

Colombian Electric Power System

New Projects Latest Investment Opportunities



MinMinas
Ministerio de Minas y Energía

**PROSPERIDAD
PARA TODOS**

1. **Invest in Colombia.**
2. **Colombia's Electricity Sector.**
3. **Generation and Transmission Expansion Plan.**
4. **Public calls. How does it work?**
5. **Public calls. New projects.**





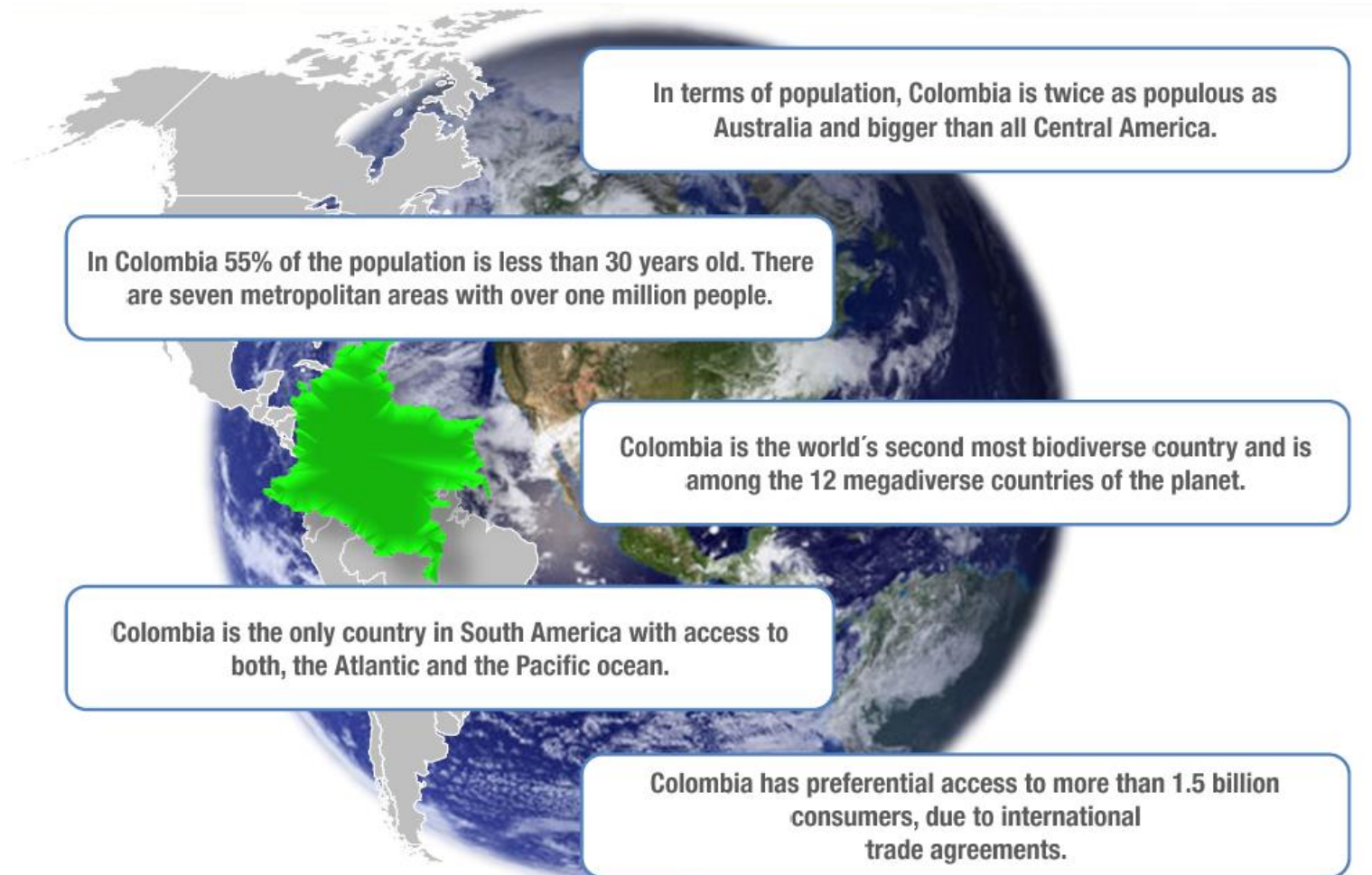
- 1. Invest in Colombia**
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Colombia's worldwide headlines



Colombia is one of the countries with the biggest potential for foreign investment

Why invest in Colombia?



Source: Proexport

Why invest in Colombia?



Economic Stability



**Highly Qualified Manpower
(Technical and Professional)**



Stable Legal System



**Export Platform and Privileged Access to
World Markets (FTAs with almost 50 countries,
including Korea, European Unión, Canada and
USA).**

Why invest in Colombia?



Special Arrangements to
Boost Foreign Trade



Infraestructure



Respect for Private and
Intellectual Property.



Stable Democracy
(National Security and Peace Process Breakthroughs)

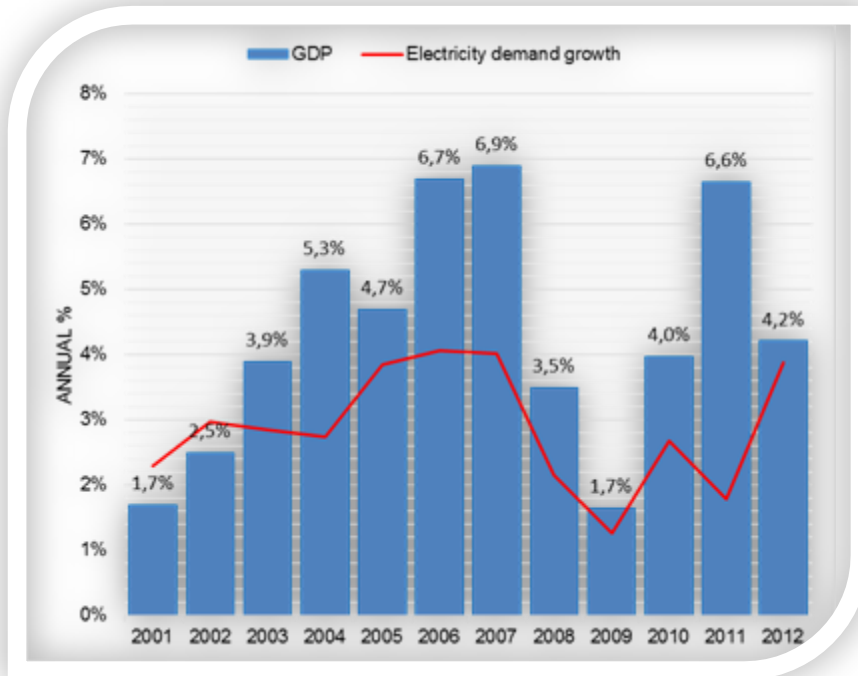
Why invest in Colombia?

The Top 3 Risk Rating Agencies awarded Investment Grade to Colombia

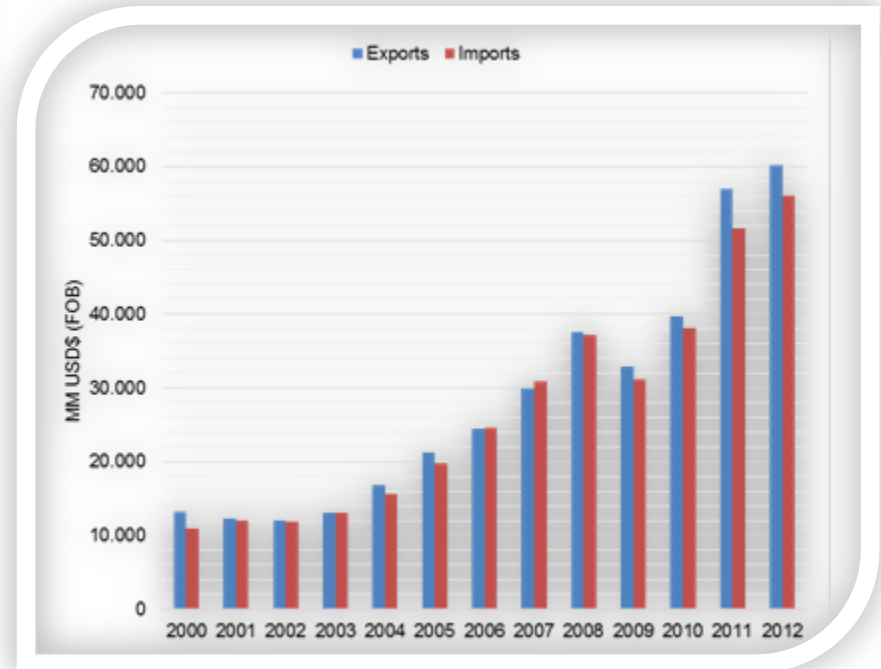
Rating Agency	Term	Rating	Date	Outlook
STANDARD & POOR'S	Long Term- Foreign Currency	BBB	24- Apr - 2013	Stable
	Short Term- Foreign Currency	A - 2	24- Apr - 2013	
	Long Term- Local Currency	BBB +	5 - Mar - 2007	
	Short Term - Local Currency	A - 2	5 - Mar - 2007	
FitchRatings	Long Term- Foreign Currency	BBB -	22 - Jun - 2011	Positive
	Short Term- Foreign Currency	F - 3	22 - Jun - 2011	
	Long Term - Local Currency	BBB	22 - Jun - 2011	
MOODY'S	Long Term- Foreign Currency	Baa3	7- Feb- 2012	Positive

