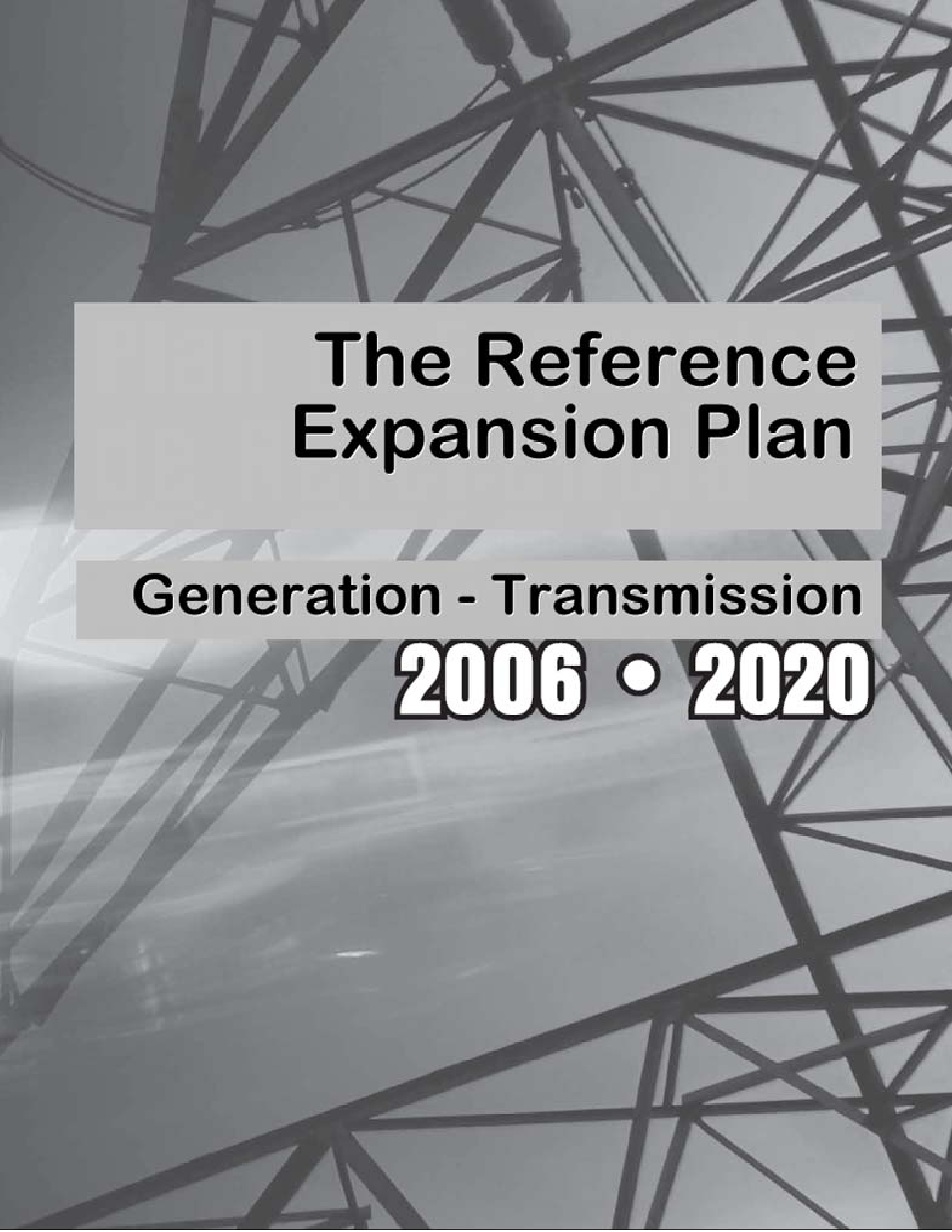

The Reference Expansion Plan

Generation - Transmission

2006 • 2020

Ministry of Mines and Energy
Unidad de Planeación Minero Energética
Minister of Mines and Energy
Hernán Martínez Torres.
General Director UPME
Carlos Arturo Flórez Piedrahita
Subdirector of Energy Planning
Alberto Rodríguez Hernández
Issued by
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Empresa de Energía del Pacífico E.I.C.E E.S.P.
UPME Team
Beatriz Herrera Jaime
Denice Jeanneth Romero López
Elga Cristina Saravia Low
Francisco de Paula Toro Zea
Henry Josué Zapata Lesmes
Jaime Alfonso Orjuela Vélez
Jaime Fernando Andrade Mahecha
Jairo Ovidio Pedraza Castañeda
Javier Andrés Martínez Gil
Johanna Alexandra Larrota Cortés
José Vicente Dulce Cabrera
Libardo Acero García
Luis Carlos Romero Romero
Oscar Patiño Rojas

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INTRODUCTION

La Unidad de Planeación Minero, The Colombian Energy Planning Unit – UPME, is pleased to present at the disposal of the whole power sector and other interested parties, the Reference Expansion Plan Generation – Transmission 2006 – 2020, which in compliance with Law 143 of 1994, Electric Law, identifies the country's needs with regard to new generation capacity and recommends National Transmission System -NTS- expansion projects, in order to ensure the appropriate electric power supply in the immediate future and in the horizon up to year 2020.

This version of the plan starts with a brief description of the country's main macroeconomic aggregates recent evolution. Chapter 1, Economic Situation, with the purpose to present the analysis and results. Chapter 2, Electricity Market Situation, presents data, indicators and relevant events in the different segments of electricity chain, from the electric power demand to the supply, starting with international interconnections, and finishing with a review of the regulatory scheme modifications since 2005, used to define the methodology and scope of the Plan. The energy demand and electric power projections, used in the analysis performed, as well as their methodological aspects, are the purpose in chapter 3. In Chapter 4, Resources Availability, Natural Gas and Coal Prices Projection, are inputs for further chapters.

The Expansion and Generation studies, described in Chapter 5, are based on expansion projects foreseen for Colombia, as well as for neighboring countries such as Ecuador, Peru, Panama, and other countries which are part of SIEPAC (Electric Interconnection System for Central American countries), considering the possible states that arise from simultaneousness between the four critical variables which determine the various scenarios of generation expansion requirements in the country: gas price and availability, increase on energy demand and the carry out of international interconnections.

In this plan, the need to incorporate at least 150 MW by 2009 and 700 MW for the period between 2011 and 2015, or 1000 MW, for same period, if the interconnection with Central America is carried out, and if there is a high increase on demand and as well as a need for new generation capacities based on mineral coal are identified.

The analysis of the Transmission Expansion on Chapter 6, considers the Bogotá and Costa projects, to initiate operation at 500 kV, at the expected dates and the expansion of the interconnection with Ecuador to 230 kV, which were executed or are underway, under UPME public bids scheme.

In addition to the long term analysis carried out for 2015-2020 period, in order to provide basic signals in regard to the efforts required in the System due to national needs, and the short and medium term detailed analysis, performed for the different areas that comprise NTS, in the period between years 2007 and 2015; in this version of the plan, the analysis is expanded and the definitions on various topics and projects that had been addressed , from the previous version of the plan, are determined, as it is the case of the Valle del Cauca area expansion, in light of new Network Operator's proposals, submitted in 2006; the Chinú area expansion alternatives, Porce III generation project connection, short-circuit level in NTS substations, and electric interconnection with Panama and the SIEPAC system, the majority of which, depended, on the most part, on regulatory affairs, which the regulator, has been defining in the course of 2006.

As a result, this Plan, recommends the reconfiguration of 500 kV San Carlos-Cerromatoso circuit, and the construction of 500 kV Porce substation, to connect Porce III generation project in 2010, to suspend the recommendation of Sub220 substation project, given in the previous Plan, and to conduct the necessary actions for the Colombia – Panama interconnection, subject, though, to pending regulatory agreements between the two countries.

We especially acknowledge the advice and contribution of Transmission Planning Advisor Committee - TPAC and the continuous contribution with information and comments coming from the agents. We hope this document, will be useful and a timely source of information and analysis for the sector and public in general.

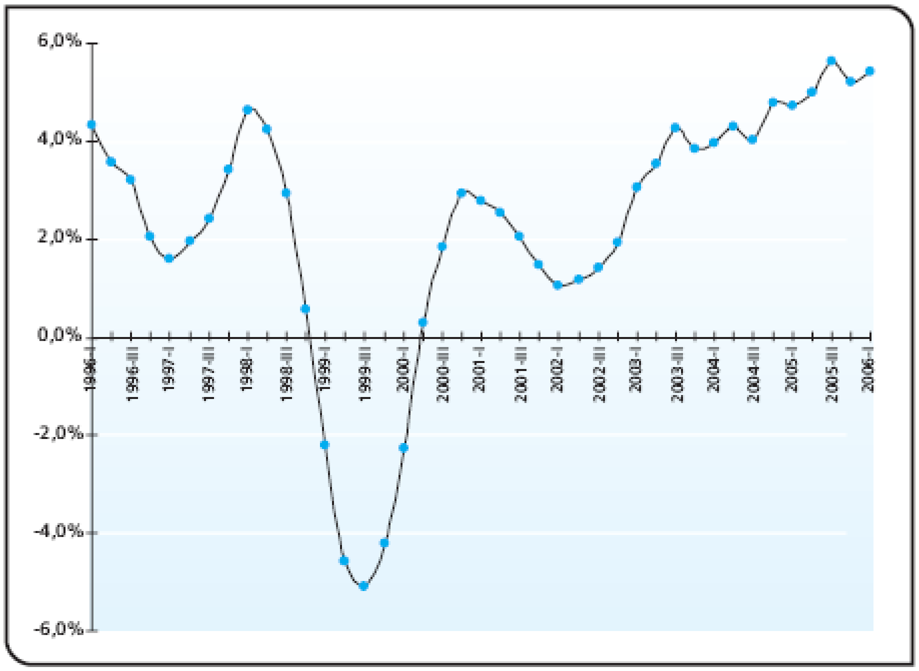
1 Economic Situation



1. ECONOMIC SITUATION

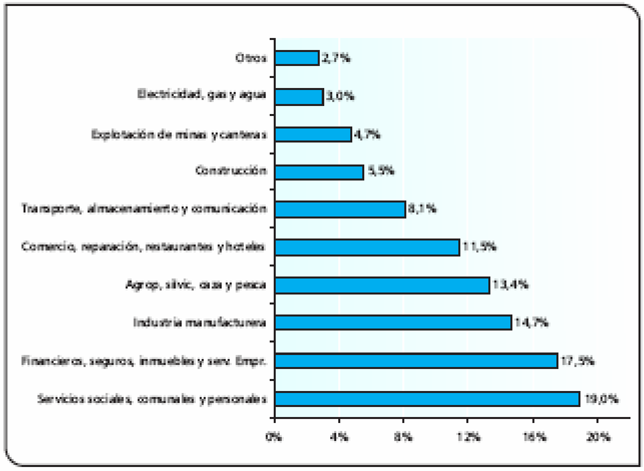
1.1. ECONOMY GROWTH

The Gross Domestic Product as of December 2005 increased to $284.5 billions, in current figures, equivalent to $88 billion in current pesos of 1994, which represents 5.2% of annual growth in real terms. The annual GDP variation is shown in graph 1-1. The GDP continues its growth trend, initiated in the first semester 2001.



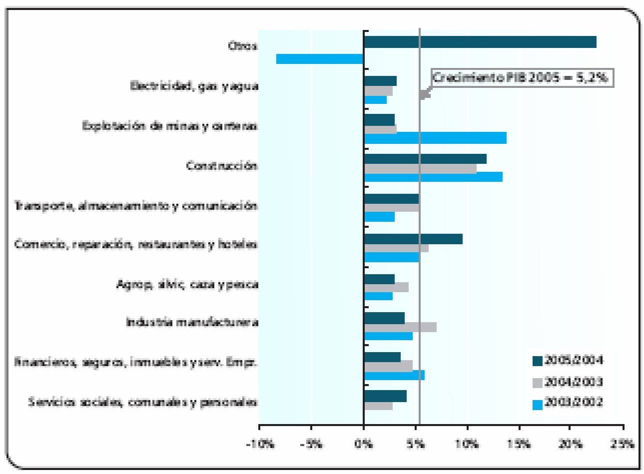
Graph 1-1 GDP annual variation (%)

The branches of the economy that participated the most in the 2005 GDP, were, social, community and personal services (19%), financial, insurance, real state and entrepreneurial services (17.5%), manufacturing industry (14.7%), agricultural, forestry, hunting and fishing (13.4%) sectors. On the contrary, the sectors with less participation were electricity, gas and water (3%) and mining and quarry exploitation (4.7%). This information is shown in Graph 1-2.



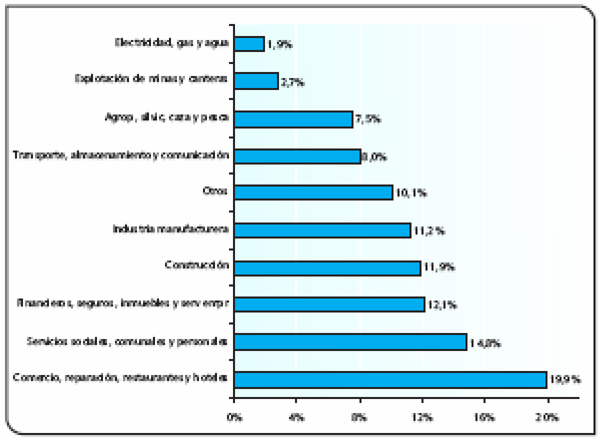
Graph 1-2 Participation of economy activity branches in the GDP (Year 2005) (%)

In graph 1-3, one can observe, that without considering the "Other" categories in the sectors classification, which measures the GDP, the sectors with the larger growth in 2005, in comparison to 2004, were Construction (11.9%) and trade, repairs, restaurants and hotels (9.4%) which recorded an inter-annual variation, exceeding the total GDP variation; the remaining sectors, recorded a smaller growth.



Graph 1-3 GDP annual variation by sectors

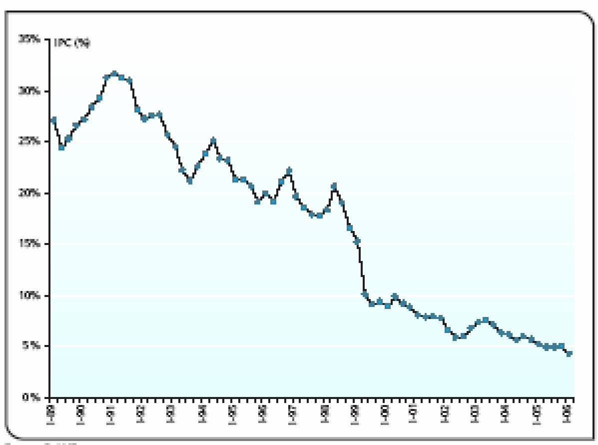
Pondering the GDP annual variation by sector, with the total GDP variation, between years 2004 and 2005, one can observe, in Graph 1-4 that the sector that most contributed to GDP growth were "trade, repairs, restaurants and hotels" (19.9%). "Social, community and personal services" (14.8%) and "Financial institutions, insurance, real state and entrepreneurial services" (12.1%); "Electricity, gas and water" (1.9%) and "Mines and quarry exploitation (2.7%), contributed the least".



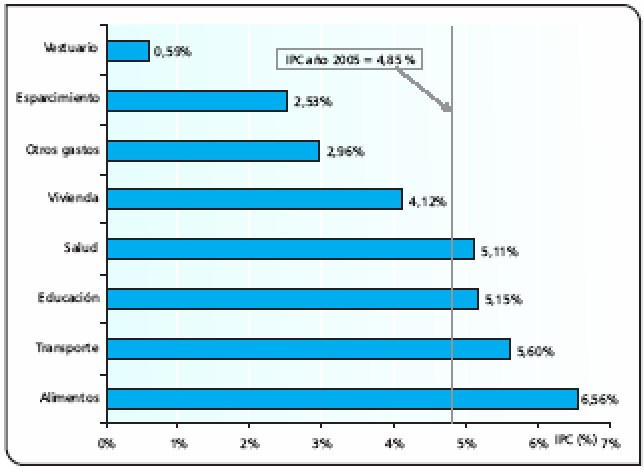
Graph 1-4 Pondered participation in Total GDP by sectors

1.2. INFLATION

In 2005, the Consumer Price Index (CPI) grew 4.85% in comparison to 2004, being the lowest inflation rate in last years. Graph 1-5 shows how inflation has declined in recent years, reaching 1 digit figures since 1999.



Graph 1-5 Annual GDP quarterly variation

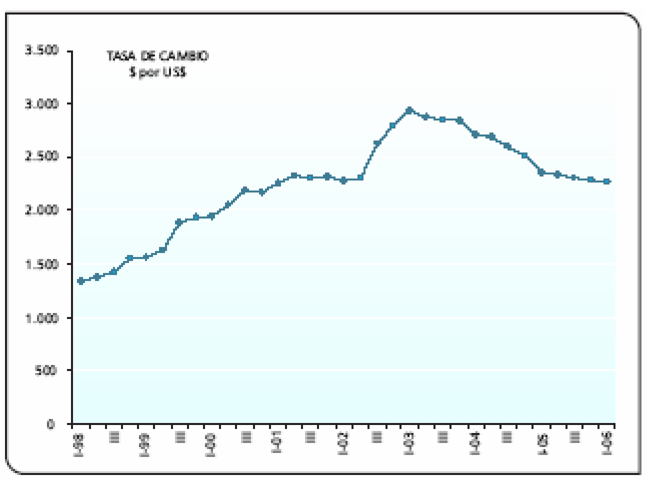


Graph 1-6 GDP variations as of December 2005, per goods and services groups

The most influencing sectors on the GDP growth for year 2005 were food, transportation, education and health. On the other hand, clothing, entertainment and housing, recorded price variations below total GDP. See graph 1-6.

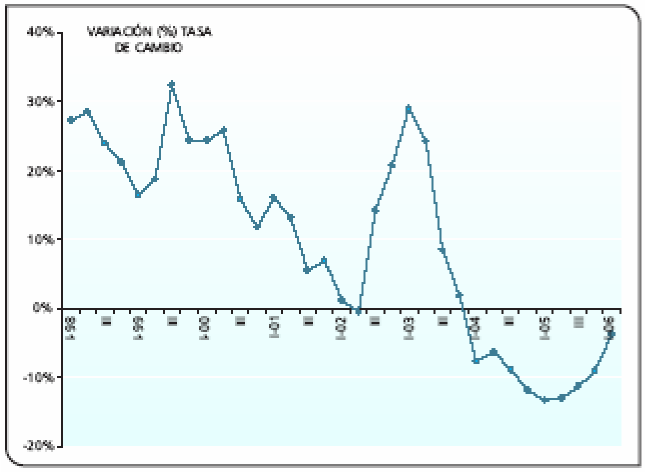
1.3. EXCHANGE RATE

In the year 2003 the national currency, showed a strong devaluation in front of the dollar, going from an exchange rate of $2,291.18, at the beginning of the year, to $2,864.79 at the end, this represents an annual devaluation of 25%. This tendency, continued during the first quarter of 2003, reaching $2,941.29, at the end of first quarter of that year. Since that date, the exchange rate has showed a revaluation trend, reaching $2,283.45 in December 2005, which represents an accumulated revaluation of 28.8%, with similar figures from those at the beginning of 2001. Graph 1-7 shows exchange rate historical behavior in recent years.



Graph 1-7 Exchange rate historical evolution

Even though, the exchange rate in 2005 continued with a decreasing tendency, the speed of change during the first semester of 2006 was reduced. Graph 1-8 shows the historical variation of the exchange rate.

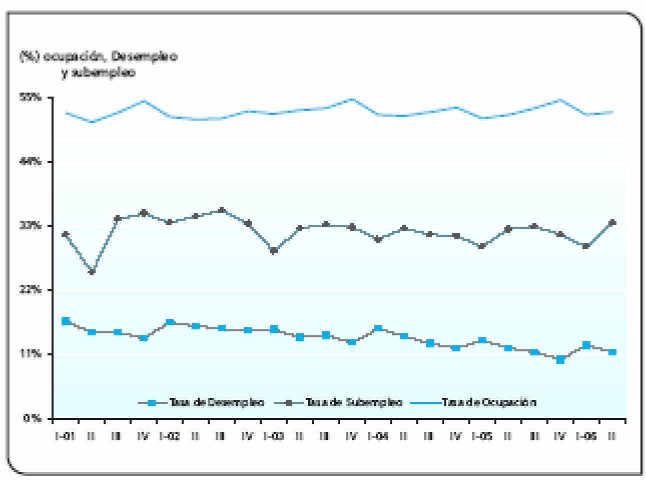


Graph 1-8 Exchange rate annual variation (%)

1.4. EMPLOYMENT

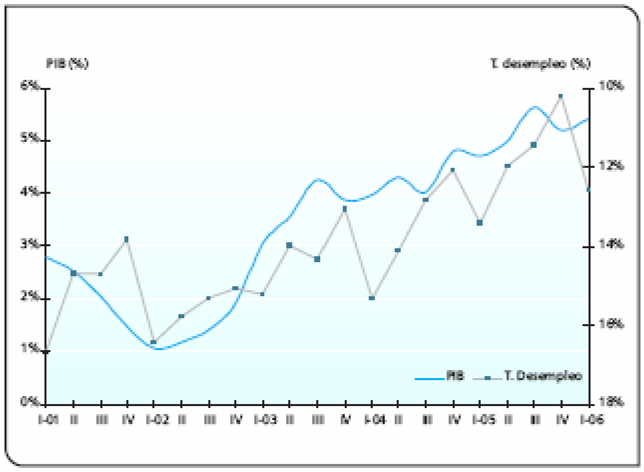
The employment rate has remained relatively constant in recent years, at about 53% of working age population. In 2005 the employment rate recorded a continuous increase from 51.6% in first quarter up to 54.6% in the fourth quarter, even though it was slightly reduced to 52.5% at the end of the first quarter of 2006.

In graph 1.9, one can observe that in the last years, the average sub-employment rate was 32.1% of total labor force. In the year 2005, this rate showed a slight reduction, reaching 31.6% level, even though, the sub-employment grew to 33.5%. The unemployment rate has showed a slight reduction, reaching 10.2% in 2005. This rate increased in the first semester of 2006, to 11.4%.



Graph 1-9 Country's employment variation

Graph 1-10 shows the inverse relationship existent between GDP variation and unemployment rate. Toward the third quarter 2005, the GDP reached its maximum growth and simultaneously the unemployment showed a clear tendency to decrease, favored by the increase in temporary jobs at the end of the year. Notwithstanding, in the first quarter of 2006, there was an increase of unemployment rate to 12.6%.

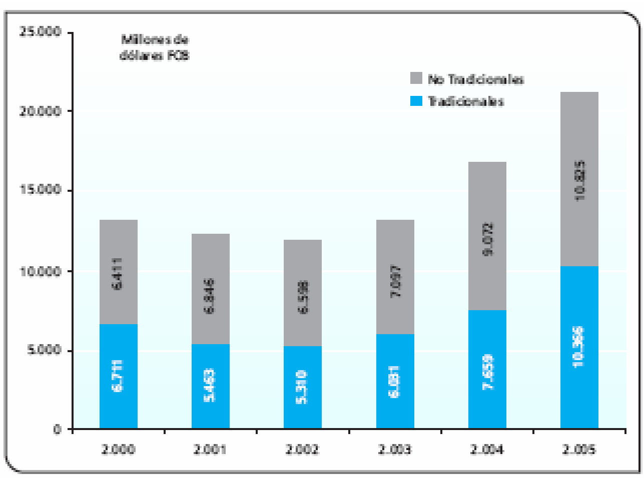


Graph 1-10 Employment - GDP relationship

1.5. EXPORTS AND IMPORTS

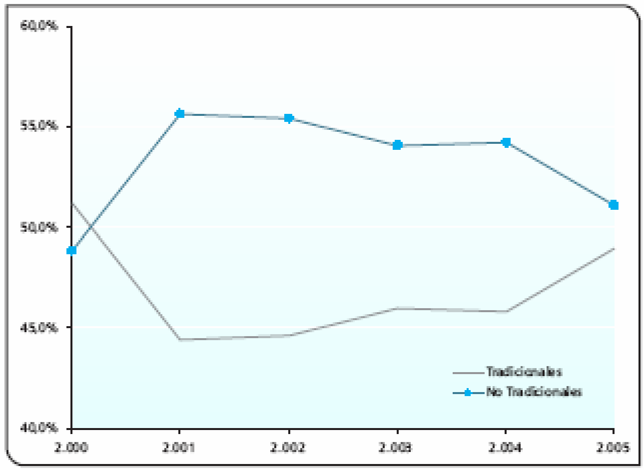
Graph 1-11, shows FOB Colombian exports evolution. In the year 2005 those imports reached US$ 21,190.5 millions, from which 48.9% corresponds to traditional and 51.1% to non-traditional exports.

Colombia's exports have showed an important growth in recent years, considering that in the 2001-2002 period they decreased 3%, in the 2002-2003 period, the increase was 10% and the 2003-2004, same as 2004-2005 period, the increase was 27%, equivalent to an annual average increase of 15% in current figures for 2001-2005.



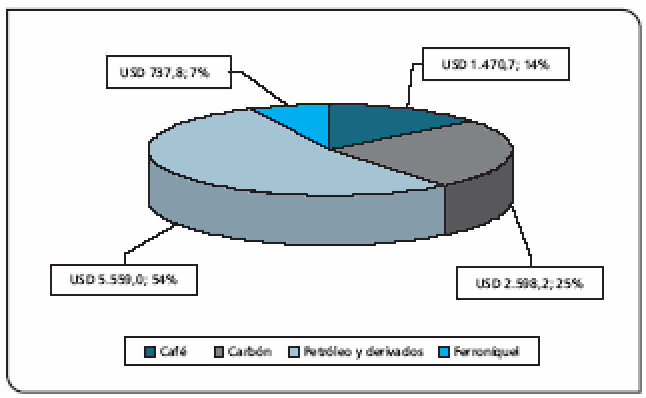
Graph 1-11 FOB Exports

In the 2001-2005 period, the non-traditional exports recorded a greater participation in total exports, even though the traditional products tend to increase their participation.



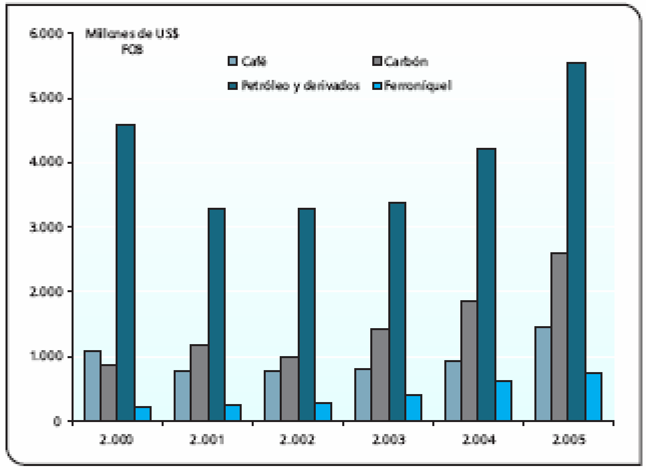
Graph 1-12 Traditional and nontraditional exports evolution

The main traditional export products are coffee, coal, ferronickel, and oil and its derivatives. In the year 2005, the main traditional export product was oil and its derivates (53.6%) followed by coal (25.1%), the third place was for coffee (14.2%) and the fourth for ferronickel (7.1%).



Graph 1-13 Main traditional export products

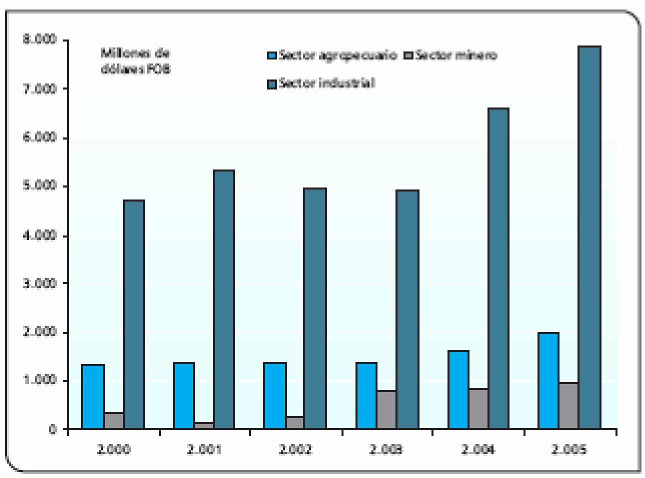
In the 2003-2005 period, ferronickel and coal showed the major increase in traditional export products, with an inter-annual growth average rate of 1.39% and 1.38% in current figures. For coffee such increase rate was 1.24%. Oil was the traditional product with the less increase in this period with an inter-annual rate of 1.19%.



Graph 1-14 Traditional export products historical evolution

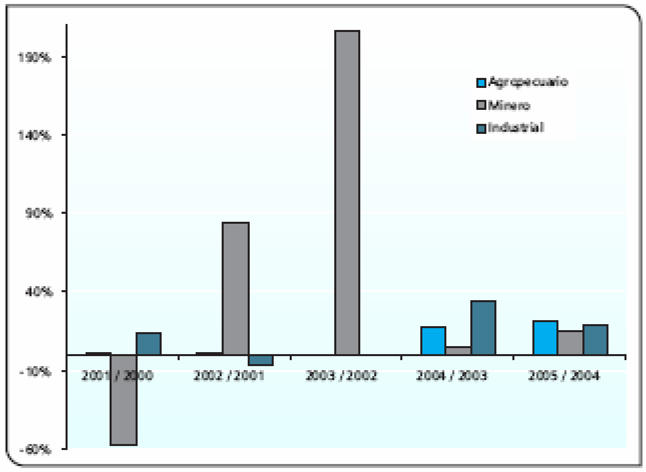
The value of non-traditional exports, recorded a significant increase in the 2000-2001 period, exceeding traditional exports, thanks to the increase on industrial sector export products and to the reduction of coffee and oil exports. The main non-traditional export products are: plantains, flowers in the agricultural sector, gold and emeralds in the mining sector, and textiles, chemicals, paper, leather and food in the industrial sector.

The industrial sector exports, were the ones with the greater participation in 2005, contributing with 72.9% of the total of non-traditional exports, the agricultural sector participated with 18.2% and the mining sector with 8.2%.



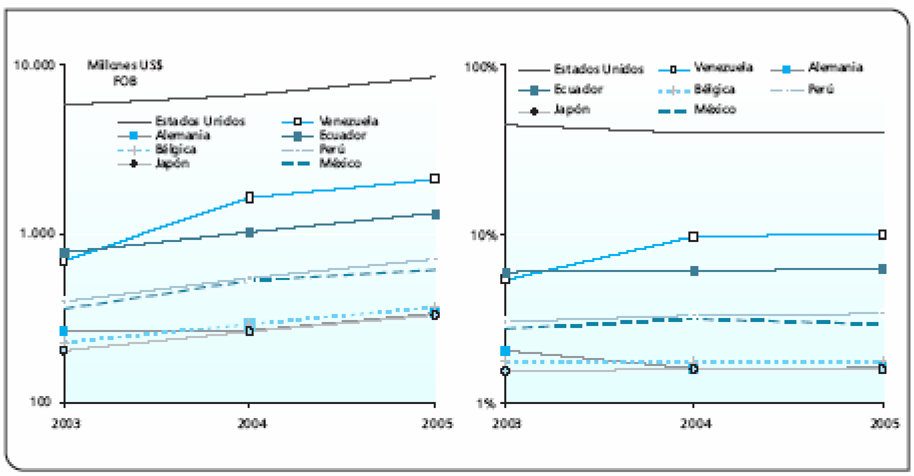
Graph 1-15 Traditional export products historical evolution

The non-traditional sectors show high volatility in exports annual growth. In the 2004-2005 period, the agricultural sector was the non-traditional export sector with faster growth, with 22%, followed by industrial sector with 19% and mining sector with 15%. In the 2000-2001 period, these sectors registered 1%, 13% and -58% rates respectively.



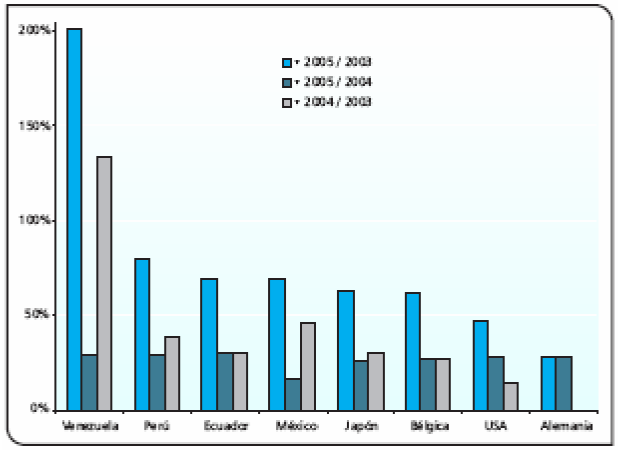
Graph 1-16 Non-traditional exports annual variation

United States is the main destination of Colombian exports, with about 40% of total, followed by Venezuela (10%), Ecuador (6.3%), Peru (3.4%), Mexico, Belgium, Germany and Japan.



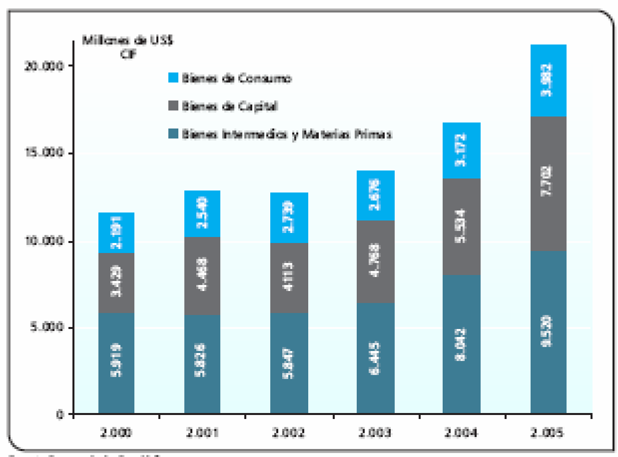
Graph 1-17 Exports destinations

In the 2003-2005 period, Venezuela was the destination with higher growth for the Colombian exports, going from US$ 696 million in 2003 to US$ 2,098 million in 2005, equivalent to 201.3% growth, followed by Peru, Ecuador and Mexico.



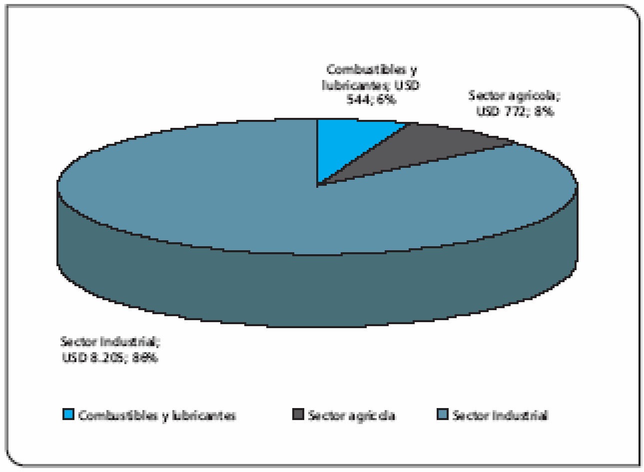
Graph 1-18 Inter-annual export variation per country of destination

In regard to imports, in the year 2005, they reached a CIF value of US$ 21,204.2 million, equivalent to 27% increase in current values with regard to 2004. The annual average increase of Colombian imports in the 2001-2005 period was 13.4%.



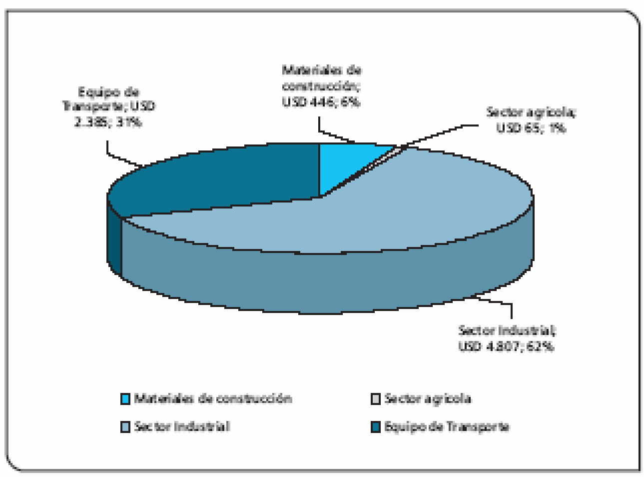
Graph 1-19 Country's imports historical evolution

The intermediate products and the row materials, such as fuel and lubricants, goods for the agricultural and industrial sectors, represent the higher percentage in imports figures; in 2005, they represented 44.6% of the total. Among the intermediate goods and raw materials group, those destined to the industrial sector have the greatest participation, with 86%.



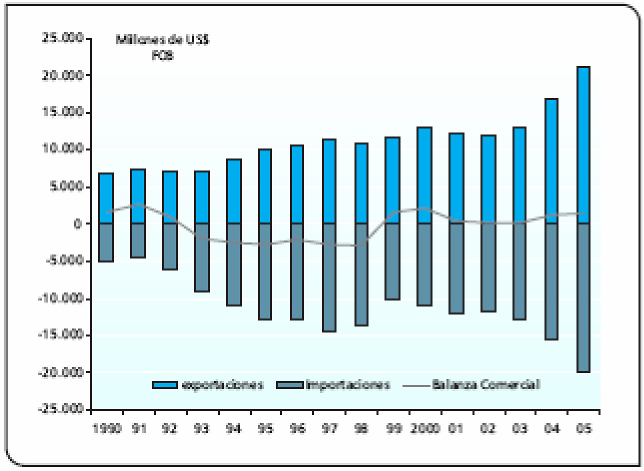
Graph 1-20 Intermediate goods import figures

The capital goods are comprised by machinery and equipment, for the agricultural, construction and transportation equipment sectors. Among these, in 2005, the industrial sector imports were those with the greater participation, with a CIF value of US$ 4,807 million, equivalent to 62% of total capital goods, followed by transportation equipment, construction materials and the agricultural sector.



Graph 1-21 Capital goods import figures

Since 1999 the commercial balance shows a net positive balance. In 2005, the exports exceeded the imports in US$ 1,392 million, with an increase of 22% in current values with regard to 2004. Graph 1-22 shows the historical evolution of trade balance in US$ million FOB.



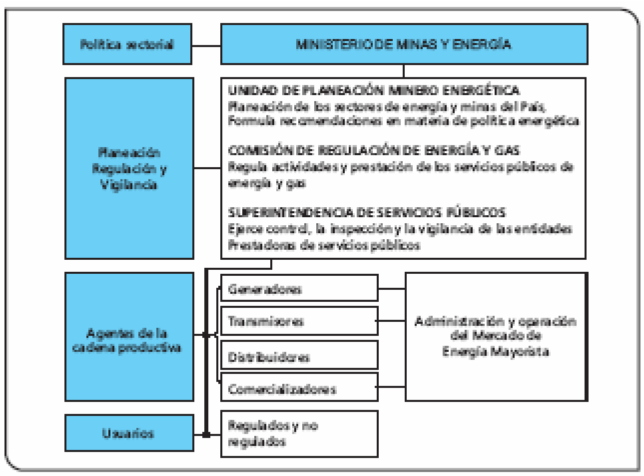
Graph 1-22 Commercial Balance

2 ELECTRICITY MARKET SITUATION

2. ELECTRICITY MARKET SITUATION

2.1. INSTITUTIONAL SCHEME

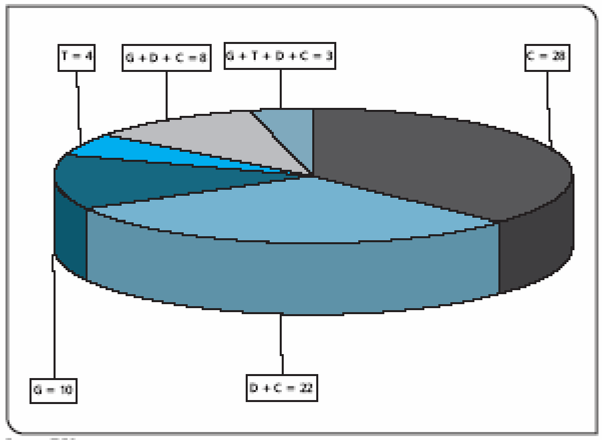
Since the 90's, The Government has modified its role as a main actor, in charge of resources administration, investor and almost absolute owner of the electric sector, toward a clear separation of the roles, between investors and Government, in which the latter is responsible for policy making, regulating and exercising control, surveillance and to carry out the electric sector planning, regulatory for the transmission expansion and indicative for generation expansion.



Graph 2-1 Institutional and Market Scheme

2.2. MARKET STRUCTURE

Graph 2-2 shows the distribution by activities, from a total of 75 electric sector regulated companies, operating in the National Interconnected System (NIS); only 3 of them remain with total vertical integration of activities: EEPPM, EPSA and ESSA. The number of pure dealers has increased in recent years, to 28 in 2005, serving the regulated and non-regulated market, located mainly in Bogotá, Cali, Medellín, Barranquilla and Bucaramanga. The majority of departmental and municipal former electric companies separated their activities and currently there are 22 which simultaneously performed distribution and selling activities, even though, there are eight companies that in addition to distribution and selling, also develop generation activities, among them: CHEC, EEP, EBSA, CEDELCA, CEDENAR and EMCALI. The companies whose exclusive objective is the transmission are: ISA, TRANSELCA, EEB and DISTASA.



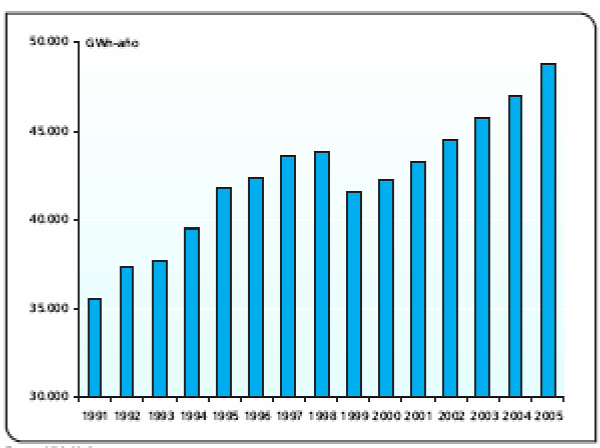
Graph 2-2 Number of companies by activity as per NIS

2.3. ELECTRIC ENERGY DEMAND

2.3.1. ELECTRICITY DEMAND HISTORICAL EVOLUTION

2.3.1.1. Energy

Graph 2-3, shows that in the 2000-2005 period, the energy demand increased at 2.75% annual average. The national annual accumulated energy[1] demand in year 2005 was 48,828.8 GWh/year, with a 3.8% growth in regard to the previous year. The year 2005 showed the most accelerating growth of the last ten years, which is coherent with the larger growth of the economy, measure through the GDP, which was 5,2% and that also corresponds to the larger growth in the last ten years.

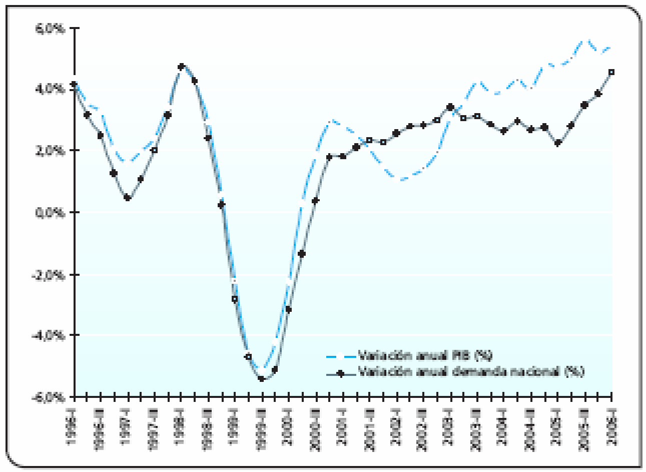


Graph 2-3 National Energy Demand (GWh/year)

Graph 2-4 shows the relationship between the annual accumulative demand quarterly variation and the GDP variation in same period. One can see, that there is a strong correlation among these series. Starting from second quarter 2003, the economy showed

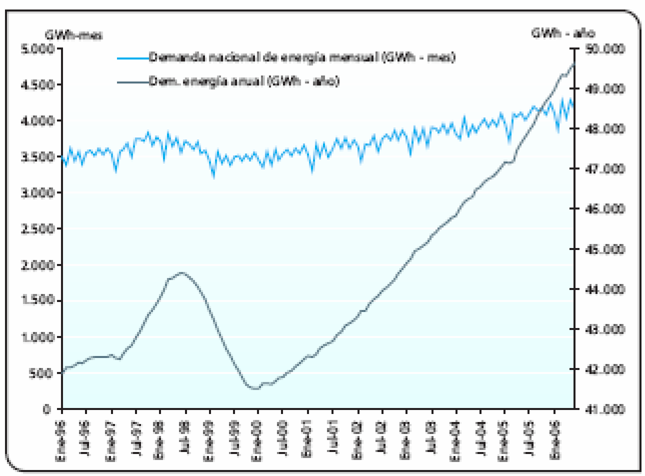
[1] XM source: The national energy demand is calculated base on net plan generation, non answered demand, limitation.

higher levels of growth than the electric energy demand, due to energetic products diversification, natural gas penetration and the actions taken by the industrial, residential and business sectors towards the efficient use of energy. Notwithstanding, the demand for energy is increasing at a more accelerating pace than the economy.



Graph 2-4 National Energy Demand vs. GDP

Graph 2-5 shows the national monthly demand evolution and the annual accumulated in (GWh).



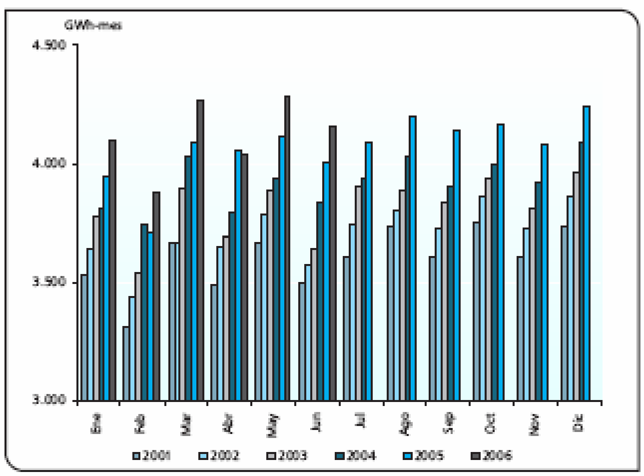
Graph 2-5 Monthly demand and annual accumulated of National Interconnected System (GWh)

MES	1997	1998	1999	2000	2001
Enero	42342,0	43807,4	43480,2	41499,7	42320,0
Febrero	42267,3	43966,0	43239,4	41619,7	42280,5
Marzo	42225,1	44226,3	42982,3	41624,9	42376,5
Abril	42378,0	44269,6	42746,0	41595,9	42498,4
Mayo	42493,5	44336,1	42498,9	41677,7	42575,0
Junio	42588,2	44398,5	42320,6	41750,1	42625,7
Julio	42768,2	44375,5	42098,7	41798,9	42692,3
Agosto	42927,3	44295,4	41945,1	41887,2	42829,7
Septiembre	43129,9	44172,3	41790,8	41949,6	42933,7
Octubre	43348,5	44046,8	41609,4	42041,2	43069,7

November	43471,0	43932,7	41520,9	42139,7	43132,4
December	43633,3	43733,6	41502,6	42239,8	43206,1
MONTH	**2002**	**2003**	**2004**	**2005**	**2006**
January	43318,5	44631,3	45804,0	47155,6	48978,6
February	43451,8	44729,7	46008,8	47120,5	49150,8
March	43457,7	44948,8	46146,5	47180,8	49330,3
April	43619,9	44988,3	46243,7	47445,8	49313,9
May	43741,9	45086,9	46288,1	47625,0	49490,6
June	43815,6	45154,4	46481,7	47792,9	49639,4
July	43495,7	45316,6	46516,6	47945,9	
August	44013,5	45399,3	46657,0	48114,4	
September	44136,7	45506,1	46724,4	48347,0	
October	44249,3	45584,7	46782,9	48513,9	
November	44372,1	45663,7	46895,1	48676,1	
December	44499,2	45767,9	47019,2	48828,8	

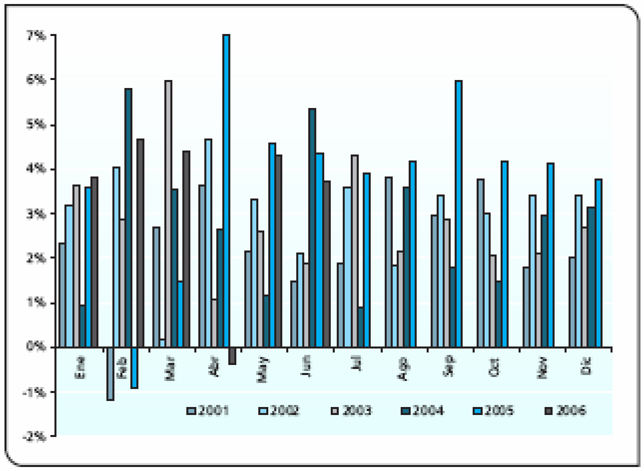
Table 2.1 Power Energy monthly demand (GWh)

In the last three years, December has been the month with higher energy demand, particularly in 2005, it reached 4,240.8 GWh/month, followed by May (4,110.8 GWh/month). February (4,708.7 GWh/month) and January (3,946.8 GWh/month) showed lower energy demand.



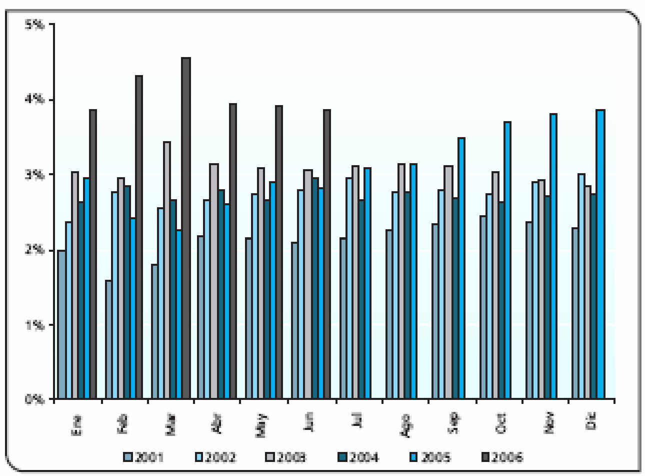
Graph 2-6 National Energy Demand (GWh/month) 2001-2005

In 2005, the energy monthly growth, with regard to same month of previous year, showed the highest monthly variation of recent years, reaching 7% and 6% in April and September, respectively.



Graph 2-7 Energy monthly variation with regard to same month of previous year

The second semester of 2005 was characterized by energy high growth rates accumulated in the last twelve months, significantly surpassing those from 2003. The growth rate for first semester of 2006, recorded even higher figures, reaching its maximum in March with 4, 6%.



Graph 2-8 Energy demand variation, last twelve months

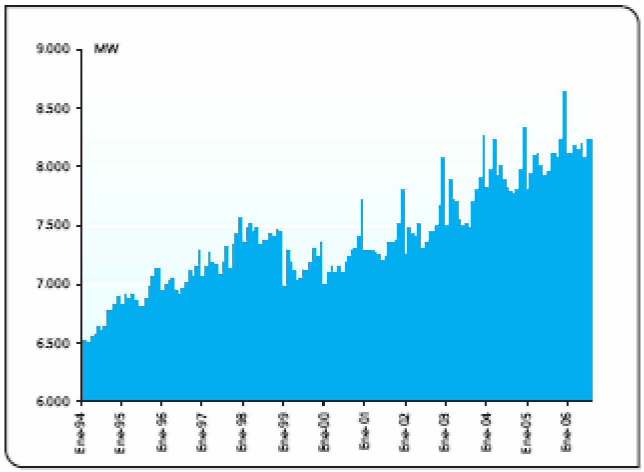
NATIONAL ENERGY DEMANDA (GWh/year) (accumulated last 12 months)						
MONTH	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
January	42320,0	43318,5	44631,3	45804,0	47155,6	48978,6
February	42280,5	43451,8	44729,7	46008,8	47120,5	49150,8
March	42376,5	43457,70	44948,8	46146,5	47180,8	49330,3
April	42498,4	43619,9	44988,3	46243,7	47445,8	49313,9
May	42575,0	43741,9	45086,9	46288,1	47625,0	49490,6
June	42625,7	43815,6	45154,4	46481,7	47792,9	49639,4
July	42692,3	43945,7	45316,6	46516,6	47945,9	
August	42829,7	44013,5	45399,3	46657,0	48114,4	
September	42933,7	44136,7	45506,1	46724,4	48347,0	
October	43069,7	44249,3	45584,7	46782,9	48513,9	
November	43132,4	44372,1	45663,7	46895,1	48676,1	

December	43206,1	44499,2	45767,9	47019,2	48828,8	

Table 2-2 Energy national demand (GWh - year)

2.3.1.2. Power

In 2005 the maximum power of National Interconnected System was 8,639 MW, recorded on December, month in which in general, in recent years[2], reached the annual power pick. This value is equivalent to the power pick increase of 3,7%, with regard to 2004.



Graph 2-9 NIS Monthly maximum power evolution (NIS)

MONTH	1995	1996	1997	1998	1999	2000
January	7130,0	7276,0	7559,0	7433,0	7345,0	7712,0
February	7126,0	7144,0	7425,0	7459,6	7234,0	7408,0
March	7065,0	7068,0	7327,0	7412,8	7291,0	7306,0
April	6980,0	7108,0	7127,0	7428,0	7176,0	7277,0
May	6885,0	7016,0	7318,0	7372,0	7116,0	7231,0
June	6804,0	6958,0	7173,0	7376,0	7118,0	7183,0
July	6798,0	6914,0	7084,0	7337,0	7053,0	7103,0
August	6869,0	6952,0	7167,0	7470,0	7030,0	7143,0
September	6920,0	7051,0	7175,0	7448,0	7107,0	7105,0
October	6871,0	7028,0	7271,0	7506,2	7178,0	7139,0
November	6905,0	6998,0	7150,0	7483,0	7278,0	7103,0
December	6811.0	6939,0	7067,0	7358,0	6980,0	6993,0
MONTH	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
January	7787,0	8078,0	8257,0	8332,0	8639,0	8226,0
February	7501,0	7654,0	7899,0	7969,0	8228,0	8225,0
March	7382,0	7492,0	7786,0	7797,0	8078,0	8074,0
April	7350,0	7433,0	7691,0	7761,0	8109,0	8196,0
May	7348,0	7437,0	7483,0	7773,0	8107,0	8140,0
June	7224,0	7352,0	7516,0	7813,0	7951,0	8165,0
July	7191,0	7296,0	7494,0	7883,0	7928,0	8104,0
August	7241,0	7513,0	7535,0	8010,0	7999,0	8113,0
September	7268,0	7404,0	7696,0	7925,0	8103,0	
October	7286,0	7417,0	7704,0	8221,0	8085,0	
November	7285,0	7482,0	7872,0	7970,0	7943,0	

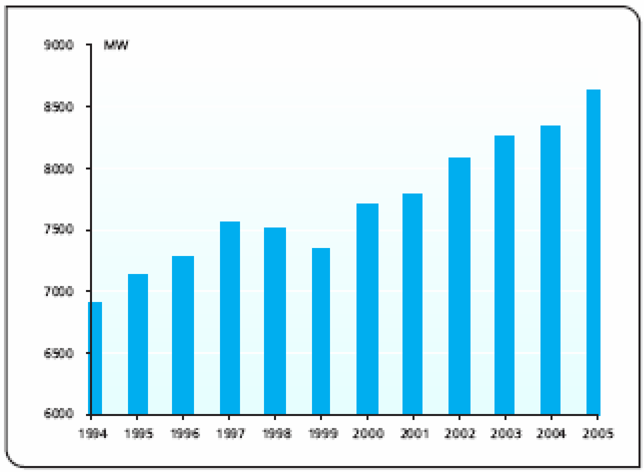
[2] Except in 1998, in which the maximum power was recorded in March

December	7282,0	7244,0	7484,0	7817,0	7797,0	

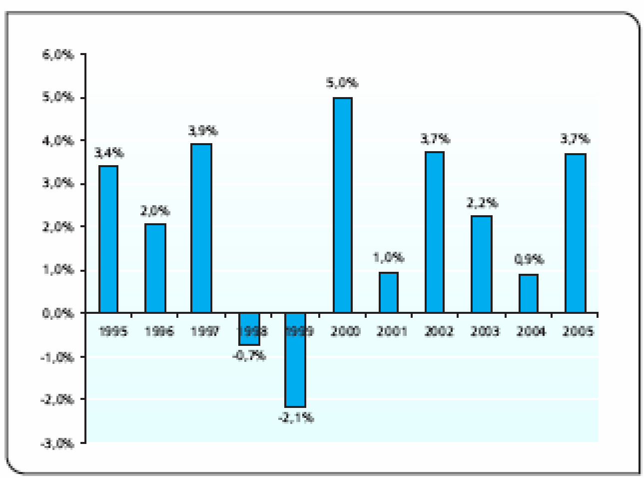
Table 2-3 NIS Monthly maximum power

In the years 1998 – 1999, the NIS maximum power showed -0,7% and -2,1% annual growth rates. Since 1999, NIS maximum power grows in a sustainable way, with an annual average rate of 2,7%.

Graph 2-10 shows the annual maximum power evolution and graph 2-11 annual maximum power percentage variation.

