

Colombian Electricity Market



MINCOMERCIO
INDUSTRIA Y TURISMO



PROCOLOMBIA
EXPORTACIONES TURISMO INVERSIÓN MARCA PAÍS

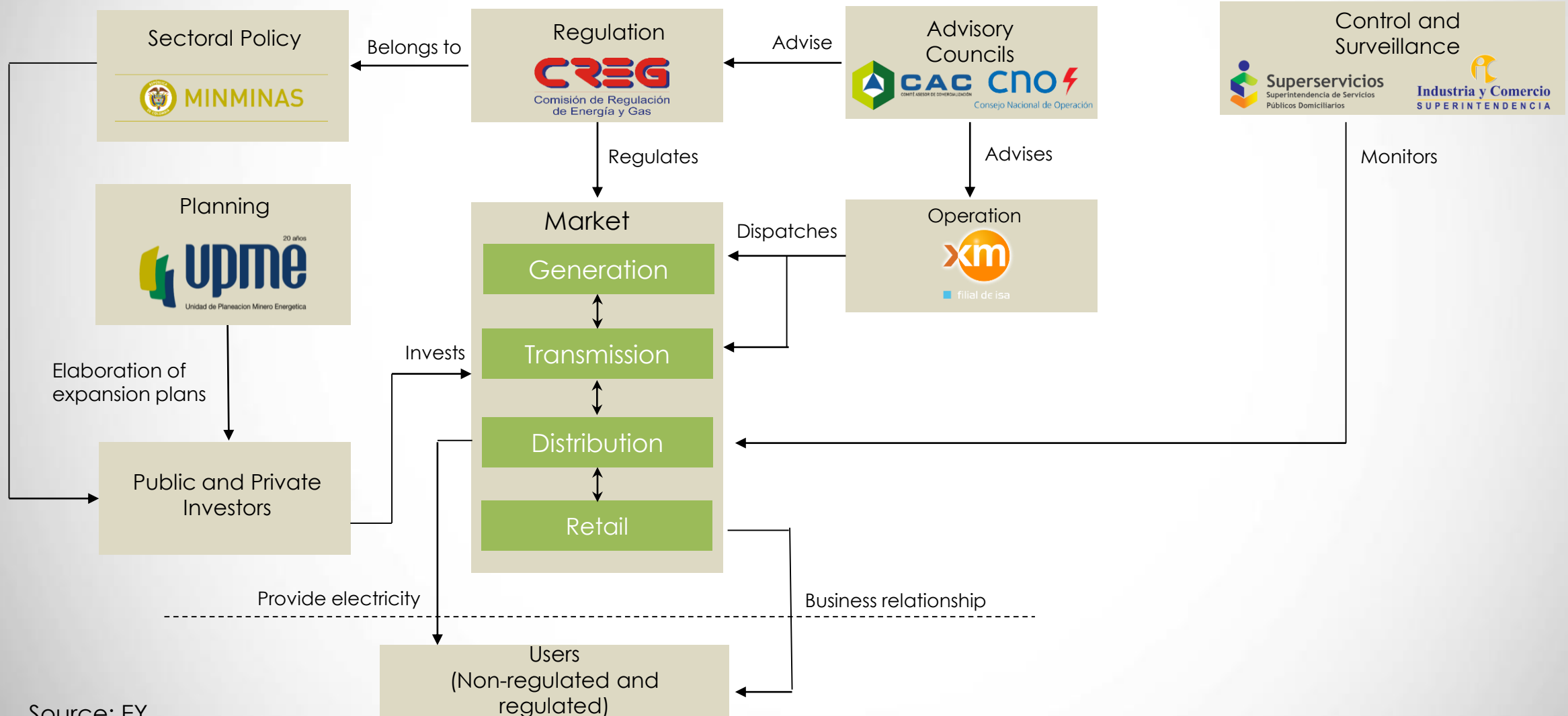


TODOS POR UN
NUEVO PAÍS
PAZ EQUIDAD EDUCACIÓN



1. Description of the Colombian Electricity System
2. Generation
3. Transmission
4. Sales and Distribution
5. Energy Demand
6. Investment Opportunities

Institutional Structure



Electricity Sector Value Chain



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Generation

Electric power generation in plants connected to the National Electric Grid (SIN, for the Spanish original) through hydroelectric, thermal and wind power generation, among others.

Generally, the power obtained has a voltage of 3 kV to 20 kV.

Subsequently, these levels are transformed, increasing their voltage level to 220 kV and 500 kV.

Market competition regulated by the CREG and managed and operated by XM.

Transmission

Operation and transportation of electric power throughout the National Transmission System (STN, for the Spanish original) through a network of high-voltage cables (equal to or higher than 220 kV), which are connected through substations to permit their distribution.

Transmitters are obliged to allow other agents to access their networks according to the regulation of the Energy and Mining Planning Unit (UPME, for the Spanish original).

These activities are regulated by the CREG.

Distribution

Distributors receive the transmitted energy and distribute it to the end users through the Regional Transmission Systems (STRs, for the Spanish original) and/or Local Distribution Systems (SDLs, for the Spanish original).

Distributors are responsible for the expansion of their networks and coverage. They must permit free access to the other market agents.

Definition of quality criteria in service provision.

The distribution process involves transformation to voltages of 110 kV and 220 kV.

Sales

Resellers are responsible for the purchase of electricity on the wholesale market and its sale to end users.

Market Agents



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Activity	Registered	In Transaction
Generation	68	57
Domestic transmission	15	12*
Distribution	32	31
Sales	104	71
Limits of regulated users	9,554	
Limits of non-regulated users	5,373	
Limits of public lighting	346	

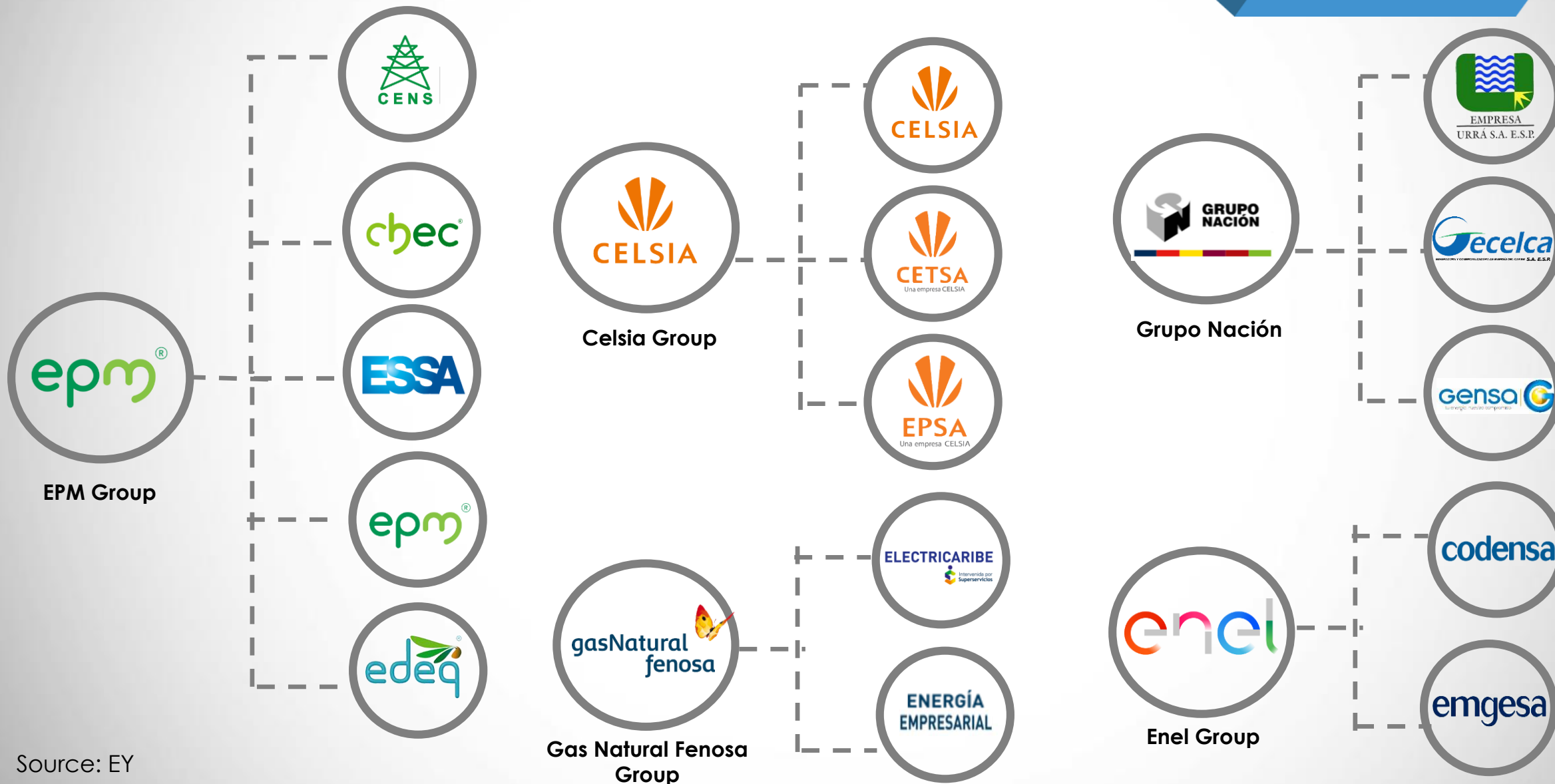
Total agents: 219

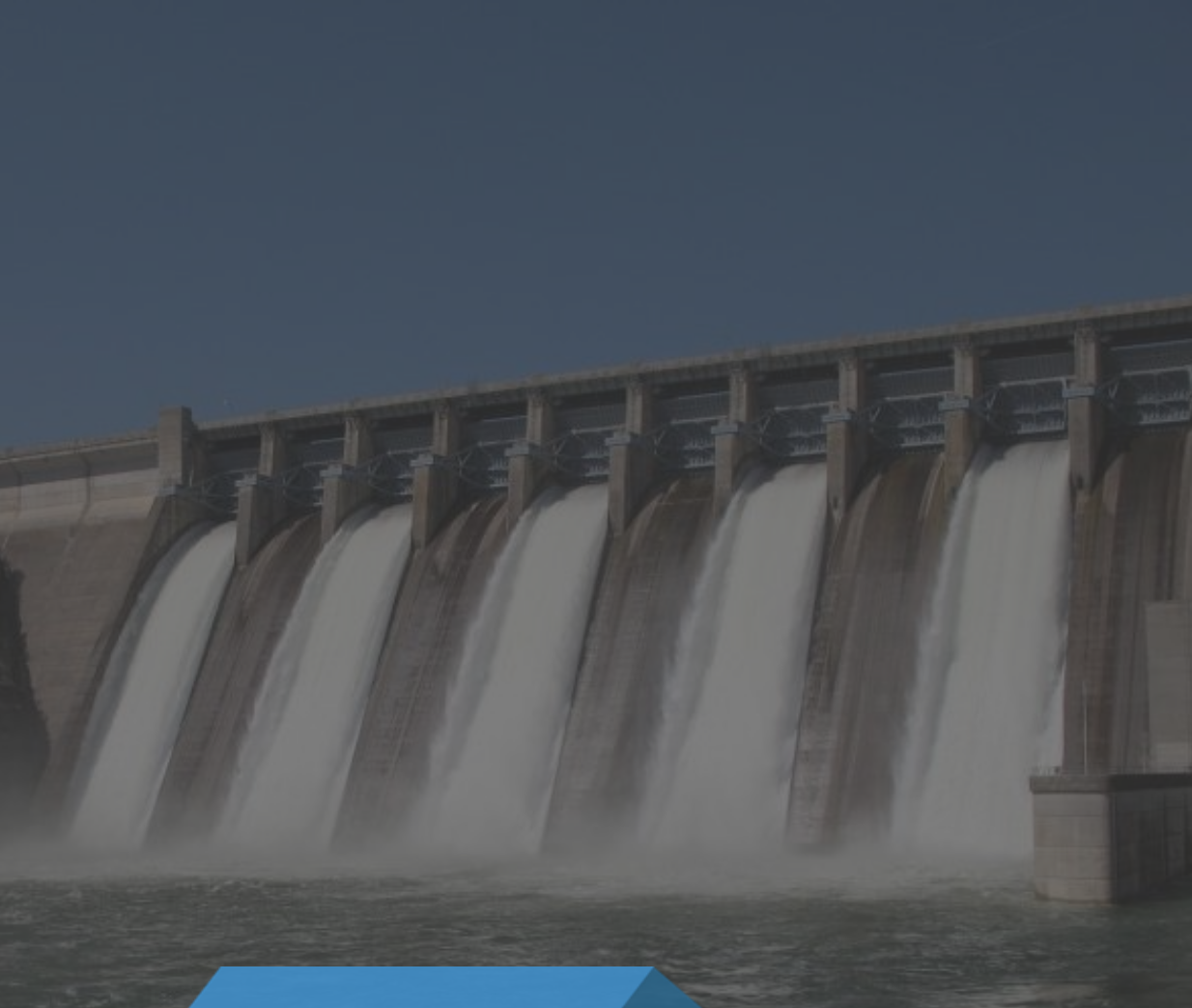
* Agents to which charges are calculated for use of the National Transmission System (STN), Regional Transmission System (STR) and Areas of Distribution (ADD, for the Spanish original).

Main Companies



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND





PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Generation

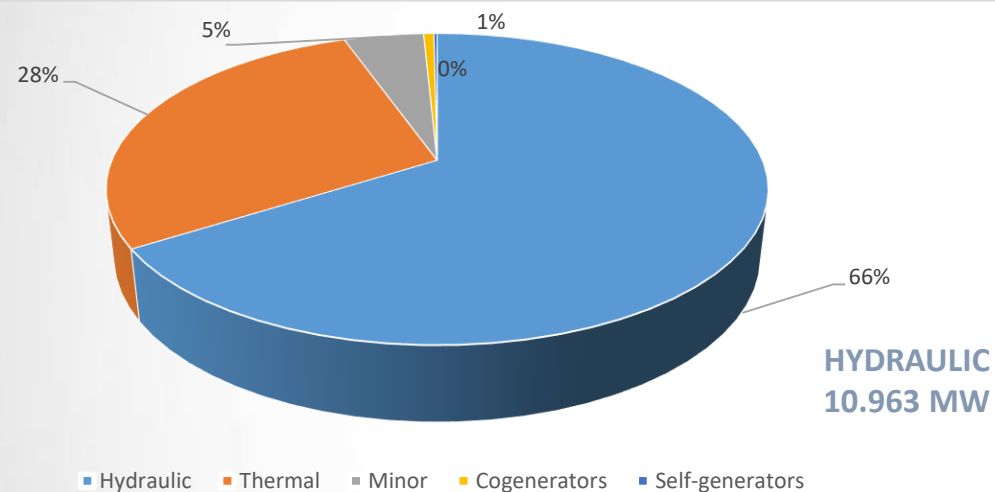


Generation of the National Electric Grid - 2016

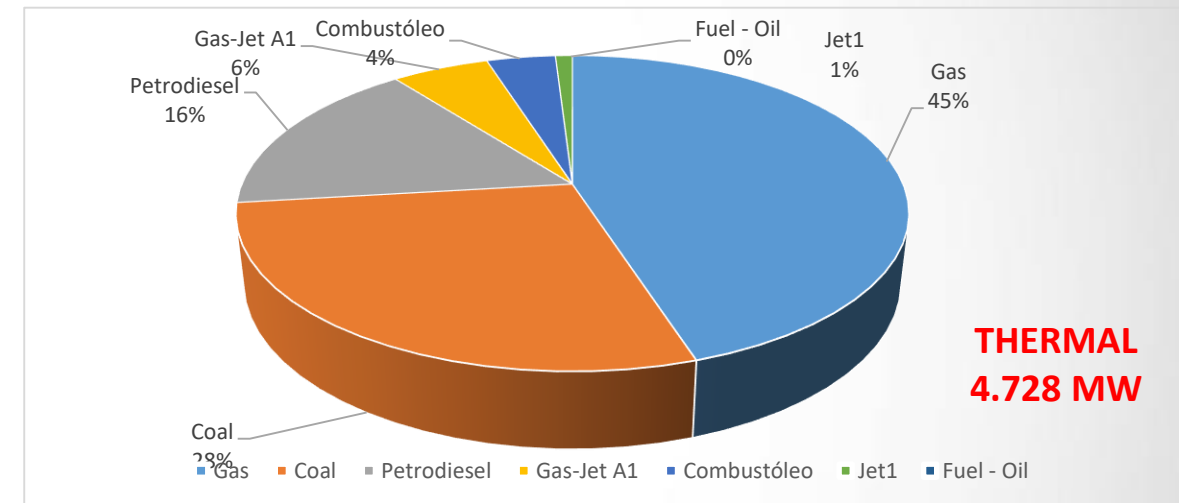


PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Effective Capacity of the National Electric Grid - 2016



Thermal Power Generation - 2016



- The installed capacity of power generation facilities in 2016 was 16,594.52 MW, 10,963 MW (66.1%) of which accounted for hydroelectric power generation, followed by 4,728 MW of thermal generation -2,128 MW generated with natural gas (12%), 1,271 MW with liquid fuel (16%) and 1,329 MW with coal power plants (8%).
- With respect to unconventional sources of energy, Colombia has a wind power farm in the department of La Guajira, which provides 0.11% of the installed capacity. Additionally, biomass plants are located in the department of Valle del Cauca on sugarcane crops.
- Colombia's installed capacity is mainly located in the center of the country, where the hydroelectric power plants and some thermal power plants are located.

