatives to create a Regulator, separating these duties from the ANDE[46], and establishing thermal generation in the area of

[46] Although the Ministry of Public Works and Communications is the enforcing authority, ANDE as a body specialising in

Table 21
Summary of the Electricity Market Structure
Source: WEC

Segment	Argentina	Chile	Paraguay	Uruguay
Generation	Private companies. State share 26%.	Private companies	State company ANDE	TEP and private companies
Transmission	Private companies	Private companies	ANDE	TEP
Distribution	Private companies, some concessions controlled by the State.	Private companies	ANDE	TEP
Regulator	SE - ENRE	CNE / SEC		URSEA

Asunción associated with the import of natural gas from Bolivia, have been unsuccessful.

Uruguay

The most recent regulatory framework of the Uruguayan electricity sector dates back to 1997 (Law no. 16.832), and continues to have a vertically integrated monopoly in charge of the **National Administration of Power Plants and Electricity Transmission (TEP)**. Nevertheless, free (private) initiative for generation and transmission ventures, free access to surplus capacity in transmission, and the organisation of a wholesale market were introduced – although not yet implemented – from cost explicit statements to the accounting separation of the TEP generation, transmission and distribution segments.

TEP was created in October 1912, to exploit the state monopoly of electric power production, transmission and distribution in the entire Uruguayan territory, but was only given its current name in 1974.

In 2002 (Law 17 598) the **Regulatory Entity for Energy and Water (URSEA)** was created as a regulator in charge of regulation and control, tariff and quality supervision, conflict resolution and prevention of anti-competitive behaviour. The **Ministry of Industry, Energy and Mining (MIEM)** is in charge of industrial policies. The **Wholesale Market (MMEE)** was founded together with the **Operator of the Electricity Market (ADME)** and the National Dispatch Centre for the operation of the system.

The Uruguayan government owns 50% of the *Comisión Técnica Mixta de Salto Grande*, which is the Bi-national Company shared by Uruguay and Argentina that exploits the hydropower plant of Salto Grande under the terms of the respective treaty.

In spite of market liberalisation reforms in Uruguay, TEP keeps its hegemonic and exclusive position over the entire domestic electricity sector, although generation has been opened to private initiative. It should be emphasised that Uruguayan consumers are allowed to buy from local or foreign (Argentine) generators on equal terms; therefore, co-ordination now exists and effective competition between Uruguayan and Argentine dispatches.

electricity matters places it in a position of administrating the regulation of the sector.

5. Main Projects For Energy Integration

5.1. Geopolitical Projects

Some of the energy integration projects are essentially geopolitical e.g. Petroamerica and IIRSA.

5.1.1 Petroamerica: Petrosur – Petroandina – Petrocaribe

Venezuela, based on existing agreements is striving to promote geopolitical zones of integration for the "socio-economic improvement for the people".[47] The project considers regional integration to be a matter for governments, although private business sectors must not be excluded. The proposal is to integrate the Latin American and Caribbean national energy companies and to sign agreements and make joint investments in oil and natural gas exploration and trade.

In Petroamerica three sub-regional energy integration projects combine: Petrosul (Argentina, Brazil, Venezuela and Uruguay); Petrocaribe (14 countries in the Caribbean); and Petroandina (Bolivia, Ecuador, Colombia, Peru and Venezuela). Of the three proposed projects, Petrocaribe is the best structured. Petroandina is still under study and Petrosul is only mentioned in bilateral agreements. The proposal also includes preferential financing mechanisms for oil supply to the Caribbean and Central American nations.[48]

Although the project covers the entire region of Latin America and was initially launched by Brazil and Venezuela, it was gradually shifted to the latter. Figure 5 shows the advance of the recent projects proposed by Venezuela.

5.1.2 IIRSA

The **Initiative for Integration of the South American Regional Infrastructure (IIRSA)** began at the first summit of South American heads of state in Brasília in 2000. The member countries are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela.

IIRSA is aimed at the integration and modernisation of the physical infrastructure in South America. This is a highly political project. Its objectives are to improve competitiveness of the regional economy to achieve a global level of performance and promote sustainable socio-economic development by integrating logistics infrastructure in the energy, telecommunication and transport sectors. The governments, private sector and international financial institutions e.g. CAF, FONPLATA, IDB, will be jointly financing the projects.

Infrastructure projects for integration must be complemented by regulatory and administrative systems that facilitate interconnections and operation of the systems. In this way, IIRSA

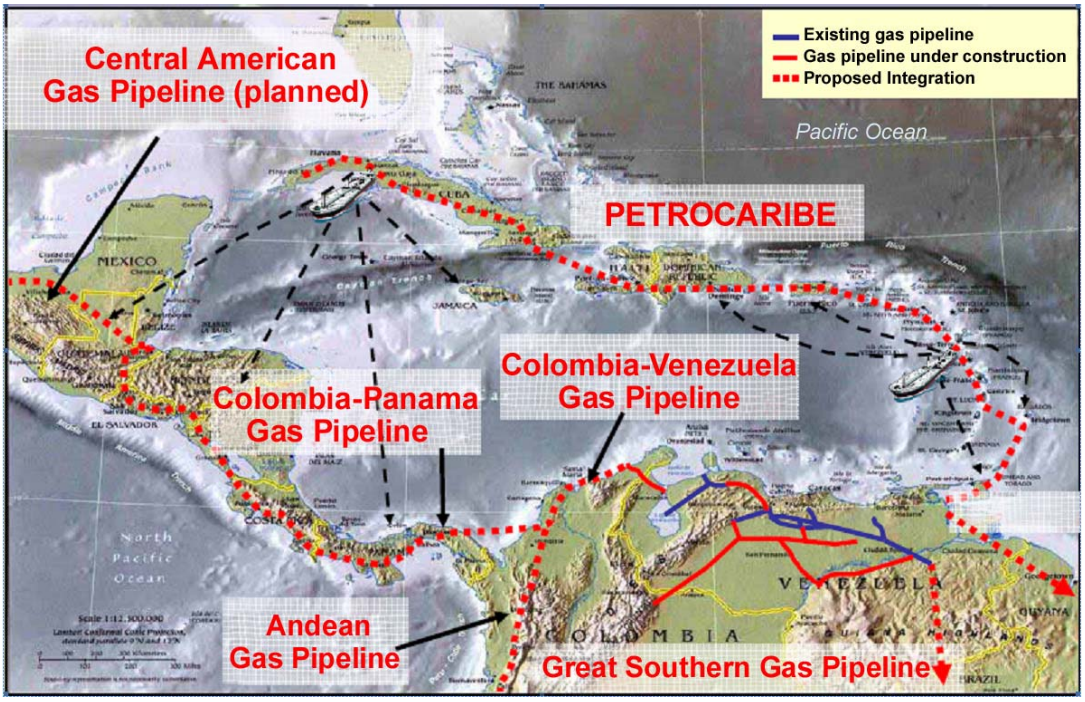
[47] Presentation in FIER 2006 by the Venezuelan Ministry of Energy and Petroleum.

[48] "Co-operation and energy integration in Latin America and the Caribbean", CEPAL, 2006.

Figure 5

Projects proposed by Venezuela

Source: FIER 2006 – Ministry of Energy and Petroleum, Venezuela



promotes the convergence of regulations and institutional mechanisms, removing the regulatory, legal, operative and institutional barriers that restrict the efficient use of the existing infrastructure, as well as the drawbacks to investments in a new infrastructure. At later stages the creation of supranational institutions would be encouraged in order to increase even more sector efficiency and regional competitiveness.

The action plan for integrating the regional infrastructure adopts integration and development zones, and sector processes.

Some of the seven sector processes defined for energy include the following: 'Financing Projects of Regional Physical Integration' and the 'Energy Market Regulatory Frameworks. The governments agreed to work on ten integration and development zones to co-ordinate the South American region (Table 22)

Table 22

Integration and Development Zones proposed by IIRSA

Source: IIRSA

Zone	Countries
Andean zone	Bolivia, Colombia, Ecuador, Peru, Venezuela
Amazon one	Brazil, Colombia, Ecuador, Peru
Guiana Shield zone	Brazil, Guyana, Suriname, Venezuela
Capricorn zone	Argentina, Brazil, Chile, Paraguay
Central Inter-ocean zone	Bolivia, Brazil, Chile, Paraguay, Peru
Mercosur-Chile zone	Argentina, Brazil, Chile, Paraguay, Uruguay
South zone	Argentina, Chile
Paraguay-Paraná waterway zone	Argentina, Bolivia, Brazil, Paraguay, Uruguay
Peru-Bolivia-Brazil zone	Bolivia, Brazil, Peru
Southern Andes zone	Argentina, Bolivia, Chile

Table 23
Main Central American Projects
Source: WEC

Project	Comments
Electricity	
• SIEPAC project	Electricity interconnection of the countries in the South American Isthmus (from Guatemala to Panama) for implementing the Regional Electricity Market through a 203 kV line 1830 km long.
• Guatemala-Mexico Interconnection	Building a 400 kV transmission line 103 km long with extension of substations.
• Panama-Colombia Interconnection	Building a transmission line in HVDC over 500-600 km to join Cerromatoso in Colombia with Panama II,
Natural Gas	
• Introducing natural gas	Building a gas pipeline approximately 2,300 km long from Ciudad PEMEX (Mexico) to Panama.

A business outlook was prepared for each zone, which identifies prevailing economic activities, existing basic infrastructure and future potential.[49] This business outlook was used as a basis for forming the IIRSA project portfolio.

5.2 Main Sub-regional Infrastructure Projects

Around forty projects are linked to Latin American energy integration. (Annex I)

5.2.1 Central America

Table 24 summarises the main Central American projects.

Electricity

SIEPAC project (Electricity Interconnection System of the Central American Countries)

The electricity interconnection system of the Central American countries is an IDB-financed project. Right from the start the SIEPAC line was designed to create a **Regional Electricity Market (MER)**. It progressed in design from a Framework Treaty of the MER signed by the six Isthmus countries in 1996, which was brought into force in 1998. The transitory regulations of MER were first applied in 2002 for the Honduras-El Salvador interconnection.

The project includes building approximately 1,830 km of 230 kV transmission lines from Guatemala to Panama and the connections and transformation substations in each country. A capacity of steady interchanges of up to 300 MW is estimated. In 2006 the construction of the transmission lines began. The project is expected to start operations in 2009.[50]

The SIEPAC project is based on the integration design model so that the construction of the network comes after the creation of a commercial and regulatory structure that permits the countries to gradually progress towards harmonious internal regulations, enjoying the benefits from regional integration. Within the framework of the **Mesoamerican Energy Integration Programme (PIEM)**[51] it is also planned to connect the SIEPAC

[49] The business views of the Paraguay-Paraná and Southern Andes zones are underway.

[50] Presentation to FIER 2006 of the General Electricity and Telecommunications Superintendence of El Salvador.

[51] On 13 December 2005, under the Declaration of Cancun, PIEM was adopted by the heads of State and government of Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua,

Figure 6

SIEPAC Project on Central American electricity interconnection

Source: SIEPAC

line with Mexico and Colombia, which would also be MER members.

Guatemala-Mexico Interconnection[52]

In 2006 construction began on a 400 kV transmission line with 300 MW and 103 km long (32 km in Mexico and 71 km in Guatemala). The initial transfer capacity would be 200 MW from Mexico to Guatemala and 70 MW from Guatemala to Mexico. From 2008 on transactions could be made with other Central American countries through the SIEPAC line. (Figure 7)

Panama-Colombia Interconnection

It is planned to extend an HVDC transmission line between the Cerromatoso (Colombia) and Panama II substations. The transfer from Colombia to Panama would be 300 MW and from Panama to Colombia 200 MW, with voltage between 250 and 400 kV. Agreements are being drafted on the regulatory framework. ISA in Colombia and Empresa de Transmisión Eléctrica S.A. in Panama (ETESA) are the project owners.

Four possible corridors are being studied, extending some 500-600 kilometres. Two of the alternatives are land based and the other two combine stretches on land with sub-sea sections in the Caribbean. Figure 8 on the next page shows the alternative outlines.

Panama, Belize, Colombia, Mexico and the Dominican Republic.

[52] "Mexico-Central America-Colombia interconnection prospects", CFE, Mexico.

Figure 7
Guatemala-Mexico Interconnection
Source: CFE Mexico

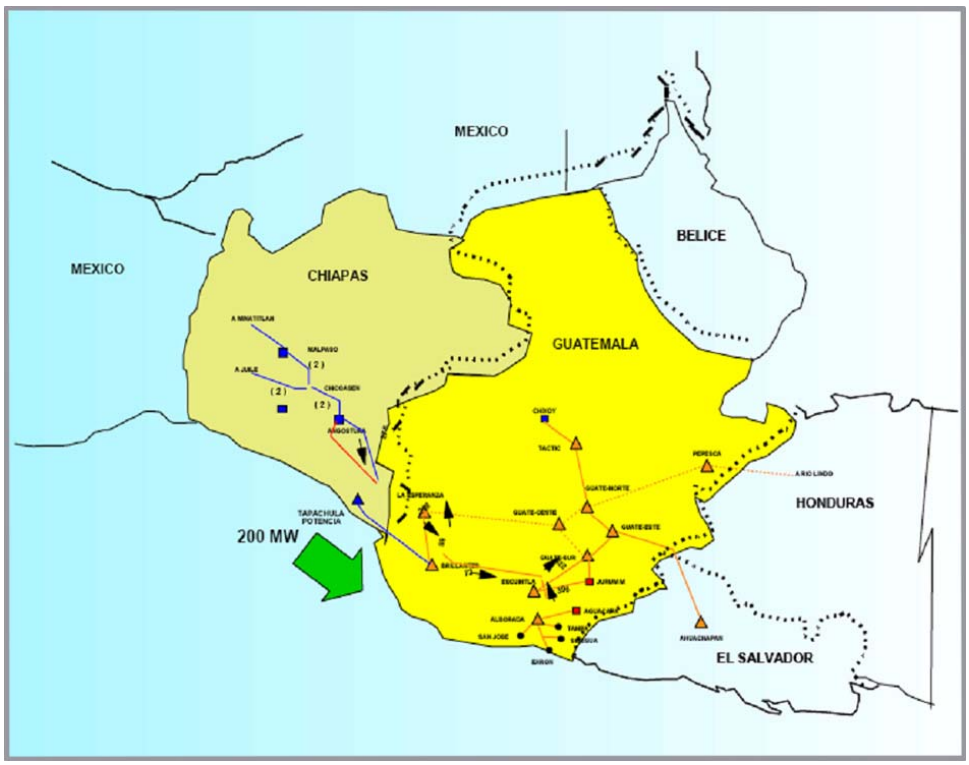


Figure 8
Panama-Colombia Interconnection
Source: OLADE (LAEO)

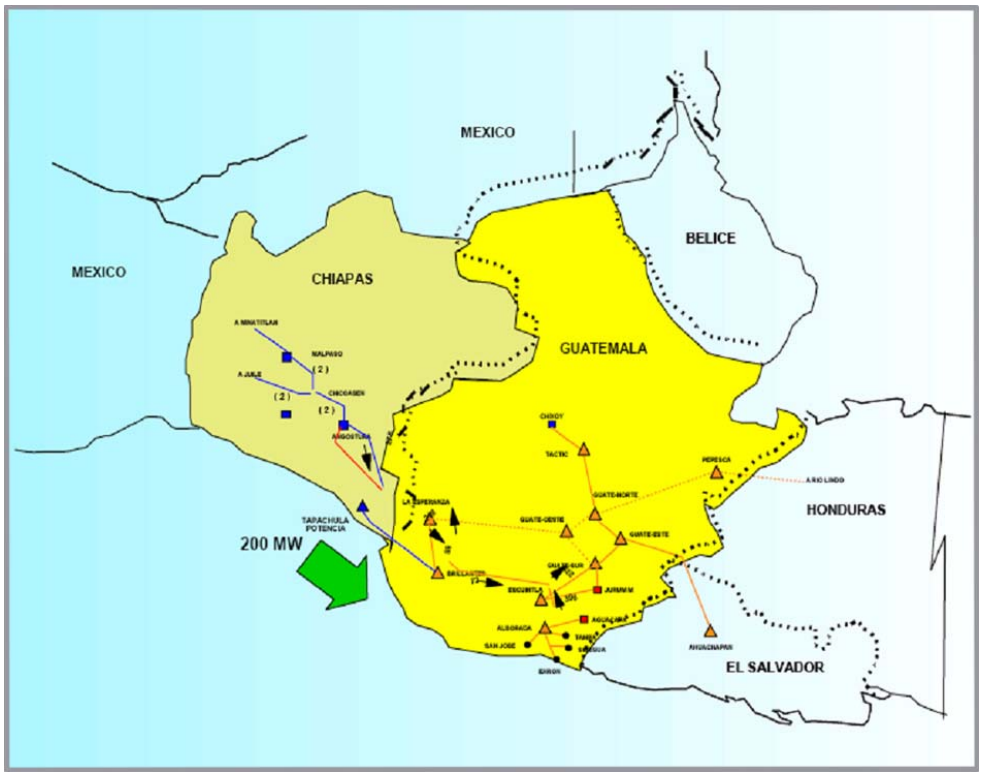
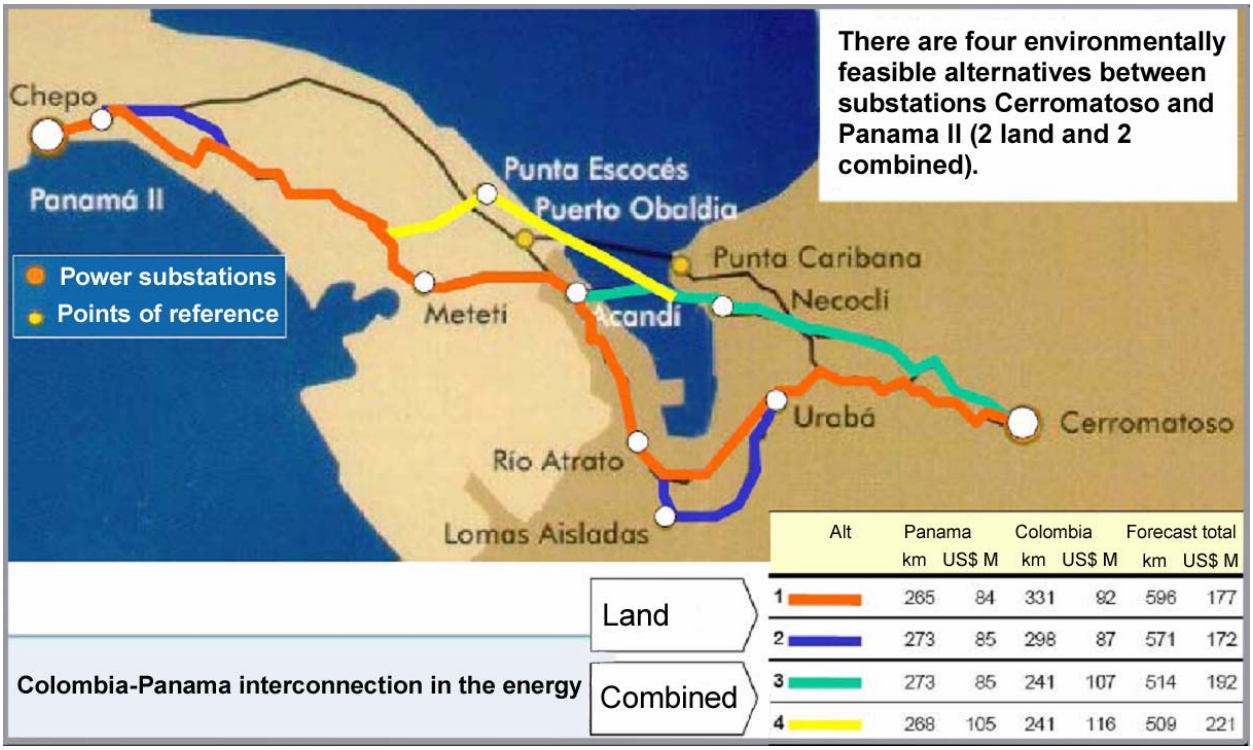


Figure 8
Panama-Colombia Interconnection
Source: OLADE (LAEO)



Alt	Panama km	Panama US$ M	Colombia km	Colombia US$ M	Forecast total km	Forecast total US$ M
1	265	84	331	92	596	177
2	273	85	298	87	571	172
3	273	85	241	107	514	192
4	268	105	241	116	509	221

Natural Gas

Since 1996, the Central American countries in the energy sector have been considering the project of introducing natural gas into the region. A search is underway for alternative fuels that can meet the energy requirements of the population and which is both economically and environmentally sustainable.

The region has no natural gas reserves. Guatemala is the only country producing associated gas in small quantities. Supply options are restricted to the supply from Mexico, Colombia and Venezuela, or possibly using LNG regasification plants. In this framework, studies of different projects have been made, such as building a regional gas pipeline from Mexico-Central American Isthmus or the supply of natural gas from Colombia and Venezuela to Costa Rica and Panama.

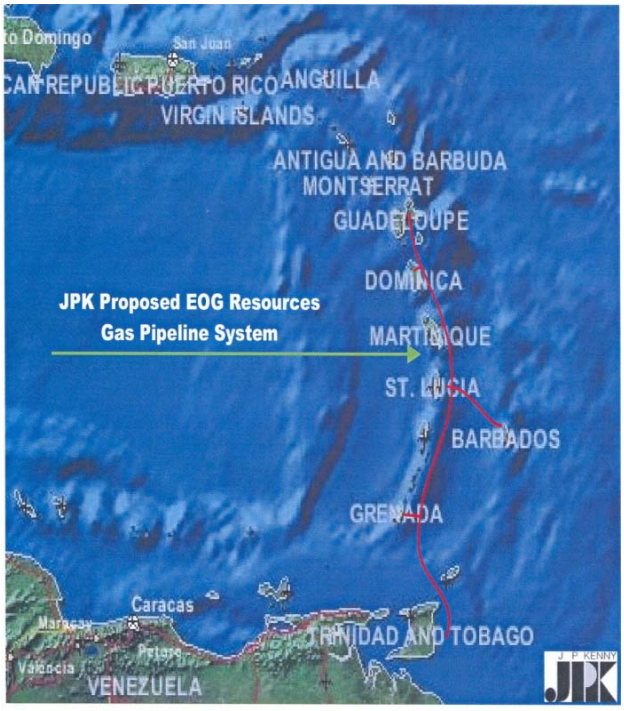
The gasification project of the Isthmus consists of building a gas pipeline from Mexico to Panama, over almost 2,300 km. Parallel to this, in 2005 Colombia and Panama agreed to a gas-exporting project from Colombia to Panama. Figures 9 and 10 show the planned interconnections.