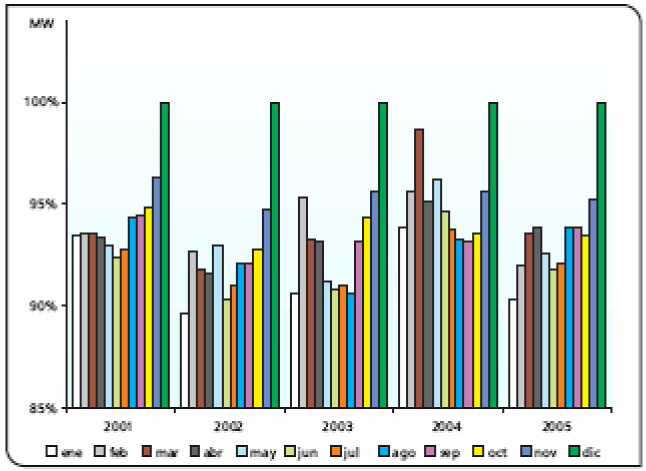


Graph 2-10 NIS annual maximum power (MW)



Graph 2-11 NIS annual maximum power variation

Between the years 2001 – 2005 the maximum power monthly distribution, is shown in graph 2-12. The minimum power values are around 90% of maximum power.



Graph 2-12 Maximum power monthly distribution

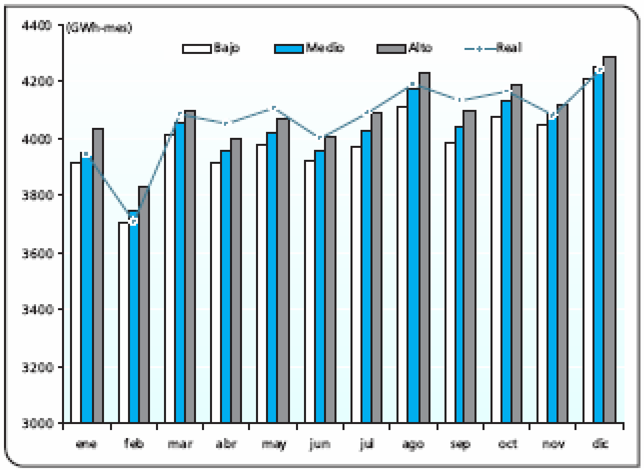
2.3.2. MODELS DEVIATION

2.3.2.1. Energy

In 2005, the energy real demand surpassed the UPME average scenario demand projection, throughout the year (Table 2-4). Seven out of the twelve months, the energy real demand was closer to the high scenario demand projection. During four months was close to the average scenario and only one month the energy real demand was closer to the low scenario.

MONTH	REAL	MEDIUM	LOW	HIGH	True deviationVs. MEDIUM SCENARIO (%)
January	3946,8	3955	3914	4041	-0,2%
February	3708,7	3748	3710	3829	-1,0%
March	4089,0	4060	4016	4104	0,7%
April	4056,0	3960	3918	4003	2,4%
May	4110,8	4025	3982	4069	2,1%
June	4003,6	3964	3922	4007	1,0%
July	4090,5	4033	3971	4095	1,4%
August	4195,7	4175	4117	4233	0,5%
September	4136,0	4043	3986	4100	2,3%
October	4167,1	4134	4075	4192	0,8%
November	4083,9	4094	4049	4124	-0,2%
December	4240,8	4258	4212	4287	-0,4%
TOTAL	**48828,8**	**48449**	**47872**	**49084**	**0,8%**

Table 2-4 Power energy national demand projection (GWh - month)



Graph 2-13 National power demand vs. 2005 demand projection scenarios

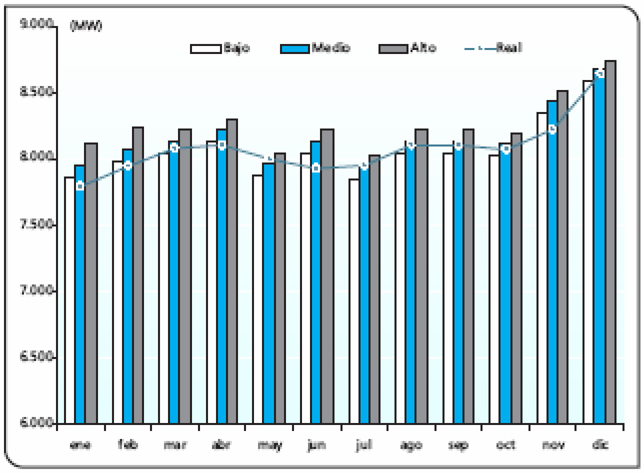
The difference in percentage terms, between the real energy demand values versus the medium scenario demand projection was 0.8%, in the annual accumulated, equivalent to 380 GWh/year. The monthly maximum difference between the real energy demand and the medium scenario was 2.4% in April, equivalent to 96 GWh/month, and the minimum was 0.2%, equivalent to – 17 GWh/month, in November. The monthly energy demand standard deviation with regard to medium scenario was 1.1%. The National Interconnected System maximum power in 2005 was inside the band comprised between the low and the medium scenario power forecast.

2.3.2.2. Power

The maximum monthly difference between the maximum power and medium scenario power forecast of was -2.5%, in November, when the current power was 211 MW below to what was estimated in such scenario. The smaller difference was recorded in July with 0.2%, equivalent to 14 MW. The power demand standard deviation in regard to the medium scenario was 1%.

MONTH	REAL	MEDIUM	LOW	HIGH	True deviationVs. SCENARIO
January	7797	7948	7866	8123	-1,9%
February	7943	8073	7990	8246	-1,6%
March	8085	8131	8043	8218	-0,6%
April	8103	8217	8129	8305	-1,4%
May	7999	7965	7880	8051	0,4
June	7928	8129	8042	8217	-2,5%
July	7951	7937	7852	8023	0,2
August	8107	8139	8050	8225	-0,4%
September	8109	8131	8044	8218	-0,3%
October	8078	8113	8028	8200	-0,4%
November	8228	8439	8348	8503	-2,5%
December	8639	8684	8591	8744	-0,5%

Table 2-5 Maximum power projection (MW)

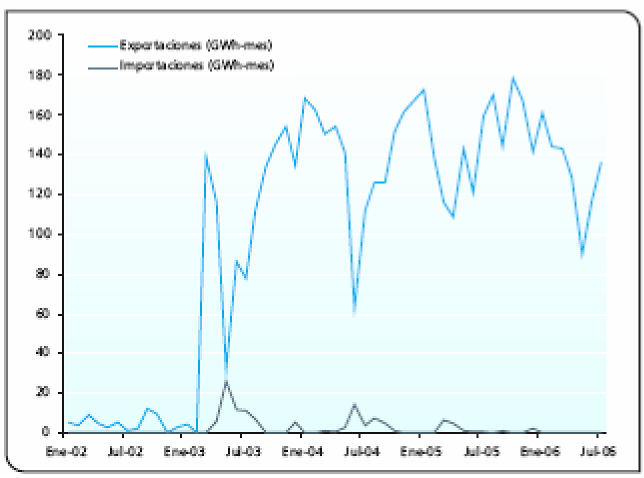


Graph 2-14 Maximum power (MW) vs. demand projection scenarios 2005

2.3.3. INTERNATIONAL INTERCONNECTIONS

2.3.3.1. Colombia - Ecuador

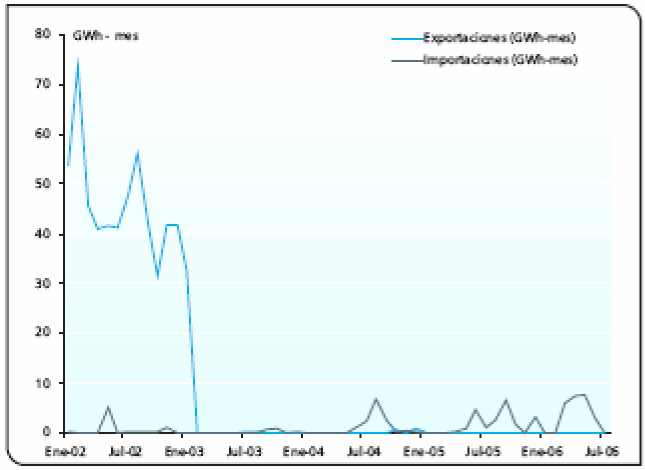
The energy interchange with Ecuador, are in force by the Short Term International Transactions mechanism (TIE), regulated mainly by CREG resolutions 004 of 2003 and 014 of 2004, whose main rules, were established in Decision CAN No. 536 of 2002. Graph 2-15 shows the energy interchange with Ecuador in GWh/month. In 2005, the total exported energy to Ecuador was 1,757.8 GWh, with an annual growth of 4.57%. The imports in 2005 from Ecuador reached 16.03 GWh, which represented a decrease of 54.16%, with regard to 2004 in which 34.97 GWh were imported.



Graph 2-15 Colombia – Ecuador energy Interchanges

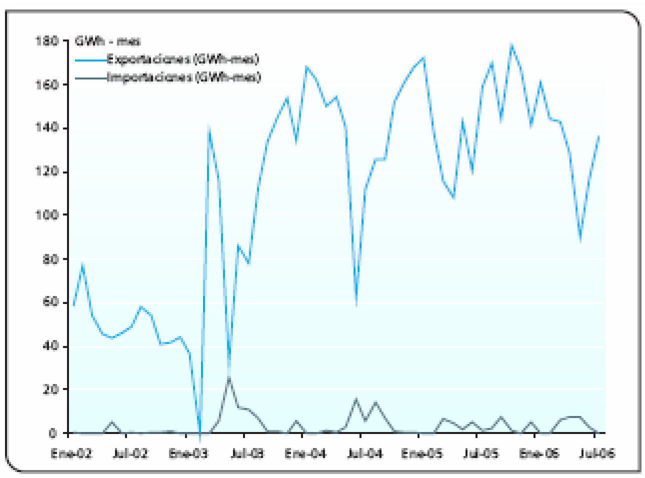
2.3.3.2. Colombia - Venezuela

Between Colombia and Venezuela there is not a TIE's scheme for energy interchange. Graph 2-16, shows the energy interchange with Venezuela from 2003, where Colombia has been basically an importer. In 2005, Colombia imported 20.92 GWh, with an increase of 55.42% with regard to 2004.



Graph 2-16 Colombia net energy interchanges

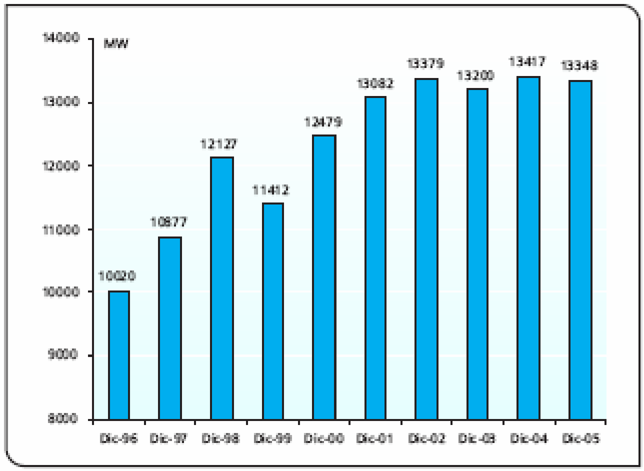
Graph 2-17, shows the Colombia net energy interchange with Ecuador and Venezuela together. One can see that the country is mainly an electric energy exporter. In 2005, Colombia exported 1,757.8 GWh with an annual increase of 4.5%, while the imports decreased 23.7%, going from 48.43 GWh in 2004 to 36.95 in 2005.



Graph 2-17 Colombia net energy interchanges

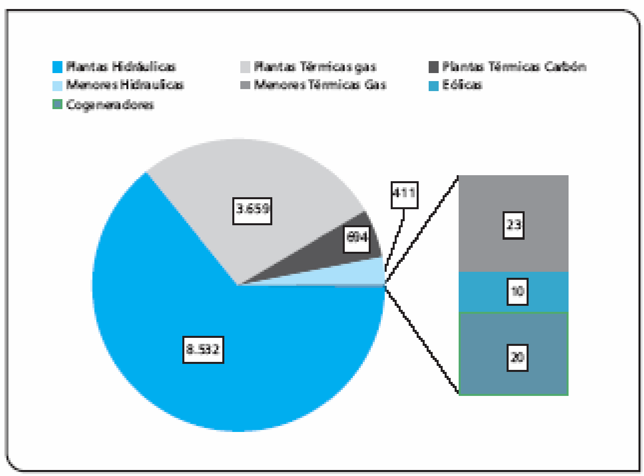
2.4. INSTALLED CAPACITY AND GENERATION

The effective net capacity installed as of December 31, 2005 was 13,348 MW (Graph 2-18 and Graph 2-19), with a net reduction of 69 MW with regard to the end of 2004. In the course of the year 2005, 57 new MW entered, with Termoyopal 1 with 19 MW, and 126 MW left, highlighting Barranca 3 with 63 MW.



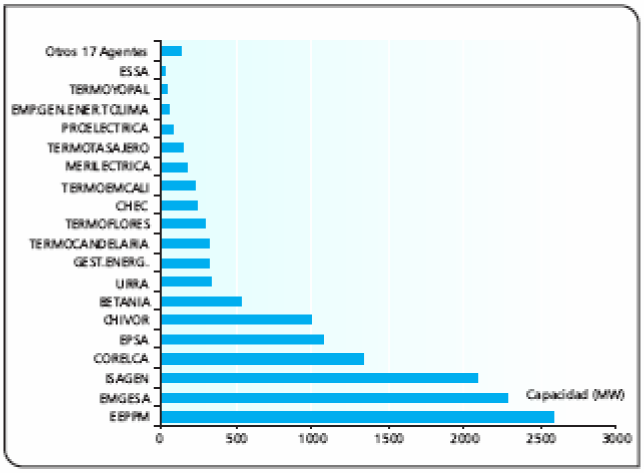
Graph 2-18 Net effective capacity at the end of the year (MW)

The central managed plants represent 96.53% (12,885 MW) and the non-central managed 3.47% (463.44 MW), From the total effective capacity at the end of 2005, the hydraulic plants constitute 63.92%, gas thermoelectric 27.41% and coal 5.2%. The minor hydraulic plants 3.08%, minor gas 0.17%. The co-generators represent 0.15% and eolic plant 0.07%.



Graph 2-19 Net effective capacity as of 31/12/2005: 13,348 MW (MW figures)

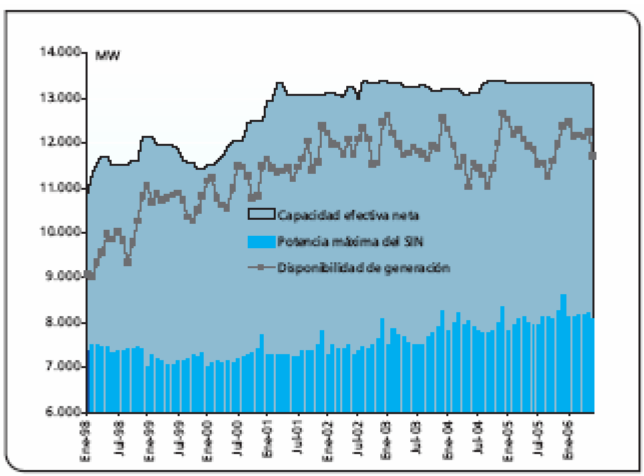
Graph 2-20 presents the percentage participation by agent in the installed capacity at the end of 2005. EEPPM, EMGESA and ISAGEN are the three agents with more participation, the effective capacity of these three agents together, represents 52.2% of total capacity.



Graph 2-20 Generation participation (%)

2.4.1. AVAILABILITY OF GENERATION PLANTS

The system's daily average availability in the year 2005 was 11,924 MW, the maximum was 12,842 MW, which occurred in January 7, and the minimum was 10,726 MW, occurred on September 24. Graph 2-21, represents, the net effective capacity and the generation availability, comparing it with the NIS maximum power at the end of each month, for the period between January 1998 and June 2006. In 2005, the maximum difference between the effective capacity and the generation availability was 2,116 MW, occurred in September, and the minimum difference was 822 MW in January. In average, this difference was 1,432 MW. On the other hand, the average difference between the monthly power availability and the NIS monthly maximum power, in 2005, was 3,844 MW.



Graph 2-21 Monthly effective capacity, availability and maximum power

2.4.2. AVAILABILITY OF HYDRO RESOURCES

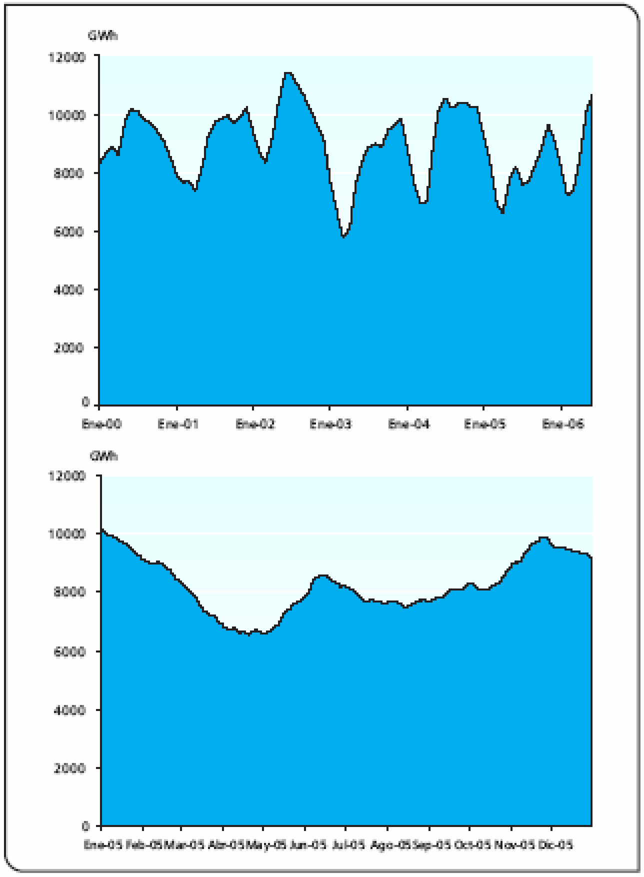
Graphs 2-6 shows monthly evolution of reservoir aggregated, in 2000-2006 period. The minimum figure was recorded in March 2003 with 46.53% and the largest in November 2004 with 87.43%. In 2005 the minimum was in March with 57.06% and the maximum in December with 84.41%, the annual average was 73.62%.

MONTH	2000	2001	2002	2003	2004	2005	2006
January	76,24	72,10	75,80	65,31	72,14	74,22	70,86
February	73,70	64,14	67,66	54,64	61,02	64,99	59,61
March	70,40	59,99	61,88	46,53	53,44	53,64	57,06
April	68,40	57,15	67,09	48,73	53,83	51,52	63,67
May	75,65	63,48	75,25	59,35	65,79	59,83	75,09
June	81,78	73,16	84,69	67,87	77,23	65,65	81,74
July	83,72	78,45	86,84	73,03	82,67	64,95	83,24
August	84,20	80,58	86,31	75,77	82,55	67,41	81,46
September	84,37	82,32	85,06	76,56	84,59	72,11	79,07
October	84,10	81,13	83,32	81,38	86,16	76,54	84,41
November	84,07	84,09	81,79	83,62	87,43	84,14	
December	79,37	83,82	76,70	80,71	82,47	79,56	
Yearly average	**78,83**	**73,37**	**77,70**	**67,79**	**74,11**	**67,88**	**73,62**

Table 2-6 National aggregated reservoir monthly evolution (%)

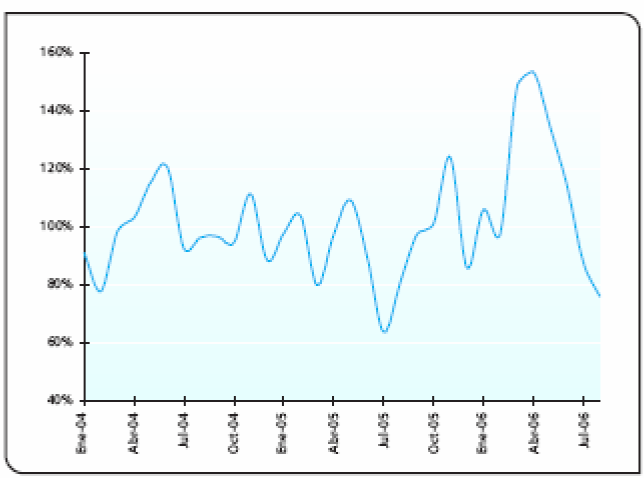
The total hydro contribution in 2005 was 44,934, 7.56% less than the one recorded the previous year. March presented the lower hydro contribution with 1,905 GWh/month, reaching 79.8% of the historical average, while May showed the maximum contribution with 5,618 GWh/month with 109.3% of the historical average.

The monthly reservoir supply in the period between January 2000 and June 2006 and its daily value in 2005 are shown in Graph 2-22. The maximum value in 2005 was 10,180.5 GWh in January 1st and the minimum was 6,548.6 GWh in April 24.



Graph 2-22 Reservoir supply

The monthly reservoir hydro contribution as a percentage of historical average, for the period between January 2004 and August 2006 is shown in Graph 2-23, in which, one can observe that in July 2005, the smallest value was recorded with 64.1% and the maximum in April 2006 with 153.2%. The hydro contribution percentage average value with regard to the historical average, for this period of time is 101.2% with a variance of 3.85%.

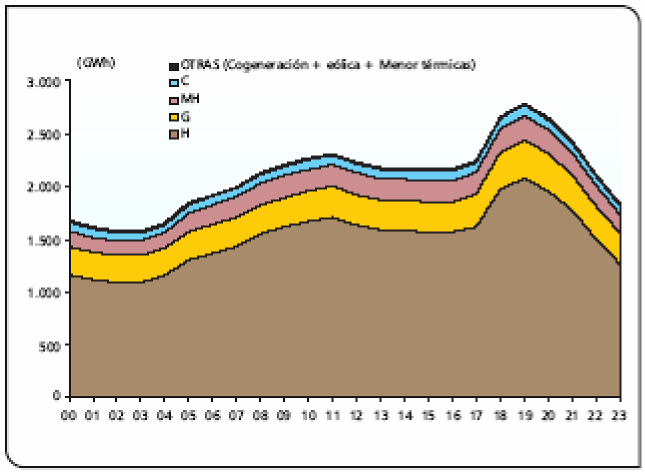


Graph 2-23 Monthly hydro contribution as a percentage of historical average

2.4.3. ELECTRIC ENERGY GENERATION IN COLOMBIA

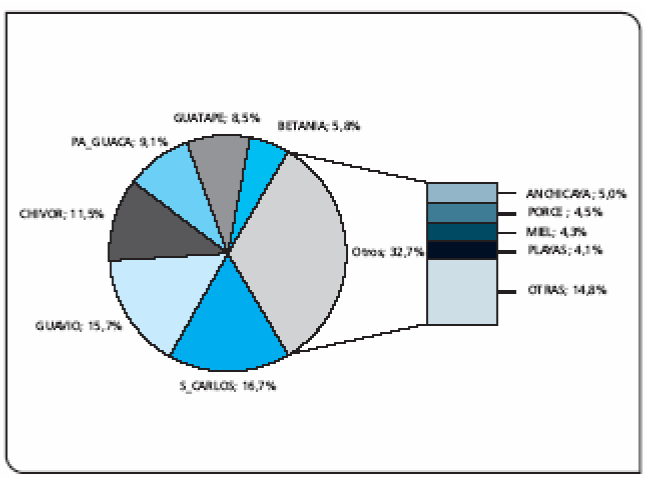
The NIS total generation in 2005, reached 50,415 GWh[3], exceeding in 3.7% the generation in 2004. The hydroelectric plants contributed with 72.2% of the total generation, and the minor hydroelectric 9.1%, which means that the hydro resource contributes with 82.2% of the total generation. The central managed plants which operate with natural gas, participated with 13.8% and the minor gas plants with 0.4%, therefore, the gas participation in the total generation was 14,2%, coal contributed with 4.1%. The co-generation and the eolic resource have smaller contribution, with 0.23% and 0.1% respectively.

The hourly participation per energy resource is shown in Graph 2-24.



Graph 2-24 Hourly participation per energy resource

The energy generated by the hydroelectric plants centrally dispatched was 36,376.3 GWh, in 2005. Graph 2-25 shows the percentage participation of main hydroelectric plants. San Carlos (6,065.34 GWh), Guavio (5,722.81 GWh) and Chivor (4,185.05 GWh).



Graph 2-25 Hydraulic plants generation participation

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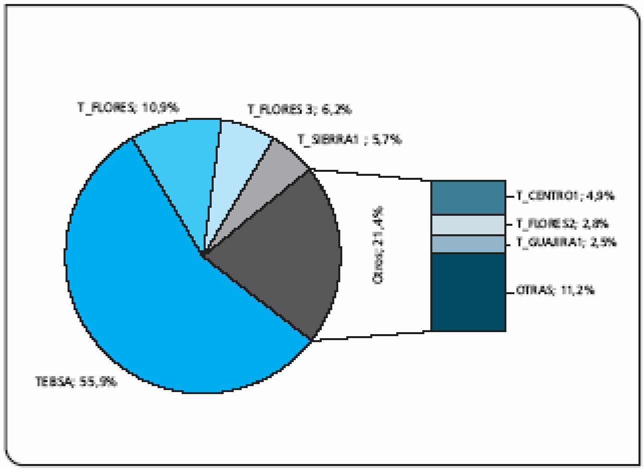
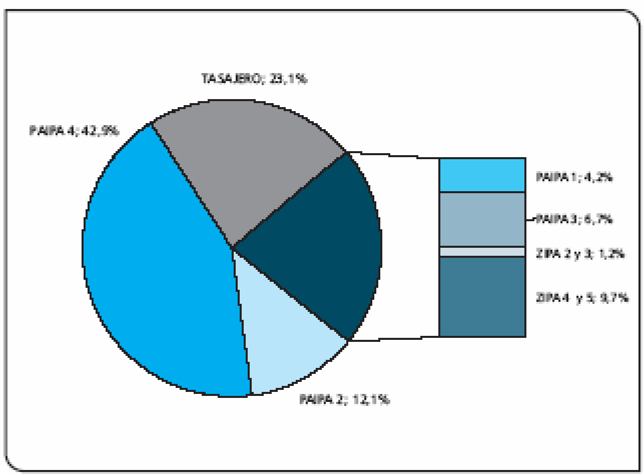
[3] Includes international connections

The gas generation plants was 6,980 GWh, being the second most used resource for the electric energy generation. TEBSA contributed with 4,024.87 GWh, followed by Termoflores with 786.12 GWh.



Graph 2-26 Gas plants generation participation

Coal is in third place as a resource for electric energy generation in the country, participating with 2,085.6 GWh in 2005. Paipa was the most used plant with 895.46 GWh, followed by Tasajero with 481.23 GWh.



Graph 2-27 Coal participation in generation

Graph 2-28 Country's main centrals

2.5. TRANSMISSION

NIS transmission activity is performed by seven agents, from whom four are exclusively transmitters: ISA, EEB, TRANSELCA and DISTASA. The remaining, EEPPM, ESSA and EPSA, perform the transmission activity along with other activities in the electric energy chain, it means, they are totally integrated.

The National Transmission System is comprised by 10,999 km of transmission lines that operate at 220 and 230 kV levels and by 1,449 km of lines at 500 kV. ISA is the owner of 72% of National Transmission System networks; Transelca owns 12.4%, EEPPM, 6.5%, EEB 5.6% and EPSA 2.2%.

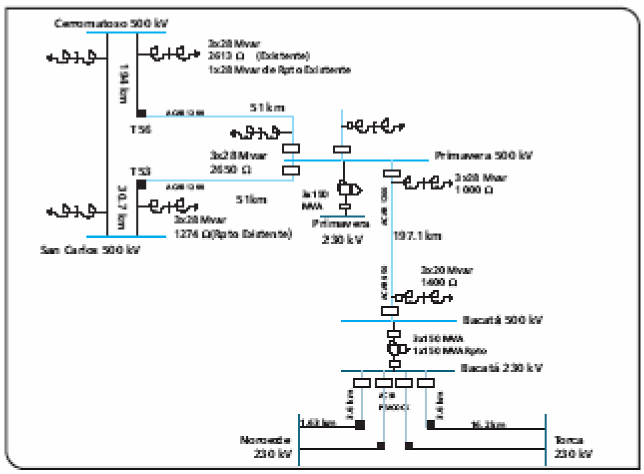
The transformation capacity at 500 kV level, is of 4,560 MVA and at 220 and 230 kV voltage levels, is of 12,638 MVA.

2.5.1. NATIONAL TRANSMISSION SYSTEM EXPANSION

In June 18, 2006, two capacity compensation banks, entered into commercial operation, each one with 75 MVAr, at 115 kV level, in Tunal Substation in Bogota, projects that were awarded through UPME-01-2004 public bid to Empresa de Energía de Bogota.

Currently the NTS expansion projects under execution are:

1. Transmission line at 500 kV, between Bacata and Primavera substations. This project was awarded to ISA, through UPME-01-2003 public bid. The project progress status as of October 2006 was 88.45%. It is estimated that it will be operational at the end of 2006.

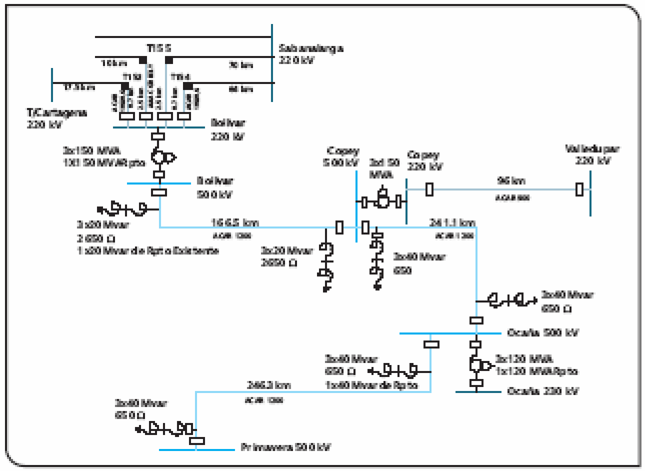


Graph 2-29 Primavera – Bacata project

The following are the characteristics of this project:

299.1 Km in 500 kV lines (single circuit)
7.2 Km in 230 kV lines (double circuit)
2 New substation at 500 kV (Primavera and Bacata)
1 New substation at 230 kV (Bacata)
1 Existent substation expansion at 230 kV (Primavera)

2 Transmission line at 500 kV that interconnects Primavera – Copey – Ocaña - Bolivar (Bolivar) substations. This project was awarded to ISA through UPME-02-2003 public bid. The project progress status as of October 2006 was 87.19%. It is estimated that it will operational in April 2007.

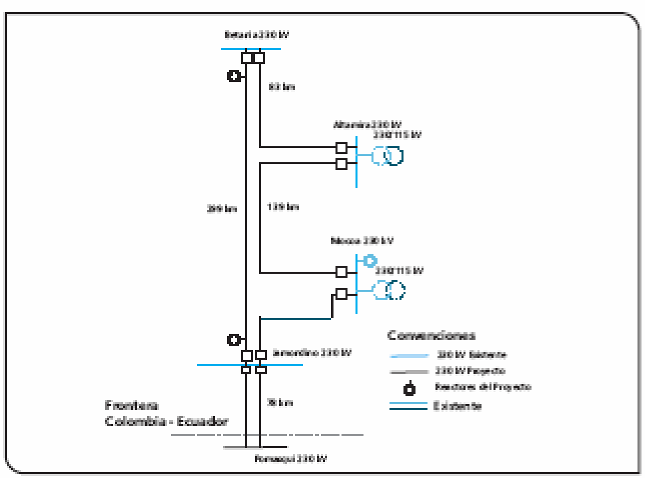


Graph 2-30 Primavera – Bolivar project

The following are the characteristics of this project:

654 Km in 500 kV lines (single circuit)
96 Km in lines 230 kV (single circuit)
3.2 Km in 230 kV lines (double circuit)
3 New substations at 500 kV (Bolivar, Copey and Ocaña)
1 New substation at 230 kV (Bolivar)
3 Existent substation expansions at 230 kV (Copey, Ocaña and Valledupar)

3. Transmission line at 230 double circuit Betania - Altamira – Mocoa – Jamondino – limits with Ecuador and associated substations. Project awarded through UPME-01-2005 public bid to EEB. The project status as of October 2006 was 46.2% and it is estimated that will be operational in June 2007.

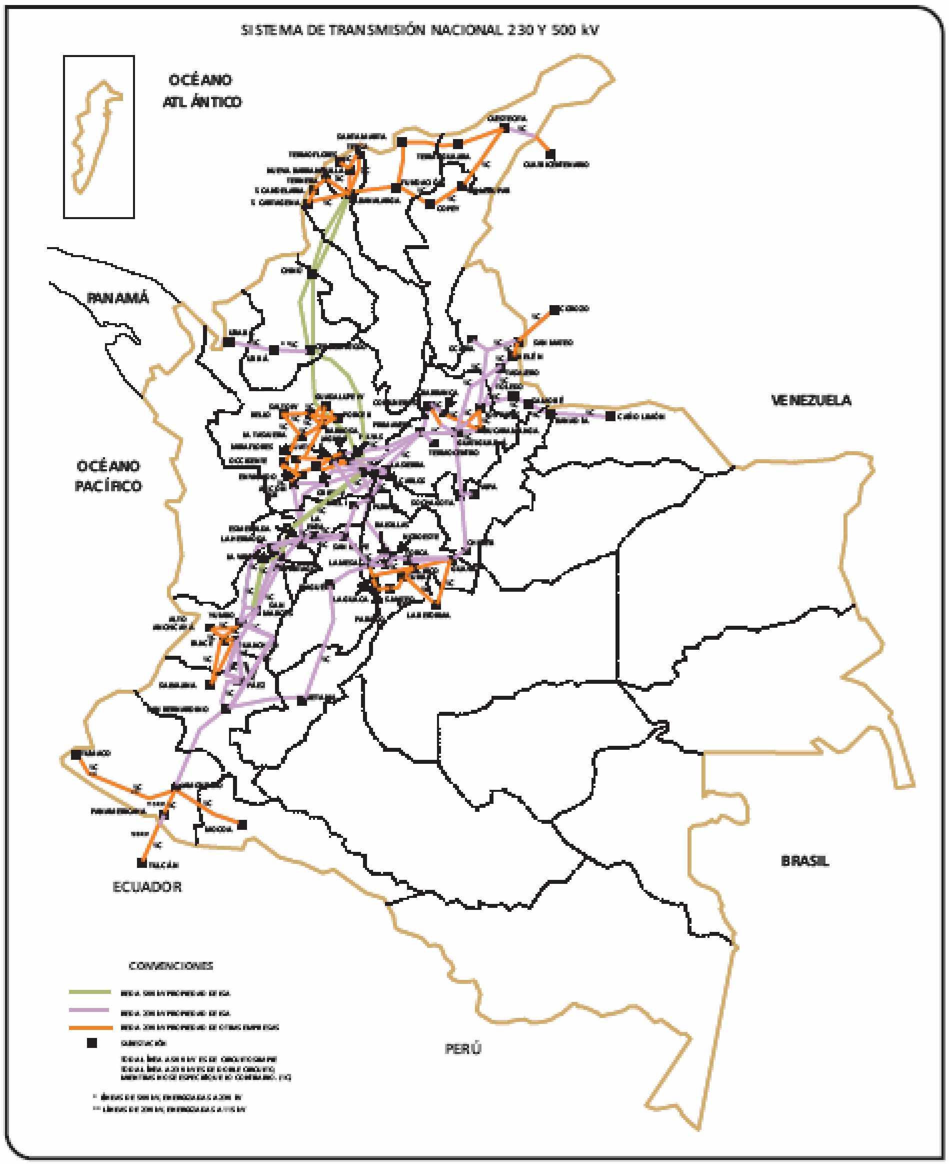


Graph 2-31 Betania - Altamira – Mocoa – Jamondino – limits with Ecuador

The following are the characteristics of this project:

299 Km in 230 kV lines (double circuit)

79 Km in 230 kV lines (single circuit)
2 New substations at 230 kV (Altamira and Mocoa)
2 Substation expansions at 230 kV
3 Compensation banks at 25 MVAr, each at 230 kV

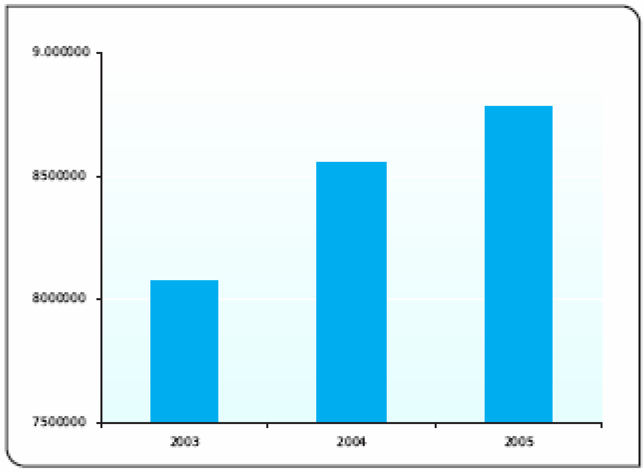


Graph 2-32 National Transmission System

2.6. DISTRIBUTION AND SELLING

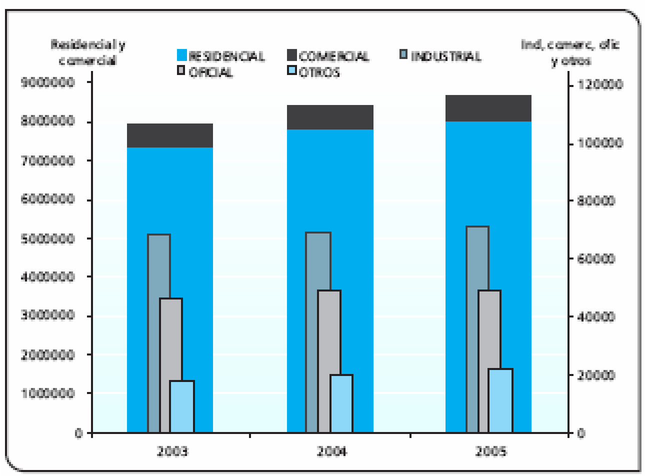
Currently, there are 28 pure dealers. The simultaneous distribution and sales activities are performed by 22 companies. 8 companies vertically integrate the generation, distribution and selling activities, and 3 companies remain with totally integrated activities.

The total number of users, located at the NIS in 2005 was 8,779,000, with an increase of 2.6% with regard to the previous year.



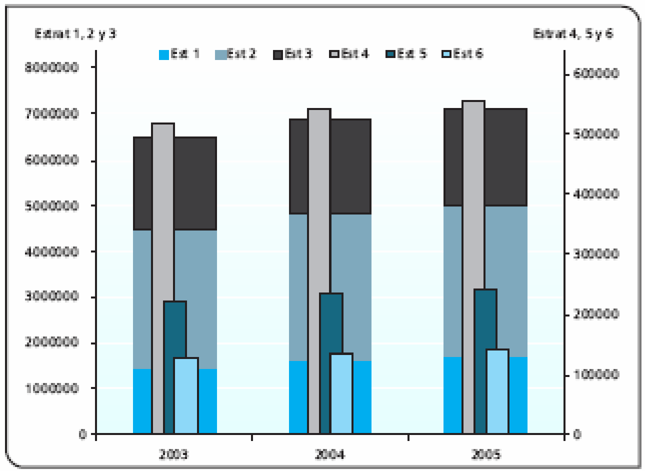
Graph 2-33 NIS total number of users

The 91.3% of total users belongs to the residential sector, the commercial and industrial sectors, participate with 7.03% and 0.81% respectively.



Graph 2-34 Number of users by sector

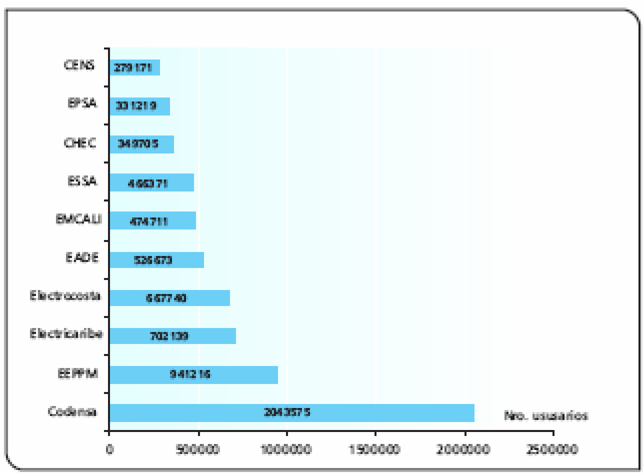
Number of users by sector



Graph 2-35 Residential users per socioeconomic level

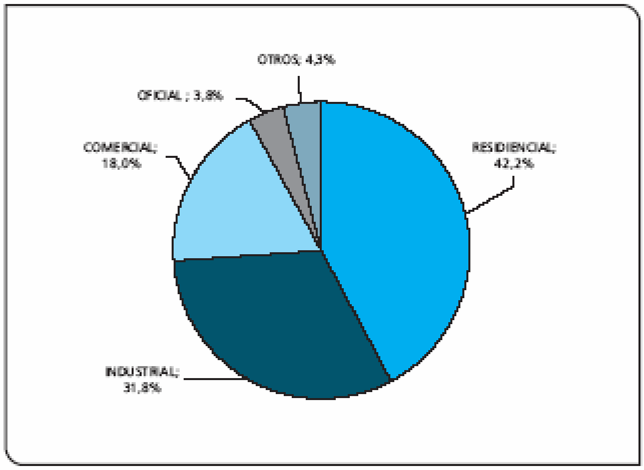
At the end of 2005, there were 3,960 non regulated users, from which 2,266 belonged to the industrial sector, 1,325 to the business, 144 to the government and 225 to other types of loads.

Graph 2-36 shows the ten first companies with the largest number of users. Codensa serves 23.26% of total users and EPM 10.7%.



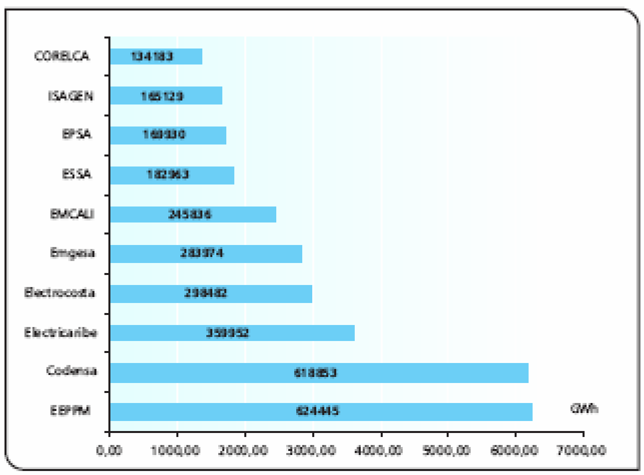
Graph 2-36 Companies with the largest number of users

The electric energy consumption of connected users to NIS, recorded an increase of 7.9% in the 2004 – 2005 period, reaching 39.65 GWh.



Graph 2-37 Electric Energy consumption by sector

Graph 2-38 shows the first ten companies with greater demand served. EEPPM serves 15.7% of total consumption and Codensa 15.6%.



Graph 2-38 Companies with greater demand served

2.7. MODIFICATIONS TO 2005 – 2006 REGULATORY SCHEME

Following there are the most outstanding modifications to regulatory scheme between June 2205 and November 9, 2006, with regard to Reference Expansion Plan.

2.7.1. UPME PUBLIC BIDS

With CREG Resolution 071, 2005, The Empresa de Energía de Bogotá S.A. E.S.P, the monthly expected income, for the design, supply, construction, assembly, operation and maintenance of two compensation banks with 75 MVar capacity in the Tunal Substation in Bogotá, at 115 kV level, is established.

With CREG Resolution 077, 2005, The Empresa de Energía de Bogotá S.A. E.S.P. the annual expected income, for the design, supply, construction, assembly, operation and maintenance of transmission line at 230 kV, double circuit, Betania - Altamira - Mocoa – Pasto (Jamondino) – Frontier and associated works, is established.

2.7.2. LEVEL 4 VOLTAGE, USE OF ASSETS

With CREG Resolution 085, 2005, the ELECTRIFICADORA DEL META S.A. E.S.P The Annual Cost for use of assets of level 4 Voltage, of 40 MVA La Reforma line – Ocoa at 115 kV and Ocoa substation 115/34.5/13.2 kV, to become operational, was updated.

With CREG Resolution 093, 2005, the EMPRESA DE ENERGIA DE BOYACA S.A. E.S.P., the Connection Assets Annual Cost for the coming into operation of 180 MVA Paipa 230/115 kV Substation, was updated.

With CREG Resolution 095, 2005, the Regional Transmission Systems (RTS) Voltage 4 level, Annual Cost for use of Assets, and the Local Distribution System (LDS) Maximum Charges of Voltage 3, 2 and 1 levels, operated by EMPRESA DE ENERGIA ELECTRICA DEL DEPARTAMENTO DEL GUAVIARE S.A. E.S.P., was approved.

With CREG Resolution 112, 2005, the Annual Cost of assests connected to NIS, and approved to ELECTRIFICADORA DEL CARIBE S.A. E.S.P., for Valledupar transformer 01 45/30/15 MVA 220/34.5/13.8 kV and its associated modules, to be operational, was updated.

With CREG Resolution 113 of 2005, the Annual Cost for the use of Assets of level 4 Voltage and the DISTRIBUIDORA DEL PACIFICO S.A. E.S.P. Connection Cost, for Virginia – Cértegui 115 kV, project operation with other associated assets, was updated.

With CREG Resolution 122 of 2006, the Annual Cost for use of assets of level 4 Voltage, approved to CONDENSA S.A. E.S.P., for Substation Chia's start up, was updated.

With CREG Resolution 010 of 2006, the Annual Cost of Connected Assets to NIS, operated by ELECTRIFICADORA DE SANTANDER S.A. E.S.P., for the start up of Termobarranca 90 MVA second transformer Substation, was updated.

2.7.3. GENERATION

With CREG Resolution 084 of 2005, some dispositions established in CREG Resolution 034 of 2001, in regard to the use of alternative fuels, were modified.

With CREG Resolution 087 of 2005, some dispositions established in CREG Resolution 025 of 1995, with regard to non-availability of historical indexes, were modified.

With CREG Resolution 088 of 2005, CREG Resolution 023 of 2000, Paragraph 2 of Article 3, with regard to the selling of natural gas by producers, determines that the regulated prices, established in CREG Resolution 023 of 2000, will be effective for 5 years, is derogated.

With CREG Resolution 101 of 2005, CREG Resolution 116 of 1996, Annex 4, A-4.2 format "Thermoelectric Plants or Units", used for reporting information in regard to parameters for the Capacity Charges calculation, was modified.

With CREG Resolution 108 of 2005, some dispositions established in CREG Resolution 084 of 2005, with regard to natural gas and alternative fuel daily consumption declaration, were modified.

With CREG Resolution 119 of 2005, CREG Resolution 023 of 2000, Article 3, with regard to natural gas Maximum Regulated Price, was replaced.

With CREG Resolution 125 of 2005, some dispositions that regulate the report of information, by the generation agents with regard to fuel contracts, to determine the firm energy to be used in the Capacity Charges allocation, were complemented.

With CREG Resolution 070, some CREG Resolution 023 of 2000, dispositions for the natural gas supply contracts, are derogated and some others are established.

With CREG Resolution 071 and modifying 078 – 079 - 086 and 094 of 2006, the methodology for Reliability Charges retribution in the Energy Wholesaler Market, is adopted

2.7.4. OTHER RELATED CREG RESOLUTIONS

With CREG Resolution 078 of 2005, the Operation Regulation, with regard to the activities assigned to the company established by Decree 848 of 2005 (XM), the National Dispatch Center (NDC), to the Commercial Trade System Administrator (CTSA), and to the Accounts Liquidator and Administrator (ALA), of the charges for used of National Interconnected System, networks, was modified.

With CREG Resolution 001 of 2006, some modifications to calculation method of market share of electric energy companies, are done, and some other dispositions are established.

With CREG Resolutions 019 and modifying 026 -042 and 087 of 2006, some dispositions with regard to guaranties and advance payments by the participant agents in the wholesaler Energy Market, are adopted.

With CREG Resolution 036 of 2006, wholesaler additional costs calculation, included in the cost for rendering the service, is modified.

3 ENERGY AND ELECTRIC POWER DEMAND PROJECTIONS

3. ENERGY AND ELECTRIC POWER DEMAND PROJECTIONS

3.1. METHODOLOGY

To obtain the energy and electric demand projections, a combination of models are used that allow having a better approximation of what could happen in the 2006-2020 Plan evaluation lapse of time. For the purpose of projection methodology, the following horizons have been determined: short term (2006), and long term 2007-2020.

The long term electric energy, demand projection methodology, considers that domestic energy demand is equal to distributor's sales, plus the special industrial loads demand, (very large consumers) and the loss of energy due to transmission and distributions.

Electric energy demand = Sales + Special loads + loses

In the first methodology stage, the energy demand and the series of annual sales of energy behavior, is analyzed with regard to different variables such as Gross Domestic Product – GDP Products by sector GDPsec, aggregated value of the economy, final consumption of economic sectors, prices behavior, population growth, etc., in order to identify explanatory variables, that allow to estimate the sales and energy demand evolution, through econometric models. This analysis is done for the total sales as well as for each of the sectors organized by residential, business, industrial and other.

From the econometric models, the annual domestic electric energy sales are obtained, to which it is necessary to add, in an exogenous way, the special industrial loads demand, such as: OXI, Cerrejón and Cerromatoso, and the energy losses at the Distribution, Sub transmission and Transmission levels. As a result, the Annual Domestic Demand is obtained.

In the second stage, an electric energy demand monthly analysis is performed, using the time series method, with short term results, which then is taken to an annual scale, which in turn is consolidated with the model results in the first part.

Up to this point, the electric energy annual demand projections, for the forecast horizon, have been obtained. Then the monthly distribution of each year is obtained, using the short term model results, as well as the percentage distribution structure of each month, with regard to the year that has presented the historical data for 1999-2005 period.

Some exogenous elements such as climate effects, leap years[4] effects, etc., are added to the monthly forecast, to obtain the final projection in the defined horizon.

[4] The day of the week for January 29, should be considered, because the demand in a Sunday is not the same as the one in a working day.

The power is obtained from the monthly electric energy demand, to which the monthly load factor should be applied. From the power monthly results, the maximum value is selected for each year, which will be the annual domestic maximum power.

In the monthly load measuring factor, three scenarios were executed, using the 2005 behavior and its evolution, according to what happened in 2006.

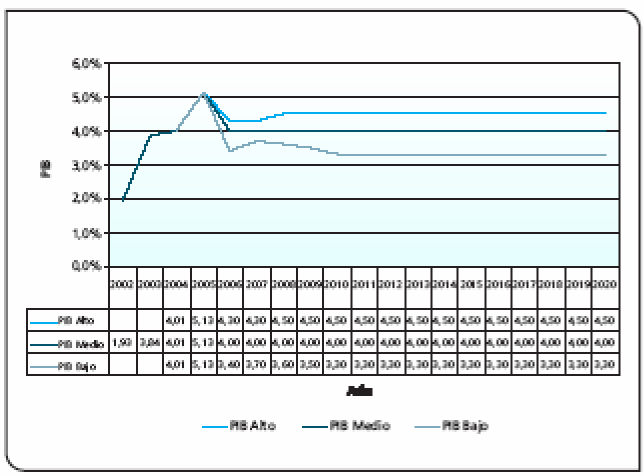
Finally, for the projections, the perspective of the National Interconnected Operator System, is taken into consideration, upon the possible demand evolution, for which the XM contribution is available.

3.2. MARCH 2006 ASSUMPTIONS

The assumptions used in these projects are the following:

3.2.1. GROSS DOMESTIC PRODUCT

The assumptions used to build the growth scenarios of economic variable, Gross Domestic Product- GDP, are provided by National Planning Department (NPD) effective as of March. Graph 3-1, shows these scenarios.



Graph 3-1 GDP Growth scenarios

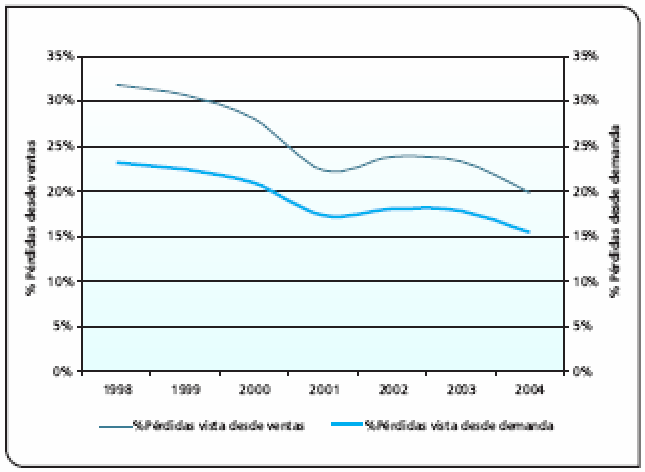
3.2.2. ELECTRIC ENERGY LOSSES IN THE NTS

The electric energy losses, associated to the National Transmission System (Seen from the low voltage side), maintain its historic behavior, reaching in average, 2.5% of total electric energy sales. This figure is constant throughout the projection horizon.

3.2.3. ELECTRIC ENERGY LOSSES IN DISTRIBUTION

The electric energy losses in the distribution system, correspond to the technical and non-technical losses aggregate that are observed in these voltage levels.

The losses scenario, adjusted for this review, is obtained from the updating of sales historical series, with what happened in the last years and the losses behavior scenario observed. In graph 3-2, one can see the losses behavior, observed from the sales and the demand.



Graph 3-2 Electric Energy losses historical behavior

Table 3-1 shows the losses scenarios assumed for the forecast horizon, from the sales point of view.

MONTH	2000	2001	2002	2003	2004	2005	2006
January	76,24	72,10	75,80	65,31	72,14	74,22	70,86
February	73,70	64,14	67,66	54,64	61,02	64,99	59,61
March	70,40	59,99	61,88	46,53	53,44	53,64	57,06
April	68,40	57,15	67,09	48,73	53,83	51,52	63,67
May	75,65	63,48	75,25	59,35	65,79	59,83	75,09
June	81,78	73,16	84,69	67,87	77,23	65,65	81,74
July	83,72	78,45	86,84	73,03	82,67	64,95	83,24
August	84,20	80,58	86,31	75,77	82,55	67,41	81,46
September	84,37	82,32	85,06	76,56	84,59	72,11	79,07
October	84,10	81,13	83,32	81,38	86,16	76,54	84,41
November	84,07	84,09	81,79	83,62	87,43	84,14	
December	79,37	83,82	76,70	80,71	82,47	79,56	
Yearly average	**78,83**	**73,37**	**77,70**	**67,79**	**74,11**	**67,88**	**73,62**

Table 3-1 Distribution System's losses percentage scenarios

The value of losses for the remaining forecast horizon is the same as that for 2012.

For the high scenario, it was assumed that the losses could increase again according to the historical behavior, to then, lineally decrease, up to the fixed level in 2012.

These losses percentages in the distribution system are applied on the sales value showed in the models. For each year the losses difference between consecutive years is assumed as a recuperated demand, which is then, part of the sales with one year delay. In this way, is been considering that the distribution system losses recuperation, is made mainly, upon the non-technical losses and the effect occurs upon the following year sales.

3.2.4. SPECIAL LOADS

In this projection, the special loads demand, are adjusted according to the agent's perspective and the possibility of satisfying the demand with the infrastructure available, taking into account, the required time to dispose of a new demand, if it is necessary. In table 3-2, the demand for the forecast horizon is shown.

YEAR	HIGH	MEDIUM	LOW
2006	2166,00	2056,00	2036,00
2007	2166,00	2074,00	2036,00
2008	2370,87	2074,00	2036,00
2009	2405,85	2278,87	2036,00
2010	2409,33	2313,85	2036,00
2011	2415,59	2317,33	2036,00
2012	2321,66	2323,59	2036,00
2013	2226,72	2229,66	2036,00
2014	2166,41	2134,72	2036,00
2015	2056,44	2074,41	2066,41
2016	1948,82	1964,44	1956,44
2017	1776,76	1856,82	1848,82
2018	1657,07	1684,76	1676,76
2019	1657,07	1565,07	1557,07
2020	1657,07	1565,07	1557,07

Table 3-2 Energy demand scenarios per special loads in GWh/year

3.3. ENERGY AND ELECTRIC POWER DEMAND PROJECTION SCENARIOS

The current review results, are as follows:

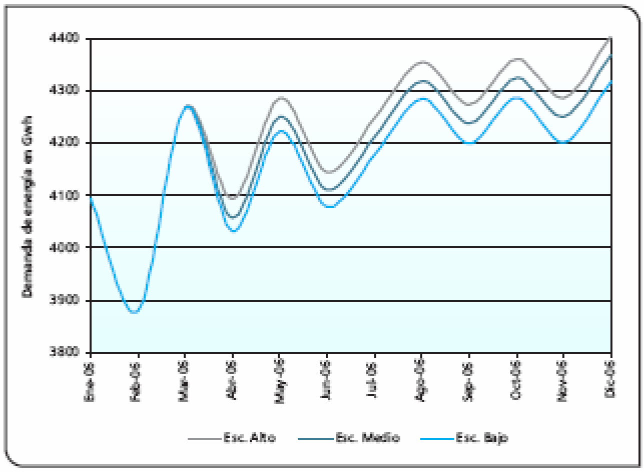
3.3.1. ELECTRIC ENERGY DEMAND

The NIS domestic electric energy demand projections, for the forecast horizon are shown in table 3-3.