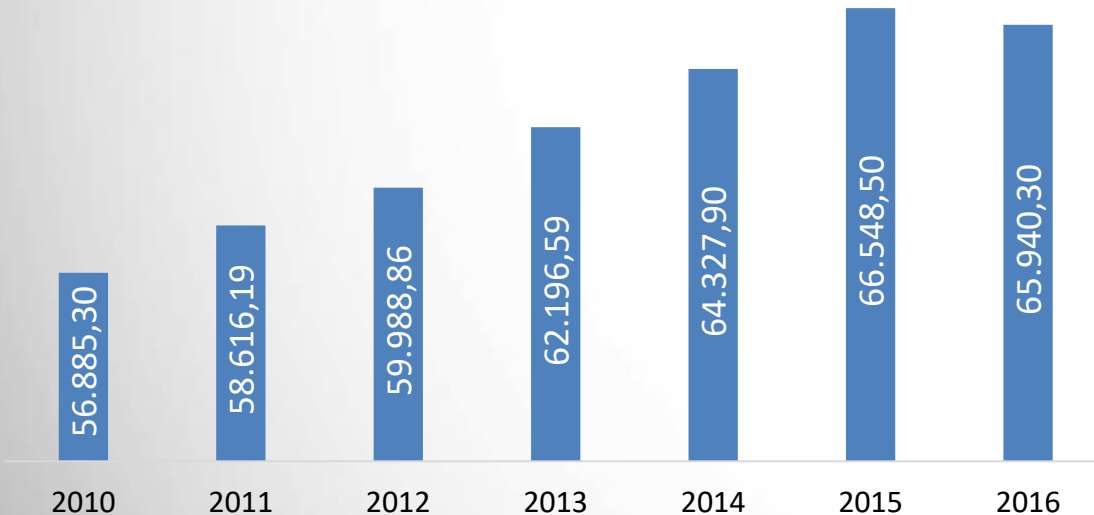
Generation and Demand of the National Electric Grid - 2016



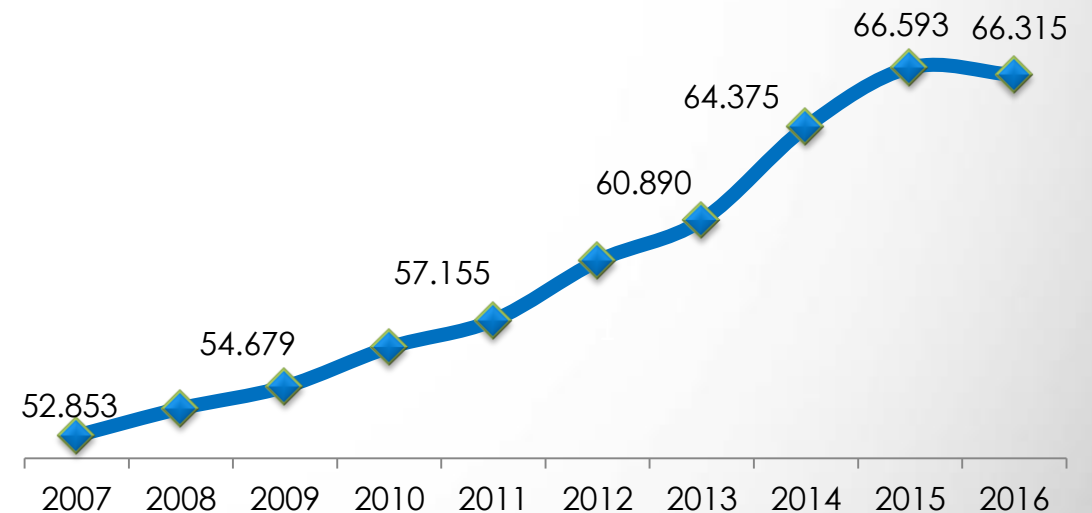
PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

- The demand has grown 26% over the last 8 years. In 2016, the electricity demand decreased 0.2% from 2015. In the first months, as a result of the El Niño phenomenon, the demand increased because of the high temperatures. However, from March, the demand decreased with the “**Apagar Paga**” (**Switching off Pays**) campaign.
- Generation has grown 17% over the last 5 years. The performance of power generation during 2016 was affected by the low water availability and decreased 0.9% from 2015.

Total National Electric Power Generation (GWH)



Total National Electricity Demand (GWH)



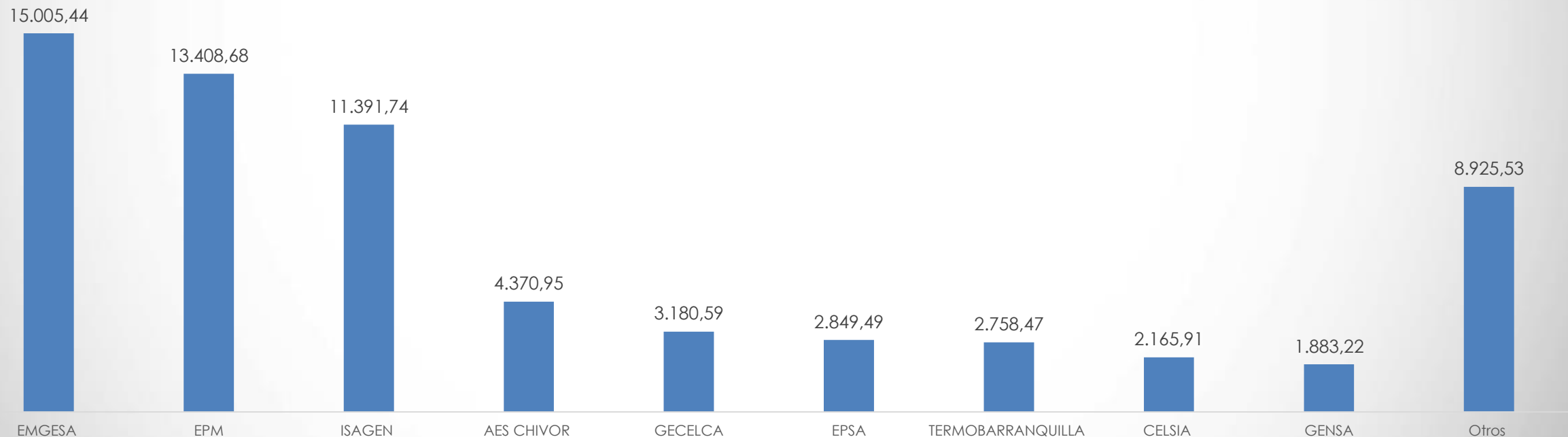
Main Power Generation Companies in Colombia



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Nine power generation companies produce more than 86% of the country's energy.

- EMGESA leads with 15,005.44 GWh in 2016, which represents 22.76%.
- EPM comes in second place with a generation of 13,408.68 GWh in 2016, which represents 20.33%.
- ISAGEN follows with 11,391.74 GWh, representing a 17.28% share in the same year.



Main Hydroelectric Power Plants in Colombia



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

NAME	CAPACITY	LOCATION	AGENT
SAN CARLOS HYDROELECTRIC POWER PLANT	Capacity 1,240 MW	ANTIOQUIA	ISAGEN ENERGÍA PRODUCTIVA
GUATAPE HYDROELECTRIC POWER PLANT	Capacity 560 MW Annual generation 2,730 GWh		epm®
PORCE III	Capacity 660 MW Annual generation 4,254 GWh		
SOGAMOSO HYDROELECTRIC POWER PLANT	Capacity 820 MW Annual generation 5,056 GWh	SANTANDER	ISAGEN ENERGÍA PRODUCTIVA
CHIVOR HYDROELECTRIC POWER PLANT	Capacity 1,000 MW Annual generation 4,110 GWh	BOYACA	AES Chivor somos la energía
EL GUAVIO HYDROELECTRIC POWER PLANT	Capacity 1,222 MW	CUNDINAMARCA	emgesa

Total effective capacity (2016): 16,594 MW
Hydroelectric effective capacity: 10,963 MW



Hydroelectric Power Plants – Projects under Construction





PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Total effective capacity (2016): 16,594 MW
Hydroelectric effective capacity: 10,963 MW






PROJECT	CAPACITY	LOCATION	AGENT
ITUANGO HYDROELECTRIC POWER PLANT Start-up date: December 2018	1,200 MW	ANTIOQUIA	


PROJECT	CAPACITY	LOCATION	AGENT
PORVENIR II	352 MW	ANTIOQUIA	





Thermal Power Plants in Colombia – Effective Capacity



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

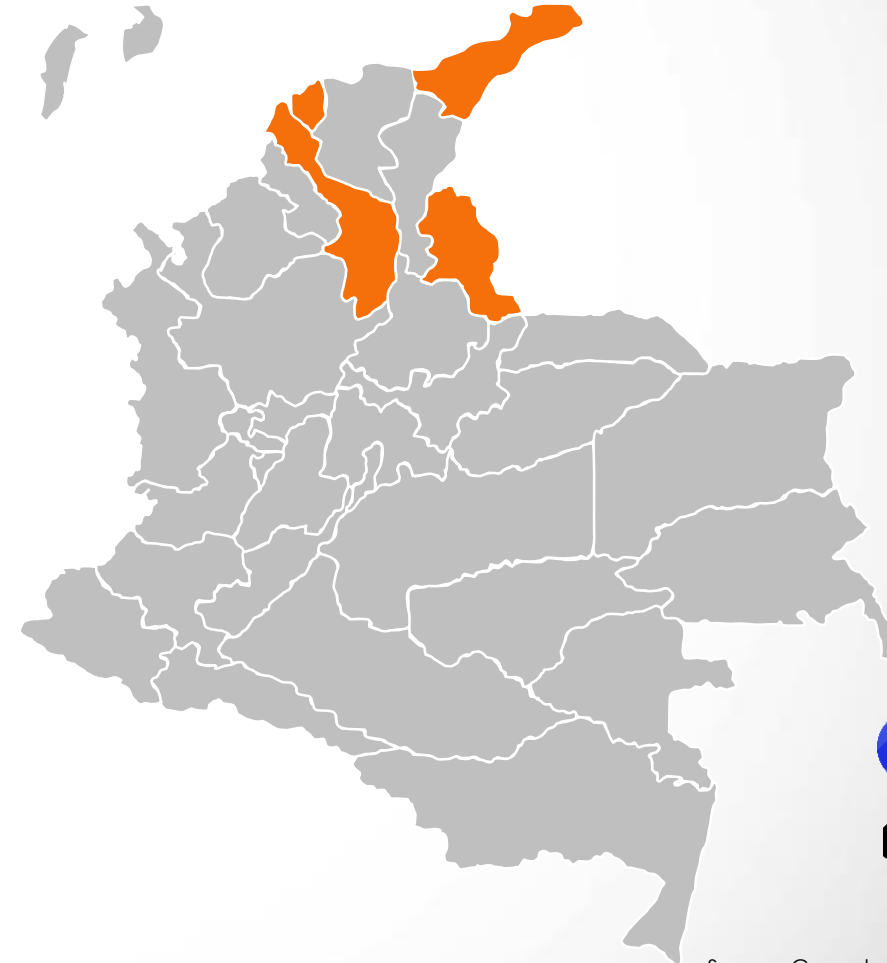
RESOURCE	GUAJIRA		AGENT
 	TERMOGUAJIRA I	143 MW	
	TERMOGUAJIRA II	143 MW	

ATLANTICO			
RESOURCE	TERMOFLORES		AGENT
 	FLORES I	160 MW	
	FLORES IV	450 MW	
RESOURCE	TERMOBARRANQUILLA		AGENT
		791 MW	

RESOURCE	BOLIVAR		AGENT
	TERMOCANDELARIA I	157 MW	
	TERMOCANDELARIA II	157 MW	
RESOURCE	NORTE DE SANTANDER		AGENT
	TASAJERO 1	163 MW	
	TASAJERO 2	163 MW	



Total effective capacity (2016): 16.594 MW
Thermal effective capacity: 4,728 MW





 Natural gas
 Coal







Main Thermal Power Plants in Colombia – Effective Capacity



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

RESOURCE	SANTANDER		AGENT
	MERIELECTRICA 1	166 MW	

RESOURCE	BOYACA - TERMOPAIPA		AGENT
	PAIPA 1	31 MW	
	PAIPA 2	72 MW	
	PAIPA 3	70 MW	
	PAIPA 4	154 MW	

RESOURCE	ANTIOQUIA		AGENT
	TERMOSIERRA B	364 MW	
	TERMOCENTRO 1	264 MW	
	GECELCA 3	164 MW	

RESOURCE	VALLE DEL CAUCA		AGENT
 	TERMOEMCALI	213 MW	



Total effective capacity (2016): 16.594 MW
Thermal effective capacity: 4,728 MW





Source: Cocentra. Effective Capacity - April 2017
<https://www.cocentra.co/productos/mapas/plantas-termoelectricas-en-colombia>

Thermal Power Plants – Projects under Construction



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

RESOURCE		ANTIOQUIA		STATUS
		TERMOSINFANA	350 MW	2

RESOURCE		SANTANDER		STATUS
		TERMOBERRIO	700 MW	2


RESOURCE		NORTE DE SANTANDER		STATUS
		TERMOTASAJERO III	180 MW	2




Non-Conventional Sources of Renewable Energy



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

 **Wind power:** The regions with wind power potential are: La Guajira, San Andres, Boyaca and central areas of the Caribbean Coast.

 **Solar power:** It is possible to generate solar power on a large scale in the departments of Magdalena, La Guajira, San Andres and Providencia.

Law 1715/2014 establishes the incorporation of non-conventional renewable energy into the national electricity system.

It promotes the development and use of non-conventional sources of energy (especially those from renewable sources) in the national electricity system.

It establishes the legal framework and the instruments for the use of non-conventional sources of energy, especially those from renewable sources.



Jepirachi Wind Farm
19.5 MW
La Guajira



Minor Resources, Cogeneration and Self-Generation



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Minor Resources

- Plants with an effective capacity of less than 20 MW.
- In 2016, these accounted for 4.6% of the country's power generation matrix.

Cogeneration:

- Process that involves the combined production of electricity and thermal power that is part of the production process and which does not have the generation of electricity as its main activity. It is for both own consumption and use by third parties, and it is used in industrial or sales processes.
- In 2016, cogeneration accounted for 0.6% of total generation.

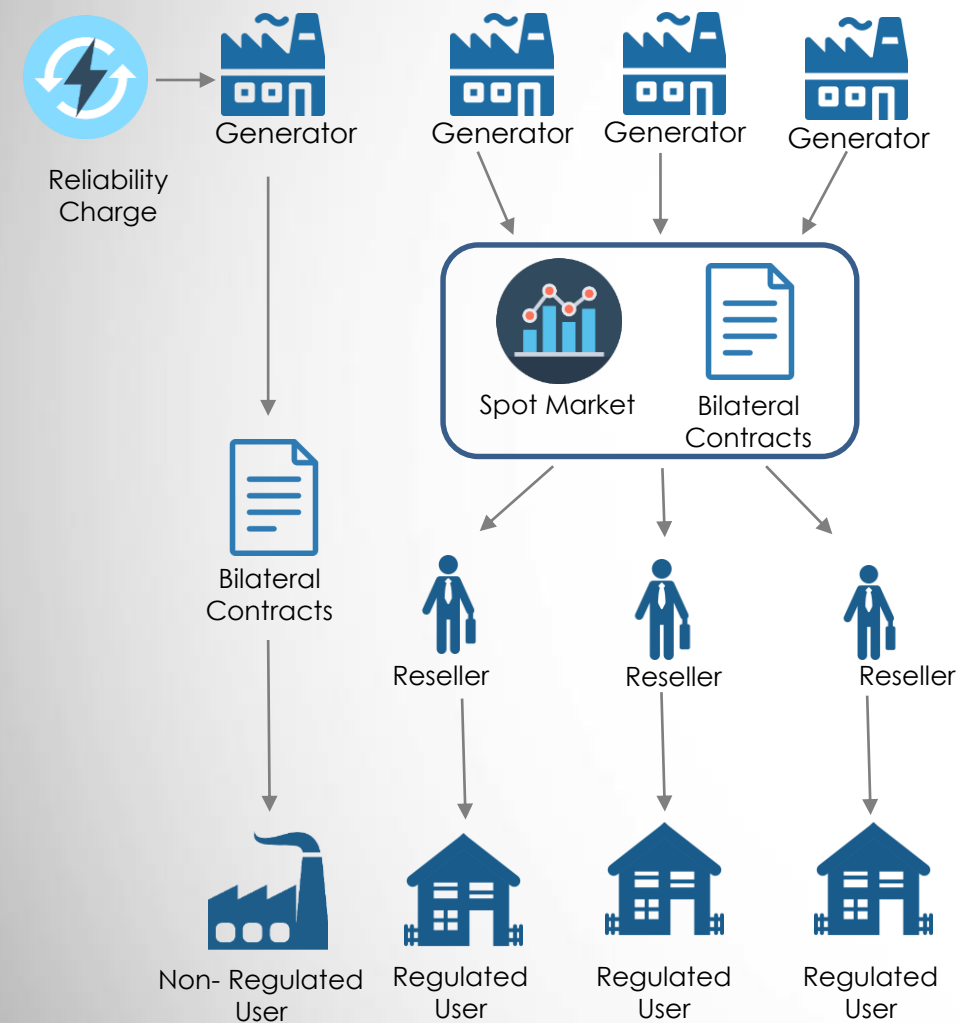
Self-Generation:

- Generation by individuals and/or companies to respond to their own needs. Surpluses from this activity may be delivered to the grid under the terms established by the Commission for the Regulation of Energy and Gas (CREG. for the Spanish original).
- On a small scale with a 1 MW power limit, and it must be in accordance with the installed capacity of the self-generator.
- In the total generation of the National Electric Grid, self-generators accounted for 0.2% of the total generation in 2016.