Source: Proexport

Economic indicators

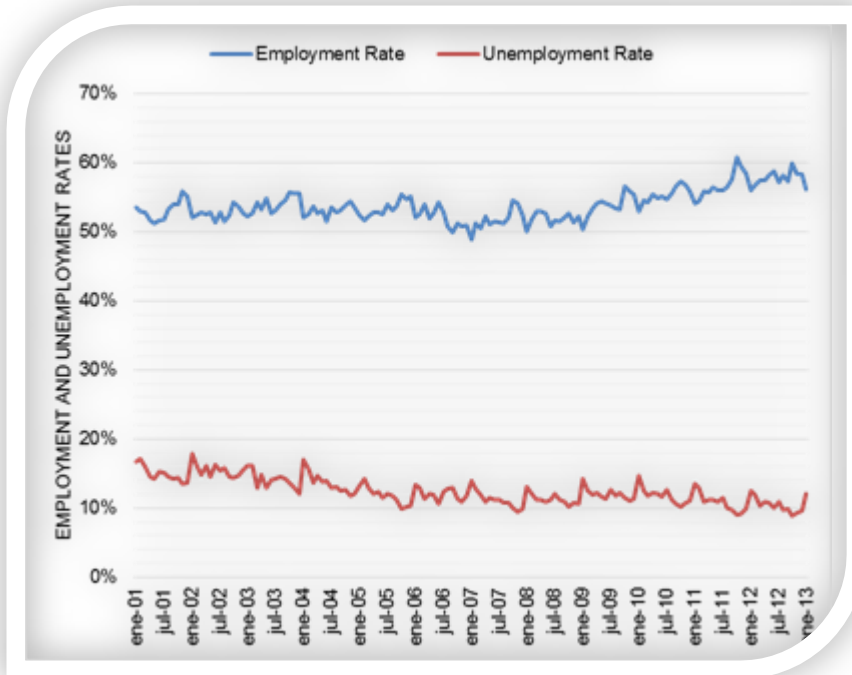


GDP growth: 4,2%. december 2012

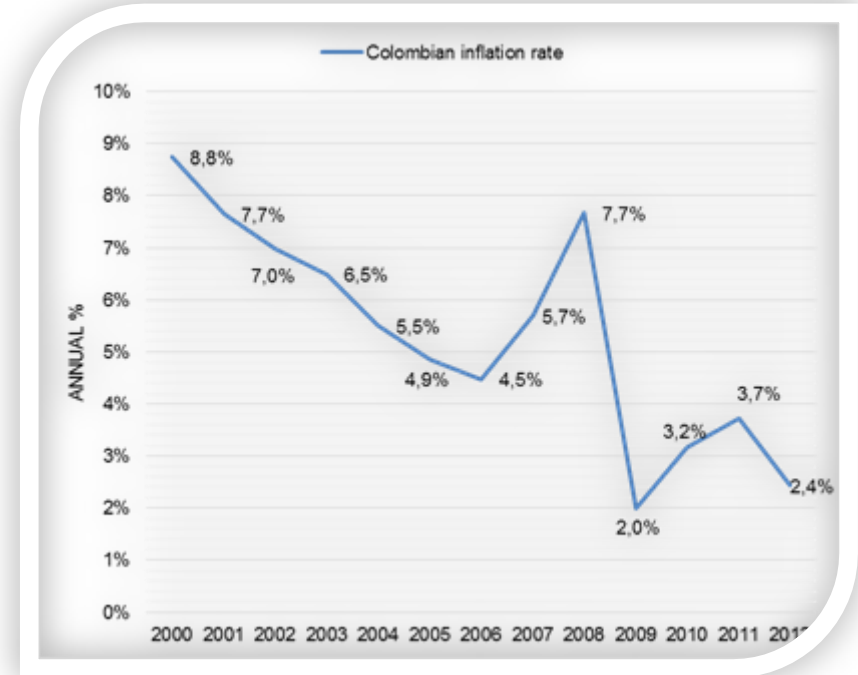


Exports of Goods and Services: US\$ 60,667 MM
 5,7% growth rate

Economic indicators



Unemployment rate 9,6%. december 2012



Controlled inflation 2,4%

Colombia's economy has achieved to stay afloat with positive economic growth, even better than other major economies in Latin America

Foreign Companies in Colombia





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Colombia's electricity sector

Management and Policy

Ministry of Mines and Energy



MinMinas
Ministerio de Minas y Energía

Planning

Mining and Energy Planning Unit



Regulation

Energy and Gas Regulatory Commission



Surveillance

Superintendent of Public Services



System Operation and Market Administration

XM - Markets Experts



Technical Consulting

- Planning Advisory Committee of Transmission - CAPT
- National Operation Council - CON
- Advisory Committee for Coordination and Follow Country Energy Situation - CACSSE

Composition of Colombian electricity sector

GENERATION (G)

Energy production from primary sources

Wholesale Market

- Competition on short-term deals, the Energy Exchange
- Competition in contract offers to retailers and large customers

TRANSMISSION (T)

Energy transport at voltage levels above 220 kV

Regulated Revenue

- Natural monopoly
- Competition for the expansion since 1999
- Free access to the network
- National stamp fee
- National collection and distribution of revenue to owners through the LAC (XM)



Porce III Hydroelectric - EPM



Substation Bolivar 500/220 kV - ISA

Composition of Colombian Electricity Sector

DISTRIBUTION (D)

Energy transport at voltage levels below 220 kV

Regulated Charges

- Natural monopoly
- Maximum Charges regulated by voltage level for each regional and local system
- Subtransmission Remuneration: Maximum income
- Payment Distribution: Maximum Charges

COMMERCIALIZATION (C)

Purchase of energy in the wholesale market and retail sales for users. Trade cycle management the customers

Energy purchase Sale and Customer Management

- Transfer of the purchase price to the fare
- Regulated charges for the regulated market
- Open range to the unregulated market



Distribution networks.



City of Bogotá D.C.

Numbers of the sector in Colombia

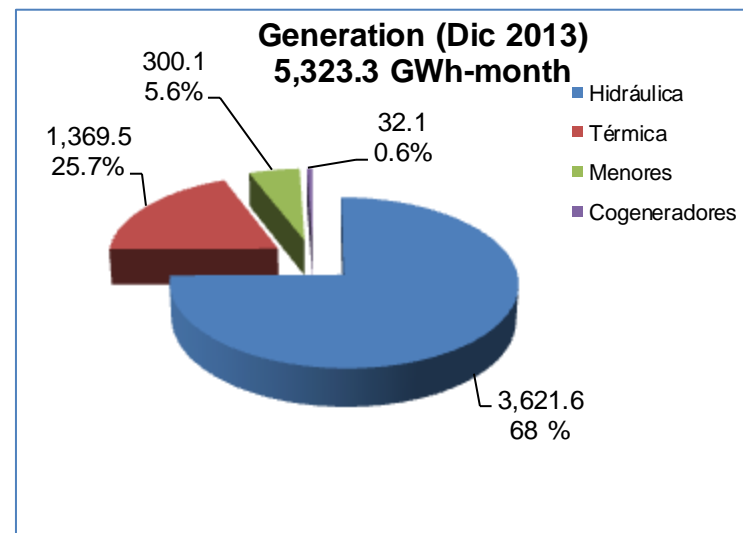
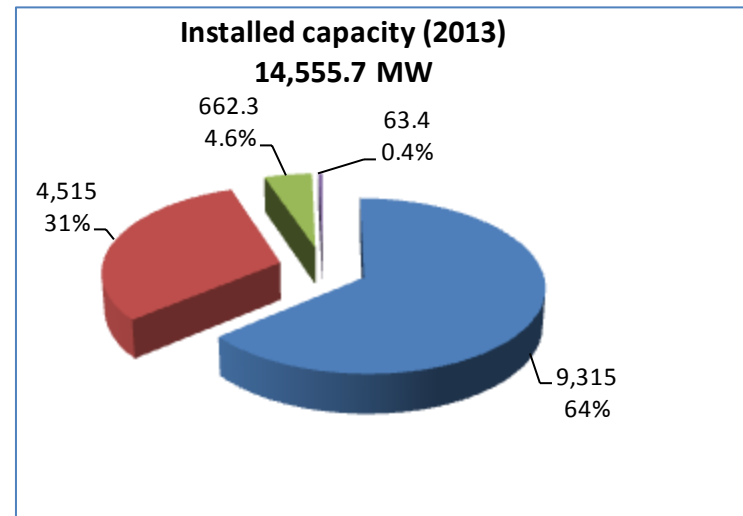
CONCEPT	2012
GDP	US \$ 472 Billion
GDP growth	4,20%
Natural Gas proved reserves	5.73 Tcft
Oil proved reserves	2377 MBBL
Coal Reserves	16.643 MTon
Generation capacity	14.360MW
Energy demand	59.366 GWh
Peak power load	9.504 MW
Peak power demand growth	6.58%
Energy traded in the stock market	17.019 GWh
Declared firm energy for the reliability charge	61.175 GWh
Total energy traded	84.195 GWh
Value of the transactions carried out in the energy market	US\$ 5.7Billion

Market's agents

Activity	Registered
Generation agents	50
Transmission agents	11
Distribution agents	30
Commercialization agents	92
Regulated users borders	7.189
Nonregulated users borders	5.422
Street lighting border	403