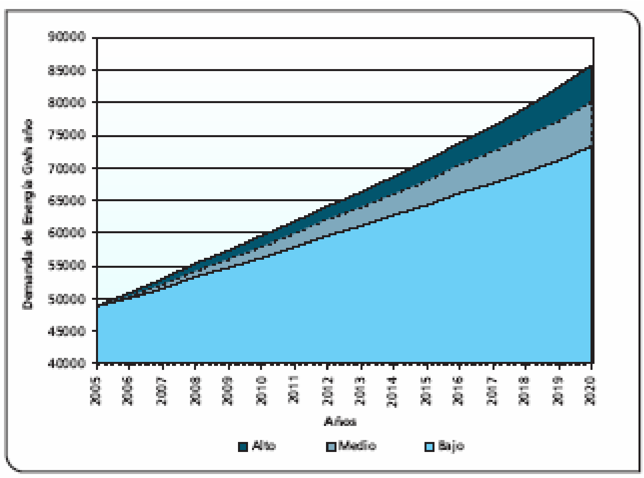
GWh/yr.	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW
2005	48829	48829	48829			
2006	50819	50393	50003	4,10%	3,20%	2,40%
2007	53007	52190	51610	4,30%	3,60%	3,20%
2008	55457	54160	53358	4,60%	3,80%	3,40%
2009	57424	56069	54790	3,50%	3,50%	2,70%
2010	59534	57970	56283	3,70%	3,40%	2,70%
2011	61747	59922	57832	3,70%	3,40%	2,80%
2012	64106	62106	59584	3,80%	3,60%	3,00%
2013	66186	63912	61033	3,20%	2,90%	2,40%
2014	68615	65930	62668	3,70%	3,20%	2,70%
2015	71022	67987	64313	3,50%	3,10%	2,60%
2016	73850	70377	66161	4,00%	3,50%	2,90%
2017	76333	72461	67670	3,40%	3,00%	2,30%
2018	79167	74746	69345	3,70%	3,20%	2,50%
2019	82230	77161	71114	3,90%	3,20%	2,60%
2020	85613	79979	73248	4,10%	3,70%	3,00%

Table 3-3 Projection scenarios of electric energy Total Domestic Demand in GWh/year

In Graph 3-3, the projection tunnel for the electric energy monthly domestic demand for 2006 is shown. Graph 3-4 shows the projection tunnel for the projection horizon.



Graph 3-3 Projection tunnel for 2006 electric energy domestic demand



Graph 3-4 Projection tunnel for 2006-2020 electric energy domestic demand

3.3.2. ELECTRIC POWER DEMAND

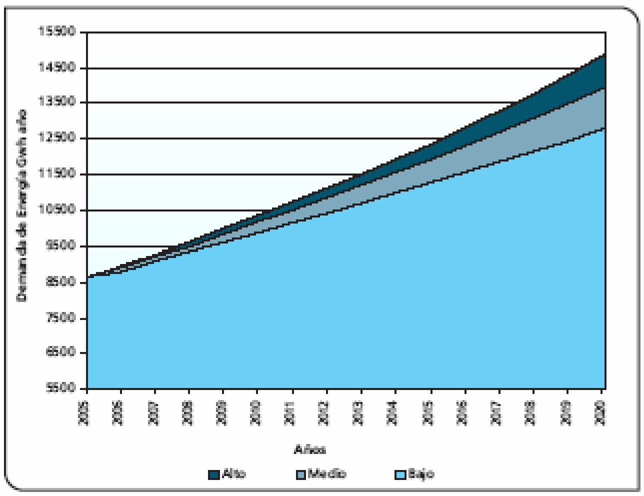
Table 3-4 shows the annual maximum power demand for the projection horizon.

MW	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW
2005	8639	8639	8639			
2006	9022	8895	8791	4,43%	2,96%	1,76%
2007	9362	9216	9111	3,77%	3,61%	3,64%
2008	9725	9495	9351	3,88%	3,03%	2,64%
2009	10091	9850	9623	3,76%	3,74%	2,91%
2010	10462	10184	9885	3,67%	3,39%	2,73%
2011	10844	10520	10151	3,65%	3,30%	2,69%
2012	11228	10874	10429	3,55%	3,36%	2,74%

2013	11616	11214	10706	3,45%	3,12%	2,66%
2014	12042	11568	10993	3,67%	3,16%	2,68%
2015	12456	11921	11274	3,44%	3,05%	2,56%
2016	12919	12307	11564	3,71%	3,24%	2,58%
2017	13379	12697	11855	3,56%	3,17%	2,51%
2018	13876	13098	12148	3,71%	3,15%	2,48%
2019	14403	13512	12450	3,80%	3,16%	2,48%
2020	14960	13970	12788	3,87%	3,39%	2,71%

Table 3-4 Project scenarios for domestic power demand

In graph 3-5, one can see, the projection tunnel for the total domestic power demand, in the projection horizon.



Graph 3-5 Projection tunnel for the domestic power demand 2006-2020

3.3.3. ELECTRIC ENERGY DEMAND BY SECTORS

Based on the electricity consumption projection by sector, obtained for this projection, the final domestic demand was disaggregated, for each of the modeled sectors, in order to get it, it was assumed that the recuperated demand, is proportionally distributed among the residential, and business sectors, and in addition, the special loads demand, was added to industrial sector, The demand for each sector, includes losses.

GWh	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW
2005	19722	19722	19722			
2006	20287	20250	20235	2,86%	2,68%	2,60%
2007	20868	20703	20621	2,87%	2,24%	1,90%
2008	21442	21215	21099	2,75%	2,47%	2,32%
2009	21886	21610	21445	2,07%	1,86%	1,64%
2010	22394	22068	21811	2,32%	2,12%	1,71%
2011	22911	22532	22157	2,31%	2,10%	1,59%
2012	23499	23058	22562	2,57%	2,34%	1,83%
2013	23949	23477	22847	1,92%	1,82%	1,26%
2014	24525	23964	23191	2,40%	2,08%	1,51%
2015	25115	24460	23523	2,41%	2,07%	1,43%
2016	25778	25027	23950	2,64%	2,32%	1,81%
2017	26318	25463	24237	2,10%	1,74%	1,20%
2018	26935	25971	24592	2,34%	2,00%	1,47%

2019	27562	26485	24946	2,33%	1,98%	1,44%
2020	28267	27071	25368	2,56%	2,21%	1,69%

Table 3-5 Residential Demand

GWh	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW
2005	8078	8054	8022			
2006	8623	8569	8521	6,75%	6,40%	6,22%
2007	9208	9081	8978	6,78%	5,97%	5,36%
2008	9792	9627	9487	6,35%	6,02%	5,66%
2009	10327	10130	9948	5,47%	5,22%	4,86%
2010	10875	10645	10431	5,30%	5,08%	4,85%
2011	11476	11208	10941	5,52%	5,29%	4,89%
2012	12140	11827	11503	5,78%	5,52%	5,13%
2013	12738	12396	12010	4,93%	4,81%	4,41%
2014	13406	13004	12555	5,24%	4,91%	4,54%
2015	14037	13574	13068	4,71%	4,39%	4,08%
2016	14885	14345	13752	6,04%	5,68%	5,23%
2017	15701	15074	14384	5,48%	5,08%	4,60%
2018	16602	15880	15084	5,74%	5,35%	4,87%
2019	17551	16726	15814	5,72%	5,33%	4,84%
2020	18597	17658	16620	5,96%	5,57%	5,10%

Table 3-6 Business Demand

GWh	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW
2005	17546	17539	17535			
2006	18371	18106	17837	4,70%	3,23%	1,72%
2007	19336	18936	18639	5,25%	4,58%	4,50%
2008	20585	19834	19425	6,46%	4,74%	4,21%
2009	21547	20853	20095	4,67%	5,14%	3,45%
2010	22566	21781	20778	4,73%	4,45%	3,40%
2011	23626	22706	21516	4,70%	4,25%	3,55%
2012	24688	23734	22340	4,49%	4,53%	3,83%
2013	25689	24562	23057	4,06%	3,49%	3,21%
2014	26835	25484	23856	4,46%	3,76%	3,47%
2015	27980	26476	24714	4,27%	3,89%	3,60%
2016	29247	27521	25503	4,53%	3,95%	3,19%
2017	30345	28452	26163	3,76%	3,38%	2,59%
2018	31621	29426	26848	4,21%	3,42%	2,62%
2019	33068	30486	27600	4,58%	3,60%	2,80%
2020	34652	31781	28569	4,79%	4,25%	3,51%

Table 3-7 Industrial Demand

GWh	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW
2005	3483	3448	3414			
2006	3539	3468	3410	1,61%	0,57%	-0,15%
2007	3596	3471	3372	1,61%	0,08%	-1,10%
2008	3638	3484	3349	1,17%	0,37%	-0,69%
2009	3664	3476	3302	0,72%	-0,23%	-1,39%
2010	3699	3477	3263	0,97%	0,02%	-1,18%
2011	3735	3477	3218	0,95%	0,01%	-1,40%
2012	3780	3487	3179	1,21%	0,29%	-1,20%
2013	3810	3478	3119	0,79%	-0,27%	-1,89%
2014	3850	3477	3065	1,05%	-0,02%	-1,73%
2015	3890	3476	3008	1,05%	-0,02%	-1,87%

2016	3940	3484	2957	1,28%	0,22%	-1,69%
2017	3970	3472	2886	0,75%	-0,35%	-2,39%
2018	4009	3468	2821	0,99%	-0,09%	2,25%
2019	4048	3464	2753	0,97%	-0,12%	-2,40%
2020	4097	3469	2691	1,20%	0,12%	-2,28%

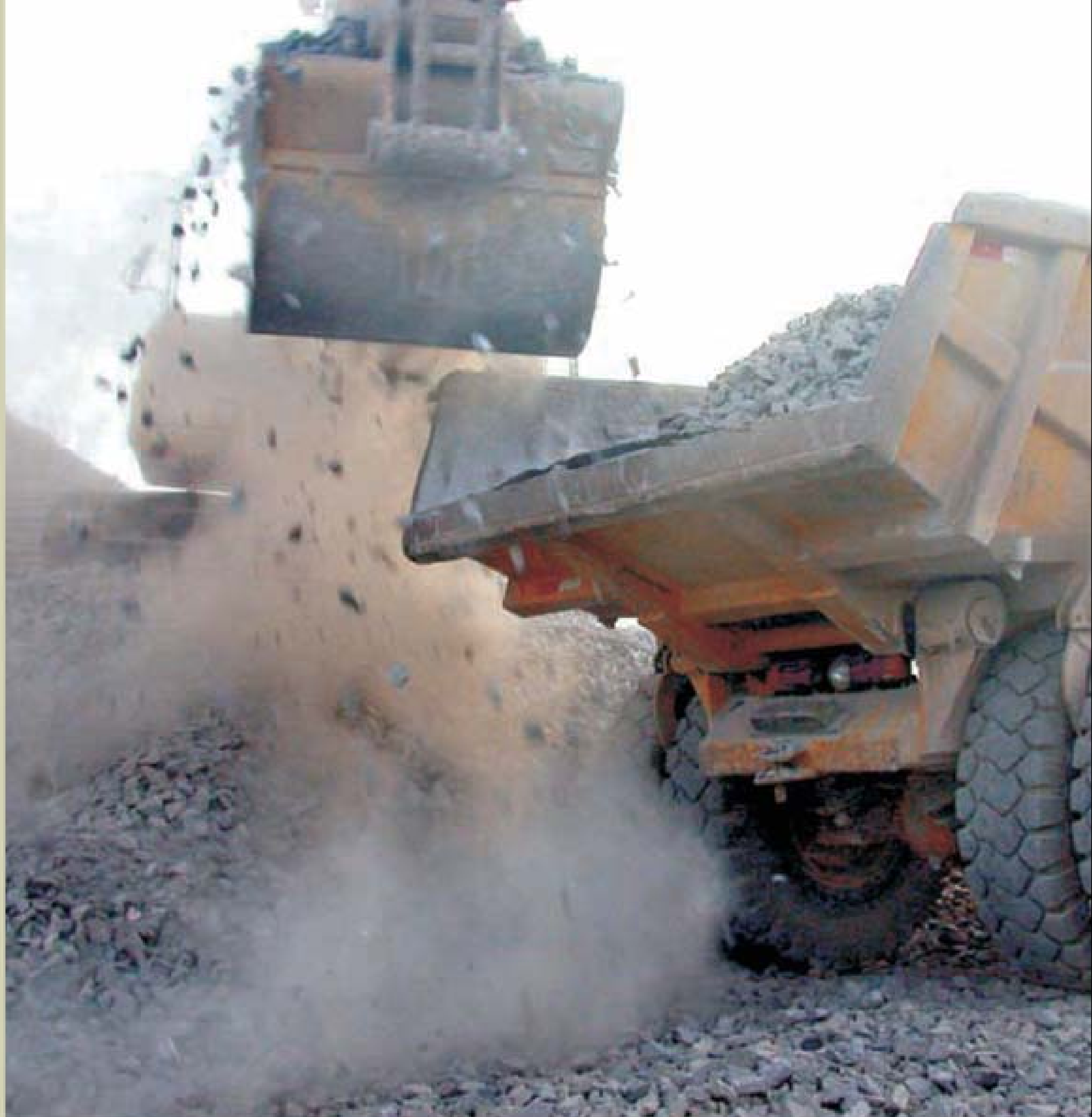
Table 3-8 Other's Demand

3.3.4. SENSITIVITY WITH NPD GROWTH SCENARIO VISION COLOMBIA 2019

In this projection, for public knowledge, the sensitivity for a growth scenario is included, as outlined in the NPD 2005-2019 exercise, which is complemented with the asumptions considered for the highest scenario, presented in the following pages.

YEAR	GNP DNP 2019	ENERGY (GWh/yr)	POWER (MW)
2006		48829	8639
2007	4.03%	50819	9022
2008	3.99%	52886	9341
2009	4.48%	55321	9701
2010	4.46%	57266	10063
2011	4.97%	59576	10469
2012	5.01%	60024	10892
2013	5.50%	64881	11364
2014	5.83%	67673	11877
2015	5.97%	70964	12454
2016	5.97%	74319	13035
2017	5.96%	78179	13678
2018	6.04%	81845	14345
2019	5.98%	85935	15062
2020	6.03%	90406	15836

Table 3-9 Energy and Power Demand with assumptions on exercise NPD 2019



4 RESOURCE AVAILABILITY AND PRICE PROJECTION

4. RESOURCE AVAILABILITY AND PRICE PROJECTION

4.1. RESOURCES AVAILABILITY

4.1.1. COAL

Colombia is a country with plenty of coal reserves. Studies done in 2004 indicate that the reserves reach 7,603.8 million tons, distributed regionally, as shown in the following table:

AREA	GUAJIRA	CÉSAR	CORDOBA-NORTE DE ANTIOQUIA	ANTIOQUIA-ANTIGUO CALDAS	BOYACÁ	CUNDINA-MARCA	NORTE DE SANTANDER	SANTAN DER	VALLE DEL CAUCA	TOTAL PAÍS
Resources and reserves Basic Measures (MILLIONS OF TONS)	3933,33	2035,4	381,0	90,1	170,4	236,2	119,7	56,1	41,4	7063

Table 4-1 Coal reserves distribution 2004

From these reserves, 3,789.78 million tons have title deed, and 897.88, corresponding to additional reserves, classified as measured reserves for the Descanso project.

The coal production in Colombia is assigned mainly to export, due to the mayor exploitation fields are located in the North Coast; the mining exploitations located at the country's interior , are destined to supply the domestic consumption and the surplus, to export. Regionally, the production is concentrated in the Atlantic Coast, and the rest of the country contributed with 14%, as shown in table 4-2.

AREA	GUAJIRA	CÉSAR	CORDOBA-NORTE DE ANTIOQUIA	ANTIOQUIA-ANTIGUO CALDAS	BOYACÁ	CUNDINA-MARCA	NORTE DE SANTANDER	SANTAN DER	VALLE DEL CAUCA	Others	TOTAL Country
NATIONAL	0	0,24	0,08	0,07	1,21	0,85	0,29	0	0,06	2,56	2,8
EXPORTS	27,18	27,47	0,1	0	0,07	0,33	1,11	0	0	1,61	56,26
TOTAL	27,18	27,71	0,18	0,07	1,28	1,18	1,4	0	0,06	4,18	59,06

Table 4-2 2005 Coal production distribution

4.1.2. NATURAL GAS

Natural gas availability, makes reference to the proved reserves the country has and the supply capacity, as well as transportation capacity. As of December 31, 2005, the country had 6,711 Giga Cubic Feet (GCF), from which, 3,994.9, correspond to the proved reserves category, 1,778.9 GCF, maintain the non-proved reserves condition and oil operation consumption 937.2[5].

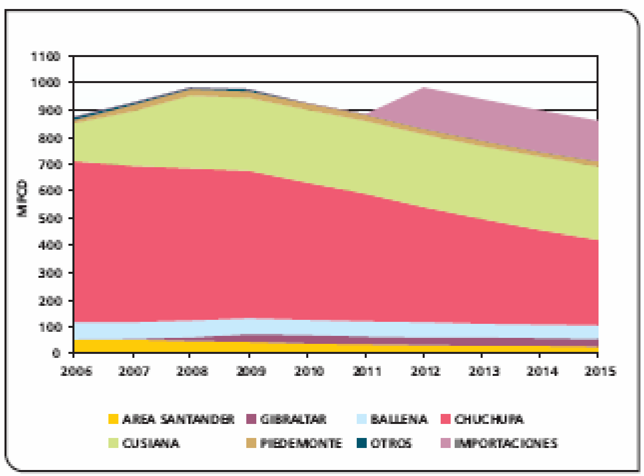
[5] Source: ECOPETROL

The volume destined to oil operation consumption, could be available in the market, according to what is indicated in the ECOPETROL Reserves Report as of December 2005.

From the proved reserves, 63.8% are developed reserves, and 36.2%, are non-developed. The discovery expectations of natural gas are important, considering the great exploitation activity in the basin, which currently presents production, and a high probability of discovery, especially off shore, is estimated.

Under the current reserve conditions and gas natural production capacity, the supply would be limited at about 2010, if there is not incorporation of new discoveries; this situation could be reverted in front of the intensive exploration hydrocarbons program, aimed to incorporate new gas natural reserves, as well as to expand the production capacity, in order to provide a better reliability to the system and to ensure the domestic supply and the gas natural exports.

It is appropriate to point out, that the production capacity in the Guajira fields, which maintained a declining situation in recent years, increased the levels thanks to the perforation of three wells in the Chuchupa field, whose capacity reaches 610 MCFD (million cubic feet per day), providing the opportunity to contribute to the Colombian commercial balance, through exports to Venezuela, with the bi-national pipeline, that will be built in 2006. The following graph shows the production forecast.



Graph 4-1 Projections of natural gas production by field. MCFD units

The behavior natural gas consumption by sector indicates the thermoelectric generation, as the major consumer, followed by the industrial sector, as well as the domestic use. The total demand growth has been moderated and determined mainly by the hydrologic behavior. The major dynamism, is presented in the domestic sector and the VNG (gas for the transportation sector), specially at the country's interior.

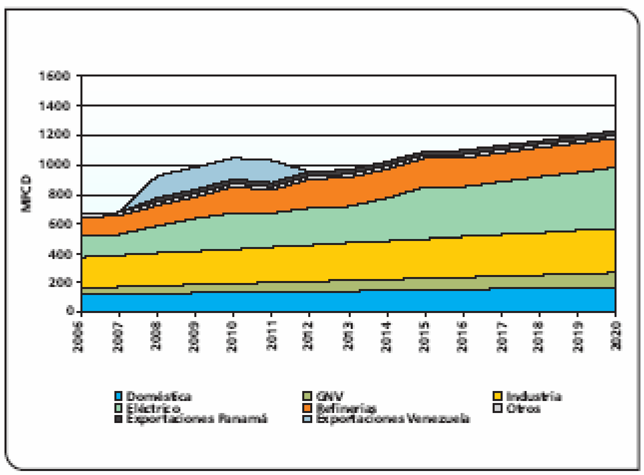
The demand fluctuations are mainly because of the electric sector behavior, which is used mainly to cover the demand picks, generating in turn, natural gas demand picks. In addition, in periods of low hydrology, for example, when the Niño phenomenon is present, the need to generate with natural gas is evident, which carries with it, an increase on average demand for longer periods of time.

For the demand projections in high and base scenarios of the different sectors, excluding the thermoelectric sector, the simulations in the ENPEP model, were executed, in which the demands are projected, using energetic competition assumptions, for different uses, from prices, for useful energy costs (that is, including final use equipment efficiency), preferences and other market variables.

To determine the demand in the thermoelectric sector, the MPODE model is used, in which, from different hydrologic series, fuels price projections and generation system configuration, the requirements for natural gas are established.

The demand projections include gas exports to Venezuela and Panama, starting 2008, the figures for these exports are 159 and 27 MCFD respectively.

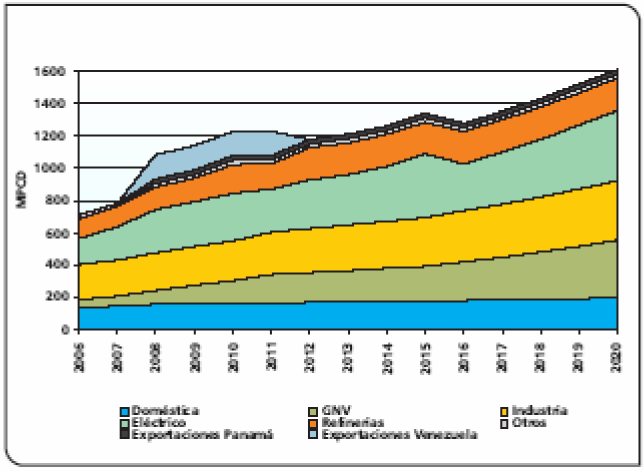
In the following graph, the natural gas demand projections in the different sectors are shown, in the scenario base for 2006-2015 period.



Graph 4-2 Natural gas demand projections by sector. Base Scenario

For the high scenario demand, a higher economic growth rate is assumed and a higher natural gas vehicles conversion factor as well.

In the following table, the natural gas national demand projections, in different sectors in the high scenario for 2006-2015 period, are shown.



Graph 4-3 Natural gas demand projections by sector. High Scenario

4.1.3. COAL PRICES

The coal international prices have been relatively stable, notwithstanding, at the national level, these fell due to the excess of domestic supply. It is worth mentioning, that while the prices kept the high levels, new shafts, were reopen and developed, which increased the domestic supply, without this surplus being located at the foreign markets, due to lack of compliance with quality specifications, required by international markets.

The prices projection exercise, is based in a behavioral analysis of coal domestic and export prices, transportation costs, and port handling[6], from the production areas to the shipping areas and the Bocamina coal price projections from the Energy Information Administration (EIA).

For the development of these projections, information updates were made, such as the Colombian coal export price series; the correlation factor between the Pto Bolivar, Santa Marta and Venezuela series was found; the information about industrial coal prices was completed, as well as the information about coal prices for thermoelectric plants. In addition, prices information since 1998, from the EIA Energy Outlook, was added.

The price analysis includes the prices behavior comparison in thermals and industrial coal, with export prices. At international level, coal behavior comparisons were made, with similar characteristics to the domestic price, with Australia, South Africa, and the annual prices of United States.

The United States prices are comparable with the industrial, Bocamina, electric plants and export prices; at this point, it was found that the series behavior of export coal, USA has the most similar behavior, with other international price series.

To determine the price behavior, the transportation projections are considered, using the Consumer Price Index (CPI), because this variable has more correlation with long term behavior of prices for this energetic.

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[6] Transportation infrastructure plan for mining development in Colombia, UPME, 2004

In the EIA Energy Outlook, there are three price scenarios, and from the reference scenario, the high and low price scenario, the coal price growth rates are determined. The domestic price is determined considering the caloric contents.

As a result of calculations, the following coal domestic price scenarios, for thermoelectric plants, that use the energy coming from Boyacá and Cundinamarca mines, with caloric content of 12,200 BTU/lb, and from the Santander and Guajira with 12,600 BTU/lb, were determined.

In the following table, thermoelectric plants prices are shown.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
HIGH	27,87	29	29,65	30,04	30,62	30,16	29,21	28,39	27,75	26,87	26,03	26,63	25,67	26,29	26,29	26,54	26,76	26,84	26,85	26,85	2673
MEDIUM	27,87	29,02	29,55	29,95	30,49	29,95	29,04	28,19	27,33	26,48	25,67	25,28	25,79	26,04	26,04	26,32	26,55	26,71	26,82	26,82	26,91
LOW	27,87	28,95	29,46	29,82	30,34	29,8	28,86	27,9	27,16	26,37	25,35	24,95	25,53	25,74	25,74	25,98	26,1	26,42	26,51	26,51	26,52

Table 4-3 Coal prices for Cundinamarca and Boyacá thermoelectric plants US$/tons

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
HIGH	17,66	18,37	18,79	19,04	19,4	19,11	18,51	17,99	17,58	17,03	16,49	16,24	16,26	16,51	16,66	16,82	16,95	17,01	17,03	17,01	16,94
MEDIUM	17,66	18,38	17,72	18,98	19,32	18,98	18,4	17,86	17,32	16,78	16,27	16,02	16,05	16,34	16,5	16,68	16,82	16,92	16,93	16,99	17,05
LOW	17,66	18,34	18,67	18,89	19,22	18,88	18,29	17,68	17,21	16,71	16,06	15,81	15,85	16,18	16,31	16,46	16,54	16,67	16,74	16,8	16,81

Table 4-4 Coal prices for Norte de Santander thermoelectric plants US$/tons

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
HIGH	63,82	66,40	67,89	68,80	70,12	69,06	66,89	65,01	63,53	61,53	59,59	58,69	58,77	59,66	60,19	60,78	61,27	67,47	61,55	61,48	61,21
MEDIUM	63,82	66,44	67,65	68,59	69,82	68,57	66,48	64,54	62,59	60,64	58,79	57,88	57,98	59,05	60,27	60,27	60,80	61,16	61,17	61,40	61,63
LOW	63,82	66,30	67,47	68,28	69,46	68,22	66,09	63,89	62,19	60,39	58,05	57,14	57,28	58,47	59,48	59,48	59,77	60,25	60,49	60,70	60,73

Table 4-5 Coal prices for Guajira (exports) thermoelectric plants US$/tons

4.1.4. NATURAL GAS PRICES

4.1.4.1. Natural gas maximum price at plant

The natural gas maximum price projection, at thermoelectric plant, corresponds to an exercise done by UPME in August 2006.

The natural gas projection exercise, for thermoelectric sector, is comprise by three parts: i) Gas price estimate at well head, of different supply sources, Guajira, Opón, Payoa and Cusiana, ii) transportation charges estimate, for the different system stretches and iii) total cost estimate supply, plus gas transportation for each generation plant during the horizon analysis.

4.1.4.2. Methodology

For head well price calculation, in the Guajira, Opón and Payoa fields, the procedures established in CREG Resolution 119/2005, are used; while the Cusiana Gas price is 1.50 in constant 2005 U$/MBTU for the horizon projection.

The transportation cost for each stretch of the pipeline is projected applying the current resolutions. The gas transportation value for each generation plant is the sum of the necessary stretches to take the gas from its supply source up to the plant.

The final price is the sum of head well price in a specific field, according to the contracts determined, or that one, which represents the minimum cost, and the transportation cost from the producer field to the generation plant. For this analysis the supply and transportation contracts are considered.

4.1.5. GUAJIRA AND OPON GAS PRICES

For the Guajira and Opon gas prices, the effective regulations are applied, considering what it is established in CREG Resolution 119 of December 2005, in which the Guajira gas price is regulated, and the formulae to recalculate the price, is updated each semester, from February 1st and from August 1st for the second semester. For the Opón field gas, the semestral prices are calculated from January 1st to July 1st each year, the formula specified in CREG resolution 119, 2005 is the following.

Where:

$$PMR_t = PMR_{t-1} \times \frac{INDEX_{t-1}}{INDEX_{t-2}}$$

PMR_t = Maximum Regulated Price effective during the following semester (t), expressed in dollars per million BTU (US$BTU).

PMR_{T-1} = Maximum Regulated Price previous semester (t-1)

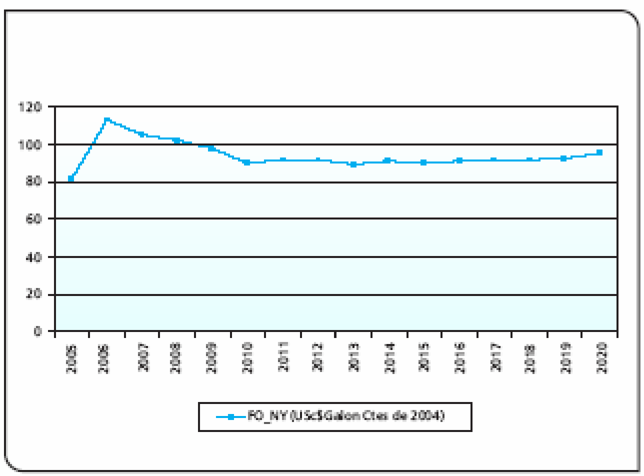
$INDEX_{T-1}$ = Aritmetic Average Index previous semester (t-1)

$INDEX_{T-2}$ = Arithmetic Average Index precedent semester to previous one (t-2)

INDEX = New York Harbor Residual Fuel Oil 1.9%, Sulfur LP Spot Price, according to series published by United Sates Department of Energy.

In this analysis, the Residual Fuel industrial projection, found in the Energy Outlook for 2006, published by EIA, were used

The projected Fuel Oil NY Prices , are shown in the following graph:



Graph 4-4 New York Fuel Oil Prices Projection

4.1.6. CUSIANA GAS PRICES

From the Cusiana production capacity expansion to 180 MCFD, the price for this field is released, according to CREG resolution 119, 2005, which restrains the price to 1.40 US$/MBTU, if the plant installed capacity is equal of below 180 MCFD.

Considering the above mentioned, the natural gas price for this field, was defined as current 2005, 1.50 US$/MBTU, according to information provided by this gas dealers. It is worth mentioning; that the thermoelectric generation plants, except Termoemcali, have subscribed gas supply contracts, coming from Guajira, for this reason, the Cusiana gas has a minimum impact on thermoelectric generation.

4.1.7. TRANSPORTATION PRICES

The transportation charges were estimated, applying the effective resolutions, for each of the Costa and interior system stretches, the tariffs are maintained the same as ones of the last year's, after the current resolutions expiration.

For all cases, a pair of 50%-50% variable and fixed prices was applied. To determine each thermoelectric plant gas transportation costs, the gas point of entry and exit, were considered, in the current transportation contracts. From the contracts termination, the smallest supply cost (well head plus transportation), from the supply alternatives, each generator plant has.

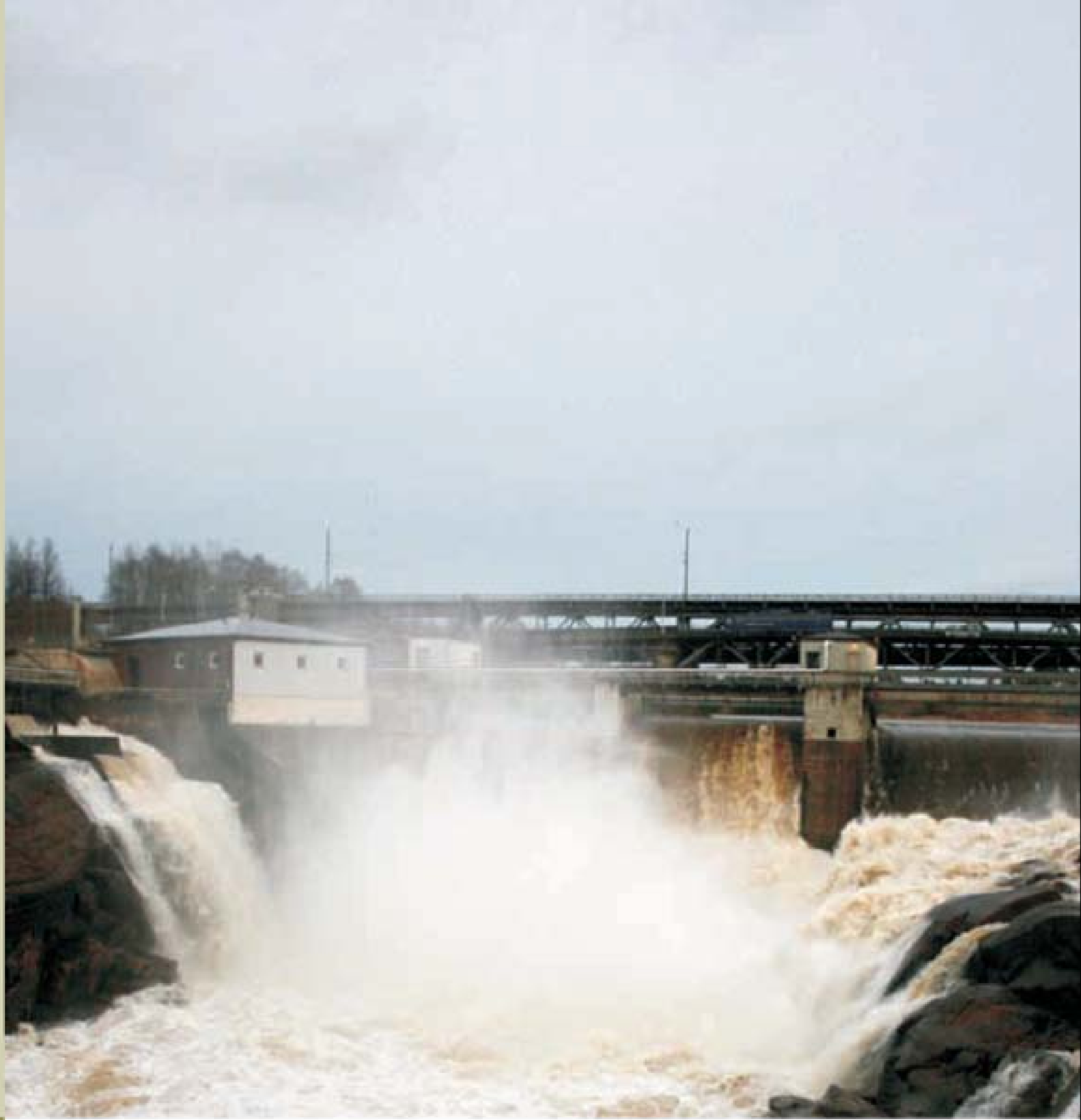
The characteristic of this methodology is the transportation charges determination, is the distance signal, which is similar to what would occur in a competition market, where the tariffs reflect the costs of rendering services. The consequence of this situations is that the gas is more expensive, as long as the demand centers are located at a farther distances from the production fields, as it is the case for Bogotá, Medellín and in particular, the West market.

According to the tariffs structure, defined in CREG resolution 011, 2003, the payment of transportation taxes and other contributions related to same, should be included in the transportation cost. To this regard, the taxes are: Transportation Taxes and Fondo Especial Cuota de Fomento.

The gas transportation system expansion is based on the contracts scheme or "contract carriage", while electric system, is funded in the "common carriage" or common carrier, where the expansion is centrally planned, and the transportation service is paid through a stamp type tariff. Such situation implies that the natural gas transportation system expansion, will be developed, when the contracts provide the carriers, the necessary guarantees to count on a critical mass volume, to justify the expansions, so that, they will enter into service, when the supply and demand balance require it.

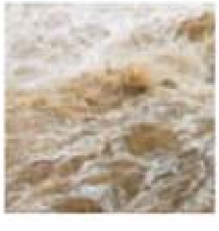
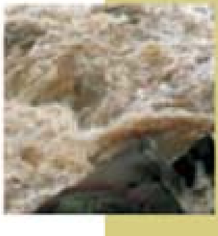
This consideration is particularly critical in stretches that can be rapidly filled, or have transportation restrictions, in events, in which it is necessary the natural gas continuous thermoelectric generation. In consequence, it is necessary to asses the affectivity of signal expansion, through contracts, considering, for example, what happened in 2005, like the removal of Barrancabermeja compressors, and its impact in the gas supply at the country's interior.

In annex 8-1 the results of this projection are shown.



5

GENERATION EXPANSION
Alternatives & Strategies


5. GENERATION EXPANSION

The generation expansion planning long term objective is to establish the capacity needs, based on the analysis of NIS behavior, according to the behavior of diverse variables such as energy demand, energetic resources, electric interconnections, etc. Such needs look for satisfying the energy and power demand requirements, considering also, economic, social, technological and environmental criteria.

This version of the plan, with regard to generation, presents the requirements in expansion, considering the evolution and availability of energetic variables, fuel costs, and progress of the new generation projects. The analysis, also consider the interconnection effects on the SIEPAC, Ecuador and Peru systems.

For those scenarios, in which it is required the entry of new projects, the natural gas development of closing cycles, currently operating in Colombia, as well as the entry of coal projects, to provide a greater diversity and reinforcement of the system's reliability. Similarly, the expansion was analyzed, considering the manifested intention of private agents, in the development of new projects.

Likewise, the effect of possible generation units removal, due to useful life completed was not considered in the different analysis, because in the Standard Planning Information request, carried out by UPME, at the beginning of the year, the removals were not reported, by the generator agents.

The Plan analysis, correspond to simulations done to the National Interconnected System with the Stochastic Dual Dynamic Program version 8.03d.

5.1. GENERATION EXPANSION PROJECTS IN COLOMBIA

The NIS short term (2007-2010) future generation expansion is subject to projects main progress, which is currently under construction, among them:

Porce III: This is a hydraulic project with 660 MW capacity, located at the Antioquia Department, in the Porce river basin, which, it is expected to provide 3,106 GWh/year. At this time, the project is at 18% of physical works. Estimating that, first unit (165 MW) will enter into commercial operation, in September 2010, the second unit (165 MW) in January 2011, the third unit (165 MW) in May 2011, and the fourth unit (165 MW) in September 2011.

Amoyá: A run-of-river hydraulic generation plant, with a capacity of 80 MW, which could provide 515 GWh/year, located in the Tolima Department. It is expected that this project be incorporated to the National Interconnected System, commencing July 2009. Recently ISAGEN, summons, through a public bid, the contracting of the civil works construction, design, manufacturing, procurement, assembly, equipment trials and project operation delivery.

Trasvase Guarinó River: It consists of the deviation of part of the Guarinó river waters towards La Miel River, affluent of Miel I reservoir, which it is expected to provide 238 GWh/year of energy. Recently, through Resolution 3684, 2006, The Ministry of Environment, Housing and Territorial Development, confirmed the awarding of environmental license to ISAGEN. It is estimated to be operational in October 2009.

Manso River: Hydraulic project, with 27 MW capacity, located in the Caldas Department, which will be developed in two phases, the first is the deviation of Manso River towards the Miel I reservoir, which is expected to provide 179 GWh/year. The second phase consists of installation of 27 MW, providing the system with 138 GWh/year. The possible commercial operational date is August 2010.

Following, in table 5-1, the projects considered in the energetic planning, for the short and long term Colombia's energy generation, are shown. The 19.9 MW Calderas project, which was part of the 2006 expansion in the preliminary plan, was considered to be operational in this document, because it is working since the end of July 2006.

PROJECT	TYPE	MW CAPACITY	DATE
EL MORRO	GAS C.A.	54	Feb – 07
TRASVASE GUARINÓ	HIDRO	-	Oct – 09
RÍO AMOYÁ	HIDRO	80	Jul – 09
ARGOS	CARBÓN	50	Ene – 10
RÍO MANSO	HIDRO	27	Ago – 10
PORCE III	HIDRO	660	Sep – 10 / Ene – 11 / May – 11 / Sep - 11
TOTAL - MW		871	

Table 5-1 Projects considered in Colombia's expansion

On the other hand, TERMOFLORES, current operator of Flores 2 and Flores 3 units, manifested its intention to close natural gas open cycles of this units. The new capacity to be incorporated to the system would be 163 MW, therefore, all plants will have 450 MW installed capacity, starting January 2009.

In the medium term (2011-2015), the System expansion is not defined yet, even though, there are studies from several generation companies, to incorporate greater capacity, such is the case of EMGESA, which would develop two projects, one of them, a natural gas combined cycle with an estimated capacity of 400 MW, to be commercially operational starting July 2012; a hydraulic project upstream of Betania plant, and whose capacity will be also of 400 MW, expecting to be operational in July 2015. Notwithstanding, this company has subjected the development of these projects, once a simple and predictable methodology of reliability charge, that make feasible the entry of new projects in the future, is established.

Following, Table 5-2, summarizes the projects upon which, the several agents, have manifested their interest in executing, but the financial closing is pending and are under study.

PROJECT	TYPE	MW CAPACITY	DATE
FLORES	GAS C.C	163	Ene – 09
CC EMGESA	GAS C.C	400	Ene – 12
QUIMBO	HIDRO	400	Ene - 15
TOTAL - MW		963	

Table 5-2 Projects under study, without financial closing

5.2. ENERGY GENERATION AND DEMAND PROJECTS IN ECUADOR

The main generation expansion projects in Ecuador are focused in the San Francisco and Mazar hydroelectric projects. According to information provided by UPME, the San Francisco project has 89% in progress. It is worth mentioning, that this project consists of taking advantage of the turbined water of Agoyán Central, which will be conducted through a conduction and pressure tunnel, to a machine house, in which there will be a turbo generator, comprised of two 116 MW (each) generating units. It is expected to be operational by February 2007, and at the latest, June 2007.

On the other hand, with regard to Mazar project, the definite environmental impact was submitted in May, in a public hearing. Similarly, the civil works construction and the deviation of Paute River are under way. The progress status is close to 12%.

Another project contemplated to be operational this year is the 150 MW Termoguayas barge, composed of 5 units. The barge requested a connecting permit to Transelectric and has the environmental permits.

In Table 5-3, the commercial operational dates of projects considered in the expansion analysis for Ecuador, are shown.

PROYECTO	TIPO	CAPACIDAD MW	FECHA
SIBIMBE	HIDRO	15	Mar – 06
LA ESPERANZA	HIDRO	6	Mar – 06
POZA HONDA	HIDRO	3	Abr – 06
CALOPE	HIDRO	15	Abr - 06
SAN FRANCISCO	HIDRO	230	Jun – 07
LOW HIGH 2	GAS C.C	95	Ago – 08
OCAÑA	HIDRO	26	Oct – 08
MAZAR	HIDRO	190	Mar – 09
INCREM. MAZAR	HIDRO	-	Mar – 09
LOW HIGH 3	GAS C.C	87	May - 11
TOTAL - MW		667	

Table 5-3 Projects considered in Ecuador expansion

5.3. GENERATION AND DEMAND EXPANSION PROJECTS IN PERU

The expansion presented in table 5-4 was considered, which consists of the capacity increase of 1,391 MW. In 2006, 708 MW correspond to the entry of several projects which are natural gas operated, which are not certainty of whether to be operational this year.

Similarly, the potential of generation projects, natural gas-based, coming from Camisea field in Peru is estimated in 2.900 MW, from which 1.400 MW approximately, correspond to projects that can operate in open cycles and 1,500 MW with closing of cycles. With regard to hydraulic projects, and approximate potential of 1,400 MW, can be considered, from which the 71 MW Machupichu hydroelectric plant is in rehabilitation.

YEAR	HYDRO	THERMOELECTRIC
2006		708
2007		
2008		
2009	157	134
2010		49
2011		343
2012		
2013		
2014		
2015		
Mw TOTAL	1391	

Table 5-4 Projects considered in Peru's expansion

Following, in table 5-5, the energy demand projection, used for simulations in Peru's case, is shown.

AÑO	GWh/año	TASA ANUAL (%)
2006	22637	3
2007	23531	3,9
2008	24349	3,5
2009	25920	6,5
2010	27151	4,7
2011	28153	3,7
2012	29205	3,7
2013	30290	3,7
2014	31375	3,6

Table 5-5 Peru's energy demand projection

5.4. GENERATION AND DEMAND EXPANSION PROJECTS IN PANAMA

In Panama, the generation expansion is subject to the development of hydroelectric projects in Teribe and Changuinola rivers, in which the Chan 75, Chan 140 and Chan 220 projects, with 158 MW, 132 MW and 126 MW capacities, respectively, can be developed. Even though, from these three projects, only Chan 75, will start its development by AES Company, and will be in commercial operation in July 2010.

Similarly, other series of projects, such LOW Mina and Gualaca, have energy procurement contracts, and in that sense, its commercial operation is expected in the short term. In Table 5-6, the projects considered in the Panama's expansion analysis, as well as the possible starting of commercial operation dates are shown.

PROJECT	TYPE	MW CAPACITY	DATE
LOW MINA	HIDRO	51	Ene - 08
GUALACA	HIDRO	24	Ene - 08
BONYIC	HIDRO	30	Ene – 09
MMV 50 – 1	TÉRMICA	100	Ene – 10
CHAN 75	HIDRO	158	Jul – 10
PANDO	HIDRO	32	Ene - 14
TOTAL - MW		395	

Table 5-6 Projects considered in Panama's expansion

Following, Table 5-7 shows, projected energy demand for Panama, and used to determine the effects on the Colombian System expansion.

AÑO	GWh/año	TASA ANUAL (%)
2006	5548	3,5
2007	5782	4,2
2008	5976	3,4
2009	6178	3,4
2010	6392	3,5
2011	6612	3,4
2012	6834	3,4
2013	7060	3,3
2014	7304	3,5
2015	7556	3,5

Table 5-7 Panama's energy demand projection

5.5. GENERATION AND DEMAND EXPANSION PROJECTS IN THE REST OF SIEPAC COUNTRIES

Following, Table 5-8, shows the capacity to be installed in Costa Rica, Nicaragua, Honduras, El Salvador and Guatemala. It is estimated, that in such countries, 4.500 MW approximately, will be installed, from which 2,800 MW, are thermoelectric and the remaining 1,700 MW hydraulic.

YEAR	GWh/yr.	YEARLY RATE (%)
2006	5548	3,5
2007	5782	4,2
2008	5976	3,4
2009	6178	3,4
2010	6392	3,5
2011	6612	3,4
2012	6834	3,4
2013	7060	3,3
2014	7304	3,5
2015	7556	3,5

Table 5-8 Projects considered in the SEPIA countries, different from Panama

On the other part, the removal of 110 MV in Costa Rica, 200 MV in Nicaragua and 230 MW in Honduras, is expected.

In Table 6-9, the energy demand for Costa Rica, Honduras, Nicaragua, El Salvador and Guatemala, is shown, to determine the effects on the Colombian System expansion.

YEAR	COSTA RICA		HONDURAS		NICARAGUA		EL SALVADOR		GUATEMALA	
	GWh/yr.	Rate Yearly (%)	GWh/yr.	Rate Yearly (%)	GWh/yr.	Rate Yearly (%)	GWh/yr.	Rate Yearly (%)	GWh/yr.	Rate Yearly (%)
2006	8768	5,4	5636	4,9	2912	2,4	4740	3,1	8207	7,4
2007	9234	5,3	5922	5,1	3062	5,2	4887	3,1	8693	5,9
2008	9722	5,3	6222	5,1	3214	5,0	5035	3,0	9199	5,8
2009	10236	5,3	6539	5,1	3371	4,9	5185	3,0	9710	5,6
2010	10778	5,3	6867	5,0	3531	4,7	5339	3,0	10210	5,2
2011	11351	5,3	7210	5,0	3696	4,7	5499	3,0	10734	5,1
2012	11955	5,3	7564	4,9	3870	4,7	5664	3,0	11285	5,1
2013	12581	5,2	7934	4,9	4054	4,7	5833	3,0	11864	5,1

2014	13231	5,2	8317	4,8	4249	4,8	6007	3,0	12472	5,1
2015	13919	5,2	8709	4,7	4458	4,9	6186	3,0	13109	5,1

Table 5-9 Energy demand projection in SIEPAC countries different from Panama

5.6. GENERATION EXPANSION PLAN METHODOLOGY

The reference generation expansion plan, from its beginnings, has been elaborated, considering scenarios that establish different alternatives in the short term and strategies in the long term. It is observed, lately, that the decisions of different participants of sectors and energetic chains have a major impact on the electric system. This situation has motivated the establishing of scenarios with diverse main variables behavior, which have high impact in the planning, as well as in the decision making of different participant agents from the Colombian electric sector.

The determination of future requirements, in the generation expansion, comes from the analysis of scenarios, which consider different critical variable relations and their possible status. Among the critical variables, those that have greater sensitivity, in the generation expansion are determined, such as: natural gas availability and prices, energy and power demand, international interconnections.

5.6.1. CRITICAL VARIABLES

5.6.1.1. Natural Gas availability

In the possible states, in which this variable can evolve, it is considered unlimited gas availability for the electric sector considering the entry of new gas projects, and the closing of open cycles, that currently operate in the country. The other possible state, considers, a limited gas availability, in which it is estimated that with the increase and the incorporating of new gas fields, 300 new MW, could be installed and close the unit cycles, which currently operate as open cycles in Colombia.

Even though, practically, the gas availability is subject to infrastructure and the production capacity, in case of non-availability, the gas is distributed according to what was stipulated in decree 1484, 2005. This gas availability is related to the type of contract, dispatchers have.

5.6.1.2. Gas prices

This variable considers three possible states: high, medium and low and the assumption is the behavior of fuel oil international price, described in previous chapter.

5.6.1.3. Energy and power demand

This variable determines three possible states, for the short as well as for the medium term. In the short term, the high scenario shows, an average growth of 4.0%. The medium 3.5% and the low scenario, 2.9%. For the medium term, the high, medium and low scenarios show a growth of 3.7%, 3.3% and 2.7% respectively.

In addition, a state that takes into consideration the Plan Vision Colombia 2019, presented in the demand chapter, in which the energy demand, assumes that the GDP has an average growth of 5.7% during 2011 – 2015, and 6% during 2016 - 2020.

5.6.1.4. International Connections

In the international connections, the following states were considered: One that supposes a high level of interconnection, in which Colombia is interconnected with the Central America System SIEPAC, Peru and Ecuador; another that perceives a medium level of interconnection, in which the country, only considers the current interconnection, as well as an increase in the export capacity in the first semester 2007 with Ecuador and Ecuador with Peru; and another state, that analyzes Colombia without energy exports and operating in an autonomous way.

Table 5-10, summarizes the possible different states, in which the critical variables used in the generation expansion analysis, can evolve. It is worth mentioning that in this table, the variables do not have relation among them, but their states are used in the construction of different scenarios, further described in the document.

POSSIBLE CONDITION	VARIABLES			
	1. GAS AVAILABILITY	2. GAS PRICES	3. ENERGY DEMAND (GWH/YEAR)	4. INTERNATIONAL INTERCONNECTIONS
A	UNLIMITED AVAILABILITY	HIGH	HIGH	SIEPAC – ECUADOR – PERU
B	UNLIMITED AVAILABILITY EXPANSION THERMOELECTRIC 300 MW	MEDIUM	MEDIUM	ECUADOR – PERU
C	**	LOW	LOW	COLOMBIA AUTÓNOMO

Table 5-10 possible critical variables in the generation expansion

5.6.2. ASSUMPTIONS USED IN THE GENERATION ANALYSIS

With the purpose of performing the different generation analysis, for Colombian electric sector, the following assumptions are used:

5.6.2.1. Colombia's data

- Hydrology from January 1938 to March 2006.
- Non-availability indexes considered in the Capacity Charge calculation as of November 2005.
- Registered projects and reported information to UPME.
- Projection scenarios for energy and power demand, high, medium and low scenarios, as of March 2006.
- Characteristics of reported generators to XM and UPME by the agents.
- UPME variable and fixed generations indicative costs.
- 12% discount rate.

5.6.2.2. Ecuador's data

- Hydrology from January 1956 to March 2006.
- Non-availability indexes as of April 2006.
- CONELEC generation projects as of April 2006.
- Generator characteristics, data base from XM as of April 2006.
- CONELEC Energy and power demand as of April 2006.
- Price projection as of January 2006.
- Interconnection with Peru, with 80 MW capacity until December 31, 2006 and from January 2007, with 125 MW.
- 12% discount rate.

5.6.2.3. Panama's data

- Hydrologies from January 1975.
- Non-availability indexes.
- Energy and power demand projections, XM data base as of April 2006.
- Generation projects, Plan version 2005, updated with information from Internet.
- Generator characteristics, data base from XM as of April 2006.
- Fuels price projection as of January 2006.
- 12% discount rate.

5.6.2.4. Costa Rica, Nicaragua, Honduras, El Salvador and Guatemala' s data

- Hydrology from January 1975.
- Non-availability indexes.
- Energy and power demand projections, XM data base as of April 2006.
- Generation projects, Plan version 2005, updated with information from Internet.
- Generator characteristics, data base from XM as of April 2006.
- Fuels price projection as of January 2006.
- 12% discount rate.

5.7. GENERATION REQUIREMENTS FOR ENERGY IN THE COLOMBIAN ELECTRIC SYSTEM

The analysis for generation requirements that are presented below, correspond to the Colombian Electric System needs in the future, to serve the energy demand. For analysis effects, presented in this chapter, the horizon for the short term comprises years 2007-2010 and in the long term, two periods: 2011-2015 and 2016-2020 were analyzed.

5.7.1. GENERATION SCENARIOS AS OF 2015

To elaborate the Expansion Plan, several scenarios have been identified, constructed from the variables considered in Table 5-10.

5.7.1.1. Expansionary country scenario

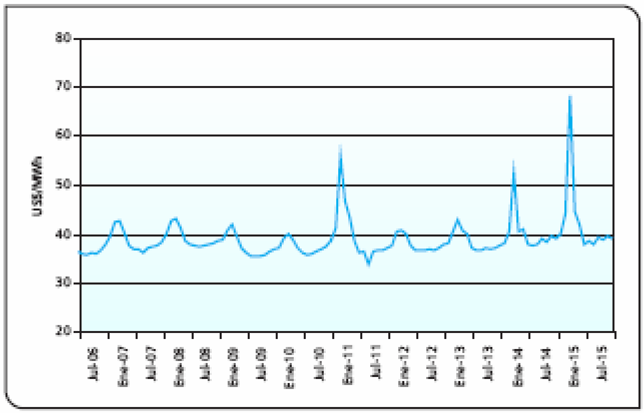
This scenario conditions the electric sector expansion to the occurrence of Plan Vision Colombia 2019, so to speak, in this plan the conditions that should happen in the country at the generation level, in order to serve the energy demand, which considers a 6% GDP growth, for which, it is necessary to have an unlimited natural gas availability, average gas price, and Colombia international interconnections with Ecuador, Peru and the SIEPAC system.

Under the previous assumptions, one can see, that the national interconnected system, requires the installation of 2,294 MW (See table 5-11), as well as a diversification of the energetic matrix, and in that sense, there is a need to execute additional expansions in hydraulic plants, in natural gas with the closing of open cycles and in mineral coal plants.

YEARS	HYDRO	GAS	COAL
2006			
2007		54	
2008			
2009	80	163	
2010	192		50
2011	495		
2012			150
2013		40	
2014			160
2015	400	150	
SUBTOTAL – MW	1167	767	360
TOTAL - MW	2294		

Table 5-11 Expansionary country generation requirements

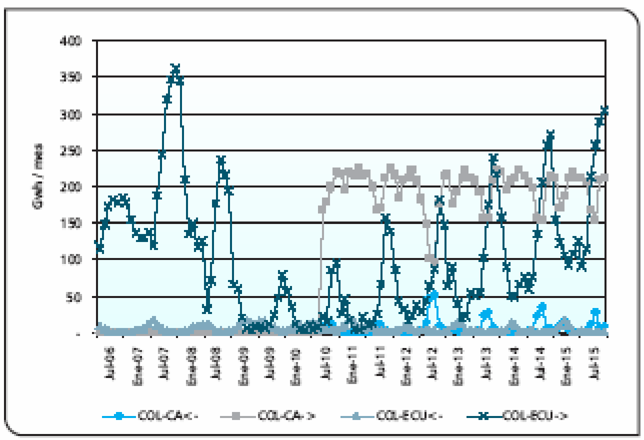
The behavior of the marginal cost, for the period of analysis, is observed in Graph 5-1. In average, in the horizon of medium term, between January 2011 and December 2015, the cost would be 39.93 US$/MWh in dollars at December 2005, with months in which the costs exceeds 50 US$/MWh, The marginal costs include CEE, FAZNI (Supporting fund to non-interconnected zones) Law 99, 1993 contributions.



Graph 5-1 Expansionary country scenario marginal cost

On the other hand, the energy interchanges, under this scenario, are presented in Graph 5-2, in which an average of 200 GWH/month of Colombian exports to Central America and to Ecuador between 200 and 300 GWh/month in some summers, are considered.

In this graph, one can see also, some reductions of Colombian exports to Ecuador between 2009 and 2011, as a consequence of the entry of new generation projects in Ecuador.



Graph 5-2 Expansionary country scenario, Colombia – Ecuador and Colombia- Central America energy exports and imports

With regard to reliability limits that would be presented for the Colombian system in this scenario one can see in table 5-12, that the system would reach a maximum of four failed series at the end of year 2015 with Energy Expected Rationing Value (EREV) and Conditioned Energy Expected Rationing Value, within the limits established in CREG 025, 1995[7].

[7]The CREG through resolution 025, 1995, established as a maximum acceptable risk in the procurement to energy demand, the following reliability limits: Energy Rationing Expected Value (EREV): It is defined as the energy average rationing in a determined month, which should not exceeds 1.5% of the demand. Conditioned Energy Rationing Expected Value (CEREV): Defined as the energy average rationing of cases with deficit in a determined month, should not exceeds 3% of the demand, with a maximum of 5 cases.