Wholesale Energy Market Transactions



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Source: EY

Wholesale Energy Market (WEM) Transactions



Spot Market

- Power generation companies bid prices and declare availability of their energy through a daily auction.
- Centrally dispatched plants: All power plants with an effective capacity greater than 20 MW.



Bilateral Contracts

- Used in the financial market.
- Commitments acquired by electric power generation companies and resellers to buy and sell electricity at prices, in amounts and under contractual conditions freely arranged between the parties.



Reliability Charge

- Mechanism for increasing the generation capacity.
- It pays a stable amount to the power generation company.
- Commitment to generate power in times of scarcity.

Type of Users

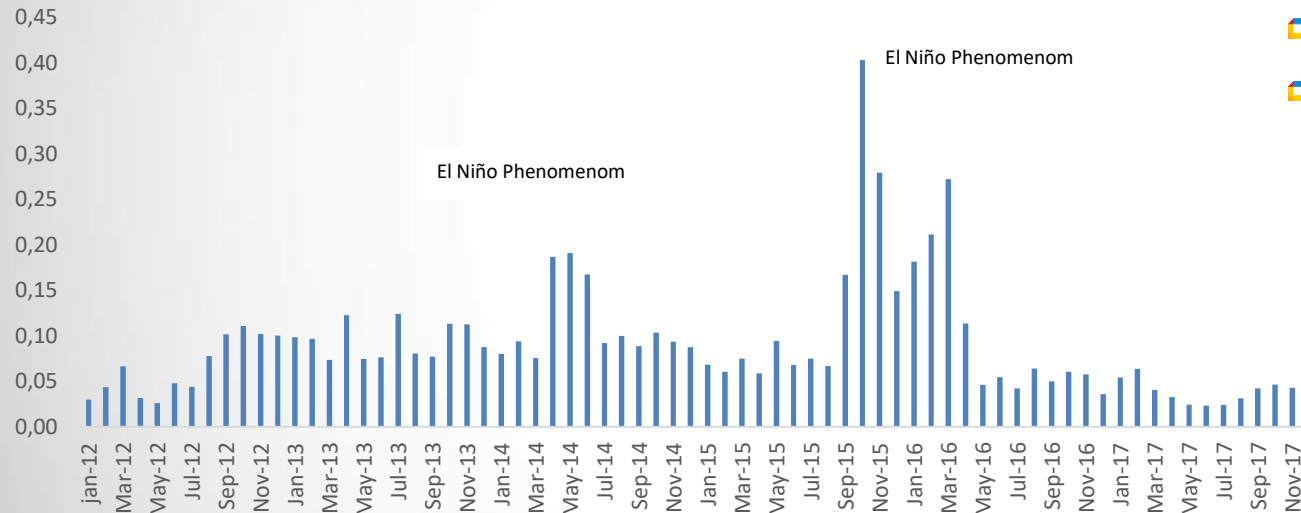
Non-regulated Users	Regulated Users
<ul style="list-style-type: none"> Energy demand greater than 100 kW or consumption of 55 MWh/month. They can freely negotiate part of the supply rate with the reseller. 	<ul style="list-style-type: none"> They pay a regulated rate. Covers industrial, commercial and residential users.



Record of National Spot Market Prices



Historical Spot Prices in Colombia (2012-2017) (US\$ cents / Kwh)



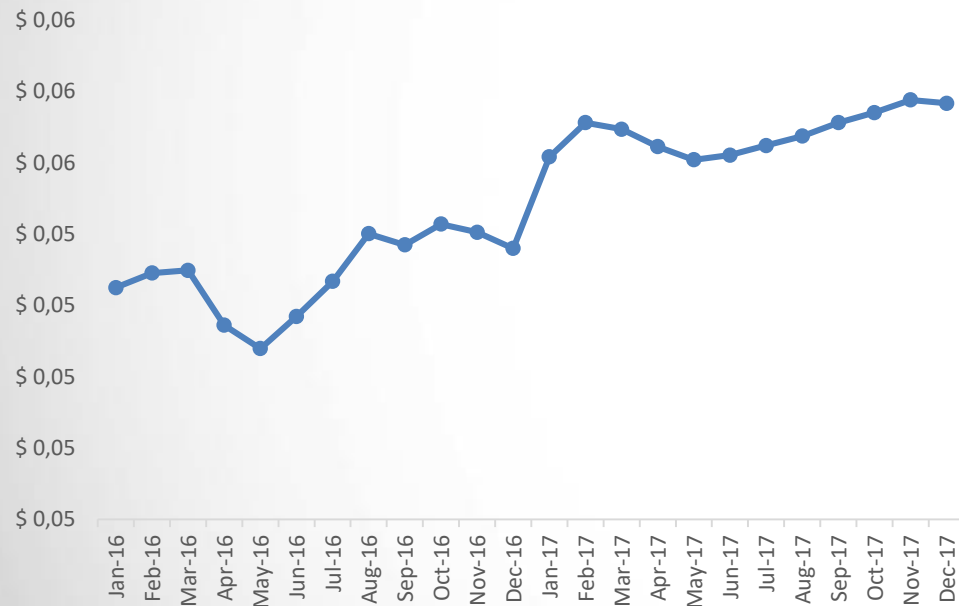
- Energy spot market prices have increased over the last five years
- Main factors that affect the price:
 - Weather conditions – El Niño phenomenon
 - Low water availability
 - Occurs every four years
 - Expectations beyond actual conditions
 - Changes in the supply curve – more generation using liquid fuels and less generation using natural gas
 - Availability of fuel and prices (especially natural gas)
 - Constant increase in the demand over the years

Record of Bilateral Contract Prices



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

**Record of Bilateral Contract Prices US\$
Cents/KWH**



- Contracts are negotiated between generation companies and resellers/users.
 - On the over the counter (OTC) market, the sales conditions (amount and price) are freely agreed between the parties.
 - Contracts for regulated uses are made through a public auction process.
 - Contracts for non-regulated users are made directly or by auction.
- There are two kinds of contract:
 - Pay on demand - PD
 - Pay by contract – PC

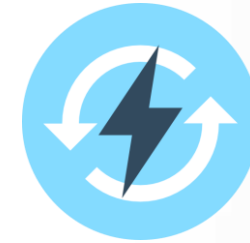
Reliability Charge



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

- One of the essential components of the new system is the existence of firm energy obligations (OEFs, for the Spanish original), which are the result of a commitment by the generation companies backed by generation assets capable of producing firm energy during critical supply conditions. This new system ensures guaranteed reliability of the energy supply in the long term at efficient prices.
- For these purposes, the OEFs required to cover the system's demand are auctioned between the generation companies.
- The generation company to which an OEF is assigned, receives a known, stable remuneration during an established term and commits to deliver a certain amount of electricity when the spot market price exceeds a threshold previously established by the CREG, called the scarcity price.

- Said remuneration is calculated and collected by the Commercial Exchange System Administrator (ASIC, for the Spanish original) and paid by users of the National Electric Grid at the rates charged by the resellers.



- Two auctions have been held.

2008 USD 13.998/MWh
2011 USD 15.7/MWh

Market Variables



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Variable	2015	2016	Variation	Growth
TRANSACTIONS				
Energy traded on the spot market (GWh)	16,905	20,143	3,237	19.15%
Energy traded in contracts (GWh)	71,564	65,715	-5,849	-8.17%
Total energy traded (GWh)	88,469	85,858	-2,611	-2.95%
Deviations (GWh)	199.09	149.1	-50	-25.12%
Percentage of the energy demand traded on the spot market (%)	25.56%	30.45%	0.05	19.12%
Percentage of the energy demand traded in contracts (%)	108.22%	99.35%	-0.09	-8.19%
Value traded on the Colombian spot market (millions of COP)	3,909,029	4,108,954	199,925	5.11%
Value traded in contracts (millions of COP)	10,263,593	10,256,458	-7.134	-0.07%
Arithmetic mean Colombian spot market price (COP/kWh)	378.19	299.81	-78	-20.73%
Weighted average Colombian spot market price (COP/kWh)	378.31	305.19	-73	-19.33%
Weighted average contract price (COP/kWh)	143.42	156.07	13	8.82%

Increase in Generation



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

- The increase in generation through the reliability charge allows the development of new projects in the country so that in the future, it is possible to ensure the energy reliability of the National Electric Grid. No generation projects with firm energy obligations started operations in 2016.
- However, 152.35 MW from minor power plants (hydroelectric, thermal and biogas), cogeneration, and self-generation projects started operations.
- Most of these projects started operations during the El Niño phenomenon, which contributed to the response to demand.

Power Generation Projects that Started Operations in 2016			
Item	Type of Project	Project	[MW]
1	Minor power plant (hydroelectric)	Magallo 5.7 MW	5.7
2		Coello Small Hydroelectric Power Plant (SHPP) 3 (1.2 MW)	3.6
3		Morro Azul SHPP (19.9 MW)	19.9
4		Tunjita SHPP (19.7 MW)	19.7
5		El Cocuyo SHPP (0.7 MW)	0.7
6		La Frisolera SHPP (0.5 MW)	0.5
7		Guavio SHPP (9.9 MW)	9.9
8		Porce III SHPP	1.8

Power Generation Projects that Started Operations in 2016			
Item	Type of Project	Project	[MW]
9	Minor power plant (thermal)	Termobarranca 1 Power Plant (12 MW)	12
10		Termobarranca 3 Power Plant (24 MW)	24
11		Termobolivar (9.7 MW)	9.7
12	Minor power plant (thermal and biogas)	Tequendama (SHPP)	2.25
13		Doña Juana Biogas Power Plant (1.7 MW)	1.7

Increase in Generation



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Power Generation Projects that Started Operations in 2016			
Item	Type of Project	Project	[MW]
14	Cogeneration	Risaralda Cogeneration Plant (5 MW)	5
15		Manuelita Cogeneration Plant (3.5 MW)	3.5
16	Self-Generation	Reficar Self-Generator (9.9 MW)	9.9
17		Yaguarito Self-Generator (1.6 MW) Connected to SDL of EMSA	1.6
18		Argos Yumbo Self Generator (9.9 MW)	9.9
19		Unibol Self-Generator (1.1 MW)	1.1
20		Argos Cartagena Self Generator (9.9 MW)	9.9

- As at March 2016, a new type of power generation was incorporated into the National Electric Grid called self-generation. This was incorporated thanks to the process of making requirements more flexible by CREG Resolution 026/2016.
- Additionally, under **Decree 348 / March 1, 2017**, the obligation for self-generators with an installed capacity of less than 100 kV to sign network backup contracts was removed. These self-generators include residential, commercial and small industry users that generate their own electricity with technology including solar panels.

International Energy Exchanges



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

International Exchanges				
Variable	2015	2016	Variation	Growth
Exports to Ecuador (GWh)	457.2	43.9	-413.3	-90.4%
Imports from Ecuador (GWh)	45.2	378.3	333.1	737.0%
Exports to Venezuela (GWh)	3.4	0.8	-2.6	-75.1%

- In 2016, energy exchanges were carried out with Ecuador and Venezuela, exporting a total of 43.9 GWh to Ecuador, less than the amount recorded in 2015 (457.2 GWh), and 0.86 GWh to Venezuela.
- Colombia imported 378.27 GWh from Ecuador, the highest figure recorded in the last five years. Said imports occurred during the El Niño phenomenon faced by the country at the start of 2016.
- Since the implementation of international electricity transactions (TIEs, for the Spanish original) with Ecuador in 2003, around 12,971 GWh have been exported to said neighboring country for approximately USD 1,147,580.8 million.



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Transmission

Main Companies of the National Transmission System

The **National Transmission System (STN)** is the country's backbone, as it connects the power plants to the centers of consumption. **The STN includes a total of 25,482.16 km** of transmission lines.

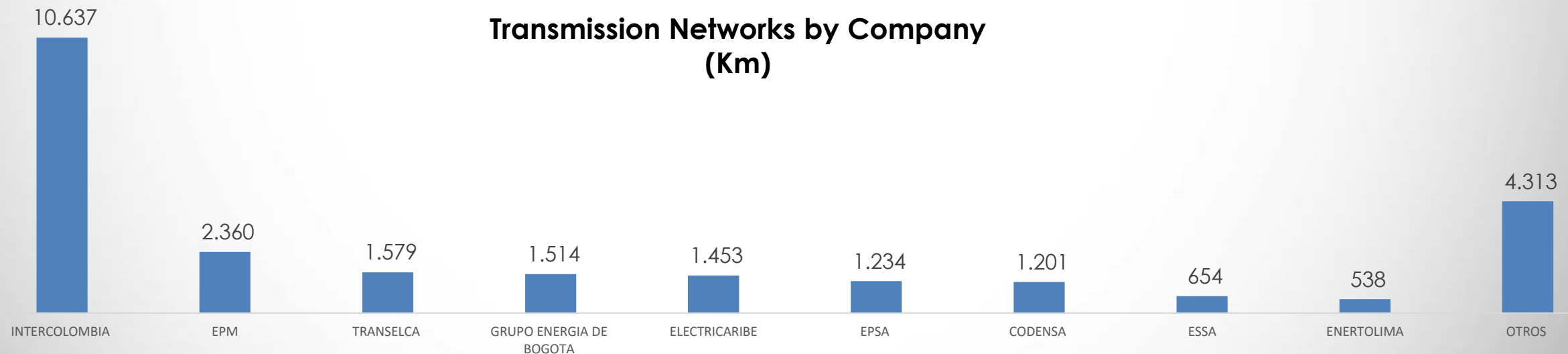
Nine transmission agents account for 83% of the country's transmission networks.

Specificities of transmission in Colombia:

- Transmission voltage of over 220 kV
- Regulated revenue
- Natural monopoly
- Free competition for network expansion projects since 1999
- Free access to the network



Transmission Networks by Company (Km)



Areas Connected by the National Electric Grid



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



National Electric Grid (SIN)

- It stretches over 48% of the national territory and provides 96% coverage of the population.
- Estimations of the future demand are based on the interconnected areas.

Unconnected Areas (ZNIs)

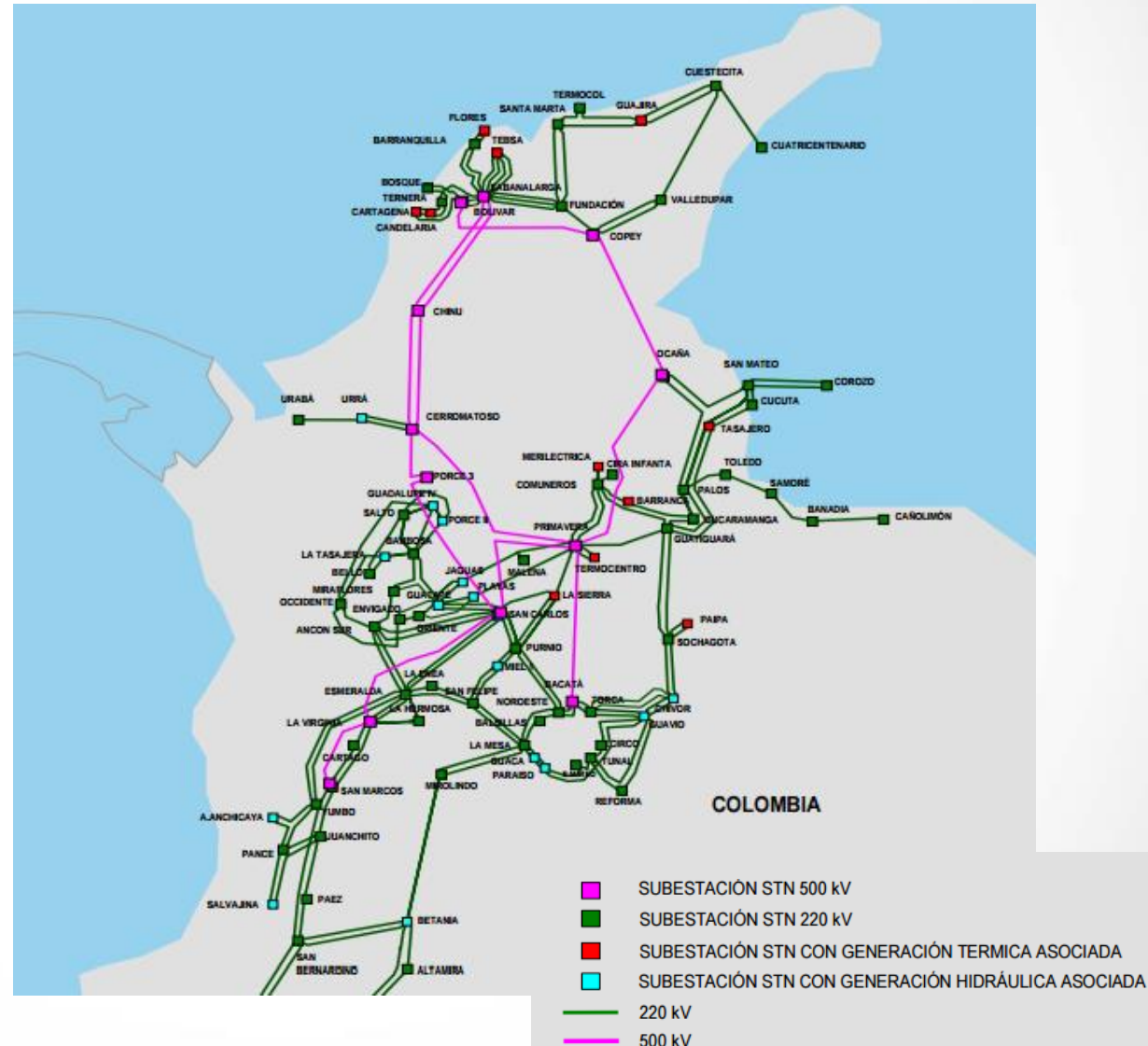
- Unconnected Areas (ZNIs, for the Spanish original) comprise 52% of the national territory: 17 departments and 1,440 localities.
- They are supplied mainly by diesel generators.