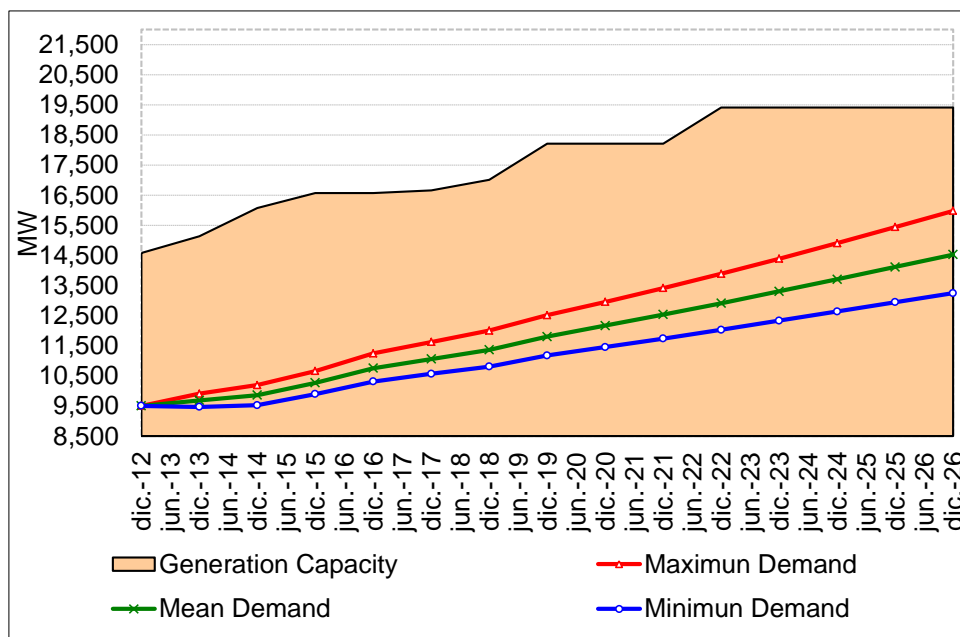
Numbers of the sector in Colombia

Generation Capacity		
Source	Capacity MW	%
Hydraulic	9,315	64%
Thermal	4,515	31%
Smaller (≤ 20 MW)	662.3	4,6%
Cogeneration	63.4	0,4%
Total generation capacity	14,555.7	100,00%



Generation Projects Underway

Name	Capacity [MW]	Type	Date
Amoyá	78	Hydropower	abr-13
Cucuana	60	Hydropower	oct-13
Gecelca 3	164	Thermal	dic-13
Termocol	201.6	Thermal	dic-13
Sogamoso, unidad 3	266.7	Hydropower	feb-14
Sogamoso, unidad 3 y 2	533.3	Hydropower	abr-14
Sogamoso, unidad 3, 2 y 1	800	Hydropower	may-14
El Popal	19.9	Hydropower	jun-14
El Quimbo	420	Hydropower	dic-14
San Miguel	42	Hydropower	dic-15
Ambeima	45	Hydropower	dic-15
Carlos Lleras	78.1	Hydropower	dic-15
Tasajero II	160	Thermal	dic-15
Gecelca 3.2	250	Thermal	dic-15
Termonorte	88.3	Thermal	dic-17
Ituango, unidad 1	300	Hydropower	sep-18
Porvenir II	351.8	Hydropower	dic-18
Ituango, unidades 1 y 2	600	Hydropower	dic-18
Ituango, unidades 1, 2 y 3	900	Hydropower	mar-19
Ituango, unidades 1, 2, 3 y 4	1,200.00	Hydropower	jun-19
Ituango, unidades 1, 2, 3, 4 y 5	1,500.00	Hydropower	sep-21
Ituango, unidades 1, 2, 3, 4, 5 y 6	1,800.00	Hydropower	dic-21
Ituango, unidades 1, 2, 3, 4, 5, 6 y 7	2,100.00	Hydropower	mar-22
Ituango, unidades 1, 2, 3, 4, 5, 6, 7 y 8	2,400.00	Hydropower	jun-22



Current Scheme

Existing network:

 220 kV

 500 kV

Transmission lines	Length Km
100 -115 kV	10.267
138 kV	15,5
220 -230 kV	11.679,9
500 kV	2.436,7
Total	24.399,1





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Responsibility on service supply

The State and local authorities function and the provision of service

- Supplying electricity demand under economic criteria and financial feasibility
- Ensure an efficient operation, safe and reliable in the sector activities

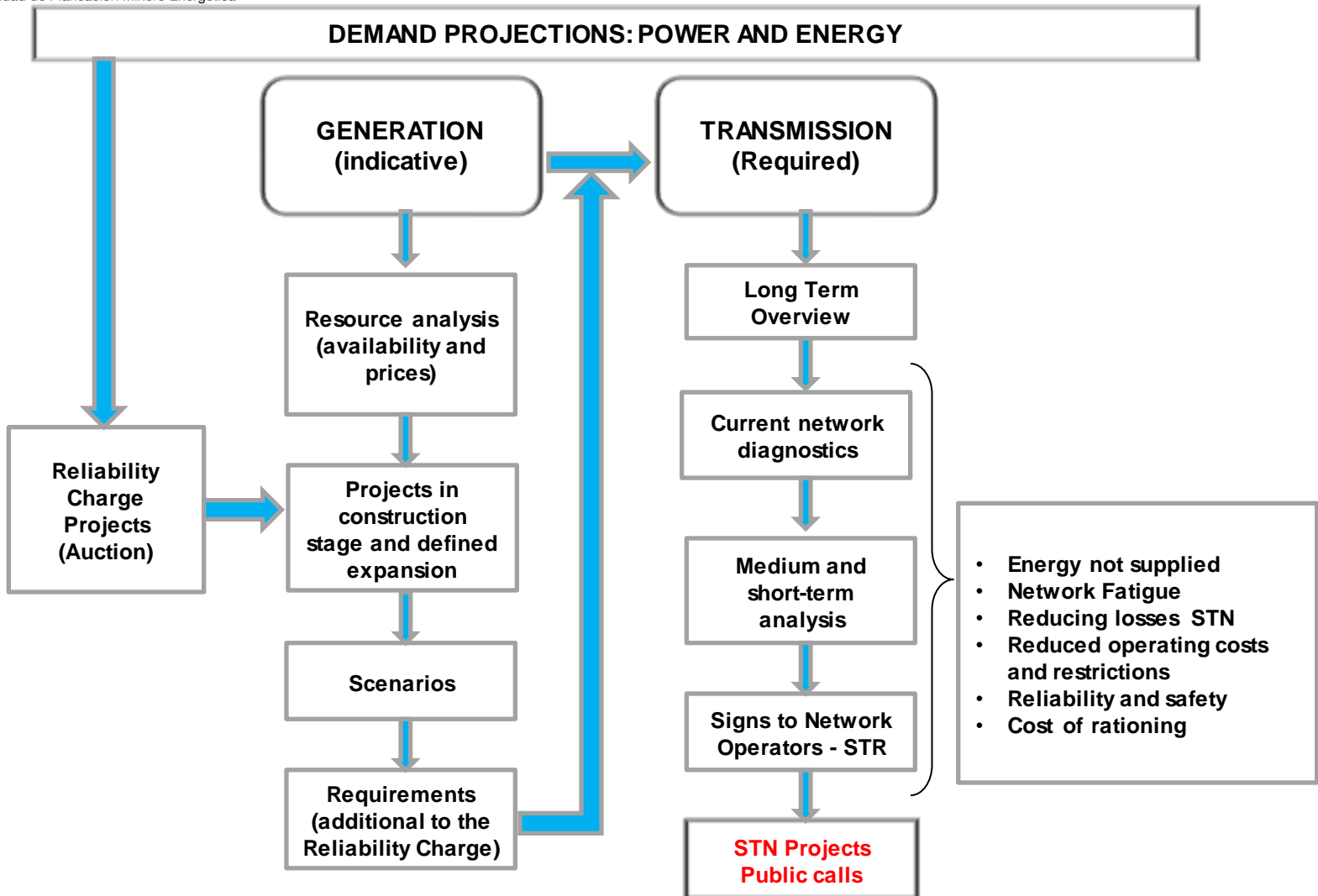
What does the Mining and Energy Planning Unit – UPME do?

- It is responsible, among other things, of the electricity demand projections and ***Generation and Transmission Expansion Plan.***

What is the Generation and Transmission Expansion Plan?

The Expansion Plan identifies the scheme deficiencies and determines the expansion in generation and transmission infrastructure

- Generation plants are built by interest and initiative of the agents.
- Transmission projects are built by an investor selected through a public call.

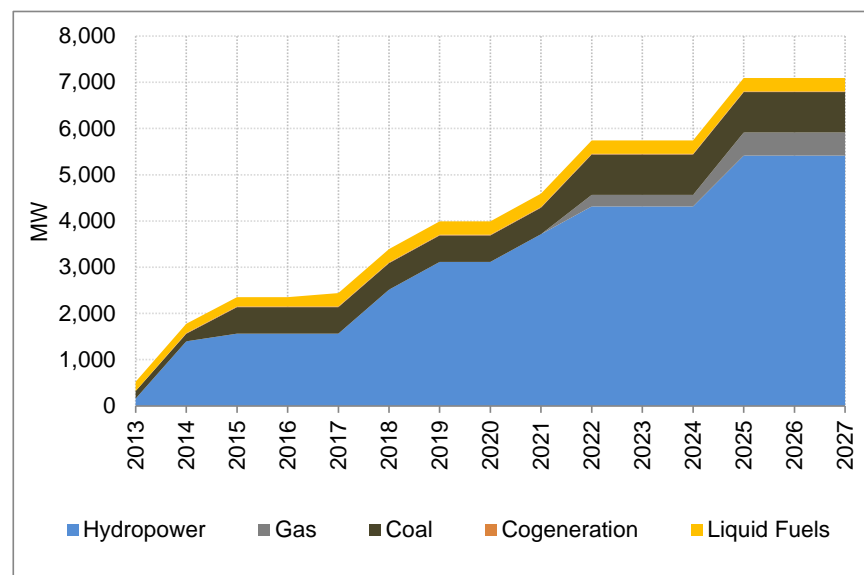


Alternative 4. Long Term Base Scenario

Generation Capacity Expansion

Year	Technology				
	Hydropower	Gas	Coal	Cogeneration	Liquid Fuels
	[MW]	[MW]	[MW]	[MW]	[MW]
2013	157.9		164		201.6
2014	1,239.90			14	
2015	165.1		410		
2016					
2017					88.3
2018	951.8				
2019	600				
2020					
2021	600				
2022	600	250	300		
2023					
2024					
2025	1,100	250			
2026					
2027					
Subtotal [MW]	5,414.70	500	874	14	289.9
Total [MW]	7,092.60				