PERIOD	No. SERIES	VERE	VEREC
01/2014	1	0,01%	0,53%
03/2015	2	0,03%	1,72%
05/2015	1	0,00%	0,03%
12/2015	4	0,00%	0,03%

Table 5-12 Reliability Limits for Expansionary country scenario

5.7.1.2. Optimistic System scenario

This scenario contemplates, that the electric sector would be developed considering the following states: limited gas availability, low gas price, high energy and power demand, Colombia interconnected with Ecuador, Peru and the Central American System, SIEPAC.

As observed in Table 5-13, the national Interconnected System, under these assumptions, requires, in whole horizon of analysis, the installation of at least 2.060 MW, from which, 1,200 MW, do not have financial closing.

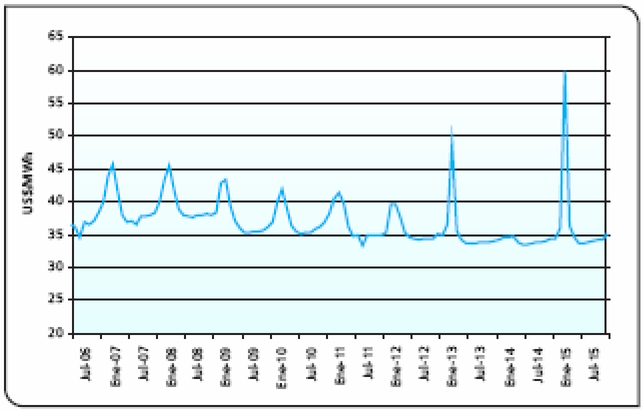
It is worth mentioning, that under the above considerations, further to 2009, the country should install, at least 150 MW in coal mineral units, in order to provide a greater energetic stability.

YEARS	HYDRO	GAS	COAL
2006			
2007		54	
2008			
2009	80	163	
2010	192		50
2011	495		150
2012		150	
2013		166	160
2014			
2015	400		
Sub-TOTAL (MW)	1167	533	360
MW TOTAL	2066		

Table 5-13 Generation requirements optimistic system scenario

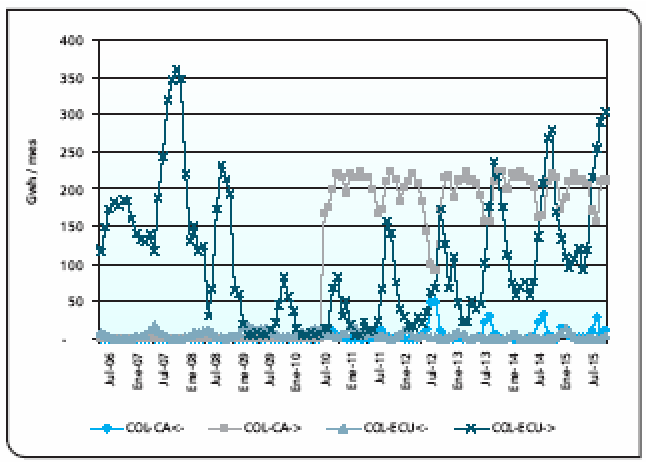
The expected marginal average cost behavior for this scenario, shows that under the previously considered expansion, it is situated at 35.73 US$/MWh. Graph 5-3 shows the cost for the different years of the analysis.

In the graph, the decreasing tendency of the marginal cost is due to the entry of new mineral coal based projects, as well as the incorporation into the closing system of units combined cycles that currently, operate as open cycles which implies greater plants efficiency, and therefore, a smaller marginal cost for the System.



Graph 5-3 Colombia's marginal cost, optimistic system scenario

At the export level, in this scenario, one can observe, that a greater number of sustained interchanges are executed towards Central America, being this in average of 198 GWh/month, while towards Ecuador; the exports are 100 GWh/month in average. The exports and imports behavior is shown in Graph 5-4.



Graph 5-4 Colombia- Ecuador and Colombia-Central America Exports and Imports, optimistic system scenario

With regard to reliability limits assessment, it is observed, that in front of the proposed expansion, the system would present a deficit, which is inside the permissible EREV and CEREV values established in CREG resolution 025, 1995. The results are shown in Table 5-14.

PERIOD	No. SERIES	VERE	VEREC
02/2009	1	0,00%	0,09%
12/2010	5	0,00%	0,02%
12/2012	5	0,00%	0,03%
03/2013	1	0,03%	2,91%
10/2013	1	0,00%	0,01%
12/2014	3	0,00%	0,01%
03/2015	2	0,04%	2,21%
10/2015	3	0,00%	0,00%
11/2015	2	0,00%	0,02%
12/2015	3	0,00%	0,03%

Tabla 5-14. Límites de confiabilidad escenario sistema optimista

5.7.1.3. Continuity Scenario

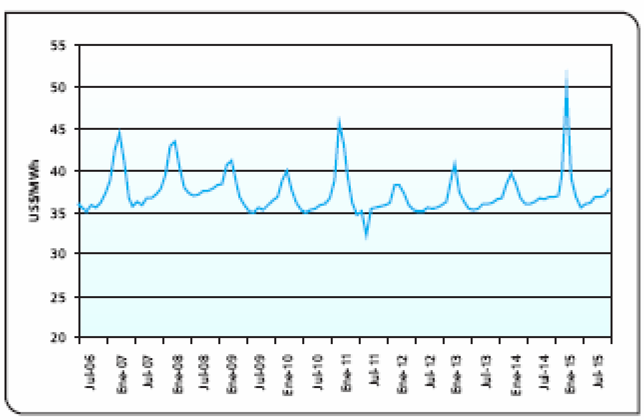
This scenario considers that the country would present GDP normal growth conditions, and that major infrastructure investments, are not executed, which could imply the occurrence of the following states in the electric sector: limited gas availability, medium gas price, medium energy and power demand, Colombia interconnected with Ecuador and Peru.

The generation requirements, to serve this scenario demand, indicates that the system in the whole period of analysis, needs the installation of 1,734 MW, from which 913 MW are still without financial closing by the private agents. Table 5-15, shows the years, in which the projects would be operational according to their capacity and technology.

YEARS	HYDRO	GAS	COAL
2006			
2007		54	
2008			
2009	80	163	
2010	192		50
2011	495		
2012			150
2013			
2014			
2015	400	150	
SUB-TOTAL (MW)	1167	367	200
MW TOTAL	1734		

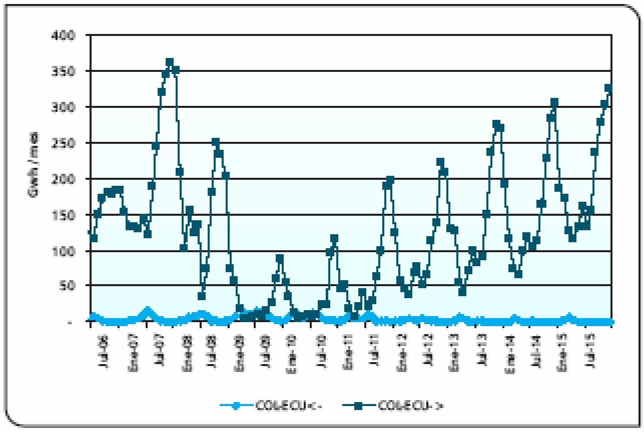
Table 5-15 Generation requirements continuity scenario

The marginal cost behavior under this scenario is shown in Graph 5-5. In average, the marginal cost in the long term is 37.05 US$/MWh in dollars as of December 2005, reaching in the summer periods, values near to 40 US$/MWh.



Graph 5-5 Colombian marginal cost, continuity scenario

The Colombian electric system exports and imports behavior with Ecuador shows that the system is mainly an exporter, reaching levels of 131 GWh/month average, with export picks of 300 GWh/month in the summer periods. Graph 5-6 shows the Colombian system export and imports behavior under this scenario.



Graph 5-6 Colombia – Ecuador energy exports and imports continuity scenario.

With regard to reliability, for this scenario, with the proposed expansion, some deficit would be presented, which is inside the limited values of reliability. Following, Table 5-16 shows the EREV and CEREV values.

PERIOD	No. SERIES	VERE	VEREC
03/2013	1	0,01%	0,89%
12/2014	2	0,00%	0,01%
03/2015	5	0,14%	2,81%
09/2015	1	0,04%	2,12%
12/2015	4	0,00%	0,02%

Table 5-16 Reliability limits continuity system scenario

5.7.1.4. Limited scenario with interconnection

This scenario considers the occurrence of events, that makes the country's GDP growth to be reduced, leading to certain situations that would imply a decrease in infrastructure investment, carrying with it, a critical situation in the supply and expansion of electric system, and in that sense, the following would be the possible states: non-availability of gas, high gas price, low energy and power demand, Colombia interconnected with Ecuador, Peru and the SIEPAC system.

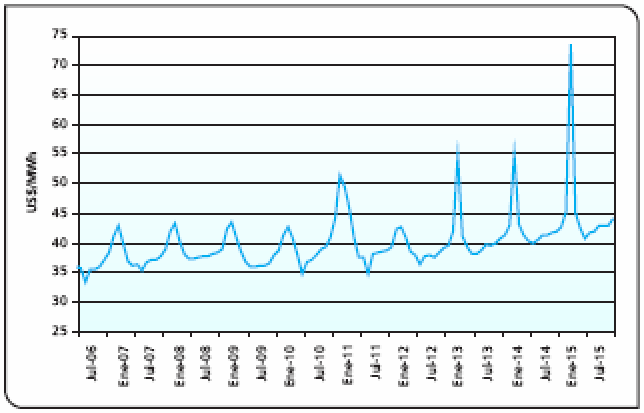
Table 5-17 shows the generation needs that the national interconnection system would require, noting that, in additional to the projects currently under construction, the closing of 163 MW of a gas open cycle, is required.

YEARS	HYDRO	GAS	COAL
2006			
2007		54	
2008			
2009	80		
2010	192		50
2011	495		
2012		163	

2013			
2014			
2015			
SUB-TOTAL (MW)	767	217	50
MW TOTAL	1034		

Table 5-17 Generation requirements limited scenario with interconnection

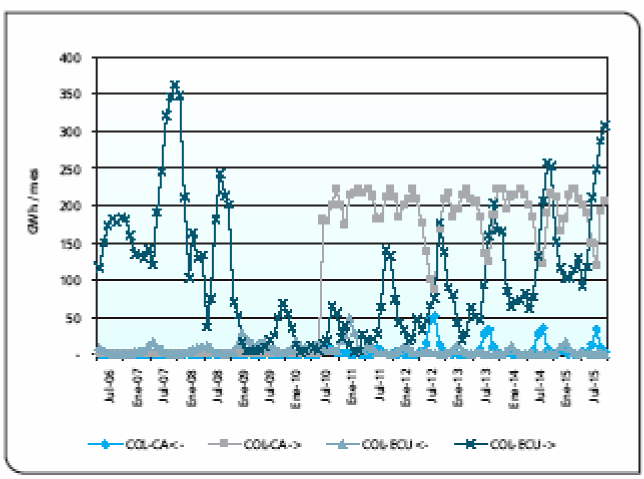
The marginal cost behavior for this scenario is observed in Graph 5-7, in which it is shown that from 2011, there is an average increase of marginal cost, reaching 40.9 US$/MWh in dollars as of December 2005.



Graph 5-7 Marginal cost Colombia interconnected with Ecuador and Central America – limited scenario

With regard to exports, the country is still an exporter but at a lesser degree, in relation to an optimistic scenario. In this case, the exports to Central America are 191 GWh/month in average and 98 GWh/month to Ecuador, as shown in Graph 5-8.

In this scenario, and because the Colombian installed capacity is only 163 MW, there are reductions with regard to country's energy exports towards the Ecuador and Central America markets.



Graph 5-8 Colombia's exports and imports – Ecuador and Colombia – Central America – limited scenario with interconnection with Central America.

If this scenario occurs, the required expansion could serve the energy demand, inside the reliability established limits, as the greater values of EREV and CEREV are present (See Table 5-18).

PERIOD	No. SERIES	VERE	VEREC
03/2013	1	0,01%	0,59%

Table 5-18 Reliability limits, limited scenario with interconnection

5.7.1.5. Limited scenario without interconnection

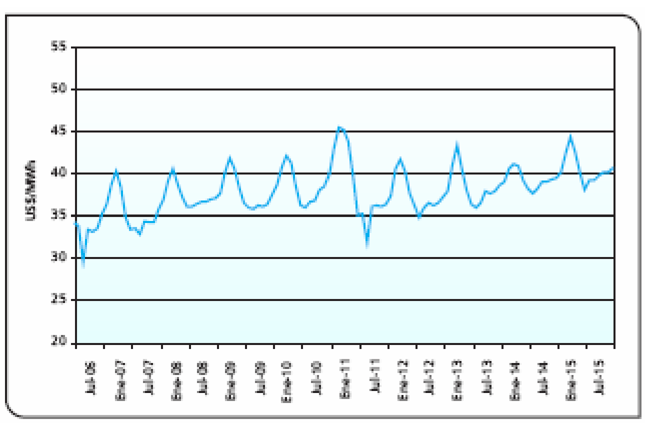
This scenario considers, that the country presents a moderate GDP growth, as well as a low investment in infrastructure, limiting the electric system expansion, and in that sense, the possible following states would occur: limited gas availability, high gas prices, low energy and power demand, Colombia operating autonomously.

Table 5-19 shows the requirements for generation needed to serve the Colombian System demand, and in that sense, it is necessary the installation of 163 MW in year 2014, in addition to the projects currently under construction.

YEARS	HYDRO	GAS	COAL
2006			
2007		54	
2008			
2009	80		
2010	192		50
2011	495		
2012		163	
2013			
2014			
2015			
SUB-TOTAL (MW)	767	217	50
MW TOTAL	1034		

Table 5-19 Generation requirements, limited scenario without interconnection

The marginal cost in the system through this scenario, shows that in average, starting from year 2011, such cost would be 38.93 US$/MWh. Graph 5-9 shows the cost evolution in the horizon analysis.



Graph 5-9 Colombia's marginal cost, limited scenario without interconnection

With the expansion previously presented, an energy deficit in only one series is shown in this scenario, and in that sense, the reliability limits are met.

PERIOD	No. SERIES	VERE	VEREC
03/2013	1	0,01%	0,59%

Table 5-20 Reliability limits limited scenario without interconnection

5.7.2. GENERATION SCENARIO AS OF 2020

To determine the expansion requirements the Colombian electric system needs as of year 2020, a generation scenario was analyzed. This scenario considers the occurrence of the following states: limited gas availability, average gas prices, average energy and power demand and Colombia interconnected with Ecuador, Peru and Central America.

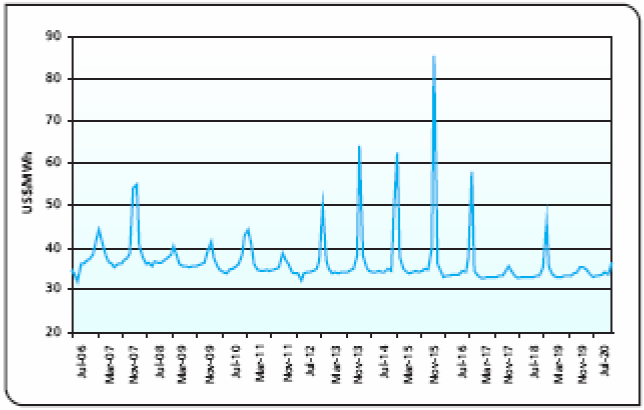
The generation requirements to serve the demand in this scenario, point out, that the system throughout the analysis period 2006-2020, requires the installation of 3,510 MW, from which approximately 2,000 MW, correspond to hydraulic resources, 900 MW to natural gas (supposedly 500 MW execute the closing of cycles of the plants that currently operate in Colombia, plus the addition of 400 new MW) and 600 MW, based on the plants that would operate with mineral coal. Following, in Table 5-21, the required expansion per year, for this generation scenario, is shown.

YEARS	HYDRO	GAS	COAL
2006			
2007		54	
2008			
2009	80	163	
2010	192		
2011	495		
2012			150
2013			160
2014			
2015	400		
2016		166	300
2017	800	150	
2018		400	
2019			
2020			
SUB-TOTAL (MW)	1967	933	610
MW TOTAL	3510		

Table 5-21 Generation requirements as of 2020

Similarly, it is necessary to clarify that the hydraulic 800 MW, could correspond to various hydraulic projects, and not exclusively to one project; likewise, the coal thermoelectric projects, may correspond to two 150 MW projects.

Graph 5-1 shows the Colombian system marginal cost behavior. For this scenario, as one can see, the average marginal cost, is situated at approximately US$ 36 /MWh, for the period between January 2011 and December 2020, this value is in current dollars as of December 2005.



Graph 5-10 Colombian marginal cost, generation scenario as of 2020

The reliability limits, considering the previously proposed capacity, is shown in Table 5-22, in which the main deficit periods are in year 2016.

PERIOD	No. SERIES	VERE	VEREC
02/2008	1	0,03%	2,51%
02/2012	1	0,02%	1,55%
03/2013	1	0,02%	2,15%
03/2014	3	0,06%	2,11%
02/2015	2	0,03%	2,54%
03/2016	5	0,02%	2,76%
03/2017	2	0,06%	2,91%
03/2019	1	0,03%	2,98%
05/2020	3	0,00%	0,02%

Table 5-22 Reliability limits, generation scenario as of 2020

5.7.3. SENSITIVITY CASES

The sensitivity cases analyzed in this version of the Reference Generation Expansion Plan consisted of a high gas prices case, as well as the occurrence of medium demand and interconnection to Central America and Ecuador. A second case consisted of the entry of 82 MW to the National interconnection system analysis. A third case analyzed a scenario of critical hydrology, for the Colombian system and a fourth case, determined the effects of the removal of Guaca – Paraíso chain, on the National interconnection system. Following, the results of each one of these sensibilities are shown.

5.7.3.1. Sensitivity Case 1

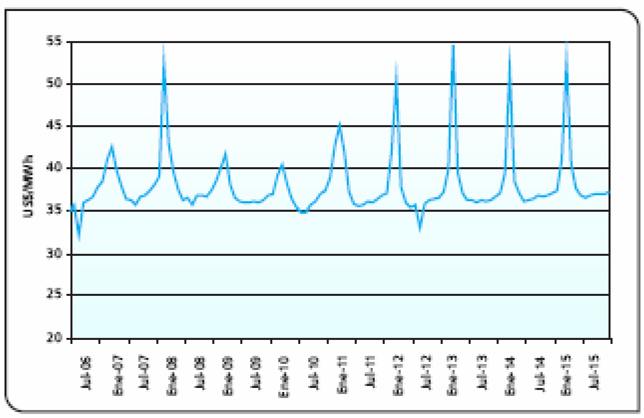
This case was suggested in comments received on the Preliminary Plan, and pretends to analyze National Interconnected System generation requirements, if a scenario, in which the installation of 400 MW natural gas, high natural gas prices and medium energy demand and interconnection towards Central America, without minimal preparation, would occur.

The following were the results with regard to expansion requirements (see Table 5-23).

YEARS	HYDRO	GAS	COAL
2006			
2007		54	
2008			
2009	80	163	
2010	192		50
2011	495		
2012			150
2013		400	
2014			
2015	400		
SUB-TOTAL (MW)	1167	617	200
MW TOTAL	1984		

Table 5-23 Generation requirements sensitivity case 1

As shown in Table 5-23, the system demands the installation of approximately 2,000 MW and the marginal cost in the system for this case shows that in average, in the long term, such cost would be 38,32 US$/MWh. Graph 5-11, shows the marginal cost evolution in the horizon analysis.



Graph 5-11 Colombia's marginal cost sensitivity case 1

The reliability limits for this sensitivity case, show that the system would comply with the established limits and their behavior is shown in Table 5-24.

PERIOD	No. SERIES	VERE	VEREC
02/2008	1	0,03%	2,85%
03/2008	1	0,01%	1,05%
02/2012	1	0,02%	1,57%
03/2012	1	0,02%	2,08%
03/2013	2	0,02%	1,24%
03/2014	1	0,03%	2,99%
11/2014	1	0,00%	0,01%
12/2014	1	0,00%	0,01%
03/2015	1	0,02%	1,82%

Table 5-24 Reliability limits sensitivity case 1

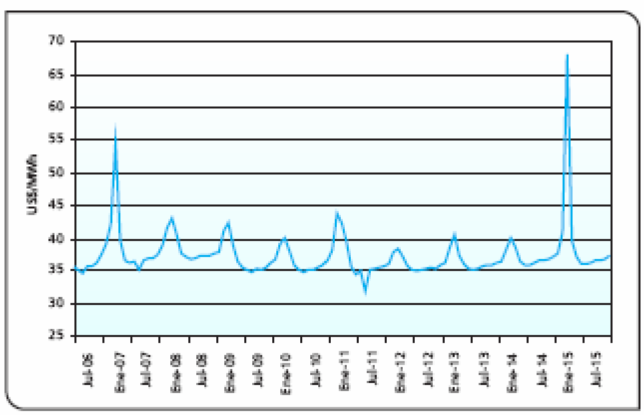
5.7.3.2. Sensitivity Case 2

A second analyzed sensitivity case, considers gas limited availability, medium gas prices, medium energy and power demand, Colombia interconnected with Ecuador and Peru and the entry of 82 MW of co-generation. The effects on the system's required capacity are shown in Table 5-25.

YEARS	HYDRO	GAS	COAL	COG
2006				
2007		54		
2008				82
2009	80	163		
2010	192		50	
2011	495			
2012			150	
2013				
2014				
2015	400	150		
SUB-TOTAL (MW)	1167	367	200	82
MW TOTAL	1984			

Table 5-25 Generation requirements sensitivity case 2

As one can see in the previous table, the installation of 82 MW in co-generation in the short term does not imply reductions in the expansion for the system, with regard to other cases analyzed in the Plan, as the continuity one. The marginal cost behavior, is shown in Graph 5-12 and its evolution, between 2011 and 2015, is 37.9 US$/MWh in average.



Graph 5-12 Colombia's marginal cost sensitivity case 2

The reliability limits for this sensitivity case, are presented in Table 6-26. As one can see, with the installation of the suggested capacity, the system is inside the limits established by the regulation.

PERIOD	No. SERIES	VERE	VEREC
03/2007	1	0,02%	2,40%
02/2011	1	0,01%	1,45%
03/2013	1	0,01%	1,43%
12/2014	1	0,01%	0,00%
03/2015	4	0,12%	2,96%
11/2015	1	0,00%	0,01%

Table 5-26 Reliability limits sensitivity case 2

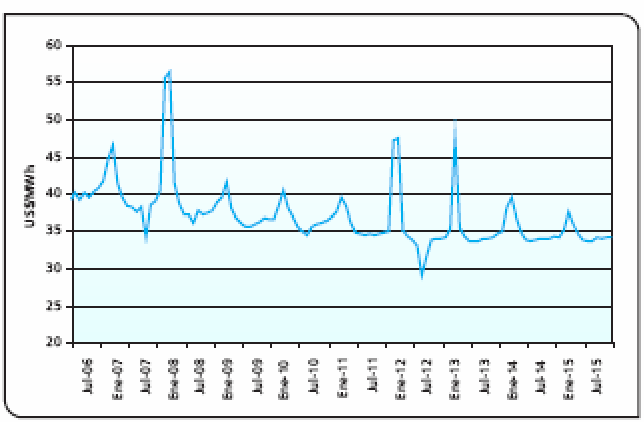
5.7.3.3. Sensitivity Case 3

This sensitivity case pretends to establish the national interconnection system capacity requirements, in front of hydrology critical cases, for which, the system behavior with hydrology between the years 1990 to 2005, was analyzed. In addition, it is assumed, for this case, the occurrence of a medium growth demand scenario of energy and interconnection with the Central America countries, Ecuador, and from the latter, to Peru. The expansion requirements show that the system demands, at least, the installation of 2,050 MW, some of them consist of the installation of new generation plants, which operate with mineral coal, as well as with units that execute closing of open cycles that use natural gas. (See Table 5-27).

YEARS	HYDRO	GAS	COAL
2006			
2007		54	
2008			50
2009	80	163	
2010	192		
2011	495		300
2012		166	
2013			
2014		150	
2015	400		
SUB-TOTAL (MW)	1167	533	350
MW TOTAL	2050		

Table 5-27 Generation requirements sensitivity case 3

Since this case considers the occurrence of critical hydrology on the system in the short term, marginal costs between 40 and 45 US$/MWh are present in such period, which are attenuated, in the long term, with the entry of new generation plants with greater efficiency.



Graph 5-13 Colombia's marginal cost, sensitivity case 2

If the proposed expansion is present, in this case, diverse series with deficit would be present. Even though, these are adjusted inside the values established in the regulation, see Table 5-28.

PERIOD	No. SERIES	VERE	VEREC
02/2008	1	0,07%	2,45%
03/2008	1	0,01%	1,45%
12/2010	1	0,00%	0,01%
02/2012	1	0,03%	2,85%
03/2012	1	0,03%	2,69%
03/2013	1	0,04%	2,51%
12/2013	4	0,00%	0,03%
03/2014	2	0,07%	2,89%
04/2014	1	0,02%	2,45%
03/2015	1	0,01%	1,48%

Table 5-28 Reliability limits sensitivity case 3

5.7.3.4. Sensitivity Case 4

This case pretends to determine the effects that, the possible removal of Cauca – Paraíso Hydraulic chain, would have on the system, considering that it would take place starting January 2007, on a scenario that considers that the following conditions would be present in the system: Gas limited availability, medium gas prices, medium energy an power demand, Colombia interconnected with Ecuador and Peru.

The results of the simulations, shows that even with the installation of new 700 MW, different from the ones currently under construction, the system could be impacted, by energy deficit of 5,600 MW, in the period of analysis, comprised between the years 2011 and 2015, which in turn, would reach EREV values of 7,89%.

5.8. CONCLUSIONS AND RECOMMENDATIONS

The following are the conclusions and recommendations obtained from the generation analysis, from the different simulations performed for the national interconnection system expansion in the horizon 2006-2015.

- In order to serve the country's high and medium energy demand, it is necessary, to have at least 150 new MW, in the year 2009, to maintain the country's exporting trend.

- For the period between 2011 and 2015, it is necessary to consolidate, in the country, the entry of at least 700 new MW, for a scenario that considers the interconnection with Ecuador, as well as the occurrence of a medium energy demand, and 1,000 MW for a high energy demand scenario, considering the interconnection with Central America and Ecuador.

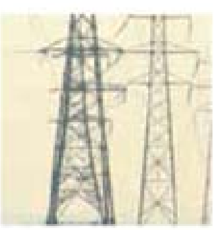
- It is necessary to consolidate the entry of at least 150 new MW in mineral coal, between the years 2010 and 2012, in order to reduce the system's vulnerability and provide greater energy stability.

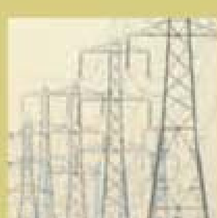
- The possible effect of Cauca - Paraíso hydraulic chain removal on the system would include energy deficit in 670 GWh average per year, in the horizon of analysis comprised between 2007 and 2015. This rationing value was estimated considering, even the installation of 700 new MW in the 2011 and 2015 period, which are not yet under construction.

- The different scenarios analyzed, show that in the cases in which the international interconnections towards Central America and Ecuador, were evaluated, from the energy point of view, the country shows the characteristic of being mainly an exporter and preferentially towards Central America. Even though, a considerable reduction is observed, in the energetic interchanges with Ecuador in the period of analysis.

- In the expansion analysis, that considers the gas natural availability limitation, to serve the country's energy demand, it is necessary the installation of new generation units based of mineral coal.

6 TRANSMISSION EXPANSION





6. TRANSMISSION EXPANSION

6.1. BASIC INFORMATION

The basic information for this analysis corresponds to the medium growth scenario of the energy and power electric demand projections, and the short and long term generation scenarios, taking into account the continuity scenario without interconnection with Peru, described in previous chapters.

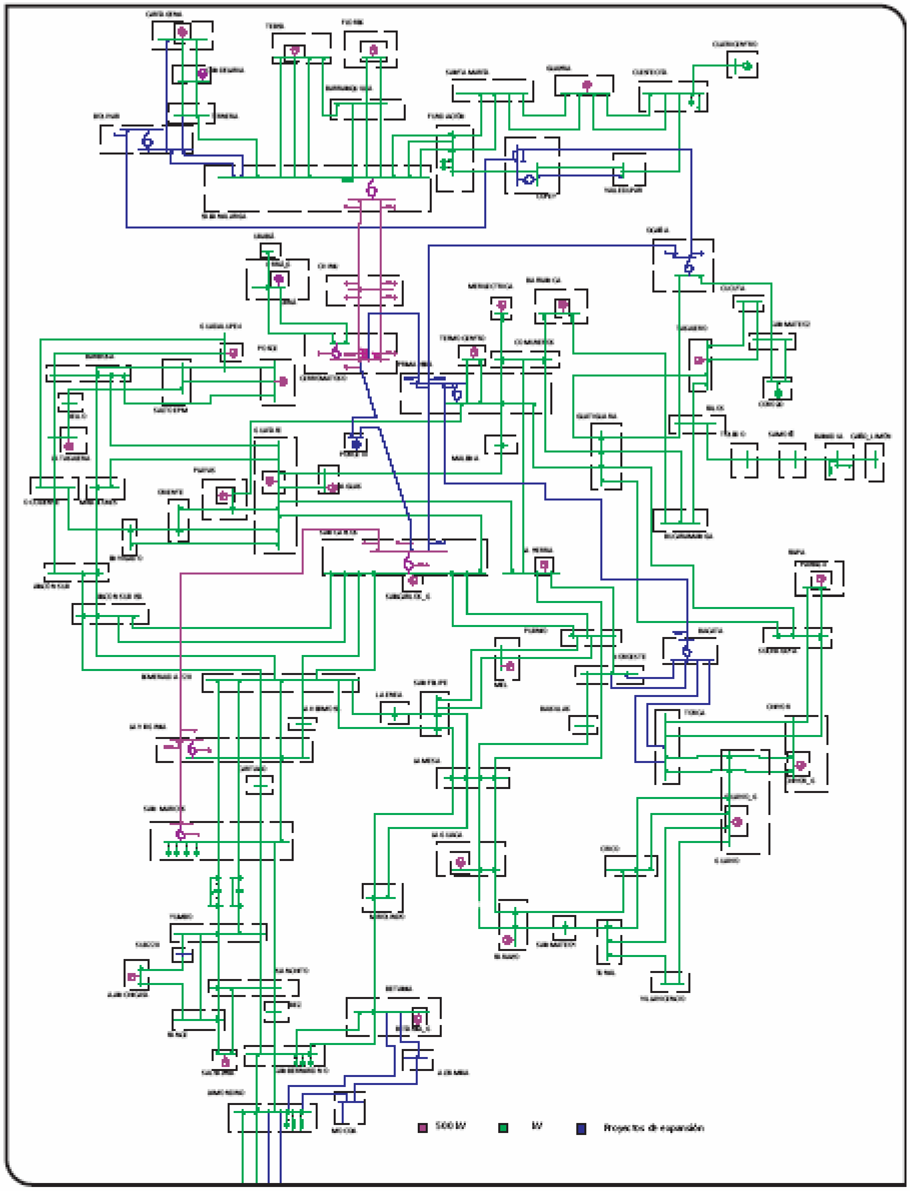
Network modeling, takes into consideration Colombia's as well as Ecuador's NTS, and level 4 voltage Regional Transmission Systems (RTS) and the generation units at the voltage level at which they operate; including the corresponding control schemes. The system's data and electrical parameters were provided by the different agents and complemented with the available information from CND.

The following projects are also considered to be under way with the entry dates.

PROJECT	ENTRY DATE
500 kV Bacatá – Primavera and associated works project	31-Dec-06
500 kV Bolivar – Copey – Ocaña – Primavera and associated works project	31- Mar-07
230 kV interconnection expansion with Ecuador project	27- Jun-07

Table 6-1 NTS expansion projects

Graph 6-1 shows the NTS single-wire diagram with the expansion works foreseen up to year 2013.



Graph 6-1 National Transmission System 2013

6.2. LONG TERM ANALYSIS 2015-2020

Load flow simulations are performed, in order to obtain signals to reinforce the electric network in the NTS as well as in the RTS and the possible opportunities of generation plants locations.

The analysis takes the network with the expansion defined and the alternatives resulting from the short and medium term analysis. The medium growth power demand is applied for year 2020 given by UPME. There are not interchanges with other countries considered.

6.3. COASTAL AREA ANALYSIS

The analysis comprises the Bolivar, Atlántico, Guajira, Cesar, Magdalena, Chinú and Cerromatoso sub-systems. It is necessary to increase the transformation capacity in some of the sub-centrals, among them 230/110 kV Candelaria, 230/66 kV Ternera, 230/110 Santa Marta, Fundación and Valledupar.

The third transformer in 500/110 kV Chinú and the 230 kV Urrá – Montería line, with 230/110 transformation in Montería. There is a 30 MVAr compensation with Mompox; nevertheless, a long term solution should be pursued, since the compensation is not sufficient.

6.3.1. NORTHEAST AREA ANALYSIS

The area requires transformation expansion and works in the NTS, for the transformation problems, a new injection point was considered at 500 kV in Nueva Bucaramanga, with 500/115 kV transformation, reconfiguring the 500 kV Primavera – Ocaña line in Primavera – Nueva Bucaramanga – Ocaña and the transfer of load to this sub-station. Reconfigurations should be done for the STR and expand transportation of some lines.

6.3.2. BOGOTA AREA ANALYSIS

For the Bogotá area, the whole generation scheme is available. Even under this condition, the demand originated in the area is not supplied.

Some alternatives that allow the import from other generation centers are required. For this reason, a 500 kV expansion alternative, submitted in the short and medium term analyses should be implemented, which implies 500/115 kV transformation, in addition, the increase of transformation to 115 kV, is required, as the second transformer in La Guaca and the Third in the Northeast.

6.3.3. ANTIOQUIA AREA ANALYSIS

This area, thanks to the generation capacity, is self sufficient and exports to other areas. There are over loads in the transformation of 110 kV Envigado, Bello, Apartadó and Apartadó – Urabá line.

6.3.4. CALDAS – QUINDÍO – RISARALDA AREA ANALYSIS

This area requires of all generation available, the second transformer in La Hermosa, Third transformer in Esmeralda in Pavas – Virginia connection with 230/115 kV transformation expansion in Virginia. A long term solution to voltage problems in 115 kV Armenia, Tebaida and Regivit sub-stations, is required.

The Armenia sub-station connection to 230 kV should be studied in more detailed and compared with other transformation expansion alternatives for the area.

6.3.5. VALLE AREA ANALYSIS

For solution of overloads in the area, the 230/115 kV transformation in HIGH Anchicayá, the reconfiguration of one of the 115 kV LOW Anchicayá – Chipichape, into 115 kV LOW Anchicayá. – HIGH Anchicayá – Chipichape and the Sub220 substation reconfiguring 230 kV HIGH Anchicayá – Yumbo with two 230/115 kV transformers, are considered to be in operation.

6.3.6. CAUCA-NARIÑO AREA ANALYSIS

In Cauca, the 230/115 kV transformation expansion, is required in San Bernardino and Páez. In Nariño, to expand the transformation in Ipiales and a long term solution to low voltages in Junin and Tumaco, are required, since the 2020 compensation in Tumaco is not sufficient.

6.3.7. TOLIMA – HUILA- CAQUETÁ AREA ANALYSIS

In order to evacuate the Amoyá generation through 115 kV Natagaima, the links between Bote y Prado are considered closed, even though, it is not sufficient, the associated lines capacity should be expanded or an alternative that allows such evacuation. The 230/115 kV second transformer in Mirolindo is considered in operation.

6.4. SHORT AND MEDIUM TERM ANALYSIS 2007 - 2015

In this analysis, the behavior of each of the areas comprising the National Transmission System, for the 2007 – 2015 horizon, is studied. The exercise is done for the maximum domestic demand scenario, considering the power medium growth rate, using generation dispatches for hydraulic and thermoelectric scenarios, considering the expansion projects that were reported by the Network Operators in the 2006 Planning Standard Information.

The entry into operation of 500 kV Bolivar – Copey – Ocaña – Primavera – Bacatá and the 230 kV Betania – Altamira – Mocoa – Jamondino – Limits with Ecuador line projects are among the general considerations for the horizon.

6.4.1. NORTHEAST AREA ANALYSIS

In the area the Barranca – Palenque and Lizama – Palenque are considered normally open circuits. Under these conditions and even with the entry of the 230/115 kV second transformer in Barranca, for 2007, high levels of load ability are observed in 230/115 kV transformers of Bucaramanga and Palos substations, situation that becomes more critical, for the low hydrology scenario, in which, starting 2007, the level of overloading in Bucaramanga is approximately 5%, and starting 2009, exceeds 10%.

In the whole analysis horizon, one can observe that the Barranca – San Silvestre circuit, presents loads exceeding 115% and that towards 2011, the San Silvestre – Lizama circuit, would reach overload figures near 5%.

It is recommended that the Network Operator (NO), study solutions to the mentioned problems by means of transformation expansion and CT’s alternatives.

Considering the OXY projected demand growth, voltage problems in the NTS, are no evidenced, after the entry into operation of SVC, which will be connected to 34.5 kV level starting 2006.

6.4.2. BOGOTA AREA ANALYSIS

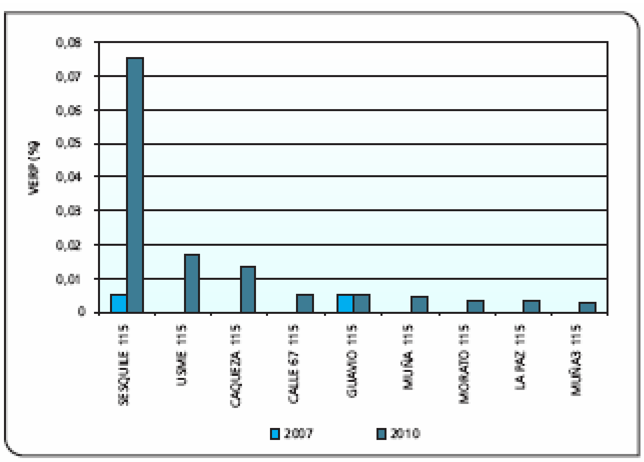
For the year 2006 the Networks Operators report 27 new MW of demand in the area, which are planned to supply, through a new substation called Comsisa, at 115 kV level, which would be connected to Chía and Termozipa substations and would not require additional expansion works to serve the new demand.

Among the expansion information reported, the NO proposed a capacity compensation bank of 87.5 MVAr in the 115 kV El Sol substation. The analyses show that with this project the reliability of the area is improved, specifically in the substations near the project, which improve their voltage levels, and therefore, are less vulnerable facing non-availability events of the system.

With the projected dispatches, in normal operating conditions, before the year 2011, it is not necessary the installation of a third 230/115 kV transformer in the Northwest.

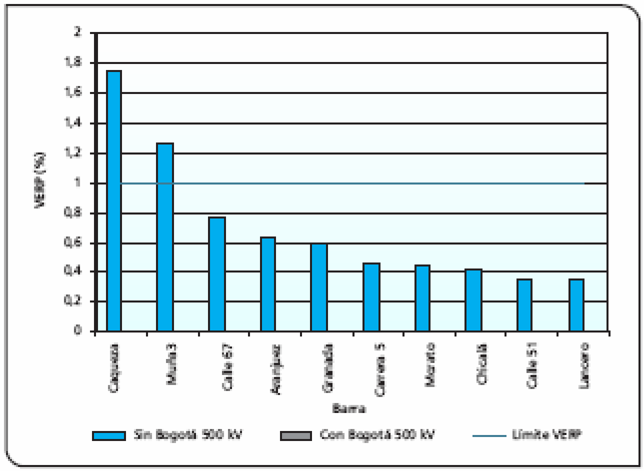
In 2015, there will be load ability problems in the Circo and Torca transformers, as well as in the Torca – Aranjuez line, these problems can be solved with a new injection point towards 115 kV south of the Bogotá system. (See 1, 2 and 4 alternatives, numeral 6.3.2.1). The second transformer in Bacatá could provide benefits in the increase of the import limit for the area.

The reliability analysis shows that for year 2007, with the entry of 500 kV Bogotá project, a significant Power Rationing Expected Value (PTEV), is not present. The results are shown in graph 6-2.



Graph 6-2 PTEV in Bogotá, area 2007

Even though, in case of no generation with Paraíso – La Guaca chain, and if the 500 kV Bogotá project, is not available, power rationing expected values, exceeding 1%, can be present, in some of the area bars. Graph 6-3 shows the most significant area values.



Graph 6-3 PTEV in Bogotá, area after the Paraíso – La Guaca withdrawal.

6.4.2.1. Expansion alternatives in Bogotá, area

Although the short and medium term analyses do not show NTS's needs in the area, this version of the plan makes a review of the expansion alternatives submitted in the 2005 version, in order to start definition and foreseen the expansions that will be required ahead. Such alternatives are funded in the contributions done by the Empresa de Energía de Bogotá and Codensa, so as to the plans be compatible.

The alternative variations with regard to the ones submitted in the previous version of the Plan, refer to reconfigurations in the NTS network that allows evacuating the transformation capacity and the configurations that seek for a better NTS performance.

Following, the resulting alternatives are shown:

Alternative 1. A 215 km, 500 kV Primavera – Nueva Substation circuit. The associated works to this project are:

- 500/230/115 kV Nueva Substation, located south west of Bogotá city.
- 450 MVA 500/230 kV and 450 MVA 500/115 kV transformations.
- 230 kV Reforma – Tunal line, reconfiguration in 230 kV Reforma – Nueva Subestación and Nueva Subestación – Tunal, 60 km and 15 km long respectively.
- 230 kV Circo –Tunal line reconfiguration in Circo - Nueva Subestación and Nueva Subestación – Tunal 2 37 km and 15 km long, respectively.
- 115 kV Bosa – Tunal line reconfiguration in Bosa –Nueva Subestación y Nueva Subestación – Tunal, 8.2 km and 3.5 km long, respectively.
- 115 kV Bosa – Techo line reconfiguration in Bosa – Nueva Subestación and Nueva Subestación – Techo, 2.5 km and 9.5 km long respectively.
- 115 kV Chicalá – Nueva Subestación new line.

Alternative 2. 500 kV La Virginia – Nueva Subestación and Nueva Subestación – Bacatá circuit, 230 km and 33 km respectively and its associated works:

- 500/230/115 kV Nueva Subestación, located south west of Bogotá city.
- 450 MVA 500/230/115 kV and 450 MVA 500/115 kV transformations.
- 230 kV Reforma – Tunal line reconfiguration in Reforma – Nueva Subestación and Nueva Subestación – Tunal 60 km and 15 km long respectively.
- 230 kV Circo –Tunal line reconfiguration in Circo - Nueva Subestación and Nueva Subestación – Tunal 2 37 km and 15 km long, respectively.
- 115 kV Bosa – Tunal line reconfiguration in Bosa –Nueva Subestación y Nueva Subestación – Tunal, 8.2 km and 3.5 km long, respectively.
- 115 kV Bosa – Techo line reconfiguration in Bosa – Nueva Subestación and Nueva Subestación – Techo, 2.5 km and 9.5 km long respectively.
- 115 kV Chicalá – Nueva Subestación new line.

Alternative 3. A 230 km 500 kV La Virginia **-** Bacatá circuit. This project only implies the start up of 450 MVA 500/115 kV second transformer in Bacatá, and it is not necessary complementary works in the NTS.

Alternative 4. 500 kV Primavera – Bacatá and Bacatá – Nueva Subestación second circuit and its associated works:

- 500/230/115 kV Nueva Subestación, located south west of Bogotá city.
- 450 MVA 500/230/115 kV and 450 MVA 500/115 kV transformations.
- 230 kV Reforma – Tunal line reconfiguration to Reforma – Nueva Subestación and Nueva Subestación – Tunal 60 km and 15 km long respectively.
- 230 kV Circo –Tunal line reconfiguration in Circo - Nueva Subestación and Nueva Subestación – Tunal 2 37 km and 15 km long, respectively.
- 115 kV Bosa – Tunal line reconfiguration in Bosa –Nueva Subestación y Nueva Subestación – Tunal, 8.2 km and 3.5 km long, respectively.
- 115 kV Bosa – Techo line reconfiguration in Bosa – Nueva Subestación and Nueva Subestación – Techo, 2.5 km and 9.5 km long respectively.
- 115 kV Chicalá – Nueva Subestación new line.

From the analyzed alternatives, the number 1 shows the greatest level of imports for the Bogotá area. Alternatives 1, 2 and 4, which implies the construction of a new substation south west of Bogotá city, offer voltage support to adjacent substations and alleviates the 230/115 kV transformers load ability in the area, specially those from Circo substation.

ALTERNATIVES DESCRIPTION	TOTAL (US$ Million Dec -05)
Alternative 1	118.78
Alternative 2	134.94
Alternative 3	79.00
Alternative 4	135.26

Table 6-2 500 kV expansion alternatives cost

These alternatives and their possible additional variants will be subject to permanent assessment in the next Expansion Plan Reviews.

6.4.3. BOLIVAR AREA ANALYSIS

The NO, inside the reported expansion to UPME, considers the change of level of Zaragocilla substation from 66 to 110 kV starting 2007. The rest of the changes in level, reported in the planning information from previous years, were not maintained in the reported information to UPME for this version of the Plan.

Towards 2009, and in front of a hydraulic generation dispatch, load levels exceeding 100% in Cartagena Substation 230/110 kV transformer, are shown, which could be solved by the Network Operator, increasing the voltage level of Chambacú and Bocagrande substations, as it was proposed in previous expansion plans, or carrying out the installation of the second transformer.

For this horizon, the need for transformation capacity expansion in 230/110 kV Candelaria, reported by NO in its expansion plan, is not evident.

6.4.4. ATLANTIC AREA ANALYSIS

According to the complementary analyses performed for the area, it is considered the entry of connection project in Nueva Barranquilla and the 110 kV Veinte de Julio – Silencio line reconfiguration, developed in two stages:

First Stage:

Connection of 100 MVA 230/110/13.8 kV to NTS in Nueva Barranquilla substation, that initially will take load from the 13.8 kV winding and subsequently, when the second stage is operational, such load will be transferred to a 110 kV bar. To be operational in 2006.

Second Stage:

- A 100 kV substation in Nueva Barranquilla and 110 kV Veinte de Julio – Silencio line reconfiguration into 110 kV Veinte de Julio – Nueva Barranquilla – Silencio. To be operational in 2007.

- Connection of a 100 MVA 230/110/13.8 kV second transformer to NTS in Nueva Barranquilla substation. To be operational in 2007.

The benefits of the project are given by the reductions of security generations and the costs estimated with constructive units of CREG Resolution 082 of 2002. The costs do not consider the transformer which will be in operation in the first phase, since such was considered as back up.

6.4.5. CALDAS – QUINDIO – RISARALDA AREA ANALYSIS

The analysis considers the Pavas substation operation, which reconfigures 115 kV Dosquebradas – Papeles Nacionales line in 2007. Similarly, 115 kV Cajamarca – Regivit and Manzanares – Victoria channels are considered open.

For year 2009, problems with overloads or low voltages in the area, are not identified. In that sense, the need for an expansion alternative, as proposed by Empresa de Energía de Pereira , 115 kV Pavas – Virginia connection and a 230/115 kV second transformer in Virginia, is not evident.

Only until year 2011, overloads in the 230/115 kV Esmeralda and la Hermosa transformers, are evident. For this reason, the area Network Operators are recommended to study alternatives such the 230/115 kV transformation expansion, initially in la Hermosa and then in Esmeralda, or the 115 kV Pavas – Virginia connection and the 230/115 kV transformation expansion in Virginia. To install a second transformer in la Hermosa is a possible solution in 2015.

The transformers load ability depends on the hydraulic generation in the area, which is dispatched at the base. In front of a critical hydrology, in which such generation is not available, the transformer will present overloads.

The voltage in Armenia, Tebaida and Regivit, progressively diminish, and towards year 2011, tend to 0.9 p.u. limit. In 2015, 115 kV Tebaida violates the limit, and therefore, it is recommended to the Network Operators, to evaluate an alternative such as the installation of compensation capacity.

According to the planning information, provided for the year 2006 by the Network Operators, for the CRQ and Tolima areas, and the analyses performed by UPME, only until year 2015 the San Felipe CT end will become a limitation for the transfer through the 115 kV San Felipe – Mariquita - Victoria line.

6.4.6. META AREA ANALYSIS

With the entry of 230/115 kV transformer in La Reforma substation, the Meta demand is adequately supplied, but towards the end of the analysis horizon, capacity compensation, to maintain voltages above 0.9, is required.

6.4.7. VALLE AREA ANALYSIS

According to planning information submitted by EPSA, the 230/115 kV second transformer in San Marcos substation, enters into operation starting year 2006.

Notwithstanding, this expansion, starting 2007, high levels of loads, are evident, which can be present at the Yumbo and Juanchito transformers, depending on tap changers. This situation becomes critical starting 2009, when overloads on said transformers are present.

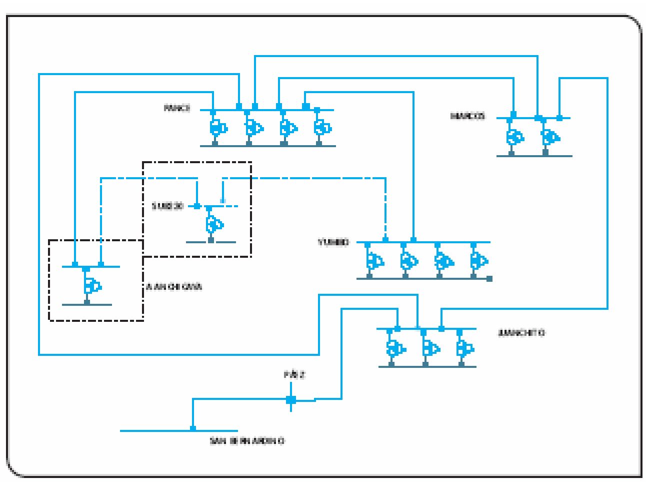
Through Standard Planning Information submitted to UPME, in the years 2002 to 2005, the Network Operator proposed the alternative of constructing a new 230/115 kV substation in the area. Called Sub220, which would reconfigure 230 kV Pance – Yumbo line and would have an initial capacity of 90 MVA. This alternative was technically and economically assessed in front of other alternatives and finally was recommended in the Generation – Transmission Reference Expansion Plan 2005 – 2019. Even though, during current plan analyses, The Network Operator sent to the Unit, a proposal study modifying such recommendation, requesting a new study of the alternative, described as following:

- Connection of a 90 MVA 230/115 kV transformer in 230 kV HIGH Anchicayá.

- Reconfiguration of one of the 115 kV Chipichape – LOW Anchicayá circuits, into 115 kV Chipichape – HIGH Anchicayá – LOW Anchicayá.

According to Network Operator's study, the described alternative, would enter into operation in the year 2008, delaying the entry of Sub220 substation (90 MVA), for the year 2010 and its reinforcement (additional 90 MVA), for the year 2014. As part of the given justification by the Network Operator, it is mentioned that with the entry of 230/115 kV transformation in HIGH Anchicayá, the reliability of the Buenaventura area is improved. It is worth to mention that for the Sub220 project, the reconfiguration of 230 kV HIGH Anchicayá – Yumbo circuit, instead of 230 kV Pance – Yumbo, is proposed.

In Graph 6-4, the single-wire diagram of 230 kV Valle ring, including the proposed expansion, is shown.



Graph 6-4 Valle Area Expansion Projects

In order to analyzed the new alternative, the new area conditions were studied without considering the entry of expansion projects, finding that, from the load flow and reliability analyses results, the necessary alternative, to eliminate the overloading problems in the transformers is required starting 2009.

Analyzing the proposed alternatives, one can observe, that the 230/115 kV HIGH Anchicayá transformer expansion, presents a similar technical performance to Sub220 project, no matter if this latter reconfigures the 230 kV Pance – Yumbo or HIGH Anchicayá – Yumbo circuit, that is, with any of these alternatives, it is possible to solve the overloading problems up to year 2012. Starting 2012, it is necessary to have an additional expansion alternative, since the area transformers loading ability, again surpasses their capacity.

With regard to reliability of the area, the results show that with the HIGH Anchicayá transformation, better levels are obtained, than those obtained with Sub220 project in the analysis horizon.

With regard to the alternative economic evaluation, the costs of each alternative are shown in Table 6-3.

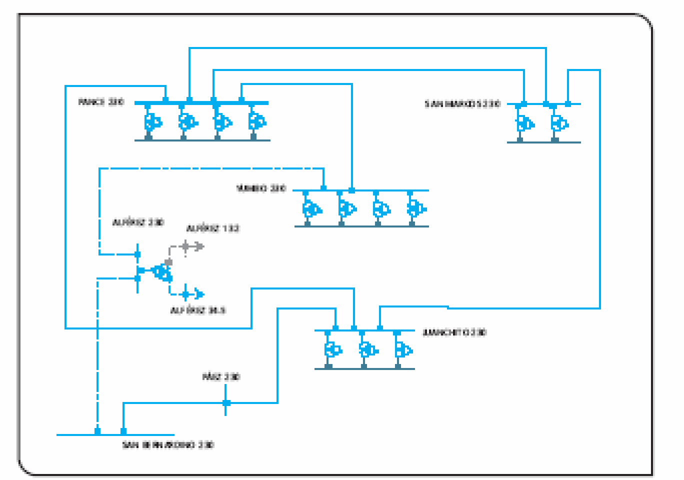
2009 Investment	HIGH Anchicayá Transformation	Sub 220 Substation
NTS constructive Units	0.89	3.96
RTS constructive Units	2.42	4.02
2012 Investment	HIGH Anchicayá Transformation	Sub 220 Substation
NTS constructive Units	3.96	0.89
RTS constructive Units	4.02	1.49
Present Value	6.58	7.35

Table 6-3 Expansion alternatives comparison costs in Valle (US$M) as of Dec 2005

Considering that with the entry of the HIGH Anchicayá transformer alternative in 2009, the area problems up to year 2012 are solved, and that the present value of the annuity payments of 25 years investment is smaller than that one of Sub220 project, concluding that this is the optimal alternative. Based on the above, the Sub220 project is tentatively delayed until year 2012, date which will be analyzed in next Plan's reviews.

6.4.7.1. 230/34.5/13.2 kV Alférez Substation project

On the other hand, the 230/34.5/13.2 kV Alférez Substation project, proposed by EMCALI, was analyzed. With this project starting 2009, it is planned to serve the demand of different industrial and residential projects, which are under construction south of Cali city, and unload the Pance and Melendez substations at 34.5 kV level, The project consists of the construction of a new substation with 90 MVA capacity, at 230 kV voltage level, interrupting the 230 kV San Bernardino –Yumbo line, In graph 6-5, the area single-wire diagram including this expansion, is shown.



Graph 6-5 230/34.5/13.2 kV Alférez Project

From the analysis, one can observe, that with 230/34.5/13.2 kV Alférez substation, is it possible to serve the demand, but in case of failure of feeding from the NTS, not having a back up at level 4 voltage and considering what was exposed by the Network Operator, with regard to the high levels of load in the 34.5 and 13.2 kV networks, would be not possible to serve the demand in a reliable way.

Likewise, being a NTS level project, the benefits obtained in the area with this project, were analyzed, showing that with this project, and being focused in serving a specified demand, does not contribute to improve the load ability levels of area transformers.

Based on the above, the Network Operators are recommended to analyze other expansion alternatives, to serve the demand considering levels 3 or 4 voltage, assessing the technical benefits and valuing the economic impact for the user.

6.4.8. TOLIMA – HUILA – CAQUETA AREA ANALYSIS

With The entry of 168 MVA 230/115 transformation in Altamira substation, one can observe that the voltage levels in the radial network at 115 kV, going from Altamira up to Florencia and Pitalito, remain inside the limits throughout the analysis horizon.

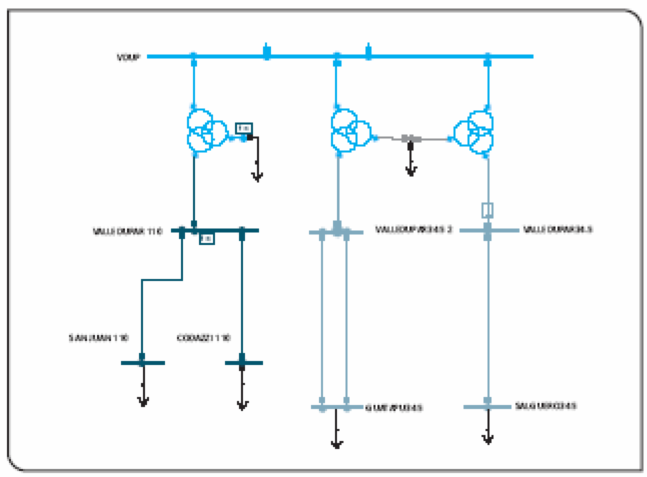
Starting year 2007, the 230/115 kV transformer load level of Mirolindo substation exceeds 90%, even though; it is until year 2009, when this value is close to the limit. For this reason, it is recommended that the Network Operator, delays the entry date of the second transformer until such year.

For year 2009, it is expected the entry of Amoyá (78 MVA) generation project, connected to Tuluní (Natagaima), which will reduce the imports from Bogotá area. Considering the current network topology, the evacuation of Amoyá generation will be done through the 115 kV Natagaima – Prado circuit; therefore, it is recommended that the Network Operator reviews the transportation limit of such line, since under the current conditions, there would be overloads of around 18% and up, depending on the dispatch. Another alternative to analyze is the closing of 115 kV Bote – Natagaima – and Bote – Prado links, even though, for this case the links operating limits associated to Amoyá generation, should be assessed.

6.4.9. GUAJIRA – CESAR – MAGDALENA AREA ANALYSIS

According to what the Network Operator reported, after the entry into operation of 230/34.5/13.8 kV transformer in Valledupar substation, with 45/30/15 MVA capacity, which was carried out in 2005, the demand distribution was modified, to avoid overloading in the 34.5 kV windings of the three transformers connected to 230 kV Valledupar substation.