Current Transmission System



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Transmission Line	Length (km)
110 kV – 115 kV	10,358.93
138 kV	15.49
220 kV – 230 kV	12,572.37
500 kV	2,535.37
Total	25,482.16



Increase in Transmission

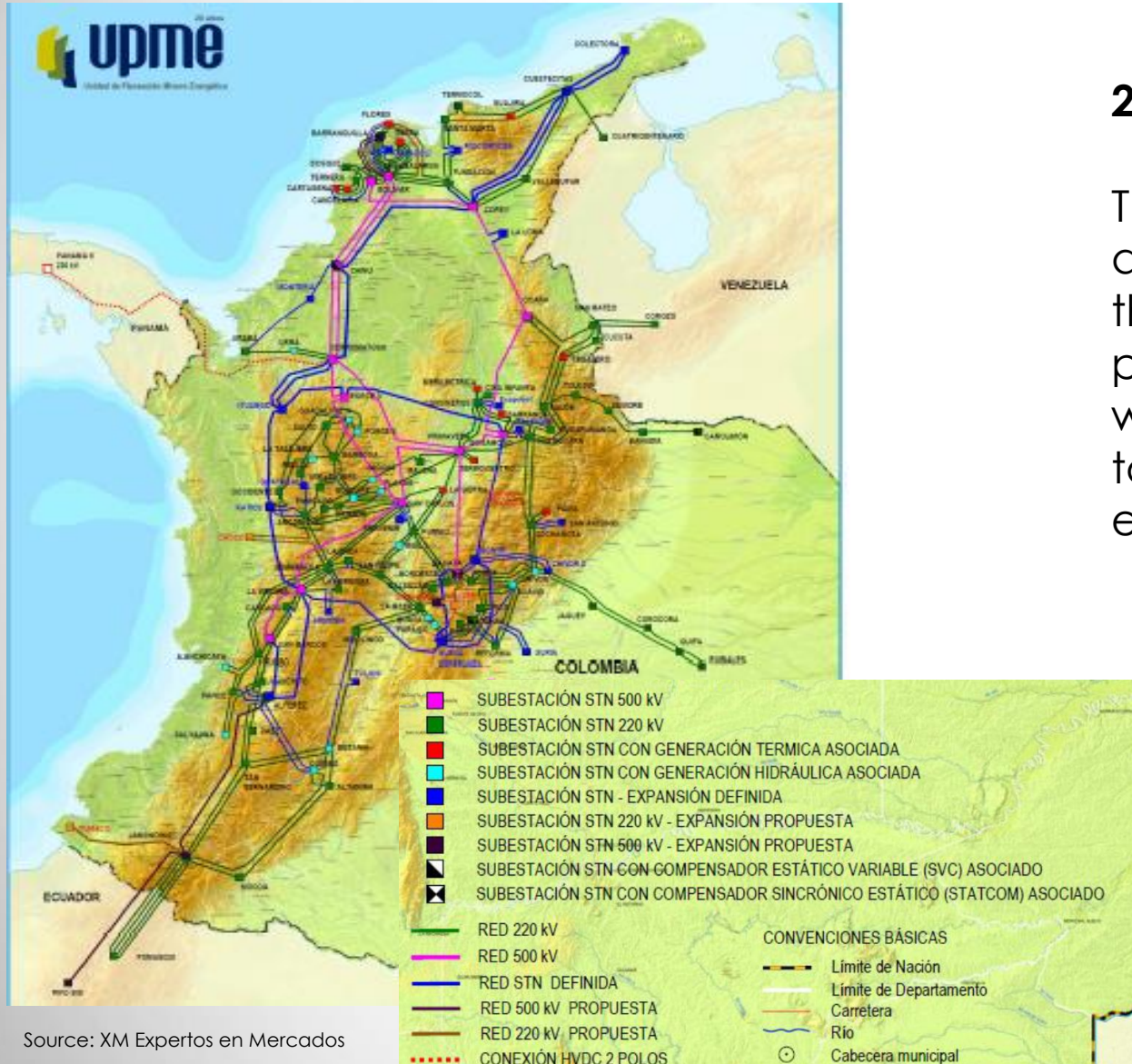
In 2016, four projects of the National Transmission System and ten projects of the Regional Transmission System started operations, including three projects of connection to the National Transmission System. Activities related to connection to the National Electric Grid and subsequent start-up were coordinated for each of the projects.

Transmission Projects that Started Operations in 2016		
Item	Type of Project	Project
1	National Transmission System	UPME 01-2008 Stage I: Nueva Esperanza - Paraiso 1 and 2 (230 kV), Nueva Esperanza - San Mateo 1 (230 kV) and Circo - Nueva Esperanza 1 (230 kV) lines
2		UPME 08-2014: Extension of Valledupar substation (220 kV)
3		UPME 09-2015 Connection of the Cartago substation (230 kV) to the La Virginia - San Marcos circuit (230 kV)
4		Second Betania - Ibagu� circuit (230 kV)
5	Connection to the National Transmission System	Magdalena Medio substation(Ecopetrol) (220 kV).
6		Provisional connection in Barranca: BARRANCA 3 transformer (90 MVA 230/115 kV)
7		Transformers 2 and 3 on the Oca�a substation: Oca�a 2 (90 MVA 230/115 kV) and Oca�a 3 (90 MVA 230/115 kV)
8	STR	UPME STR 04-2015 - Capacity offsets in El Carmen, El Banco and Monteria
9		UPME STR 01-2015 Stage I: Offsetting of 15 MVA in the Riohacha (110 kV) and Maicao (110 kV) substations
10		Extension of the Nueva Cospique Substation (110 kV)
11		Extension of the Caucasia Substation (110 kV) and installation of two transformers (60 MVA 110/44 kV)
12		Juan Mina Substation (110 kV) and related assets
13		Campobonito Substation (115 kV) and related assets
14		Reconfiguration of the Barranca - Palenque (115 kV), Barranca - Lizama (115 kV), and Lizama - Palenque (115 kV) lines.

Transmission System – 2028 Vision



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Source: XM Expertos en Mercados

2014-2028 Transmission Expansion Plan

The national and regional transmission works were defined, taking into account the information on the current electricity infrastructure, the future projects and the expected energy demand, as well as the new power plants that are connected to the system to ensure the reliable, safe and efficient supply of electricity.

Public Calls for Proposals System



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

The UPME is the entity responsible for establishing the transmission infrastructure required in the country in the medium and long term, which must be executed through the public calls for proposals system.

Public Calls for Proposals System

- The investor is responsible for the design, supply, definition of routes, environmental licenses, disclosure, permits, easements, construction, start-up, operation and maintenance.
- The selected investor is the one with the lowest share of expected revenue over the first 25 years of operation of the project, discounted at a rate established by the CREG.



Expansion Plan in Generation and Transmission 2016 - 2030



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Transmission Expansion Plan

The UPME carries out annually the updating of the Transmission Expansion Plan, defining the priorities of the system in the short, medium and long term, analyzing the National Transmission System - STN and the Regional Transmission Systems - STR, identifying the effects of growth of the demand and the incorporation of generation plants. The foregoing, in order to guarantee the provision of electric power service in a reliable, safe and efficient manner.



Expansion plan 2017-2031 (preliminary)



Expansion plan in Transmission

Works are proposed in different levels and areas of the country such as:

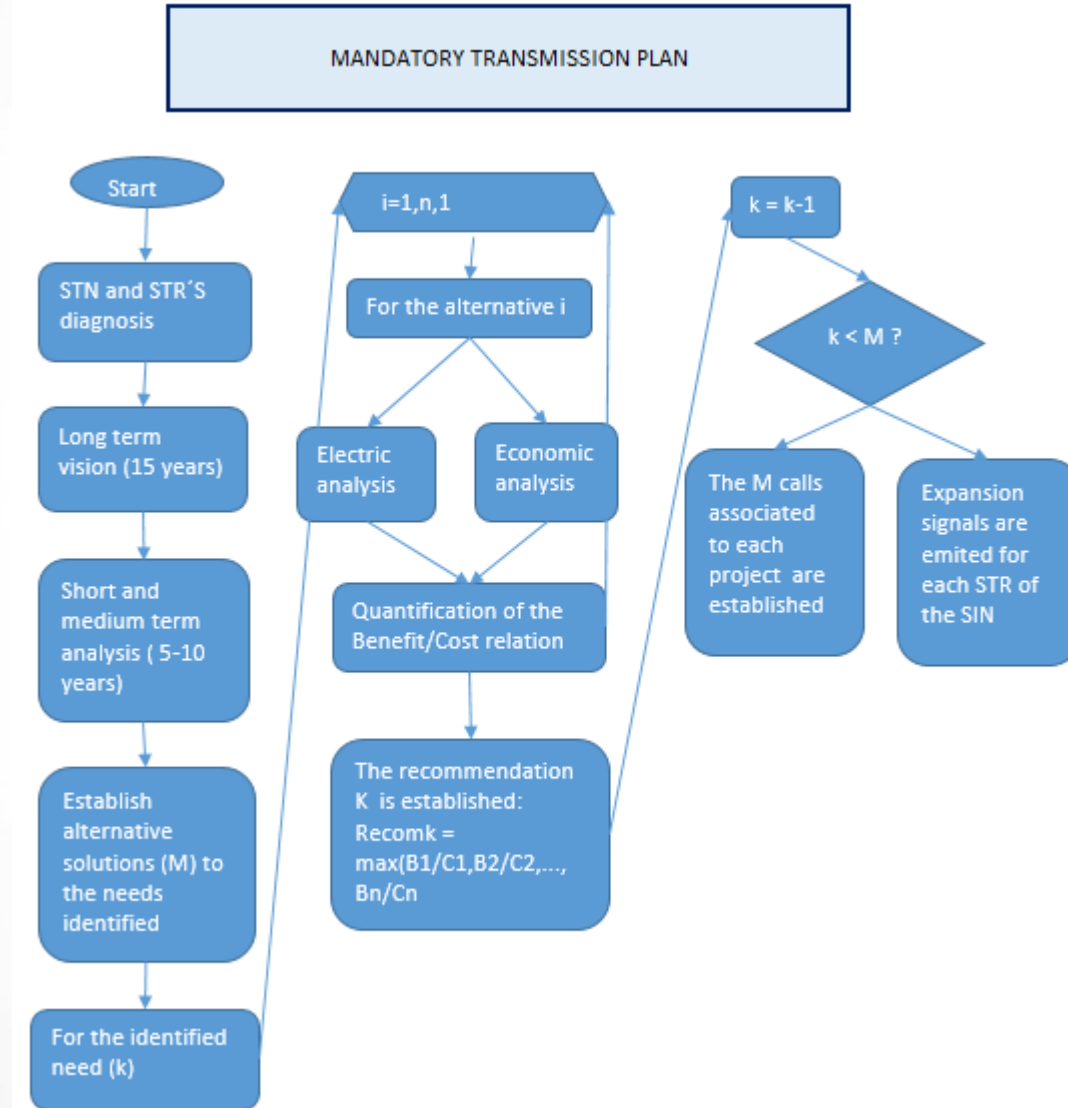
Works for the incorporation of water resources in Antioquia and Caldas -
Quindío - Risaralda,
Works in the southwestern area,
Analysis of the interconnection with Ecuador,
Incorporation of renewables in the Guajira - Cesar - Magdalena area.

* It is open to comments until January 31, 2018

General methodology



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Basic assumptions



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

- Existing Colombian generation system-Feb. 2017, organizing the SIN in 15 operational areas in G and T.
- Indices of unavailability considered in the calculation of the Reliability Charge of each agent.
- Consideration of some projects registered in the UPME registry in October 2017, others with connection studies approved or approved and for the GCM area the projects that expressed interest (Upme circulars from March 16 and May 30, 2017).
- Energy and power demand projections, national and regional, medium and high scenarios for the July 2017 review.
- Characteristics and conditions of the reservoirs associated with the generation plants and their corresponding topology.
- Projections of prices of natural gas, liquid fuels and mineral coal, first semester review 2017, in constant dollars of December 2016.

Basic assumptions



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

- Current operating minimums-Feb 2017
- Risk Aversion Curve (CAR).
- Limitations on the supply of natural gas are not considered.
- Indicative costs of generation, as well as fixed and variable costs determined by the UPME based on information from the registers and the GEOLCOE application.
- The expected value of the marginal costs that are calculated with the SDDP model are expressed in constant dollars of December 2016, and consider the real equivalent cost in Energy of the Reliability Charge-CERE, the cost associated with the Fund for the Energization of the Non-Interconnected Zones-FAZNI, and those that are contemplated in the law.
- Updated historical wind speed measurements in situ, associated with 27 wind farms.
- Updated historical series of solar radiation for 40 solar projects using nearby IDEAM stations

Basic assumptions



PROCOLOMBIA
EXPORTACIONES TURISMO INVERSIÓN MARCA PAÍS

- Updated historical series of solar radiation from the main cities of the country (15 electric areas) for the GD
- 100 synthetic series of flows generated with the ARP model are used, the previous from historical data of the 1937-2017 period. This hydrology contains the dry periods of the horizons 1991-1992, 1997-1998, 2009-2010, 2013-2014, 2014-2015 and January 2017.
- Regarding the projects defined by the Reliability Charge mechanism (green), the dates presented in the following table are considered. Other plants and second stages are also contemplated, which are common expansions in long-term scenarios.

Headquarter	Capacity (MW)	Date of entry into operation
Ituango	300	23/11/2018
	600	02/02/2019
	900	27/05/2019
	1200	21/08/2019
	1500	01/09/2021
	1800	01/12/2021
	2100	01/03/2022
	2400	01/06/2022
Gecelca 3,2	250	30/11/2017
Termonorte	88,6	01/09/2018
Termomechero	57	01/01/2018

STR Analysis -Caribe



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Atlántico:

Depletion STN/STR, STR, SDL

Bolívar

Depletion STR y STN/STR

Córdoba – Sucre

Depletion STN/STR

Guajira – Cesar – Magdalena:

Depletion STR y STN/STR

STR Analysis -Caribe



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Atlántico:

Caracolí and associated works

Atlántico Works

The River and Associated works

Bolívar

Exhaustion STR and STN / STR

The marine

Bolívar and associated works Campestre
and associated works Turbaco and
associated works

Córdoba – Sucre

Tolúviejo and associated works

Montería

Cerete

Fourth TRF Chiinu Fourth TRF Cerro

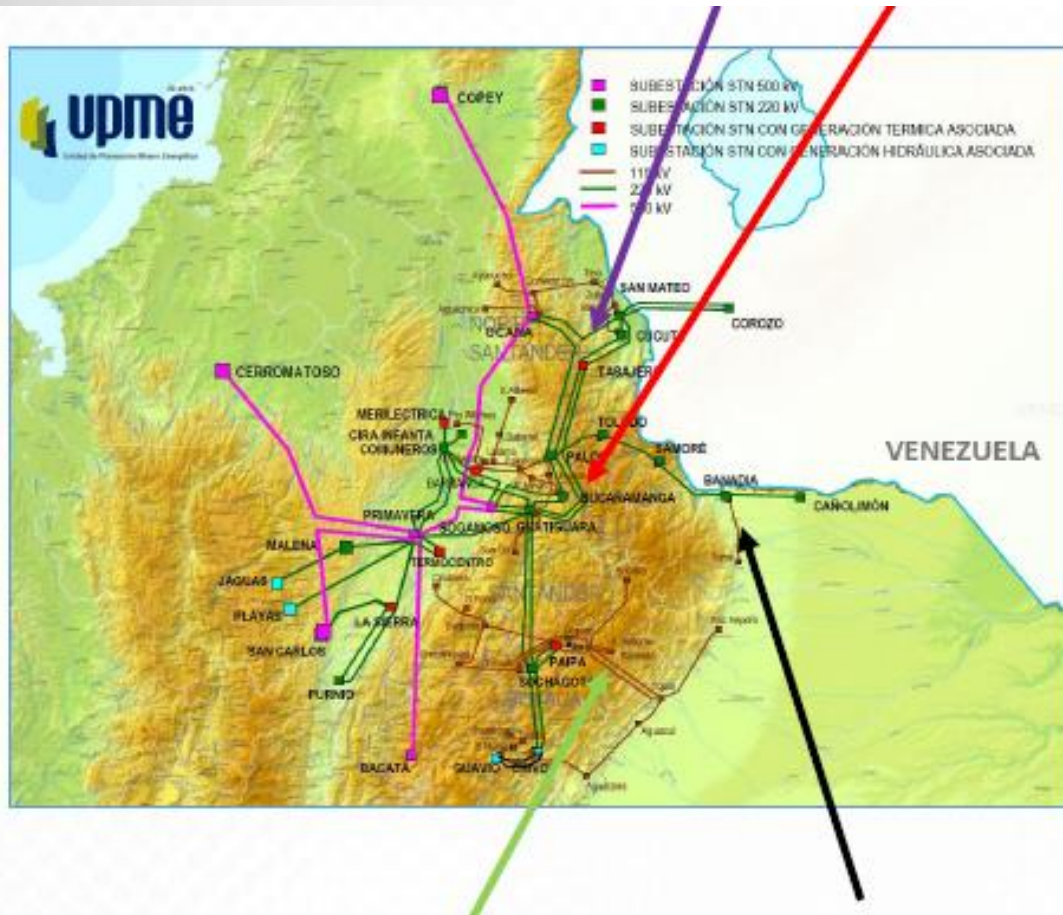
Guajira – Cesar – Magdalena

Exhaustion STR and STN / STR La Loma and associated
works Rio Cordoba and associated works Extension
capacity Valledupoar Expansion of capacity Santa
Marta expansion Capacity Copey SRT Guajira