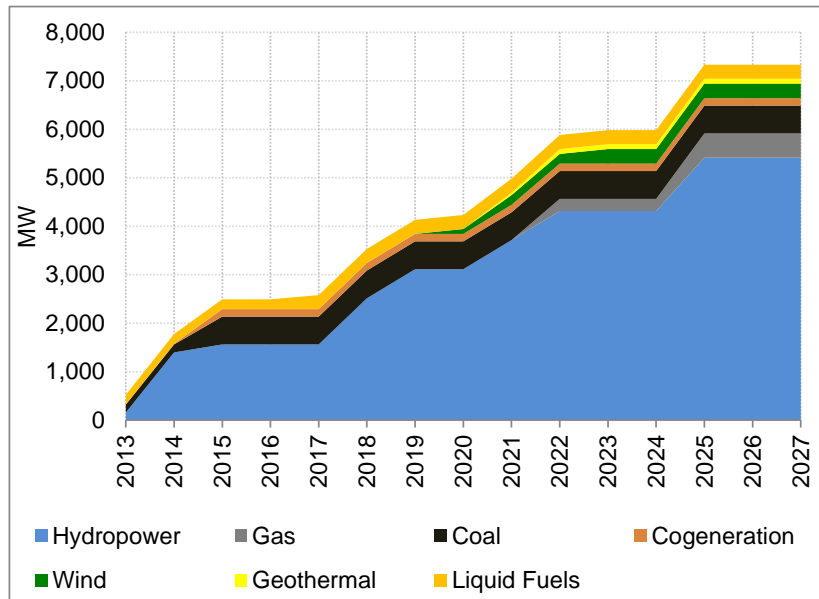
Expansion by Fuel



Under those assumptions, the system require the installation of 3,100 MW and those established by the Reliability Charge. The first reinforcement it would require in the 2021.

Alternative 4B. Renewable Long Term Scenario

Expansion by Fuel

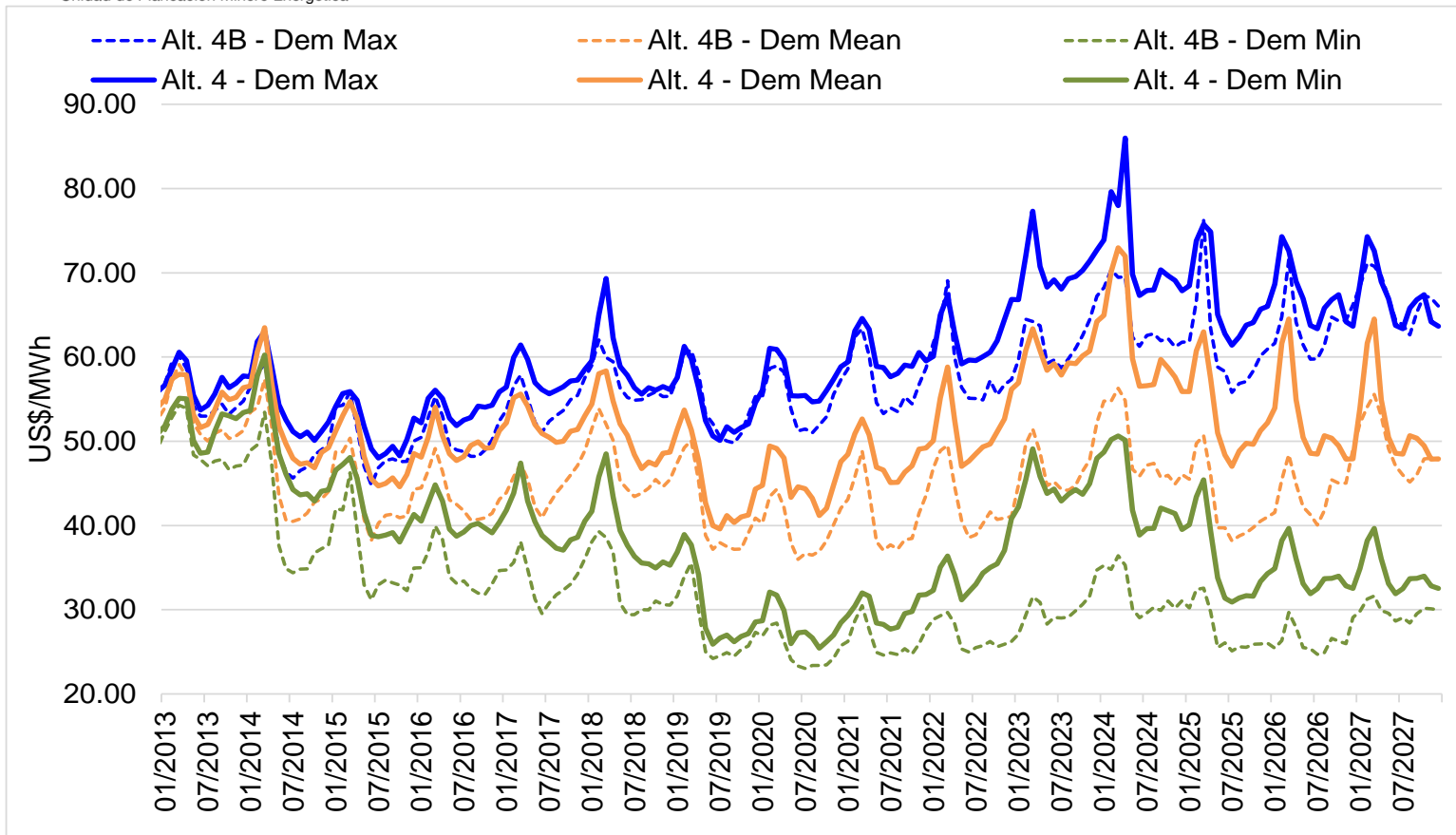


Generation Expansion Capacity

Year	Technology (MW)						
	Hydropower	Gas	Coal	Cogeneration	Wind	Geothermal	Liquid Fuels
2013	157.9		164				201.6
2014	1,239.90			14			
2015	165.1		410	140			
2016							
2017							88.3
2018	951.8						
2019	600						
2020					100		
2021	600				100	50	
2022	600	250				50	
2023					100		
2024							
2025	1,100	250					
2026							
2027							
Subtotal [MW]	5,414.70	500	574	154	300	100	289.9
Total [MW]	7,332.60						

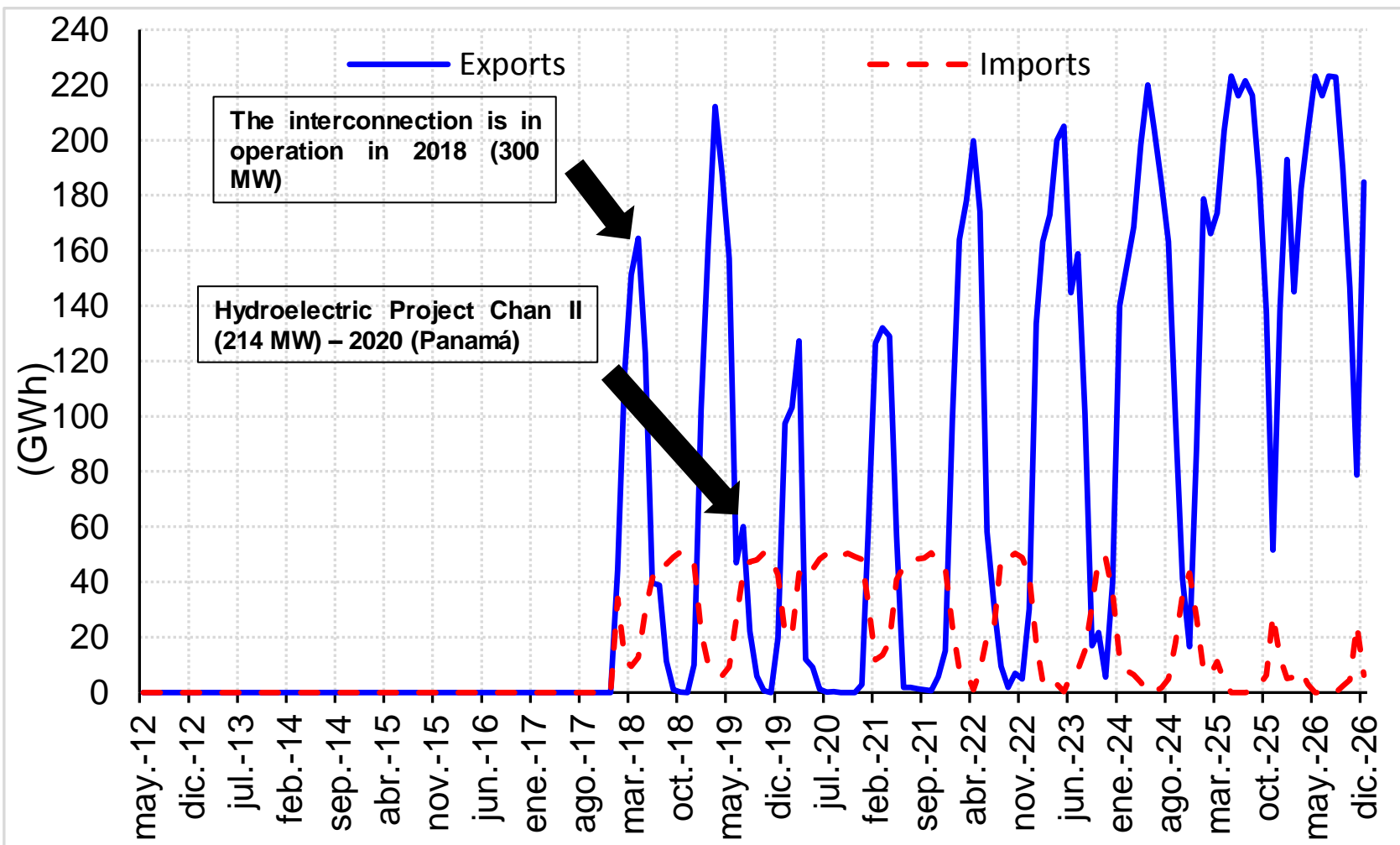
Under those assumptions, the system require the installation of 3,340 MW and those established by the Reliability Charge. The first reinforcement it would require in the 2021.