The adopted configuration is shown in Graph 6-6.



Graph 6-6 Valledupar substation configuration

On the other hand, in this substation, the analysis results shows that since 2007, the 110 kV winding of 230/110/34.5 kV transformer, from which the San Juan and Codazzi demands are served, the load level exceeds 100%, same as in year 2011 for the 230 kV winding.

In the year 2011, the secondary winding of the 45/30/15 MVA, 230/34.5/13.8 kV Valledupar transformer, that supplies the Guatapurí demand, is close to the capacity limit.

It is suggested to the Network Operator, to analyze an alternative to solve these problems, such as to transfer parts of San Juan, Codazzi and Guatapurí demands to nearby substations, or, in case it is necessary, to expand the transformation capacity.

The Cuestecitas – Riohacha line will operate at 100% of its capacity in 2015. It is recommended, to take it into account for Network Operator's expansion plans.

6.4.10. ANTIOQUIA AREA ANALYSIS

With the current NTS network, the area demand is served without any need for expansion.

6.4.11. CHOCO AREA ANALYSIS

The area demand is considered to be served, from 115 kV Virginia substation, through Virginia – Cértegui and open Quibdó – El Siete links. Under these conditions and with compensations in Quibdó, Istmina and Cértegui, only until 2011, voltage problems below 0.9, are detected. In 2015 the voltages are close to 0.85 p.u. in these substations; therefore, it is recommended, starting 2013, the installation of a new compensation in the area, to maintain the voltages inside the limits.

6.4.12. CERROMATOSO AREA ANALYSIS

For this horizon there are not problems in the area. Only until 2015, the 110 kV Apartadó – Urabá line capacity is exceeded in 2%, therefore, it is recommended to study the capacity expansion.

6.4.13. CAUCA – NARIÑO AREA ANALYSIS

In 2007, load levels exceeding 100% are observed in the 150 MVA transformer in Jamondino substation. It is recommended for the Network Operator to install a second transformer in that substation, in order to eliminate the problem, and to guarantee serving the demand in the area.

With this transformation expansion, the demand growth is served without NTS expansion requirements. Even though, and due to the 115 kV Jamondino – Junín – Tumaco radial network extension, the Tumaco voltage level, would be below 0.9 p.u., therefore, it would be a solution to install a 12 MVAr compensation capacity in such station, up to 2014. In that sense, in front of demand increase outside the projections, there would be necessary to study the solution in more detail.

6.4.14. CHINU AREA ANALYSIS

As mentioned by UPME, in the 2002, 2003, 2204 and 2005 expansion plans, the 500/110/34.5 kV Chinú substation transformer load level, is closed to its capacity limit in the short term. In the different versions of the Plan, two alternatives have been analyzed: transformation capacity expansion in Chinú or the circuit at 230 kV from Urrá up to 230/110 kV new substation, which would be connected to 110 kV Montería.

Based on the analyses results, it is recommended to the Network Operator, the transformation expansion capacity alternative in Chinú, through the installation of a 150 MVA third transformer, alternative which will solve the problem, during the analysis horizon and carrying with it, less investment costs.

This recommendation is maintained, and even though, the Network Operator has suggested the 230 kV Urrá – Montería alternative inside the expansion plan, reported to UPME, it is still pending the submission of alternatives´ analysis. Therefore, in case that the Network Operator, is not interested in executing such expansion in its system, the CREG Resolution 070, of 1998 Numeral 3.2.4, should be reinforced, with regard to the responsibility for the execution of projects included in the RTS´s and/or SDL's expansion plans, but not included in the Network's Operators expansion plans. The alternative cost of a third transformer in Chinú substation is US$M 5.7.

On the other hand, the 110 kV Urrá – Tierra Alta line load exceeds the limit in 2009, to solve this problem, we recommend the Network Operator to review the operating limit of the line, since it is below the conductor nominal capacity.

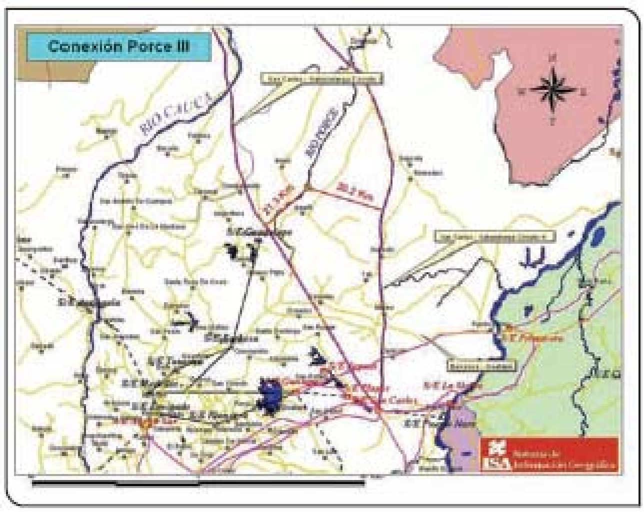
The 110 kV Montería – Rio Sinú circuit, should be normally open, since there are not additional problems observed, which justify its permanent closing, since, contrary of what is desirable, it would generate increase of load levels in Urrá – Tierra Alta circuit.

In the year 2007, voltage levels below 0.9 p.u. are present, in Magangue and Mompox substations. With the Network's Operator expansion suggestion of installing a 15 MVAr in 110 kV Mompox capacity bank, would not solve the problems in the short neither in the medium term, since the voltages would be close to 0.9 p.u. in 2007, and in 2009, again, would be below 0.9 p.u. In that sense, it is recommended to install a capacity bank of around 20 MVAr in Mompox in 2007, and another of around 15 MVAr in 2011.

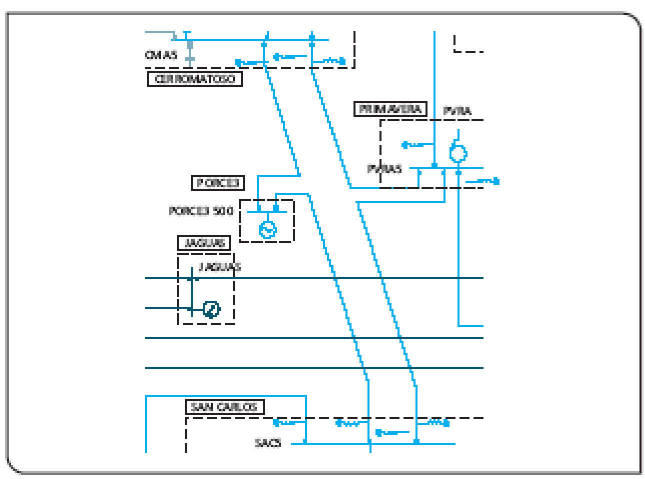
In 110 kV Rio Sinú, without counting on a compensation capacity starting 2007, voltages below 0.9 p.u. would be observed. In this case, it is recommended to install compensation of around 15 MVAr.

6.4.15. PORCE III GENERATION PROJECT CONNECTION

Since 2003, in the previous versions of Expansion Plan, the Porce III generation project connection, carried out by EEPPM to the National Transmission System, has been analyzed, showing as the best technical and the minimum cost alternative, the construction of a new 500 kV substation, that would reconfigure the 500 kV San Carlos – Cerromatoso circuit, through additional line stretches with 22 km individual length. In graph 6-7 and Graph 6-8, the project geographic location and electric configuration alternative, is described.



Graph 6-7 Project Geographic Location



Graph 6-8 Electric configuration of selected connection alternative

Following, among other aspects, a review and update of the analyses, a timetable and selected connection alternative costs, are shown.

6.4.15.1. Electrical analysis and investment costs

The steady-state results show that the selected alternative, meets the planning criteria established in the Network Code. In addition, voltage stability analysis, small signal stability and transient stability for the most critical contingencies for the system, in front of the project connection condition, were carried out.

The results of the analyses described in numeral 6.3.17, show that the Porce III project connection, does not affect the stability of the system and the connection alternative is strong, with regard to stability problems because of contingencies.

In Table 6-4, shows the desegregation costs of selected connection alternative. The line reactors Constructive Units (CU) costs were not included, since more detailed analyses are required, to determine the reactors number, scheme and capacity, which will be previously executed at the public bid process.

Description Building Unit	Quantity	Installed ea. (M$US Dec-97)	TOTAL (M$US Dec-05)
Porce III Substation 500 kV – Switch 1/2			
Common Module	1	$ 3,11	$ 4,00
Line bay	2	$ 2,90	$ 7,46
Line runs San carlos – Porce III – Cerromatoso 500 kV			
Line Km of 500 kV	44	$ 0,25	$ 13,97
		Total	$ 25,42

Table 6-4 Cost of connection to NTS selected alternative

6.4.15.2. Public Bid Process and Regulatory Aspects

The project works progress, has suffered some delays, and therefore, as shown in Chapter 5, the entry of the total number of units, which will complete the 660 MW of total capacity, would be performed in September 2011. Even though, for startup trials, and Porce III machines and electrical equipments connection to 500 kV new substation, it is necessary that the new substation and expansion works be operational, in advance way before the expected date of the first unit entry.

Considering an approximate term of two and a half years, to execute the public bid process and the required NTS expansion works, as indicated in Table 6-5, initiating the process at the beginning of the third quarter 2007, there would be around eight months between the conclusion of the expansion works, and the entry into operation of first unit.

III – 06 IV-06	I-07	II-07	III-07	IV-07	I-08	II-08	III-08	IV-08	I-09	II-09	III-09	IV-09	I-10	II-10	III-10	IV-10
Plan 2006			Bidding processes and work execution												Entry First Unit	

Table 6-5 General timetable

Even though, this time could be longer than necessary, for the execution of startup trials and machines and substation connection, before initiating the public bid process that will take place during the curse of 2007, UPME will define, considering the information provided by EEPPM and/or effective regulatory dispositions, the timely entry date of operation of expansion works.

In addition, with regard to the contract connection signing procedure, with the generator, and because of the non existence of previous owner of the connection point and a mechanism that guarantees, that once the NTS expansion works are done, the generator will enter into operation, the parties that are committed with the development of the project, should comply with what is established by CREG, to that regard, resulting from the disclosure process and resolution projects public consultation, that will partially modify the CREG Resolution 022, 2001, as well as the general procedures, for the generators connection points allocation to the NTS and RTSs or SDLs, which shall be defined and regulated before the public bid starts.

6.4.16. NTS SUBSTATIONS SHORT-CIRCUIT LEVEL

In annex D, the NTS substations short-circuit level, for the odd years starting 2007 up to 2015, are shown. For 2007, with the entry of 500 kV Costa and Bogotá projects, the short-circuit level in 230 kV San Carlos substation, exceeds its current 40 kA short-circuit capacity. In addition, the single-phase, as well as three-phase short-circuit level in 230 Kv Chivor substation, exceed 25 kA capacity, for which the substation equipments were designed and constructed.

These cases were also, described and confirmed by ISA, as owner of both substations, in response to UPME communications, in which the carriers were requested to identify and inform NTS substations cases, that exceed the design levels in the short and medium terms, in order to consolidate an inventory of those situations and to have more elements for judgment and analysis, to determine definite solutions.

Similarly, the CND was requested to propose short term alternatives, in order to diminish the risk in both substations, which were submitted in the June 2006 Restrictions Evaluations Quarterly Report.

Following, different alternatives are described and assessed, for the two basic types of possible solutions at the short-circuit level in both substations. The first type, consists on reducing the short-circuit level, present in both substations, thus, adjusting it to the equipments capacity, and the second type, corresponds to substations equipments short-circuit capacity expansion, in this way is the capacity of those equipments, which is adjusted to the short-circuit level.

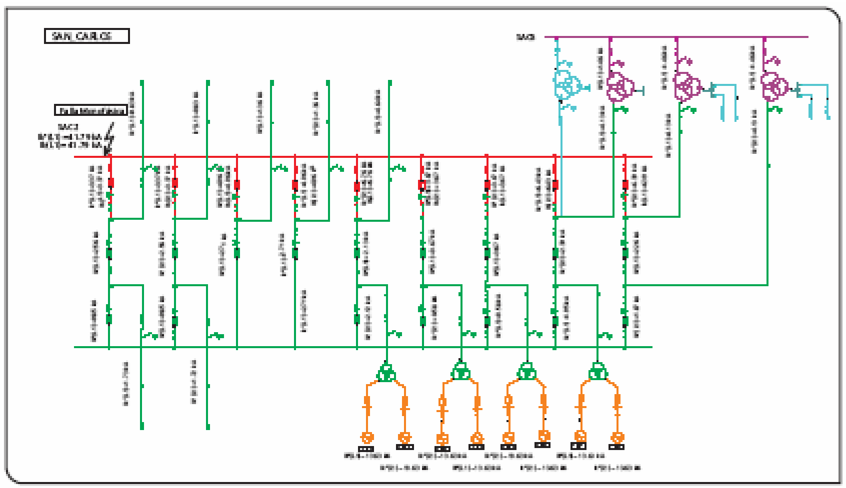
Among the different first type alternatives, those suggested by CND, are analyzed, to face, in the short term, the short-circuit level, on one hand, with the objective to identify, if a short term solution could be feasible in a longer term, thus, delaying another type of solutions; and on the other hand, as a reference comparing exercise, for the long term definite solutions proposal.

For the second type alternatives, the advantages and disadvantages that each alternative comparatively presents, with regard to other considered alternative, are listed, which even though, individually as well as a group, should be analyzed and assessed in more detailed, as long as there are more information and studies for each case.

In all analyses performed for the case of 230 kV San Carlos, the reconfiguration of 230 kV Guatapé- San Carlos circuits and 230 kV San Carlos – La Sierra into 230 kV Guatapé- La

Sierra, is considered to be operative; executed to reduce the current contribution of this circuits at the short-circuit level of the substation. Even though, and since such configuration implies the interconnection and system operation de-optimization, as well as, for the rest of the short term measures, implemented in both substations, while the definite solutions works are executed, this de-optimizations should be reverted as soon as, the definite works are available for the entry of operation.

6.4.16.1. 230 kV San Carlos Substation

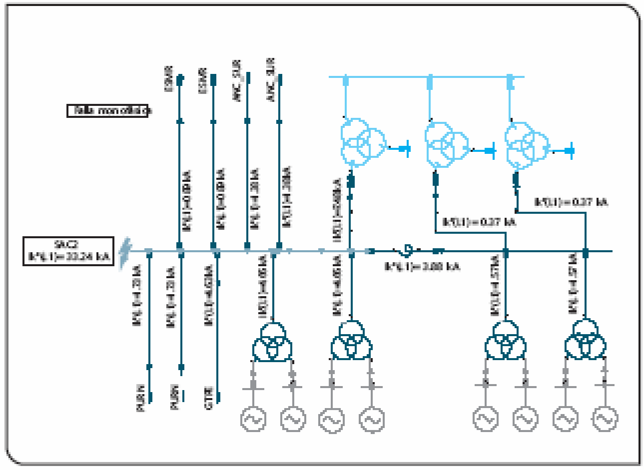


Graph 6-9 Configuration and short level 1Φ year 2007

6.4.16.1.1. First type alternatives, to reduce the short-circuit level in the substation

- The first alternative, consist of the installation of conventional series reactors of 1.9 Ω impedance in each of the substation entrances, thus, in the generation connection bays (4), 230 kV line bays (7) and 500/230 kV transformer bays (3), for a total of 14 equipments to be installed. This alternative, besides that, does no significantly reduce the short-circuit level in the dike, requires additional space availability in each of the substation bays, which implies to execute all works in the bays and represents high investment costs, given the quantity of equipments.

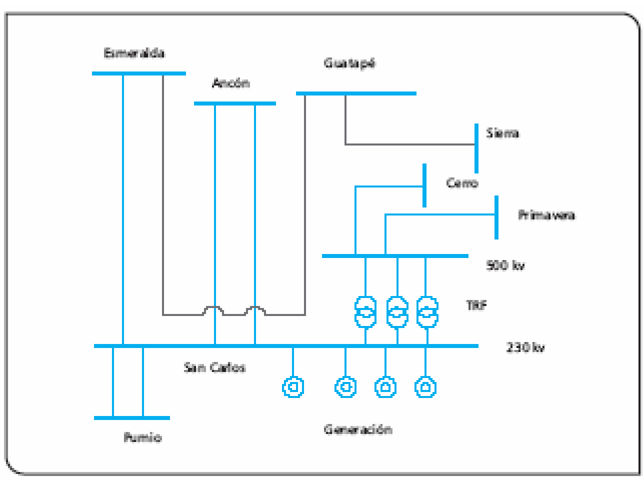
- The second alternative is to install FACTS equipments (Transmission Flexible Systems in Alternating Current) – current limiting reactors. This alternative would imply the 230 kV dike sectioning of substation, the most symmetrically way possible, with regard to the generation distribution, whose sections would be electrically unified, through the reactors available between both sections in each dike, as described in Graph 6-10. The cost for this alternative, is only indicative of the market, corresponding to the equipments cost (two 22.13 Ω reactors and 1000 nominal amperes), with an installation factor equals to 2.0.



Graph 6-10 Current limiting FACTS equipments alternative

- The third alternative consists in limiting the generation units of San Carlos central, along with its associated transformer. This alternative becomes more restrictive with time, and represents extra operating charges. This alternative's cost are calculated based on MPODE, estimating the systems operating costs difference, with and without the alternative in present value at a discount rate of 10%. In addition to the high costs that this alternative represents for the system, the generation capacity limitations can not be considered as a long term feasible alternative for this type of problems.

- The fourth Alternative, described in previous Plans, refers to the 230 kV Guatapé – San Carlos and San Carlos – Esmeralda circuits, into Guatapé – Esmeralda circuit. This alternative, even though, of easy and fast application, carries with it, extra operating costs for network de-optimization. The costs for this alternative are calculated based on MPODE, estimating the system's operating costs difference with and without alternative in present value.



Graph 6-11 230 kV Esmeralda – San Carlos – Guatapé circuit reconfiguration

Short level 1f in barraje 230 kV (kA) – Norm IEC60909 of 2001				
YEAR	1. Reactors Conventional series	2. FACTS Limiters I	3. Restriction G Units	4. Reconf. Circ. Esm-Guat 220
2007	36,4	33,2	38,0 (-2)	36,7
2009	-	-	38,0 (-2)	36,8
2011	-	-	38.9 (-3)	38,9
2013	-	-	38,9 (-3)	38,9
2015	-	-	38,9 (-3)	38,9
Cost of alternatives (M$US Dec-05)				
Períod	Inv. Costs 14 Installed Reactors	Inv. Costs 2 Installed Reactors	VP D costs Operating	VP D costs Operating
2006-2015	-	$56,4	$59,3	$16,0

Table 6-6 Alternatives summary for the short level in 230 kV San Carlos Substation

6.4.16.1.2. Second type alternatives, to expand the substation equipments short-circuit capacity

a) Equipments change from 40 to 63 kA

This alternative consists of current capacity changes from 40 kA to 63 kA short-circuit equipments. According to information provided by the substation owner company, the equipments subject to change are: switches, sectionalizers, current transformers, lightning arresters, and wave traps, among others.

The dikes, the structures and other substation civil works, would no require changes, except for the two switches. In addition, the substation ground connection grid should be reinforced.

Considering the time from the equipment contracting until the execution of works and the necessary disconnections, the change of equipments would take approximately between 20 and 24 months. The estimated total investment cost would be US$ 16.6M, which will be transferred to the users, depending on the CREG regulation.

Advantages:

- The change of equipments is done in the lands and other equipment and elements, structures and existent civil works are still used.
- Probably shorter implementation terms, for this alternative.

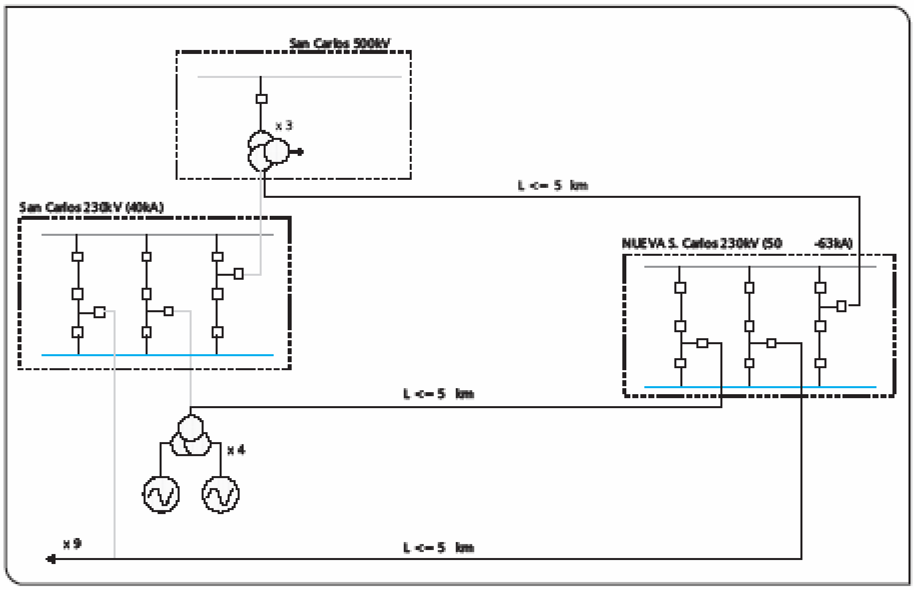
Disadvantages:

- Since the San Carlos substation already has completed 25 years of service, new equipment along with equipment, elements and structures that has such time of service, could present an obsolescence condition, which might limit the reliability and performance of the substation.

- Even though, the flexibility that the configuration of the substation provides, the execution of works, obliges to incur in consignments and partial non-availability of the substation for periods of time, in which the System can be de-optimized, and incur in extra operating costs.

b) New conventional substation with 50-63 kA short-circuit capacity

This alternative consists of the construction of a new 230 kV substation, between 50 and 63 kA short-circuit capacity. The new substation would be located in independent lands, 5 km from those lands in which the current substation is located, which would imply the construction of additional stretches, to connect with the three 500/230 kV transformers, nine 230 kV lines and four connection transformers of San Carlos central generation, that would remain in the current location. Graph 6-12 describes the simplified version of this alternative.



Graph 6-12 230 kV/50-63 kA new San Carlos substation alternative description

Considering the time for the public bids, and the execution of works and the necessary disconnections, the execution of the new substation would approximately take between 20 to 26 months. Depending on the number of additional bays required, the investment cost would be between US$ 17.82M and US$ 30M.

Advantages:

- The construction of the new substation will be executed independently, and therefore, except for the existent substation connections, there is not need to have system equipment or connections available for works, and to incur in complexities, risks and extra operating costs, that a change of equipment represents.

- Contrary to the current substation that presents space limitations, with the new substation, according to the planned relocation, more possibilities should be allowed for future expansions.

- The substation is integrally renewed and the equipment and elements technology is updated.

- The impedances added by the additional line stretches, contribute to reducing, in some way, the substation short-circuit level.

Disadvantages:

- The separation of current connections of the substation implies additional lines stretches and possibly additional bays, which, on one hand, causes in some way, harm to the system's reliability, and on the other hand, would increase the investment cost.

- The additional line stretches can increase the NTS losses.

c) New encapsulated substation with 63 kA short-circuit capacity

This option consists of construction of a new 230 kV encapsulated substation with 63 kA short-circuit capacity. Because of the reduction of space needed for its construction, the new substation can be located in independent land very close to that in which the current substation is located, so that, if necessary, it will only require adding short distance additional line stretches.

Considering the time for the public bids, and the execution of works, and necessary disconnections, the execution of the new substation would approximately take between 18 to 28 months.

Advantages:

- The construction of the new substation will be executed independently, and therefore, except for the existent substation connections, there is not need to have system equipment or connections available for works and to incur in complexities, risks and extra operating costs, that a change of equipment represents.

- Contrary to the current substation that presents space limitations, with the new substation, according to the planned relocation, more possibilities should be allowed for future expansions.

- The substation is integrally renewed and the equipment and elements technology is updated.

- The required space is considerably reduced.

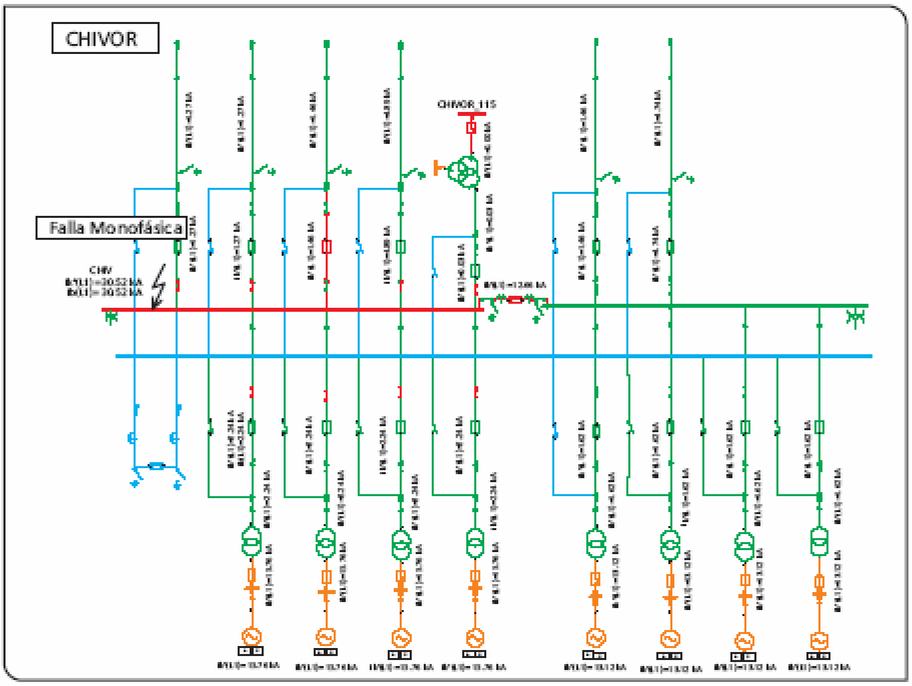
- In addition to the above advantages, for the new substation connection, there is not need to add significant line stretches, and in consequence, no need of additional bays either.

Disadvantages:

The SF6 isolation of substation is environmentally harmful. Notwithstanding, its environmental risk and impact can be alleviated and controlled.

The cost of equipments for an encapsulated substation is higher than that of a conventional substation.

6.4.16.2. 230 kV Chivor Substation



Graph 6-13 230 kV Chivor Substation configuration and short level 1Φ

6.4.16.2.1. First type alternatives to reduce the short-circuit level in the substation

- The first alternative, consist of the installation of conventional series reactors of 1.9 Ω impedance in each of the substation entrances, thus, in the generation connection bays (8), 230 kV line bays (6), for a total of 14 equipments to be installed. This alternative, besides that does no significantly reduce the short-circuit level in the dike, requires additional space availability in each of the substation bays, which implies the execution of all works in the bays and represents high investment costs, given the quantity of equipments.

- The second alternative consists of limiting the generation units of Chivor central, along with its associated transformer. To reduce the short-circuit level in the substation equipments below 25 kA capacity, it is necessary to restrict the capacity of the central to half its capacity (4 units – 500 MW), which represents significant extra operating costs. This alternative's costs are calculated based on MPODE, estimating the systems operating costs difference, with and without the alternative in present value. In addition to the high costs that this alternative represents for the system, the generation capacity limitations can not be considered as a long term feasible alternative for this type of problems.

- The third alternative requires the opening of the substation main dike bars coupling, electrically separating both substation sections. Even though, the short-circuit level is reduced, and there is not direct cost incurred, following the deterministic method, this alternative does not comply with the reliability criteria established in the Network Code, with high generation in Chivor, in dealing with simple contingencies in any of the 230 kV Chivor – Guavio or Chivor – Torca circuits.

Table 6-7 presents the impact summary at the short-circuit level and the cost of the alternatives described.

Short level 1f in barraje 230 kV (kA) – Norm IEC60909 of 2001				
YEAR	1. Reactors Conventional series	2. FACTS Limiters I	3. Restriction G Units	4. Reconf. Circ. Esm-Guat 220
2007	36,4	33,2	38,0 (-2)	36,7
2009	-	-	38,0 (-2)	36,8
2011	-	-	38.9 (-3)	38,9
2013	-	-	38,9 (-3)	38,9
2015	-	-	38,9 (-3)	38,9
Cost of alternatives (M$US Dec-05)				
Períod	Inv. Costs 14 Installed Reactors	Inv. Costs 2 Installed Reactors	VP D costs Operating	VP D costs Operating
2006-2015	-	$56,4	$59,3	$16,0

Table 6-7 Alternatives summary for the short-circuit level in 230 kV Chivor substation

6.4.16.2.2. Second type alternatives, to expand the substation equipments short-circuit capacity

a) Equipments change from 25 to 40 kA

This alternative consists of current capacity changes from 25 kA to 40 kA short-circuit equipments. According to information provided by the substation owner company, the equipments subject to change are: switches, sectionalizers, current transformers, lightning arresters, wave traps, and stage II dikes, among others. In addition to the reinforcement of ground connection grid, the substation structure, crossbars, and foundations reinforcement, is required.

Considering the time from the contracting of equipment up to the execution of works and necessary disconnecting, the change of equipments would take approximately between 24 to 30 months. The estimated total investment cost, would be US$ 7.3M, which, will be transferred to the users, depending on the CREG regulation.

Advantages:

- The change of equipments is done in the lands, and other equipment and elements, structures and existent civil works are still used.

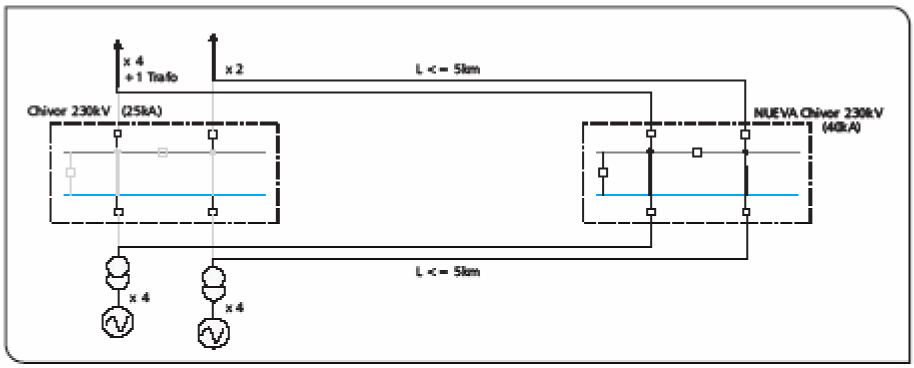
Disadvantages:

- Since the Chivor substation almost completes 25 years of service, new equipment along with equipment, elements and structures that has such time of service, could present an obsolescence condition, which might limit the reliability and performance of the substation.

- Even though, the flexibility that the configuration of the substation provides, the execution of works, obliges to incur in consignments and partial non-availability of the substation for periods of time, in which the System can be de-optimized, and incur in extra operating costs.

b) New conventional substation with 40 kA short-circuit capacity

This alternative consists of the construction of a new 230 kV substation, with 40 kA short-circuit capacity. The new substation would be located in independent lands, 5 km from those lands in which the current substation is located, which would imply the construction of additional stretches, to connect with the six 230 kV lines, and eight connection transformers of Chivor central generation, that would remain in the current location. Graph 6-14 describes the simplified version of this alternative.



Graph 6-14 230 kV/40 kA Chivor substation alternative description

Considering the time for the public bids, the execution of works and the necessary disconnections, the execution of the new substation would approximately take between 24 to 30 months. Depending on the number of additional bays required, the investment cost would be between US$ 11.65M and US$ 24M.

Advantages:

- The construction of the new substation will be executed independently, and therefore, except for the existent substation connections, there is not need to have system equipment or connections available for works and to incur in complexities, risks and extra operating costs, that a change of equipment represents.

- Contrary to the current substation that presents space limitations, with the new substation, according to the planned relocation, more possibilities should be allowed for future expansions.

- The substation is integrally renewed and the equipment and elements technology is updated.

- The impedances added by the additional line stretches, contribute to reducing, in some way, the substation short-circuit level.

Disadvantages:

- The separation of current connections of the substation implies additional lines stretches and possibly additional bays, which, on one hand, causes in some way, harm to the system's reliability, and on the other hand, would increase the investment cost.

- The additional line stretches can increase the NTS losses.

c) New encapsulated substation with 40 kA short-circuit capacity

This option consists of construction a new 230 kV encapsulated substation with 40 kA short-circuit capacity. Because of the reduction of space needed for its construction, the new encapsulated substation might be located in independent land very close to that in which the current substation is located, so that, if necessary, it will only require adding short distance additional line stretches.

Considering the time for the public bids, the execution of works and the necessary disconnections, the execution of the new substation would approximately take between 22 to 32 months.

Advantages:

- The construction of the new substation will be executed independently, and therefore, except for the existent substation connections, there is not need to have system equipment or connections available for works and to incur in complexities, risks and extra operating costs, that a change of equipment represents.

- Contrary to the current substation that presents space limitations, with the new substation, according to the planned relocation, more possibilities should be allowed for future expansions.

- The substation is integrally renewed and the equipment and elements technology is updated.

- The required space is considerably reduced.

- In additional to the above advantages, for the new substation connection, there is not need to add significant line stretches, and in consequence, no need of additional bays either.

Disadvantages:

The SF6 isolation of substation is environmentally harmful. Notwithstanding, its environmental risk and impact can be alleviated and controlled.

The cost of equipments for an encapsulated substation is higher than that of a conventional substation.

6.4.16.3. Conclusion and regulatory aspects

With regard to the first type alternatives, the benefits of reducing the short-circuit below the equipments capacity, are used up, in the short and medium term, and is becoming more restrictive for the system, representing very high investment or operating costs, which discards the alternatives as definite and feasible solutions. Similarly, the possibility of do nothing, operating at risk conditions, is considered inadmissible because of the implications for the system and the impact on domestic economy. With the sole valuation of the operating implications of doing nothing, in case substations' failure, for the San Carlos case, in the medium and long term, represents a value of around US$ 20M, exceeding the cost of the existent substation, and for the Chivor case around US$ 77M.

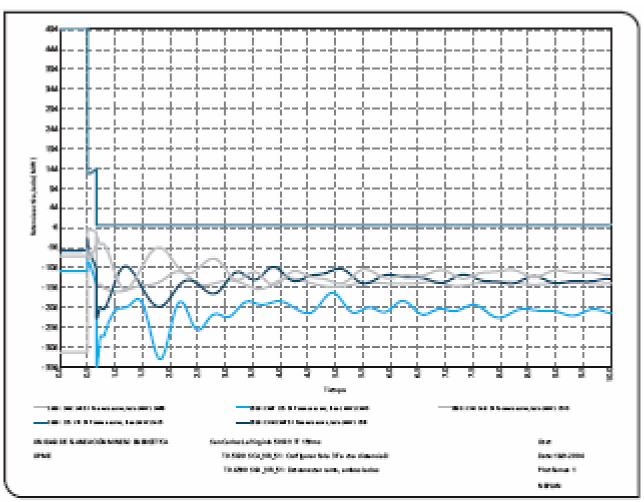
The second type alternatives present important advantages, that along with their corresponding disadvantages, should be analyzed and evaluated in more detailed, in order to have the complete information and necessary elements, to make a decision with regard to the definite solution for each substation. The equipments replacement (or expansion), supposes the definition or clarification of the regulatory treatment, for this type of projects, which is been analyzed by the regulator, and similarly, with regard to the works execution terms and the accountability for the costs incurred by the system in case of breach of contract.

In addition, for the new substations, the concept of "Active Elements" indicated in CREG resolutions 051 of 1998, 004 of 1999, and 021 of 2001 paragraph of Article 7, to dismantle or definitely remove the assets comprising the existent substation, should be defined and developed.

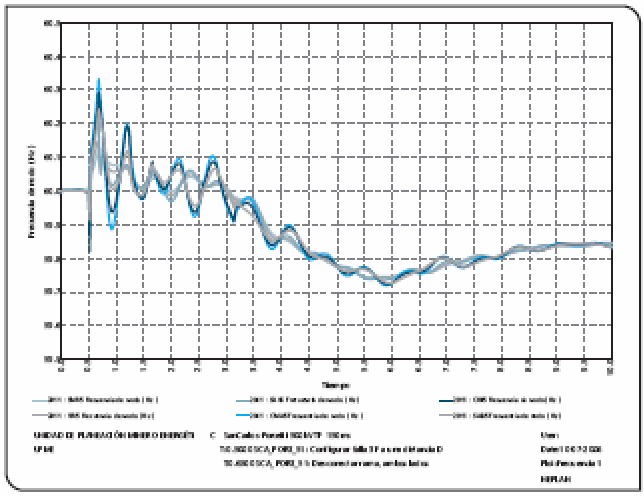
6.4.17. NIS STABILITY ANALYSIS

6.4.17.1. Transient stability

The stability analysis, show that the system is steady in front of the executed contingencies, presenting transient lessen responses, as observed in the following graphs. The contingencies correspond to three-phase short-circuits on the transmission lines.

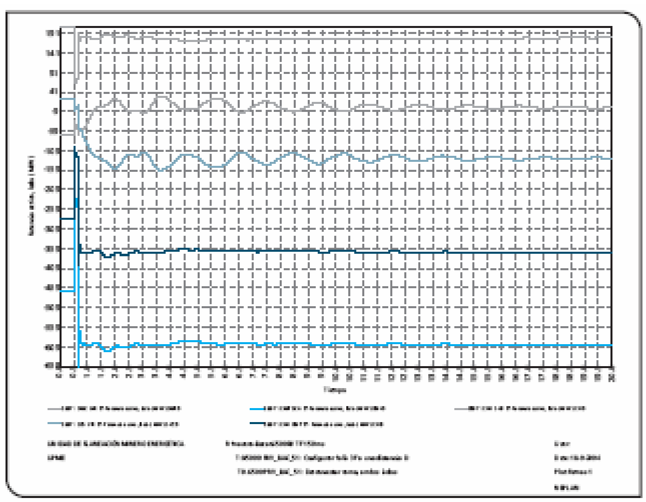


Graph 6-15 Active power oscillations – 500 kV San Carlos – Virginia contingency, 2009 maximum demand

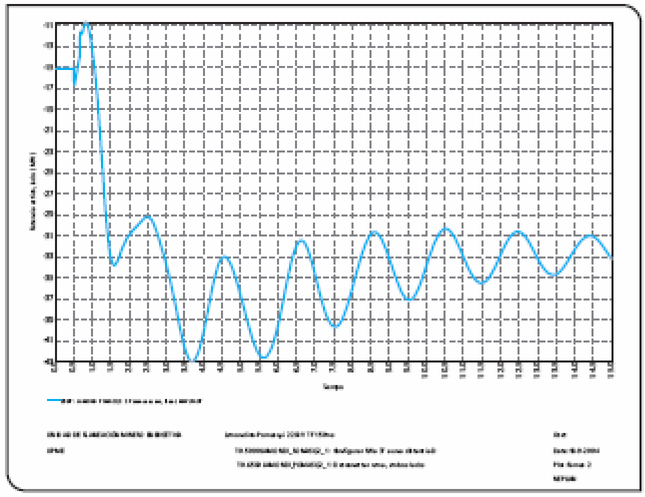


Graph 6-16 Node frequency oscillations 500 kV San Carlos – Porce III contingency, 2011 maximum demand

It should be noted, that in minimum demand, and flow from Colombia to Ecuador conditions, the system remains steady. Notwithstanding, in minimum demand, flow from Ecuador to Colombia and if dealing with a contingency of 500 kV Primavera – Bacatá line, or in one of the 230 kV Ecuador links, there are stability problems, and therefore, a minimum generation in the Santa Rosa – Ecuador area, is required, to eliminate such problems.



Graph 6-17 Active power oscillations – 500 kV Primavera – Bacatá contingency, 2007 minimum demand, Colombia exporting.



Graph 6-18 Active power oscillations – 230 kV Jamondino – Pomasqui 1 contingency, 2007 minimum demand, Colombia importing, steady case

6.4.17.2. Small signal stability

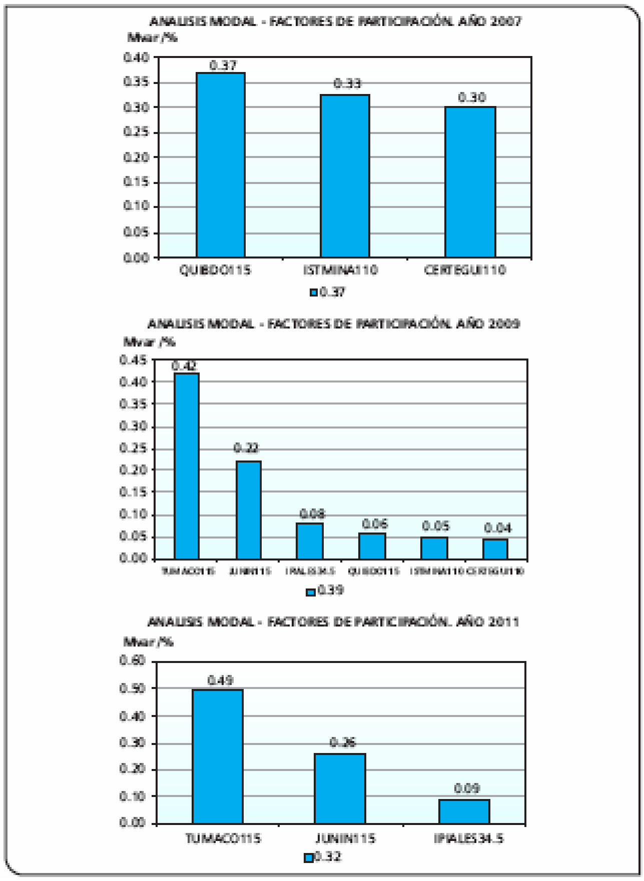
For 2007 and 2009, the system modes of oscillation present lessening factors, exceeding 3% (decline by oscillation), which are considered sufficient.

For 2011, the Colombia – Ecuador modes of oscillation, with an oscillation frequency of 0.4 Hz and an lessening factor of 8.1%, which can be considered equally sufficient.

We also have the Costa and Centro mode of oscillation, with an oscillation frequency of 0.8 Hz and a lessening factor of 2.5%. This mode, that even is lessened, has a lessening factor below 3%, which is considered low.

6.4.17.3. Voltage stability

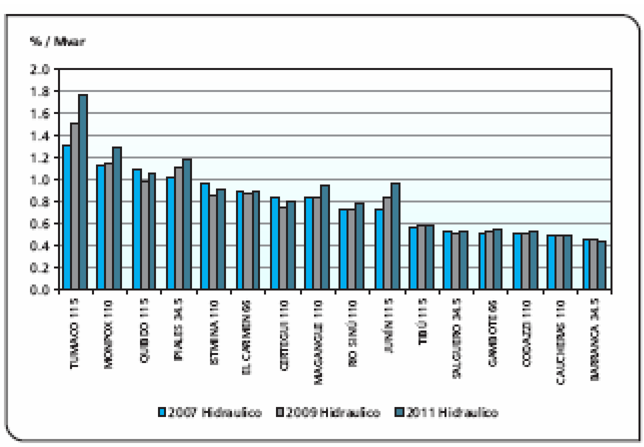
The modal voltage stability analysis, performed for 2007, 2009 and 2011, show a system that is in a steady degree of operation, with regard to voltage stability, represented in positive proper values.



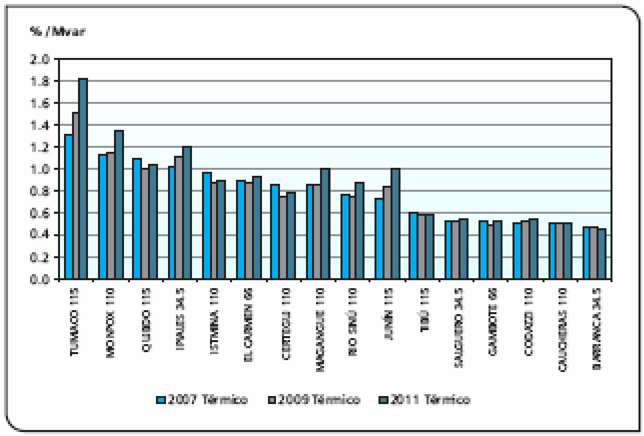
Graph 6-19 Hydraulic scenario participation factors

The participation factors show that the system's weakest zones are the Tumaco, Junín, and Ipiales in the Nariño area substations. Also the Quibdó, Istmina, Certegui, fed from Virginia substation. All of them correspond to radial networks.

The voltage stability sensitivity analyses show that the system is operating under steady conditions, represented as proper sensitivities with positive values for all substations. From this, the weakest substations are Tumaco, Junín, and Ipiales in the Nariño area, Mompox and Magangue in Bolivar and Quibdó, Istmina, Certegui, in Chocó, among others.



Graph 6-20 2007 – 2011 Hydraulic - Voltage sensitivity analysis



Graph 6-21 2007 – 2011 Thermoelectric - Voltage sensitivity analysis

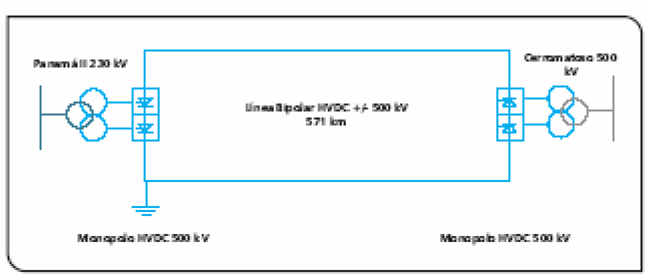
6.5. COLOMBIA – ECUADOR – VENEZUELA INTERCONNECTION ANALYSIS WITH PANAMA SYSTEM SIEPAC

Following, the electrical analyses performed in the framework of UPME contracted study, recently completed, are shown. Even though the study focused specially in analyzing and assessing the use of new technologies in the solution of NTS concrete problems in 2008, 2010 and 2012, the interconnection of the Colombian System with Panamá-SIEPAC, was also analyzed in detail, considering the interconnections with Ecuador and Venezuela, since this is the scenario with the greatest interest for analysis in the medium term.

The analysis considered variants to some of the interconnection alternatives in DC, proposed in the 2005 Plan:

- 250 kV DC and 500 kV DC interconnection voltage level.
- Converter connection point in Cerromatoso substation, from the 500 kV AC voltage level, through the power transformers dedicated to the DC converter.

Graph 6-22 shows the single-wire diagram of connection, considering 500 kV DC.



Graph 6-22 Colombia – Panamá connection scheme in DC

Other characteristics of the DC interconnection are:

- AC/DC Converter stations in Cerromatoso and Panamá II.

- 70 MVAr capacity compensation in Cerromatoso and 70 MVAr in panama II, in order to provide the required reactor for the converters.

Anticipating the study conclusions, it is important to point out, that even though, there are two alternatives for the DC transmission line, already described in the previous Plans, which change part of the routes, including, in one of them, an underwater stretch, from the steady-state and stability point of view, both alternatives present the same behavior and performance.

6.5.1. STEADY-STATE ANALYSIS

From the analysis performed for the 2008 -2012 horizon, one can conclude, that a 450 MW power transmission capacity is obtained. These transfers can be reached with a 250 kV DC link, as well as with a 500 kV DC link. The differences presented in such DC voltage levels, are the loss of power upon the DC transmission line and the fall of the DC voltage, between the rectifier equipment and the converter. The behavior in this steady-state is similar in the two voltage levels.

6.5.2. VOLTAGE STABILITY ANALYSIS

The analyses show that due to the interconnection, the system is steady with regard to voltage stability for the base case as well as for the simulated contingencies in the years of the study (2008, 2010, and 2012). As indicated in previous analyses, the most representative failure is on the DC interconnections, thus, there is a failure and the DC Colombian Converter substation – Panamá Converter substation, for which the lower proper values are obtained.

6.5.3. TRANSIENT STABILITY ANALYSIS

For the transient stability analysis, a 50% of the line three-phase free failure contingency, with the corresponding disconnection at the two ends, 150 ms after the beginning of the even, was considered. A failure upon the DC interconnection, with the disconnection of same, was analyzed.

ELEMENT	TYPE of EVENT	LOCATION	CONDITION
Line	Three-phase failure 50% of line, with 150 ms of broken conection	CerromatosoDC-Panama II DC	Stable
Line		Cerromatoso-Primavera 500 kV	Stable
Line		Primavera-Ocaña 500 kv	Stable

Table 6-8 250 kV DC link transient stability simulated failure

As indicated previously, is it possible to transfer the same 450 MW power with a DC 250 kV link or with a DC 500 kV link, for which the analyses for the two cases were performed, maintaining the AC connection from the 500 kV Cerromatoso substation and applying contingencies, considered as the most severe ones.

ELEMENT	TYPE OF EVENT	LOCATION	STATE
Line	Three-phase failure at 50% of the line, with 150 ms of disconnection	500 kV Cerromatoso- San Carlos	Steady
Line		500 kV Cerromatoso - Primavera	Steady
Line		500 kV Cerromatoso - Chinu	Steady
Line		500 kV Chinu - Sabanalarga	Steady
Line		500 kV Cerromatoso – Urrá	Steady
Line		DC Cerromatoso- DC Panama II	Steady
Line		230 kV Failure in Panamá II	Steady

Table 6-9 500 kV DC link transient stability simulated failure

The transient stability analyses show a steady system facing of the applied contingencies, with power oscillation for the DC interconnection, characterized by a strong lessening; due to the high control ability of converters systems. One can observe then, the isolation of the transient behavior of the two systems, the Colombian and the Central American one.

6.5.4. SMALL SIGNAL STABILITY ANALYSIS

For the small signal stability analysis, the system operation cases in the analyzed horizon, were considered.

YEAR	CASE	MODE	OWN VALUE	Z (%)	F (Hz)
2008	Colombia exporting to Venezuela	Colombia – Ecuador	0.246+j5.472	4.4	0.87
		Center – Coast	-0.185+j5.745	3.2	0.91
		Colombia - Venezuela	-0.147+j5.060	2.9	0.81
	Colombia importing from Venezuela	Colombia – Ecuador	-0.246+j9.916	2.5	1.58
		Center - Coast	-0.256+j5.823	4.4	0.93
		Colombia - Venezuela	-0.075+j5.073	1.5	0.81
2010	Colombia importing from Venezuela	Colombia – Ecuador	-0.270+j5.670	4.7	0.9
		Center - Coast	-0.224+j5.223	4.3	0.83
		Colombia - Venezuela	-0.198+j1.803	10.9	0.29
2012	Colombia exporting to Venezuela	Colombia – Ecuador	-0.246+j5.578	4.3	0.89
		Center – Coast	-0.200+j4.962	4	0.79
		Colombia - Venezuela	-0.020+j1.845	1.1	0.29

Table 6-10 Coast – Center (Colombia) modes of oscillation summary

Whit the SIEPAC system, having a DC link, there are no oscillation modes, because of the technical characteristics of the interconnection, and not being synchronized. Associated to the Colombian interconnection side, the oscillation mode between the Coast and Center are highlighted, with an average frequency of 0.87 Hz and with lessening factors between 3.2% and 4.4%, being acceptable according to international standards. On the contrary, between the Colombian and the Venezuelan systems, low lessening modes are observed.

6.5.5. COLOMBIA – PANAMA INTERCONNECTION RECENT PROGRESS

From established agreements in bi-national meetings, both countries' regulatory entities have been requested (Energy and Gas Regulation Commission -CREG- in Colombia, and

Public Utilities National Authority ANSP – in Panamá), to prepare, in a short term first stage, a study that allows the bi-national regulatory harmonization, to facilitate the energy interchanges, and in a medium term second stage, a study that considers the harmonization of markets.[8]

Concerning the project environmental aspects, with regard to the Colombian part, ISA initiated the project licensing process before the MAVDT, establishing the alternative to develop the Environmental Impact Study.

Concerning the Panamá's part, even though the Alternatives Environmental Diagnose is not required by the Panama's Environmental Authority, the definition of a route corridor is a requisite, for the execution of basic engineering studies and for the environmental impact study. In that sense, Panamá has considered the entry of the line to that country, using an underwater wire, in order to minimize the environmental and social impacts at the limiting territories.

In the following tables, the most updated data and estimated preliminary costs of the interconnection alternative, which, because of the above mentioned aspects, can be considered as the more eligible one, are described.

	Colombia	**Panamá**	**Total**
Aerial (km)	325	234	569
Underwater (km)	15	40	55
Total (km)	**340**	**274**	**614**

Source: ISA – ETESA

Table 6-11 Estimated lengths alternative with greater eligibility

US$ values in Mio	Line/Cable		Environmental	HVDC Stations	Total
	Aerial	Underwater			
Colombia	$ 38.0	$ 11.4	$ 5.0	$ 41.8	$ 96.2
Panama	$ 27.4	$ 30.4	$ 11.4	$ 41.8	$ 111.0
Total	$ 65.4	$ 41.8	$ 16.4	$ 83.6	$ 207.2

Source: ISA – ETESA

Table 6-12 Estimated preliminary costs alternative with greater eligibility

Finally, with regard to the preliminary valuation of the interconnection economic benefits, the UPME continues making progress in the line analysis of the executed assessments with this regard, in the 2004 Plan, until there is a definition of applicable commercial scheme.

6.6. USE OF NEW TECHNOLOGIES IN THE NTS's SOLUTION OF SPECIFIC PROBLEMS

The UPME, carried out the study "National transmission network improvement with the use of New Technologies" in 2000, whose objective among others, was the FACTS[9] state

[8] ISA-ETSA (2006) COLOMBIA-PANAMA ELECTRIC INTERCONNECTION, Basic studies for the development of the Project. Progress Report.
[9] Flexible AC Transmisión Systems.

of the art analysis of the different current technologies, to improve or expand the transmission capacity. In addition, such study included a preliminary analysis of the series and parallel FACTS devices application, for steady-state analysis.

Considering that the Expansion Plan revision is done each year, and that with time, physical restrictions, to find new corridors for the transmission lines construction, are present, and that there are new technological advances, the UPME, contracted the execution of NTS detailed studies, which would include stability analysis, to contemplate expansion solutions, with non-traditional technologies in Colombia, FACTS.

Following, there is a brief summary of the main findings and recommendations of study analyses, carried out by Unión Temporal GER-ISA-KEMA, for the three largest country's zones, which, and given that the study was recently completed, is still under UPME evaluation.

6.6.1. ATLANTIC COAST ZONE

The Atlantic Coast zone tends to reduce its export with time, due to the thermoelectric generation increase, required to serve the demand throughout the country.

From the economic point of view, it is not viable to install FACTS equipment in this area, since the whole area imports capacity will not be used in the future.

6.6.2. BOGOTA ZONE

The Bogotá zone, presents an increase of its imports with time, which allows to obtain high benefits for increasing its imports capacity.

The installation of a SVC, does not considerably improves the area's imports capacity.

6.6.3. SOUTH WEST ZONE

The South-West zone uses the imports capacity frequently, particularly with the entry into operation of the Colombia – Ecuador interconnection reinforcement, which will increase the Colombia's exports capacity to 500 MW.

The installation of FACTS equipment in the South-west, is highly attractive, since, in additional to the export capacity increase to Ecuador, there are no additional generation projects foreseen in the area.

6.6.4. ADDITIONAL RECOMMENDATIONS OF THE STUDY

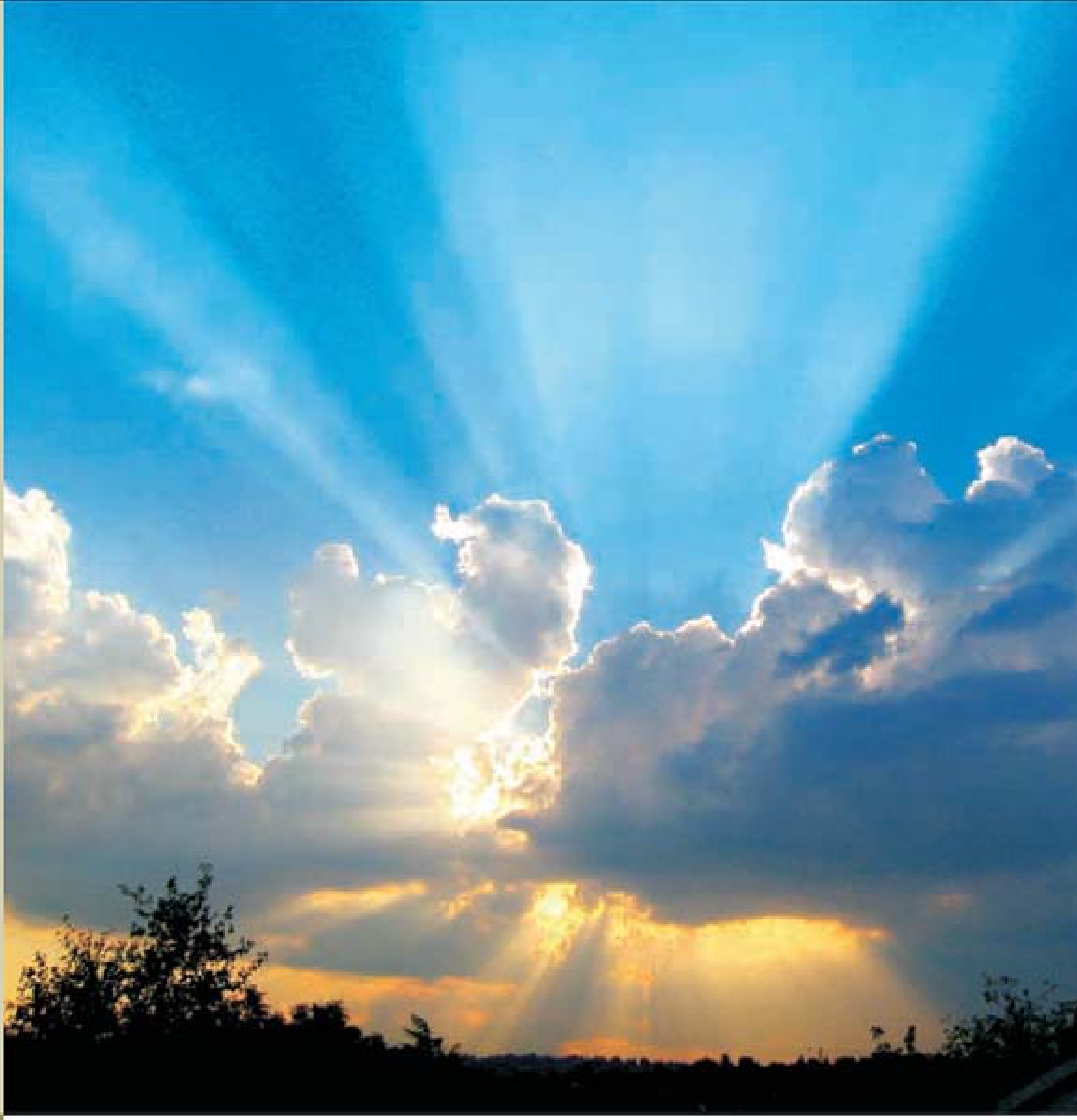
To analyze in detail the location, size and type of parallel compensation, to be installed in the South-West zone, in order to increase its import capacity.