STR Analysis -Northeast



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Norte de Santander

Depletion STN/STR, STR

Santander:

Depletion STN/STR, STR

Arauca

Depletion STN/STR, STR

Boyacá –Casanare:

Depletion STN/STR, STR y SDL

STR Analysis -Northeast



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Norte de Santander

Transformation Increase STN / STR

New substations and lines

Compensations

Santander:

Palenque and associated works

Increase STN / STR transformation and new S / E STR

Arauca

Associated works Casanare interconnection -Arauca

Boyacá –Casanare:

Expansion of STN / STR capacity

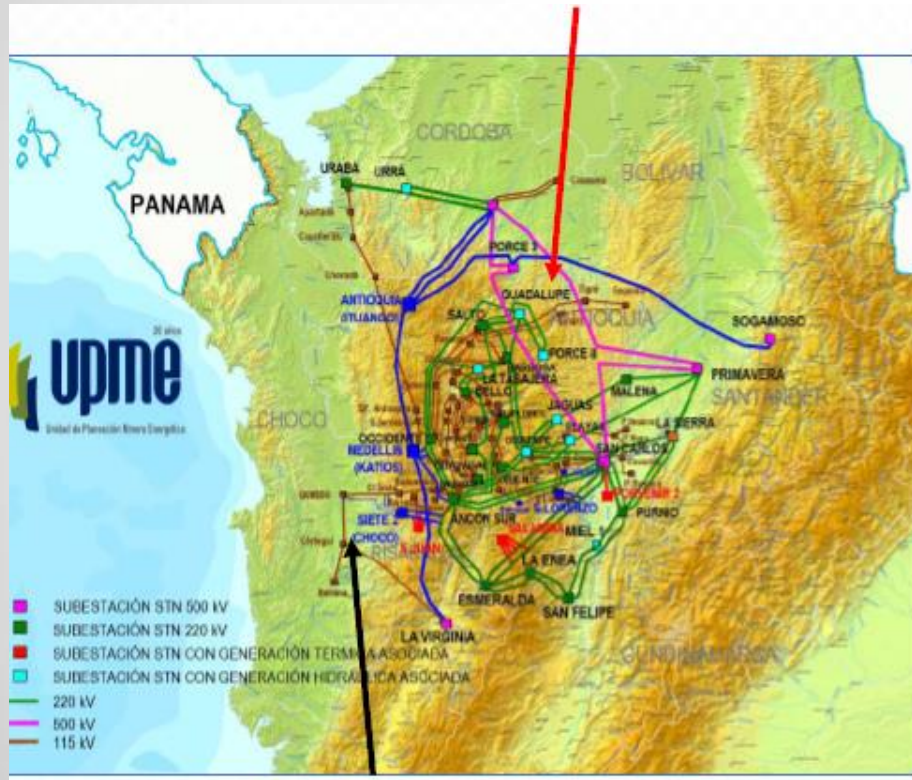
San Antonio and associated works

New S / E and STR lines

STR Analysis –Antioquia -Chocó



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Antioquia:

Depletion STN/STR, STR, SDL

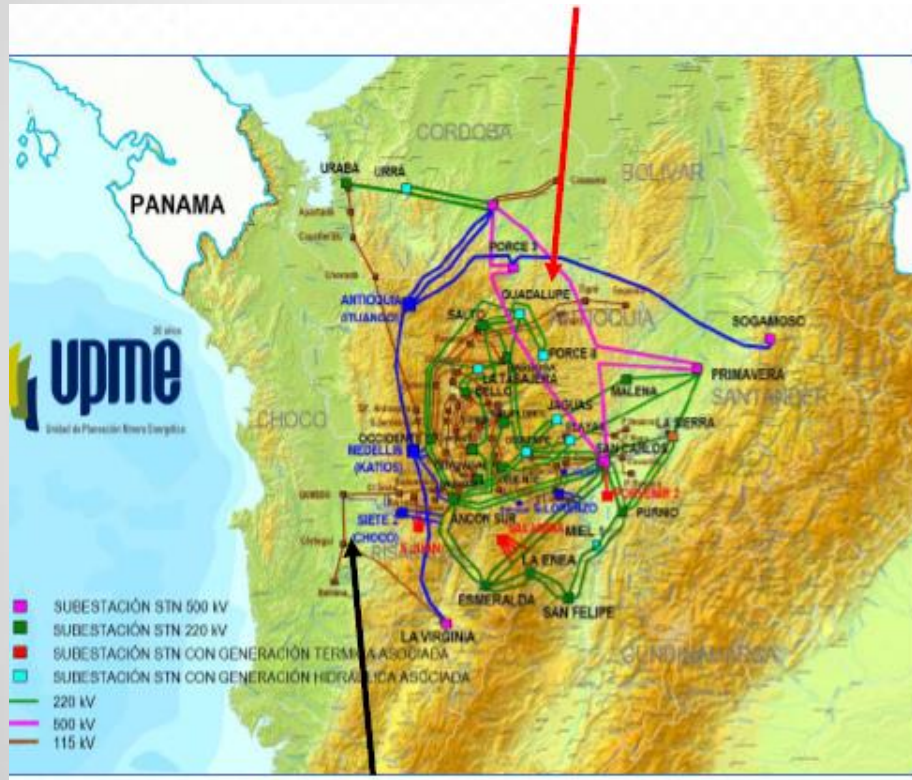
Chocó

Depletion STN/STR, STR

STR Analysis –Antioquia -Chocó



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Antioquia:

San Lorenzo and associated works
S / E and Lines in the STR

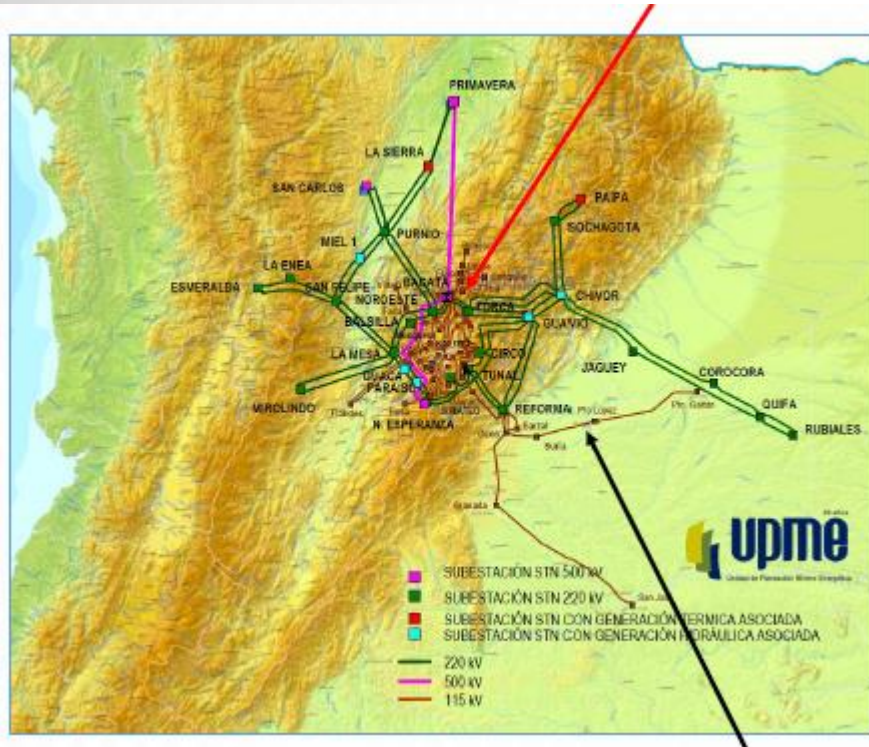
Chocó

The New Seven and associated works
Lines in the STR

STR Analysis –Oriental Bogotá



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



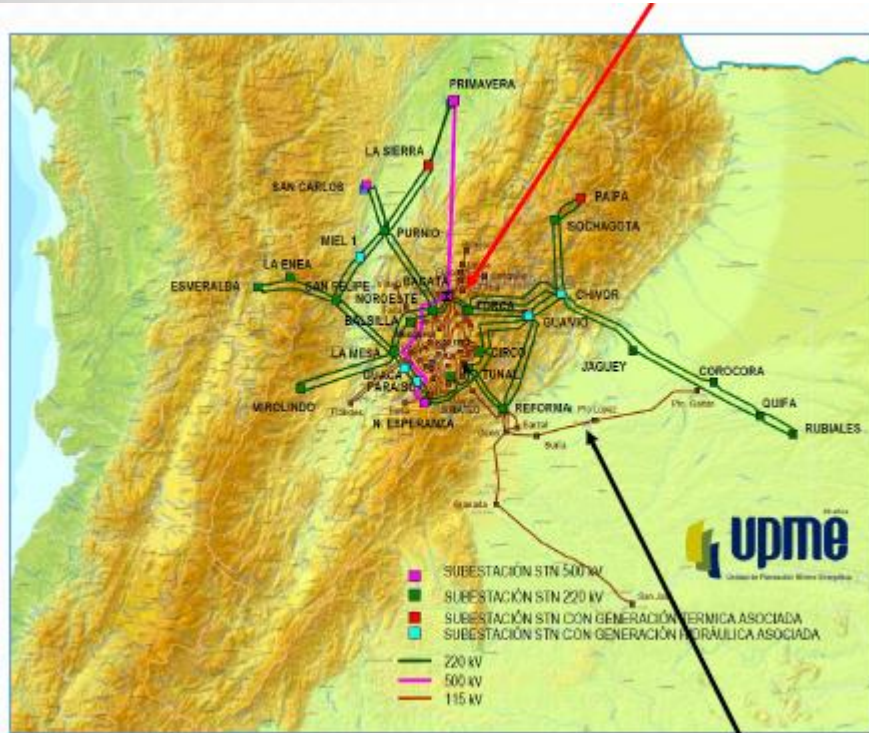
Bogotá -Cundinamarca
Depletion STN/STR, STR

Meta -Guaviare:
Depletion STN/STR y STR

STR Analysis–Oriental Bogotá



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Bogotá -Cundinamarca

Extension capacity connection STN / STR
New works of STR and STN

Meta -Guaviare:

Suria and associated works
N / E and lines in the STR

STR Analysis -Suroccidente



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Caldas –Quindío -Risaralda:
Depletion STN/STR, STR

Tolima –Huila –Caquetá
Depletion STN/STR y STR

Cauca –Nariño
Depletion STN/STR y STR

Valle
Depletion STN/STR y STR

STR Analysis -Southwest



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Caldas –Quindío -Risaralda:

Transformation extension STN / STR
New S / E STR

Tolima –Huila –Caquetá

New S / E STR and Lines
Compensations

Cauca –Nariño

New Substations and STR lines

Valle

New S / E and STR lines

Outline of public calls



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

The Energy Mining Planning Unit (UPME) is the entity in charge of defining the transmission infrastructure that is needed in the medium and long term, which must be executed through the system of public calls.

Outline of public calls

- The investor is responsible for the design, supply, route definition, environmental licenses, socialization, permits, rights of way, construction, commissioning, operation and maintenance.
- The selected investor is the one with the lowest present value of the expected income during the first 25 years of operation of the project, discounted at a rate established by the CREG.





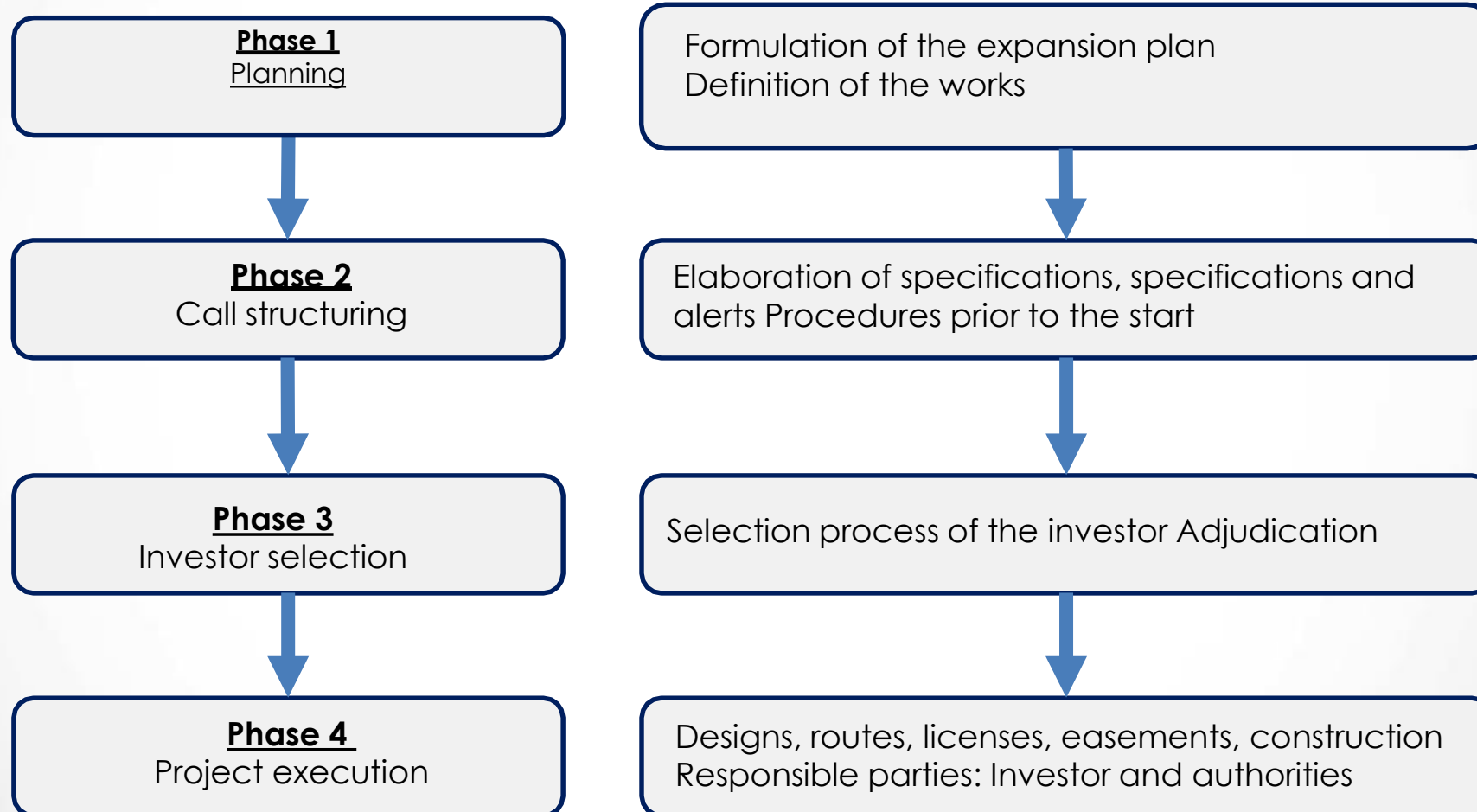
PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Process of Planning and execution of Transmission projects

Phases of the projects



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

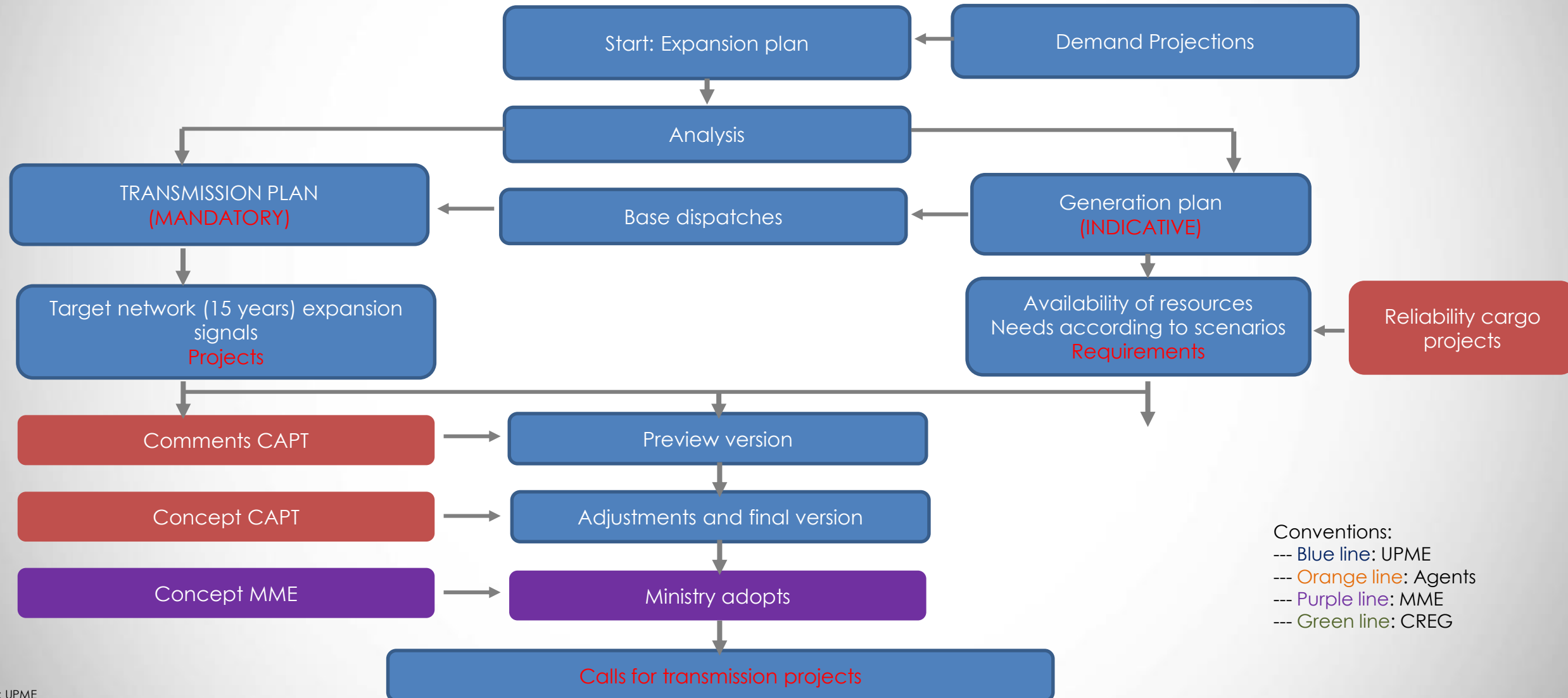


The UPME does not define the routes

Planning process



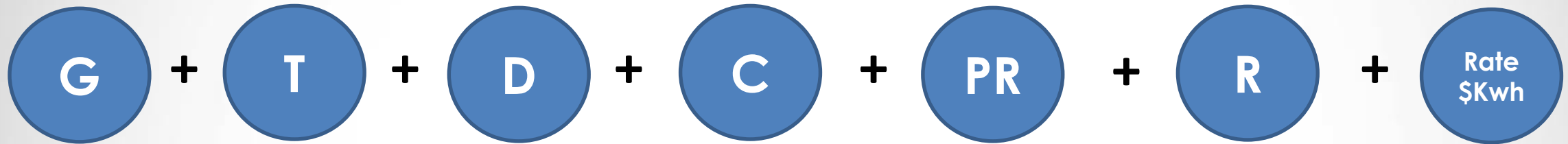
PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



How is a broadcast work determined?