Comparative Marginal Cost between Alternative 4 and 4B

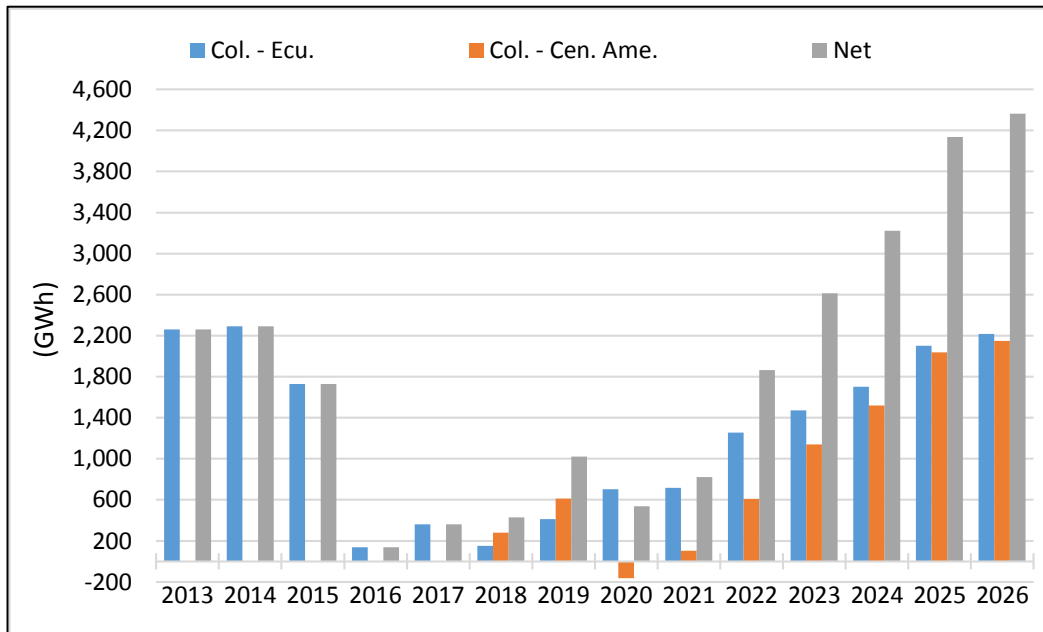


Between both alternatives, exists a difference of generation capacity around of 240 MW. Anyway for the three demand scenarios the marginal cost of the 4B alternative is less in comparison with the alternative 4. The average savings are 3.37, 6.87 y 6.88 US\$/MWh in maximum demand, mean demand and minimum demand.

International Interconnection's: Colombia – Central America



International Interconnection's: Annual Energy Flow



- ✓ Export added throughout the entire period.
- ✓ The maximum value of exportation is located around 4,350 GWh throughout the 2016. This value represent the 4.5 % of the projected demand for this year.
- ✓ Between 2016 and 2018, the net energy flow decreases, because during this period Ecuador expected build some generation projects.

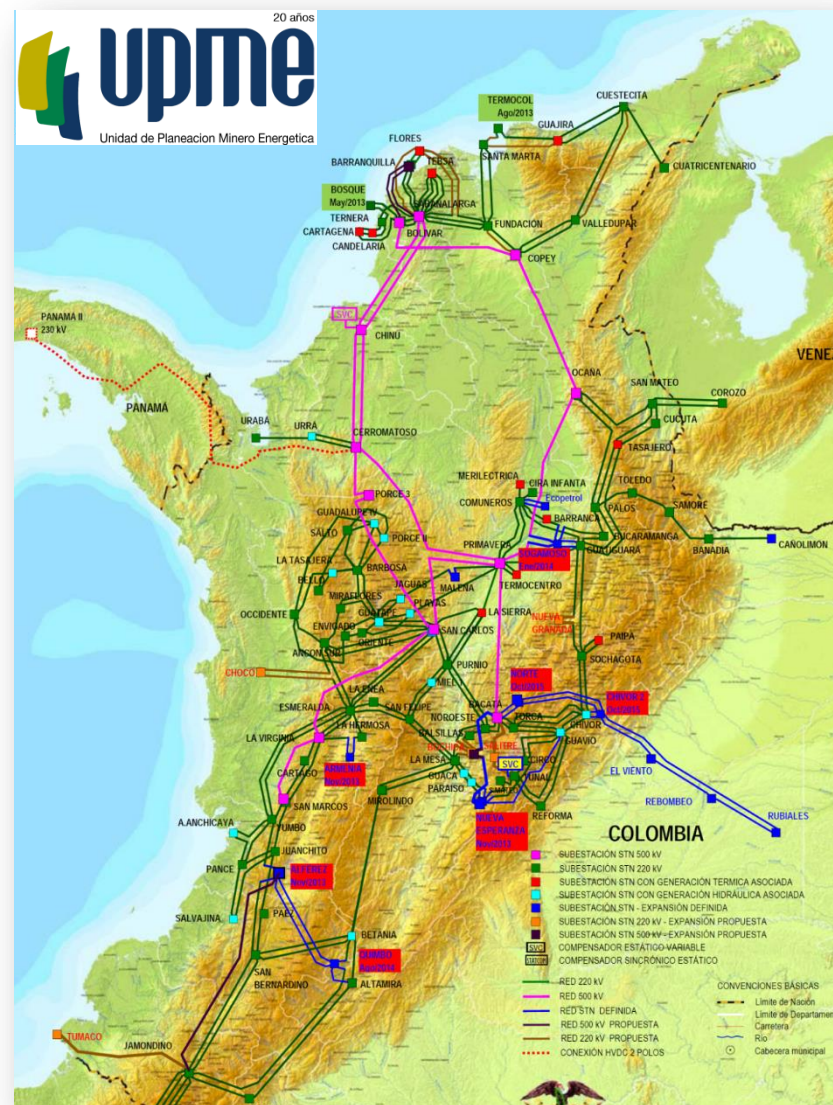
Andean Electrical Integration System (SINEA)

Progress:

- Between 2011 and 2012 agreements were signed between the authorities of Bolivia, Chile, Colombia, Ecuador and Peru, in order to promote the development of the electrical integration of the Andean countries
- Resources were negotiated with the BID for \$1.4 MUS in order to develop Planning and Regulatory studies.
- Two studies were contracted:
 - ✓ Infrastructure Planning
 - ✓ Regulatory Harmonization
- The work is done in 4 phases with 3 deliverables
- Those studies are in the final phase.
- The integration involves high regulatory arrangements and infrastructure investments (500 kV AC and HVDC Technology)