To install the San Carlos – Esmeralda line compensation series, in order to increase the imports capacity in the South-West area.

6.7.2006 PLAN RESULTS

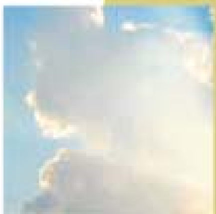
- Stop the recommendation of Sub220 substation project, given in the Reference Expansion Plan, Generation – Transmission 2005 – 2019 delaying its definition to next Expansion Plan reviews.
- Initiate, starting 2007, the public bid process, for the NTS expansion works construction, necessary for the Porce III hydraulic generation project connection, through the reconfiguration of 500 kV San Carlos – Cerromatoso circuit and the construction of 500 kV Porce substation, required to be operational in 2010.
- Conduct the necessary actions for the Colombia – Panamá interconnection, conditioning the open of the public bid to the regulatory agreements, to be entered into, between the two countries.

In addition, we insist in the Network Operators invitation, to perform the joint analysis to establish the best solutions to the problems encountered by UPME.



7

ENVIRONMENTAL ISSUES for Electric Expansion



7. ENVIRONMENTAL ASPECTS

Decision making in the electric sector expansion, involves a very important subject, which is the environmental topic, which implies a very large number of activities previous to infrastructure project design and execution. In consequence, it is necessary, in the execution of this Expansion Plan, to identify the environmental regulation issued, as well as the transfers that current and future generation plants, should make.

On the other hand, in this Chapter, an estimated amount of CO_2 emissions is established for current generation projects, as well as that considered in the scenarios presented.

7.1. ENVIRONMENTAL REGULATION

Following, the most recent environmental regulation issued, which should be considered in the generation projects development and the transmission lines, is present.

With the expedition of Law 99, 1993 (environmental law), it was established, among others, the regulation to obtain environmental licenses, related to the generation projects as well as to the transmission lines. In that sense, Law 143 of July 1994, (electric law), included that electrical projects development in the country, shall be considered under environmental criteria.

On that extend, through Decree 1220 of April 2005, The Ministry of Environment, Housing and Territorial Development, regulated and established the concept and scope of an environmental license, as well as its issuance by the Ministry and the Autonomous Regional Corporations, for the development of generation projects, and the wiring of transmission and distribution lines. On the other hand, that same Decree in its Article 13, establishes, that all environmental studies, such as environmental diagnose of alternatives and environmental impact study, will be carried out base on the reference terms issued by the Ministry of Environment.

Recently, The Ministry of Environment issued two resolutions, 1287 and 1288 of 2006. In the first one, the reference terms for the elaboration of environmental impact study, for the construction and operation of electric energy generators thermoelectric centrals, with an install capacity equals or above 100 MW, are agreed, and also other determinations are adopted. In the second one, (1288 resolution), the reference terms for the elaboration of the Environmental Impact Study, for the National Transmission System lines wiring of electric interconnection, which operate at voltages equal or above 220 kV, are agreed, also other determinations are adopted.

7.2. TRANSFERS

Through Decree 1933 of August 1994, the Article 45 of Law 99, of 1993, was regulated, in which the transfers that the generator companies with installed capacity greater than 10 MW, should assign to the Environmental National System – SINA-. In order to provide an estimated of the future transfer by the electric sectors, to the Regional Autonomous

Corporations and Municipalities, a valuation of the money to be transferred for generation, is shown in Table 7-1. Such estimates, were calculated from the possible generation dispatches obtained from the MPODE model, for each oh the proposed scenarios in the generation chapter, which also include the plants that are currently in operation.

	EXPANSIONIST			OPTIMIST			CONTINUIST			LIM CON INTERCONEX			LIM SIN INTERCONEX		
	HYDRO	THERMO	TOTAL	HYDRO	THERMO	TOTAL	HYDRO	THERMO	TOTAL	HYDRO	THERMO	TOTAL	HYDRO	THERMO	TOTAL
2007	121477	17042	138519	121938.6	16698	138637	121679	16083	137761	119816	15968	135784	122389	9614	132003
2008	121892	20796	142689	119387	21640	141027	119094	19860	138955	121157	18961	139848	119617	15124	134740
2009	121434	18780	140214	118053.7	22120	140174	117414	20338	137752	121412	17802	139214	121636	17271	138907
2010	126139	20604	146744	124226.3	24818	149055	124952	22117	147069	127713	19897	147609	123290	18746	142036
2011	131315	25745	157060	128309.3	29257	157566	125623	24069	149691	128327	25758	154085	126351	20451	146801
2012	133409	26910	160320	136586.2	30071	166658	134489	24926	159415	133172	24457	157629	136151	19022	155173
2013	138136	29746	167882	133890.9	35446	169337	134776	27933	162709	137329	24864	162193	135373	20991	156364
2014	138040	35416	173455	138624.2	37448	176072	139219	29047	168267	137116	28999	166115	138490	21609	160099
2015	137208	41490	178698	135624.7	40264	175889	137050	30081	167131	138295	32062	170358	137651	24593	162244

Table 7-1 Transfers estimates in thousand of million pesos

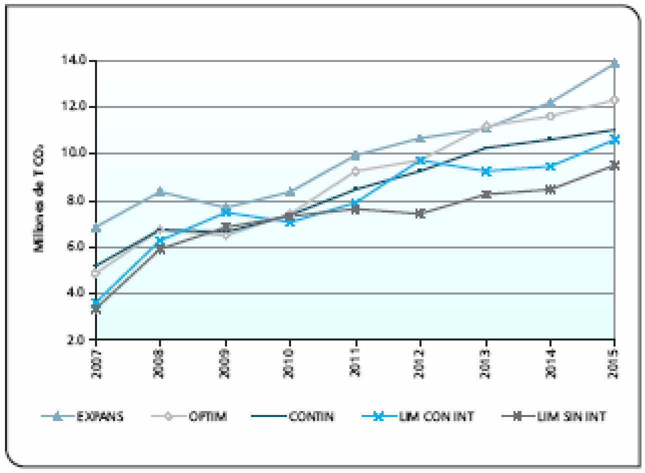
7.3. EMISSIONS

In developed countries, the majority of CO_2 emissions come from the energetic sectors, and the strategies to mitigate this phenomenon are reduced to fuels replacement, equipment efficiency improvement or increase of drains.

In some developing countries, especially those with low per capita energy consumption, the majority of CO_2 emissions come from deforestation; in Colombia 30% of the emissions come from the energy sector.

In order to provide an estimate of the future emissions level by the electric sector, in graph 7-1 the CO_2 emissions, in million tons, for each of the generation scenarios considered in the current Expansion Plan, are shown. It is worth mentioning that the analyses are contemplated starting 2007.

As inferred from the Graph and the results of the generation dispatches models (MPODE), in the short term, the country's level of CO_2 emissions, might increase, due to the thermoelectric generation participation increase, especially in some plants that present natural gas substitute for mineral coal, this trend prevails until 2010 and the beginning of 2011, in which with the entry of Porce III project, are stabilized. The growth in the whole period of analysis, would be between 6 and 7 CO_2 million tons.



Graph 7-1 CO_2 emissions in Colombia's expansion scenarios

The analysis for the long term shows that for the majority of the scenarios, the emissions could be of 10 million tons CO_2 in average. In those scenarios that present high growth of energy demand, as the one proposed in the expansionist scenario, (Vision Colombia 2019), and in the optimistic scenario with international connections, the emissions exceed 12 million tons of CO_2.

It is important to mention, that by itself, the increase of CO_2 emissions, in all the scenarios of the Expansion Plan, results as a consequence of the country's thermoelectric generation increase in participation, especially if the installation of new projects, operating with mineral coal is made real.

8 ANNEXES

8. ANNEXES

8.1. RESOURCES AVAILABILITY AND PRICES PROJECTION

TABLE 8-1. PRICE FOR HYDROELECTRIC PLANTS ATLANTIC COAST REFERENCE SCENARIO (U$ 2005/MBTU)

YEAR	SEMESTER	HYDROELECTRIC PLANTS COAST																	
		Guajira						Barranquilla						Cartagena - MAMONAL					
		BALLENA – LA MAMI		RATE TRANSPORTATION	Well head price (US$/MBTU) AÑO 2005	COMER.	PRICE GAS NATURAL	BALLENA – LA MAMI – BARRANQUILLA		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES	BALLENA – LA MAMI – B/QUILLA – CARTAGENA (MAMONAL)		Transport RATE	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES
		CF	CV					CF	CV					CF	CV				
2007	1	0.110	0.181	0.292	2.595	0.000	2.887	0.166	0.226	0.392	2.595	0.000	2.987	0.254	0.269	0.523	2.595	0.000	3.118
2007	2	0.110	0.181	0.292	2.448	0.000	2.740	0.166	0.226	0.392	2.448	0.000	2.840	0.254	0.296	0.523	2.448	0.000	2.971
2008	1	0.110	0.181	0.292	2.405	0.000	2.697	0.166	0.226	0.392	2.405	0.000	2.797	0.254	0.269	0.523	2.405	0.000	2.928
2008	2	0.110	0.181	0.292	2.381	0.000	2.672	0.166	0.226	0.392	2.381	0.000	2.773	0.254	0.269	0.523	2.381	0.000	2.903
2009	1	0.110	0.181	0.292	2.332	0.000	2.623	0.166	0.226	0.392	2.332	0.000	2.723	0.254	0.269	0.523	2.332	0.000	2.854
2009	2	0.110	0.181	0.292	2.272	0.000	2.564	0.166	0.226	0.392	2.272	0.000	2.664	0.254	0.269	0.523	2.272	0.000	2.795
2010	1	0.110	0.181	0.292	2.211	0.000	2.503	0.166	0.226	0.392	2.211	0.000	2.603	0.254	0.269	0.523	2.211	0.000	2.734
2010	2	0.110	0.181	0.292	2.091	0.000	2.393	0.166	0.226	0.392	2.091	0.000	2.483	0.254	0.269	0.523	2.091	0.000	2.614
2011	1	0.110	0.181	0.292	2.073	0.000	2.364	0.166	0.226	0.392	2.073	0.000	2.464	0.254	0.269	0.523	2.073	0.000	2.595
2011	2	0.110	0.181	0.292	2.136	0.000	2.428	0.166	0.226	0.392	2.136	0.000	2.528	0.254	0.269	0.523	2.136	0.000	2.659
2012	1	0.110	0.181	0.292	2.109	0.000	2.400	0.166	0.226	0.392	2.109	0.000	2.500	0.254	0.269	0.523	2.109	0.000	2.631
2012	2	0.110	0.181	0.292	2.133	0.000	2.424	0.166	0.226	0.392	2.133	0.000	2.525	0.254	0.269	0.523	2.133	0.000	2.655
2013	1	0.110	0.181	0.292	2.096	0.000	2.388	0.166	0.226	0.392	2.096	0.000	2.488	0.254	0.269	0.523	2.096	0.000	2.619
2013	2	0.110	0.181	0.292	2.078	0.000	2.369	0.166	0.226	0.392	2.078	0.000	2.470	0.254	0.269	0.523	2.078	0.000	2.600
2014	1	0.110	0.181	0.292	2.058	0.000	2.350	0.166	0.226	0.392	2.058	0.000	2.450	0.254	0.269	0.523	2.058	0.000	2.581
2014	2	0.110	0.181	0.292	2.115	0.000	2.406	0.166	0.226	0.392	2.115	0.000	2.506	0.254	0.269	0.523	2.115	0.000	2.637
2015	1	0.110	0.181	0.292	2.084	0.000	2.376	0.166	0.226	0.392	2.084	0.000	2.476	0.254	0.269	0.523	2.084	0.000	2.607
2015	2	0.110	0.181	0.292	2.095	0.000	2.387	0.166	0.226	0.392	2.095	0.000	2.487	0.254	0.269	0.523	2.095	0.000	2.618
2016	1	0.110	0.181	0.292	2.073	0.000	2.365	0.166	0.226	0.392	2.073	0.000	2.465	0.254	0.269	0.523	2.073	0.000	2.596
2016	2	0.110	0.181	0.292	2.121	0.000	2.412	0.166	0.226	0.392	2.121	0.000	2.512	0.254	0.269	0.523	2.121	0.000	2.643
2017	1	0.110	0.181	0.292	2.095	0.000	2.387	0.166	0.226	0.392	2.095	0.000	2.487	0.254	0.269	0.523	2.095	0.000	2.618
2017	2	0.110	0.181	0.292	2.127	0.000	2.419	0.166	0.226	0.392	2.127	0.000	2.519	0.254	0.269	0.523	2.127	0.000	2.650
2018	1	0.110	0.181	0.292	2.102	0.000	2.393	0.166	0.226	0.392	2.102	0.000	2.493	0.254	0.269	0.523	2.103	0.000	2.624
2018	2	0.110	0.181	0.292	2.135	0.000	2.426	0.166	0.226	0.392	2.135	0.000	2.526	0.254	0.269	0.523	2.135	0.000	2.657
2019	1	0.110	0.181	0.292	2.109	0.000	2.401	0.166	0.226	0.392	2.109	0.000	2.501	0.254	0.269	0.523	2.109	0.000	2.632
2019	2	0.110	0.181	0.292	2.143	0.000	2.434	0.166	0.226	0.392	2.143	0.000	2.534	0.254	0.269	0.523	2.143	0.000	2.665
2020	1	0.110	0.181	0.292	2.129	0.000	2.421	0.166	0.226	0.392	2.129	0.000	2.521	0.254	0.269	0.523	2.129	0.000	2.652
2020	2	0.110	0.181	0.292	2.219	0.000	2.511	0.166	0.226	0.392	2.219	0.000	2.611	0.254	0.269	0.523	2.129	0.000	2.742

TABLE 8-1 ATLANTIC COAST THERMOELECTRIC PLANTS PRICING – REFERENCE SCENARIO (US$ 2005/MBTU)

TABLE 8-2. THERMOELECTRIC PLANT PRICING INTERIOR 1 MERIELÉCTRICA, T. PALENQUE Y T. CENTRO REFERENCE SCENARIO (U$ 2005/MBTU)																			
		Merilectrica						**T. Palenque**						**T. Centro**					
		TRANSPORTATION						TRANSPORTATION						TRANSPORTATION					
YEAR	SEMESTER	CF	CV	RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL	CF	CV	RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES	CF	CV	TRANSPORT RATE	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES
2007	1	0.766	0.556	1.322	2.595	0.000	3.918	0.596	1.219	1.815	4.293	0.000	6.108	0.833	0.622	1.455	2.595	0.000	4.051
2007	2	0.766	0.556	1.322	2.448	0.000	3.771	0.596	1.219	1.815	4.445	0.000	6.260	0.833	0.622	1.455	2.448	0.000	3.903
2008	1	0.766	0.556	1.322	2.405	0.000	3.728	0.596	1.219	1.815	4.491	0.000	6.306	0.833	0.622	1.455	2.405	0.000	3.861
2008	2	0.766	0.556	1.322	2.381	0.000	3.703	0.596	1.219	1.815	4.341	0.000	6.156	0.833	0.622	1.455	2.381	0.000	3.836
2009	1	0.766	0.556	1.322	2.332	0.000	3.654	0.596	1.219	1.815	4.225	0.000	6.040	0.833	0.622	1.455	2.332	0.000	3.787
2009	2	0.766	0.556	1.322	2.272	0.000	3.594	0.596	1.219	1.815	4.101	0.000	5.916	0.833	0.622	1.455	2.272	0.000	3.727
2010	1	0.766	0.556	1.322	2.211	0.000	3.534	1.101	1.037	2.138	1.450	0.000	3.588	0.833	0.622	1.455	2.211	0.000	3.667
2010	2	0.766	0.556	1.322	2.091	0.000	3.413	1.101	1.037	2.138	1.450	0.000	3.588	0.833	0.622	1.455	2.091	0.000	3.546
2011	1	0.766	0.556	1.322	2.073	0.000	3.395	1.101	1.037	2.138	1.450	0.000	3.588	0.833	0.622	1.455	2.073	0.000	3.528
2011	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2012	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2012	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2013	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2013	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2014	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2014	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2015	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2015	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2016	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2016	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2017	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2017	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2018	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2018	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2019	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2019	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2020	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2020	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.900

TABLE 8-2 INTERIOR 1 MERIELECTRICA, T.
PALENQUE T. CENTRO THERMOELECTRIC PLANTS PRICING – REFERENCE SCENARIO (US$ 2005/MBTU)

TABLE 8-3. THERMOELECTRIC PLANT PRICING INTERIOR 2 T. SIERRA, T. DORADA Y T. VALLE
REFERENCE SCENARIO (U$ 2005/MBTU)

YEAR	SEMESTER	T. Sierra						T. Dorada						T. VALLE					
		TRANSPORTATION		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL	TRANSPORTATION		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES	TRANSPORTATION		TRANSPORT RATE	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES
		CF	CV					CF	CV					CF	CV				
2007	1	0.876	0.566	1.441	2.595	0.000	4.04	1.050	0.632	1.682	2.595	0.000	4.277	1.727	0.750	2.477	2.595	0.000	5.072
2007	2	0.876	0.566	1.441	2.448	0.000	3.89	1.050	0.632	1.682	2.448	0.000	4.130	1.727	0.750	2.477	2.448	0.000	4.925
2008	1	0.876	0.566	1.441	2.408	0.000	3.85	1.050	0.632	1.682	2.405	0.000	4.119	1.727	0.750	2.477	2.405	0.000	4.882
2008	2	0.876	0.566	1.441	2.381	0.000	3.82	1.050	0.632	1.682	2.381	0.000	4.246	1.727	0.750	2.477	2.381	0.000	4.857
2009	1	0.876	0.566	1.441	2.332	0.000	3.77	1.050	0.632	1.682	2.332	0.000	4.204	1.727	0.750	2.477	2.332	0.000	4.808
2009	2	0.876	0.566	1.441	2.272	0.000	3.71	1.050	0.632	1.682	2.272	0.000	4.191	1.727	0.750	2.477	2.272	0.000	4.749
2010	1	0.876	0.566	1.441	2.211	0.000	3.65	1.050	0.632	1.682	2.211	0.000	4.166	1.727	0.750	2.477	2.211	0.000	4.688
2010	2	0.876	0.566	1.441	2.091	0.000	3.53	1.050	0.632	1.682	2.091	0.000	4.231	1.727	0.750	2.477	2.091	0.000	4.568
2011	1	0.876	0.566	1.441	2.073	0.000	3.51	1.050	0.632	1.682	2.073	0.000	4.221	1.727	0.750	2.477	2.073	0.000	4.549
2011	2	0.610	0.820	1.431	1.450	0.000	2.88	1.050	0.632	1.683	2.136	0.000	4.360	1.727	0.750	2.477	2.136	0.000	4.613
2012	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.727	0.750	2.477	2.109	0.000	4.585
2012	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.727	0.750	2.477	2.133	0.000	4.609
2013	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.727	0.750	2.477	2.096	0.000	4.573
2013	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2014	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2014	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2015	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2015	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2016	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2016	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2017	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2017	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2018	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2018	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2019	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2019	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2020	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2020	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876

TABLE 8-3 INTERIOR 2 T. SIERRA, T. DORADA AND T. VALLE THERMOELECTRIC PLANTS PRICING– REFERENCE SCENARIO (US$ 2005/MBTU)

TABLE 8-4. THERMOELECTRIC PLANT PRICING INTERIOR 3 - T. EMCALI ESCENARIO HIGH (US$ 2005/MBTU)							
YEAR	SEMESTER	T. Emcali					
		CUSIANA - CALI		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES
		CF	CV				
2007	1	1.462	0.964	2.426	1.450	0.000	3.876
2007	2	1.462	0.964	2.426	1.450	0.000	3.876
2008	1	1.462	0.964	2.426	1.450	0.000	3.876
2008	2	1.462	0.964	2.426	1.450	0.000	3.876
2009	1	1.462	0.964	2.426	1.450	0.000	3.876
2009	2	1.462	0.964	2.426	1.450	0.000	3.876
2010	1	1.462	0.964	2.426	1.450	0.000	3.876
2010	2	1.462	0.964	2.426	1.450	0.000	3.876
2011	1	1.462	0.964	2.426	1.450	0.000	3.876
2011	2	1.462	0.964	2.426	1.450	0.000	3.876
2012	1	1.462	0.964	2.426	1.450	0.000	3.876
2012	2	1.462	0.964	2.426	1.450	0.000	3.876
2013	1	1.462	0.964	2.426	1.450	0.000	3.876
2013	2	1.462	0.964	2.426	1.450	0.000	3.876
2014	1	1.462	0.964	2.426	1.450	0.000	3.876
2014	2	1.462	0.964	2.426	1.450	0.000	3.876
2015	1	1.462	0.964	2.426	1.450	0.000	3.876
2015	2	1.462	0.964	2.426	1.450	0.000	3.876
2016	1	1.462	0.964	2.426	1.450	0.000	3.876
2016	2	1.462	0.964	2.426	1.450	0.000	3.876
2017	1	1.462	0.964	2.426	1.450	0.000	3.876
2017	2	1.462	0.964	2.426	1.450	0.000	3.876
2018	1	1.462	0.964	2.426	1.450	0.000	3.876
2018	2	11.462	0.964	2.426	1.450	0.000	3.876
2019	1	1.462	0.964	2.426	1.450	0.000	3.876
2019	2	1.462	0.964	2.426	1.450	0.000	3.876
2020	1	1.462	0.964	2.426	1.450	0.000	3.876
2020	2	1.462	0.964	2.426	1.450	0.000	3.876

TABLE 8-4 INTERIOR 3 – T. EMCALI THERMOELECTRIC PLANTS PRICING – HIGH SCENARIO (US$ 2005/MBTU)

TABLE 8-5. PRICE FOR HYDROELECTRIC PLANTS ATLANTIC COAST SCENARIO LOW (U$ 2005/MBTU)

YEAR	SEMESTER	HYDROELECTRIC PLANTS COAST																	
		Guajira						Barranquilla						Cartagena - MAMONAL					
		BALLENA – LA MAMI		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL	BALLENA – LA MAMI BARRANQUILLA		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES	BALLENA – LA MAMI – B/QUILLA CARTAGENA (MAMONAL)		TRANSPORT RATE	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES
		CF	CV					CF	CV					CF	CV				
2007	1	0.110	0.181	0.292	2.595	0.000	2.887	0.166	0.226	0.392	2.595	0.000	2.987	0.254	0.269	0.523	2.595	0.000	3.118
2007	2	0.110	0.181	0.292	2.448	0.000	2.740	0.166	0.226	0.392	2.448	0.000	2.840	0.254	0.296	0.523	2.448	0.000	2.971
2008	1	0.110	0.181	0.292	2.383	0.000	2.675	0.166	0.226	0.392	2.383	0.000	2.775	0.254	0.269	0.523	2.383	0.000	2.906
2008	2	0.110	0.181	0.292	2.255	0.000	2.546	0.166	0.226	0.392	2.255	0.000	2.647	0.254	0.269	0.523	2.255	0.000	2.778
2009	1	0.110	0.181	0.292	2.194	0.000	2.485	0.166	0.226	0.392	2.194	0.000	2.586	0.254	0.269	0.523	2.194	0.000	2.716
2009	2	0.110	0.181	0.292	2.069	0.000	2.360	0.166	0.226	0.392	2.069	0.000	2.461	0.254	0.269	0.523	2.069	0.000	2.592
2010	1	0.110	0.181	0.292	2.004	0.000	2.296	0.166	0.226	0.392	2.004	0.000	2.396	0.254	0.269	0.523	2.004	0.000	2.527
2010	2	0.110	0.181	0.292	1.848	0.000	2.140	0.166	0.226	0.392	1.848	0.000	2.240	0.254	0.269	0.523	1.848	0.000	2.371
2011	1	0.110	0.181	0.292	1.814	0.000	2.106	0.166	0.226	0.392	1.814	0.000	2.206	0.254	0.269	0.523	1.814	0.000	2.337
2011	2	0.110	0.181	0.292	1.788	0.000	2.079	0.166	0.226	0.392	1.788	0.000	2.179	0.254	0.269	0.523	1.788	0.000	2.310
2012	1	0.110	0.181	0.292	1.745	0.000	2.037	0.166	0.226	0.392	1.745	0.000	2.137	0.254	0.269	0.523	1.745	0.000	2.268
2012	2	0.110	0.181	0.292	1.674	0.000	1.965	0.166	0.226	0.392	1.674	0.000	2.065	0.254	0.269	0.523	1.674	0.000	2.196
2013	1	0.110	0.181	0.292	1.641	0.000	1.933	0.166	0.226	0.392	1.641	0.000	2.033	0.254	0.269	0.523	1.641	0.000	2.164
2013	2	0.110	0.181	0.292	1.609	0.000	1.901	0.166	0.226	0.392	1.609	0.000	2.001	0.254	0.269	0.523	1.609	0.000	2.132
2014	1	0.110	0.181	0.292	1.583	0.000	1.874	0.166	0.226	0.392	1.583	0.000	1.974	0.254	0.269	0.523	1.583	0.000	2.105
2014	2	0.110	0.181	0.292	1.573	0.000	1.865	0.166	0.226	0.392	1.573	0.000	1.965	0.254	0.269	0.523	1.573	0.000	2.096
2015	1	0.110	0.181	0.292	1.544	0.000	1.836	0.166	0.226	0.392	1.544	0.000	1.936	0.254	0.269	0.523	1.544	0.000	2.067
2015	2	0.110	0.181	0.292	1.521	0.000	1.813	0.166	0.226	0.392	1.521	0.000	1.913	0.254	0.269	0.523	1.521	0.000	2.044
2016	1	0.110	0.181	0.292	1.495	0.000	1.786	0.166	0.226	0.392	1.495	0.000	1.886	0.254	0.269	0.523	1.495	0.000	2.017
2016	2	0.110	0.181	0.292	1.479	0.000	1.770	0.166	0.226	0.392	1.479	0.000	1.871	0.254	0.269	0.523	1.479	0.000	2.001
2017	1	0.110	0.181	0.292	1.469	0.000	1.760	0.166	0.226	0.392	1.469	0.000	1.860	0.254	0.269	0.523	1.469	0.000	1.991
2017	2	0.110	0.181	0.292	1.571	0.000	1.818	0.166	0.226	0.392	1.527	0.000	1.919	0.254	0.269	0.523	1.527	0.000	2.050
2018	1	0.110	0.181	0.292	1.504	0.000	1.795	0.166	0.226	0.392	1.504	0.000	1.896	0.254	0.269	0.523	1.504	0.000	2.026
2018	2	0.110	0.181	0.292	1.505	0.000	1.797	0.166	0.226	0.392	1.505	0.000	1.897	0.254	0.269	0.523	1.505	0.000	2.028
2019	1	0.110	0.181	0.292	1.484	0.000	1.776	0.166	0.226	0.392	1.484	0.000	1.876	0.254	0.269	0.523	1.484	0.000	2.007
2019	2	0.110	0.181	0.292	1.494	0.000	1.786	0.166	0.226	0.392	1.494	0.000	1.886	0.254	0.269	0.523	1.494	0.000	2.017
2020	1	0.110	0.181	0.292	1.471	0.000	1.763	0.166	0.226	0.392	1.471	0.000	1.863	0.254	0.269	0.523	1.471	0.000	1.994
2020	2	0.110	0.181	0.292	1.470	0.000	1.761	0.166	0.226	0.392	1.470	0.000	1.862	0.254	0.269	0.523	1.470	0.000	1.993

TABLE 8-5 ATLANTIC COAST THERMOELECTRIC PLANTS PRICING – LOW SCENARIO (US$ 2005/MBTU)

TABLE 8-6. THERMOELECTRIC PLANT PRICING INTERIOR 1 MERIELÉCTRICA, T. PALENQUE and T. CENTRO SCENARIO LOW (U$ 2005/MBTU)

YEAR	SEMESTER	Merilectrica						T. Palenque						T. CENTRO					
		TRANSPORTATION		RATE TRANSPORTATION	WELL HEAD PRICE	COMMERCIAL	NAT GAS PRICES NATURAL	TRANSPORTATION		RATE TRANSPORTATION	WELL HEAD PRICE	COMMERCIAL	NAT GAS PRICES	TRANSPORTATION		TRANSPORT RATE	WELL HEAD PRICE	COMMERCIAL	NAT GAS PRICES
		CF	CV					CF	CV					CF	CV				

					(US$/MBTU) YEAR 2005						(US$/MBTU) YEAR 2005						(US$/MBTU) YEAR 2005		
2007	1	0.766	0.556	1.322	2.595	0.000	3.918	0.596	1.219	1.815	4.293	0.000	6.108	0.833	0.622	1.455	2.595	0.000	4.051
2007	2	0.766	0.556	1.322	2.448	0.000	3.771	0.596	1.219	1.815	4.445	0.000	6.260	0.833	0.622	1.455	2.448	0.000	3.903
2008	1	0.766	0.556	1.322	2.383	0.000	3.706	0.596	1.219	1.815	4.491	0.000	6.306	0.833	0.622	1.455	2.383	0.000	3.839
2008	2	0.766	0.556	1.322	2.255	0.000	3.577	0.596	1.219	1.815	4.341	0.000	6.156	0.833	0.622	1.455	2.255	0.000	3.710
2009	1	0.766	0.556	1.322	2.194	0.000	3.516	0.596	1.219	1.815	4.225	0.000	6.040	0.833	0.622	1.455	2.194	0.000	3.649
2009	2	0.766	0.556	1.322	2.069	0.000	3.391	0.596	1.219	1.815	4.101	0.000	5.916	0.833	0.622	1.455	2.069	0.000	3.524
2010	1	0.766	0.556	1.322	2.004	0.000	3.326	1.101	1.037	2.138	1.450	0.000	3.588	0.833	0.622	1.455	2.004	0.000	3.459
2010	2	0.766	0.556	1.322	1.848	0.000	3.171	1.101	1.037	2.138	1.450	0.000	3.588	0.833	0.622	1.455	1.848	0.000	3.303
2011	1	0.766	0.556	1.322	1.814	0.000	3.136	1.101	1.037	2.138	1.450	0.000	3.588	0.833	0.622	1.455	1.814	0.000	3.269
2011	2	0.766	0.556	1.322	1.788	0.000	3.110	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2012	1	0.766	0.556	1.322	1.745	0.000	3.068	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2012	2	0.766	0.556	1.322	1.674	0.000	2.996	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2013	1	0.766	0.556	1.322	1.641	0.000	2.963	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.866	1.540	1.450	0.000	2.990
2013	2	0.766	0.556	1.322	1.609	0.000	2.931	1.101	1.037	2.138	1.609	0.000	3.571	0.653	0.866	1.540	1.450	0.000	2.990
2014	1	0.766	0.556	1.322	1.583	0.000	2.905	1.146	0.816	1.962	1.583	0.000	3.544	0.653	0.866	1.540	1.450	0.000	2.990
2014	2	0.766	0.556	1.322	1.573	0.000	2.896	1.146	0.816	1.962	1.573	0.000	3.535	0.653	0.866	1.540	1.450	0.000	2.990
2015	1	0.766	0.556	1.322	1.544	0.000	2.866	1.146	0.816	1.962	1.544	0.000	3.506	0.653	0.866	1.540	1.450	0.000	2.990
2015	2	0.766	0.556	1.322	1.521	0.000	2.844	1.146	0.816	1.962	1.521	0.000	3.483	0.833	0.622	1.455	1.521	0.000	2.976
2016	1	0.766	0.556	1.322	1.495	0.000	2.817	1.146	0.816	1.962	1.495	0.000	3.457	0.833	0.622	1.455	1.495	0.000	2.950
2016	2	0.766	0.556	1.322	1.479	0.000	2.801	1.146	0.816	1.962	1.479	0.000	3.441	0.833	0.622	1.455	1.479	0.000	2.934
2017	1	0.766	0.556	1.322	1.469	0.000	2.791	1.146	0.816	1.962	1.469	0.000	3.430	0.833	0.622	1.455	1.469	0.000	2.924
2017	2	0.766	0.556	1.322	1.527	0.000	2.849	1.146	0.816	1.962	1.527	0.000	3.489	0.833	0.622	1.455	1.527	0.000	2.982
2018	1	0.766	0.556	1.322	1.504	0.000	2.826	1.146	0.816	1.962	1.504	0.000	3.466	0.833	0.622	1.455	1.504	0.000	2.959
2018	2	0.766	0.556	1.322	1.505	0.000	2.827	1.146	0.816	1.962	1.505	0.000	3.457	0.833	0.622	1.455	1.505	0.000	2.960
2019	1	0.766	0.556	1.322	1.484	0.000	2.806	1.146	0.816	1.962	1.484	0.000	3.446	0.833	0.622	1.455	1.484	0.000	2.969
2019	2	0.766	0.556	1.322	1.494	0.000	2.817	1.146	0.816	1.962	1.494	0.000	3.456	0.833	0.622	1.455	1.494	0.000	2.950
2020	1	0.766	0.556	1.322	1.471	0.000	2.793	1.146	0.816	1.962	1.471	0.000	3.433	0.833	0.622	1.455	1.471	0.000	2.926
2020	2	0.766	0.566	1.322	1.470	0.000	2.792	1.146	0.816	1.962	1.470	0.000	3.432	0.833	0.622	1.455	1.470	0.000	2.925

TABLE 8-6 INTERIOR 1 MERIELECTRICA, T. PALENQUE AND T. CENTRO THERMOELECTRIC PLANT PRICING - LOW SCENARIO (US$ 2005/MBTU)

TABLE 8-7. THERMOELECTRIC PLANT PRICING INTERIOR 2 T. SIERRA, T. DORADA Y T. VALLE LOW SCENARIO (U$ 2005/MBTU)

YEAR	SEMESTER	T. Sierra						T. Dorada						T. Valle					
		TRANSPORTATION						TRANSPORTATION						TRANSPORTATION					
		CF	CV	RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL	CF	CV	RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES	CF	CV	TRANSPORTATION RATE	PRECIO BOCA POZO (US$/MBTU) AÑO 2005	COMER.	NATURAL GAS PRICE
2007	1	0.876	0.566	1.441	2.595	0.000	4.04	1.050	0.632	1.682	2.595	0.000	4.277	1.727	0.750	2.477	2.595	0.000	5.072
2007	2	0.876	0.566	1.441	2.448	0.000	3.89	1.050	0.632	1.682	2.448	0.000	4.130	1.727	0.750	2.477	2.448	0.000	4.925
2008	1	0.876	0.566	1.441	2.408	0.000	3.85	1.050	0.632	1.682	2.383	0.000	4.065	1.727	0.750	2.477	2.383	0.000	4.860
2008	2	0.876	0.566	1.441	2.381	0.000	3.82	1.050	0.632	1.682	2.255	0.000	3.937	1.727	0.750	2.477	2.255	0.000	4.731
2009	1	0.876	0.566	1.441	2.332	0.000	3.77	1.050	0.632	1.682	2.194	0.000	3.875	1.727	0.750	2.477	2.194	0.000	4.670
2009	2	0.876	0.566	1.441	2.272	0.000	3.71	1.050	0.632	1.682	2.069	0.000	3.751	1.727	0.750	2.477	2.069	0.000	4.545

2010	1	0.876	0.566	1.441	2.211	0.000	3.65	1.050	0.632	1.682	2.004	0.000	3.686	1.727	0.750	2.477	2.004	0.000	4.481
2010	2	0.876	0.566	1.441	2.091	0.000	3.53	1.050	0.632	1.682	1.848	0.000	3.530	1.727	0.750	2.477	1.848	0.000	4.325
2011	1	0.876	0.566	1.441	2.073	0.000	3.51	1.050	0.632	1.682	1.814	0.000	3.496	1.727	0.750	2.477	1.814	0.000	4.291
2011	2	0.610	0.820	1.431	1.450	0.000	2.88	1.050	0.632	1.683	1.788	0.000	3.469	1.727	0.750	2.477	1.788	0.000	4.264
2012	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.727	0.750	2.477	1.745	0.000	4.222
2012	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.727	0.750	2.477	1.674	0.000	4.150
2013	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.727	0.750	2.477	1.641	0.000	4.118
2013	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2014	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2014	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2015	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2015	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2016	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2016	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2017	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2017	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2018	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2018	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2019	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2019	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2020	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2020	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876

TABLE 8-7 INTERIOR 2 T. SIERRA, T. DORADA AND T. VALLE THERMOELECTRIC PLANTS PRICING – LOW SCENARIO (US$ 2005/MBTU)

TABLE 8-8. THERMOELECTRIC PLANT PRICING INTERIOR 3 - T. EMCALI SCENARIO LOW (U$ 2005/MBTU)							
YEAR	SEMESTER	T. EMCALI					
		CUSIANA - CALI		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL
		CF	CV				
2007	1	1.462	0.964	2.426	1.450	0.000	3.876
2007	2	1.462	0.964	2.426	1.450	0.000	3.876
2008	1	1.462	0.964	2.426	1.450	0.000	3.876
2008	2	1.462	0.964	2.426	1.450	0.000	3.876
2009	1	1.462	0.964	2.426	1.450	0.000	3.876
2009	2	1.462	0.964	2.426	1.450	0.000	3.876
2010	1	1.462	0.964	2.426	1.450	0.000	3.876
2010	2	1.462	0.964	2.426	1.450	0.000	3.876
2011	1	1.462	0.964	2.426	1.450	0.000	3.876
2011	2	1.462	0.964	2.426	1.450	0.000	3.876
2012	1	1.462	0.964	2.426	1.450	0.000	3.876
2012	2	1.462	0.964	2.426	1.450	0.000	3.876
2013	1	1.462	0.964	2.426	1.450	0.000	3.876
2013	2	1.462	0.964	2.426	1.450	0.000	3.876
2014	1	1.462	0.964	2.426	1.450	0.000	3.876
2014	2	1.462	0.964	2.426	1.450	0.000	3.876
2015	1	1.462	0.964	2.426	1.450	0.000	3.876
2015	2	1.462	0.964	2.426	1.450	0.000	3.876
2016	1	1.462	0.964	2.426	1.450	0.000	3.876
2016	2	1.462	0.964	2.426	1.450	0.000	3.876
2017	1	1.462	0.964	2.426	1.450	0.000	3.876
2017	2	1.462	0.964	2.426	1.450	0.000	3.876
2018	1	1.462	0.964	2.426	1.450	0.000	3.876
2018	2	11.462	0.964	2.426	1.450	0.000	3.876
2019	1	1.462	0.964	2.426	1.450	0.000	3.876
2019	2	1.462	0.964	2.426	1.450	0.000	3.876
2020	1	1.462	0.964	2.426	1.450	0.000	3.876
2020	2	1.462	0.964	2.426	1.450	0.000	3.876

TABLE 8-8 INTERIOR 3 – T.
EMCALI THERMOELECTRIC PLANTS PRICING – LOW SCENARIO (US$ 2005/MBTU)

TABLE 8-9. PRICE FOR HYDROELECTRIC PLANTS ATLANTIC COAST SCENARIO HIGH (U$ 2005/MBTU)																			
YEAR	SEMESTER	HYDROELECTRIC PLANTS COAST																	
		Guajira						BARRANQUILLA						Cartagena - MAMONAL					
		BALLENA – LA MAMI		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL	BALLENA – LA MAMI – BARRANQUILLA		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES	BALLENA – LA MAMI – B/QUILLA CARTAGENA (MAMONAL)		TRANSPORT RATE	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL
		CF	CV					CF	CV					CF	CV				
2007	1	0.110	0.181	0.292	2.595	0.000	2.887	0.166	0.226	0.392	2.595	0.000	2.987	0.254	0.269	0.523	2.595	0.000	3.118
2007	2	0.110	0.181	0.292	2.448	0.000	2.740	0.166	0.226	0.392	2.448	0.000	2.840	0.254	0.296	0.523	2.448	0.000	2.971
2008	1	0.110	0.181	0.292	2.438	0.000	2.729	0.166	0.226	0.392	2.438	0.000	2.830	0.254	0.269	0.523	2.438	0.000	2.960
2008	2	0.110	0.181	0.292	2.565	0.000	2.856	0.166	0.226	0.392	2.565	0.000	2.956	0.254	0.269	0.523	2.565	0.000	3.087
2009	1	0.110	0.181	0.292	2.522	0.000	2.814	0.166	0.226	0.392	2.522	0.000	2.914	0.254	0.269	0.523	2.522	0.000	3.045
2009	2	0.110	0.181	0.292	2.509	0.000	2.801	0.166	0.226	0.392	2.509	0.000	2.901	0.254	0.269	0.523	2.509	0.000	3.032
2010	1	0.110	0.181	0.292	2.484	0.000	2.776	0.166	0.226	0.392	2.484	0.000	2.876	0.254	0.269	0.523	2.484	0.000	3.007
2010	2	0.110	0.181	0.292	2.549	0.000	2.841	0.166	0.226	0.392	2.549	0.000	2.941	0.254	0.269	0.523	2.549	0.000	3.072
2011	1	0.110	0.181	0.292	2.540	0.000	2.831	0.166	0.226	0.392	2.540	0.000	2.931	0.254	0.269	0.523	2.540	0.000	3.062
2011	2	0.110	0.181	0.292	2.678	0.000	2.970	0.166	0.226	0.392	2.678	0.000	3.070	0.254	0.269	0.523	2.678	0.000	3.201
2012	1	0.110	0.181	0.292	2.669	0.000	2.960	0.166	0.226	0.392	2.669	0.000	3.061	0.254	0.269	0.523	2.669	0.000	3.191
2012	2	0.110	0.181	0.292	2.818	0.000	3.110	0.166	0.226	0.392	2.818	0.000	3.210	0.254	0.269	0.523	2.818	0.000	3.341
2013	1	0.110	0.181	0.292	2.799	0.000	3.090	0.166	0.226	0.392	2.799	0.000	3.191	0.254	0.269	0.523	2.799	0.000	3.322
2013	2	0.110	0.181	0.292	2.910	0.000	3.202	0.166	0.226	0.392	2.910	0.000	3.302	0.254	0.269	0.523	2.910	0.000	3.433
2014	1	0.110	0.181	0.292	2.907	0.000	3.199	0.166	0.226	0.392	2.907	0.000	3.299	0.254	0.269	0.523	2.907	0.000	3.430
2014	2	0.110	0.181	0.292	3.104	0.000	3.395	0.166	0.226	0.392	3.104	0.000	3.495	0.254	0.269	0.523	3.104	0.000	3.626
2015	1	0.110	0.181	0.292	3.085	0.000	3.377	0.166	0.226	0.392	3.085	0.000	3.477	0.254	0.269	0.523	3.085	0.000	3.608
2015	2	0.110	0.181	0.292	3.223	0.000	3.515	0.166	0.226	0.392	3.223	0.000	3.615	0.254	0.269	0.523	3.223	0.000	3.746
2016	1	0.110	0.181	0.292	3.197	0.000	3.489	0.166	0.226	0.392	3.197	0.000	3.589	0.254	0.269	0.523	3.197	0.000	3.720
2016	2	0.110	0.181	0.292	3.307	0.000	3.598	0.166	0.226	0.392	3.307	0.000	3.698	0.254	0.269	0.523	3.307	0.000	3.829
2017	1	0.110	0.181	0.292	3.278	0.000	3.569	0.166	0.226	0.392	3.278	0.000	3.670	0.254	0.269	0.523	3.278	0.000	3.801
2017	2	0.110	0.181	0.292	3.381	0.000	3.673	0.166	0.226	0.392	3.381	0.000	3.773	0.254	0.269	0.523	3.381	0.000	3.904
2018	1	0.110	0.181	0.292	3.356	0.000	3.647	0.166	0.226	0.392	3.356	0.000	3.478	0.254	0.269	0.523	3.356	0.000	3.878
2018	2	0.110	0.181	0.292	3.481	0.000	3.773	0.166	0.226	0.392	3.481	0.000	3.873	0.254	0.269	0.523	3.481	0.000	4.004
2019	1	0.110	0.181	0.292	3.436	0.000	3.728	0.166	0.226	0.392	3.436	0.000	3.828	0.254	0.269	0.523	3.436	0.000	3.959
2019	2	0.110	0.181	0.292	3.475	0.000	3.766	0.166	0.226	0.392	3.475	0.000	3.867	0.254	0.269	0.523	3.475	0.000	3.998
2020	1	0.110	0.181	0.292	3.450	0.000	3.741	0.166	0.226	0.392	3.450	0.000	3.841	0.254	0.269	0.523	3.450	0.000	3.972
2020	2	0.110	0.181	0.292	3.581	0.000	3.873	0.166	0.226	0.392	3.581	0.000	3.973	0.254	0.269	0.523	3.581	0.000	4.104

TABLE 8-9 ATLANTIC COAST THERMOELECTRIC PLANTS PRICING – HIGH SCENARIO (US$ 2005/MBTU)

TABLE 8-10. THERMOELECTRIC PLANT PRICING INTERIOR 1 MERIELÉCTRICA, T. PALENQUE AND T. CENTRO SCENARIO HIGH (U$ 2005/MBTU)																			
YEAR	SEMESTER																		
		Merilectrica						T. Palenque						T. CENTRO					
		TRANSPORTATION		RATE TRANSPORTATION	WELL HEAD PRICE	COMMERCIAL	NAT GAS PRICES NATURAL	TRANSPORTATION		RATE TRANSPORTATION	WELL HEAD PRICE	COMMERCIAL	NAT GAS PRICES	TRANSPORTATION		TRANSPORT RATE	WELL HEAD PRICE	COMMERCIAL	NAT GAS PRICES NATURAL
		CF	CV					CF	CV					CF	CV				

					(US$/MBTU) YEAR 2005						(US$/MBTU) YEAR 2005						(US$/MBTU) YEAR 2005		
2007	1	0.766	0.556	1.322	2.595	0.000	3.918	0.596	1.219	1.815	4.293	0.000	6.108	0.833	0.622	1.455	2.595	0.000	4.051
2007	2	0.766	0.556	1.322	2.448	0.000	3.771	0.596	1.219	1.815	4.445	0.000	6.260	0.833	0.622	1.455	2.448	0.000	3.903
2008	1	0.766	0.556	1.322	2.438	0.000	3.760	0.596	1.219	1.815	4.491	0.000	6.306	0.833	0.622	1.455	2.438	0.000	3.893
2008	2	0.766	0.556	1.322	2.565	0.000	3.887	0.596	1.219	1.815	4.341	0.000	6.156	0.833	0.622	1.455	2.565	0.000	4.020
2009	1	0.766	0.556	1.322	2.522	0.000	3.845	0.596	1.219	1.815	4.225	0.000	6.040	0.833	0.622	1.455	2.522	0.000	3.978
2009	2	0.766	0.556	1.322	2.509	0.000	3.831	0.596	1.219	1.815	4.101	0.000	5.916	0.833	0.622	1.455	2.509	0.000	3.964
2010	1	0.766	0.556	1.322	2.484	0.000	3.807	1.101	1.037	2.138	1.450	0.000	3.588	0.833	0.622	1.455	2.484	0.000	3.940
2010	2	0.766	0.556	1.322	2.549	0.000	3.871	1.101	1.037	2.138	1.450	0.000	3.588	0.833	0.622	1.455	2.549	0.000	4.004
2011	1	0.766	0.556	1.322	2.540	0.000	3.862	1.101	1.037	2.138	1.450	0.000	3.588	0.833	0.622	1.455	2.540	0.000	3.995
2011	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2012	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2012	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2013	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2013	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2014	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2014	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2015	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2015	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2016	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2016	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2017	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2017	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2018	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2018	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2019	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2019	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2020	1	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.990
2020	2	0.720	0.971	1.691	1.450	0.000	3.142	1.101	1.037	2.138	1.450	0.000	3.588	0.653	0.886	1.540	1.450	0.000	2.900

TABLE 8-10 INTERIOR 1 MERIELECTRICA, T.
PALENQUE AND T. CENTRO THERMOELECTRIC PLANTS PRICING - HIGH SCENARIO (US$ 2005/MBTU)

TABLE 8-11. THERMOELECTRIC PLANT PRICING INTERIOR 2 T. SIERRA, T. DORADA Y T. VALLE
HIGH SCENARIO (U$ 2005/MBTU)

YEAR	SEMESTER	T. Sierra						T. Dorada						T. VALLE					
		TRANSPORTATION		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL	TRANSPORTATION		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES	TRANSPORTATION		TRANSPORT RATE	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL
		CF	CV					CF	CV					CF	CV				
2007	1	0.876	0.566	1.441	2.595	0.000	4.04	1.050	0.632	1.682	2.595	0.000	4.277	1.727	0.750	2.477	2.595	0.000	5.072
2007	2	0.876	0.566	1.441	2.448	0.000	3.89	1.050	0.632	1.682	2.448	0.000	4.130	1.727	0.750	2.477	2.448	0.000	4.925
2008	1	0.876	0.566	1.441	2.438	0.000	3.88	1.050	0.632	1.682	2.438	0.000	4.119	1.727	0.750	2.477	2.438	0.000	4.914
2008	2	0.876	0.566	1.441	2.565	0.000	4.01	1.050	0.632	1.682	2.565	0.000	4.246	1.727	0.750	2.477	2.565	0.000	5.041
2009	1	0.876	0.566	1.441	2.522	0.000	3.96	1.050	0.632	1.682	2.522	0.000	4.204	1.727	0.750	2.477	2.522	0.000	4.999
2009	2	0.876	0.566	1.441	2.509	0.000	3.95	1.050	0.632	1.682	2.509	0.000	4.191	1.727	0.750	2.477	2.509	0.000	4.986

2010	1	0.876	0.566	1.441	2.484	0.000	3.93	1.050	0.632	1.682	2.484	0.000	4.166	1.727	0.750	2.477	2.484	0.000	4.961
2010	2	0.876	0.566	1.441	2.549	0.000	3.99	1.050	0.632	1.682	2.549	0.000	4.231	1.727	0.750	2.477	2.549	0.000	5.026
2011	1	0.876	0.566	1.441	2.540	0.000	3.98	1.050	0.632	1.682	2.540	0.000	4.221	1.727	0.750	2.477	2.540	0.000	5.016
2011	2	0.610	0.820	1.431	1.450	0.000	2.88	1.050	0.632	1.683	2.678	0.000	4.360	1.727	0.750	2.477	2.678	0.000	5.155
2012	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.727	0.750	2.477	2.669	0.000	5.145
2012	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.727	0.750	2.477	2.818	0.000	5.295
2013	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.727	0.750	2.477	2.799	0.000	5.275
2013	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2014	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2014	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2015	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2015	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2016	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2016	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2017	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2017	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2018	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2018	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2019	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2019	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2020	1	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876
2020	2	0.610	0.820	1.431	1.450	0.000	2.88	0.785	0.898	1.683	1.450	0.000	3.133	1.462	0.964	2.426	1.450	0.000	3.876

TABLE 8-11 INTERIOR 2 T.
SIERRA, T. DORADA AND T. VALLE THERMOELECTRIC PLANTS PRICING – HIGH SCENARIO (US$ 2005/MBTU)

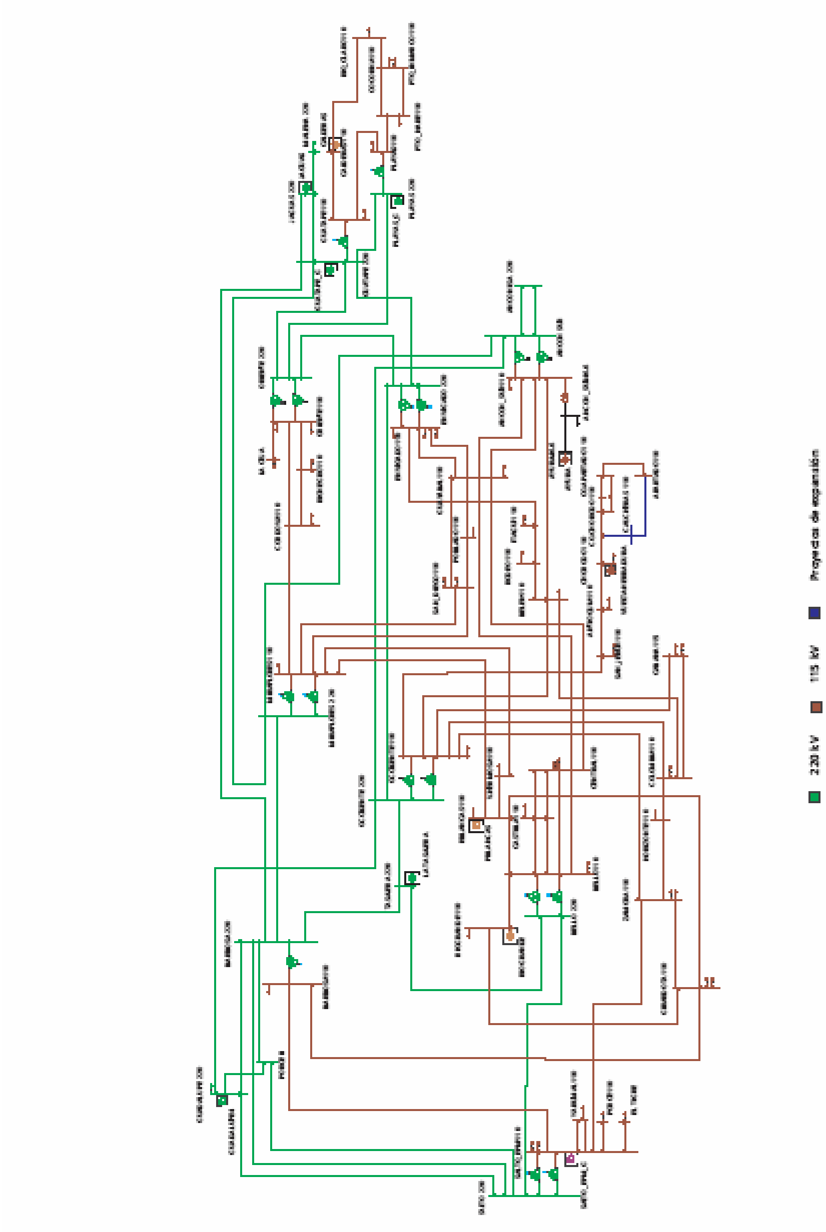
TABLE 8-12. THERMOELECTRIC PLANT PRICING INTERIOR 3 - T. EMCALI SCENARIO LOW (U$ 2005/MBTU)							
YEAR	SEMESTER	T. EMCALI					
		CUSIANA - CALI		RATE TRANSPORTATION	WELL HEAD PRICE (US$/MBTU) YEAR 2005	COMMERCIAL	NAT GAS PRICES NATURAL
		CF	CV				
2007	1	1.462	0.964	2.426	1.450	0.000	3.876
2007	2	1.462	0.964	2.426	1.450	0.000	3.876
2008	1	1.462	0.964	2.426	1.450	0.000	3.876
2008	2	1.462	0.964	2.426	1.450	0.000	3.876
2009	1	1.462	0.964	2.426	1.450	0.000	3.876
2009	2	1.462	0.964	2.426	1.450	0.000	3.876
2010	1	1.462	0.964	2.426	1.450	0.000	3.876
2010	2	1.462	0.964	2.426	1.450	0.000	3.876
2011	1	1.462	0.964	2.426	1.450	0.000	3.876
2011	2	1.462	0.964	2.426	1.450	0.000	3.876
2012	1	1.462	0.964	2.426	1.450	0.000	3.876
2012	2	1.462	0.964	2.426	1.450	0.000	3.876
2013	1	1.462	0.964	2.426	1.450	0.000	3.876
2013	2	1.462	0.964	2.426	1.450	0.000	3.876
2014	1	1.462	0.964	2.426	1.450	0.000	3.876
2014	2	1.462	0.964	2.426	1.450	0.000	3.876
2015	1	1.462	0.964	2.426	1.450	0.000	3.876
2015	2	1.462	0.964	2.426	1.450	0.000	3.876
2016	1	1.462	0.964	2.426	1.450	0.000	3.876
2016	2	1.462	0.964	2.426	1.450	0.000	3.876
2017	1	1.462	0.964	2.426	1.450	0.000	3.876
2017	2	1.462	0.964	2.426	1.450	0.000	3.876
2018	1	1.462	0.964	2.426	1.450	0.000	3.876
2018	2	11.462	0.964	2.426	1.450	0.000	3.876
2019	1	1.462	0.964	2.426	1.450	0.000	3.876
2019	2	1.462	0.964	2.426	1.450	0.000	3.876
2020	1	1.462	0.964	2.426	1.450	0.000	3.876
2020	2	1.462	0.964	2.426	1.450	0.000	3.876