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



- G** Generation: depends on the purchases of the Marketer.
- T** National transmission: users pay throughout the territory.
- D** Distribution: pay users according to area (ADD).
- C** Marketing: administrative charge for the provision of the service.
- PR** Recognized Losses: technical and non-technical.
- R** Restrictions: cost overruns due to deficiencies in the networks (non-permanent).

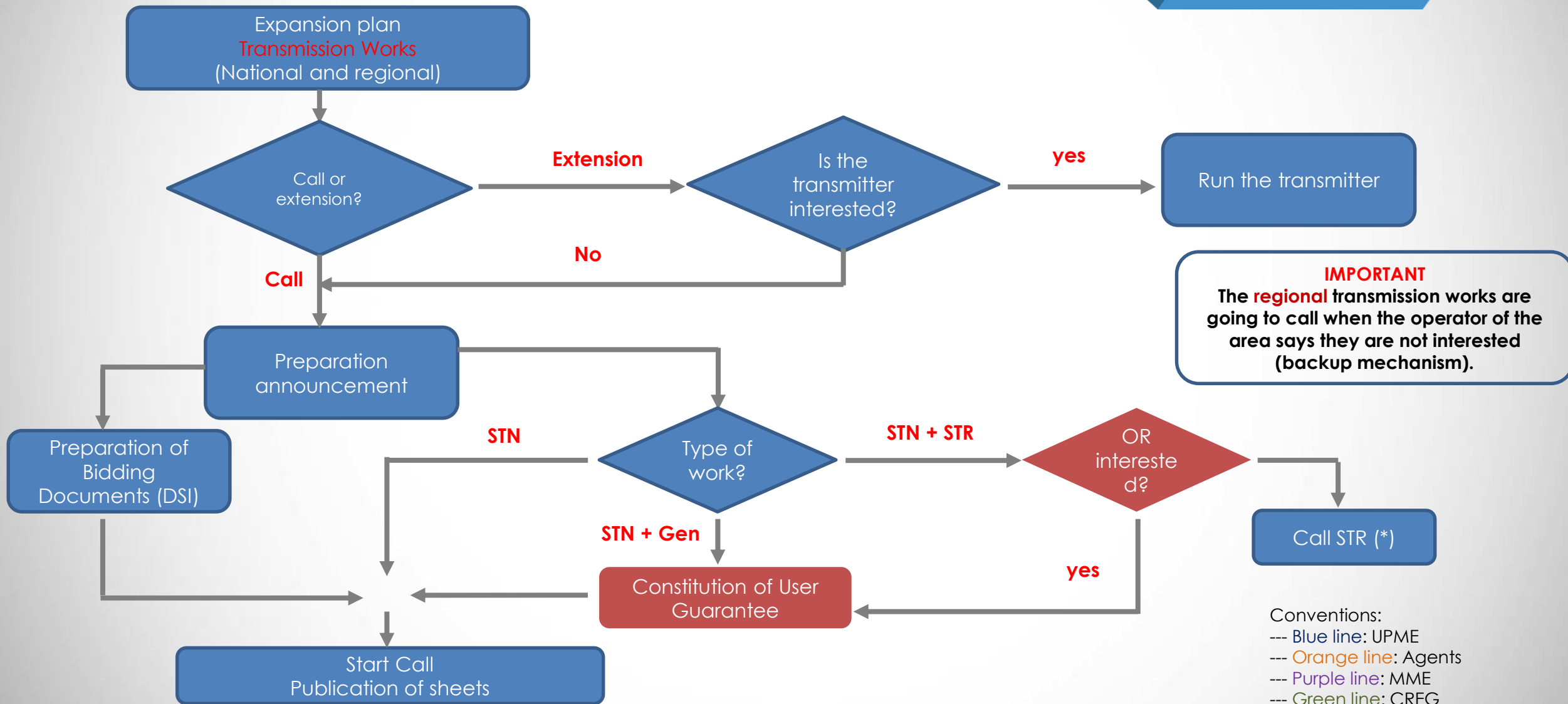
Regulatory framework



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Law 142 of 1994, Public Services Law	Law 143 of 1994, Electric Law	Res. 181313/2002 of MinMinas	Res. 180924/2003 of MinMinas	Decree 2201/2003. Territorial Entities
Status: Ensure supply, reliability and security Public service: public utility	UPME: Project consumption of Electricity UPME: Elaborate Plan of Expansion: projects Art. 52. The agent is responsible for licensing Art. 85. The agent assumes the risks inherent in the execution and exploitation of the projects	Expansion criteria Establishes calls for transmission works	Regulates calls with foundation in art. 85 of Law 143/94 Investor selection that execute a Transmission project Sheet content Selection: lower offer Responsibilities	Projects can be developed throughout the territory The POTs will not be opposable to projects of public utility

Structuring and user guarantee (previous)



Structuring: Investor Selection Documents -DSI



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Volume 1. DSI. Conditions of participation: **Enabling criteria, content of envelopes and economic offer**

Annex 1. Description, scope and technical specifications of the project.

Annex 2. Specifications for the development of the quality plan.

Annex 3. Terms of reference for the selection of the financial controller. **STN qualifies experience, STR prequalification by the CNO.**

Annex 4. Minute of the audit contract.

Annex 5. Description of the current regulations.

Annex 6. Minute of the confidentiality agreement.

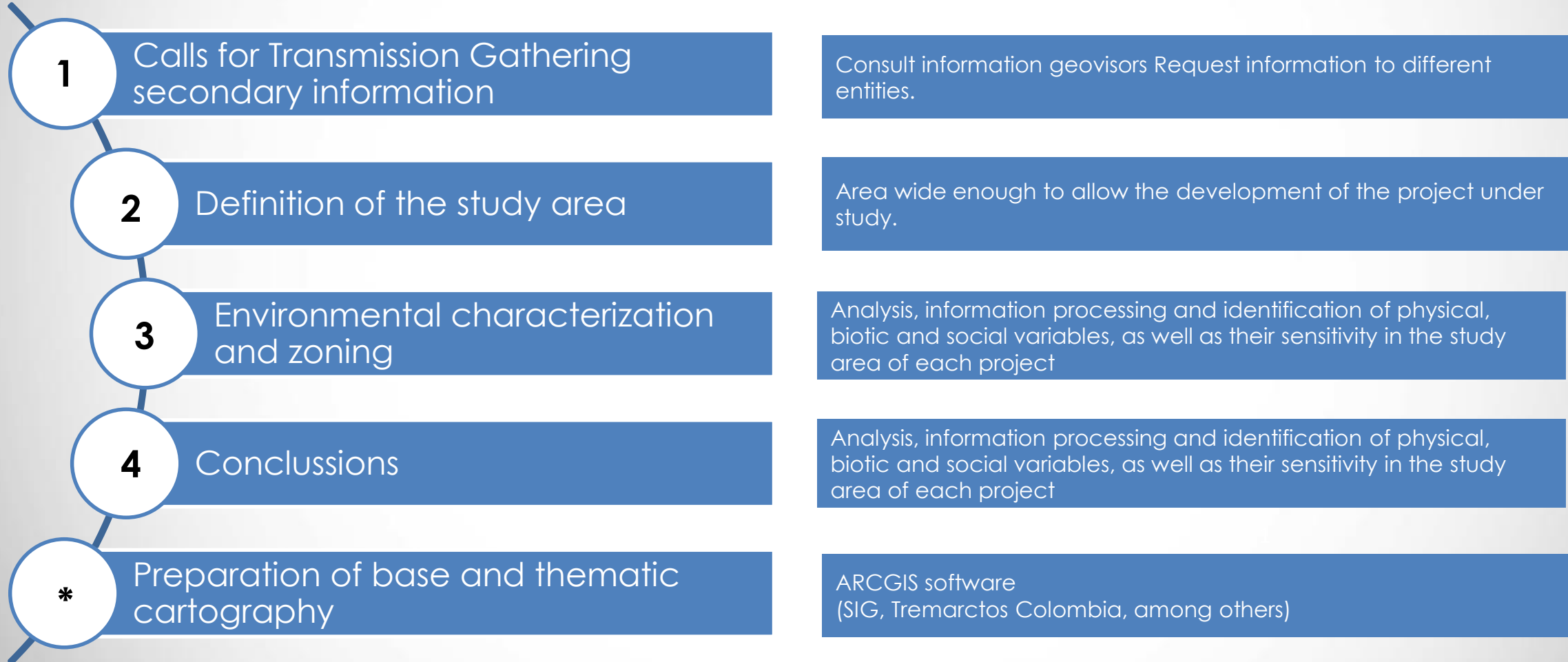
Annex 7. Minutes of the trust contract.

"Study Area Analysis and Early Alerts". Preliminary identification of the possibilities, restrictions and conditions of environmental and social type. **Informative document**

Transmission Calls



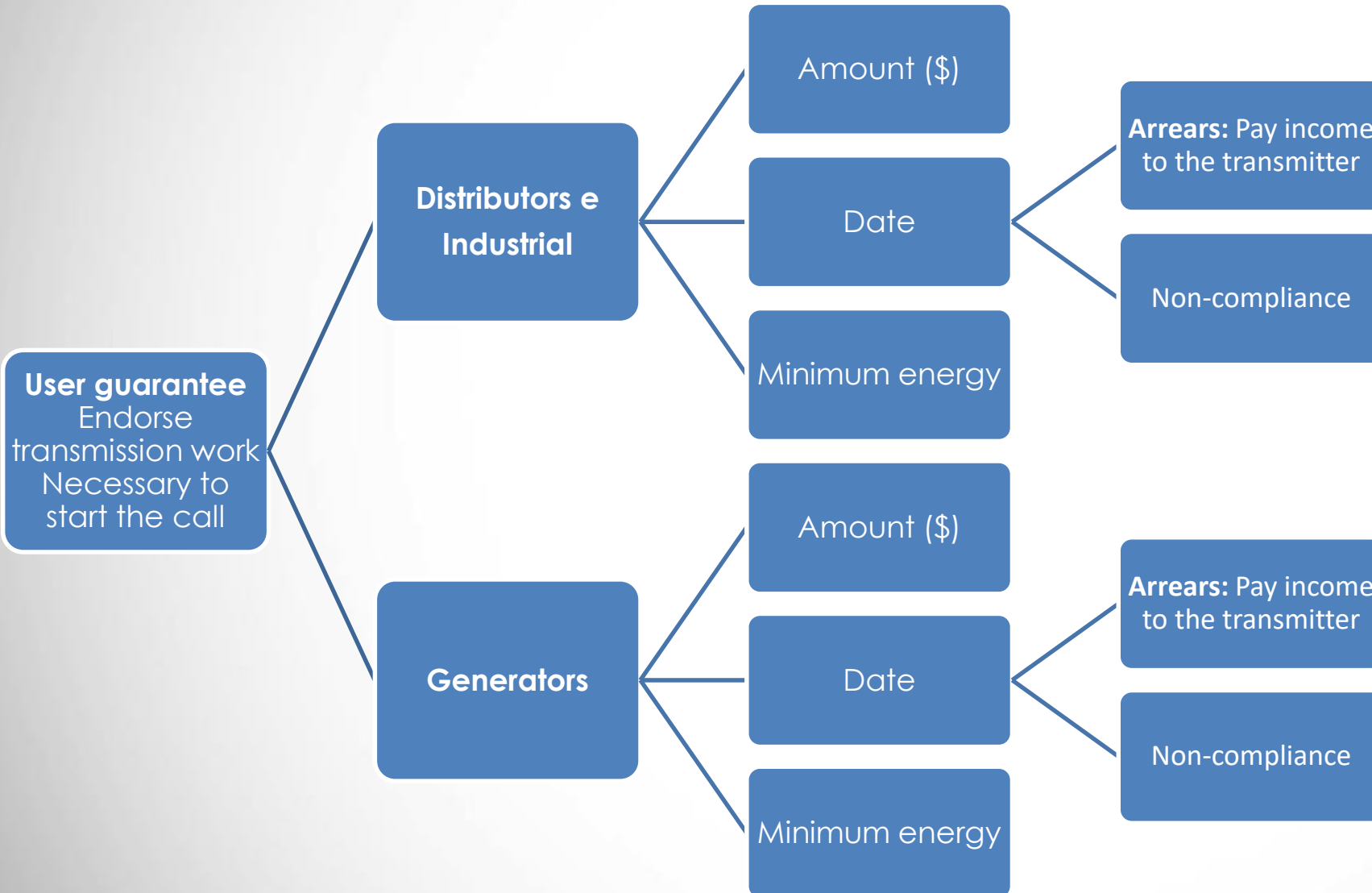
PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



User Guarantee



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



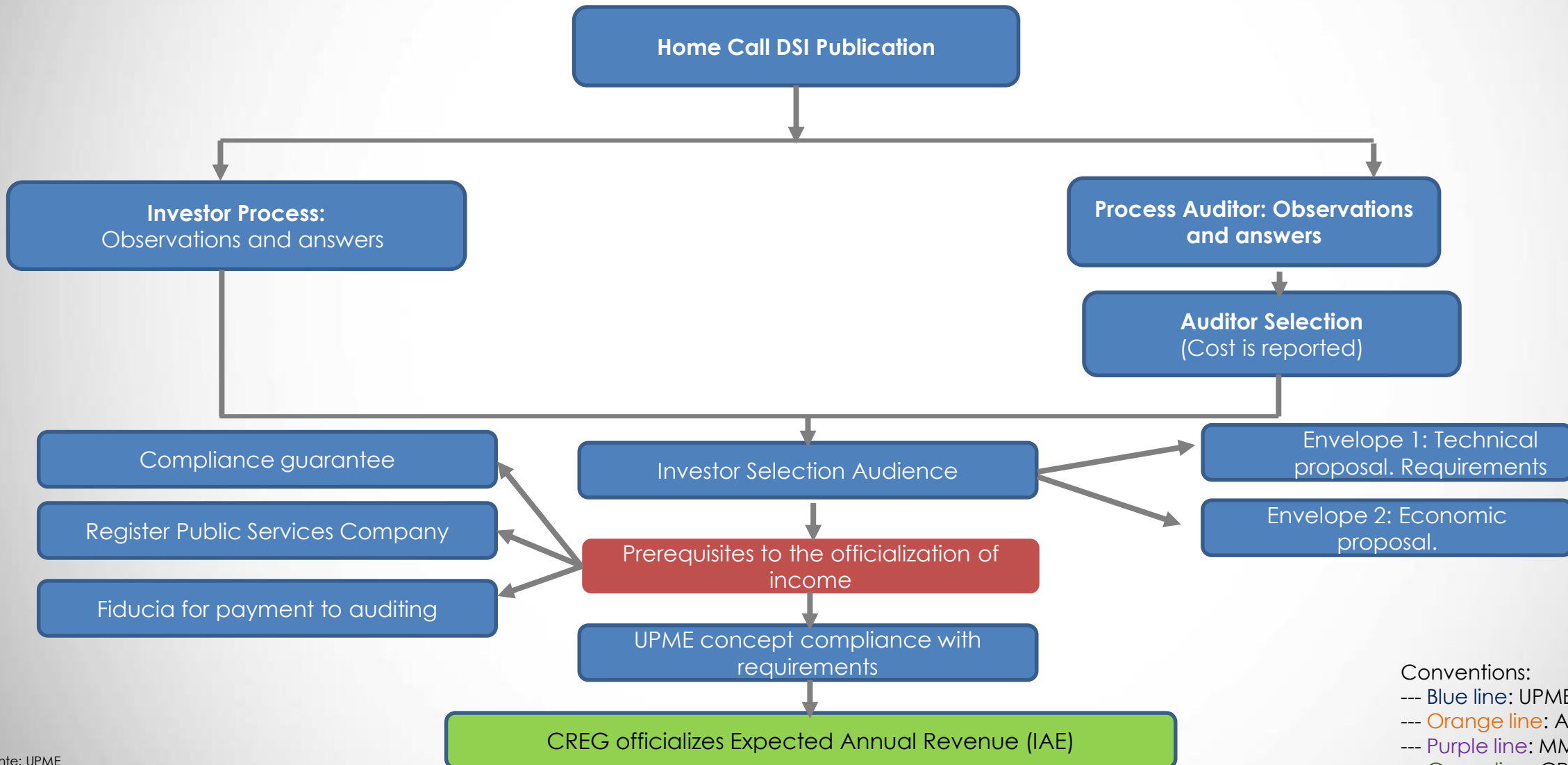
Guarantee criteria: Number 3 of the Annex to Resolution CREG 022 of 2001 (Resolution CREG 093 of 2007)

- a) Unconditional and irrevocable in favor of the ASIC
- b) Payment upon first request
- c) Liquid and easily realizable
- d) Granting entity with risk rating
- e) Grantor must waive legal requirements for payment
- f) In national currency and required by Colombian law
- g) Paid value equal to coverage, free of deductions

Call: selection of investor and investor



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Conventions:
--- Blue line: UPME
--- Orange line: Agents
--- Purple line: MME
--- Green line: CREG

What are public calls?