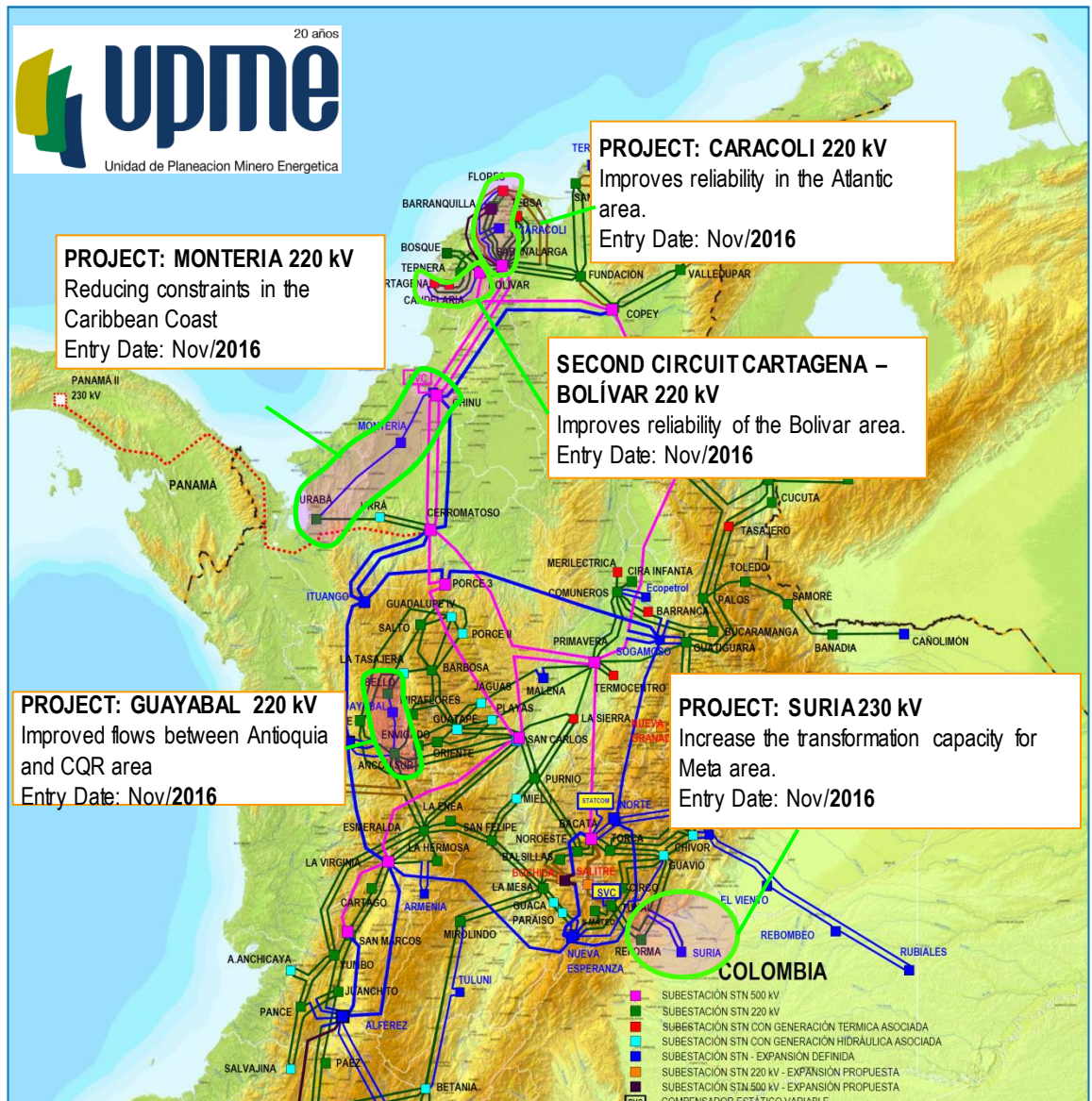
Projects underway

PROJECTS	PUBLIC CALL	TRANSMISSION AGENT	OFFER Millions US\$
NUEVA ESPERANZA 500/230 kV	UPME 01-2008	EPM	\$ 20.23
SOGAMOSO 500/230 kV	UPME 04-2009	ISA	\$ 38.60
ARMENIA 230 kV	UPME 02-2009	EEB	\$ 10.43
ALFEREZ 230 kV	UPME 01-2010	EEB	\$ 6.45
QUIMBO 230 kV	UPME 05-2009	EEB	\$ 89.23
CHIVOR II, NORTE, BACATÁ 230 kV	UPME 03-2010	EEB	\$ 44.84
Total Invest			\$ 209.79



These projects must be in service between 2015 and 2020.

Defined in the expansion plan 2012-2025



These projects must be in service between 2015 and 2020.

Defined in the expansion plan 2013-2027

CARIBBEAN COAST REINFORCEMENT
Reducing constraints in the Caribbean Coast
Entry Date: 30/Sep/2018

2nd TRF COPEY
Reducing constraints GCM
Entry Date: 30/Nov/2015

PROJECT: LA LOMA 500 kV
Connecting new demand and new injection in Cesar area
Entry Date: Nov/2016

PORCE III 500 kV REINFORCEMENT
Elimination of generation constraints
Entry Date: 30/Jun/2018

PROJECT: ITUANGO
Connection of the Ituango hydroelectric plant
Entry Date: 30/Jun/2018

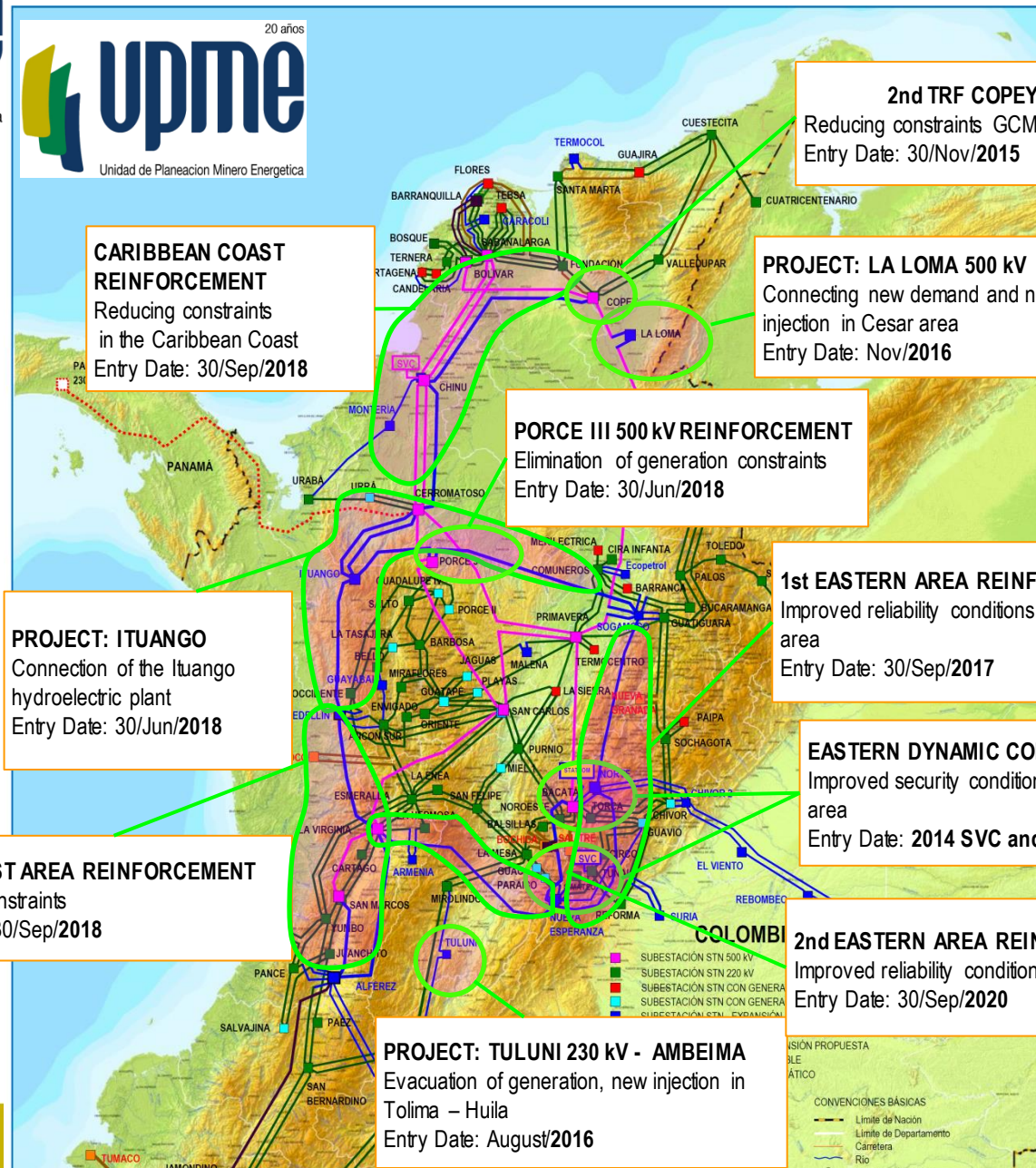
1st EASTERN AREA REINFORCEMENT
Improved reliability conditions in the eastern area
Entry Date: 30/Sep/2017

SOUTHWEST AREA REINFORCEMENT
Reducing constraints
Entry Date: 30/Sep/2018

EASTERN DYNAMIC COMPENSATION
Improved security conditions in the eastern area
Entry Date: 2014 SVC and 2015 STATCOM

PROJECT: TULUNI 230 kV - AMBEIMA
Evacuation of generation, new injection in Tolima – Huila
Entry Date: August/2016

2nd EASTERN AREA REINFORCEMENT
Improved reliability conditions in the eastern area
Entry Date: 30/Sep/2020



Projects Cost – Public Calls

Project	Cost Millions USD \$
Ituango 500 kV	\$ 427,17
Southwest Area Reinforcement 500 kV	\$ 291,69
Caribbean Coast Reinforcement 500 kV	\$ 225,88
1st Eastern Area Reinforcement 500 kV	\$ 186,07
Guayabal 220 kV	\$ 84,65
2nd Eastern Area Reinforcement 500 kV	\$ 84,52
Chinú - Moteria -Uraba 220 kV	\$ 72,82
La Loma 500 kV	\$ 44,42
Tuluni - Ambeima 230 kV	\$ 41,74
Caracoli 220 kV	\$ 38,01
* Rio Cordoba 220 kV	\$ 19,00
Suria 230 kV	\$ 18,31
Porce III 500 kV Reinforcement	\$ 15,57
2nd Circuit Cartagena Bolivar 220 kV	\$ 8,19
* Complementary works Caracoli 220 kV	\$ 5,99
* Reforma 230 kV	\$ 3,90
TOTAL COST OF PROJECTS	\$ 1.564,03

* Projects in definition process

Projects Cost – Expansions

Projects	Execution mechanism	Cost M USD \$
FACTs (SVC - STATCOM)	Expansions	\$ 276,05
Malena 220 kV	Expansions	\$ 8,30
Caño Limon 230 kV	Expansions	\$ 4,06
TOTAL COST OF PROJECTS		\$ 288,40

The “expansions” projects, are constructed by the owner of the assets



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Stages, responsible and responsibilities