It may be said that the Central American region has a firm commitment to integration. Nevertheless, the absence of critical mass of demand, lack of financial resources, technical weakness and poor management have all delayed these projects. The project to introduce natural gas into the Isthmus reflects this clearly. This project is one that the countries involved and international organisations have been developing for years but no economic-financial alternative has been found so far with private investments.

Figure 9
Project to introduce natural gas in Central America
Source: UPME – Colombia

Figure 10
Project to export gas from Colombia to Panama
Source: UPME – Colombia

Figure 11
Proposed route for the Caribbean Gas Pipeline
Source: Ministry of Energy and Industries – T & T



5.2.2 The Caribbean

In the Caribbean, Trinidad & Tobago has skilfully developed and marketed its vast natural gas reserves. Trinidad & Tobago has been the first in the region to seize the opportunity, and is way ahead of other gas producers in Latin America in producing and marketing its gas as LNG. The concept of a sub-sea Caribbean gas pipeline network to supply gas to several small Caribbean markets is another aspect of the same business strategy.

Efforts are underway to promote development of a sub-sea natural gas pipeline system from Trinidad & Tobago northward through the Caribbean Sea. The initial idea is to take gas from the island of Trinidad through the Caribbean as far as the French dependencies of Martinique and Guadeloupe, but there is also the possibility of the gas reaching Miami. The concept offers potential for diversifying energy sources and reducing costs.

The proposed Caribbean gas pipeline project has a possible terminal point in Guadeloupe. 1t would be of a fixed type infrastructure consisting of 500+ miles of pipeline and two compressor stations. The economic load for the pipeline has been put at 160 million standard cubic feet per day. The variable operating costs of the pipeline would be quite small. It is being suggested that a "postage stamp" type pricing mechanism be applied whereby all customers pay the same price for the gas irrespective of their actual location along the pipeline route.

The government of Trinidad & Tobago regards this project as a feasible way of sharing natural resources and its benefits with the Caribbean neighbours on a commercial basis that results in a win-win situation for all stakeholders.

5.2.3 Andean Countries

Table 24 gives a brief idea of the main ACN projects.

Table 24
Andean countries – Main Projects
Source: WEC

Project	Comments
Electricity	
• Colombia - Ecuador Interconnection	Extension of the current line from 250 MW to 500 MW.
• Ecuador – Peru Interconnection	Regulatory and tariff combination is fundamental to implement the increase from 100 MW to 250 MW.
Natural Gas	
• Ecuador-Peru gas pipeline	Stage 1: Reform the production platform in Corvina, build a gas pipeline of 3.5 Mm^3/d as far as the mainland and a thermal power plant in Nueva Esperanza (Peru) with 160 MW. Stage 2: Connection with gas pipeline of 2 MMm^3/d for a thermal power plant of 300 MW in Arenillas (Ecuador). Stage 3: Connection by gas pipeline of 4.5 MMm^3/d to Guayaquil (Ecuador)
• Colombia – Ecuador gas pipeline	Gas pipeline of 8.9 MMm^3/day and 790 km long between Cali and Guayaquil.
• Colombia -Venezuela – Panama gas pipeline	Gas pipeline of 4 Mm^3/d will connect Ballenas province in Colombia to western Venezuela. Later it may be extended and connected to the eastern Venezuela to export gas to Panama
• Peru – Chile gas pipeline	A gas pipeline will first carry 1 MMm^3/d from Humay in Peru to Tocopillas in Chile. Later it shall be extended to carry up to 14.1 MMm^3/d in its third phase.
LNG	
• Camisea II (Peru)	A gas pipeline of 17 MMm^3/d will connect the gas bearing complex of Camisea with the coast, where a natural gas liquefaction plant will be built for exports. It also includes a combination carrier for liquid exports.

Electricity

Colombia-Ecuador Electricity Interconnection

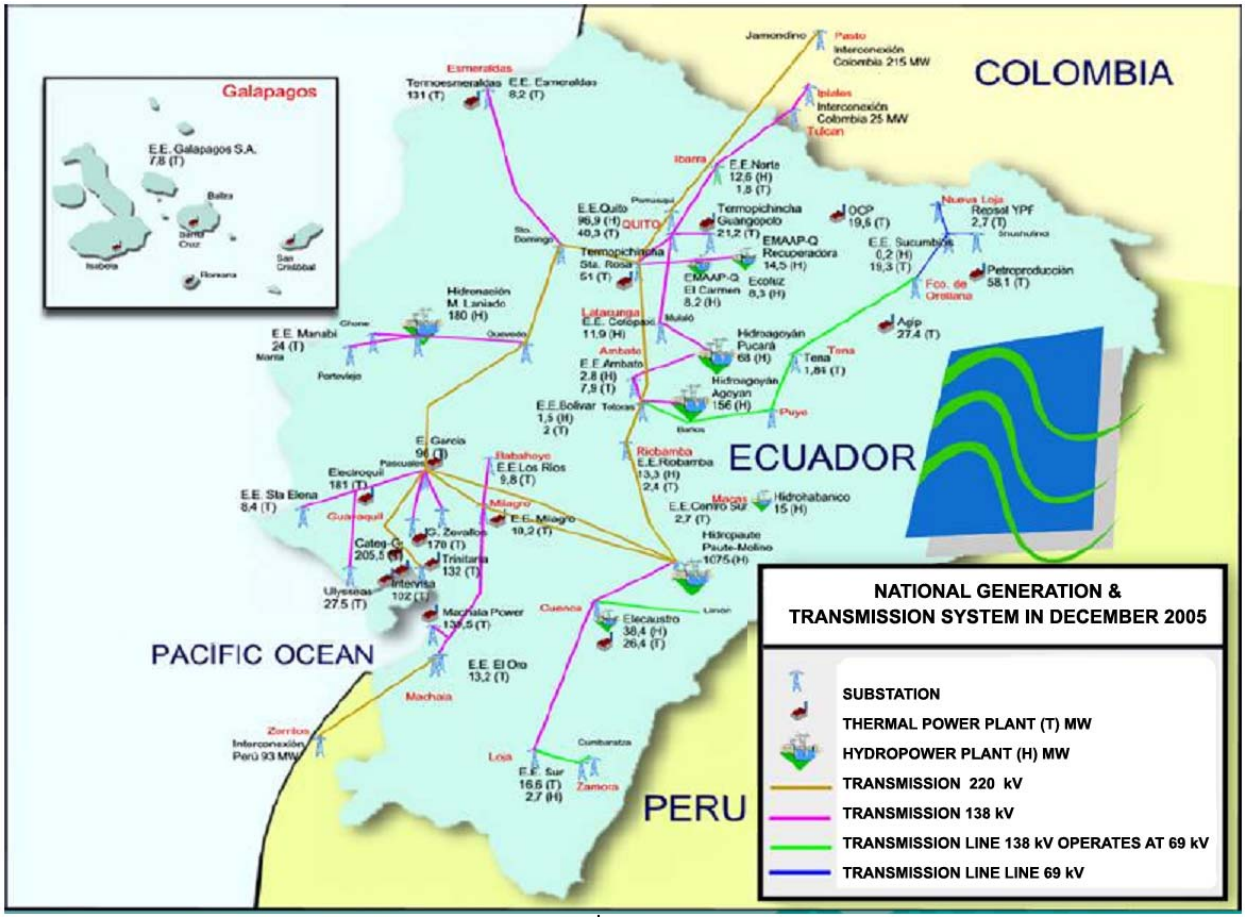
This is an IIRSA project for the Andes zone, for the interconnections between Colombia and Venezuela, Colombia and Panama, Ecuador and Colombia and Ecuador and Peru. The main project plans the regulatory and tariff interaction between the countries involved. This will be the basis on which real integration may be built.

Presently Colombia and Ecuador exchange electricity with each other through two lines already installed one of 138 kV, operating independently and the other 230 kV operating on a synchronised basis. The maximum transmission capacity through these lines is 35 MW and 250 MW, respectively. The IIRSA project plans to extend this second line to increase its transmission capacity by a further 250 MW. Although the project is approved there is no funding. The installation of a back-to-back converter substation is also planned and this will enable the transmissions networks in both countries to operate in synchronous mode. Although during the wet seasons energy can be exported from Ecuador to Colombia, there are also intense flows in the other direction. This project is governed by the ACN resolution, which provides a regulatory framework for the sub-regional interconnection of electricity systems and electricity exchange.

Figure 12

Electricity interconnections between Ecuador, Colombia and Peru

Source: Ministry of Energy & Mines, Ecuador



Ecuador-Peru Interconnection

This also belongs to group in the IIRSA Andean zone. The project is practically completely installed. It consists of a power transmission line from southern Ecuador connecting with the north-western region of Peru. The line operates radially with voltage of 230 kV and transmits up to 100 MW, with transmission capacity of up to 734 GWh a year, as illustrated in figure 12.

The project plans to expand the transmitted volumes to 250 MW and 1800 GWh a year. The next step for integrating the markets involves uniform tariffs and regulations. Only after that, new investments shall be made in this area. The installation of a back-to-back converter substation is planned.

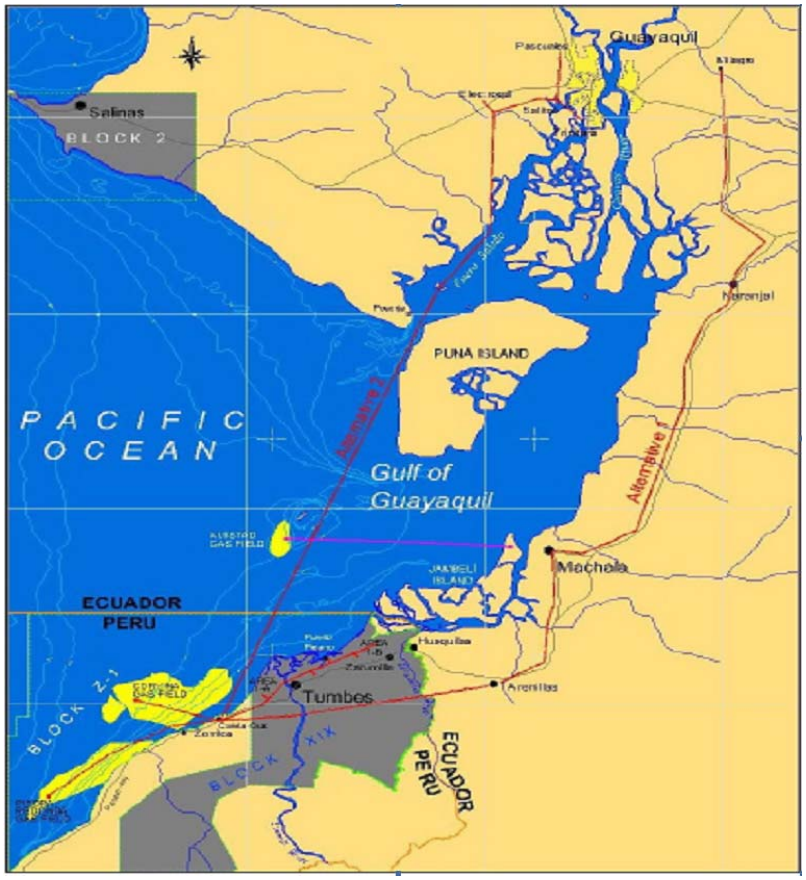
Natural Gas

Corvina-Calleta Cruz-Arenillas-Guayaquil Gas Pipeline (Peru-Ecuador)[53]

In 2006, BPZ Energy, Peru, signed a Memorandum of Understanding with Suez Energy, Peru, for operation of a 180 MW thermal power plant in southern Ecuador. This agreement is a complement to the BPZ project of developing the oil potential in these two countries and exploring the gas potential in northern Peru. The company plans to build a gas pipeline linking North Peru to the city of Calleta Cruz, where the 160 MW thermal power plant of Nueva Esperanza will be installed. The unused gas will cross the border to Ecuador, where it will be used by the Suez plant, initially of

[53] Sources: BPZ Site: Gas interconnection in the Peru-Ecuador bi-national zone, CIER, 2006.

Figure 13
Guayaquil Gas Pipeline
Source: CIER



300 MW which may be increased to 600 MW. The remainder will be sold to industrial consumers in the city.

A third stage will reach Guayaquil, where the gas will be distributed to industrial consumers and energy generators. The gas pipeline will stretch 210 kilometres to Guayaquil. Figure 13 show two alternatives for the Guayaquil gas pipeline.

Cali-Guayaquil Gas Pipeline (Colombia-Ecuador) [54]

This gas pipeline is part of the Grand Libertadores Gas Pipeline, which is an alternative to the Grand Southern Gas Pipeline. The Libertadores gas pipeline intends to use the existing gas pipeline network in the countries along the Pacific coast in South America, from Venezuela to Chile, and from there to Argentina and Brazil, as shown in figure 14.

It is estimated that the project will benefit around 77 million people. The stretch between Cali and Guayaquil, over 700 kilometres or so, has not yet been built. It is included in the Colombian plan of goals, but without a formal agreement.

[54] Source: UPME Colombia; petroleumworld.com.

Figure 14
Ecuador-Colombia gas pipeline
Source: UPME - Colombia

Transguajiro (Colombia-Venezuela) and Trans-Caribbean (Colombia-Venezuela-Panama)[55] Gas Pipeline

In 2006, the first pipelines of a 225-kilometre pipeline were laid from Colombia to Venezuela to address the shortage of natural gas in the western region of Venezuela, and help restructure its oil by-products market, since oil use will be substituted by the new fuel. Venezuela will be given time to develop its gas producing fields and reverse the flow to export gas to Colombia. Colombia signed a Memorandum of Understanding for gas trade with Panama. As soon as Venezuela starts exporting it, the gas will be traded as compressed natural gas and carried in barges from Punto Ballenas to Panama City. The plan is also to extend the gas pipeline under the sea to that city. A combination carrier is also planned to allow Venezuela to export its petroleum and by-products to the Pacific Ocean. Figure 15 on the next page illustrates the intended gas pipeline.

Humay-Tocopillas Gas Pipeline (Peru – Chile)

This project integrates the Southern Gas Pipeline Network with the Andean markets of Mercosur (Southern Cone + Brazil), crossing 1356 km in the Andes from the town of Humay, in the middle of the Camisea gas complex in Peru, to Tocopillas in North Chile.

It is strategically placed and may be connected to the Northeast Argentina gas pipeline (GNEA), reinforcing the gas supply to the region from the Bolivian reserves. The Chilean government intends to build a liquefied natural gas (LNG) regasification plant, with imports from Peru or other international suppliers. GNEA will carry its fuel to the regions not supplied by the LNG port and also to the markets in Argentina, Brazil, Uruguay and Paraguay, as shown in Figure 16 on the next page.

[55] Sources: MME of Colombia in FIER LAEO 2006; UPME of Colombia in FIER LAEO 2006.

Figure 15
Transguajiro gas pipeline (Colombia - Venezuela)
Source: UPME, FIER OLADE (LAEO) 2006

Figure 16
Tocopillas (Chile) – Argentina connection
Source: WEC

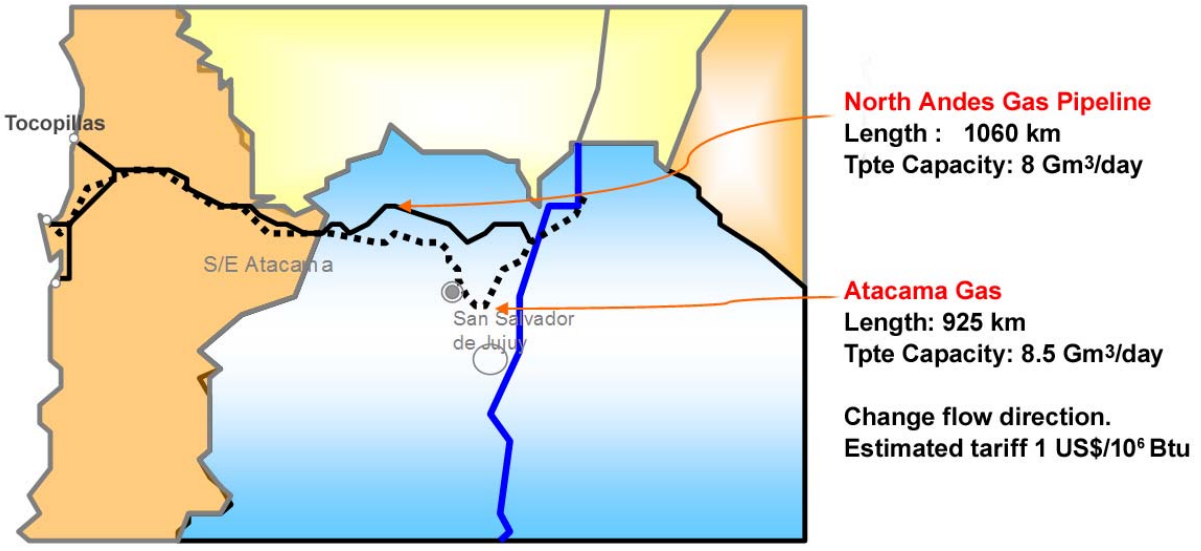
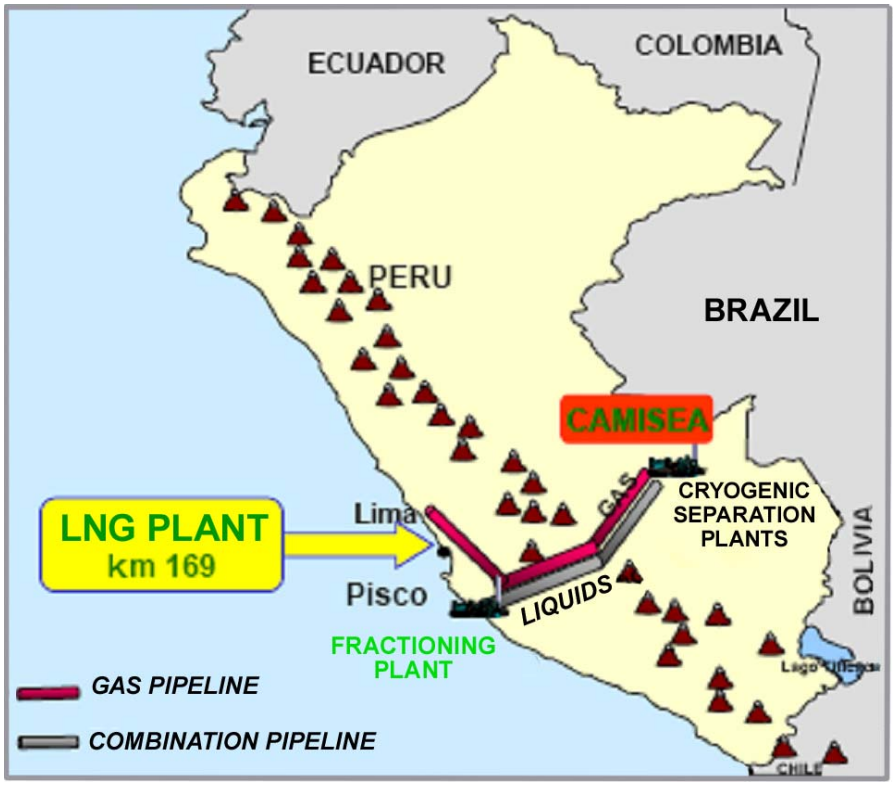


Figure 17
Location of the liquefaction plant for gas from Camisea fields
Source: FIER OLADE (LAEO) – 2006



Liquefied Natural Gas (LNG)

LNG-natural gas plant from Camisea[56]

The Camisea II project is the heaviest Peruvian investment in infrastructure. It can carry crude oil and other liquids from the heart of the Peruvian Amazon to the Pacific coast, crossing the Andes mountain range. A new proposed gas pipeline will follow the same route, carrying the gas to a liquefaction plant to be built in the coastal region.

The Camisea field has proven reserves of 425 billion m³ natural gas, enough to supply the Peruvian market for decades, and also light liquid reserves that may reach 500 million barrels. In 2010, the liquefaction plant should export around 17 million m³/d of natural gas to the Mexican, North American and probably Chilean markets. The main gas pipeline will extend for 729 kilometres and carry gas to Lima, while the liquefaction plant will be on the coast, 169 kilometres from the capital. At the same time a combination carrier will carry the liquid fraction direct to the port over a distance of 548 kilometres. Both will cross altitude of up to 4500 metres above sea level. This is all shown in Figure 17.

The countries in the Andean Community, even if their governments have different beliefs, share a number of common features, and energy integration will be achieved in this sub-region.

A close examination shows that the Andean nations confront a number of challenges:

(i) Overcoming severe social and ethnic disparities;

(ii) Sustainable development of the rich Amazon resources;

(iii) The physical barrier of the Andes mountain range to the movement of resources.

[56] Sources: IDB FIER LAEO 2006

Table 25
Mercosur Southern Cone + South Brazil – Main Projects
Source: WEC

Project	Comments
Electricity	
Hydropower projects	
• River Madeira	River Madeira hydropower complex, with facilities in Brazil and Bolivia to reach 7480 MW.
• Corpus Christi	River Paraná hydropower scheme (Argentina-Paraguay) with 2900 MW.
• Garabí	River Uruguay hydropower scheme (Argentina-Brazil) with 1800 MW.
• Yacyretá	Increase of elevation to 83 metres: 1100 MW.
Electricity interconnection lines	**See description**
Natural Gas	
• Southern gas pipeline network	Consists of different natural gas transport infrastructures between Argentina, Bolivia, Brazil, Chile, Paraguay, Peru and Uruguay. A regulatory framework is planned for infrastructure.
• Humay-Tocopillas gas pipeline	Peru-Chile
• Northeast Argentine gas pipeline	Bolivia-Argentina
• Uruguayana-Porto Alegre gas pipeline	Argentina-Uruguay-Peru
• Grand Southern gas pipeline	This mega-project will connect the Venezuelan reserves with the demand centres in Brazil and Argentina, over a distance of 9300 km.
• Bolivia-Paraguay gas pipeline	
LNG	
• Bahia Quinteros plant	Chile began building a LNG regasification plant to start operating in 2008.
• Regasification plants in Brazil	Petrobras is designing the installation of two LNG plants to assure supply.

5.2.4 Mercosur

The small or midsize projects in progress or under study are more feasible for local than regional development. They seem to be aimed at developing the national energy markets. These projects, although more modest than the Grande Libertadores Gas Pipeline between Venezuela and Argentina, must be interpreted as components of future integration projects. Accordingly, long-term planning is essential, together with good political and economic dialogue between the countries in the region. Table 25 above summarises the main energy projects in Mercosur, covering the Southern Cone plus Brazil.