TABLE 8-12 INTERIOR 3 – T.
EMCALI THERMOELECTRIC PLANTS PRICING – HIGH SCENARIO (US$ 2005/MBTU)

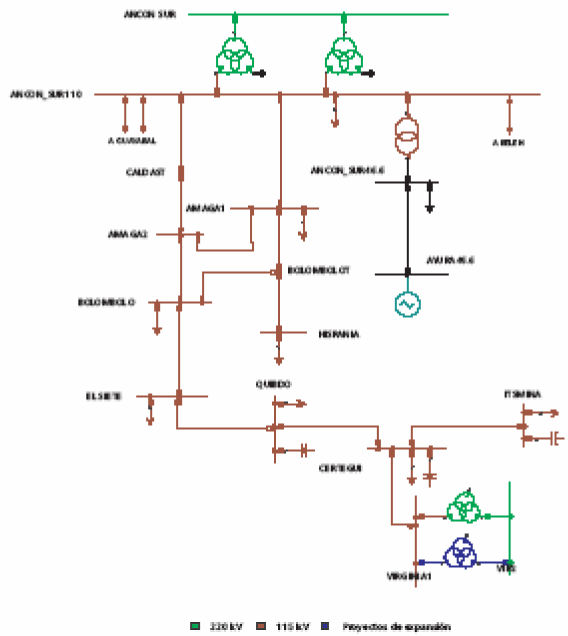
8.2. NETWORK OPERATORS EXPANSION PLANS

YEAR	NAME	LEVELS of VOLTAGE	ELEMENT	EXPANSION DESCRIPTION	CAPACITY
ELECTRIC POWER PLANTS NORTE DE SANTANDER - CENS					
2006	INSULA	115	SUBSTATION	CONNECTED TO THE SAN MATEO, CUCUTA Y ZULIA SUBSTATIONS	
CODENSA					
2006	BACATÁ	500/115	TRANSFORMER	FIRST TRANSFORMER, TRIPLE WINDING	450 MVA
2006	BACATÁ	115	SUBSTATION		
2006	NORTHEAST - TECHO	115	LINE	RECONFIGURED CIRCUIT BALSILLAS - TECHO	800 A
2006	BACATÁ - SALITRE	115	LINE	RECONFIGURED CIRCUIT DUE TO THE ENTRY AT SUBSTATION BACATÁ	800 A
2006	BACATÁ – EL SOL	115	LINE	RECONFIGURED CIRCUIT DUE TO THE ENTRY AT SUBSTATION BACATÁ	800 A
2006	BACATÁ - TIBABUYES	115	LINE	RECONFIGURED CIRCUIT DUE TO THE ENTRY AT SUBSTATION BACATÁ	800 A
2006	BACATÁ - SUBA	115	LINE	RECONFIGURED CIRCUIT DUE TO THE ENTRY AT SUBSTATION BACATÁ	800 A
2006	BOGOTÁ - CHÍA	115	LINE	RECONFIGURED CIRCUIT DUE TO THE ENTRY AT SUBSTATION BACATÁ	800 A
2006	EL SOL	115	COMPENSATION	NEW COMPENSATION	87,5 MVAr
2006	COMSISA	115	SUBSTATION	CATERS TO NEW DEMAND	
2006	COMSISA - CHIA	115	LINE	RECONFIGURED CIRCUIT TERMOZIPA - CHIA	800 A
2006	COMSISA - TERMOZIPA	115	LINE	RECONFIGURED CIRCUIT TERMOZIPA - CHIA	800 A
2007	CALLE PRIMERA	115	SUBSTATION	CHANGING VOLTAGE LEVEL FROM 57,5 kV to 115 kV	
2007	CONCORDIA – CALLE PRIMERA	115	LINE	CHANGING VOLTAGE LEVEL FROM 57,5 kV to 115 kV	800 A
2007	VERAGUAS – CALLE PRIMERA	115	LINE	NEW CIRCUIT	800 A
2008	TERMINAL	115	SUBSTATION		
2008	SALITRE - TERMINAL	115	LINE	RECONFIGURE SALITRE - FONTIBON	800 A
2008	TERMINAL - FONTIBON	115	LINE	RECONFIGURE SALITRE - FONTIBON	800 A
2008	NORTHEAST 3	230/115	TRANSFORMER	THIRD TRANSFORMER	168 MVA
ELECTRICARIBE					
2006	NUEVA BARRANQUILLA	230/110/13,8	TRANSFORMER	TWO TRANSFORMERS, TRIPLE WINDING AT 100 MVA EACH	200 MVA
2006	NUEVA BQUILLA – SINCELEJO	115	LINE	RECONFIGURED CIRCUIT SILENCIO – VTE JULIO	800 A
2006	NUVA BQUILLA – VTE DE JULIO	115	LINE	RECONFIGURED CIRCUIT SILENCIO – VTE JULIO	800 A
ELECTROCOSTA					
2006	MOMPOX	110	COMPENSATION		15 MVAr
2007	ZARAGOCILLA	110	SUBSTATION	CHANGING VOLTAGE LEVEL FROM 66 kV to 110 kV	
2007	CANDELARIA – ZARAGOCILLA	110	LINE	NEW CIRCUIT	712 A
2007	EL CARMEN	110	COMPENSATION		15 MVAr
2008	CANDELARIA	230/110	TRANSFORMER	SECOND TRANSFORMER	100MVA
EMPRESA DE ENERGÍA DE PEREIRA - EEP					
2006	PAVAS	115	SUBSTATION		
2006	PAVAS – DOSQUEBRADAS	115	LINE	REBUILT CIRCUIT DOSQUEBRADAS – PAPELES	527 A
2006	PAPELES – PAVAS	115	LINE	RECONFIGURED CIRCUIT DOSQUEBRADAS – PAPELES	527 A
2009	VIRGINIA - PAVAS	115	LINE	NEW DOUBLE CIRCUIT	687 A
YEAR	**NAME**	**LEVELS OF VOLTAGE**	**ELEMENT**	**EXPANSION DESCRIPTION**	**CAPACITY**
EMCALI					

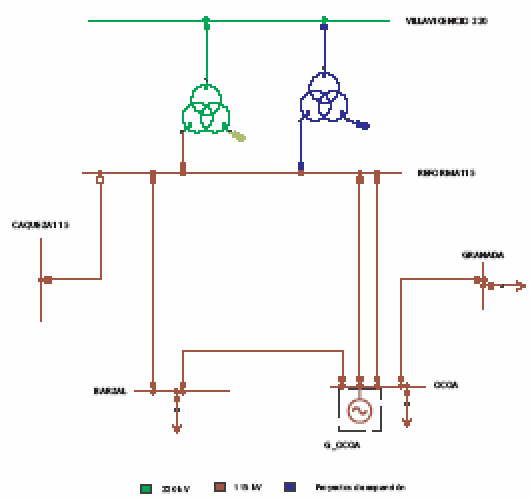
2007	ARROYOHONDO	115	SUBSTATION	CONNECTED TO THE TERMOYUMBO and GUACHAL SUBSTATIONS	
2008	ALFEREZ	230	SUBSTATION	EXPANSION PROPOSAL TO STN LEVEL, CONNECTED BETWEEN JUANCHITO AND PAEZ SUBSTATIONS	
2008	ALFEREZ	230/34,5/13,2	TRANSFORMER	EXPANSION PROPOSAL TO STN LEVEL	90 MVA
2008	ACUEDUCTO	230	SUBSTATION	EXPANSION PROPOSAL TO STN LEVEL	
2008	ACUEDUCTO	230/115	TRANSFORMER	STN CONNECTION THROUGH THE SUBSTATION ACUEDUCTO PROPOSAL	90 MVA
ELECTRIFICADORA DEL META - EMSA					
2007	REFORM	230/115	TRANSFORMER	SECOND TRANSFORMER	150 MVA
EMPRESA DE ENERGÍA DEL PACÍFICO - EPSA					
2006	SAN MARCOS	230/115	TRANSFORMER	SECOND TRANSFORMER	168 MVA
2008	SUB 220	230	SUBSTATION		
2008	SUB 220	230/115	TRANSFORMER	FIRST TRANSFORMER, TRIPLE WINDING	168 MVA
2008	SUB 220 -115	115	SUBSTATION		
2008	PANCE – SUB 220	230	LINE	RECONFIGURED CIRCUIT PANCE - YUMBO	1000 A
2008	SUB 220 - YUMBO	230	LINE	RECONFIGURED CIRCUIT PANCE - YUMBO	1000 A
2008	LOW ANCHICAYA – SUB 220-115 I Y II	115	LINE	RECONFIGURED CIRCUIT LOW ANCHICAYA – CHIPICHAPE I Y II	
2008	CHIPICHAPE – SUB 220 – 115 I Y II	115	LINE	RECONFIGURED CIRCUIT LOW ANCHICAYA – CHIPICHAPE I Y II	
2008	PAILON	230	SUBSTATION	EXPANSION PROPOSAL TO STN LEVEL, CONNECTED TO THE ANCHICAYA SUBSTATION	
2008	PAILON	230/115	TRANSFORMER	EXPANSION PROPOSAL TO STN LEVEL	90 MVA
2008	HIGH ANCHICAYA - PAILON	230	LINE	EXPANSION PROPOSAL TO STN LEVEL	
2009	JAMUNDÍ	115	SUBSTATION		
2009	JAMUNDI - SANTANDER	115	LINE	NEW CIRCUIT	330 A
2009	PANCE - JAMUNDI	115	LINE	NEW CIRCUIT	330 A
2010	BITACO	115	SUBSTATION		
2010	LOW ANCHICAYA - BITACO	115	LINE	RECONFIGURED CIRCUIT LOW ANCHICAYA – CHIPICHAPE II	470 A
2010	BITACO – SUB220 - 115	115	LINE	RECONFIGURED CIRCUIT LOW ANCHICAYA – CHIPICHAPE II	470 A
2010	CHIPICHAPE – SUB220 - 115	115	LINE	RECONFIGURED CIRCUIT ANCHICAYA – CHIPICHAPE III	470 A
2010	SEVILLA	115	SUBSTATION		
2010	ZARZAL - SEVILLA	115	LINE	NEW CIRCUIT	
2012	TULUA	230	SUBSTATION	EXPANSION PROPOSAL TO STN LEVEL, CONNECTED TO CARTAGO AND SAN MARCOS SUBSTATIONS	
2012	CARTAGO - TULUA	230	LINE	EXPANSION PROPOSAL TO STN LEVEL	984 A
2012	TULUA SAN MARCOS	230	LINE	EXPANSION PROPOSAL TO STN LEVEL	984 A
ELECTROHUILA					
2007	ALTAMIRA	230/115	TRANSFORMER		150 MVA
EMPRESA DE ENERGÍA DE BOYACÁ - EBSA					
2006	TUNJA – CHIQUINQUIRA	115	LINE	NEW CIRCUIT	443 A
2007	PAIPA	230/115	TRANSFORMER	TRANSFORMER CHANGE FROM CURRENT 90 MVA	180 MVA
2006	PUERTO BOYACÁ	115	SUBSTATION	CHANGE CURRENT T CONFIGURATION FOR STANDARD CONFIGURATION	
ENERTOLIMA					
2006	MIROLINDO	230/115	TRANSFORMER	SECOND TRANSFORMER	150 MVA



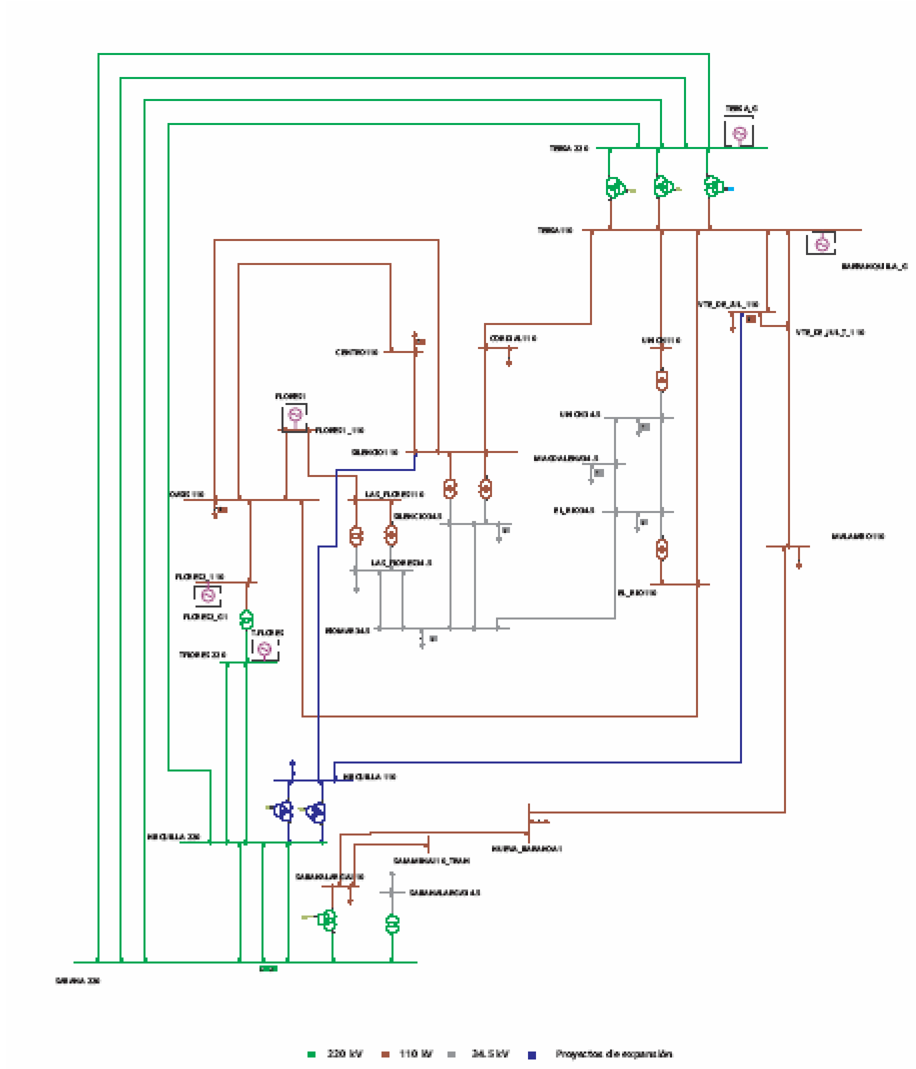
Antioquia Area



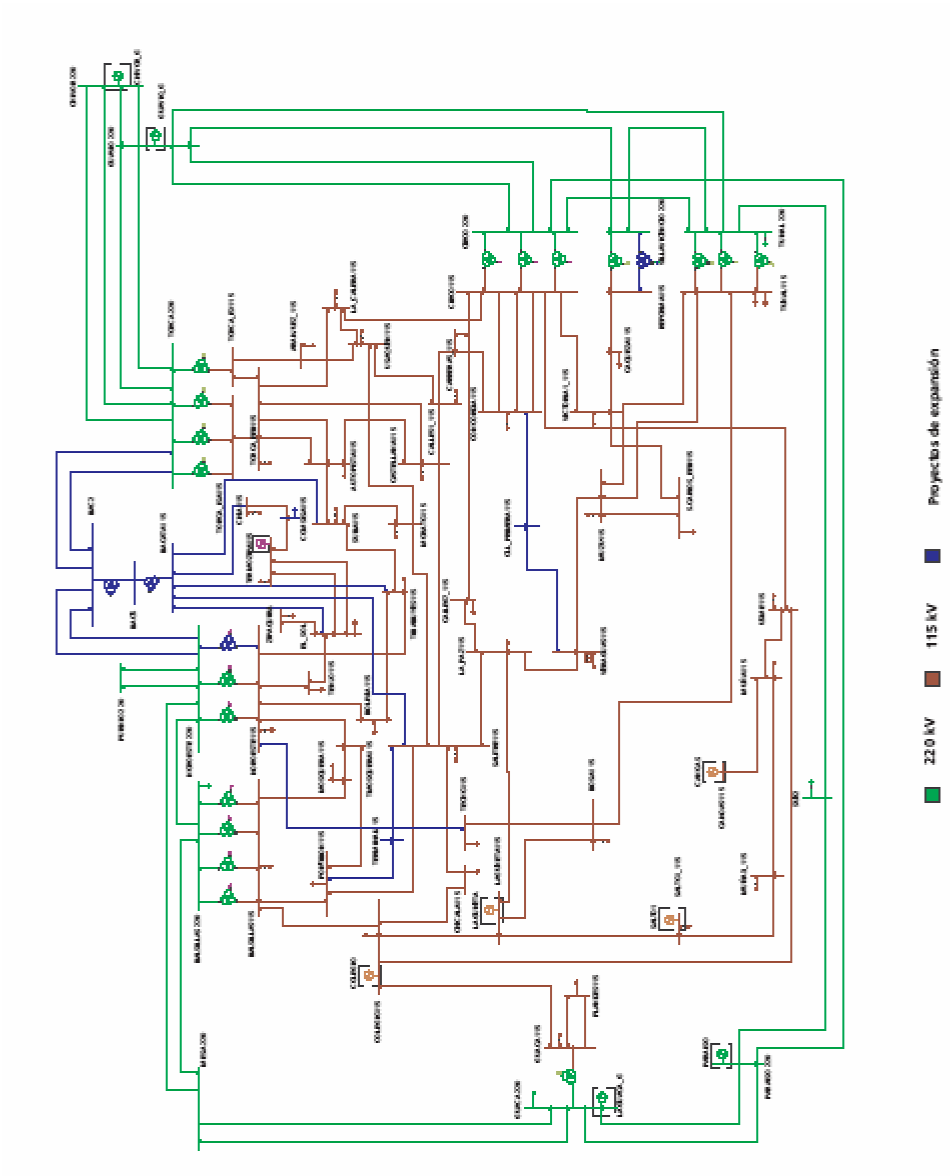
Área Chocó



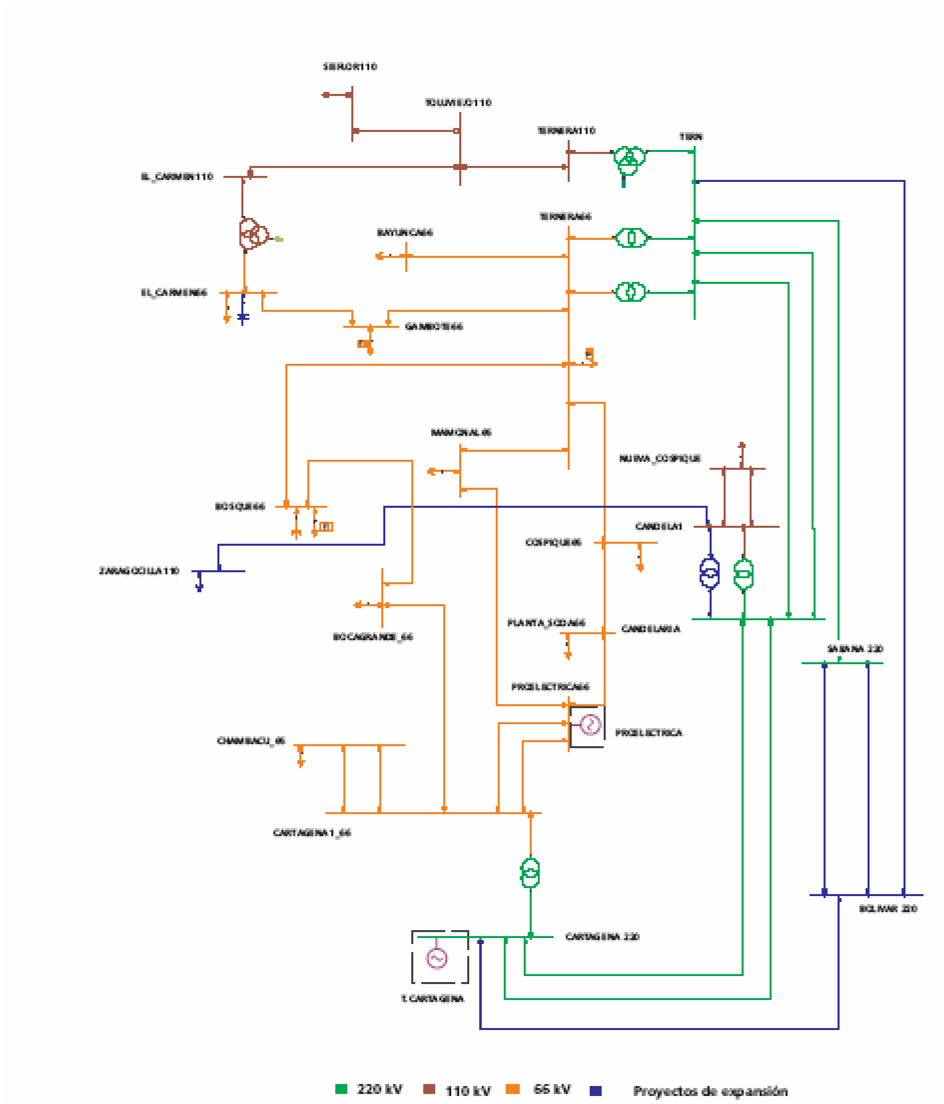
Meta Area



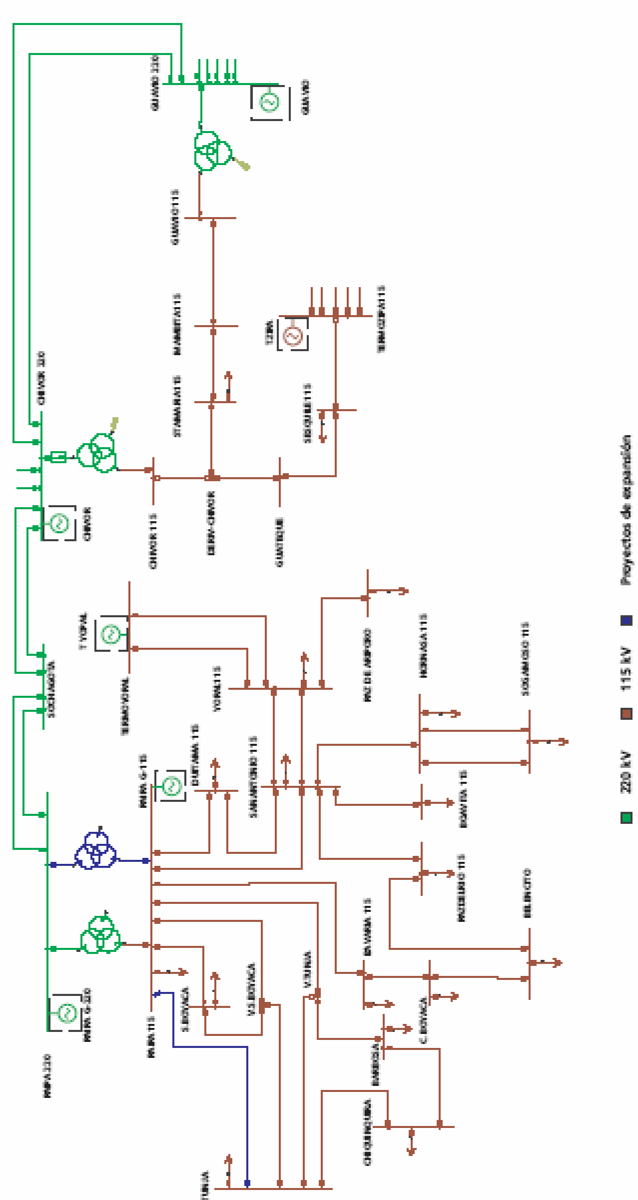
Atlantic Area



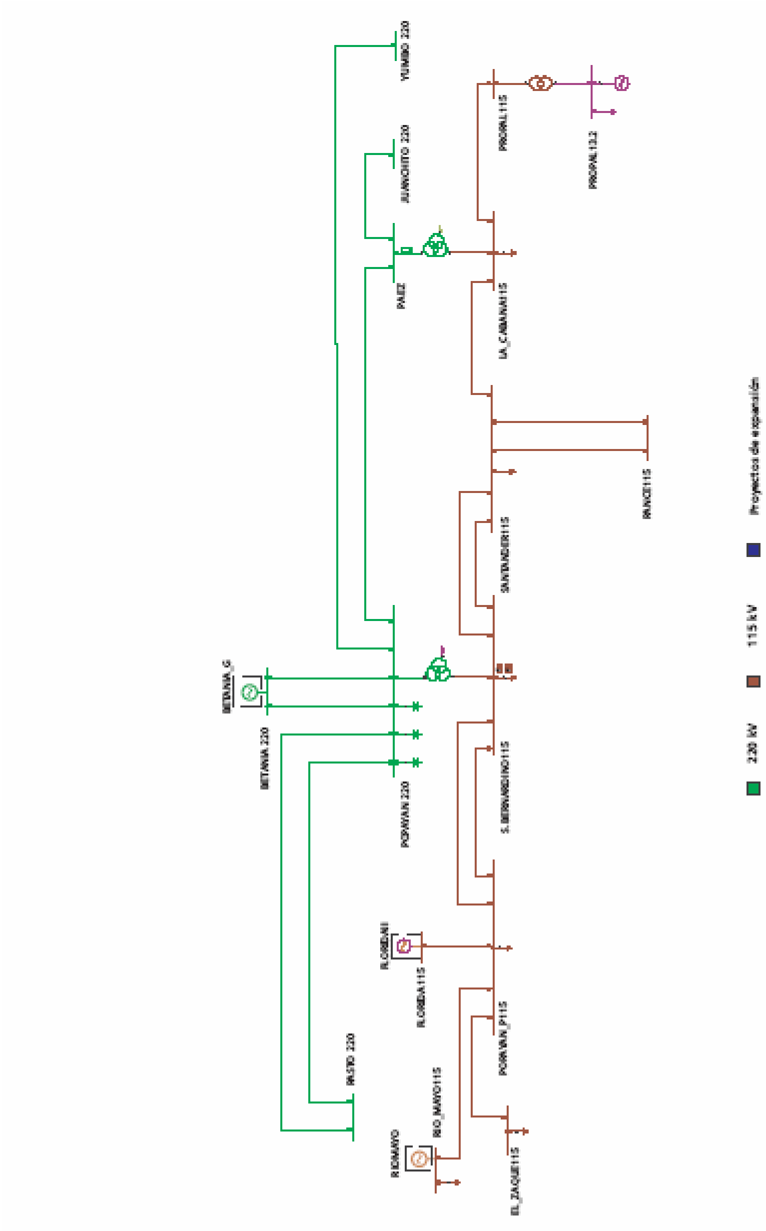
Bogotá Area



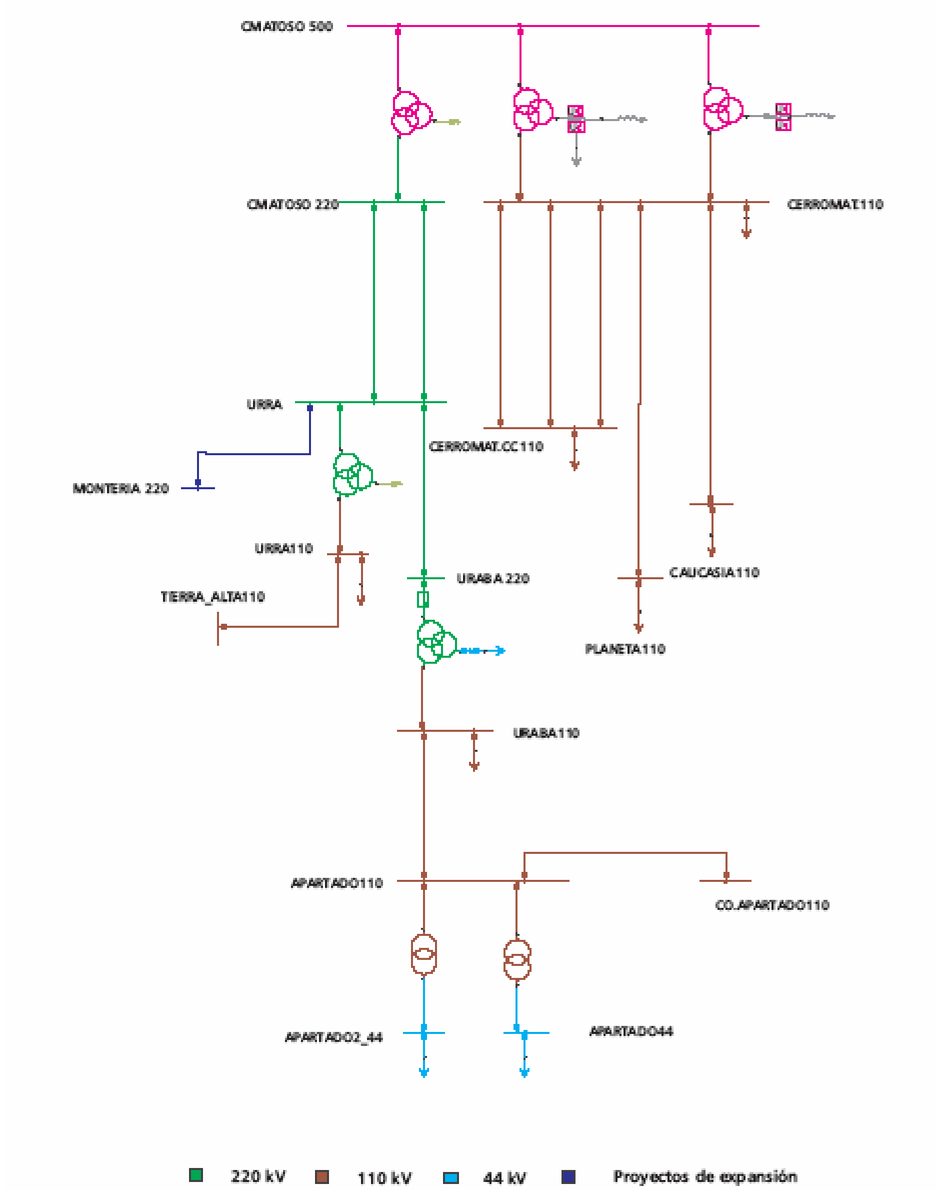
Bolivar Area



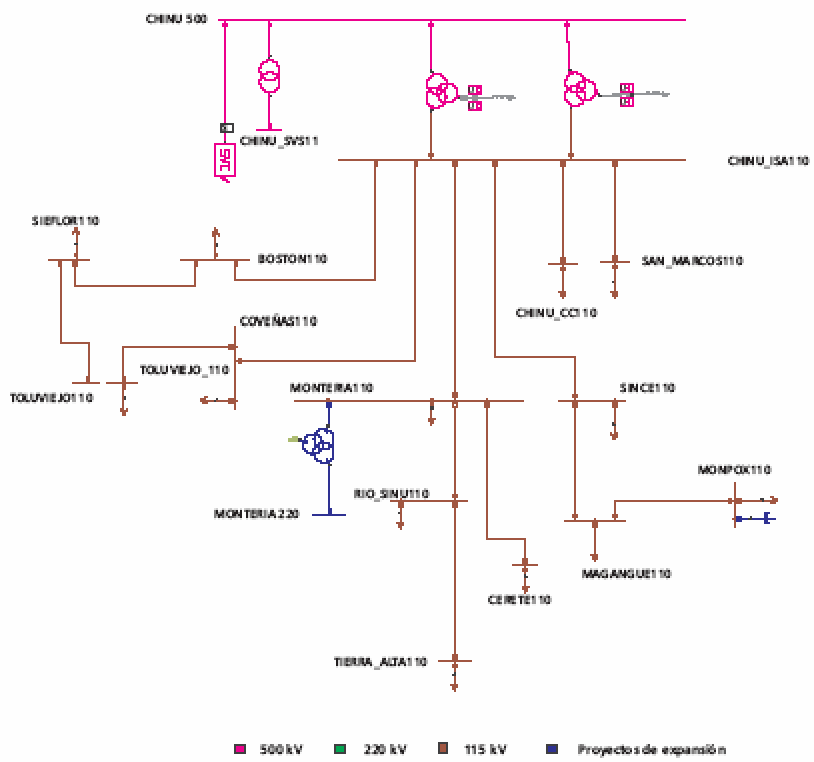
Boyacá Area


YUMBO 220
JUANCHITO 220
PAEZ
PROPAL115
PROPAL13.2
LA_CABANA115
SANTANDER115
S.BERNARDINO115
POPAYAN 220
BETANIA 220
BETANIA_G
FLORIDA115
POPAYAN_P115
PASTO 220
RIOMAYO
220 kV
115 kV
Proyectos de expansión

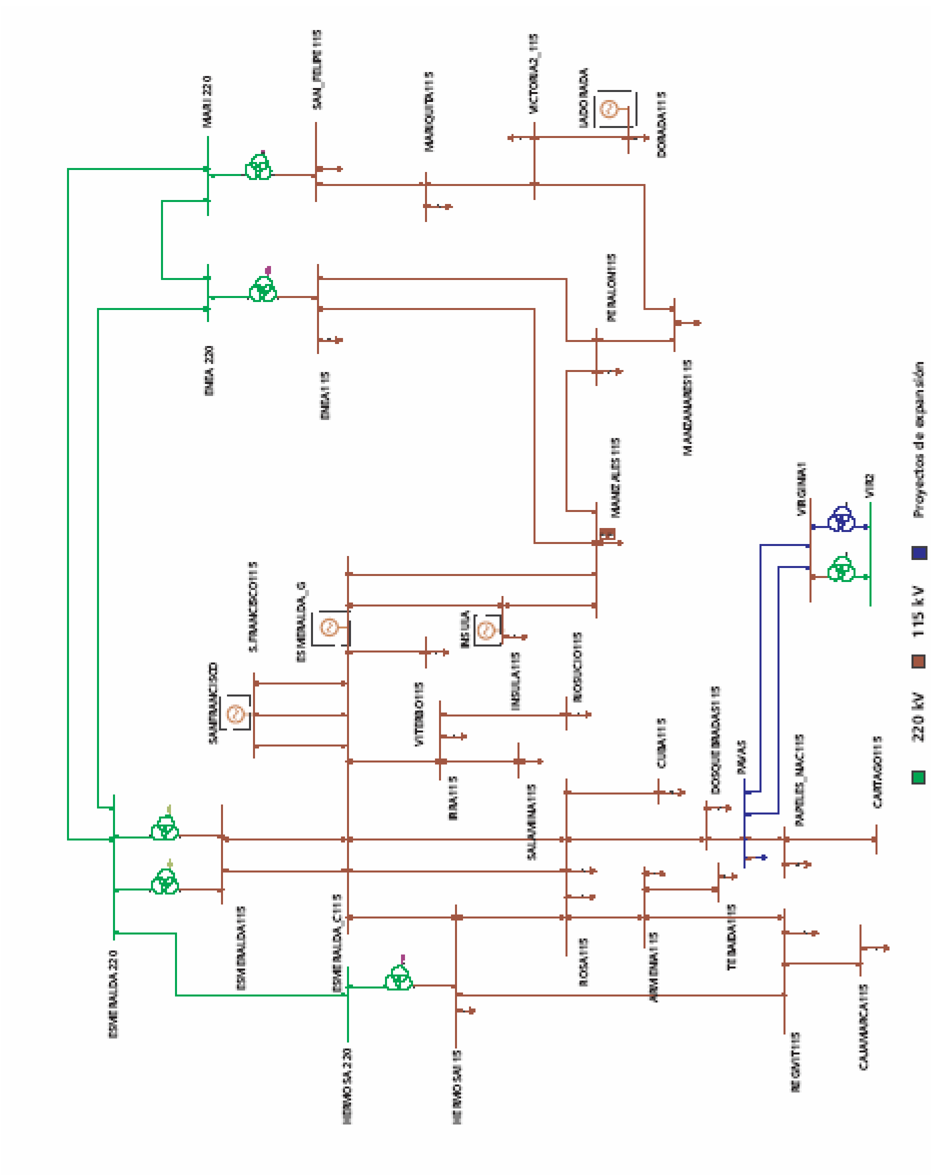
Cauca Area



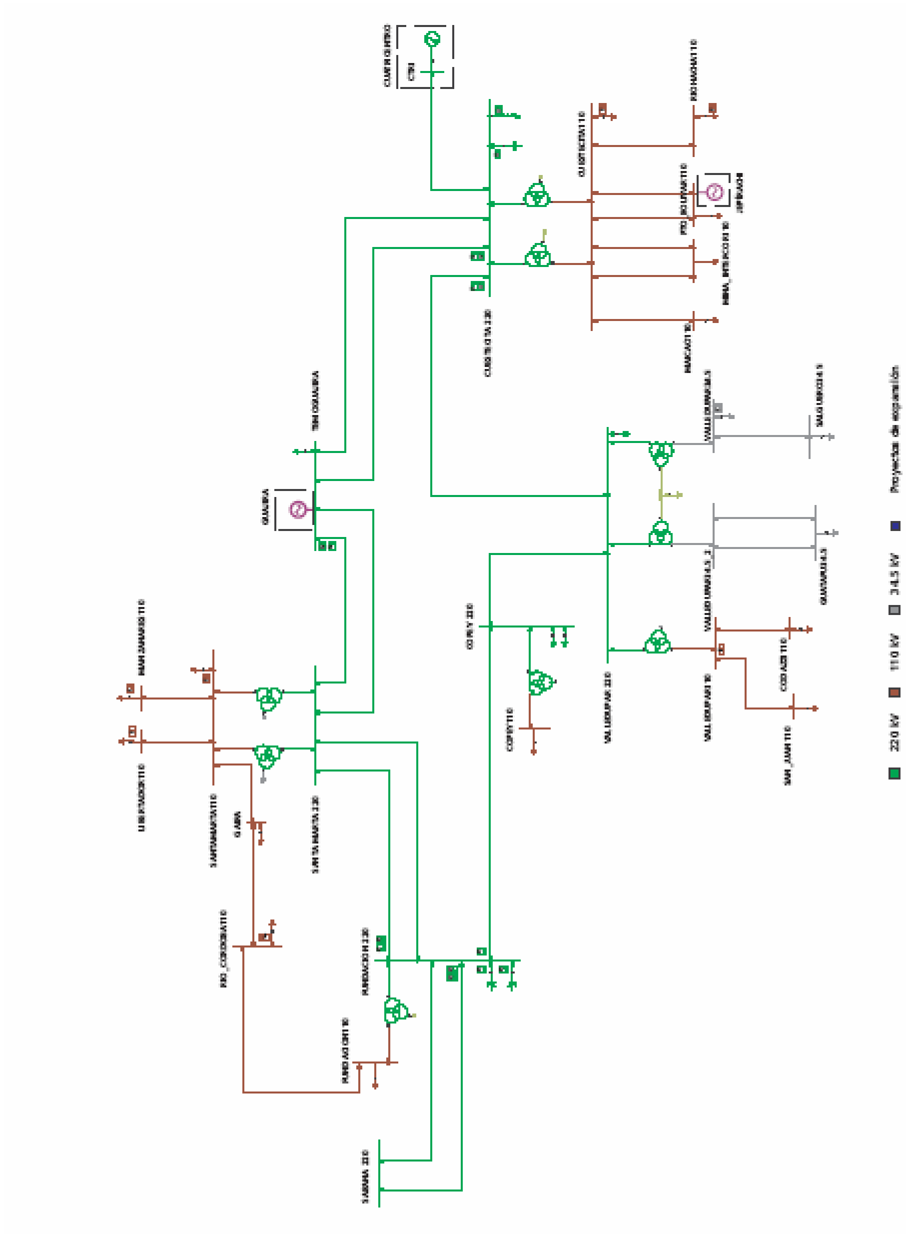
Cerromatoso Area


CHINU 500
CHINU_SVS11
SVC
CHINU_ISA110
SIEFLOR110
BOSTON110
SAN_MARCOS110
CHINU_CC110
COVEÑAS110
TOLUVIEJO_110
TOLUVIEJO110
MONTERIA110
SINCE110
MONPOX110
RIO_SINU110
MONTERIA220
MAGANGUE110
CERETE110
TIERRA_ALTA110
500 kV
220 kV
115 kV
Proyectos de expansión

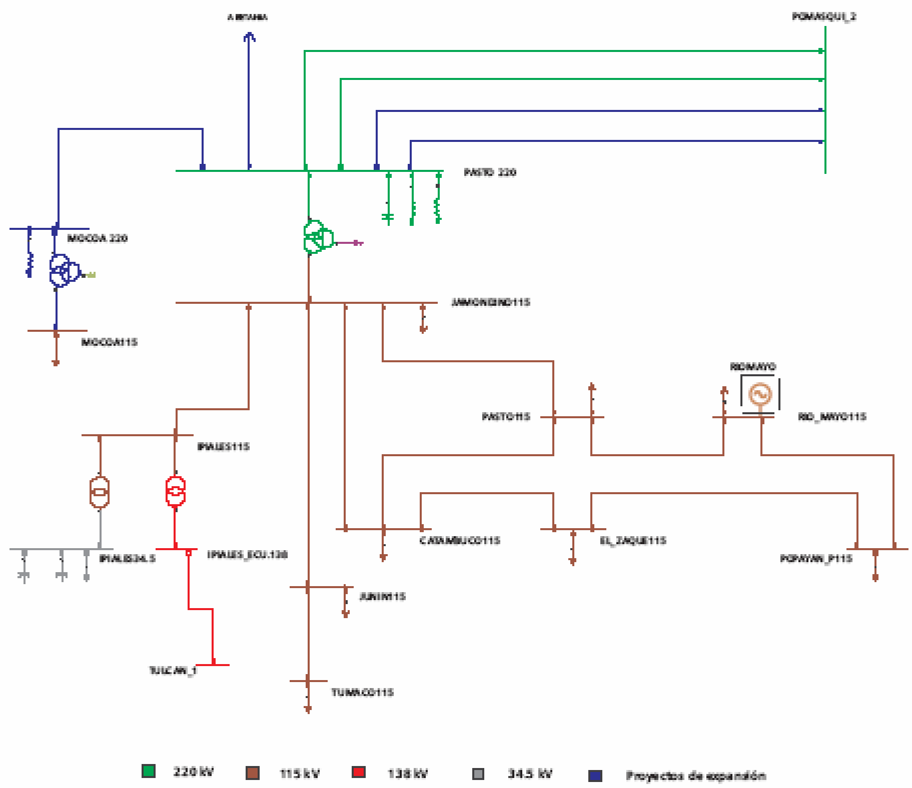
Chinú Area



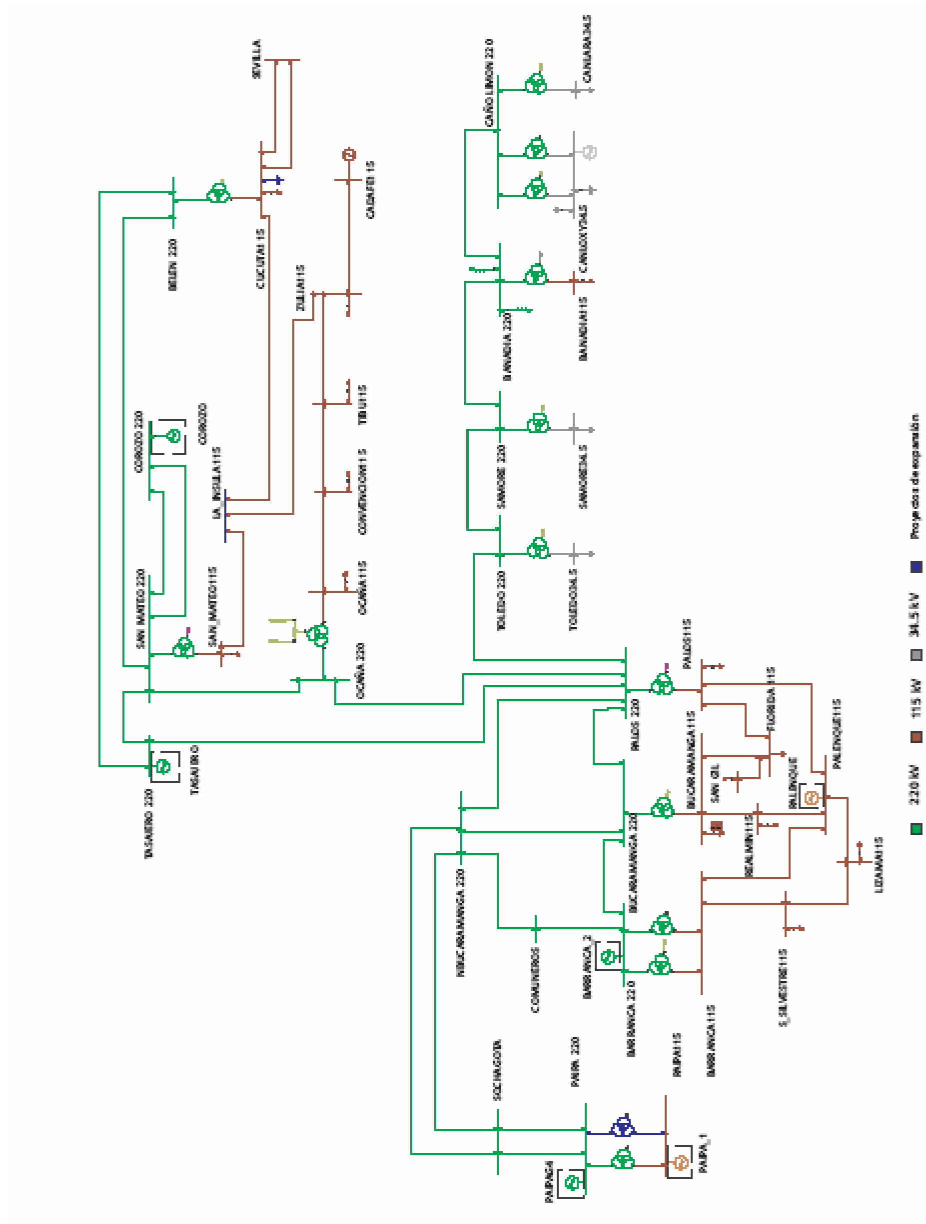
Caldas – Quindío – Risaralda Area



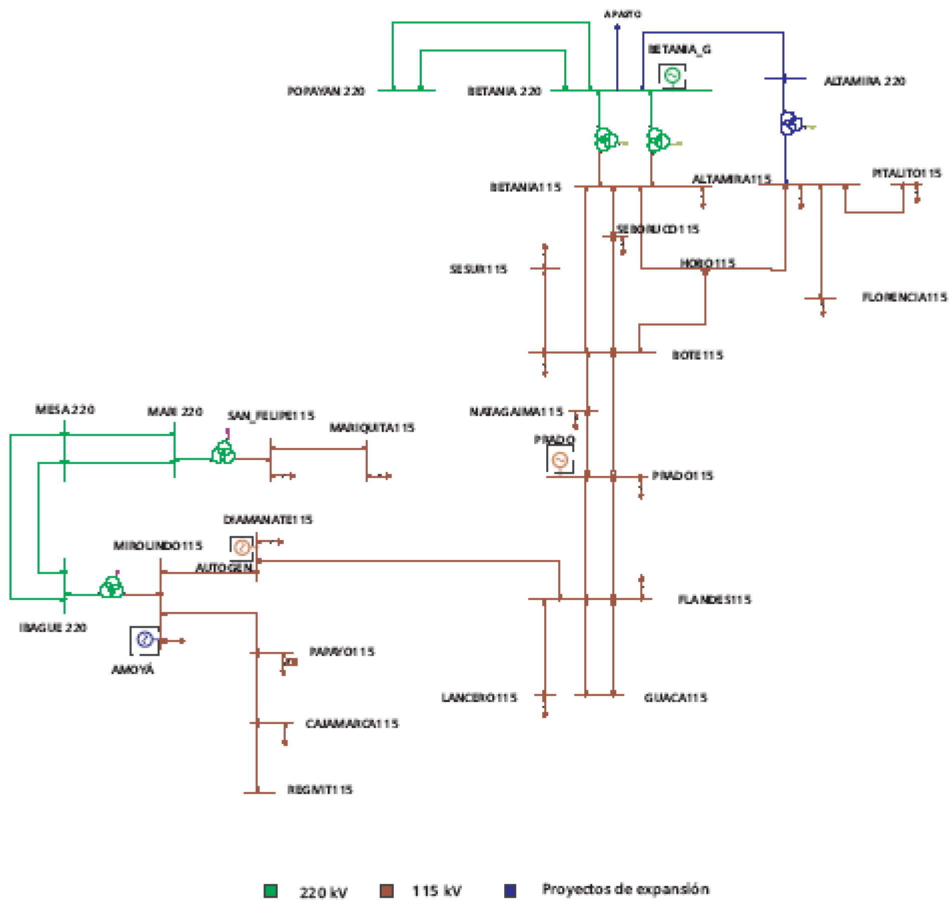
Guajira – Cesar – Magdalena Area


POMASQUI_2
PASTO 220
MOCOA 220
JAMONDINO115
MOCOA115
RIOMAYO
PASTO115
RIO_MAYO115
IPIALES115
IPIALES34.5
IPIALES_ECU.138
CATAMBUCO115
EL_ZAQUE115
POPAYAN_P115
JUNIN115
TULCAN_1
TUMACO115
220 kV
115 kV
138 kV
34.5 kV
Proyectos de expansión

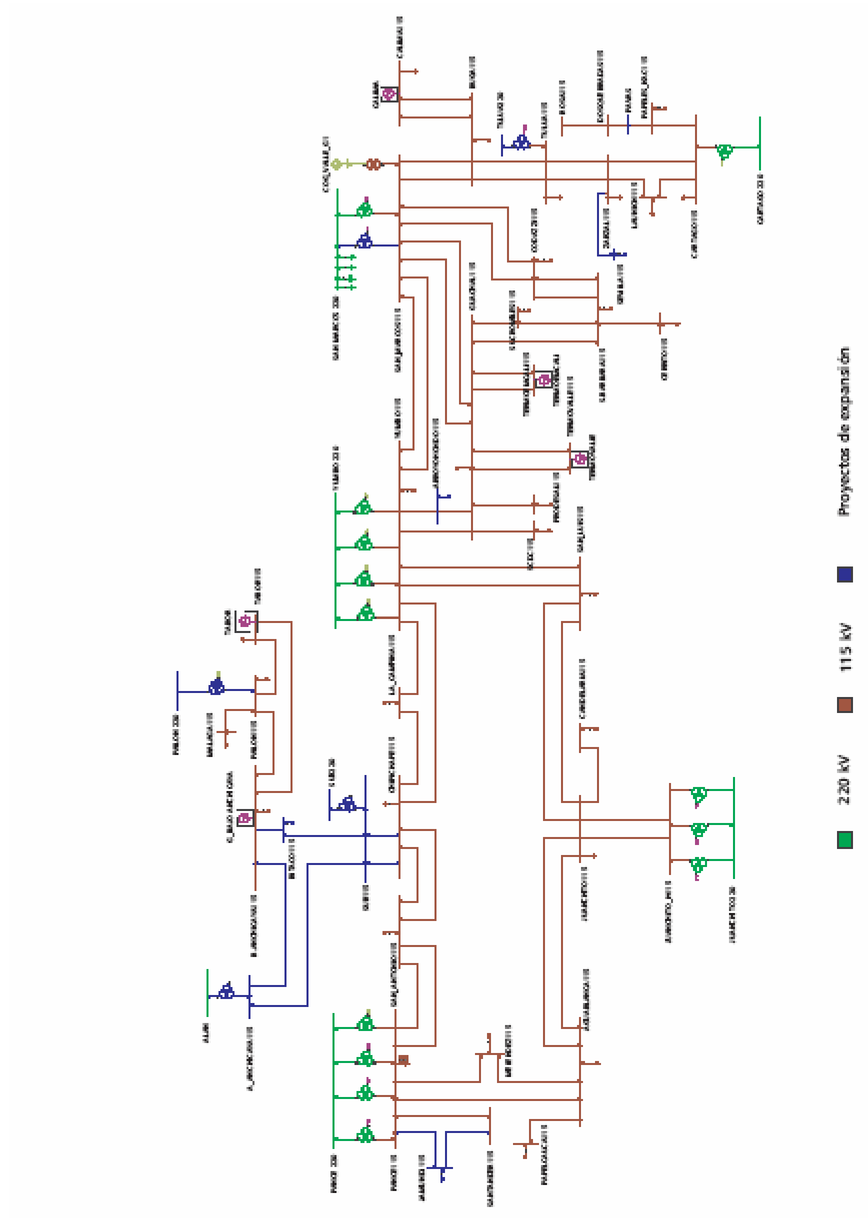
Nariño Area



Northeast Area



Tolima – Huila Area



Valle Area

8.3. SHORT-CIRCUIT LEVELS IN THE NTS SUBSTATIONS

SHORT-CIRCUIT LEVELS AT STN SUBSTATIONS

SUBSTATION	Area	Voltage kV	Equipment capacity		Short circuit interruption levels (IEC standard)									
					2007		2009		2011		2013		2015	
			Reports	(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)
BACATÁ	Bogotá	500	ISA	40	7,6	7,7	7,6	7,7	7,7	7,8	7,7	7,8	7,8	7,8
Bolívar	COSTA	500	ISA	40	4,9	4,6	4,9	4,6	4,9	4,6	4,9	4,6	4,9	4,6
Cerromatoso	COSTA	500	ISA	25	8,9	8,8	8,9	8,8	9,8	9,6	9,8	9,6	9,8	9,6
Chinú	COSTA	500	ISA	31,5	29,2	8,4	7,9	8,6	8,3	9,0	8,3	9,0	8,3	9,0
Copey	COSTA	500	ISA	40	5,0	4,5	5,0	4,5	5,0	4,5	5,0	4,5	5,0	4,5
Ocaña	NORDESTE	500	ISA	40	5,4	4,7	5,4	4,7	5,5	4,7	5,5	4,7	5,5	4,7
Primavera	EPM	500	ISA	40	12,7	11,2	12,7	11,2	13,8	11,8	13,8	11,8	13,8	11,8
Sabana	COSTA	500	ISA	40	8,5	9,6	8,5	9,7	8,7	9,9	8,7	9,9	8,7	9,9
San Carlos	EPM	500	ISA	40	13,9	14,0	13,9	14,0	15,9	15,8	15,9	15,8	16,0	15,8
San Marcos	EPSA	500	ISA	40	5,3	4,9	5,4	5,0	5,5	5,0	5,5	5,0	5,5	5,0
Virginia	EPSA	500	ISA	40	40,0	6,2	7,2	6,3	7,4	6,4	7,4	6,4	7,4	6,4
Altamira	THB	230	-	N.D.	4,0	3,6	4,1	3,7	4,1	3,7	4,1	3,7	4,6	3,7
HIGH Anchicayá	EPSA	230	EPSA	31,5	9,7	9,9	9,8	10,0	9,9	10,0	9,9	10,0	9,9	10,0
Ancón EEPPM	EPM	230	EEPM	40	18,5	16,7	18,6	16,8	18,8	16,8	18,8	16,8	18,8	16,8
Ancón ISA	EPM	230	ISA	40	18,5	16,6	18,6	16,6	18,7	16,7	18,7	16,7	18,7	16,7
Bacatá	BOGOTÁ	230	ISA	40	22,8	24,5	22,9	24,6	23,1	24,8	23,1	24,7	23,1	24,7
Balsillas	BOGOTA	230	EEB	31,6	16,3	15,4	16,4	15,5	16,5	15,6	16,5	15,6	16,5	15,6
Banadia	NORDESTE	230	ISA	12,5	1,8	2,0	1,9	2,0	1,9	2,1	1,9	2,1	1,9	2,1
Barbosa	EPM	230	EEPPM	40	19,4	17,6	19,4	17,7	19,5	17,7	19,5	17,7	19,5	17,7
Barranca	NORDESTE	230	ESSA	7,9	8,9	9,2	9,0	9,2	9,0	9,2	9,0	9,2	9,0	9,2
Belén	NORDESTE	230	-	N.D.	5,3	5,8	5,3	5,8	5,3	5,8	5,3	5,8	5,3	5,8
Bello	EPM	230	EPPM	31,5	13,5	12,5	13,5	12,5	13,6	12,6	13,6	12,6	13,6	12,6
Betania	THB	230	-	N.D.	9,4	11,6	9,5	11,7	9,5	11,7	9,5	11,7	14,9	11,7
Bolívar	COSTA	230	ISA	40	18,1	19,0	18,1	19,0	18,2	19,1	18,2	19,1	18,2	19,1
Bucaramanga	NORDESTE	230	ESSA	31,5	9,0	8,5	9,2	8,6	9,2	8,6	9,2	8,6	9,2	8,6
Candelaria	COSTA	230	EEB	40	19,7	24,3	19,7	24,1	19,7	24,2	19,7	24,2	19,7	24,2
Caño Limón	NORDESTE	230	ISA	12,5	1,5	1,7	1,6	1,8	1,6	1,6	1,6	1,8	1,6	1,8
Cartagena	COSTA	230	TRANSELCA	31,5	19,1	22,5	19,0	22,1	19,1	22,1	19,1	22,1	19,1	22,1
Cartago	EPSA	230	EPSA	40	8,8	7,8	8,9	7,8	8,9	7,9	8,9	7,9	8,9	7,9