STAGES

Stage 1 Planning

Stage 2 Preparation call

Stage 3 Public Call

Stage 4 Project Execution

Responsible and responsibilities

UPME, Generators, Transmitters and Operators

- ✓ Identifying needs and definition of projects
- ✓ Expansion Plan

UPME, Generators and Operators

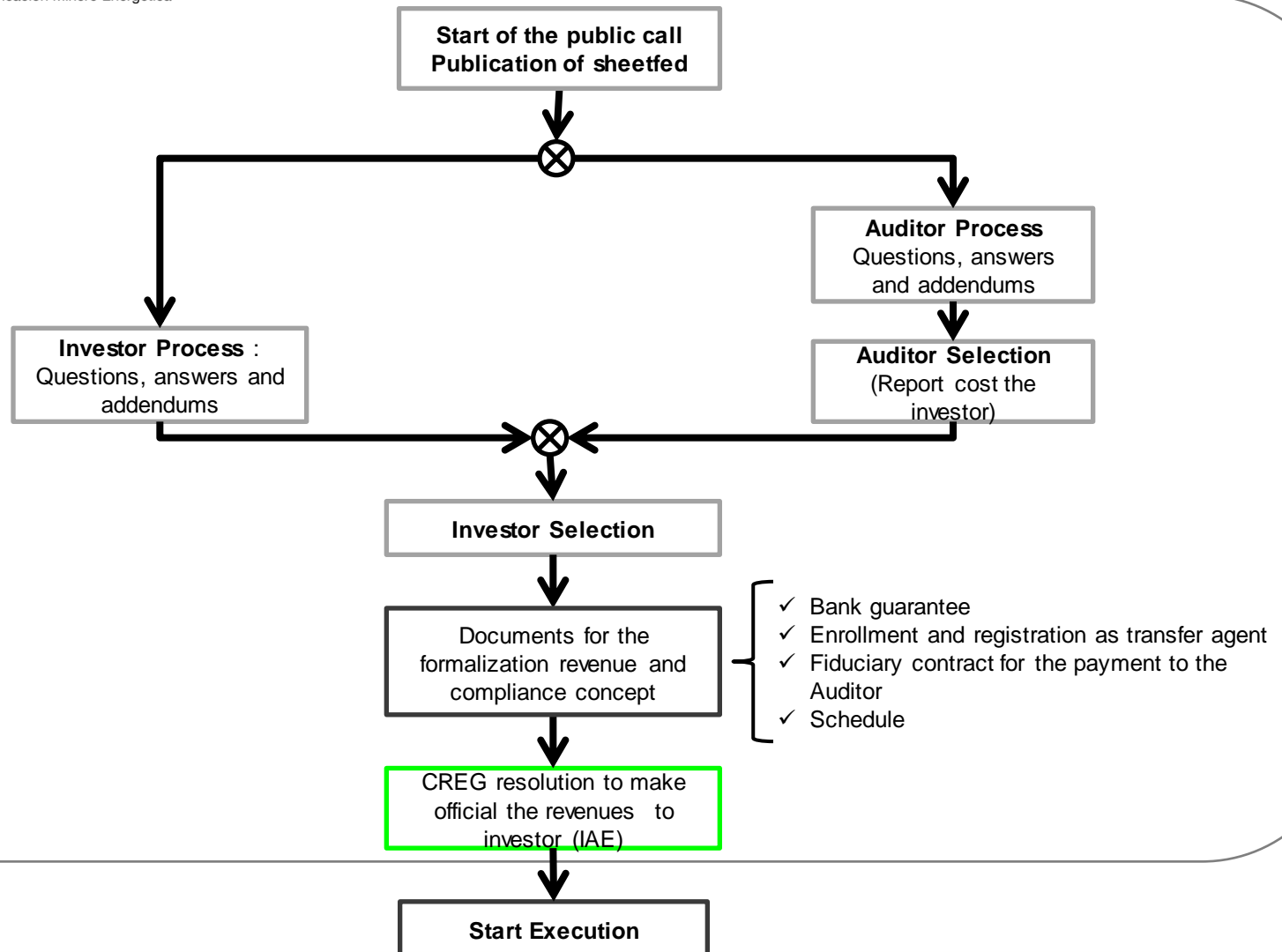
- ✓ Preparation of specifications and technical conditions of the project
- ✓ Identify early warnings

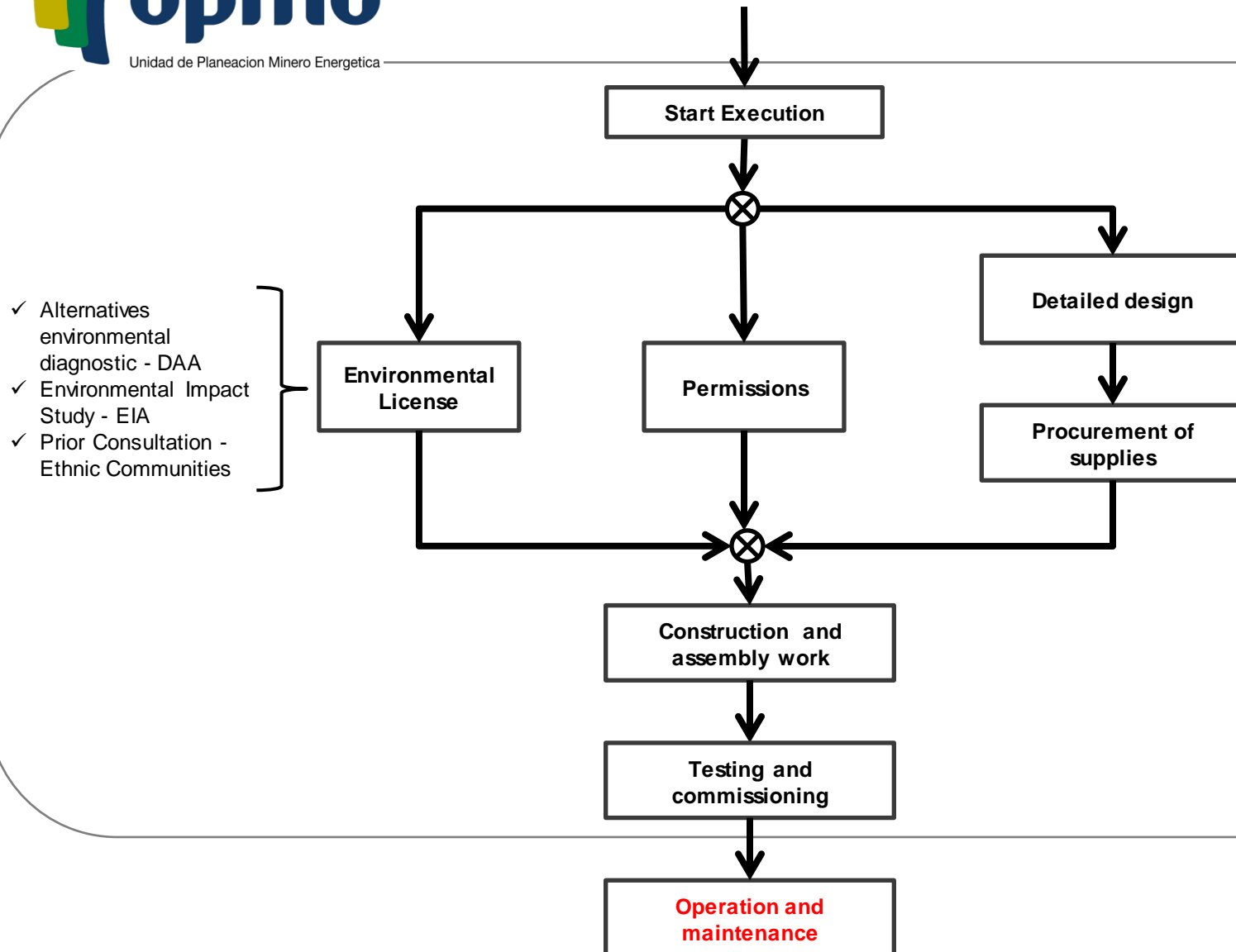
UPME

- ✓ Adjudication to whoever presents the best offer
- ✓ Constitution guarantee and establishment as a transmitter

Investor

- ✓ Designs, supplies, route definition, environmental licensing, socialization, permits, right of way, construction, commissioning, operation and maintenance

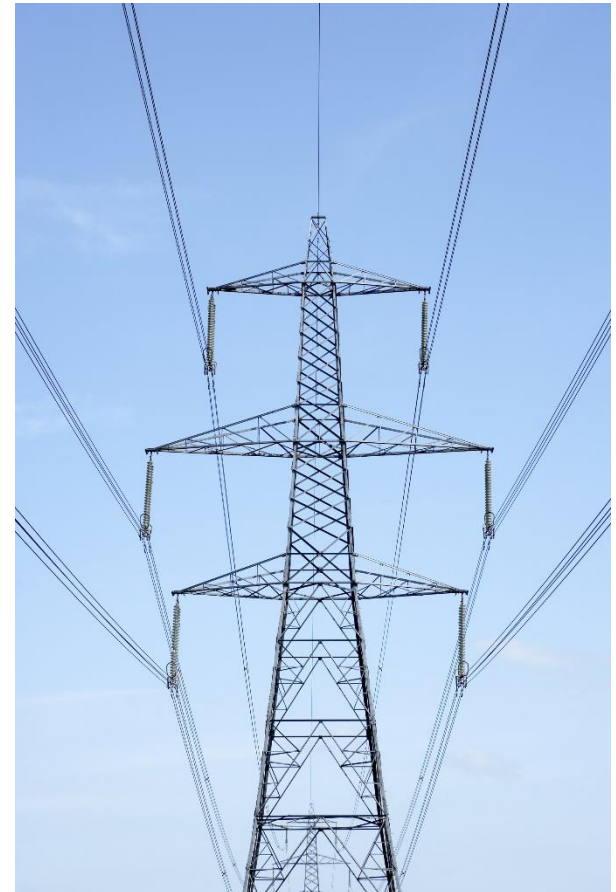




Scheme of the public calls

Explanation

- The investor is responsible for the design, supply, route definition, environmental licenses, socialization, permits, rights of way, construction, commissioning, operation and maintenance. Art. 52 and 85 of the Law 143/1994, Resolution MME (Mining and Energy Ministry) 180924/2003 and Resolution CREG (Energy and Gas Regulatory Commission) 022/2001
- The investor selected is the one with the lowest present value of the revenues expected during the first 25 years of operation of the project, discounted at the rate established by CREG.
- The project will have an auditor or controller selected by UPME, who certifies the compliance of the schedule and technical obligations.
- Along with the offer, it must be presented a commitment to provide a bank guarantee in case of selection as successful bidder. After selection, the bank guarantee is approved by the system operator.