Electricity – Bi-national hydropower projects

River Madeira (Brazil-Bolivia)

The River Madeira hydropower complex involves building two new hydropower plants in Brazilian territory (Jirau 3,150 MW and Santo Antonio 3,300 MW) and a future plant in Bolivia. In addition, the creation of a river corridor is being considered as far as the mouth of the Amazon River and, possibly, to the River Plate estuary. These corridors would reduce the transport costs of farm produce, principally soya, produced in the hinterland of Bolivia and Brazil, opening up prospects for exports to the international market. The energy generated in the Madeira complex will

be carried to Southeast Brazil through transmission lines crossing parts of the Brazilian Amazon. The first plant (Jirau 3,150 MW) will start operating in 2011 and the complete project will reach 7480 MW. This project initially raised objections from the environmental viewpoint but they have all been settled.

Corpus Christi (Argentina-Paraguay)

The Corpus Christi project is a bi-national hydropower scheme (Argentina-Paraguay) on the Paraná River. Three alternatives for possible sites were analysed – Itacuá, Itacurubí and Pindoí – and the last was chosen. This alternative at 1656 km on Paraná River, could have an installed capacity of 2,880 MW and power generation of 20,175 GWh/year. It has fewer issues related to the environment and population resettlement. The power generation is 20% of the demand in the Argentine electricity market. In 1971, Argentina and Paraguay created a committee to study the existing options. In 1979, Paraguay, Brazil and Argentina signed a Tripartite Agreement to make the Itaipu and Corpus Christi hydropower projects compatible, the Corpus Christi has a construction period of 7.5 years and the start of commercial generation in the fifth year.

Garabí (Argentina-Brazil)

Garabí is a bi-national hydropower project between Argentina and Brazil, which goes back to the seventies. It is located on the Uruguay River 47 km from Aposteles, Argentina and 100 km from São Borja, Brazil. With installed capacity of 1,800 MW, it could generate an average of 6,083 GWh energy a year. Environmentalists and local people opposed the project. It was proposed to lower the height of the dam with consequent drop in capacity from 1,800 to 863 MW. The flooded area was reduced. The project requires uniform Argentine and Brazilian regulations regarding the level of the reservoirs. In 2005, both countries signed a declaration of interest in building the plant. Eletrobras-Brazil and EBISA-Argentina are studying the design.

Yacyretá (Argentina-Paraguay) – Increase in installed capacity

Yacyretá bi-national hydropower complex on Paraná River has been operating since 2006 at an elevation of 77.6 metres and with 2070 MW of installed capacity to generate 13,180 GWh/year. To increase the operating elevation of the dam to 83 metres above sea level, complementary sanitation is required and some facilities and population relocated. The plan is to gradually increase the operating elevation by 2009, and when ready to generate 19,545 GWh/year. The design also plans to incorporate the Aña Cua hydropower plant, which will increase the steady supply capacity by 250 MW, with firm energy of another 2,000 GWh/year.

Table 26
Electricity interconnection lines
Source: WEC

Interconnection	MW
Argentina-Brazil	
• Yacyretá-Foz de Iguaçu	1,200
• Yacyretá-Porto Alegre	600
Argentina-Chile	
• Mendoza-Santiago	200
Argentina-Uruguay	500
Argentina-Paraguay	
• Northeast-Asuncion	undefined

Electricity interconnection lines

Table 26 shows the following bi-national interconnection lines in the Mercosur area, which are being assessed.

Natural Gas

South Gas Pipeline Network (Argentina–Bolivia–Brazil–Chile–Paraguay–Peru– Uruguay)

The project of the South Gas Pipeline network has already been mentioned with regard to the Peru-Bolivia connection (Andean countries) and with the demand centres of the Southern Cone countries. The project consists of the following:

(i) Construction of a new or extended infrastructure of the already existing natural gas transport pipeline, to link up the production centres with the Southern Cone consumer centres;

(ii) Preparation of the legal and institutional framework to regulate the infrastructure of the countries party to this agreement with regard to the international gas transactions that use this infrastructure.

In 2005, Argentina, Bolivia, Brazil, Chile, Paraguay, Peru and Uruguay made significant progress in preparing a regulatory framework for natural gas transactions. The negotiations were interrupted by the resumed border dispute between two of the countries involved. It is hoped that the negotiations will be restarted, and the proposal is open for other countries in South America to join.

The major infrastructure projects considered in this framework are the Humay-Tocopillas gas pipeline to supply Chile with gas from Camisea; the Northeast Argentine-GNEA gas pipeline and Uruguayan-Porto Alegre connection. These gas pipelines will play a leading role in the integration process of the Southern Cone. After the crisis in gas production in Argentina in 2004, these projects are even more justifiable, considering the regional energy supply security and connection of the Bolivian and Peruvian reserves with the major regional consumer centres, as shown in Figure 18.

Figure 18
Southern Gas Pipeline Network
Source: WEC

Northeast Argentina Gas Pipeline (GNEA)

The main branch of the GNEA project plans a capacity of 20 million m^3/d over 1500 km and a 30-inch diameter pipe. The secondary branch lines will cover 1,000 km in diameters of 4-12 inches. The objective is to provide gas to the provinces in Northeast Argentina and bring gas from Bolivia to Buenos Aires, releasing reserves from the Argentine basin of Neuquén to meet the Chilean demand, as shown Figure 19.

In 2004, in a Protocol Argentina and Bolivia agreed to build the gas pipeline and, after the 2006 Framework Agreement to supply Bolivian gas to Argentina, the feasibility study of the project was resumed. YPFB-Bolivia would be the gas supplier and ENARSA-Argentina the buyer. ENARSA will be responsible for the gas pipeline in Argentine territory. It is expected to start operating in the second half of 2009.

Figure 19
Northeast Argentine Gas Pipeline
Source: WEC

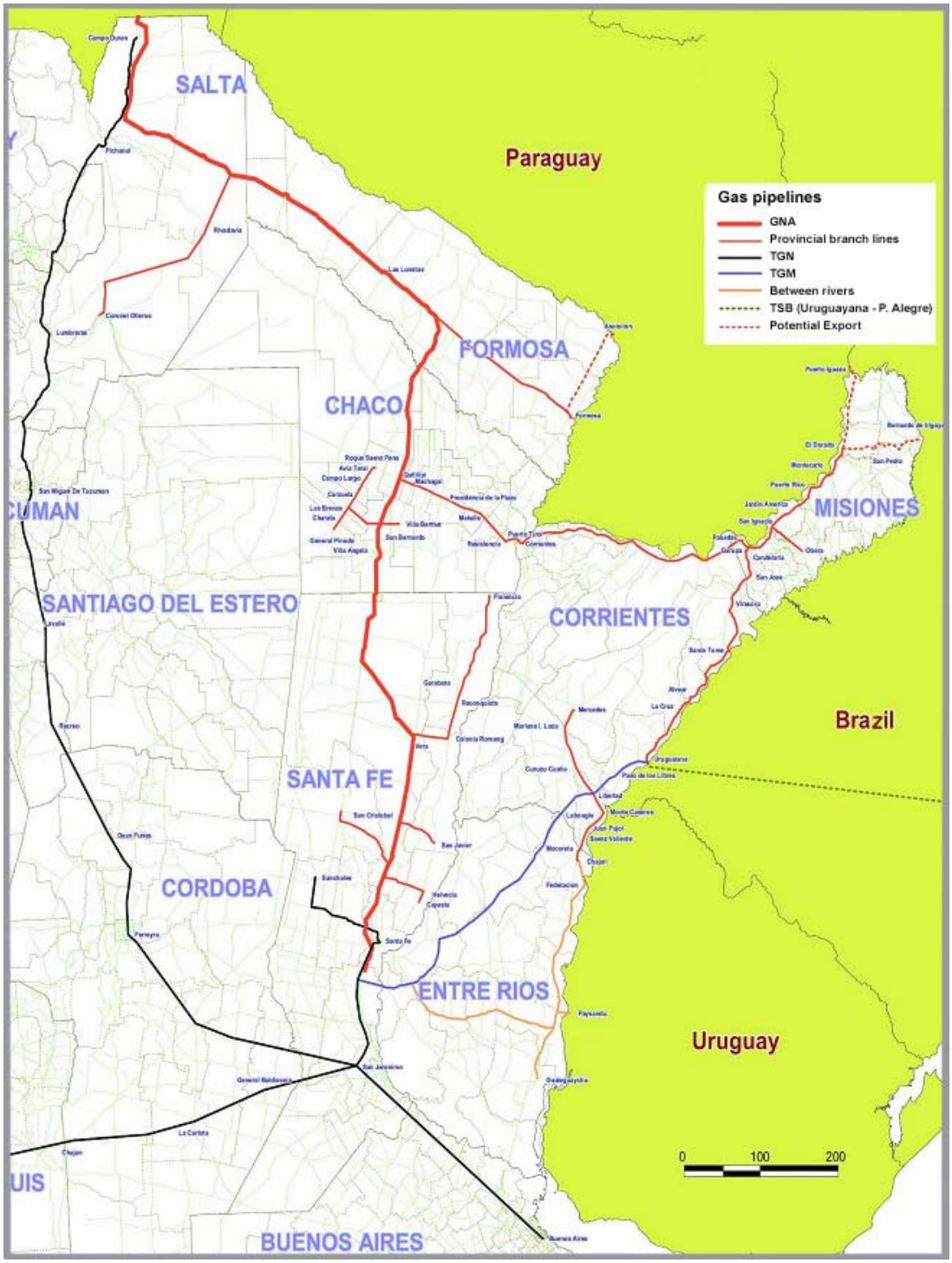
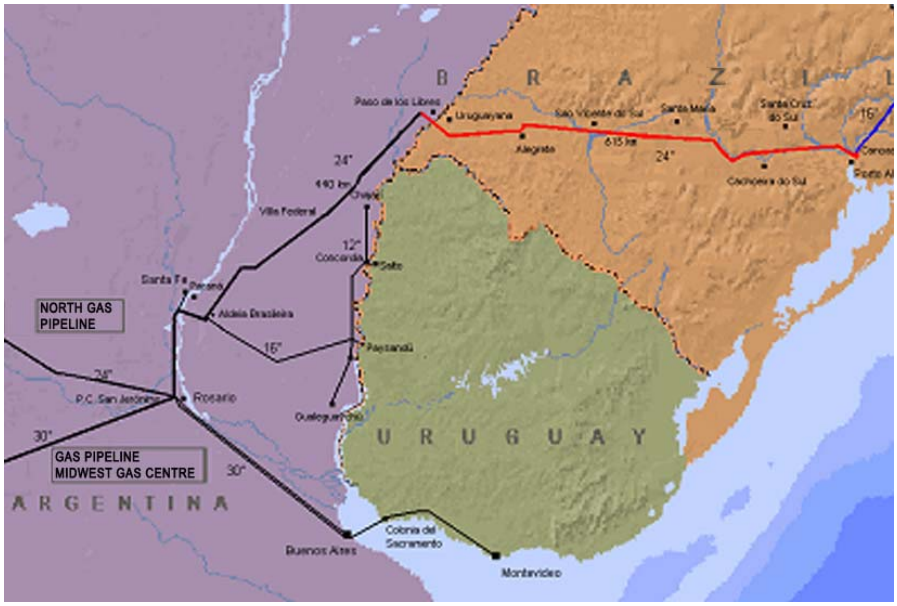


Figure 20
Uruguayana – Porto Alegre gas pipeline
Source: WEC



Uruguayana–Porto Alegre Gas Pipeline

This is one of the stretches planned for the Southern Gas Pipeline Network project. According to the pre-feasibility study, it could achieve 18.1 million m^3/d by 2025. The extension is planned to be 565 km, with a 24-inch diameter pipe, and is shown in figure 20.

Grand Southern Gas Pipeline (Argentina–Brazil–Venezuela)

In 2005, Argentina, Brazil and Venezuela signed a Memorandum of Understanding that started feasibility studies for building a gas pipeline between the gas fields in Venezuela and the main consumer centres in Brazil and Argentina. It might be integrated with the stretches already planned for the Southern Gas Pipeline Network, and also incorporate Bolivia as supplier, with Uruguay and Paraguay as consumers, as in Figure 21.

It is considered to have a capacity of 20-150 billion m3/d, over a distance of 9283 km, 30 to 58-inch diameter pipes for the Southern Cone in the mid- and long-term. The construction will take from five to seven years.

Bolivia–Paraguay Gas Pipeline

An agreement between Bolivia and Paraguay guarantees the supply of Bolivian natural gas at a quantity yet to be decided. Both parties agree not to adopt customs or non-customs restrictions on exporting and importing the product, and to give permission to build and operate a gas pipeline between the two countries.

The gas pipeline will have an 18-inch diameter and total length of 846 km (102 km in Bolivia and 744 km in Paraguay).

Figure 21
Southern Grand Gas Pipeline
Source: WEC

Liquefied Natural Gas (LNG)

Chile intends to have a supply of liquefied natural gas by 2009, and Brazil plans to receive LNG to guarantee flexibility and minimise the risk of natural gas supply disruption.

6. Exchange Price Formation

6.1 Natural Gas – Exports from Bolivia and Argentina

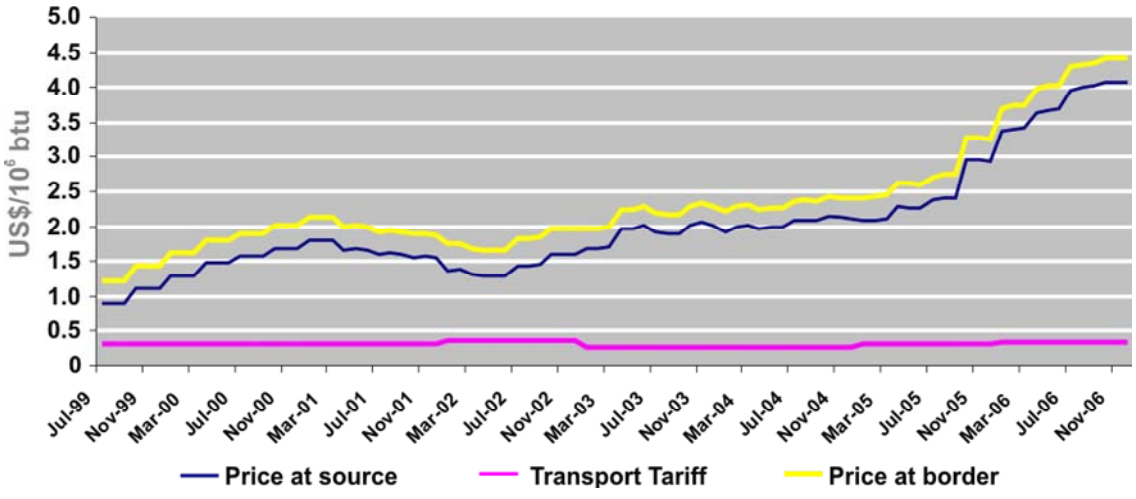
The absence of a diversified gas market and heavy infrastructure investment without alternative uses have upset the power in terms of fixing prices for the exporting countries Bolivia and Argentina. The average border export price from Bolivia was approximately US$ 4.1/million Btu in the second quarter of 2007. This figure is not very different from the average border figure for Argentine gas exports of US$ 4.3/million Btu for the same period in 2007. Nevertheless, there are big differences in the price structure of both countries, and in their adjustment mechanisms.

Petrobras (Brazil) and YPFB (Bolivia) signed a natural gas purchase agreement with two volume components: the basic daily contract quantity (BDCQ) up to 16 million m3 and the additional daily contract quantity (ADCQ) to increase these volumes to 30 million m3/day as provided in gas transport contracts. Both BDCQ and ADCQ base the adjustment formula of their price on the fuel oil price sold in the USA and Europe. Graph 20 shows the performance of the Bolivian natural gas price.

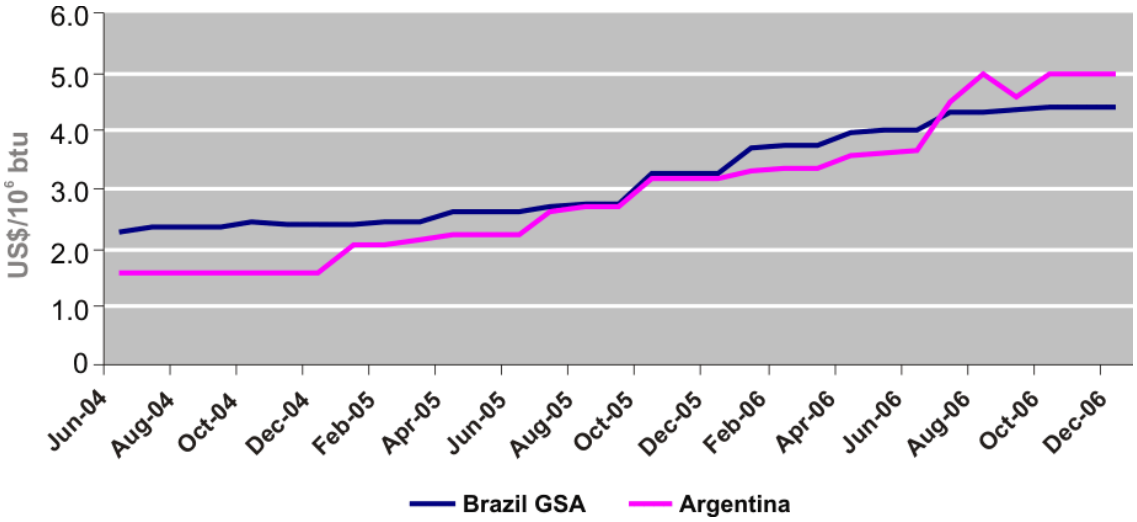
Graph 20

Export prices to Brazil – GSA

Source: WEC



Graph 21
Bolivia – natural gas exports - Prices at border according to destination
Source: WEC



In addition to this contract, there are other minor export contracts from Bolivia to Brazil but among more significant is export to Cuiabá, through a branch gas pipeline to GTB. This export is based on a supply agreement, with bottom prices between US$ 1.2/million Btu and US$ 1.225/million Btu. In 2007, it was agreed to increase the price to US$ 4.2/million Btu. A less important agreement is between YPF-Bolivia-CONGAS, the last being the Brazilian São Paulo gas distributor, wherein the price is constantly negotiated by YFPB-Bolivia-British Gas, and its level in 2007 was US$ 3.1/million Btu.

Bolivia exported gas to Argentina from 1972 to 1999. In 2004, the exports resumed with the "Temporary Natural Gas Purchase Agreement" and in 2006 the "Framework Agreement" was signed between Argentina and Bolivia for Natural Gas Purchase and undertaking "Integration Projects", under which it is planned to progressively increase sales from Bolivia up to 27.7 million m3/day. In this agreement a border price was fixed at US$ 5/million Btu. In 2006, ENARSA (Argentina) and YPFB (Bolivia) signed the natural gas purchase agreement. The bottom price at 12/31/2006 was to be US$ 5/million Btu and will be adjusted subject to a multi-product formula that includes fuel oil and diesel. Graph 21 illustrates the performance of the border price for exports to Argentina, since its restart in 2004.

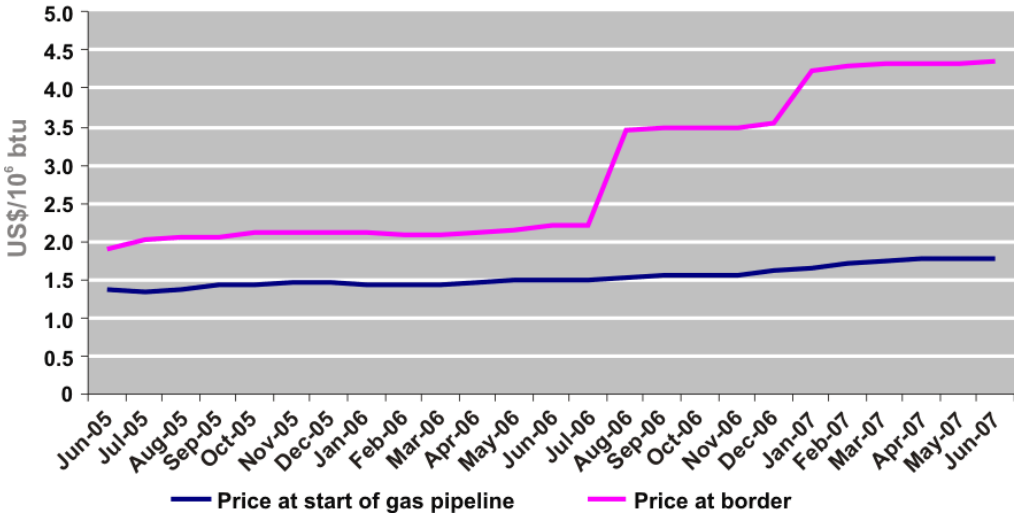
Since 2004, Argentina, as a result of the macroeconomic crisis and conversion back to pesos, decided to undertake an ambitious plan to expand the gas transport systems, thereby creating a new mechanism to encourage, finance and repay the investments. As a result of this measure, the weighted average border price of the Argentine exports performed as shown in Graph 22.

Argentina granted export licences for Chile (36.73 million m3/day), Brazil (2.8 million m3/day) and Uruguay (3.25 million m3/day). These exports had their bottom prices and the update formula linked to the Argentina home gas price market. Despite the return to pesos, the government renegotiated the agreements in order to release its adjustment of the internal price performance. These negotiations have been irregular, with export prices lagging behind the international performance of crude and its by-products.

Prices in the regional gas exchanges in the Southern Cone tend to level out over time. Bolivia considerable increased the border price of natural gas. The agreed adjustment formula for sales to Brazil and Argentina lies on the performance of liquid fuels that can be replaced by natural gas.

Argentina became involved in a more complex process, in which the border price adjustment was considerably affected by the financing plans of a new transport capacity, as well as by the

Graph 22
Argentina Natural Gas Export Price Performance
Source: WEC



application of export rights related to the simultaneous import and export operations. It is hard to forecast how the Exchange prices will behave in the future.

6.2 Electricity

Concerning electricity, the first major transactions occurred in the Southern Cone after the shared use of water resources. For the first agreement (Salto Grande between Argentina and Uruguay) the energy prices were linked to the marginal costs of the electricity systems in the respective countries, sharing the resulting benefit. The subsequent agreements (Itaipu-Bi-national between Brazil and Paraguay, and between Argentina and Paraguay) fixed prices agreed in advance by treaties with updated clauses.

The first transactions relate to Salto Grande, followed by those of Itaipu and Yacyretá, respectively. More recently, within the scope of Andean countries, a resolution was passed to link the market directly to their prices. Modern interconnections between Colombia, Ecuador and Peru are the reflection of these new links, based on market prices.

6.2.1 Salto Grande

Electricity exchanges between Argentina and Uruguay are based on agreements.