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Mechanism to select the executor
of the work

Those who submit the lowest offer of the income they expect to receive are selected. The State invests

It is not a concession. There is no contractual link.

The awardee is in charge of the investment, designs, supplies, license, construction and operation.

You must obtain environmental license before starting construction

Compliance guarantee: supports the execution and the date of commissioning

The investor is remunerated what he bid. It is subject to the rules of operation.

The UPME elaborates sheets, selects and monitors

Content of the Proposals



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

1. Seriousness guarantee of the proposal

2. Documents that prove existence, conformation of the consortium in such case and powers.

3. Shareholder composition of the Proponent.

4. Statement indicating actual beneficiary

5. Irrevocable commitment of a Financial Entity to issue a Compliance Policy or Guarantee.

6. Irrevocable commitment to sign a Trust Agreement.

7. Declarations of conformity according to the forms of the call.

8. Quality plan

9. Detailed Schedule of the Project, with critical path and "S" curves of each activity

10. Quality certificates

11. The draft statutes of the E.S.P, in the event that the Proponent is not an E.S.P.

12. Experience in executing projects for STR calls

Selection



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

STN

- It evaluates About 1 and it is determined if it is satisfied or not.
- If you agree, you can evaluate Over 2 with the economic proposal.
- The one who offers the lowest present value of the expected annual income for the first 25 years is chosen.
- In case of only valid offer, you must consult the CREG before awarding

Selection

STR

- It evaluates About 1 and it is determined if it is satisfied or not.
- If you agree, you can evaluate Over 2 with the economic proposal.
- The one who offers the lowest present value of the expected annual income for the first 25 years is chosen.
- In the case of a single valid offer, a counter-proposal process is issued.

STR - COUNTEROFFER

The value of the economic proposal is published.
Other stakeholders may submit lower value counterproposals.

The Proponent is informed.

If the Bidder agrees to execute the Project for the value of the counterproposal it will be awarded. Otherwise it will be awarded to the counterproponent.

In case no valid counteroffers are submitted, the project will be awarded to the Proponent of the only valid Offer.

The same requirements of the proposals must be met and the same evaluation procedures must be fulfilled

Requirements for approval of income



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

If it is a E.S.P.

- Prove your existence and legal representation

If it is not a E.S.P.:

- Constitution as E.S.P.
- Transfer in favor of the E.S.P. of the rights and obligations acquired as a result of the Public Call for Proposals
- Have within its corporate purpose the activities developed by a National Transmitter in relation to the electricity sector.

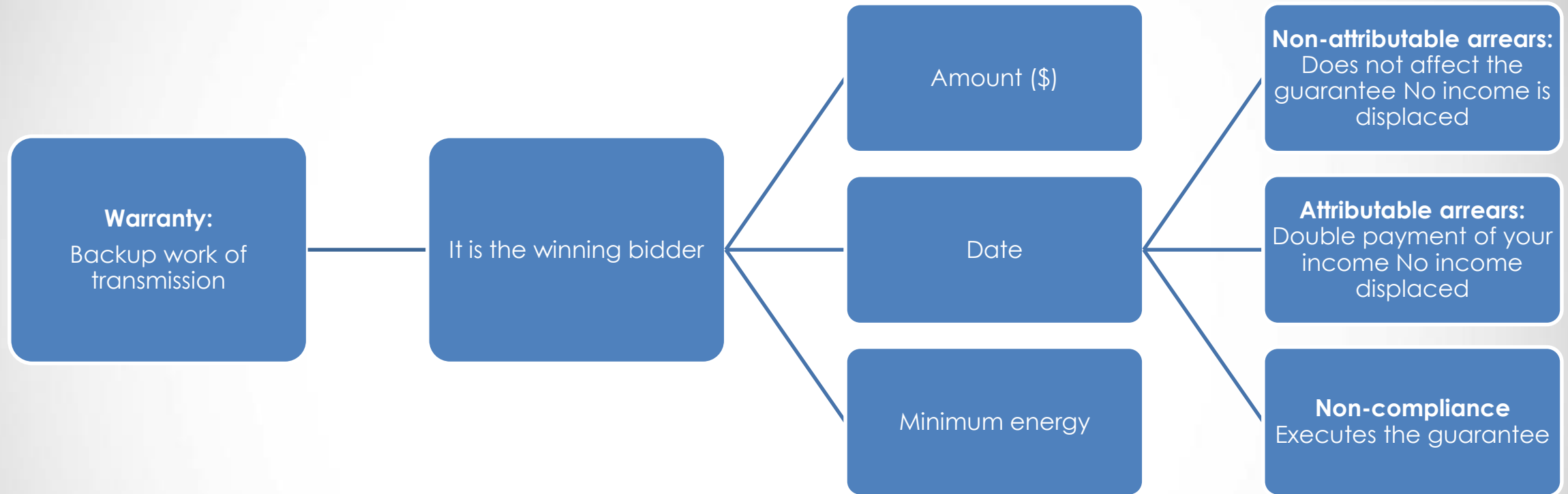
All:

- Registration in the CREG and other relevant entities, according to the Applicable Laws.
- Compliance or Compliance Guarantee Policy and approval by XM.
- Subscription of the Trust Contract

Investor compliance guarantee



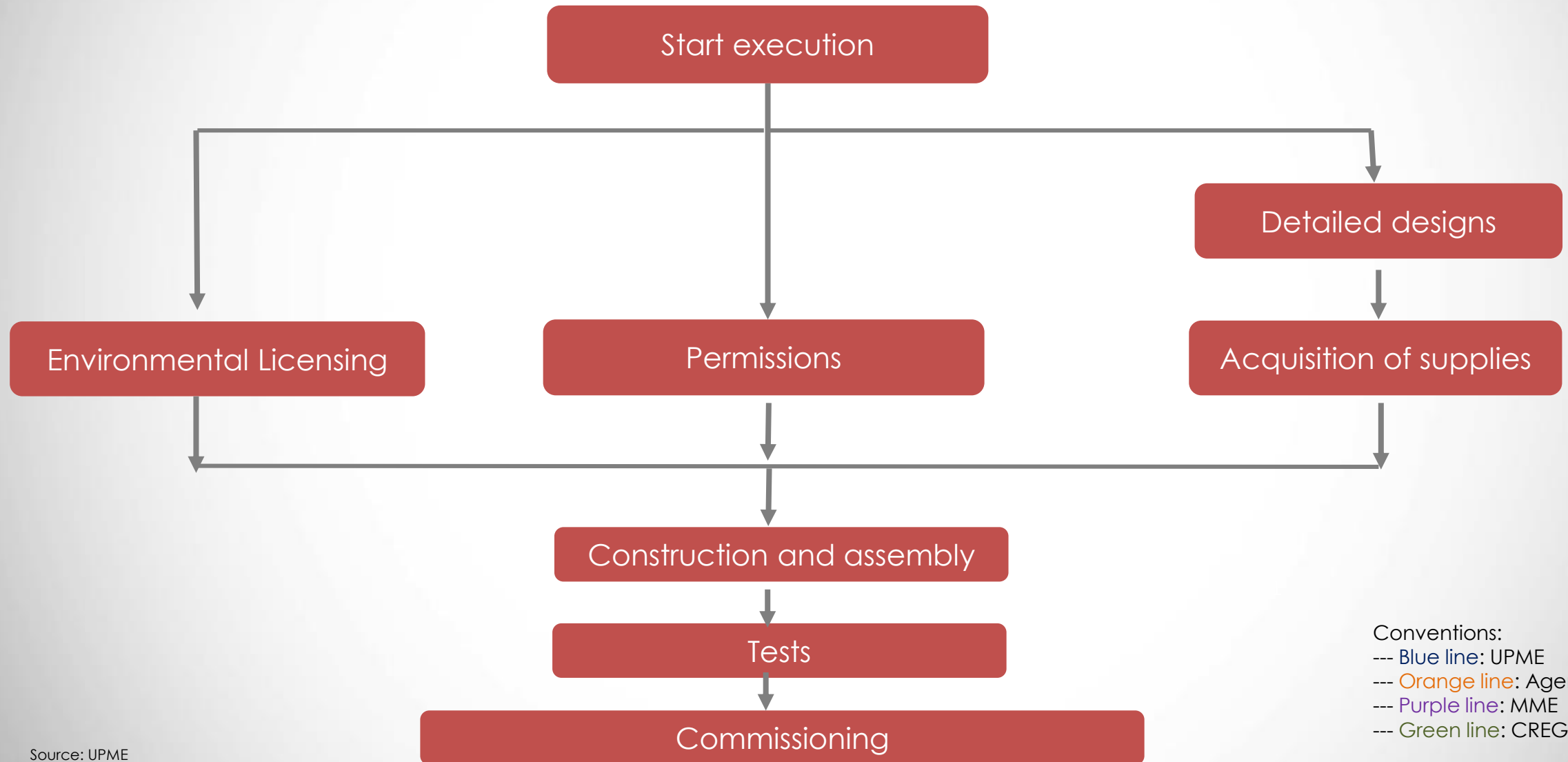
PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Guarantee criteria: Number 3 of the Annex to Resolution CREG 022 of 2001 (Resolution CREG 093 of 2007)

- a) Unconditional and irrevocable in favor of the ASIC
- b) Payment upon first request
- c) Liquid and easily realizable
- d) Granting entity with risk rating
- e) Grantor must waive legal requirements for payment
- f) In national currency and exigibles according to Colombian law
- g) Paid value equal to the coverage, free of deductions

Execution and monitoring UPME

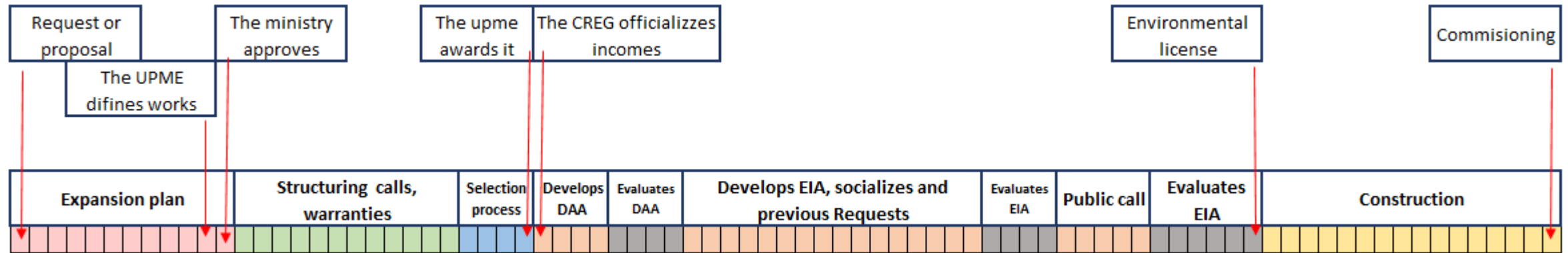


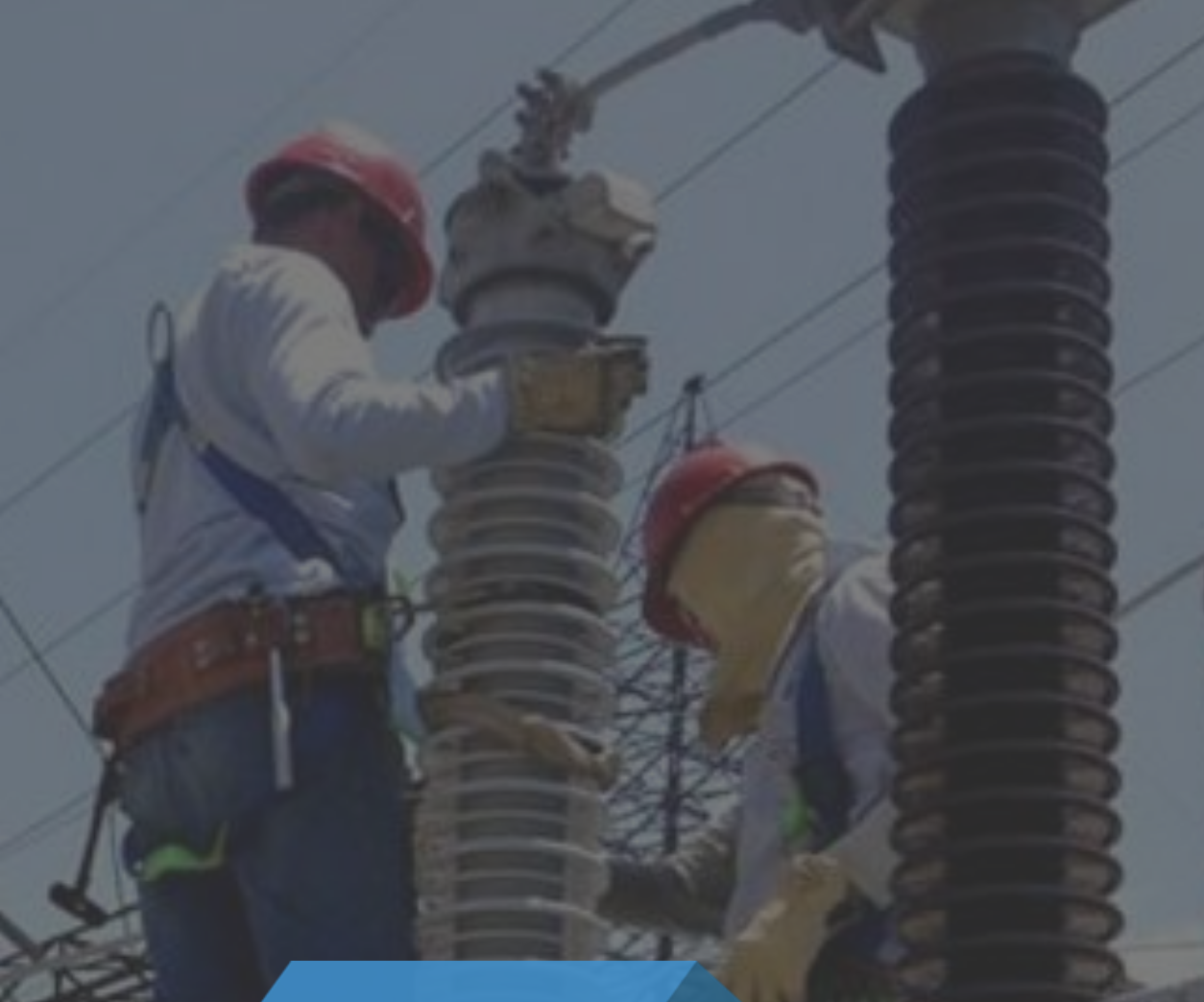
Conventions:
--- Blue line: UPME
--- Orange line: Agents
--- Purple line: MME
--- Green line: CREG

Planning and execution



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND





PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Sales and Distribution

Sales and Distribution



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Purchase of energy on the wholesale market and retail energy sale to users. Management of the sales cycle involving all clients

- Allotment from purchase price to rate
- Regulated charges for the regulated market
- Free margin for the non-regulated market

Regulated Users*
13,760,432

Residential: 12,543,016



Non-residential: 1,217,416

Industrial: 98,832

Commercial: 1,001,660

Activity	Registered	In Transaction
Generation	68	57
Domestic transmission	15	12*
Distribution	32	31
Sales	104	71
Limits of regulated users	9,554	
Limits of non-regulated users	5,373	
Limits of public lighting	346	

Type of Users

Non-regulated Users	Regulated Users
<ul style="list-style-type: none">■ Energy demand greater than 100 kW or consumption of 55 MWh/month.■ They can freely negotiate part of the supply rate with the reseller. 	<ul style="list-style-type: none">■ They pay a regulated rate.■ Covers industrial, commercial and residential users. 