Scheme of the public calls

Explanation

- Successful bidders who are not agents of the Colombian electricity sector yet have to incorporate as transmission agent with the exclusive purpose of performing into the National Transmission activity.
- The selection gives the right to receive the revenue for the offer and obliges the investor to execute the project according to the requirements of selection documents and applicable technical standards. CREG issues a resolution that approves such revenues.
- There is no contract between the investor and the State
- The project cost is transferred to the tariff.
- The transmitter is paid by the Liquidator and Accounts Manager - LAC, that is part of the System Operator. The collection is made through the tariff.
- After the 25 year period the assets can remain into the system and paid according to reposicion costs.





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	PROJECTS	2013				2014												2015												2016												
		s	o	n	d	e	f	m	a	m	j	j	a	s	o	n	d	e	f	m	a	m	j	j	a	s	o	n	d	e	f	m	a	m	j	j	a	s	o	n	d	
1	2nd transformer 500/230 kV in Copey substation					21																																				
2	2nd C Bolívar - Cartagena 220 kV					30																																				
3	Project Tuluní 230 kV					20																																				
4	Project Suria 230 kV					30																																				
5	Project Caracolí 220 k V					30																																				
6	Project Montería 220 kV					30																																				
7	Project Guayabal 220 kV					30																																				
8	Project La Loma 500 kV					30																																				
9	1 st Eastern Area Reinforcement 500 kV								42																																	?
10	Project: Ituango 500 kV Connection of the Ituango hydroelectric plant									49																																?
11	Caribbean Coast Reinforcement 500 kV									49																																?
12	Southw est Area Reinforcement 500 kV									49																																?
13	Río Córdoba 230 kV (*)									28																																

The numbers correspond to project execution time

Blue:

Light orange:

Public Calls – selection

Execution

Project Caracolí 220 kV:

Date of entry: **Nov/2016.**

- Construction of new substation Caracolí 220 kV and related modules, projected near the municipality of Malambo - Atlantic, southeast of the city of Barranquilla.
- Construction of a 220 kV single circuit line with an approximate length of 27 km, from the new substation Caracolí 220 kV to the substation Flores 220 kV.
- Construction of a 220 kV single circuit line with an approximate length of 27 km, from the new substation Caracolí 220 kV to the substation Sabanalarga 500/220 kV.

Project Montería 220 kV:

Date of entry: **Nov/2016.**

- Construction of new substation Montería 220 kV and related modules, located in the city of Montería – Córdoba.
- Construction of a 220 kV single circuit line with an approximate length of 60 km, from the new substation Montería 220 kV to the substation Chinú 500/220 kV.
- Construction of a 220 kV single circuit line with an approximate length of 128 km, from the new substation Montería 220 kV to the substation Urabá 220 kV.
- Installation of 450 MVA of transformation 500/220 kV in the substation Chinú 500/220 kV.

Project Suria 230 kV:

Date of entry: **Nov/2016.**

- Construction of new substation Suria 230 kV and related modules, located near the city of Villavicencio – Meta.
- Construction of a 230 kV double circuit line with an approximate length of 27 km, from the new substation Suria 230 kV to a point on the existing transmission line Guavio - Tunal 230 kV to reconfigure the lines in Guavio - Suria 230 kV and Suria – Tunal 230 kV.

2nd Circuit Bolívar Cartagena 220 kV:

Date of entry: **30/11/2016.**

- Construction of a 220 kV single circuit line with an approximate length of 18 km, from the substation Bolívar 500/220 kV to the substation Cartagena 220 kV. (Includes the related modules)

Project Guayabal 220 kV:

Date of entry: **Nov/2016.**

- Construction of new substation Guayabal 220 kV and related modules, located in the city midtown of Medellín - Antioquía.
- Construction of a 220 kV single circuit line with an approximate length of 16 km, from the new substation Guayabal 220 kV to the substation Bello 220 kV.
- Construction of a 220 kV single circuit line with an approximate length of 12 km, from the new substation Guayabal 220 kV to the substation Ancón Sur 220 kV.

Project Tuluní 230 kV:

Date of entry: **August/2016.**

- Construction of new substation Tuluní 230 kV and related modules, locates in the municipality of Chaparral – Tolima.
- 2nd circuit Betania – Mirolindo 230 kV, with an approximate length of 206 Km.
- Construction of a 230 kV double circuit line with an approximate length of 22 km, from the new substation Tuluní 230 kV to a point on the existing transmission line Betania - Mirolindo 230 kV to reconfigure the lines in Betania - Tuluní 230 kV and Tuluní – Mirolindo 230 kV.

Project La Loma 500 kV:

Date of entry: **30/11/2016.**

- Construction of new substation La Loma 500 kV and related modules, projected near the municipality of El Paso – Cesar.
- Construction of a 500 kV two single circuit line with an approximate length of 10 km, from the new substation La Loma 500 kV to a point on the existing transmission line Copey - Ocaña 500 kV to reconfigure the lines in Copey – La Loma 500 kV and La Loma – Ocaña 500 kV.

Porce III 500 kV Reinforcement:

Date of entry: **30/06/2018.**

- Construction of a 500 kV two single circuit line with an approximate length of 6,25 km, from the substation Porce III 500 kV to a point on the future transmission line Ituango - Sogamoso 500 kV to reconfigure the lines in Ituango – Porce III 500 kV and Porce III – Sogamoso 500 kV.

** The Ituango - Sogamoso 500kV line layout must ensure a distance of 6.25 Km to substation Porce III 500 kV.*

1st Eastern Area Reinforcement :

Date of entry: **30/09/2017.**

- Construction of new substation Norte 500 kV and related modules, located near the municipality of Gachancipa – Cundinamarca.
- Installation of one transformer 500/220 kV with 450 MVA of capacity in the substation Norte 500/230 kV, with an overload capacity of 20%
- Construction of a 500 kV single circuit line with an approximate length of 257 km, from the substation Sogamoso 500 kV to the new substation Norte 500 kV.
- Construction of a 500 kV single circuit line with an approximate length of 87 km, from the substation Nueva Esperanza 500 kV to the new substation Norte 500 kV.

2nd Eastern Area Reinforcement:

Date of entry: **30/09/2020.**

- Construction of a 500 kV single circuit line with an approximate length of 190 km, from the substation La Virginia 500 kV to the substation Nueva Esperanza 500 kV. (Includes the related modules)

Caribbean Coast Reinforcement:

Date of entry: **30/09/2018.**

- Construction of a 500 kV single circuit line with an approximate length of 131 km, from the substation Cerromatoso 500 kV to the substation Chinú 500 kV.
- Construction of a 500 kV single circuit line with an approximate length of 200 km, from the substation Chinú 500 kV to the substation Copey 500 kV.
- Installation of 450 MVA of transformation 500/220 kV in the substation Copey 500/220 kV.

Southwest Area Reinforcement:

Date of entry: **30/09/2018.**

- Construction of new substation Alférez 500 kV and related modules, located near the city of Cali – Valle del Cauca.
- Installation of two transformers 500/220 kV each with 450 MVA of capacity in the substation Alférez 500/230 kV, each with an overload capacity of 20%
- Construction of a 500 kV single circuit line with an approximate length of 158 km, from the New substation Medellín 500 kV to the substation La Virginia 500 kV.
- Construction of a 500 kV single circuit line with an approximate length of 183 km, from the substation La Virginia 500 kV to the substation Alférez 500 kV.
- Construction of a 500 kV single circuit line with an approximate length of 35 km, from the substation San Marcos 500 kV to the substation Alférez 500 kV.
- Construction of a 230 kV double circuit line with an approximate length of 2 km, from the substation Alférez 230 kV to a point on the existing transmission line Juanchito - Pance 230 kV to reconfigure the lines in Juanchito – Alférez 230 kV and Alférez – Pance 230 kV.

Project Ituango (Connection of the Ituango hydroelectric plant): Date of entry: **30/06/2018**.

- Construction of new substation Ituango 500 kV and related modules, located near to the generation plant hidroituango located in Antioquía.
- Construction of new substation Medellín 500 kV and related modules, located near the city of Medellín - Antioquía.
- Installation of two transformers 500/220 kV each with 450 MVA of capacity in the substation Medellín 500/230 kV, each with an overload capacity of 20%
- Construction of a 500 kV two single circuit line with an approximate length of 110 km each, from the new substation Ituango 500 kV to the substation Cerromatoso 500 kV.
- Construction of a 500 kV single circuit line with an approximate length of 260 km, from the new substation Ituango 500 kV to the substation Sogamoso 500 kV.
- Construction of a 500 kV single circuit line with an approximate length of 260 km, from the new substation Ituango 500 kV to the new substation Medellín 500 kV.
- Construction of a 230 kV double circuit line with an approximate length of 10 km, from the new substation Medellín 230 kV to a point on the existing transmission line Occidente - Ancón 230 kV to reconfigure the lines in Occidente – Medellín 230 kV and Medellín – Ancón 230 kV.
- Construction of a 230 kV single circuit line with an approximate length of 10 km, from the new substation Medellín 220 kV to the substation Ancón 230 kV.

More Information : <http://www1.upme.gov.co/>

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THANKS



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