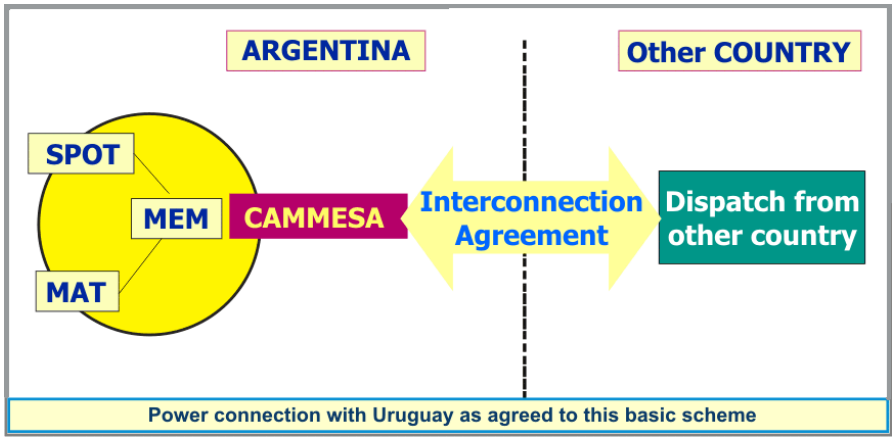
Energy exchanges have been very important over the years, varying in direction from one country to another, according to the needs and possibilities of each of them, with the view of optimising dispatch and aid in emergencies.

Argentine generating companies make the energy exchanges by contract with TEP in Uruguay, as shown in Figure 22.

Electricity exchange between Uruguay and Argentina has been traded for over twenty years, and during this time it has undergone a variety of legal frameworks and regulations of both countries and different market realities. Even with occasional drawbacks, a way has been found to make relevant and beneficial exchanges for both countries.

The energy exchanges between Argentina and Uruguay are shown in Graph 23.

Figure 22
Physical and operating characteristics
Source: CAMMESA. Wholesale Electricity Market Administration Company



Graph 23
Energy exchanges Argentina-Uruguay GWh/year
Source: WEC

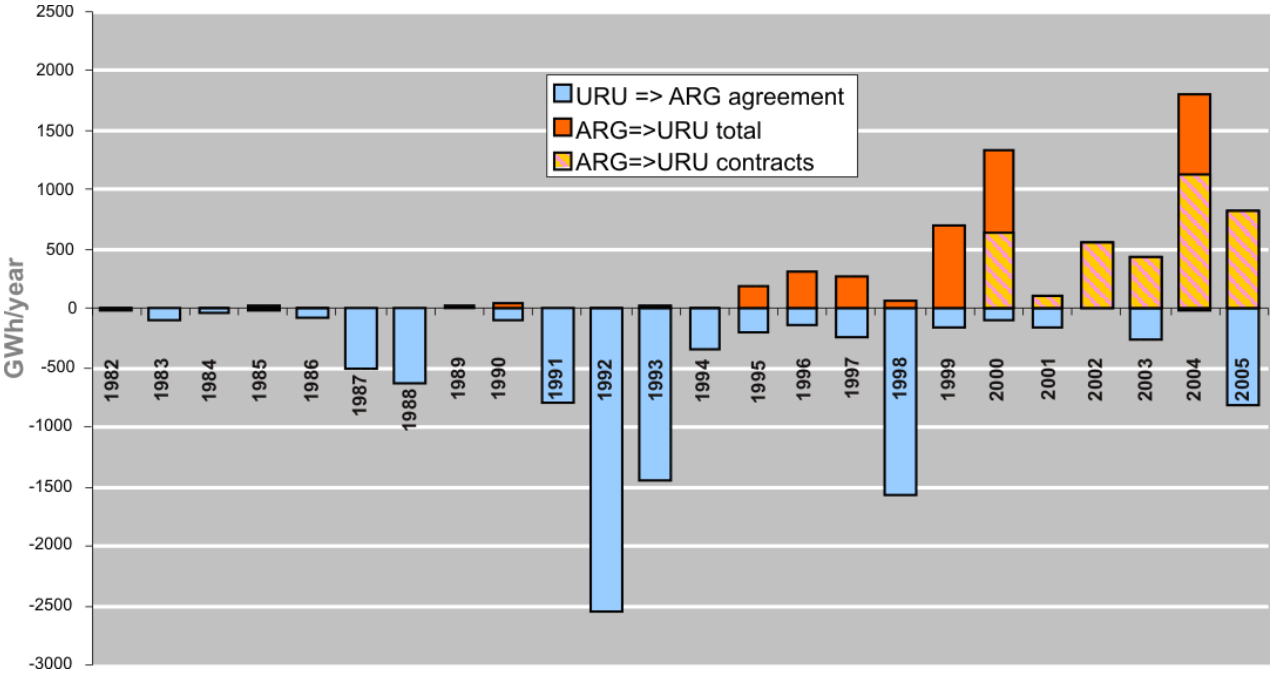


Table 27
Itaipu Bi-National prices 2007
Source: Itaipu Bi-National

Year 2007	US$/kW
Tariff fixed by ITAIPU	22.2000
Cost energy given	0.8126
Commercial account balance	0.7398
Total Eletrobras	23.7524

6.2.2 Itaipu Bi-National

Eletrobras receives Itaipu energy through its subsidiaries Furnas and Eletrosul. The power plant tariff is a financial calculation, which is established as an annual budget that is fixed by the Itaipu Bi-national Board. The original treaty included an annual budget that covers all O&M costs, management, investments and debt service. Eletrobras buys at a tariff fixed by Itaipu and adjusts it with the necessary increases for compensation of energy sold to Paraguay, based on a concept called the marketing account balance (it considers adjustments of the Itaipu financial budget approved by its Board), also including the expenses of Eletrobras. Thus the new tariff is a pass-through to distributors, who must absorb the costs of Itaipu and require previous approval by the Brazilian electricity regulatory agency ANEEL. The energy portion corresponding to Paraguay and not taken by ANDE, is given to Brazil. Table 27 shows the 2007 tariffs.

6.2.3 Yacyretá

Electricity buyers are ANDE (Paraguay) and EBISA (Argentina). The power plant tariff originally included in the treaty was a financial calculation, which is established as an annual budget to cover all O&M costs, management, investments, debt services and considering the adjustment at the end of the previous year to be the same as for Itaipu Bi-national.

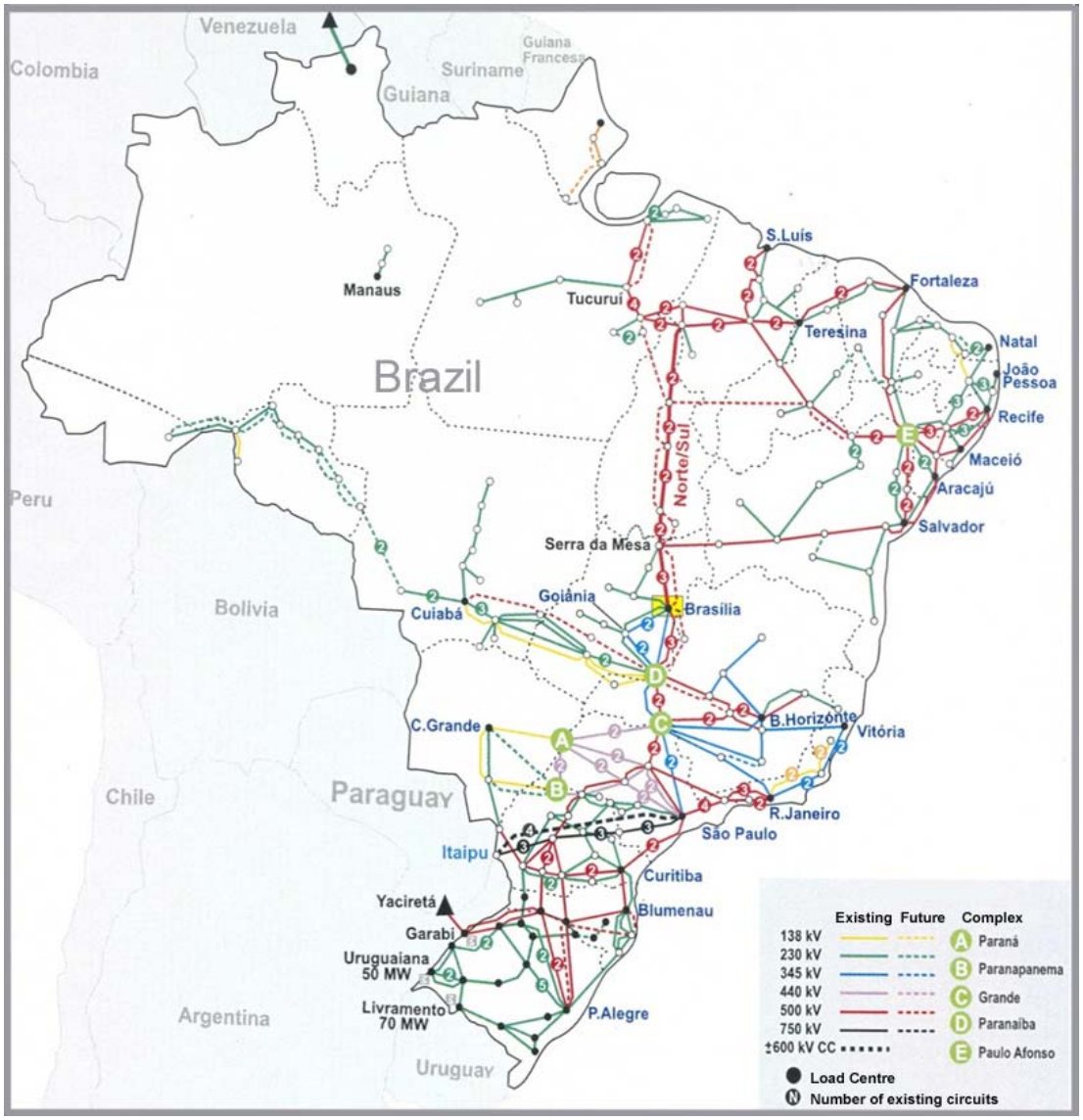
At present the energy tariff is fixed based on notes of 1992 at US$ 30 /MWh, updated monthly using the indexes of the Treaty. The values in US$/MWh, during 2007, performed according to Table 28.

Moreover, the quota of energy allocated to Paraguay and not taken by ANDE is given to Argentina.

Table 28
Yacyretá prices
Source: Yacyretá

2007	US$/MWh
January	36.9026
February	37.3107
March	37.2963
April	37.5488
May	38.0901
June	37.8042
July	38.1436

Figure 23
Brazil: power interconnections with Argentina, Paraguay, Uruguay and Venezuela
Source: EPE



6.2.4 Interconnections

In the Brazil-Argentina interconnections through transmission lines with a transport capacity of 2,100 MW, and with frequency converter stations of 50-60 Hz, built by private investors, the fixed price is applied for the purchase of a power reserve with associated energy based on long-term agreements. This has developed today toward a two-way use of the lines, with short-term contract transactions, whose prices are fixed administratively.

Figure 23 shows the Brazilian interconnected system and existing power connections with Argentina, Paraguay, Uruguay and Venezuela.

In the case of the Andean and Central American countries, the most recent connections have adopted tariff principles more in line with market criteria and the following rules:

- Non-discrimination of national and foreign prices,
- Free access to networks,
- Physical use of interconnections by co-ordinated economic dispatch,
- Free agreements between markets without extra restraints,
- Prices and tariffs that reflect economic costs, preventing abuse of a dominant position,
- Short-term international transactions admissible,
- Profits from co-management not assigned to international connection, and
- Subsidies, duties or restraints are not admissible.

The major difference in Southern Cone exchanges is that inter-market transactions are made according to the prevailing prices in each country, and the benefit arises through co-management profits.

Figure 12 on page 78 shows the electricity interconnection facilities in the Andean countries between Colombia, Ecuador and Peru.

7. Integration: Where to go?

The leading multilateral organisations agree in their assessment of the economic performance of the countries in Latin America and the Caribbean in recent years. The favourable international prices of commodities have been encouraging exports of both farm produce and raw materials. The region is a net oil exporter, benefiting from the recent increase in prices of this fuel on the international market. The economic dynamism started by exports is spreading to the regional market, creating solid foundations for a period of sustained growth. However, the fragility of this growth cycle lies in the lack of adequate infrastructure to support the flows of goods and services.

The insufficient energy transport infrastructure is an example of this reality. The Brazilian energy crisis in 2001 could have been mitigated if, at that time, there was the transmission capacity to bring the energy available in Argentina to the Brazilian market. Likewise, the current critical situation of the Argentine energy system could be minimised if the Argentine consumers were able to have access to the energy available in Brazil.

The difficulties facing the sub-regional blocs seem to multiply with wider integration schemes such as Unasur, for example. When there is a concrete project, from an economic viewpoint it is heavily dependent, in some cases, on the political context.

For example, the gas integration projects between Venezuela and Central America, and between ACN with the Southern Cone and South Brazil seem particularly feasible, bearing in mind the objectives of supply security. Nevertheless, the economic, political and regulatory risks are major drawbacks for these projects.

To achieve scales and help cut costs thus increasing investment opportunities, energy integration needs the reduction of the protectionism in the domestic markets of the economies involved. To ensure equal distribution of the integration benefits, it is fundamental to adopt policies for reducing the economic disparities, mainly in physical infrastructure and strive for compatibility of the regulatory and institutional systems.

Graph 24 is an example of the different regulatory systems in the various regions of the world, and shows that the Latin American and Caribbean region is less favourable to regulatory change.

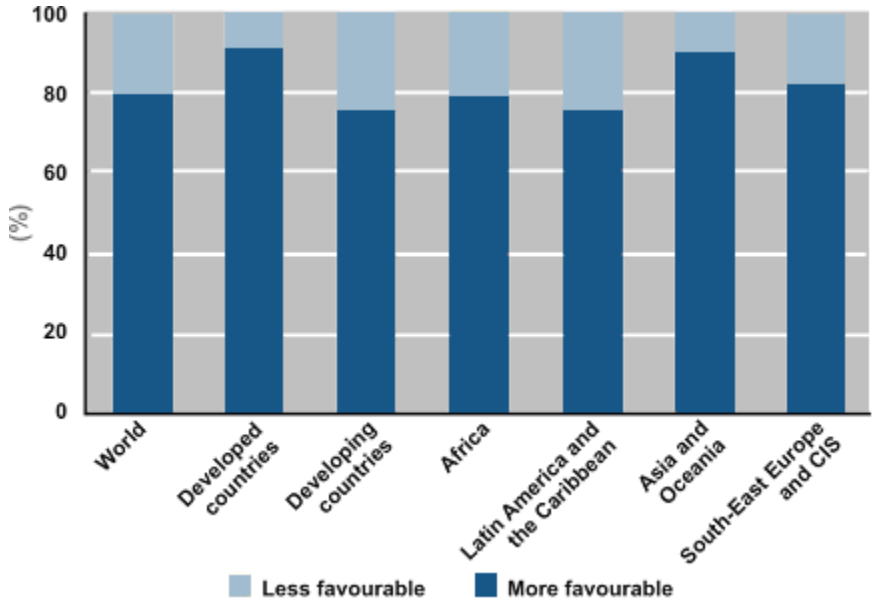
Understanding this reality is at the heart of the IIRSA geopolitical project for integration of the South American physical and regulatory infrastructure. The project is multi-disciplinary and has the co-ordinated support of three multilateral funding institutions that operated in the region (IDB, CAF and Fonplata).

The global environment in general has been favourable to private investment and financing from multilateral credit organisation. 2006 was a positive year for world economy, both in terms of growth and of trade and financing.

A key variable for the long-term trends is Foreign Direct Investment (FDI) in the region. According to the UNCTAD annual report (2006), the FDI rose

Graph 24
2005 regulatory changes by nature and region

Source: UCTAD



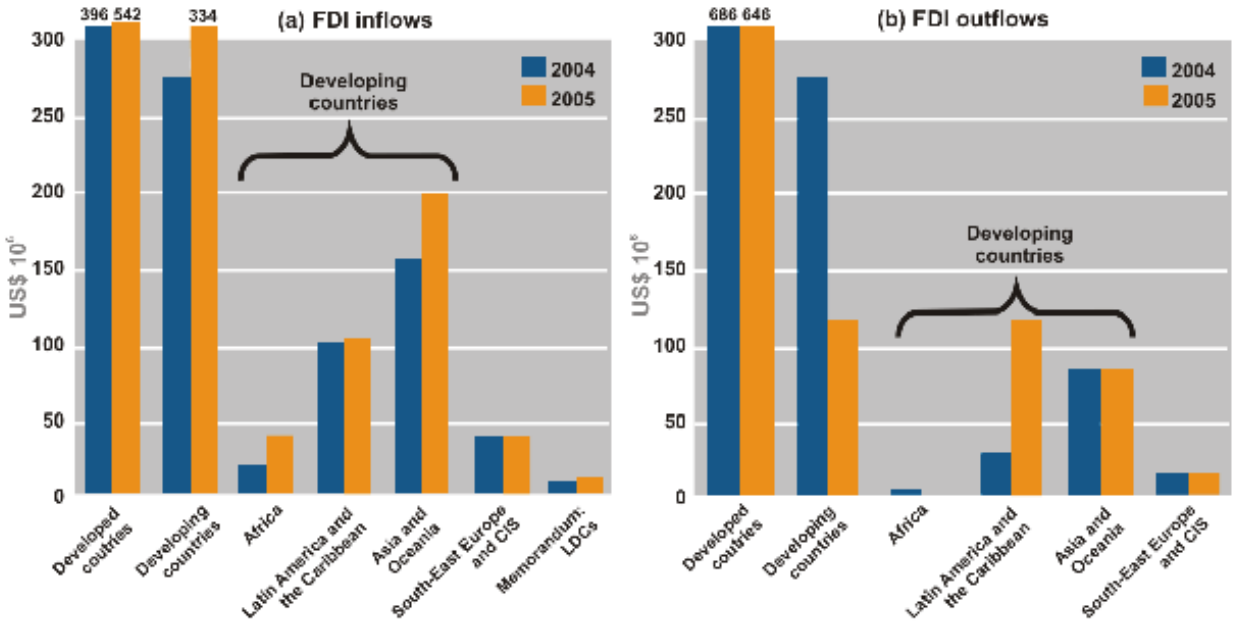
29% in 2005. It should be mentioned that 2004 also showed an increase of 27% in FDI, although still far from the investment peak observed in 2000.

Brazil is fifth ranking among the developing countries attracting most FDI. On the other hand, taking the Central and South American region as a whole, the investment flow has only been of US$ 65 billion.

Graph 25 shows the flow of FDI inputs and outputs in Latin America and the Caribbean compared to other regions of the world.

Graph 25
2004-2005 Foreign Direct Investment Flow (US$ billion)

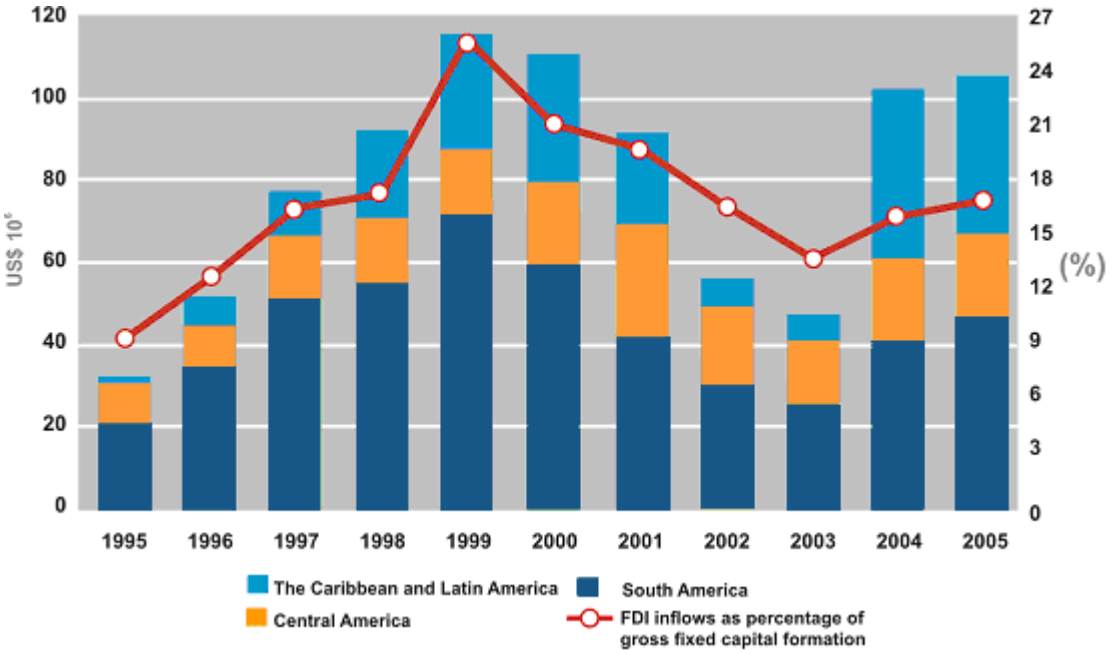
Source: UNCTAD



Graph 26

Latin America and the Caribbean. Foreign direct investment flow and its participation in the gross fixed capital formation. 1995-2005

Source: UNCTAD



The FDI performance varied according to the country. Brazil, Chile and Mexico have experienced a decrease, while Uruguay, Colombia, Venezuela, Peru and Ecuador have had significant growth.

Energy integration is only one of the aspects involved in the process of economic and political integration of the countries that share a geographical area. Energy integration was conceived in the IIRSA "as a necessary condition for development but whose sustainability is linked to major transformations in four key dimensions: competitiveness, environmental quality, institutional quality and social quality.

In this way, energy integration may have various objectives, some of which are as follows:

(i) increase in the security of the energy supply;

(ii) reduction in cost of investments in the supply system;

(iii) peaceful and equal development of the countries in the region.

To achieve such objectives, it is necessary to approach the design of the integration projects with an overall focus that considers the questions of efficiency relating to the economic costs of the projects. I.e. the degree of political and regulatory exposure, and the possibilities for equal, harmonious and sustainable development of the countries involved in the interchanges.