SUBSTATION	Area	Voltage kV	Equipment capacity		Short circuit interruption levels (IEC standard)									
					2007		2009		2011		2013		2015	
			Reports	(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)
Cerromatoso	COSTA	230	ISA	20	8,1	9,4	8,1	9,4	8,3	9,8	8,3	9,8	8,3	9,8
Chivor	BOGOTA	230	ISA	25	27,0	30,5	27,1	30,5	27,1	30,6	27,1	30,5	27,1	30,5
Circo	BOGOTA	230	EEB	31,6	14,7	13,5	14,8	13,5	14,8	13,6	14,8	13,5	14,8	13,5
Comuneros	NORDESTE	230	ISA	20	10,3	10,7	10,3	10,8	10,3	10,8	10,3	10,8	10,3	10,8
Copey	COSTA	230	TRANSELCA	25	8,2	9,2	8,2	9,2	8,3	9,2	8,3	9,2	8,3	9,2
Cuestecitas	COSTA	230	TRANSELCA	31,5	4,6	4,7	4,6	4,7	4,6	4,7	4,6	4,7	4,6	4,7
El Salto	EPM	230	EEPPM	31,5	16,7	17,7	16,7	17,8	16,8	17,8	16,8	17,8	16,8	17,8
Enea	CHEC	230	ISA	31,5	9,3	7,8	9,4	7,8	9,4	7,8	9,4	7,8	9,4	7,8
Envigado	EPM	230	EEPPM	40	15,1	13,7	15,2	13,7	15,3	13,8	15,3	13,8	15,3	13,8
Esmeralda	CHEC	230	ISA	31,5	19,0	17,9	19,2	18,1	19,5	18,3	19,5	18,3	19,6	18,3
Fundación	COSTA	230	TRANSELCA	40	10,8	9,5	10,9	9,5	10,9	9,5	10,9	9,5	10,9	9,5
Guaca	BOGOTÁ	230	EEB	31,5	20,8	22,2	20,9	22,4	21,0	22,5	21,0	22,4	21,1	22,4
Guadaluoe	EPM	230	EEPPM	40	17,4	19,2	17,5	19,3	17,5	19,3	17,5	19,3	17,5	19,3
Guatapé	EPM	230	EEPPM	40	29,5	30,7	29,6	30,8	30,0	31,0	30,0	31,1	30,0	31,1
Guavio	BOGOTA	230	EEB	40	29,2	33,0	29,3	33,1	29,3	33,1	29,3	32,8	29,3	32,8
Ibagué	THB	230	ISA	20	6,4	5,2	6,4	5,8	6,4	5,8	6,4	5,8	6,4	5,8
Jaguas	EPM	230	ISA	31,5	19,9	19,1	20,0	19,1	20,2	19,3	20,2	19,3	20,2	19,3
Juanchito	EPSA	230	EPSA	30	13,8	13,1	14,2	13,6	14,4	13,7	14,4	13,7	14,5	13,7
La Hermosa	CHEC	230	ISA	N.D.	11,3	10,1	11,4	10,2	11,5	10,2	11,5	10,2	11,5	10,2
La Mesa	BOGOTA	230	ISA	26,2	21,1	21,2	21,2	21,4	21,3	21,5	21,3	21,4	21,4	21,4
La Sierra	EPM	230	ISA	31,5	17,5	17,8	17,5	17,9	17,6	17,9	17,6	17,9	17,6	17,9
Malena	EPM	230	EEPPM	40	15,5	13,7	15,3	13,7	15,7	13,8	15,7	13,8	15,7	13,8
Merielectrica	NORDESTE	230	-	N.D.	9,9	10,4	9,9	10,5	9,9	10,5	9,9	10,5	9,9	10,5
Miel	EPM	230	ISA	40	17,0	16,6	17,0	16,7	17,4	17,3	17,4	17,3	17,4	17,3
Miraflores	EPM	230	EEPM	40	16,1	14,4	16,2	14,5	16,3	14,5	16,3	14,5	16,3	14,5
Mocoa	CEDELCA	230	-	N.D.	3,4	2,9	3,4	3,0	3,4	3,0	3,4	3,0	3,6	3,0
Noroeste	BOGOTA	230	EEB	40	22,6	22,8	22,8	23,1	23,0	23,2	23,0	23,2	23,1	23,2
Nva Barranquilla	COSTA	230	TRANSELCA	31,5	19,4	19,0	20,5	20,9	20,7	21,0	20,7	21,0	20,7	21,0

Nva Bucaramanga	NORDESTE	230	ISA	40	10,4	9,4	10,5	9,5	10,6	9,5	10,6	9,5	10,6	9,5
Nueva Paipa	NORDESTE	230	ISA	40	11,1	10,6	11,1	10,6	11,2	10,8	11,2	10,8	11,5	10,8
Ocaña	NORDESTE	230	ISA	20	7,1	8,1	7,1	8,2	7,2	8,2	7,2	8,2	7,2	8,2
Occidente	EPM	230	EEPPM	40	17,1	15,5	17,2	15,5	17,3	15,6	17,3	15,6	17,3	15,6
Oriente	EPM	230	EEPM	40	14,1	12,4	14,1	12,5	14,2	12,5	14,2	12,5	14,2	12,5

SHORT-CIRCUIT LEVELS AT STN SUBSTATIONS

SUBSTATION	Area	Voltage kV	Equipment capacity		Short circuit interruption levels (IEC standard)									
					2007		2009		2011		2013		2015	
			Reports	(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)	3F(kA)	1F(kA)
Paez	CEDELCA	230	ISA	31,5	7,4	6,1	7,5	6,2	7,5	6,5	7,5	6,2	7,6	6,2
Paipa	NORDESTE	230	-	N.D.	10,8	11,0	10,8	11,0	10,9	11,2	10,9	11,2	10,9	11,2
Palos	NORDESTE	230	ESSA	40	8,7	8,2	8,8	8,3	8,8	8,3	8,8	8,3	8,8	8,3
Pance	EPSA	230	EPSA	30	14,0	13,4	14,5	13,8	14,6	13,9	14,6	13,9	14,7	13,9
Paraiso	BOGOTA	230	EEB	31,5	19,4	20,1	19,5	20,2	19,6	20,3	19,6	20,2	19,6	20,2
Paato	CEDELCA	230	ISA	31,5	6,6	6,3	7,1	6,6	7,1	6,6	7,1	6,6	7,4	6,6
Playas	EPM	230	EEPPM	40,	15,6	15,2	15,6	15,2	15,8	15,3	15,8	15,3	15,8	15,3
Popayán	CEDELCA	230	ISA	31,5	8,4	6,9	8,5	6,9	8,5	7,0	8,5	7,0	9,2	7,0
Porce II	EPM	230	EEPM	31,5	17,3	19,4	17,4	19,4	17,4	19,5	17,4	19,5	17,4	19,5
Porce III	EPM	500	N.D.	N.D.	-	-	-	-	11,7	14,6	11,7	14,6	11,7	14,6
Primavera	EPM	230	ISA	31,5	21,3	22,8	21,4	22,8	21,7	23,1	21,7	23,1	21,7	23,1
Purnio	EPM	230	ISA	31,5	19,5	15,1	19,5	15,1	19,8	15,3	19,8	15,3	19,5	15,3
Reforma	BOGOTA	230	ISA	20	7,9	7,5	7,9	7,5	7,9	7,5	7,9	7,1	7,9	7,1
Sabana	COSTA	230	TRANSELCA	31,5	26,4	29,3	26,7	29,7	27,1	30,0	27,1	30,0	27,1	30,0
Salavajina	EPSA	230	EPSA	31,5	8,4	8,4	8,4	8,5	8,5	8,5	8,5	8,5	8,5	8,5
Samoré	NORDESTE	230	ISA	31,5	2,2	2,3	2,3	2,4	2,3	2,4	2,3	2,4	2,3	2,4
San carlos	EPM	230	ISA	40	34,8	41,8	34,9	41,9	36,9	44,0	36,9	44,0	36,9	44,0
San Felipe	CHEC	230	ISA	31,5	15,0	12,3	15,0	12,3	15,2	12,4	15,2	12,4	15,2	12,4
San Marcos	EPSA	230	ISA	31,5	17,6	18,6	18,2	19,3	18,5	19,5	18,5	19,5	18,6	19,5
San Mateo Bogotá	BOGOTA	230	EEB	31,5	11,8	9,5	11,8	9,5	11,9	9,5	11,9	9,5	11,9	9,5
San Mateo Cúcuta	NORDESTE	230	ISA	20	5,4	5,9	5,4	5,9	5,4	5,9	5,4	5,9	5,4	5,9
Santa Martha	COSTA	230	TRANSELCA	31,5	6,6	6,0	6,6	6,0	6,7	6,0	6,7	6,0	6,7	6,0
Tasajera	EPM	230	EEPPM	40	17,6	17,7	17,7	17,7	17,8	17,8	17,8	17,8	17,8	17,8
Tasajero	NORDESTE	230	DISTASA	40	6,0	6,6	6,0	6,7	6,0	6,7	6,0	6,7	6,0	6,7
Tebsa	COSTA	230	TRANSELCA	31,5	24,7	28,2	24,7	28,2	24,9	28,4	24,9	28,4	24,9	28,4
Termocentro	EPM	230	-	N.D.	17,9	18,8	17,9	18,8	18,1	19,0	18,1	19,0	18,1	19,0
Termoflores	COSTA	230	TRANSELCA	40	17,5	18,4	18,2	19,3	18,3	19,4	18,3	19,4	18,3	19,4
Termoguajira	COSTA	230	TRANSELCA	31,5	7,8	9,1	7,8	9,1	7,8	9,1	7,8	9,1	7,8	9,1
Ternera	COSTA	230	TRANSELCA	31,5	19,9	24,5	19,9	24,4	20,0	24,5	20,2	24,5	20,2	24,5
Toledo	NORDESTE	230	ISA	31,5	2,9	2,9	3,0	2,9	3,0	2,9	3,0	2,9	3,0	2,9
Torca	BOGOTA	230	ISA	25,	21,9	22,3	22,0	22,4	22,2	22,5	22,2	22,5	22,3	22,5
Tunal	BOGOTA	230	EEB	31,5	14,6	13,7	14,6	13,7	14,7	13,7	14,7	13,6	14,7	13,6
Urabá	COSTA	230	ISA	20	3,0	3,2	3,0	3,2	3,0	3,3	3,0	3,3	3,0	3,3
Urrá	COSTA	230	ISA	25	6,3	7,9	6,3	7,9	6,4	7,9	6,4	7,9	6,4	7,9
Valledupar	COSTA	230	TRANSELCA	31,5	4,6	4,3	4,6	4,3	4,6	4,3	4,6	4,3	4,6	4,3
Virginia	EPSA	230	ISA	31,5	16,1	16,3	16,5	16,8	16,7	16,9	16,7	16,9	16,8	16,9
Yumbo	EPSA	230	ISA	31,5	18,1	18,5	18,9	19,3	19,1	19,6	19,1	19,6	19,3	19,6

8.4. DESCRIPTION OF EVENTS AND AVAILABILITY OF NTS ELECTRICAL SUBSYSTEMS, DECEMBER 2004 - DECEMBER 2005 PERIOD

DESCRIPTION OF EVENTS AND AVAILABILITY OF NTS ELECTRICAL SUBSYSTEMS
DECEMBER 2004 TO DECEMBER 2005 PERIOD

ELEMENT	Length	Event > 10 min		Event < 10 min		Number of events per cause				Total Number of events
		Duration (h)	Number	Duration (h)	Number	Unforced	Forced External	Force Marjeure	Others	
Lines of 500 kV										
CERROMATOSO – SAN CARLOS 1 500 kV	209,6	0,00	0,00	0,02	13	3	0	10	0	13
CERROMATOSO – SAN CARLOS 2 500 Kv	229,0	0,00	0,00	0,00	7	0	0	7	0	7
CHINU ISA – CERROMATOSO 2 500 Kv	132,0	0,00	0,00	0,11	3	3	0	0	0	3
LA VIRGINIA – SAN MARCOS 1 500 Kv	166,8	0,00	0,00	0,08	2	2	0	0	0	2
SABANALARGA – CHINU 2 500 kV	185,0	0,00	0,00	0,05	6	3	0	3	0	6
SABANALARGA – CHINU 1 500 kV	183,0	0,20	1,00	0,00	2	1	0	2	0	3
SAN CARLOS – LA VIRGINIA 1 500 kV	212,9	0,00	0,00	0,05	6	4	0	2	0	6
Lines of 230 kV										
HIGH ANCHICAYA – PANCE 1 230 kV	53,7	0,00	0,00	0,00	2	0	0	2	0	2
HIGH ANCHICAYÁ – YUMBO 1 230 kV	54,2	0,37	1	0,06	4	3	0	2	0	5

ANCÓN SUR – MIRAFLORES 1 220 kV	20,0	0,00	0,00	0,05	1	1	0	0	0	1
ANCON SUR – OCCIDENTE 1 220 kV	28,3	3,63	2	0,06	2	4	0	0	0	4
ANCON SUR ISA – ESMERALDA 1 230 kV	129,5	0,00	0.00	0,08	2	2	0	0	0	2
ANCON SUR ISA – ESMERALDA 2 230 kV	129,5	18,67	1	0.10	6	7	0	0	0	7
ANCON SUR ISA – SAN CARLOS 1 230 kV	107,2	0,00	0.00	0.08	2	2	0	0	0	2
ANCON SUR ISA – SAN CARLOS 2 230 kV	10,72	0,00	0.00	0.10	13	12	0	1	0	13
BALSILLAS – NOROESTE 1 230 kV	15,4	0,00	0.00	0.06	2	2	0	0	0	2
BANADIA – CAÑO LIMON 1 230 kV	86,5	2,78	2	0.00	10	0	0	12	0	12
BANADIA – SAMORE 1 230 kV	51,2	0,00	0.00	0.00	2	0	0	2	0	2
BARBOSA – EL SALTO 4 220 kV	44,3	2,89	2	0.006	6	8	0	0	0	8
BARBOSA – GUADALUPE IV 1 220 kV	2,0	0,70	1	0.003	3	4	0	0	0	4
BARBOSA – GUATAPE 1 220 kV	35,5	14,26	1	0.003	3	3	0	1	0	4
BARBOSA – LA TASAJERA 1 220 kV	14,6	13,07	2	0,08	4	6	0	0	0	6
BARBOSA – MIRAFLORES 1 220 kV	54,0	0,00	0,00	0,05	8	7	0	1	0	8
BARRANCA – BUCARAMANGA 1 230 kv	99,4	3,11	3	0,02	5	8	0	0	0	8
BARRANCA – COMUNEROS 1 230 kV	11,1	18,67	1	0,06	2	2	0	1	0	3
BELLO – EL SALTO 1 220 kV	71,7	0,00	0,00	0,02	1	1	0	0	0	1
BETANIA – IBAGUE (MIROLINDO) 1 230 kV	206,0	23,47	1	0,02	5	3	0	3	0	6
BETANIA – SAN BERNARDINO 1 230 kV	144,0	9,26	3	0,08	7	7	0	3	0	10
BETANIA – SAN BERNARDINO 2 230 kV	144,0	0,00	0,00	0,05	2	1	0	1	0	2
BUCARAMANGA – LOS PALOS 1 230 kV	18,0	0,00	0,00	0,10	1	1	0	0	0	1
CARTAGENA – SABANALARGA 1 220 kV	82,0	0,00,	0,00	0,05	2	1	0	1	0	2
CARTAGO – SAN MARCOS 1 230 kV	147,9	0,00,	0,00	0,05	1	1	0	0	0	1
CERROMATOSO – URRA 1230 kV	84,5	0,00	0,00	0,14	3	3	0	0	0	3
CHIVOR – SOCHAGOTA 1 230 kV	119,0	0,00	0,00	0,12	2	2	0	0	0	2
CHIVOR – SOCHAGOTA 2 230 kV	119,0	0,00	0,00	0,12	2	2	0	0	0	2
CHIVOR – TORCA 1 230 Kv	104,5	0,00	0,00	0,08	4	3	0	1	0	4
CHIVOR – TORCA 2 230 kV	104,5	0,00	0,00	0,06	6	5	0	1	0	6
CIRCO – GUAVIO 1 230 kV	109,6	0,38	1	0,08	2	3	0	0	0	3
CIRCO – GUAVIO 2 230 kV	109,9	0,00	0,00	0,03	1	1	0	0	0	1
CIRCO – PARAISO 1 230 kV	50,1	6,45	1	0,07	6	5	2	0	0	7
CIRCO – TUNAL 1230 kV	29,8	0,00	0,00	0,09	2	1	1	0	0	2
COMUNEROS – GUATIGUARA 1 230 kV	99,5	0,00	0,00	0,07	1	1	0	0	0	1
CUCUTA (BELEN) – SAN MATERO 1 230 kV	8,6	1,58	2	0,00	0,00	2	0	0	0	2
CUCUTA (BELEN) – TASAJERO 1 230 kV	13,1	0,00	0,00	0,06	2	2	0	0	0	2
EL COPEY – VALLEDUPAR 1 220 kV	90,8	0,00	0,00	0,08	1	1	0	0	0	71
ENVIGADO – GUATAPE 1 220 kV	63,2	4,35	1	0,00	2	1	0	2	0	23
ENVIGADO – ORIENTE 1 230 kV	26,8	0,00	0,00	0,02	2	1	0	1	0	2
ESMERALDA – YUMBO 1 230 kV	193,3	0,0	0,00	0,14	2	2	0	0	0	2
ESMERALFA – YUMBO 2 230 kV	193,3	0.00	0.00	0.15	1	1	0	0	0	1
FUNDACION – SANTA MARTA 1 220 kV	84,2	0.00	0,00	0.08	3	3	0	0	0	3
FUNDACION – SANTA MARTA 2 220 kV	84,2	0.00	0.00	0.07	8	8	0	0	0	8
GUSDALUPE IV – EL SALTO 1 220 kV	8,8	0.27	1	0.00	0,00	1	0	0	0	1
GUADALUPE IV – OCCIDENTE 1 220 kV	81,3	0.00	0.00	0.03	1	1	0	0	0	1
GUADALUPE IV – PORCE III 1 220 kV	2,0	0.00	0.00	0.03	1	1	0	0	0	1
GUAJIRA – CUESTECITAS 1 220 kV	95,5	46,52	1	0.0	2	1	0	0	0	3
GUAJIRA – CUESTECITAS 2 220 kV	95,5	0.00	0.00	0.02	9	0	0	0	0	9
GIAJIRA – SANTA MARTA 1 220 kV	91,5	0.00	0.00	0.08	5	4	0	0	0	5
GUAJIRA – SANTA MARTA 2 220 kV	91,5	8,35	1	0.06	6	5	0	2	0	7
GUATAPE – JAGUAS 1 230 kV	18,8	0.43	1	0.10	1	2	0	0	0	2
GUATAPE – JAGUAS 2 230 kV	14,5	0.00	0.0	0.09	3	3	0	0	0	3
GUATAPE – MIRAFLORES 1 220 kV	51,3	0.00	0.00	0.04	2	1	0	0	0	2
GUATAPE – ORIENTE 1 220 kV	37,4	0.00	0.00	0.00	1	0	0	0	0	1
GUATAPE – PLAYAS 1 220 kV	21,2	1032,00	1	0,06	4	3	0	0	0	5
GUATIGUARA – BUCARAMANGA 1 230 kV	13,8	0,52	1	0,10	4	2	0	0	0	2
GUATIGUARA – PRIMAVERA 1 230 kV	163,0	2,97	1	0,14	2	3	0	0	0	3
GUATIGUARA – TASAJERO 1 230 kV	128,1	0,00	0,00	0,00	1	0	0	0	0	1
GUAVIO – CHIVOR 1 230 kV	23,5	0,00	0,00	0,08	1	1	0	0	0	1
GUAVIO – CHIVOR 2 230 kV	22,8	0,00	0,00	0,07	4	4	0	0	0	4

DESCRIPTION OF EVENTS AND AVAILABILITY OF NTS ELECTRICAL SUBSYSTEMS
DECEMBER 2004 TO DECEMBER 2005 PERIOD

ELEMENT	Length	Event > 10 min		Event < 10 min		Number of events per cause				Total Number of events
		Duration (h)	Number	Duration (h)	Number	Unforced	Forced External	Force Marjeure	Others	
GUAVIO – LA REFORMA 1 230 kV	80,7	19,52	1	0,06	8	9	0	0	0	9
GUAVIO – TORCA 1 230 kV	84,9	0,00	0,00	0,05	1	1	0	0	0	1
GUAVIO – TORCA 2 230 kV	84,7	0,00	0,00	0,03	1	1	0	0	0	1
GUAVIO TUNAL 1 230 kV	155,1	0,00	0,00	0,07	3	3	0	0	0	3
JAMONDINO – POMASQUI 1 230 kV	188,0	0,00	0,00	0,12	3	3	0	0	0	3
JAMONDINO – SAN BERNARDINO 2 230 kV	188,0	0,00	0,00	0,00	1	0	0	1	0	1
JUANCHITO-PAEZ 1 230 kV	34,0	0,00	0,00	0,12	2	2	0	0	0	2
JUANCHITO – SALVAJINA 1 230 kV	63,1	0,00	0,00	0,05	4	4	0	0	0	4

JUANCHITO – SAN MARCOS 1 230 kV	21,5	0,00	0,00	0,06	7	6	0	1	0	7
LA ENEA – SAN FELIPE 1 230 kV	67,4	0,00	0,00	0,07	4	3	0	1	0	4
LA GUACA – LA MESA 1 239 kV	5,0	0,00	0,00	0,15	1	1	0	0	0	1
LA MIEL – PURNIO 1 230 kV	25,7	0,00	0,00	0,15	1	1	0	0	0	1
LA MIEL – PURNOP 2 230 kV	25,7	0,00	0,00	0,09	3	3	0	0	0	3
LA MIEL – SAN FELIPE 1 230 kV	56,7	0,00	0,0	0,13	2	2	0	0	0	2
LA MIEL – SAN FELIPE 2 230 kV	56,7	0,00	0,00	0,11	2	2	0	0	0	2
LA SIERRA – PURNIO 1 230 kV	100,5	0,00	0,00	0,03	2	1	0	1	0	2
LA SIERRA – PURNIO 2 230 kV	100,5	0,00	0,00	0,03	2	1	0	1	0	2
LA TASAJERA – BELLO 1 220 kV	15,9	0,38	1	0,08	3	4	0	0	0	4
LA VIRGINIA – LA HERMOSA 1 230 kV	27,0	0,00	0,00	0,05	1	1	0	0	0	1
LOS PALOS – GUATIGUARA 1 239 kV	26,3	0,37	1	0,00	0,00	1	0	0	0	1
MALENA – JAGUAS 1 230 Kv	69,0	0,00	0,00	0,10	4	3	0	1	0	4
NOROESTE – ALA MESA 1 230 kV	40,4	0,00	0,00	0,05	1	1	0	0	0	1
NOROESTE – TORCA 2 230 kV	19,8	0,22	1	0,00	0,00	1	0	0	0	1
NUEVA BQUILLA – SABANALARGA 1 220 Kv	45,3	2,53	3	0,05	8	11	0	0	0	11
NUEVA BQUILLA – SABANALARGA 2 220 kV	43,3	0,00	0,00	0,03	3	2	0	1	0	3
NUEVA BQUILLA – SABANALARGA 3 220 kV	43,3	0,00	0,00	0,03	4	2	0	2	0	4
NUEVA BQUILLA – TEBSA 1 220	23,0	0,00	0,00	0,02	5	1	0	4	0	5
OCAÑA – LOS PALOS 1 230 kV	160,5	179,10	1	0,02	5	2	0	4	0	6
OCCIDENTE – LA TASAJERA 1 220 kV	23,0	0,30	1	0,08	4	5	0	0	0	5
ORIENTE – PLAYAS 1 220 kV	54,8	1,30	1	0,03	5	3	1	2	0	6
PANCE - SALVAJINA 1 230 kV	49,2	0,00	0,00	0,05	1	1	0	0	0	1
PARAISO – SAN MATEO EEB 1 230 kV	34,0	0,00	0,00	0,07	3	3	0	0	0	3
PLAYAS – PRIMAVERA 1 230 kV	104,0	0,00	0,00	0,08	8	8	0	0	0	1
PORCE III – BARBOSA 1 220 kV	52,0	0,00	0,00	0,06	10	10	0	0	0	10
PURNIO – NOROESTE 2 230 kV	107,7	0,00	0,00	0,08	1	1	0	0	0	1
SABANALARGA – TERNERA 1 220 kV	80,2	12,98	1	0,06	5	6	0	0	0	6
SABANALARGA – TERNERA 2 230 kV	80,2	0,00	0,00	0,05	6	6	0	0	0	6
SABANALARGA – FUNDACION 1 220 kV	91,1	0,00	0,00	0,05	5	4	0	1	0	5
SABANALARGA – FUNDACION 2 220 kV	91,1	0,00	0,00	0,06	3	3	0	0	0	3
SAN BERNARDINO – PAEZ 1 230 kV	116,0	0,00	0,00	0,00	5	0	0	5	0	5
SAN CARLOS – ESMERALDA 2 230 kV	193,7	0,00	0,00	0,15	1	1	0	0	0	1
SAN CARLOS – PURNIO 2 230 kV	91,3	0,00	0,00	0,13	3	3	0	0	0	3
SAN FELIPE – ESMERALDA 2 230 kV	97,4	0,00	0,00	0,03	2	1	0	1	0	2
SAN MATEO (Bog) – TUNAL 1 230 kV	14,9	0,00	0,00	0,08	1	0	1	0	0	1
SAN MATEO CENS – OCAÑA 1 230 kV	120,2	179,35	1	0,00	3	1	0	3	0	4
SOCHAGOTA – GUATIGUARA 1 230	150,0	0,00	0,00	0,05	1	1	0	0	0	1
SOCHAGOTA – GUATIGUARA 2 230 kV	158,2	0,00	0,00	0,07	1	1	0	0	0	1
TASAJERO – LOS PALOS 1 230 kV	101,7	0,00	0,00	0,06	8	7	0	1	0	8
TEBSA – SABANALARGA 1 220 kV	38,4	11,77	1	0,01	3	2	0	2	0	4
TEBSA – SABANALARGA 2 220 kV	38,4	5,78	1	0,05	3	2	0	2	0	4
TEBSA – SABANALARGA 3 220 kV	38,5	0,00	0,00	0,05	2	1	0	1	0	2
TERMOCANDELARIA – CARTAGENA 1 220 kV	3,2	2,22	1	0,02	4	5	0	0	0	5
TERMOCANDELARIA – CARTAGENA 2 220 kV	3,1	0,00	0,00	0,02	1	1	0	0	0	1
TERMOCANDELARIA – TERNERA 1 220 kV	3,3	0,00	0,00	0,02	1	1	0	0	0	1
TERMOCANDELARIA – TERNERA 2 220 kV	3,4	0,00	0,00	0,02	1	1	0	0	0	1
TERMOFLORES III – NVA BQUILLA 1 220 kV	7,4	0,00	0,00	0,02	2	1	0	1	0	2
TERMOFLORES III – NVA BQUILLA 2 220 kv	7,4	24,63	2	0,01	3	3	0	2	0	5
TUNAL – LA REFORMA 1 230 kV	75,0	0,00	0,00	0,08	3	3	0	0	0	3
URABA - URRÁ	51,0	0,00	0,00	0,11	2	2	0	0	0	2
VALLEDUPAR – CUESTECITAS 1 220 kV	116,4	0,00	0,00	0,05	5	5	0	0	0	5
YUMBO – SAN BERNARDINO 1 230 kV	122,6	0,00	0,00	0,03	13	3	0	10	0	13

ELEMENT	Event > 10 min		Event < 10 min		Number of events per cause				Total Number of events
	Duration (h)	Number	Duration (h)	Number	Unforced	Forced External	Force Marjeure	Others	
Transformers of 500 kV									
CHINU ISA 1 150 MVA 500/110/34.5 kV	0,00	0	0,03	2	2	0	0	0	2
CHINU ISA 2 150 MVA 500/110/34.5 kV	0,00	0	0,10	1	1	0	0	0	1
LA VIRGINIA 1 450 MVA 500/230/34.5 kV	0,00	0	0,13	1	1	0	0	0	1
SABANALARGA 3 450 MVA 500/220/34.5 kV	5,98	1	0,00	0	1	0	0	0	1
SAN CARLOS 2 450 MVA 500/230/34.5 kV	0,00	0	0,15	3	3	0	0	0	3
SAN CARLOS 3 450 MVA 500/230/34.5 kV	0,00	0	0,04	1	1	0	0	0	1
SAN CARLOS 4 450 MVA 500/230/34.5 kV	0,00	0	0,15	2	2	0	0	0	2
SAN MARCOS 2 450 MVA 500/230/34.5 kV	0,00	0		1	1	0	0	0	1
Transformers of 230 kV									
ANCON SUR AUTF 1 180 MVA 220/110/46.6 kV	35,98	1	0,00	0	1	0	0	0	1
ANCON SUR AUTF 2 180 MVA 220/110/46.6 kV	0,00	0	0,07	1	1	0	0	0	1
BARBOSA SUTF 1 180 MVA 220/110/44 kV	4,67	1	0,00	0	1	0	0	0	1
BETANIA 1 150 MVA 230/115/13.8 kV	3,22	1	0,00	0	1	0	0	0	1
BUCARAMANGA 1 150 MVA 230/115/13.8 kV	0,00	0	0,10	1	1	0	0	0	1

CARTAGO 5 168 MVA 230/115/13.2 kV	0,00	0	0,00	1	1	0	0	0	1
CERROMATOSO 3 360 MVA 500/230/13.8 kV	4,00	2	0,14	2	4	0	0	0	4
CUESTECITAS 1 100 MVA 220/110/13.8 kV	0,40	1	0,00	0	1	0	0	0	1
EL COPEY 1 41 MVA 220/110/34.5 kV	0,00	0	0,03	2	1	1	0	0	2
ENVIGADO AUTFS 180 MVA 220/110/44 kV	0,40	1	0,00	0	1	0	0	0	1
ESMERALDA 1 90 MVA 230/115/13.8 kV	0,00	0	0,15	1	1	0	0	0	1
FUNDACIÓN 1 55 MVA 220/110/13.8 kV	11,17	1	0,07	2	3	0	0	0	3
LA HERMOSA 1 150 MVA 230/115/13.5 kV	0,00	0	0,12	1	1	0	0	0	1
LOS PALOS 1 150 MVA 230/115/13.8 kV	19,65	1	0,00	0	1	0	0	0	1
OCAÑA 1 90 MVA 230/115/13.8 kV	0,33	1	0,00	0	1	0	0	0	1
PAEZ 1 90 MVA 230/115/13.8 kV	0,00	0	0,13	1	1	0	0	0	1
PANCE 1 90 MVA 230/115/13.2 kV	0,00	0	0,02	1	1	0	0	0	1
PLAYAS 4 90 MVA 220/110/44 kV	0,00	0	0,00	1	0	0	0	0	0
SABANALARGA 1 90 MVA 220/110/13.8 kV	0,00	0	0,07	1	1	0	0	0	1
SALTO IV AUTF1 180 MVA 220/110/44 kV	4,45	1	0,00	0	1	0	0	0	1
SAN BERNARDINO 1 150 MVA 230/115/13.8 kV	0,00	0	0,13	4	4	0	0	0	4
SAN MATEO (N. SANT) 1 150 MVA 230/115/13.8 kV	23,67	1	0,00	0	1	0	0	0	1
SANTA MARTA 1 100 MVA 220/110/34.5 kV	0,00	0	0,07	2	1	1	0	0	2
SANTA MARTA 2 100 MVA 220/110/34.5 kV	0,00	0	0,12	1	1	0	0	0	1
TEBSA 3 180 MVA 220/110/46 kV	19,33	1	0,00	0	1	0	0	0	1
TERMOFLORES II 1 150 MVA 220/110 kV	0,32	1	0,07	1	2	0	0	0	2
TERNERA 1 60 MVA 220/110/6.3 kV	0,00	0	0,02	1	0	1	0	0	1
TOLEDO 1 50 MVA 230/34.5/13.8 kV	15,67	1	0,15	1	2	0	0	0	2
TORCAS 4 168 MVA 230/115/44 kV	20,83	1	0,15	1	2	0	0	0	2
URABA 1 150 MVA 220/110/44 kV	0,25	1	0,03	1	2	0	0	0	2
URRÁ 1 90 MVA 230/110 kV	0,33	2	0,13	1	3	0	0	0	3
VALLEDUPAR 1 450 MVA 220/34.5/13.8 kV	0,00	0	0,07	1	1	0	0	0	1
VALLEDUPAR 2 60 MVA 220/110/34.5 kV	0,55	1	0,00	0	1	0	0	0	1
VALLEDUPAR 3 60 MVA 220/34.5/13.8 kV	12,67	1	0,00	0	1	0	0	0	1
YUMBO 2 90 MVA 230/115/13.2 kV	10,78	3	0,00	0	2	1	0	0	3
YUMBO 3 90 MVA 230/115/13.2 kV	1,38	2	0,15	1	3	0	0	0	3

8.5. NTS LINES AND SUBSTATIONS ENTRY DATES

NTS LINES AND SUBSTATIONS ENTRY DATES			
NAME	**# CIRCUIT**	**VOLTAGE**	**ENTRY DATE**
Fundación – Sabanalarga	3	230	21/10/2004
Jamondino – Pomasqui	1	230	01/03/2003
Jamondino – Pomasqui	2	230	01/03/203
Casa máquina Miel – Miel	1	230	01/12/2002
Casa máquina Miel – Miel	2	230	01/12/2002
Casa máquina Miel – Miel	3	230	01/12/2002
Guatapé – Variante	1	230	23/11/2002
Guatapé – Variante	3	230	23/11/2002
Miel – San Felipe	1	230	27/10/2001
Miel – San Felipe	2	230	27/10/2001
Guatiguará – Tasajera	1	230	27/09/2001
Miel Purnio	1	230	27/09/2001
Miel Purnio	2	230	27/09/2001
San Carlos – Purnio	2	230	07/09/2001
Guatiguará – Primavera	1	230	31/08/2001
La Sierra – Purnio	1	230	31/08/2001
La Sierra – Purnio	2	230	31/08/2001
Sabanalarga – Cartagena	1	220	31/08/2001
Porce II – Guadalupe IV	1	220	30/04/2001
Porce II – Barbosa	1	220	06/01/2001
Porce II – El Salto	1	220	06/01/2001
San Carlos – La Virginia	1	500	30/06/2000
Termocandelaria – Cartagena	2	220	24/06/2000
Termocanderlaria – Ternera	2	220	24/06/2000
Termocandelaria – Cartagena	1	220	24/05/2000
Termocandelaria – Ternera	1	220	19/05/2000
Guatapé – san Carlos	1	230	12/01/2011
La Virginia – La Hermosa	1	230	02/12/1999
Esmeralda – La Virginia	2	230	20/11/1999
Cartago – La Virginia	1	230	03/11/1999

Urabá – Urrá	1	230	25/10/1999
Bello – El Salto	1	220	16/09/1999
Cerromatoso – Urrá	2	230	06/09/1999
Guadalupe – El Salto	1	220	02/08/1999
Barbosa – El Salto	4	220	30/06/1999
Bucaramanga - Guatiguará	1	230	17/06/1999
Cerromatoso – Urrá	1	230	10/06/1999
Sochagota . Guatiguará	1	230	04/06/1999
Nueva Barranquilla – Sabanalarga	1	220	02/06/1999
Nueva Barranquilla – Sabanalarga	2	220	02/06/1999
Sochagota – Paipa	2	230	02/06/1999
Sochagota – Paipa	1	230	24/05/1999
Chivor – Sochagota	2	230	19/05/1999
Nueva Barranquilla – Sabanalarga	2	220	18/05/1999
Nueva Barranquilla – Tebsa	1	220	14/05/1999
Termoflores II – Nueva Barranquilla	1	220	14/05/1999
Chivor – Sochagota	1	230	07/05/1999
Playas – Primavera	1	230	07/05/1999
Termoflores II – Nueva Barranquilla	2	220	03/05/1999
Comuneros – Guatiguará	1	230	23/03/1999
Los Palos – Guatiguará	1	230	23/03/1999
Sochagota – Guatiguará	2	230	23/03/1999
Paipa – Tpaipa IV	1	230	07/03/1999
Fundación – Sabanalarga	2	220	27/02/1999
La Virginia – San Marcos	1	230	17/01/1999
Esmeralda – La Virginia	1	230	01/01/1999
La Virginia – San Marcos	1	500	01/01/1999
Juanchito – Paez	1	230	31/12/1998
San Bernardino – Paez	1	230	31/12/1998
Bello – La Tasajera	1	220	21/10/1998
Purnio - Noroeste	1	230	28/07/1998
Casa máquina San Carlos – San Carlos	4	230	23/07/1998
Guadalupe IV – Occidente	1	220	08/05/1998
Casa máquina San Carlos – San Carlos	3	230	08/05/1998

NTS LINES AND SUBSTATIONS ENTRY DATES			
NAME	**# CIRCUIT**	**VOLTAGE**	**ENTRY DATE**
Casa máquina San Carlos – San Carlos	2	230	05/05/1998
Casa máquina Jaguas – Jaguas	2	230	05/05/1998
Casa máquina Jaguas – Jaguas	1	230	05/05/1998
Guatapé – La Sierra	1	230	22/02/1998
San Felipe – Esmeralda	1	230	17/02/1998
San Felipe – La Mesa	2	230	16/02/1998
Betania – Mirolindo	1	230	30/12/1997
Balsillas – Noroeste	1	230	28/12/1997
La Sierra – Primavera	1	230	18/12/1997
Guatapé – Jaguas	2	230	17/12/1997
Comuneros – Merielectrica	1	230	30/11/1997
Purnio – Noroeste	2	230	18/11/1997
La Reforma - Tunal	1	230	09/11/1997
Tebsa – Sabanalarga	1	220	06/04/1997
Tebsa – Sabanalarga	2	220	06/04/1997
Tebsa – Sabanalarga	3	220	06/04/1997
Primavera – Comuneros	1	230	27/02/1997
Primavera – Termocentro	1	230	26/01/1997
Primavera – Termocentro	2	230	26/01/1997
Primavera – Comuneros	2	230	24/01/1997
Malena – primavera	1	230	20/01/1997
San Carlos – Purnio	1	230	01/01/1997
Ocaña – Palos	1	230	04/11/1996
San Matero – Ocaña	2	230	13/03/1996
Valledupar – Cuestecitas	1	230	09/12/1995
Yumbo – San Marcos	1	230	01/01/1995
Envigado – Occidente	1	230	01/01/1995
Ancón Sur EPM – Occidente	1	230	01/01/1995
Occidente – La Tasajera	1	220	01/01/1995
Guavio – La Reforma	1	230	01/01/1995
Guavio – Tunal	1	220	28/10/1994
Cerromatoso – San Carlos	2	220	27/05/1994
Guavio – Torca	2	220	20/05/1994
Chinú – Cerromatoso	2	230	01/01/1994
Mirolindo – La Mesa	1	230	01/01/1994
Mirolindo – La Mesa	2	500	11/12/1993
Barbosa – La Tasajera	1	230	11/12/1993
Sabanalarga – Chinú	2	230	10/12/1993
Guavio – Chivor	2	220	05/12/1993
Guavio – Chivor	1	500	05/12/1993
Guavio – torca	1	230	01/10/1993
Cuestecistas – Cuatricentenario	1	230	16/08/1993
Noroeste – Torca	1	230	17/12/1992
Noroeste – Torca	2	230	17/07/1992
Guavio Subt Ducto - Guavio	1	230	17/07/1992
Guavio Subt Ducto – Guavio	2	230	01/12/1991
La Enea – San Felipe	1	230	01/12/1991
San Felipe – La Mesa	1	230	04/08/1990
Ancón Sur ISA – Esmeralda	1	230	04/08/1990
Ancón Sur ISA – Esmeralda	2	230	21/11/1998
Ancón Sur EPM – Miraflores	1	230	21/11/1998
Ancón Sur EPM – Ancón Sur ISA	1	230	01/10/1989
Ancón Sur EPM – Ancón Sur ISA	2	230	01/10/1989
Banadía – Caño Limón	1	230	01/10/1989
Banadía – Samoré	1	230	01/10/1989
Bucaramanga – Palos	1	230	01/10/1989
Jamondino – San Bernardino	1	230	01/10/1989
Jamondino – San Bernardino	2	230	01/10/1989
Palos - Toledo	1	230	01/10/1989

NTS LINES AND SUBSTATIONS ENTRY DATES			
NAME	**# CIRCUIT**	**VOLTAGE**	**ENTRY DATE**
Samoré – Toledo	1	230	01/01/1989
Envigado – Oriente	1	200	01/07/1988
Guatapé – Playas	1	220	01/02/1988
Oriente – Playas	1	220	01/02/1988
Ancón Sur ISA – San Carlos	1	230	01/01/1987
Ancón Sur ISA – San Carlos	2	230	01/01/1987
Betania – San Bernardino	1	230	01/01/1987
Betania – San Bernardino	2	230	01/01/1987
Juanchito – Pance	1	230	01/01/1987
Yumbo – San Bernardino	1	230	01/01/1987
La Enea – Esmeralda	1	230	27/07/1986
Guatapé - Oriente	1	220	01/07/1986
Sabanalarga – Chinú	1	500	19/11/1985
Chinú – Cerromatoso	1	500	25/10/1985
Cerromatoso – San Carlos	1	500	25/10/1985
Barbosa – Guatapé	1	220	01/09/1985
Barbosa – Miraflores	1	220	01/09/1985
Barbosa – Guadalupe IV	1	220	01/01/1985
Juanchito Salvajina	1	230	01/01/1985
Pance - Salvajina	1	230	01/01/1985
Esmeralda – Yumbo	3	230	11/10/1984
Belén – San Mateo	1	230	01/01/1984
Fundación - Santa Marta	1	220	01/01/1984
Fundación – Santa Marta	2	220	01/01/1984
Guajira – Cuestecitas	1	220	01/01/1984
Guajira – Cuestecitas	2	220	01/01/1984
San Mateo – Tasajero	1	230	01/01/1984
Circo – Guavio	1	230	01/01/1983
Circo – Guavio	2	230	01/01/1983
Circo Paraíso	1	230	01/01/1983
Circo – Tunal	2	230	01/01/1983
Guajira – Santa Marta	1	230	01/01/1983
Guajira – Santa Marta	2	220	01/01/1983
Guatapé – San Marcos	2	220	01/01/1983
La Guaca – La Mesa	1	230	01/01/1983
La Guaca – La Mesa	2	230	01/01/1983
La Guaca – Paraíso	1	230	01/01/1983
La Guaca – Paraíso	2	230	01/01/1983
Paraiso – San Mateo	1	230	01/01/1983
San Mateo – Tunal	1	230	01/01/1983
Balsillas – La Mesa	1	230	01/01/1983
Belén – Tasajero	1	230	01/01/1980
Tasajero – Los Palos	1	230	01/01/1980
Guatapé – Miraflores	1	230	01/03/1978
El Copey – Valledupar	1	220	01/01/1978
Fundación – El Copey	1	220	01/01/1978
Fundación – Sabanalarga	1	220	01/01/1978
Chivor – Torca	1	220	09/05/1977
Chivor – Torca	2	230	09/05/1977
Barranca – Comuneros	1	230	01/01/1976
Guatapé – Jaguas	1	230	01/01/1976
Malena – Jaguas	1	230	01/01/1976
Noroeste – La Mesa	1	230	01/01/1976
Barranca - Bucaramanga	1	230	01/01/1975
HIGH Anchicayá – Pance	1	230	01/01/1974
HIGH Anchicayá – Yumbo	1	230	01/01/1974
Pance – Yumbo	1	230	01/01/1974
Sabanalarga – Ternera	1	230	01/01/1972
Sabanalarga – Ternera	2	220	01/01/1972
Esmeralda – Yumbo	2	220	18/11/1971
Cartago – San Marcos	1	230	01/01/1971
San Carlos – Esmeralda	1	230	01/01/1971
San Carlos – Esmeralda	2	230	01/01/1971

Envigado - Guatapé	1	220	01/01/1969

NTS LINES AND SUBSTATIONS ENTRY DATES	
SUBSTATION	**ENTRY YEAR**
HIGH anchicaya	1974
Ancón	1987
Ancón Sur ISA	1985
Balsillas	1982
Banadía	1989
Barbosa	1985
Barranca	1976
Belén	1977
Bello	1998
Betania	1998
Bucaramanga	1974
Caño Limón	1989
Cartago	1993
Cerromatoso 2	1999
Cerromatoso 5	1985
Chinú	1985
Chivor	1976
Circo	1983
Comuneros	1994
Copey	1986
Cyuestecitas	1985
Envigado	1969
Esmeralda	1971
Fundación	1973
Guaca	1986
Guadalupe IV	1985
Guatapé	1969
Guataquirá	1999
Guavio	1992
Hermosa	1995
Jaguas	1982
Jamondino	1989
Juanchito	1974
La Enea	1986
La Mesa	1984
La Miel	2001
La Reforma	1994
La Sierra	1997
La Virginia 2	1999
La Virginia 5	1999
Merilectrica	1997
Miraflores	1978
Mirolindo	1995
N. Barranquilla	1999

NTS LINES AND SUBSTATIONS ENTRY DATES	
SUBSTATION	**ENTRY YEAR**
Noroeste	1992
Ocaña	1997
Occidente	1994
Oriente	1984
Páez	1998
Paipa	1975
Palos	1990
Pance	1974
Paraíso	1986
Playas	1988
Porce II	2001
Primavera	1997
Purnio	1997
Sabanalarga	1989

Sabanalarga 5	1985
Salto IV	1999
Salvajina	1985
Samoré	1989
San Bernardino	1987
San Carlos 2	1982
San Carlos 5	1985
San Felipe	1990
San Marcos 2	1995
San Marcos 5	1998
San Mateo	1987
San Mateo Cúcuta	1986
Santa Marta	1982
Sochagota	1999
Tasajera	1993
Tasajero	1984
Termocandelaria	2001
Termocartagena	1977
Termocentro	1997
Termoflores	1997
Termoguajira	1983
Termopaipa IV	1999
Ternera	1972
Toledo	1989
Torca	1976
Tunal	1984
Uraba	1999
Urrá	1999
Valledupar	1978
Yumbo	1971

8.6. NON-CONVENTIONAL SOURCES OF ENERGY –FNCE-

The FNCE technologies, (specially the renewable ones), are becoming more competitive. In Colombia, only in the 70's, the Rational and Efficient Use of Energy, was propelled with some intensity – URE and FNCE, which will mark the competitive differences for the country in the medium and long term, and counting on diverse sources additional to the hydrocarbons one, reduce the risk associated to future procurement and that the URE contributes with energy savings, coming from the no-waste strategy of doing more with the same energy.

During 2006, the first version of the Colombia's wind atlas and the eolic energy[10], from which is expected to support the exploitation of this renewable resource, for which, the country has the most relevant project in JEPIRACHI (19.5 mw) FNCE eolic park, constructed by Empresas Públicas de Medellín.

With regard to the elaboration and updating of technical references, that make easier, the conditions for the development of FNCE's healthy market, the elaboration and updating of the Colombian technical regulation NTC, was supported; attendance of three technical committees of Colombian Institute of Technical Regulation –ICONTEC- in a) photovoltaic solar energy, b) solar thermoelectric energy and c) eolic energy, resulting in the following technical regulation and guidelines:

[10] The 2006 Colombia's Wind and Eolic Energy Atlas, as well the 2005 Colombia's Solar Radiation Atlas, are available at the UPME web page http://www.upme.gov.co

NTC-5412 Aerial-generators. Quality characteristics measurement and evaluation of eolic turbines supply, connected to networks.
GTC-139 Aerial-Generators Systems. Protection against atmospheric electric discharges.

8.6.1. COLOMBIA'S RENEWABLE ENERGETIC RESOURCES MAP

Colombia is a privileged country, because of its special conditions of being in a torrid zone, in the confluence of the tectonic plaques and in the Andean region, where the Andeans range trifurcates, making Colombia, rich in ecosystems, biologic species, hydro resources, with beneficial falls, solar, eolic and geothermal resources.

Following, an approximation of the UPME maps, compiled from an energetic perspective. In the previous versions of the Generation and Transmission Plan, the maps that complement the information, are shown, therefore, we recommend to consult them.

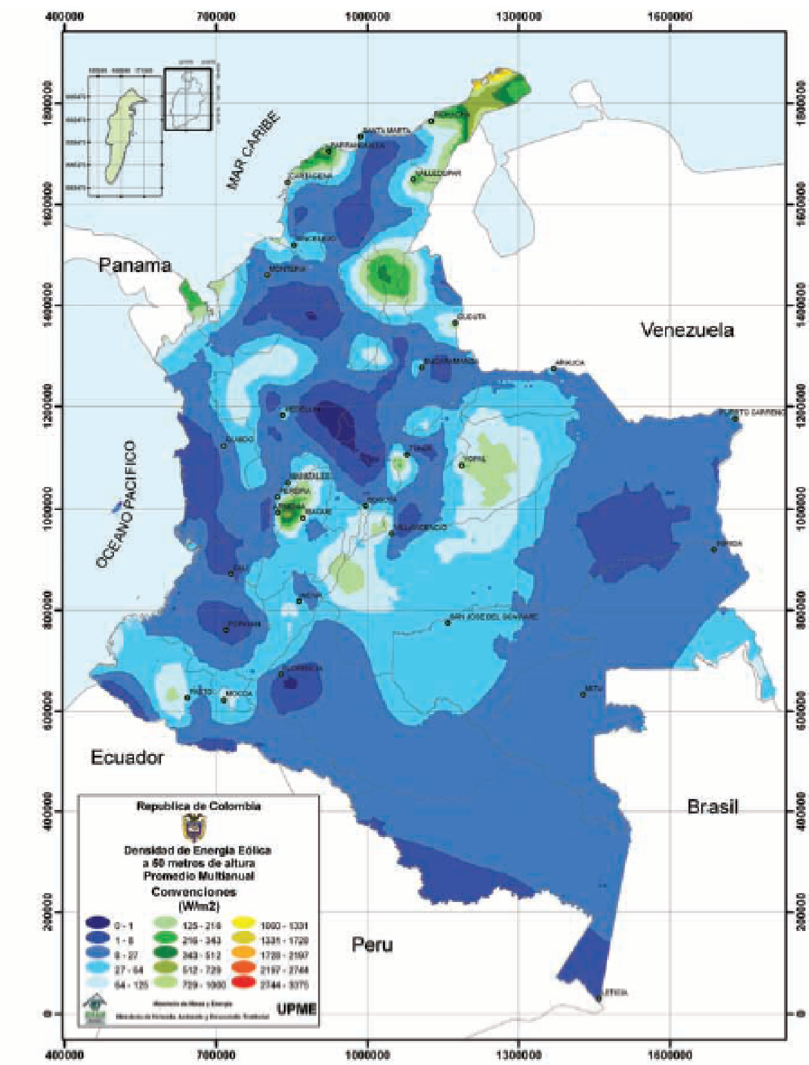
8.6.2. WIND ENERGY DENSITY MAP

The UPME in synergy with the IDEAM, has provided the country, with the first version of the Colombia's eolic energy density atlas. The work established, for the first time, a model for estimating this resource at a national level, using data series above 10 years, in more than a hundred wind measuring stations of 10 m height above ground, for which was possible to establish the wind resource maps.

The Atlas contains estimations at 50 meters height and shows that Colombia has a good eolic energy potential in some of the regions of its territory (see map in the next page). And that even for the whole territory, the multi-annual energy density average is low, close to 200 $W/m^{2,}$ the Guajira peninsula, possesses the best values in its north zone, reaching 1,700 W/m^2, a favorable figure to take advantage of the wind. An approximation at above mentioned height, of the availability of multi-annual average eolic energy density by regions, is presented in the following table:

REGION	W/ m^2
GUAJIRA:	200 -1700
ANDEAN:	125 – 700
ATLANTIC COAST:	8 – 700
ORINOQUIA:	0 – 200
AMAZON:	0 – 120
PACIFIC COAST:	1 – 64

Lastly, it is necessary to involve the scientific and technical work, in the results of this study, in order to disclose, use, and improve it, with the contribution of the public and private enterprise.



8.6.3. HYDRO-ENERGETIC POTENTIAL MAP

Currently the UPME and IDEAM are working to establish the first Colombia's Hydro-energetic Atlas.

8.6.4. BIOMASS ENERGETIC POTENTIAL MAP

During 2007 and 2008, the IDEAM and COLCIENCIAS, will work to establish the first Biomass Energetic Potential Atlas for Colombia.

9. ACRONYMS and ABBREVIATIONS

ACEM: Combustible Ecological Oil for Motor
ACP: Colombian Association of Petroleum
ACPM (Deisel): Combustible Motor Oil
ANH: National Agency for Hydrocarbons
AOM: Administration, Operation and Maintenance
API: Scale that expresses the relative density of a liquid hydrocarbon
API: (American Petroleum Institute)
BOMT: (Build-Own- Operate Own Maintenance and Transfer)
BP: British Petroleum
CNO: National Operation Council
CAFAZNI: Administrative Committee Support Fund for the Energizing of the Non-Interconnected Zones
CANREL: Andean Committee of Normative Organisms and regulating Organisms of Electrical Services
CASEC: Electrical Sector Environmental Committee
CEPAL: United Nations Economic Committee for Latin America and the Caribbean
CIB: Barrancabermeja Industrial Complex
CIURE: Institutional Committee for the Rational Use of Energy
CND: National Dispatch Center
CNR: National Commission of Royalties
COLCIENCIAS: Colombian Institute for the Development of Science and Technology
CONPES: National Council for Social and Economic Policies
CPR: Risk Participation Contracts
CRD: Regional Dispatch Center
CTL: Carbon to Liquid
CREG: Energy and Gas Regulation Commission
DANE: National Administrative Department of Statistics
DNP: National Department of Planning
DOE-EIA: United States Department of Energy
E&L: Losses, Energy and Operative Integrity
E&P: Exploration and Production Activity
ECOGAS: Colombian Gas Company
ECOPETROL: ECOPETROL S.A.
ESP: Public Services Company
FAEP: Savings Fund and Oil Industry Stabilization
FAER: Financial Support Find for the Energization of the Non-Interconnected Rural Zones
FAZNI: Financial Support Fund for the Energization of the Non-Interconnected Zones
FEN: National Electrical Financial
FES: Frequency of the Accounting Faults of the electrical energy service
FIP: Investment Fund for Peace
FNCE: Non-Conventional Sources of Energy
FNR: National Royalties Fund
FOES: Social Energy Fund
FSSRI: Solidarity Fund for Subsidies and Redistribution of Income
GLN: Liquid Natural Gas
GLP: Petroleum Liquid Gas
GNC: Compressed Natural Gas
GNCV: Compressed Vehicular Natural Gas
GNV: Vehicular Natural Gas
GTL: Gas To Liquid
ICONTEC: Colombian Institute of Technical Specifications and Certifications
ICP: Colombian Institute of Petroleum
IFO: Fuel for Boilers
IGBC: General Index of the Colombian Stock Market
IPC: Consumer Index price
IPP: Producer Index Price
IPSE: Institute for the Promotion of Energetic Solutions
ISA: Interconexión Eléctrica S.A.ESP
ISAGEN: Interconexión Eléctrica S.A
IVA: Added Value Tax
MDL: Clean Development Mechanism
MEM: Wholesale Energy Market
MHCP: Ministry of Internal Revenue and Public Credit
NBI: Unsatisfactory Basic Needs
OIEA: International Organism for Atomic Energy
OLADE: Latin American Energy Organization
OMC: World Commerce Organization
OR: Network Operation
PCH: Small Hydroelectric Plant
PEN: National Energetic Plan
PGN: General National Budget
PIB: Gross Internal Product
PPA: (Power purchase agreement)
PROURE: Rational Energy Use Program
RETIE: Technical Electrical Installation Regulations
RUT: Singular Transport Regulation
SIGOB: Presidential Negotiation Goals and Programming System2
SIMEC: Energetic Information on the Colombian Miner System
SIN: National Interconnection System
SSPD: Superintendence of Domiciliary Public Services
STN: National Transmission System
STR: Regional Transmission System
TIES: International Electricity Transactions
TRM: Representative Market Rate
UPME: Energetic Mining Plan Unit
URE: Rational and Efficient Use of Energy
US$: Dollars
WACC: Ponderated Average Cost of capital
WTI: International Reference Price of Crude Petroleum (West Texas Intermediate)
ZNI: Non-Interconnected Zone

10. CONVENCIONS AND UNITS

2D: 2 Bi-dimensional
3D: Tri-dimensional
BEP: Petroleum Equivalent Barrels
Bl: Barrel
BPD: Barrels per Day
BPDC: Barrels per Calendar Day
BTU: British Thermal Unit
CAR: Cartagena Refinery
g: Gram(s)
gal: Gallon(s)
GPC: Giga Cubic Feet
GWh: Gigawatts per hour
ha: Hectares(s)
HP: Horse-Power
KBDC: Thousands of Barrels per Calendar Day
KBLS: Thousands of Barrels
KBPD: Thousands of Crude Barrels per Day
kg: Kilogram
km: Kilometer(s)
km2: Square Kilometers
KPDC: Thousands of Cubic Feet per Day
kt: thousands of tons
kV: Thousands of Volts
kWh: Kilowatts per Hour
L: Liter(s)
lb: Pound(s)
M$: Millions of Pesos
MUS$: Millions of Dollars
m3: Cubic Meters
mA: Milliamperes
MBLS: Millions of Barrels
MBPD: Millions of Barrels per Day
MBEP: Millions of Crude Equivalent Barrels
MBTU: Millions of British Thermal Units
Mm3: Millions of Cubic Meters
MPC: Millions of Cubic Feet
MPDC: Millions of Cubic Feet per Calendar Day
Mt: Millions of tons
MVA: Megavolt amperes
MVAr: Reactive Megavolt amperes
MW: Megawatts
Oz troy: Troy Ounces
PC: Cubic Feet
PCBs: Poli-chlorinated bi-phenols
PCD: Cubic Feet per Day
rms: Root Mean Square
RUT: Singular Transport Regulation
S/E: Sub- Station
t: Ton(s)
Tcal: Teracalories
TEC: Carbon Equivalent Tons
TEP: Crude Equivalent Tons
TJ: Terajules
TPC: Cubic Therapies
US$: Dollars
US$/Bl: Dollars per Barrel
US$/KPC: Dollars per Miles of Cubic Feet
US$/MBTU: Dollars per Millions of British Thermal Units