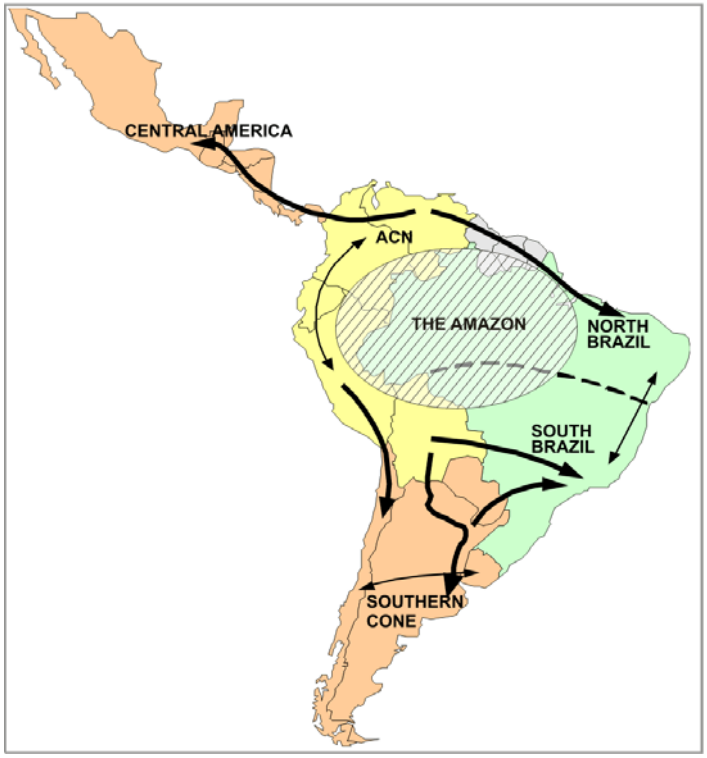
The main scenarios and proposals for future energy integration in Latin America are the following three regions, seen in Figure 24.

(i) Central America / Andean Countries;

(ii) Andean Countries / Southern Cone / South of Brazil; and

(iii) Andean Countries / North Brazil. In the long term, the Amazon (area bound by the Amazon River basin and covered mainly by equatorial rainforest) will be interconnected with these three subsystems.

Figure 24
Integration Scenarios
Source: WEC



7.1 Central America, Andean Community of Nations and Mexico

Two typical integration projects are being developed in the countries of the Isthmus:

(i) the creation and development of the Regional Electricity Market, in conjunction with the SIEPAC line currently in progress; and

(ii) the introduction of natural gas in the Isthmus, project under study.

7.1.1 Electricity

The SIEPAC Project involves building the first regional electricity transmission line in Central America, over approximately 1830 km of 230 kV lines. This project will provide the Central American countries with a reliable energy transport capacity for approximately 300 MW and the new infrastructure will permit progressive development of the Regional Electricity Market (MER).

The development of MER will increase legal security for the investors and facilitate access to financial sources, with lower intended rates of return and consequent reduction in electricity prices. It opens up the prospects for energy integration of the Central American Isthmus with Mexico to the North and the Andean countries (Colombia) to the South. Mexico and Colombia will be connected to MER, increasing the scale of transactions and extending benefits from the integrated energy area.

The following has to be resolved in order to achieve the integration objectives:

- Coordination of the energy, macroeconomic and public policies of the countries to prevent disparities that distort the prices and payments.
- Institutional strengthening of the regional organisations – supranational – created for administration of MER.

- Regulatory unification considering the current status of the project only aims at standardisation of the national regulations.

MER, as sphere of international electricity transactions, and the SIEPAC line as interconnection infrastructure (see figure 6 on page 72) establish the link between the Central American countries. In the future, it is foreseen that the Central American sub-region will be linked in the mid-term to the North with Mexico and to the South with the Andean countries (Colombia).

Electricity Interconnections between Central America, Mexico and Colombia

The Guatemala-Mexico interconnection, in Figure 7 on page 73, is another example of transmission lines between two countries under construction. Since 2006 a 400 kV, 300 MW system covers 103 km. In 2008, this line will be linked to MER through the SIEPAC line.

A transmission line is also planned between the Cerramatoso substation in Colombia and Panama II substation. The capacity from Colombia to Panama will be 300 MW and from Panama to Colombia 200 MW. This project is still being studied, as Figure 23 shows.

7.1.2 Natural Gas

The introduction of natural gas in Central America is an integration project since it will reduce the vulnerability of the national economies by diversifying the energy mix, which depends heavily on imports of crude and by-products from outside the region. The construction of a gas pipeline from Mexico to Venezuela consolidates the integration of the Mesoamerica-Andean Countries, as shown in Figure 9 on page 75.

The project contributes to mitigation of the growing deficit in the natural gas supply in Mexico, which has now become a net importer. The project operates in tune with other integration projects between the Andean countries, such as the gas interconnection project between Colombia and Central America (MER), and will act as a base for developing the regulations and institutions required to create a regional natural gas market.

The absence of a critical mass of demand to justify the construction of the infrastructure required to connect the countries in the Isthmus with the South American reserves is a problem. The Project alone is justifiable if accompanied by decisions on energy policy in terms of electricity – thermal generation is 70% of the natural gas demand forecasts – and that the demand from the Central American countries reduces the demand in Southern Mexico.

A single company that will be fully in charge of gas marketing and transport activities in the new regional market shall develop the project. This option of market organisation requires strong regulatory activities by the corresponding regional body and the agencies in each country which are responsible for explaining rules and institutions under a Framework Treaty, which will tend to be signed by all the countries, including Mexico, Colombia and Venezuela.

Figure 25
Colombia-Venezuela gas interconnection
Source: UPME – CIER – OLADE (LAEO)

The gas interconnection between Colombia and Venezuela involves the commercial exchange of 4.2 MMm3/d between Ecopetrol in Colombia and PDVSA in Venezuela. The gas pipeline is under construction and it is estimated that it will come on stream by 2011, when Venezuela will start to sell 4.2 MMm3/d to Colombia. The bi-national Colombian-Venezuelan gas pipeline (Figure 25) will be approximately 224.4 km long with 26" diameter pipe, and 88.5 km of which are in Colombian territory. This gas pipeline will have an expected maximum capacity of 14.2 MMm3/d, as shown in figure 25 above.

Another integration project may link Venezuela and Central America. The project will supply natural gas from Venezuela to Central America and South Mexico. Due to the large investments involved, it will require the countries in the region to adhere to a set of public policies that minimise the risks for the potential investor.

From the point of view of regulatory and institutional integration, Central America has the advantage of flexibility, since there is neither an organisation of the gas industry or specific regulatory framework in any of the countries. Thus, need for compatibility and harmonisation decreases while the scope for establishing a regulation institution and supranational business organisation increases. In any case, the systems established in the countries that are relevant for the project – Mexico, Colombia and Venezuela – should be taken into consideration.

7.2 Andean Community of Nations – Southern Cone – South Brazil

The bi-national hydropower projects, close interconnections of the electricity networks and trunk gas pipelines towards Argentina and Brazil offer an opportunity to develop integration processes.

However, integration of the markets is still quite restricted. Bilateral relations govern the energy flows between the countries, and national energy policies ignore their impacts on the neighbouring countries. The absence of a multilateral mechanism for governance of the energy flows reduces the boosting effect of a possible integration process of the national markets.

The purpose of the Southern Gas Pipeline Network project (see figure 18 on page 86) is to overcome this obstacle using a Regulatory and Institutional Framework – a Framework Agreement or Treaty – that is able to promote and develop different logistic projects for supplying natural gas to the region.

The project complies with the following integration objectives:

i. With regard to the infrastructure to be built, it is intended to provide further guarantees on the national regulatory frameworks in order to encourage private and possibly public investment;

ii. With regard to the existing infrastructure and its extensions, the countries will be free to influence or not the system provided in the agreement. This flexibility allows progress in setting up the new infrastructure subject to common rules, preventing disputes relating to the pre-existing regulatory systems from stopping new initiatives;

iii. The project is applicable to all or some of the stretches shown in the preceding figure – the South Gas Pipeline Network under reference, as well as the unforeseen logistics variants in the initial design of the gas circle, including LNG projects;

iv. With regard to the aforementioned design provided in the agreement, it is worth stressing that the economic and technical feasibility of this group of gas pipelines was positively assessed in the pre-feasibility study conducted by the World Bank in 2005;

v. The Northeast Argentine Gas Pipeline (GNEA), between Bolivia and Argentina, and which consists of one of the aforementioned gas branches is not yet under construction;

vi. Progress in the natural gas sector can be repeated in the electricity sector. Most of the transport infrastructure required for the flow of electricity between the countries already exists. The selection of infrastructure stretches to be provided for third countries, with common principles of open access and tariffs, especially for emergency management, will be the basis for a regional energy integration.

On the other hand, the challenges that face the project implementation are caused by the following:

- With regard to the affected infrastructure, the countries should identify and remove the obstacles facing the different national regulations. Except for Paraguay, it addresses countries with already developed natural gas markets; the project needs to be compatible and converging, not substituting the regulatory systems.

- The role of a supranational agency may only be developed in the long term, by making the resolutions more effective in terms of settling disputes. At first, the project only foresees the creation of a Council of Representatives – in charge of the political management of the project – and an administration body, in charge of adopting and technical-administrative support of the fulfilling of the commitments assumed in the agreement. To have a supranational authority, some countries shall remove their legislative restraints in order to extend the jurisdiction in organisations outside their national sphere.

- The countries should settle past border disputes that prevent them from reaching an agreement on a long term integration strategy - Chile-Peru, Chile-Bolivia -, and overcome the marked national autonomies that disallowed the sanction of the regulations required by the projects. These disputes caused successive interruptions in the negotiation of the agreement at the end of 2005 and mid-2007.

- The concretisation of GNEA and the larger export volumes from Bolivia to Argentina are still not properly backed by a flow of upstream investments to guarantee supply. The interest of Argentina and Bolivia in consolidating this project must surely be able to generate sufficient incentives in order to resume the investment process shortly.

- In the stretch of the network between Peru and Chile, Peru is continuing with its extra-regional LNG export project and, for the time being, has expressed no intentional of committing substantial gas reserves in another major export project.

The objectives of integrating the three regions are not only confined to the agreement on common regulations to govern the infrastructure but will also establish an economic model for the energy flows beyond bilateral relations. The convergence of national energy policies and the delegation of the management of national energy markets to one supranational regulatory authority go beyond regional reality. The energy flows should remain basically governed by bilateral agreements. This does not mean, however, that there is no room for multilateral agreements.

7.3 Andean Community of Nations – North Brazil

The Amazon region has practically no energy transport infrastructure. Nevertheless, integration projects are planned and under construction from North Brazil to East of the Brazilian Amazon. One of the projects underway plans to carry the gas from West Brazil (Urucu) to Manaus and there are studies to carry this gas further South of the Amazon.

The group of projects under construction in Brazil will reinforce the connections of the South Brazil energy markets with the far eastern Brazilian Amazon. Once these connections are made, widespread prospects open up for integration of the energy markets of the Brazilian Amazon with the markets of the Bolivian and Peruvian Amazon regions. In the Peruvian Amazon, ten hydropower projects could be implemented in the Amazon side of the Andes for the Brazilian and Peruvian markets. The hydropower plants Cachuela Esperanza and Guajará-Mirim on the Mamoré River would supply the Brazilian and Bolivian markets. The Brazilian projects will help reduce environmental risks from hydropower projects in the region by providing the know-how. Brazil is starting the work on the Santo Antonio (3,150 MW) and Jirau (3,300 MW) plants on the Madeira River, planned to start operating in 2011. It also intends to begin the Belo Monte project (11,182 MW) on Xingu River, with a reservoir flooding of only 440 km^2, and generation of 0.04 m^2/MW, without interfering in the lives of indigenous communities. The expected energy integration will create a second corridor for the energy flows between the Atlantic and Pacific coasts of the South American continent and the Brazilian power plants in the Madeira basin, when concluded, will provide Bolivia with an outlet to the Atlantic Ocean.

The connection of the Brazilian Amazon to the North Andes was only sketched in with the electricity transmission line carrying energy from Venezuela to Rio Branco, Brazil. Studies are now underway for another transmission line between Venezuela and North Brazil and a natural gas pipeline from Venezuela to North-Northeast Brazil. It is, however, hard to imagine that the energy integration of the Amazon with the Northern Andean countries can make major headway, considering that the Brazilian energy system in the North and South are not completely integrated with the Amazon. Therefore, the South American integration of the Amazon depends only on Brazilian progress.

7.4 Caribbean Gas Pipeline

The concept of a Caribbean Gas Pipeline sub-sea network to supply gas to several small Caribbean markets is one of the main points in the Tobago & Trinidad business strategy.

Efforts are under way to promote development of a sub-sea natural gas pipeline system from Trinidad & Tobago northwards through the Caribbean Sea. The initial idea is to carry gas from the island of Trinidad through the Caribbean as far as the French dependencies of Martinique and Guadeloupe. There is, however, also the possibility of the gas reaching Miami. The concept offers the

potential for diversifying energy sources and lowering costs.

The proposed Caribbean Gas Pipeline project has a possible terminal point in Guadeloupe. Its infrastructure would consist of 500+ miles of pipeline and two compressor stations. The economic load for the pipeline has been placed at 160 million standard cubic feet per day. The variable operating costs of the pipeline would be relatively low. It is suggested that a "postage stamp" type pricing mechanism be applied whereby all customers pay the same price for the gas irrespective of their actual location along the pipeline route. Figure 11 on page 76 shows the outline of the Caribbean gas pipeline.

7.5 Liquefied Natural Gas (LNG) Projects

To the extent that the gas is supplied from outside the region, it is considered that the LNG projects are not interconnection and integration projects, but rather on the contrary demonstrate obstacles to integration. The LNG projects may result in closer economic relations and some physical interconnection could achieve the objectives of regional integration: secure supply and efficient investments. The LNG projects with regard to their contribution to the objectives of regional integration shall be evaluated on an individual basis.

Peru plans to build a liquefaction plant with an expected 17 million m3/day to be exported from 2010 onwards.

Figure 17 shows the project in the gas-bearing region of CAMISEA in Peru.

Venezuela is also studying the construction of a liquefaction plant as an alternative to building the gas pipeline to carry natural gas from Venezuela to Brazil and the countries in the Southern Cone. In demand terms, a number of terminals for regasification of natural gas are under construction or planned in Central America, North and South Brazil and the Southern Cone. This set of projects opens up alternative routes to those of the gas pipelines for regional energy integration, as shown in Figure 26.

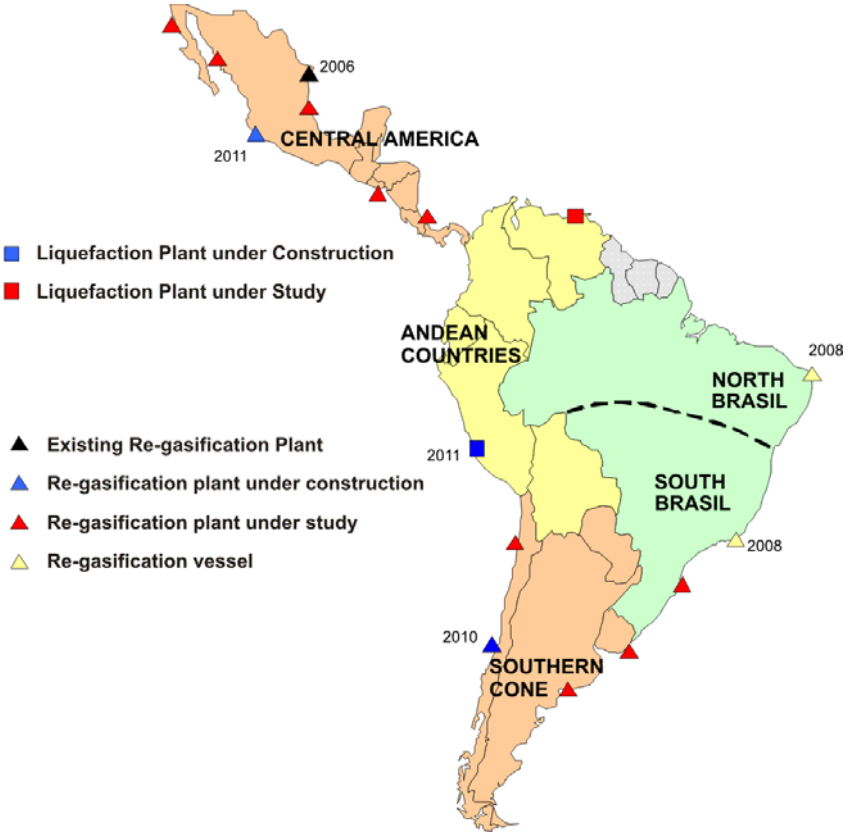
7.6 Multilateral Energy Security Reservoir

The present study found that the risk of rationing the energy supply affected all energy markets in the region. This risk could be minimised with the help of a multilateral agreement for using the natural gas and hydropower reservoir resources, and would be another project for regional integration.

The risk of rationing lies mainly in the fact that a large part of the electricity supply in the region comes from hydropower. Since rainfall in the region varies considerably, the electricity supply in years of severe drought would be insufficient to meet the demand for energy.

In fact, integration leads to economies of scale, reducing costs and increasing the reliability of the

Figure 26
Liquefaction and re-gasification plants in Latin America (for existing plants and those under construction in the year shown for start-up)
Source: OLADE (LAEO)



national energy systems. Productivity is increased by the energy systems distributing throughout the areas of national economy, increasing their competitiveness and encouraging growth. Development of the natural gas supply systems converging with that of the electricity systems in the region helps minimise the use of liquid fuels to meet the demand for energy in the region and, therefore, increase their exportable oil surpluses.

The surplus will play a leading role in the geopolitical positioning of the region. In other words, if energy integration is well managed economically and politically, it will be valuable support for a more positive inclusion of the Latin American economies in the global economy. It is necessary, therefore, to go beyond the interrelation between the national energy systems.

Interrelation, although an important aspect in the regional energy integration process, does not generate enough energy flow to assure the necessary economic feasibility of the transmission lines and gas pipelines to integrate the national energy markets. For the economic feasibility of these infrastructures, it is fundamental to encourage the steady trade of electricity and natural gas between the countries in the region.

There are many opportunities to intensify the trade. Substantial natural gas reserves and significant hydropower potential are still idle in the region, despite their low opportunity cost. This situation is a result of the weak connecting infrastructure between the regional markets that, in turn, is strongly determined by the energy policies.

In order to change this situation, it is necessary to redefine the concept of supply security. Energy imports from neighbouring countries must not be regarded as external vulnerabilities. On the contrary, integration of the energy markets opens a new outlook to interpreting the supply security

based on the corporate management of natural gas and hydropower reservoirs.

The forecasts and basic analyses of the study herein were made considering an average WTI oil price of around US$ 50/barrel with higher peaks. If the current trend to even higher prices continues, there may be a trend to accelerate the regional energy integration processes either because of the need for the consumer countries to optimise the energy resources as far as possible or to restrict financing for investments that require infrastructure.

Latin America and the Caribbean together have exceptional conditions for building up a low-cost integrated energy system, with a high degree of security for the regional supply. The bi-national hydropower plants in the River Plate basin form a natural complex to irradiate and articulate the electricity flows between the countries. The region has gas pipeline feed centres that can supply a natural gas network between the energy markets from the Southern Cone to Mexico, through Central America.

8. CONCLUSIONS AND RECOMMENDATIONS

Thanks to the abundant energy resources in Latin America and the Caribbean, the countries in the region enjoy a geopolitical advantage in terms of energy availability. The ongoing integration of Latin American energy markets will further reinforce energy security in the region.

A few projects presented as good examples of integration have been chosen primarily on their economic feasibility, in each case highlighting the political challenges involved. The South Gas Pipeline Network project is included due to its unique features, and the scope which covers many countries in the continent. The project could contribute substantially to reducing the political risk of integration in Latin America. It is based on a regulatory and institutional framework promoting a number of projects for supply of natural gas in the region. Originally, it was designed to link the production centres of Peru and Bolivia with the demand centres in Chile, Argentina, Brazil, Uruguay and Paraguay.

There are many bilateral projects but few multilateral. Potential benefits of multilateral projects in Latin America and the Caribbean have not until now been properly explored.

Central America

Central America does not have significant hydrocarbon resources and today depends on imports of crude oil and oil products from outside the region. To mitigate its dependence on the imports of oil, the countries in the sub-region would benefit from a joint strategy aimed at increasing the use natural of gas and the creation of a regional electricity market.

For more than 20 years, Central American countries have been working towards introduction of a regional electricity market, but with little progress so far. Work on the SIEPAC transmission line began in 2006 and operations are scheduled to start in 2009. The SIEPAC project involves building a regional 230 kV transmission line over approximately 1,800 km in Central America connecting the electricity systems of Mexico and Colombia, which have similar regulatory structures.

Increasing use of natural gas in Central America would make strategic and economic sense but a critical mass of demand is necessary to justify building an infrastructure to connect the Isthmus countries with the South American reserves. The project to build a gas pipeline connecting Mexico, the Central American Isthmus and Colombia would be economically sound only if matched by a complementary regional strategy for the development of the electricity sector, and also by securing additional demand from southern Mexico.

Use of LNG re-gasification plants does not seem to provide a competitive alternative for natural gas supplies in the region.

Andean Community of Nations

All member countries of the Andean Community have significant energy resources, a factor that has discouraged the integration of national energy systems. So far, the interconnection projects have

only been considered as possible solutions to temporary supply problems.

Existing natural gas reserves exceed the sub-regional demand, but gas transport infrastructure would need to be developed further to export gas to other countries. Integration opportunities in the sub-region are linked to developing natural gas industry and supplying the Southern Cone and Central American countries.

The electricity sector is more integrated than the gas sector, and the associated infrastructure is being developed further, to take full advantage of the complementary mix of hydro and thermal power, seasonal diversity, and variations in load curves. However, regulatory differences to a certain extent restrict energy flows over the interconnecting lines. Multilateral agreements would be more beneficial than the bilateral systems and would provide economies of scale.

Southern Cone

With the start of privatisation and deregulation in the nineties, the Southern Cone began to develop an electricity interconnection. Events in 2004 - supply problems in Argentina and changes in Bolivia's energy policy – prove that integration of the electricity systems makes it possible to balance shortfalls.

Regional electricity exchange is restricted to emergency and reserve supplies and to the shared use of hydropower resources. Specific rules are required to optimise trade and operations of such interconnections to benefit from the complementary nature of the national electricity systems.

Multilateral Reservoirs of Energy Security

The study concludes that the proposed Multilateral Regional Security Reservoirs (MRSR) would be feasible through a multilateral agreement between Argentina, Brazil, Paraguay and Uruguay. The major reserves in the region would be shared using the already existing interconnections or those currently under construction. The proposal is based on the commitment of each country to share a certain part of its reserves and on the agreed conditions and prices.

The concept of the Multilateral Regional Security Reservoirs (MRSR) is based on the understanding that the price for use of reserves would be in line with the long-term marginal cost for regional energy supply. The MRSR would be used when a member country for example faced a risk of an electricity shortage, or when market prices were very volatile. Investments are needed to build up energy reservoirs in the region to ensure regional supply security.

The establishment of an MRSR is the less costly option for increasing security of supply and offers the following benefits:

- less investment required to balance supply and demand in the short-term;
- improved environmental performance of the energy system (in local and global terms);

- lower consumption of oil resources; and
- reduced volatility of energy prices.

The main requirement is a consensus on the volumes to be made available to MRSR and regulations for their operation. If this route is taken, the countries would keep their rights to maintain their national energy policies but would still be encouraged to introduce progressive market integration.

RECOMMENDATIONS

The study shows that the region, with abundant energy resources at low opportunity cost, has only to gain from implementing low-cost interconnection projects with a high level of security.

Therefore the recommendations are as follows:

- to explore and quantify the comparative edge of the region's abundant resources at a low opportunity cost;
- to expand the use of the existing natural gas and water resources and reduce the use of fossil fuels, exporting surpluses;
- to lower the existing regulatory and institutional barriers to make the legal systems compatible with the each other, and allow a larger volume of regional energy trade;
- to take action at government level to create tax systems and legal and trade structures that reduce risks involving energy investments and trade;
- to maintain and improve the regional energy mix by encouraging increasing use of clean energy;
- to increase public awareness about the role of energy integration for improving the quality of life;
- to study how energy security could be enhanced by introducing the concept of Multilateral Regional Security Reservoirs (MRSR), with a view to establish joint management of natural gas and hydropower reservoirs;
- to encourage direct investments and facilitate the creation of feasible financing schemes by promoting new integration projects; and
- to attract the private sector to energy integration projects, technology transfer, research and development.

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Abbreviations and Acronyms

ALADI	*Asociación Latinoamericana de Integración* Latin America Integration Association
ALALC	*Asociación Latinoamericana de Libre Comercio* Latin America Free Trade Association
ANASEP	*Autoridad Nacional de Servicios Públicos* National Authority for Public Services - Panama
ANCAP	*Administración Nacional de Combustibles, Alcohol y Portland* National Administration of Fuels, Alcohol and Portland) - Uruguay
ANDE	*Administración Nacional de Electricidad* National Electricity Administration - Paraguay
ANEEL	*Agência Nacional de Energia Elétrica* - Brazil
ANH	*Agencia Nacional de Hidrocarburos* - Colombia
ANP	*Agência Nacional do Petróleo, Gás Natural e Biocombustíveis* - Brazil
ARESEP	*Autoridad Reguladora de los Servicios Públicos* Regulatory Authority for Public Utilities – Costa Rica
ARPEL	*Asociación Regional de Empresas de Petróleo y Gás Natural en América Latina y en el Caribe* Regional Association of Oil & Natural Gas Companies in Latin America & the Caribbean)
bbl	barrels
bbl/d	barrels per day
BCIE	*Banco Centroamericano de Integración Económica* Central America Bank for Economic Integration
BCM	billion cubic meters
BNDES	*Banco Nacional de Desenvolvimento Econômico e Social* National Economic and Social Development Bank - Brazil
boe	barrel oil equivalent
Btu	British thermal unit
CADE	*Conselho Administrativo de Defesa da Concorrência* Committee in Defence of Competition - Brazil
CAF	*Corporación Andina de Fomento* (Andean Development Corporation)
CAMMESA	*Compañia Administradora del Mercado Mayorista Eléctrico S.A.* Wholesale Electricity Market Administration Company - Argentina
CAN	*Comunidad Andina de Naciones* (Andean Community of Nations)

CCEE	Câmara de Comercialização de Energia Elétrica - Brazil
CCHAC	Comitê de Cooperación de Hidrocarburos de América Central
CEAC	*Consejo de Electrificación de América Central* Central American Electrification Council
CENACE	The National Centre for Energy Control - Ecuador
CEPAL/ECLAC	*Comisión Económica para América Latina y el Caribe* Economic Commission for Latin America and the Caribbean
CIER	*Comisión de Integración Energética Regional* Regional Energy Integration Committee
CMSE	Comitê de Monitoramento do Setor Elétrico - Brazil
CNDC	*Comisión Nacional de la Defesa de Competición* National Committee in Defence of Competition - Argentina
CNE	*Comisión Nacional de Energia* (National Energy Committee) - Honduras
CNEE	*Comisión Nacional de Energía Eléctrica* (National Electricity Committee) - Guatemala
CNG	Compressed Natural Gas
CNPE	Conselho Nacional de Política Energética - Brazil
CO	Carbon monoxide
CO_2	Carbon dioxide
COMIGAS	Natural Gas Co-ordinating and Promoting Commission - Paraguay
CONELEC	The Electricity National Council - Ecuador
CRE	*Comisión Reguladora de Energía* (Energy Regulation Committee) - Venezuela
CREG	*Comisión Reguladora de Energía y Gas* (Energy and Gas Regulation Committee) - Colombia
CRIE	*Comisión de Interconexión Eléctrica Regional* Regional Electric Interconnection Committee – Central America
CSAN	*Comunidad Sudamericana de Naciones* South American Community of Nations)
DOE	Department of Energy - USA
EBISA	Empreendimentos Energéticos Binacionais S.A. - Argentina
ECOGAS	Empresa Colombiana de Gas (Colombia Gas Company)
ECOPETROL	Empresa Colombiana de Petróleos (Colombia Oil Company)
ELETROBRÁS	Centrais Elétricas Brasileiras S.A.
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
ENARGAS	Ente Nacional del Gas (National Gas Agency) - Venezuela
ENARSA	Energía Argentina S.A.
ENRE	Ente Nacional Regulador de la Electricidad (National Regulatory Electricity Agency) - Argentina
EOR	Regional Operating Agency – Central America
EPE	Empresa de Pesquisa Energética (Energy Research Company) - Brazil
EPR	Grid Proprietor – Central America
ETESA	Empresa de Transmisión Eléctrica de Panamá

FDI	Foreign Direct Investment
FOB	Free on board
FONPLATA	*Fondo Fiduciario para el Desarrollo de la Cuenca del Plata* (River Plate Basin Development Fund)
FREAC	*Foro Regional Energético de América Central* Central American Regional Energy Forum
FUNDELEC	Fundación para el Desarrollo del Servicio Eléctrico (Foundation for Electricity Utility Development) - Venezuela
Gbbl	Giga barrel (10^9 bbl)
GDP	Gross Domestic Product
GNEA	Northeast Argentine Gas Pipeline
GNP	Gross National Product
CNGV	Compressed Natural Gas for Vehicles
GW	Gigawatt
GWh	Gigawatt hour
GSA	Gas Supply Agreement
GTB	Gás Transboliviano S.A.
HC	Hydrocarbons
HV	High Voltage
HVDC	High Voltage Direct Current
IDB	Inter-American Development Bank
IEA	International Energy Agency
IIRSA	*Iniciativa para la Integración de la Infraestructura Regional Suramericana* (Initiative for the Integration of Regional Infrastructure in South America)
IMF	International Monetary Found
INE	Instituto Nicaraguense de Energía (Nicaragua Energy Institute) - Nicaragua
IPEA	Instituto de Pesquisa Econômica Aplicada - Brazil
ISA	Interconexión Eléctrica S.A. – (ISA Colombia)
kboe	thousand boe
kg	kilogram
km	Kilometre
kt	thousands of tonnes
kV	kilovolt
kWh	kilowatt hour
LGN/*NGL*	*Líquido de Gás Natural*/Natural Gas Liquids
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
m^3	Cubic metre
Mbbl	Million Barrels
MCCA	Mercado Común Centroamericano (Central American Common Market)
MDL/CDM	*Mecanismo de Desarrollo Limpio*/Clean Development Mechanism
MEM	Ministerio de Energía y Minería (Ministry of Energy and Mines) – Colombia/Peru
MENPET	Ministerio del Poder Popular para la Energía y Petróleo (Ministry of Oil and Energy) – Venezuela
MER	Mercado Eléctrico Regional (Regional Electricity Market) – Central America

MERCOSUL	Mercado Comum do Sul (Southern Cone Common Market)
MIEM	Ministry of Industry, Energy and Mines - Chile
MME	Ministério de Minas e Energia – Brazil
MOU	Memorandum of Understanding
MPFIPS	Ministry of Federal Planning Public Investment and Services - Argentina
mtoe	Million of tonnes oil equivalent
Mton	Million tonnes
MW	Megawatt
NA	Not available
NAFTA	North American Free Trade Agreement
NEC	National Energy Commission – Chile
NG	Natural Gas
NOx	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
OLADE/LAEO	Organización Latinoamericana de Energía Latin America Energy Organisation
ONS	Operador Nacional do Sistema Elétrico - Brazil
OSINERG	Organismo Supervisor de la Inversión en Energía Supervisor Organism of Investment in Energy - Peru
PDVSA	Petróleo de Venezuela S.A.
PETROPAR	Petróleos Paraguayos
PETROBRAS	Petróleo Brasileiro S.A.
PETROPERU	S.A. Petróleos del Peru
PIEM	Programa de Integración Energética Mesoamericana Central American Energy Integration Programme
R/P	Reserves to Production Ratio
RMSE	Reservatório Multilateral de Segurança Energética
SICA/CAIS	Sistema de Integración Centroamericana System of Central American Integration System
SIEPAC	Central American Countries Electricity Interconnection System
SIGET	Superintendencia General de Electricidad y Telecomunicaciones Superintendence of Electricity and Telecommunications - El Salvador
SIRESE	Sistema de Regulación Sectorial (Sector Regulation System) - Bolivia
SOx	Sulphur oxides
SSPD	Superintendence of Public Services - Colombia
STI/ITS	Sistema Tronco de Interconexión/Interconnection Trunk System
t	tonne
TBG	Transportadora Brasileira Gasoduto Brasil-Bolívia S.A.
TEP	National Administration of Power Plants and Electricity Transmission - Uruguay
tce	tonnes coal equivalent
Tjoul	Terajoule
toe	tonnes oil equivalent
TWh	Terawatt hour
UNASUR	União das Nações Sul-americanas
UNCTAD	United Nations Conference on Trade and Development
UPME	Unidad de Planeación Minero Energética

URSEA	Regulatory Entity for Energy and Water - Uruguay
US$	United States Dollar
YPFB	Yacimientos Petrolíferos Fiscales Bolivianos
WEC	World Energy Council
WTI	West Texas Intermediate

Annexes

Annex 1

Fourty Studies on Latin American Energy Integration

Title	Contents	Area - Date
Study of electric power transactions between the Andean, Central American and MERCOSUR markets Feasibility of their integration – Proiect CIER 15	In order to analyse the commercial, operational, regulatory and technical aspects for feasibility of electric power transactions between the Central American (MER), Andean Community and MERCOSUR markets.	**MERCOSUR, ACN, CENTRAL AMERICA** Electricity in progress
Study to define a strategy to introduce natural gas into Central America	In order to analyse the feasibility of introducing natural gas into Central America, including the market study for natural gas supply and demand, infrastructure requirements, and environmental, institutional and regulatory aspects.	**CENTRAL AMERICA** Natural gas in progress
Regulation of transmission and interconnecting transportation	Presents the most important elements of the national and international power transport business in the ten South American countries members of CIER, with emphasis on the impact on profitability and incentives to expand the systems.	**MERCOSUR, ACN** Electricity November 2006
Feasibility study for implementing the Southern Gas Pipeline Grid	Analyses the technical-economic feasibility of the infrastructure comprising the Southern Gas Pipeline Grid, basically gas pipelines Humay-Tocopilla (Peru-Chile), Northeast Argentina (Bolivia-Argentina) and Uruguayana-Porto Alegre (Argentina-Uruguay-Brazil)	**MERCOSUR** Natural Gas November 2006

Title	Contents	Area - Date
Co-operation and energy integration in Latin America and the Caribbean	Analyses the energy co-operation agreements for supply of oil, gas and electricity and their compatibility from the viewpoint of regional integration. It examines the energy integration projects in the hemisphere and sub-regional sphere.	**MERCOSUR, ACN, CENTRAL AMERICA & THE CARIBBEAN** Energy in general April 2006
Diagnosis of the Energy Sector of Central America	Analyses the status of the energy sector in Central America, the effects of the oil price rise, measures taken and energy options.	**CENTRAL AMERICA** Energy in general February 2006
Legal and institutional proposal for the Southern Gas Pipeline Grid	IDB financed the consulting studies that permitted the preliminary agreement between the government delegations of the energy sector of Argentina, Brazil, Chile, Paraguay, Peru and Uruguay, on the principles applicable to the legal and institutional framework for implementing infrastructure for the gas interconnection between the countries involved.	**MERCOSUR** Natural gas November 2005
Central America: Diagnosis of the Oil Industry	Analyses of supply and demand, institutions, structure and price formation of the oil industry of the six Central American countries. It proposes bases for drafting policies and projects to enhance the management of the energy sector at national and regional levels.	**CENTRAL AMERICA** Hydrocarbons October 2005
Remuneration of manager and design of wholesale markets in South American and Spain. Part of the CIER 08 project.	It addresses a compared list of the different designs of the wholesale markets and economic incentives for generation for increasing the capacity in each national model.	**MERCOSUR, ACN** Electricity September 2005
Brazil-Argentina Energy Integration	The project analyses the integration process of the energy sector in the Southern Cone countries, looking for alternatives in the regulatory and institutional fields that permit increasing the energy flow between the countries. The main proposal is to consolidate an energy centre that combines the electricity and natural gas transactions between the Southern Cone countries.	**MERCOSUR** Electricity & Natural Gas May 2005

Title	Contents	Area – Date
Assessment of infrastructure projects for regional integration	Assessment of infrastructure projects for regional integration in relation to the IIRSA initiative, from the viewpoint of its eligibility and financing.	**MERCOSUR, ACN** General infrastructure April 2003
Energy status in Latin America	Analysis of the structure of the electricity and gas markets, regional energy flows and sector regulation for Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela.	**MERCOSUR, ACN** Electricity & Natural Gas March 2003
Methodology for implementing the Kyoto flexible mechanisms – Clean development mechanisms (CDM)	The purpose is to contribute to CDM implementation and development between Latin American and European countries. It analyses economic and technical aspects, identifying new risks and challenges for the energy companies in the new international carbon market.	**MERCOSUR, ACN** Electricity 2003
Financial structures for trans-national infrastructure projects in the IIRSA context.	Analysis of risks, asymmetries and alternatives for financing infrastructure projects for regional integration.	**MERCOSUR, ACN** General infrastructure December 2002
Regulatory Incentives for Investment and Efficient Electric Power Supply	It presents the transcendental aspects of regulation that encourages the increase in capacity of the systems.	**MERCOSUR, ACN** Electricity October 2002
Basic conditions for developing an integrated regional energy market	Study on the compatible and harmonious aspects of regulatory and institutional aspects. It refers to contents, new institutions and procedures of agreements required for integration.	**MERCOSUR, ACN** Energy in general June 2002
Natural gas supply study from Venezuela and Colombia to Costa Rica and Panama	Analysis of supply conditions, necessary infrastructure, gas price and rates for introducing natural gas from South America to Panama and Costa Rica.	**CENTRAL AMERICA** Natural Gas June 2002
Energy integration in the Andean Pact	Analysis of the national power and natural gas markets of Bolivia, Colombia, Ecuador, Peru and Venezuela, assessing the supply-demand status and regional exchanges, and proposes further integration.	**ACN** Natural Gas & Electricity June 2001

Title	Contents	Area – Date
Principles for developing a regional energy market	Recommends drafting principles and common rules to facilitate free trade of energy sources, so that the transactions generate resources to pay for the infrastructure required to integrate the markets.	**MERCOSUR, ACN** Energy in general April 2002
Study on Clean Development Mechanism (CDM) projects in South America	It identifies 47 feasible CDM projects: projects for renewable energy, hydro and non-hydro electric power and power transmissions.	**MERCOSUR, ACN** Electricity 2002
Study on evolution of the integration process in the LAIA sphere, in its bilateral, sub-regional, regional dimensions, and proposals for reinforcing the role of the Association in the next ten years.	It emphasises the importance of enhancing the regional regulatory framework and the fact that the countries have extended their focus of the regional integration process to beyond the commercial sphere. It recommends considering the priorities set by the countries.	**MERCOSUR, ACN** General integration December 2001
Institutional and regulatory profile of the South American power sector – Part of the CIER 08 project	Contains a complete survey of the regulatory framework of the power sector in South American countries and Spain.	**MERCOSUR, ACN** Electricity August 2001
Design of an organisation for co-ordinating the future Regional Electricity Markets in South America – project CIER 07.	It analyses the European experience in integration of energy markets and identifies those institutional, regulatory and organisational elements useful for South America.	**MERCOSUR, ACN** Electricity August 2001
Regional interconnections for the electricity markets of South America – proposals for increasing the electrical exchanges – Stages I and II – Project CIER 03.	It develops a full group of proposals to promote the increase in electric power trade between the ten South American countries that are members of the CIER, and to reduce the institutional, regulatory and technical restrictions curbing the development of efficient interconnections.	**MERCOSUR, ACN** Electricity July 2001
Natural gas markets in the Andean Community: development and integration prospects.	It summarises various papers on the natural gas markets in Bolivia, Colombia, Ecuador, Peru and Venezuela. It assesses projects of regional interconnection and the gas trade prospects for 2020.	**ACN** Natural Gas July 2001

Title	Contents	Area – Date
Inclusion of natural gas in the power interconnection in Central America	It assesses the possibilities of introducing natural gas in relation to the SIEPAC power interconnection project.	**CENTRAL AMERICA** Natural Gas & Electricitiy June 2001
Study for integration of the natural gas market in South America	Analysis of the natural gas markets in South American countries, with forecasts of supply and demand for three scenarios: high production in Argentina, exports from Camisea, and low demand.	**MERCOSUR, ACN** Natural Gas January 2001
Energy integration in extended MERCOSUR	It specifically addresses the electricity markets and drafts proposals for eliminating the regulatory barriers and attracting investments in interconnection projects.	**MERCOSUR** Electricity 2001
General design of the Regional Electricity Market (MER)	It draws a conceptual and structural design of the Regional Electricity Market for Central American countries, stressing the role of the institutions and requirements for compliance with the regulatory conditions and national systems.	**CENTRAL AMERICA** Electricity April 2000
The natural gas industry and its regulations in Latin America	Systematisation of the regulatory frameworks of Argentina, Bolivia, Chile, Colombia and Mexico. It stresses the importance of gas in regional energy integration.	**MERCOSUR, ACN** Natural Gas August 1999
Options for a future natural gas industry in Central America	Taking into account the specific aspects of the region and international experiences, prepares probably scenarios for the structure and operation of the natural gas industry in Central America. It presents proposals for the regulatory framework and structure of the industry.	**CENTRAL AMERICA** Natural Gas July 1999
Wholesale Markets and Interconnections – Stages I and II – Project CIER 02.	Analysis of the opportunities and obstacles for integrating the power markets of the ten South American countries that are members of the Regional Electricity Integration Committee (CIER).	**MERCOSUR, ACN** Electricity 1998-1999

Title	Contents	Area – Date
Pre-feasibility study of the Mexico-Central America regional gas pipeline	Pre-feasibility study on the economic, environmental, financial, institutional and technical aspects of the Mexico-Central America regional gas pipeline.	**CENTRAL AMERICA** Natural Gas January 1998
Study of hydrological complementary aspects in South American countries – Project CIER 01	Study of the impact of extreme hydrometeorological conditions on the reliability of energy supply and development of a hydroenergy information network in the South American region.	**MERCOSUR, ACN** Electricity 1995

Annex 2

THIRTEEN STUDIES SELECTED ON LATIN AMERICAN ENERGY INTEGRATION

The 13 studies listed below are considered as the most relevant in each of the blocs.

Title	Contents
Study of complementary hydrological aspects in South American countries	This study analyses the annual hydrology of the main drainage basins in South America. It consists of the first effort of CIER (Regional Electric Integration Committee) for the feasibility study of a wider energy integration of the electricity markets in South America.
Wholesale markets and interconnections – Stages I and II	This study was carried out under the auspices of the Andean Development Corporation (CAF) and the Synergy Program (European Commission). It identifies and analyses the effects of integration on the produces and consumers, stability of the markets and the resistances that these effects produce. It also analyses the institutional and regulatory contexts and the effects of electricity integration on the environment.
Regional Interconnections of the South American Electricity Markets – Proposals to facilitate increase in electric power exchanges – Stages I and II	This study was carried out by the ESMAP (Energy Sector Management Assistance Program) in coordination with CIER and USDOE (US Department of Energy). Its purpose is to develop a set of proposals for promoting further electric power exchanges in ten South American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela) and to reduce the institutional, regulatory and technical restrictions that limit the efficient development of the interconnections.

Design of an organisation to co-ordinate the future regional electricity markets in South America	Was performed by CIER and its purpose was to analyse the European experience of integrating the energy markets and identifying useful institutional, organisational and regulatory elements for South America. IT analyses the European experiences of developing markets in the UCTE zone (Nordic and Central European countries) for feasibility of their application in South America. It did not consider that the European experience was sustainable in the initial political agreement constituting the European Community, with supranational political and legislative institutions -conditions that do not exist in Latin America.
Regulation of the Electricity Markets	This addresses a set of successive studies by CIER, in order to describe analytically the regulation compared with the electricity sector of the South American countries and Spain. It is useful to compare the institutional, organisational and regulatory framework of the electricity sector in the South American countries and Spain, with special emphasis on the aspects relating to determining the prices and rates, and in the incentives promoting the expansion of the installed capacity. It offers the bases for a comparative analysis of the regulatory conditions of the different Latin American markets.
General design of the Regional Electricity Market (MER)	It analyses the electricity integration of the Central American countries and its purpose was to prepare the conceptual design and structure of the Regional Electricity Market (MER) for the Central American countries. It uses the requirements already established in the MER Framework Treaty signed by the Central American countries in 1996 and closely analyses the role to be played by the three basic institutions of regional electricity integration: the Regional Electricity Interconnection Committee (CRIE), the Ente Operador Regional (EOR) and the Empresa Proprietária da Linha (EPL).
Pre-feasibility study of the Mexico-Central American Isthmus Regional Gas Pipeline	It was prepared by LAEO/CEPAL/GTZ at the request of the Central American Regional Energy Forum (FREAC), made up of the Ministers of Energy for Central America. It develops the economic, environmental, financial, institutional and technical aspects of the design of the regional gas pipeline Mexico-Central America. IDB ordered a study to update the economic, institutional and technical recommendations for preparing a natural gas introduction strategy in Central America.

Brazil-Argentina Energy Integration	The study analysed the integration process of the energy sector in the Southern Cone countries and prepared recommendations in the institutional and regulatory sphere to increase the opportunities to develop the energy flow between the countries. It proposes the structuring of a power supply complex and natural gas supply ring to permit articulating the energy markets of the Southern Cone countries. Since it requires a smaller spectrum of regulatory commitments between the countries in the region, it permits the preservation of the national operating methodologies and planning.
Draft agreement for implementing the southern gas pipelines	This study was for Argentina, Bolivia (observer), Brazil, Chile, Paraguay, Peru and Uruguay, with IDB financing. The purpose of the study was to obtain a preliminary consensus on the legal and institutional framework for the operation of the gas interconnection infrastructure between the countries in the region. The Southern Gas Pipeline Network was defined as "the infrastructure to carry natural gas, to be built or already existing, which the Party States decide to allocate to the legal and institutional system provided and the international natural gas transactions that use this infrastructure". The work succeeded in achieving consensus about fundamental regulatory principles for the energy integration: free access, open access, export permits, emergency and early warning mechanisms and so on. The project stopped after the revival of an old border dispute between Peru and Chile. Nevertheless, the economic-technical feasibility study continued for the Southern Gas Pipeline Network, with the support of the World Bank. There is a possibility of resuming and completing the work of preparing the proposal of a legal and institutional framework.
Natural Gas Markets in the Andean Community. Development and Prospects of Integration.	This is a study by LAEO published in 2001, which summarises various studies of the natural gas markets in the Andean Community. The ACN countries do not have natural gas interconnections between each other, while Bolivia has an infrastructure of gas integration with the MERCOSUR countries, Argentina and Brazil.
The Energy Integration in the Andean Pact	Prepared at the request of IDB. The countries in the Andean Pact have poorly developed gas markets, although they have high reserve volumes. The development of this market depends on the thermal power generation segment. These characteristics, abundant reserves and poorly developed markets restrict the possibilities of interconnection. The electricity inter-connections existing are under-used due to regulatory issues. The opportunities for interconnection are justifiable by the hydro-thermal interrelation and major use of installed capacity.

Basic Conditions for the Development of an Integrated Regional Energy Market Principles for developing a regional energy market	IIRSA undertook these two studies to identify and order the topics to be for consideration in the regional energy integration process. Signs are that there was a major advance in bilateral transactions, and the challenge of advancing to more comprehensive multilateral agreements is pending. It proposes to conduct the integration in stages, seeking agreements. In a first stage, the search for agreements is proposed for firm contracts, spot exchanges, open access to networks, non-discrimination of agents, coordination of the exchanges and transport rights. The second study analyses the peculiar features of the electricity market, emphasising a variety of products for sale: firm energy, programmed opportunity energy, emergency energy, consumer and production deviations, firm power, ancillary services, and transmission services.
Cooperation and energy integration in Latin America and the Caribbean	This study assesses the energy integration process in Latin America and the Caribbean. Regional co-operation in terms of hydrocarbons has been boosted by Venezuela and Mexico. The paper describes the energy co-operation agreements deriving from the integration conventions of Central America, the Andean Community, MERCOSUR and LAIA, plus bilateral agreements comprising electricity interconnections deriving from the major bi-national hydropower generation projects. It identifies the difficulty of progress in multilateral integration and the relative success of bilateral actions.

Annex 3

Hydrocarbon Pricing

The concept of “rent” has historically been applied to refer to the remuneration of the means offered by nature to be used in production. This concept was first applied to the land and the mines. The distinctive feature of these means was that, unlike labour and capital, they were found in fixed amounts in nature.

At the beginning the rent was considered in a residual way, i.e. the value that remained for the owner of the land after deducting from the value of the product the price of the necessary inputs for production. Classical economists acknowledged that natural resources were not of a same quality; therefore the concept of “differential rent” was introduced. Sometime later, the neo-classical school, particularly in relation to land (since it admitted alternative uses) tried to explain the rent, by applying the same concepts of marginal productivity and opportunity cost with which it had explained labour and capital remuneration.

With reference to the non-renewable resources, this same school of thought understood that it was not possible to explain their value in a static way, but that dynamic considerations that would exactly account for the non-renewable character of the resource should necessarily be included. In this way, the concept of ‘exhaustion rent’ was introduced.

The concept of rent has also been applied to hydrocarbons. To determine that rent, in practice a residual criterion has been used. Thus, since hydrocarbons location and extraction require significant costs, it has been considered as rent the value that remains of the product once deducted all the necessary expenses for its production, including here a rate of return on invested capital, in keeping with the risk assumed.

Alternatively, the rent is like a windfall profit above normal profitability for risk activities comparable to the capital invested in exploration and production of hydrocarbons.

Two opposite law schools have attributed property rights on the subsoil, either to the State or to private individuals that are the owners of the surface. But even those States that have granted to the private individuals the ownership of the subsoil have always considered the rents arising from it as an object of special interest for taxation.

Now then, when designing a tax system to collect that extraordinary revenue, the State faces great difficulties. Each field has special characteristics, which cannot be foreseen a priori. The risks (fortuitous events whose incidence can be estimated) and uncertainties (fortuitous events whose incidence cannot be estimated) in mining matters are also hard to be considered a priori, as well as the behaviour of the prices, strongly affected by political contingencies. On the other hand, there is a significant asymmetry of information on costs among the companies investing and operating in the areas, and the State organisations.

This situation has led the governments to establish different varieties of tax systems to achieve a higher level of rent sharing. As a result, the State participates in a certain fraction of oil rent, commonly called “government take”, while the companies generally retain a part of this rent, called “contractor take”.

Classification of tax systems

The way the State participates in the rent shows a great number of varieties worldwide, which can be grouped in two broad categories: (i) Concession Systems; and (ii) Contractual Systems.

The core difference between both systems is the existence, in the case of the Concessions System, of a certain right to dispose of production (free availability). This right is generally non-existent in the Contracts System.

In these two broad systems, the fiscal instruments used combine:

- Income tax
- Resource rent tax, eventually including the application of R factor (ratio of accrued income over accrued expenditures)
- Single-rate or different-rate royalties, according to exploitation and market parameters.
- Duties/withholding taxes on exports
- Fixed payments, bonds, exploration/exploitation permits
- Participation in Production
- Rights of Association

The trends when applying the Concessions System or the Contracts System have varied along time and across regions, but in general those economies that tend to favour market mechanisms try to promote systems with free availability of the product (concessions), while the economies where there is a greater State intervention tend to limit the free availability of the product and are more orientated towards contracts systems.

The trend in the 80’s and 90’s towards the privatisation of public utilities and the deregulation of the markets led to a change in many Latin American countries, from contractual systems to concession systems based on the free availability of the production. In this sense, the free availability was a prerequisite, although not enough, to be able to generate a competitive market of hydrocarbon producers that did not require State regulation.

In Argentina, in 1991 the Concessions system came in force and State Company Y.P.F. S.A. was immediately privatised. In Bolivia, Hydrocarbons Law 1689 of 1996 introduced the concept of Shared Risk Contracts, with characteristics similar to the Concessions system, and also privatised much of Y.P.F.B.’s assets. In Peru, where already in the 80’s private participation in hydrocarbons production was predominant, Law 26 221 was passed, and the most important assets of Petroperu were privatised in two stages. On the other hand, in the mid-90’s Brazil modified its constitution, to allow the participation of private capital independently from Petrobras, under typical concession schemes. In Ecuador, production-sharing contracts were introduced, and Venezuela, with the Apertura Petrolera, or the “Opening” of the

Venezuelan oil industry to private investments in exploration and production, under different schemes: operating agreements, profit sharing agreements and strategic associations to exploit heavy crude oil in the Orinoco Belt.

At the beginning of the 21st century, this trend has stopped and reverted, initially in Venezuela, and later also in Bolivia, both countries with abundant hydrocarbons. Although in many cases the focal point of the discussion is a redefinition of the participation of the State in the oil rent, in a framework of great price increases, together with this there is a change process in the contractual mode that tends to limit the free availability and increase the role of public utilities. In Ecuador, apparently some changes might be promoted in the government take, although it is not clearly seen yet whether this will involve a change in the contractual mode. On the other hand, in Argentina, although the concessions system is still formally in force, state regulations tend to focus towards growing limitations in the free availability of the product.

Naturally the restriction of free availability in important hydrocarbon exporting countries in the region, particularly of natural gas, must have implications in the regional integration process, which will be characterised by the presence of the public utilities of those countries as leading stakeholders of the process. This marks an important difference with what happened in the 90's, particularly in the case of gas integration between Argentina and Chile, where the private stakeholders were in charge of making the investment and financing decisions of the projects.

In this section the study shows what has been mentioned to this point, describing the government take schemes in force for new ventures, in the main countries of the region that produce hydrocarbons, namely: Bolivia, Colombia, Ecuador, Peru, Venezuela, Brazil and Argentina. Thus, some conclusions linked to the future integration process can be drawn. As it can be observed, hydrocarbon reserves and production are essentially located in the Andean Countries.

Tax systems of the main producers of the region

Andean Countries

Bolivia

Because of Hydrocarbons Law number 1689 of 1996, Bolivia had a contractual regime (exploitation was performed through Shared Risk Contracts between YPFB and private companies). This put itself on an equal footing with the concessions regime, while the private investor could take possession of produced hydrocarbons and freely dispose of those hydrocarbons.

On May 17th 2005, Bolivian Congress passed the new Hydrocarbons Law number 3058, which incorporated the results of the National Referendum of July 18th 2004. The new law, sanctioned within the framework of the political and institutional crisis that affected Bolivia since the president resigned as a consequence of the "gas crisis", acknowledges "the value of natural gas and other hydrocarbons as strategic resources, that contribute to the targets of economic and social

development of the country, to the Bolivian State foreign policy, including the achievement of a useful and sovereign access to the sea".

According to section 5 of law 3058, "the Bolivian State recovers ownership of all hydrocarbons at wellhead". The State now owns not only the fields but also the hydrocarbons extracted. Private producers are obliged to hand over to the State the whole production and they will only have access to the ownership of the hydrocarbons from the so-called "production control point" and by way of payment (payment in kind) or share, according to what has been stated in the respective contracts. The State property right is exercised through YPFB.

In the former regime, the holders of Shared Risk Contracts for exploration, exploitation and commercialisation of hydrocarbons acquired the right to prospect, exploit, extract, transport and market the production obtained. The volumes required to meet domestic natural gas consumption and to fulfil export contracts previously negotiated by YPFB were excluded from free commercialisation

Law 3058 stipulated the compulsory restructuring of former Shared Risk Contracts into one of the oil contract modes accepted by the new law:

(i) Shared Production Agreement: the holder performs with their own means, and on their own account and risk, the exploration and exploitation activities, in the name and representation of YPFB. In exchange, they receive a share in production, at the production control point, once the royalties and taxes have been deducted. Shares are established in the respective contract. YPFB's share is calculated once it has been established the amortisation corresponding to the private producer for investments made in development, production, field abandonment and royalty payments.

(ii) Operational Agreements: the holder performs with their own means, and on their own account and risk, in the name and representation of YPFB, the operations corresponding to exploration and exploitation activities under the remuneration system (provided it enters exploitation stage). YPFB does not make any investment and pays for the services with a percentage of the production, in money or in kind. This payment must cover the operating costs as a whole and the profits.

(iii) Association Agreement: YPFB will have the choice to associating with the holder of an Operational Agreement who had made a commercial discovery. The agreement will stipulate the share in production corresponding to each one of the parties. At the moment of choosing the association option, YPFB shall repay the holder a percentage of the direct costs of exploration of the wells that had turned out to be productive. YPFB assumes the risks of exploitation activities in proportion to its shares.

All the agreements will have a maximum 40 year term and, in accordance with what has been said before, they oblige the private contractor to hand over to YPFB the whole production. According to the new Operational Agreements, YPFB is the only marketer of hydrocarbons: it charges the buyers and with these funds must pay each company for

the service provided or for the share agreed upon in the contracts.

Specifically, with reference to the participation of the State in the oil and gas rent, following the results of the Referendum, it was stipulated that the State will retain at least 50% of the value of oil and gas production.

In relation with the purpose of the natural gas production to be obtained from the new oil contracts formalised at the beginning of 2007, Resolution 255 of the Ministry of Hydrocarbons stipulates the natural gas supply priorities falling proportionately on all the companies: domestic market, exports to Brazil, exports to Argentina, industrialisation projects. Marginal and small fields must contribute yearly to the domestic market a gas volume equivalent to 0.5% of their annual production in relation to the previous year. For the other fields, YPFB will determine the percentage according to the relationship between the production of the previous year and the production in the current period.

Colombia

During the 90's oil exploration and exploitation in Colombia was performed in two ways: through Ecopetrol, or through association agreements between Ecopetrol and private companies.

For the association agreements, the government take during this stage was given by a 20% royalty that the State obtained, and then by the terms in which the association was given, that initially was established at 50%. The government take was given because Ecopetrol did not participate in the mining risk of exploration.

In 1998 some reforms were introduced in order to make investments more attractive, including the accelerated depreciation regime of intangible goods, royalties ranging from 5% to 20% according to the daily production level of the fields and reduction from 50% to 30% in the association right.

The greatest change in regulation took place when Decree-Law 1760 of 2003 was passed, modifying the organisation of the industry, creating the National Hydrocarbons Agency (ANH) as organisation in charge of the management of national hydrocarbon resources to take Ecopetrol's place.

Contracting forms admitted by the new legal framework allow adaptations, which may even give as a result the typical concession concept.

Nowadays the Hydrocarbon Exploration and Production Contract used in ANH's calls for tender include in item 14.2 a free availability scheme subject to state regulations. The following concepts are foreseen in relation to government take:

- Royalties ranging from 8% to 20%.
- ANH's right of participation in production (X %). Each authorised company has to suggest an "X" participation value after payment of royalties in production for the ANH. A valid proposal should have an X% participation value for liquid hydrocarbons (X% HCliq) and another X% participation value for gas (X% gas).

- Right for High Prices. Determined at 30% of the excess of prices obtained by production, with reference to a Po basic price, according to the following formula
- Payment to ANH = Value of the Hydrocarbons at the Delivery Point x Contractor's Hydrocarbon Volume x (P-Po)/P x 30%
- The system has its own peculiarities for liquids and for natural gas:
- Liquid Hydrocarbons: this right is paid from the moment the cumulative production exceeds 5 million barrels of liquid hydrocarbons. The Basic Price is determined according to the gravity of the crude oil and if it is on-shore or off-shore exploitation, according to the following table. Hydrocarbons with API gravity lower than 10 do not pay the right for high prices.
- Natural Gas. The right for High Prices is paid 5 years after the beginning of the exploitation. The basic price for exports varies according to the distance to the consumption point. For natural gas allocated to the domestic market whose price is regulated, no right of high price is paid. If it is not regulated, the basic price will be agreed upon.
- ANH's right: its economic amount, in US dollars, will be the one resulting from multiplying hydrocarbons production corresponding to the contractor by US$ 0.1036, for each barrel of Liquid Hydrocarbons

Ecuador

State-owned company Petroecuador is the biggest producer in the country. Until 1993, private participation was given through Service Contracts. New modalities were introduced with Law No. 44 of 1993.

The text ordered by the Supreme Decree No. 2967 of Hydrocarbons law stipulates that the State will explore and exploit the fields directly through Petroecuador, which will be able to do it by itself, or by signing:

- Association contracts
- Participation contracts
- Services supply contracts for hydrocarbon exploration and exploitation
- Other contractual forms of delegation in force in Ecuadorian legislation

It may also constitute mixed-economy companies with national and foreign companies legally established in the country, with acknowledged competence

In the Production Participation Contract, all expenditures and the risk associated to it are in charge of the contractor, while in the Association Contract Petroecuador contributes with rights on areas, fields, hydrocarbons or other rights of its patrimony, and the associated company commits itself to carrying out the investments agreed upon by the contracting parties.

In the Association Contract the distribution of the internal revenue is done observing contractual tops to the amount of recoverable expenditures by the associated private company. Likewise, Petroecuador keeps the option of obtaining an effective participation in the rights and shares granted in these contracts and in the assets purchased by the contractors for the purposes of these agreements. The payment of the value of the vested rights and of the corresponding obligations will be made in agreement with the terms and conditions to be determined by the parties.

The law foresees Risk Service Contracts for the exploration and exploitation of hydrocarbons, in which only when the service provider may have found commercially exploitable hydrocarbons, will he have the right to the reimbursement of its investments, costs and expenses and to the payment of his services in money. Likewise, the law foresees specific work and service contracts similar to those above, but without risk in charge of the contractor. The so-called shared management contracts introduced in 1999 were declared unconstitutional in the year 2000.

The government take arising from these contractual modes is completed by the general tax regime of income tax and specific taxes. Among these specific taxes, there are two big groups: those linked to the area and those linked to the royalties. Those linked to the area include: Entry premiums for exploration; Surface rights for exploration; Entry premiums for exploration; Surface rights for exploration. On the other hand, a regime of royalties, no lower than 12.5% over crude oil gross production is foreseen. The royalty will amount to a minimum 14% when average production in that month is between 30 000 and 60 000 barrels a day, and will go up to a minimum 18.5% when average production in that month is of 60 000 barrels or more per day. A monthly minimum royalty of 16% will be paid for the gas coming from the free gas fields and for its by-products.

According to what the current political authorities have declared, there is an interest in renegotiating the participations in the contracts, due to the increase of international prices of crude oil.

Peru

For the case of Peru, in the framework of law 26 221 and its amendments, 46 hydrocarbon exploration contracts have been signed between 1993 and 2002. The government take, apart from the general taxes, foresees a royalties system with two options:

a) Methodology by Production Scales: according to this methodology, royalties' rate varies between 5% and 20% according to the production level of the area.

b) Methodology by Economic Result – RRE: royalties' rate is the combination of a fixed royalty plus a variable royalty. The fixed royalty is of 5%. The variable royalty is determined according to R factor, which is the ratio between accrued incomes and accrued expenditures. This gives place to a completely new set of regulations linked to determining the concepts and forms of valorisation

of the same that have to be taken into consideration to calculate R factor.

For the particular case of Camisea, there is a different method to calculate the royalty: a 37.24% basic royalty is taken and then it is adjusted after a certain time has elapsed from the beginning of the exploitation.

Venezuela

Venezuela is Latin America's oil giant and its history in relation to the participation of the capital from private and state companies of third countries is highly significant for the region as a whole. In 1975 the oil industry was nationalised, created PDVSA as a holding company and it was granted the monopoly of hydrocarbons exploration and exploitation. But towards the year 1991, according to the global privatisation trend, the process called "oil opening" started, particularly from two schemes: the Operational Service Contracts or Operating Agreements and the Strategic Association Agreements.

Operating Agreements

Operating Agreements were foreseen in Section 5 of the Organic Law Reserving the Industry and Commerce of Hydrocarbons to the State (the LOREICH), popularly known as the Nationalisation law.

Under the Operating Agreements, PDVSA signed contracts with operating companies to reactivate mature fields giving in return an operating fee. Throughout the 90.s PDVSA organised three rounds of calls for tenders of Operating Agreements in 1992, 1993 and 1997, apart from a direct agreement in 1995 (Boscan Operating Agreement). Not all of them were successful. Nowadays the number of Operating Agreements signed with private investors between 1992 and 1997 amounts to 32.

Strategic Association Agreements

In 1993 and 1997 the National Congress sanctioned, within the frame of Section 5 of the LOREICH, the concept of Strategic Associations or "Association Agreements", as an association of private companies to carry out, in special cases and when convenient to the public interest, activities related to the exploitation of hydrocarbons reserves owned by the State.

Some of the approved projects were:

- Cristobal Colón Project, for the exploitation of natural gas in four deposits in the Caribbean and Gulf of Paria, in Eastern Venezuela.
- Project for the Commercialisation of Orimulsion.
- Four Associations for the exploitation of the Orinoco Oil Belt: Sincor and Petrozuata (authorised in 1993); Ameriven and Cerro Negro (authorised in 1997)

The four Association Agreements for the Improvement of Extra-heavy Crude in the Orinoco Oil Belt today produce some 660 millions of barrels

per day (MBD) of extra-heavy crude, resulting in a production of almost 600 MBD of improved crude. These Association Agreements had important tax benefits, particularly in relation to royalties, where they paid –according to Venezuelan government - 1%.

Current Venezuelan authorities have developed a revision policy of the Operative Agreements and the Strategic Associations, as well as of internationalisation of PDVSA, which had one of its main milestones in the passing of an Organic Law of Gaseous Hydrocarbons in 1999 and of a New Organic Law of Hydrocarbons in 2001.

The main change introduced by these regulations was the obligatory migration towards new contracts, in which the maximum participation of private capital is limited to 49 %. This migration has already taken place in the 32 Operative Agreements and has also been subject of negotiation in the Strategic Associations.

Likewise, royalties were increased from 16.6% to 30% and income tax for the companies involved in Operative Agreements and Strategic Association Agreements from 34% to 50%. The royalty, however, may be reduced to 20% to make less profitable projects possible, and to 16.67% for extra-heavy oil crude projects, at the discretion of the authority. There are also duties linked to the area and the on-field consumption of hydrocarbons in the fields.

Finally, it should be mentioned that the internal and external commercialisation activities of primary hydrocarbons has been limited to the public companies of Venezuela, which implies a regime other than that of free availability.

Brazil

Law 9478 of August 6 1997, which established the aims of national energy policy and made more flexible the state monopoly on the sector, which has a constitutional rank, governs Brazilian hydrocarbons industry.

According to 1988 Federal Constitution, the hydrocarbon fields and other mineral resources belong to the Federal State, although the ownership of the products extracted is guaranteed for the holder of the concession.

From Constitutional Amendment No. 9 of September 11 1995, it has been stipulated that the state monopoly could be developed directly or indirectly, through concessions or contracts with private or state companies, subject to what would be defined by a law of the Federal Congress. Although nominally the monopoly of the federal government over the activities of the industry is still kept, law 9478 regulates the participation of private companies in the Brazilian hydrocarbons industry, putting an end to 44 years of legal monopoly exerted through Petrobras.

With the opening to the private sector, it was necessary to create the National Petroleum Agency (ANP) as a regulator of the oil and gas industry and of their by-products and bio fuels; and the National Council for Energy Policy (CNPE), chaired by the Minister of Mines and Energy, as adviser of the

Executive for the definition of the measures necessary to meet the targets of energy policy.

Property rights of the Federal State on the hydrocarbon fields and related assets are managed through the ANP.

The participation of private capital in exploration, development and production of hydrocarbons, as well as in crude refining and natural gas processing, is foreseen under the concession contracts, to be granted by the ANP through competitive bidding, in favour of companies established according to Brazilian legislation, and with domicile and administration in the country. Petrobras and its subsidiaries can constitute pools with local or foreign companies to carry out exploration activities.

Section 26 of Law 9478 grants the holders of the concession the ownership of the hydrocarbons produced, subject to the charges and shares stipulated by law or in the concession contract.

Concession contracts must provide the following government take or payments in favour of the State:

- signature bonus,
- royalties,
- special participation, and
- rental fee for using or keeping the area.

The signature bonus and the special participation might not be applied, according to what the ANP stipulates in the public notice tender.

Signature bond. Bid terms and conditions must establish the minimum to be offered as signature bond, payable at the moment of signing of the contract.

Royalties. Royalties are paid monthly, in local currency, as of the beginning of the production, as 10% over oil and natural gas production, occasionally reduced to a minimum of 5% in cases of higher geological risks, production projections and other variables in the ANP's discretion. The criteria for the calculation of the royalties are stipulated by presidential decree, taking into account the market prices of oil, natural gas or condensate; product specifications; and location of the field.

In the case of oil, the reference price for the calculation of the royalties is the highest of the following values:

- the weighted average of the selling price of the holder of the concession; or
- the minimum price determined by the ANP.

For natural gas, no minimum price is fixed. The reference price is the weighted average of the selling prices of the holder of the concession. Selling price must be adjusted to the market conditions.

Southern Cone

Argentina

The launching of the concessions system envisaged in Law 17 319 and the impulse to private activity did not materialise until the 90's, when Law 23 696 of State Reform was passed. Powers were conferred to the National Executive to proceed to privatisation of state assets and to deregulation of economic activity.

To replace YPF's participation, they resorted to: (i) new concessions in "secondary areas "; (ii) associations in "central areas" that up to that moment had been directly exploited by YPF; and (iii) the "reconversion" of construction contracts, hydrocarbons extraction and exploration contracts to the regime of concession or association with the state oil company.

Law 17,319 establishes the principle of domestic self-sufficiency: the main goal is to meet the hydrocarbon needs of the country with the production of their fields, keeping reserves that would ensure this aim. For the participation of private companies, law 17 319 adopted the regime of exploration permits and exploitation concessions.

Section 6 of Law 17,319 refers to the instruments through which the State takes its share in the oil and gas rent, consisting of:

- Provincial and municipal taxes existing at the moment of the awarding.
- National taxes, including custom duties.
- Levies, according to the allocated area.
- Royalties. The historical 12% aliquot of the gross product of hydrocarbons at wellhead is kept.

To this regime, it should be added that since the year 2002 there is in force a system of important export rights, both of crude oil (floating rate up to 45%), natural gas (45% over a reference value of US$ 5/MMBtu), and to a lesser extent of oil by-products.

The federalisation of the resources (transfer to the Provinces) stipulated by Law 24 145 of 1992 and by the constitutional reform of 1994 implied the growing participation of the provinces in the tendering processes of exploration areas and in the discussion of the reform projects of Law 17 319. Since 2007, by Law 26 197, both the existing Concessions and the new Concessions have been placed under jurisdiction of the Provincial Governments. The only areas remaining under national jurisdiction are the offshore areas.

Although each Province is adopting their own contractual modes, both at national and at provincial level it is worth noting that an encouragement to private capital participation in public utilities associations, which are to participate in association with private companies[57].

57 It is worth mentioning: National Government -Energia Argentina Sociedad Anónima (ENARSA); Province of Neuquén - HIDENESA (Hidrocarburos del Neuquén S.A.); Province of Río Negro EDHIPSA (Empresa de Desarrollo Hidrocarburífero Provincial S. A.); Province of Chubut - Petrominera Chubut Sociedad del Estado; Province of Santa Cruz - FOMICRUZ S.E. (Fomento Minero de Santa Cruz Sociedad del Estado); Province of Tierra del Fuego - RENASA (Recursos Naturales Sociedad Anónima); Province

Together with this trend, there is a growing regulation on the disposal of extracted hydrocarbons, which limits the application of the free availability principle.

Influence of the State participation schemes on the integration process

It is obvious that key countries as suppliers for the integration process, such as Venezuela and Bolivia, have directed their domestic policy regarding hydrocarbons towards increasing the state participation in oil rent, but also towards intervening directly and exclusively with their public companies in the domestic and foreign commercialisation of natural gas. Within this framework PDVSA and YPFB are key stakeholders in the integration process.

Now then, the way these changes can encourage or discourage integration projects is far from having been resolved. In this sense, on the one hand they still have to solve the financing matters linked to integration projects, which –particularly in the case of Bolivia- appear to be quite complex.

On the other hand, Venezuelan policy of inviting certain countries of the region to participate through their public companies particularly in the exploitation of extra-heavy crude oil of the Orinoco belt might be affected by the juridical framework in which that exploitation is planned.

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of Mendoza - EPSE (Energía Provincial Sociedad del Estado); Formosa - Recursos y Energía Formosa Sociedad Anónima (REFSA)

Annex 4

Final Energy Consumption – Latin American and Caribbean Countries

ARGENTINA — **Unit kbep**

Sources	2003	Low Integration 2008	2013	2018	2003-18 (%)	High Integration 2008	2013	2018	2003-18 (%)
Solid Fuels	1,938	1,814	1,484	1,240	**-2.9**	1,420	973	680	**-6.7**
Natural Gas	137,668	175,490	199,773	227,963	**3.4**	191,368	245,794	315,673	**5.7**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables	0	0	0	0		400	1,183	2,588	**13.3**
Nuclear	0	0	0	0		0	0	0	
Biomass	8,700	8,035	6,723	5,847	**-2.6**	10,076	16,252	24,934	**7.3**
Electricity	51,425	65,894	74,928	85,233	**3.4**	68,517	84,148	102,567	**4.7**
Oil by-products	97,553	117,958	125,336	134,716	**2.2**	119,939	133,708	147,608	**1.4**
Ethanol						861	795	718	**-27.9**
Other	21,784	25,205	25,850	26,567	**1.3**	27,538	31,950	36,996	**3.6**
Total	**319,068**	**394,396**	**434,094**	**481,566**	**2.8**	**420,119**	**514,803**	**631,764**	**4.7**

Source: OLADE (LAEO)

BRAZIL — **Unit kbep**

Sources	2003	Low Integration 2008	2013	2018	2003-18 (%)	High Integration 2008	2013	2018	2003-18 (%)
Solid Fuels	63,993	88,563	101,331	114,109	3.9	70,407	77,378	85,043	**1.9**
Natural Gas	73,479	100,151	149,482	225,487	7.8	111,786	191,683	317,523	**10.2**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables	0	0	0	0		348	998	2264	**13.3**
Nuclear	0	0	0	0		0	0	0	
Biomass	290,545	313,631	346,051	379,806	1.8	328,733	360,426	397,717	**2.1**
Electricity	211,639	271,419	335,173	408,373	4.5	307,939	435,973	586,805	**7.0**
Oil by-products	431,605	511,171	587,923	677,314	3.0	500,250	588,302	687,159	**3.1**
Ethanol	41,700	50,793	60,448	71,981	3.7	53,223	67,693	85,438	**4.9**
Other	100,482	116,821	131,651	147,360	2.6	124,417	150,479	172,135	**3.7**
Total	**1,213,443**	**1,452,549**	**1,712,059**	**2,024,430**	**3.5**	**1,497,103**	**1,872,932**	**2,334,084**	**4.5**

Source: OLADE (LAEO)

BOLIVIA **Unit kbep**

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels									
Natural Gas	3,609	4,962	5,938	6,871	4.4	5,259	7,509	11,078	**7.8**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables						24	65	153	**20.4**
Nuclear									
Biomass	4,120	3,646	3,488	3,490	-1.1	3,572	3,621	4,185	**0.1**
Electricity	2,289	2,869	3,565	4,378	4.4	2,968	3,667	4,410	**4.5**
Oil by-products	10,357	11,814	13,258	14,715	2.4	11,956	13,433	15,126	**2.6**
Ethanol						433	458	493	**1.3**
Other	1,341	1,466	1,558	1,636	1.3	1,310	1,308	1,379	**0.2**
Total	**21,716**	**24,757**	**27,807**	**31,090**	**2.4**	**25,522**	**30,061**	**36,824**	**3.6**

Source: OLADE (LAEO)

CHILE **Unit kbep**

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels	4,998	5,006	4,823	4,602	-0.5	4,655	4,110	3,318	**-2.7**
Natural Gas	13,115	18,547	24,006	30,828	5.9	20,847	35,492	64,245	**11.2**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables	0	0	0	0		163	450	1010	**20.0**
Nuclear									
Biomass	17,248	20,958	23,988	26,991	3.0	20,353	24,172	28,345	**3.4**
Electricity	26,620	36,809	48,598	63,207	5.9	39,721	56,089	72,583	**6.9**
Oil by-products	69,595	86,118	104,093	126,535	4.1	88,758	107,633	127,122	**4.1**
Other	4,129	4,963	5,744	6,675	3.3	4,902	5,682	6,591	**3.2**
Total	**135,705**	**172,401**	**211,252**	**258,838**	**4.4**	**179,399**	**233,628**	**303,214**	**5.5**

Source: OLADE (LAEO)

COLOMBIA Unit kbep

		Low Integration				High Integration			
Sources	2003	2008	2013	2018	2003-18 (%)	2008	2013	2018	2003-18 (%)
Solid Fuels	13,252	15,801	19,309	23,729	4.0	16,347	20,870	25,801	**4.5**
Natural Gas	19,094	22,762	27,616	33,964	3.9	23,368	29,773	36,377	**4.4**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables									
Nuclear									
Biomass	33,759	39,521	44,332	49,965	2.6	39,508	45,757	49,986	**2.7**
Electricity	22,600	26,693	31,205	37,439	3.4	27,938	35,042	42,149	**4.2**
Oil by-products	64,570	70,649	84,226	101,497	3.1	74,206	92,954	116,186	**4.0**
Other									
Total	**153,275**	**175,426**	**206,688**	**246,594**	**3.2**	**181,367**	**224,396**	**270,499**	**3.9**

Source: OLADE (LAEO)

COSTA RICA Unit kbep

		Low Integration				High Integration			
Sources	2003	2008	2013	2018	2003-18 (%)	2008	2013	2018	2003-18 (%)
Solid Fuels	399	527	699	927	5.8	501	631	795	**4.7**
Natural Gas							130	1327	**59.1**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables	352	515	755	1,105	7.9	677	1,151	2,020	**12.4**
Nuclear									
Biomass	988	954	933	923	-0.5	948	927	920	**-0.5**
Electricity	4,187	5,595	7,488	10,037	6.0	5,783	7,967	11,037	**6.7**
Oil by-products	12,137	14,960	18,476	22,861	4.3	15,391	18,904	23,734	**4.6**
Ethanol						44	261	1,551	**42.8**
Other									
Total	**18,063**	**22,551**	**28,351**	**35,853**	**4.7**	**23,344**	**29,971**	**41,384**	**5.7**

Source: OLADE (LAEO)

ECUADOR Unit kbep

		Low Integration				High Integration			
Sources	2003	2008	2013	2018	2003-18 (%)	2008	2013	2018	2003-18 (%)
Solid Fuels									
Natural Gas	0	0	0	0		0	0	0	
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables									
Nuclear									
Biomass	4,642	5,039	5,314	5,003	0.5	4,601	4,691	3,731	**-1.4**
Electricity	5,176	6,509	8,168	9,446	4.1	6,413	8,642	10,114	**4.6**
Oil by-products	36,861	40,360	50,598	58,513	3.1	41,153	56,635	67,114	**4.1**
Ethanol						453	1,987	3,551	**22.9**
Other									
Total	**46,679**	**51,908**	**64,080**	**72,962**	**3.0**	**52,620**	**71,955**	**84,510**	**4.0**

Source: OLADE (LAEO)

EL SALVADOR Unit kbep

		Low Integration				High Integration			
Sources	2003	2008	2013	2018	2003-18 (%)	2008	2013	2018	2003-18 (%)
Solid Fuels	126	158	199	251	4.7	126	126	126	**0.0**
Natural Gas							133	331	**20.0**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables	0	0	0	0		118	421	1111	**25.1**
Nuclear									
Biomass	9,077	9,417	9,771	10,139	0.7	8562	8146	7805	**-1.0**
Electricity	3,092	4,155	5,618	7,640	6.2	4410	6337	9163	**7.5**
Oil by-products	10,874	14,073	18,534	24,646	5.6	14114	18813	25612	**5.9**
Ethanol						152	545	1995	**29.4**
Other	109	120	132	145	1.9	129	153	181	**3.4**
Total	**23,278**	**27,923**	**34,254**	**42,821**	**4.1**	**27611**	**34674**	**46324**	**4.7**

Source: OLADE (LAEO)

GUATEMALA Unit kbep

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels	143	138	133	128	-0.7	103	83	75	**-4.2**
Natural Gas							432	1938	**35.0**
Crude Oil	716	790	872	963	2.0	647	585	529	**-2.0**
Hydropower	0	0	0	0		0	0	0	
Renewables	0	0	0	0		123	685	2,010	**32.2**
Nuclear									
Biomass	25,508	28,604	32,212	36,447	2.4	27,413	29,649	32,310	**1.6**
Electricity	3,655	5,148	7,253	10,221	7.1	5,568	8,633	13,610	**9.2**
Oil by-products	18,655	24,854	33,250	44,660	6.0	24,934	34,012	47,032	**6.4**
Ethanol						212	1,054	5,282	**37.9**
Other									
Total	**48,677**	**59,534**	**73,720**	**92,419**	**4.4**	**59,000**	**75,133**	**102,786**	**5.1**

Source: OLADE (LAEO)

HONDURAS Unit kbep

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-2018(%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels	850	1,059	1,319	1,644	4.5	1,126	1,493	1,979	**5.8**
Natural Gas							133	331	**20.0**
Crude Oil									
Hydropower	0	0	0	0		0	0	0	
Renewables						112	471	1,124	**25.9**
Nuclear									
Biomass	10,237	10,971	11,768	12,632	1.4	10,885	11,639	12,520	**1.4**
Electricity	2,372	3,098	4,064	5,350	5.6	3,300	4,619	6,502	**7.0**
Oil by-products	10,122	12,506	15,710	20,235	4.7	13,029	17,076	22,905	**5.6**
Ethanol						145	497	1,711	**28.0**
Other									
Total	**23,581**	**27,634**	**32,861**	**39,861**	**3.6**	**28,597**	**35,928**	**47,072**	**4.7**

Source: OLADE (LAEO)

MEXICO **Unit kbep**

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels	1,296	1,572	1,907	2,314	3.9	1,577	1,918	2,334	**4.0**
Natural Gas	162,537	202,703	245,641	319,082	4.6	204,151	273,637	399,860	**6.2**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables	0	0	0	0		595	3,167	16,918	**39.8**
Nuclear	0	0	0	0		0	0	0	
Biomass	59,096	59,968	61,007	61,228	0.2	57,610	56,561	55,953	**-0.4**
Electricity	115,924	136,265	185,549	246,773	5.2	140,171	190,151	265,615	**5.7**
Oil by-products	445,975	526,696	610,216	719,233	3.2	519,596	610,583	744,371	**3.5**
Other						825	5,189	41,282	**47.9**
Total	**784,828**	**927,204**	**1,104,320**	**1,348,630**	**3.7**	**924525**	**1141206**	**1526333**	**4.5**

Source: OLADE (LAEO)

NICARAGUA **Unit**

kbep

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels	301	312	325	341	0.8	314	331	351	**1.0**
Natural Gas							113	257	**17.9**
Crude Oil	132	153	177	205	3.0	168	215	274	**5.0**
Hydropower	0	0	0	0		0	0	0	
Renewables	0	0	0	0		85	301	534	**20.2**
Nuclear									
Biomass	9,598	11,106	12,853	14,875	3.0	10,705	11,961	13,389	**2.2**
Electricity	1,106	1,539	2,203	3,252	7.5	1,635	2,498	3,950	**8.9**
Oil by-products	5,475	6,557	7,919	9,644	3.8	6,794	8,534	10,854	**4.7**
Ethanol						112	290	756	**21.0**
Other									
Total	**16,612**	**19,667**	**23,477**	**28,317**	**3.6**	**19,813**	**24,243**	**30,365**	**4.1**

Source: OLADE (LAEO)

PANAMA **Unit kbep**

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels	22	23	24	25	0.9	19	19	19	**-1.0**
Natural Gas							333	2292	**47.1**
Crude Oil									
Hydropower	0	0	0	0		0	0	0	
Renewables						116	221	423	**13.8**
Nuclear									
Biomass	4,623	4,705	4,790	4,877	0.4	4,608	4,546	4,336	**-0.4**
Electricity	2,737	3,627	4,811	6,387	5.8	3,741	5,087	6,838	**6.3**
Oil by-products	9,185	11,392	14,178	17,708	4.5	11,783	14,860	17,011	**4.2**
						40	197	956	**37.4**
Other									
Total	**16,567**	**19,747**	**23,803**	**28,997**	**3.8**	**20,307**	**25,263**	**31,875**	**4.5**

Source: OLADE (LAEO)

PARAGUAY **Unit kbep**

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels									
Natural Gas							1.085	3.771	**28.3**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables						20	52	107	**18.3**
Nuclear									
Biomass	11,198	10,264	9,210	8,081	-2.2	10,183	9,528	8,495	**-1.8**
Electricity	2,914	3,864	5,061	6,520	5.5	4,386	6,456	8,936	**7.8**
Oil by-products	8,965	10,548	12,652	15,313	3.6	10,771	12,609	14,901	**3.4**
Ethanol	4	4	5	6	2.7	4	70	148	**27.2**
Other	3,969	4,748	5,579	6,390	3.2%	5,185	5,924	6,118	**2.9**
Total	**27,050**	**29,428**	**32,507**	**36,310**	**2.0**	**30,549**	**35,724**	**42,476**	**3.1**

Source: OLADE (LAEO)

PERU **Unit kbep**

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels	3,121	3,662	4,196	4,360	2.3	3,946	4,689	5,355	**3.7**
Natural Gas	0	0	0	0		5,758	10,183	11,566	**7.2**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables									
Nuclear									
Biomass	15,495	14,520	13,532	12,806	-1.3	14,655	13,860	13,200	**-1.1**
Electricity	12,521	15,336	19,051	22,811	4.1	16,074	20,630	25,805	**4.9**
Oil by-products	43,308	52,478	61,258	68,413	3.1	49,123	56,297	65,911	**2.8**
Other									
Total	**74,445**	**85,996**	**98,037**	**108,390**	**2.5**	**89,556**	**105,659**	**121,837**	**3.3**

Source: OLADE (LAEO)

TRINIDAD & TOBAGO **Unit kbep**

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels									
Natural Gas	28,857	39,201	53,268	72,409	6.3	40,956	58,118	82,508	**7.3**
Crude Oil	2,493	3,562	5,090	7,274	7.4	3,579	5,138	7,376	**7.5**
Hydropower									
Renewables						27	88	168	**20.1**
Nuclear									
Biomass	0	0	0	0		0	0	0	
Electricity	3,790	4,866	6,297	8,207	5.3	4,876	6,323	8,260	**5.3**
Oil by-products	5,025	6,515	8,487	11,088	5.4	6,810	9,277	12,677	**6.4**
Other									
Total	**40,165**	**54,144**	**73,142**	**98,978**	**6.2**	**56,248**	**78,944**	**110,989**	**7.0**

Source: OLADE (LAEO)

URUGUAY Unit kbep

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels	8	17	33	68	15.3	6	7	7	**-0.9**
Natural Gas	326	505	738	957	7.4	586	1.558	3.130	**16.3**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables						11	30	64	**19.3**
Nuclear									
Biomass	2,893	3,205	3,113	3,038	0.3	3,283	3,620	4,023	**2.2**
Electricity	3,746	4,944	5,573	6,238	3.5	5,235	6,439	7,614	**4.8**
Oil by-products	8,775	11,514	12,905	14,633	3.5	11,399	12,686	14,136	**3.2**
Ethanol							113	252	**17.4**
Other	617	777	834	908	2.6	808	922	1049	**3.6**
Total	**16,365**	**20,962**	**23,196**	**25,842**	**3.1**	**21,328**	**25,375**	**30,275**	**4.2**

Source: OLADE (LAEO)

VENEZUELA Unit kbep

		Low Integration				High Integration			
Sources	**2003**	**2008**	**2013**	**2018**	**2003-18 (%)**	**2008**	**2013**	**2018**	**2003-18 (%)**
Solid Fuels	345	453	519	596	3.7	0	0	0	**-100.0**
Natural Gas	88,739	117,296	134,532	152,270	3.7	131,667	162,091	201,476	**5.6**
Crude Oil	0	0	0	0		0	0	0	
Hydropower	0	0	0	0		0	0	0	
Renewables									
Nuclear									
Biomass	50								**-100.0**
Electricity	38,593	48,944	56,921	64,262	3.5	51,913	63,791	77,034	**4.7**
Oil by-products	119,174	140,191	162,234	189,100	3.1	139,458	158,555	183,301	**2.9**
Other									
Total	**246,901**	**306,884**	**354,206**	**406,228**	**3.4**	**323,038**	**384,437**	**461,811**	**4.3**

Source: OLADE (LAEO)

Annex 5

Conversion Table for Energy Units

TABELA DE CONVERSÃO PARA UNIDADES ENERGÉTICAS *CONVERSION TABLE FOR ENERGY UNITS*										
	Bep/Boe	Tep/Toe	Tec/Tce	Tcal	TJ	10^3BTU 10^3BTU	MWh	Kg GLP Kg LPG	m³ Gas Nat m³ Gas Nat	pc Gas Nat cf Nat Gas
Bep Boe	1	0,13878	0.1982593	0.00139	0.00581	5524.86	161.394	131.0616	167.207304	5917.15976
Tep Toe	7.205649	1	1.4285868	0.01	0.04184	39810.22	1162952	944.3839	1204.83714	42636.9763
Tec Tce	5.04390	0.6999925	1	0.007	0.0292877	27866.85	8.14057	661.0616	843.376919	29845.5621
Tcal Tcal	720.56490	100	142.85868	1	4.184	3981022	1162.9520	94438.388	120483.714	4263697.6
TJ TJ	172.21914	23.900574	34.144044	0.2390057	1	951487	277.95214	22571.316	28796.2988	1019048.19
10^3BTU 10^3BTU	0.00018	2.51E-05	3.59E-05	2.51E-07	1.5E-06	1	0.00029	0.02372	0.030265	1.07101
MWh MWh	0.61960	0.08599	0.1228	0.00086	0.0036	3423.2	1	81.20577	103.6016	3666.27219
kg GLP kg LPG	0.00763	0.00106	0.001513	1.06-05E-05	4.43E-05	42.154696	0.0123144	1	1.27579173	45.147929
m³ Nat Gas m³ Gas Nat	0.00598	0.00083	0.001186	8.30E-06	3.47E-05	33.041989	0.0096524	0.783827	1	35.3881657
pc Gas Nat cf Nat Gas	0.00017	2,35E-05	3.35E-05	2.35E-07	9.81E-07	0.933701	0.0002728	0.0221494	0.02825803	1

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World Energy Council
Regency House 1-4 Warwick Street
London W1B 5LT United Kingdom
T (+44) 20 7734 5996
F (+44) 20 7734 5926
E info@worldenergy.org
www.worldenergy.org

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