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

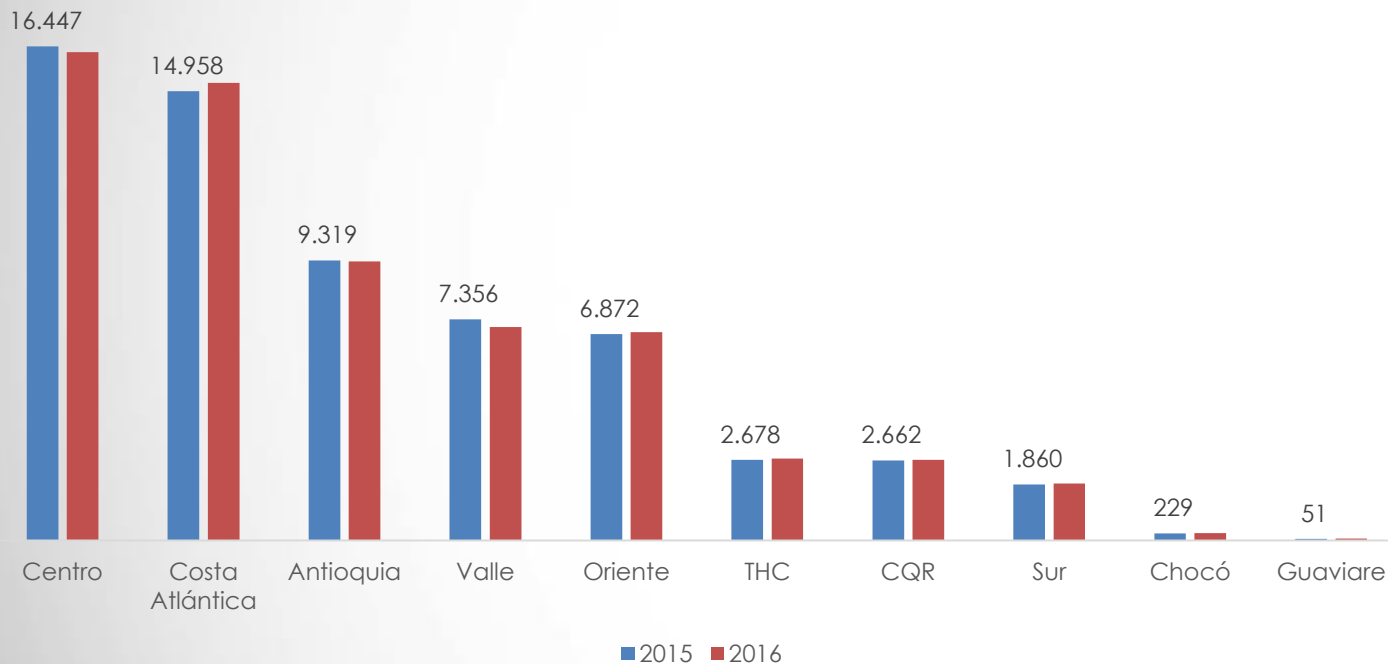
Demand

Energy Demand by Region



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Energy Demand (GWh)



TCC: Tolima, Caqueta and Cauca
CQR: Caldas, Quindio and Risaralda

Source: XM Expertos en Mercados and UPME

- Regionally, with the exception of the Center, Antioquia and Valle regions, in 2016, an increase in the energy demand was recorded.
- However, it can be seen that this growth significantly decreased from the growth recorded in 2015. This may be due to the end of the dry season (El Niño phenomenon), to the “Apagar Paga” (Switching off, pays” campaign and to the impact of inflation and devaluation on production costs. These variables have affected consumption habits in homes.

Energy Demand by Type of Market and Economic Activity



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



- The behavior of the regulated and non-regulated markets' energy demand is presented, which recorded a 1% growth in the regulated market and a 1.7% decrease in the non-regulated market as shown in Table 1.
- The growth of the non-regulated market in 2016 was affected by the voluntary disconnectable demand programs (DDV, for the Spanish original) as a result of an incident involving the Guatapé generation units, the response to demand due to critical conditions of the system during the first semester of the year, and also, cogeneration.

Expected Electricity Demand

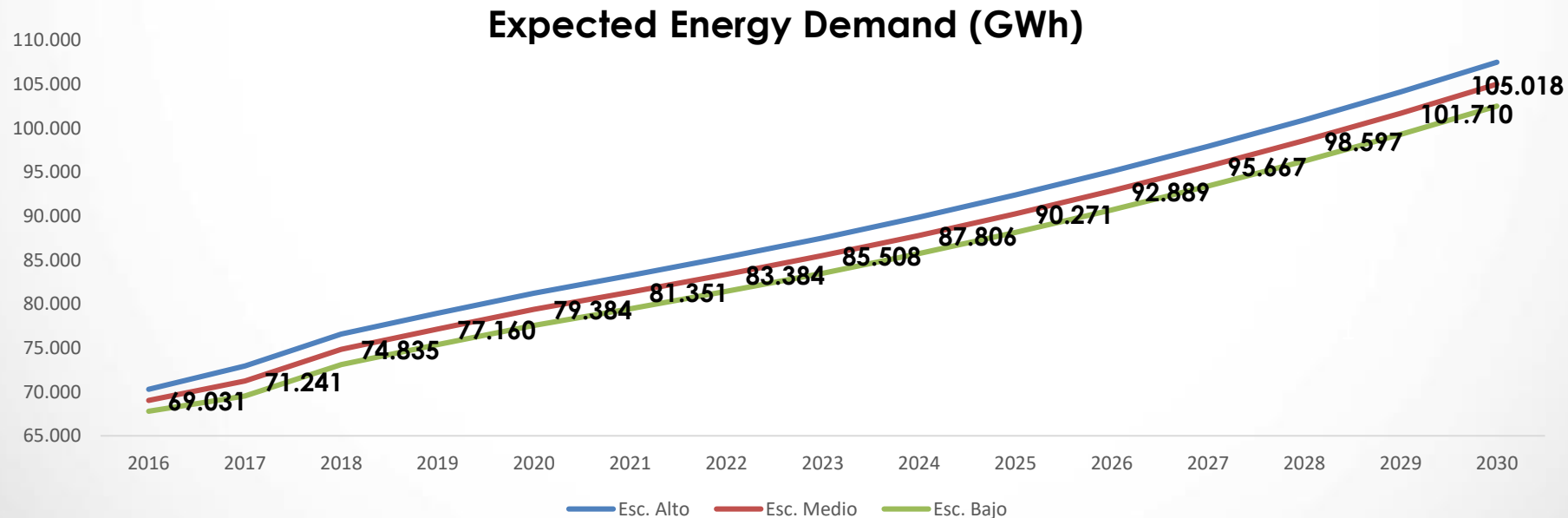
Energy Demand in Colombia + Large Consumers + Connection with Panama



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

2014-2028 Generation Expansion Plan

- An energy deficit is expected as of 2022, considering the one-year delay in the Ituango Project and the failure to execute the Porvenir II Project.
- In the long term, 2019-2028 period, an increase in the installed capacity is required in order to meet the energy reliability criteria.
- Due to the need for diversification of the power generation matrix, complementarities have been established between renewable resources and the traditionally considered hydroelectric options.





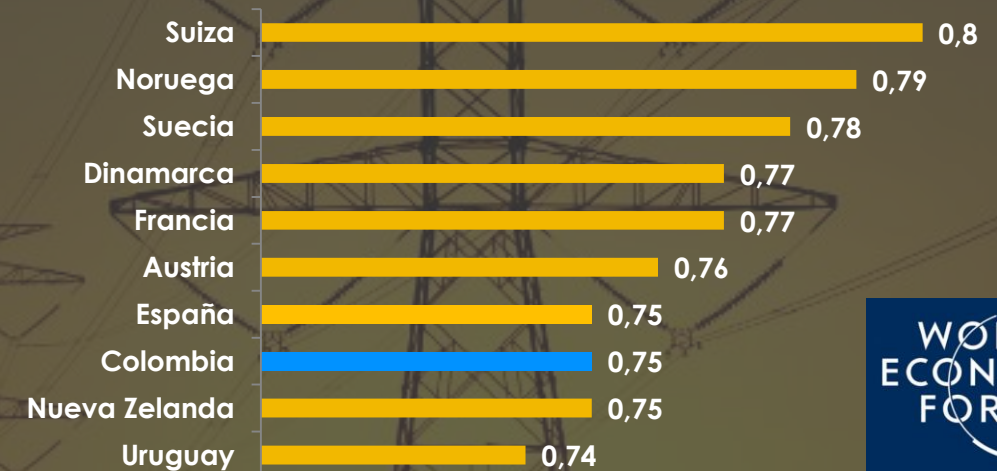
Investment Opportunities

Sectors for Opportunity - Energy: A Diversified Base of Resources and a Strategic Location in the Americas

Colombia holds first place in Latin America and eighth place in the world according to the “Energy Architecture Performance Index 2017”, WEF, 2017.

- **492 power generation projects registered with the UPME** in different stages: Installed capacity of up to **14,707 MW***.
- A **total investment of USD 542 million** is estimated for **calls for proposals open** to the public for **energy transmission projects****.
- Great potential in biofuels and alternative sources of energy.
- Projects focused on renewable energy will be exempt from VAT, customs and income tax – Law 1715.

The Global Energy Architecture Performance Index 2017



WORLD
ECONOMIC
FORUM

Some Niches with Opportunities



Thermal



SHPP



Solar



Wind



Biomass

Transmission
Network



Opportunities for Generation



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Colombia has clear and stable regulations

- Two reforms were made in 1994 (Laws 142 and 143 / 1994), which created institutions and management of the sector essentially aimed at encouraging private investment. This translates into business opportunities in specific projects.

Resources to empower expansions

- Colombia has natural resources for power generation (water, coal and potential gas projects) in amounts that allow it to supply a demand greater than that of the country.

Energy deficit in Colombia expected for 2022

- An increase in the installed capacity is required in order to meet the energy reliability criteria.

The energy demand will double between 2005 and 2030 in Latin America

- The World Bank reports that the electricity demand will double to 2,500 TWh by 2030. This growth generates the need for an additional increase of 239 GW in the region, near to 330 GW of installed capacity.

Attractive international connection projects

- which will allow an increase in energy exports to other countries in Latin America. Panama-Colombia Interconnection (2018), Ecuador-Peru-Chile Interconnection SINEDA Project: Andean Electrical Interconnection System.

Opportunities in Generation from Non-conventional Sources of Energy



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

Potential for the development of power generation projects from non-conventional resources

- **Due to its geospatial position**, Colombia has the potential to generate renewable and alternative energy resources, such as: **solar, wind, biomass, ocean and geothermal energy**.

Law 1715/2014 regulates the incorporation of non-conventional renewable energy into the national electricity system

- This law promotes the development and use of non-conventional energy resources (especially renewable sources) in the national electricity system. **It establishes a regulatory framework and instruments** for the use of non-conventional energy resources, particularly for renewable energy resources, and **creates incentives for investment in non-conventional energy sources (FNCE, for the Spanish original)**.

Unconnected areas comprise 52% of the national territory

- **The National Electric Grid** connects 48% of the national territory and covers 97% of the population. **Unconnected areas (ZNIs)** comprise the remaining 52%, amounting to 17 departments, 1,441 municipalities and 625,000 people. Currently, these areas generate electricity with diesel.

Power Generation Projects



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND

- A total of **492 power generation projects** currently being structured with a capacity of **14.707 MW** in different phases.
- Out of these projects, 84 are in Phase 2: This means that said project is technically, economically, financially and environmentally feasible. Duration of this phase: 1 year.

433 Power Generation Projects

Estado		
Phase	N° Projects	Capacity (MW)
1*	362	8.865,87
2**	98	5.465,39
3***	32	376,32

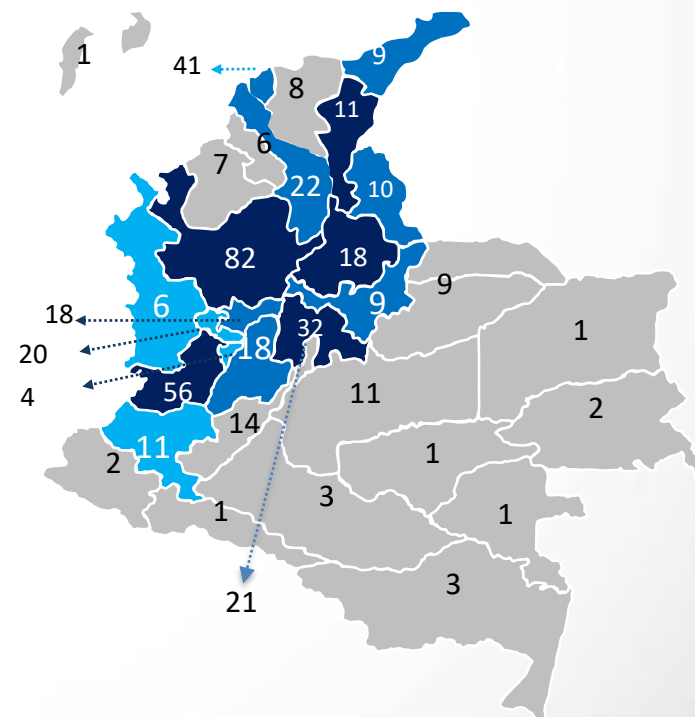
Capacity	N° Projects	Capacity (MW)
0 - 20	421	2.060,18
21 - 99	35	10.389,09
> 100	36	2.258,30
Total	492	14.707,57

*Phase 1: Prefeasibility stage

**Phase 2: Feasibility stage of the project

***Phase 3: The project must have definitive designs in place, as well as the implementation schedule.

Projects by Department



Source: SIEL – UPME Report, January, 2017

Power Generation Projects by Type of Resource



PROCOLOMBIA
EXPORTACIONES TURISMO INVERSIÓN MARCA PAÍS

Hydroelectric



Status	Projects	Installed Capacity (MW)
1	88	5.015.259
2	34	972.900
3	3	371.520
Total	125	6.359.679

Thermal



Status	Projects	Installed Capacity (MW)
1	4	392,9
2	8	2767
3	-	-
Total	12	3159,9

Solar



Status	Projects	Installed Capacity (MW)
1	249	2.270,74
2	48	1.111,09
3	29	4,79507
Total	326	3.386,62

Wind



Status	Projects	Installed Capacity (MW)
1	8	1.144,15
2	5	569,00
3	-	-
Total	13	1.713,15

Biomass



Status	Projects	Installed Capacity (MW)
1	13	42,82
2	3	45,4
3	-	-
Total	16	88,22



UPCOMING CALLS

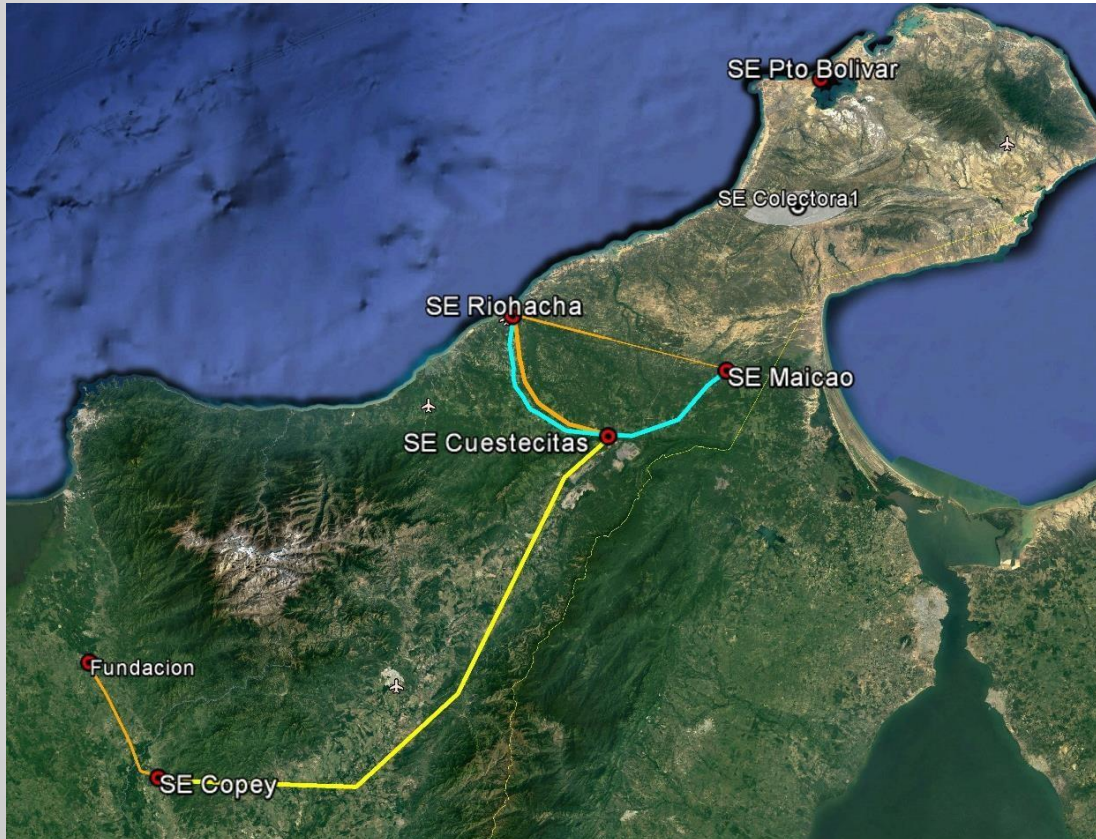
Project	Departament/ Location	Date of entry into operation	Estimated (USD)
STN- Wind conection 500 kV	CESAR	2022	167.140.776
STN- Sabanalarga – Bolívar 500 kV	ATLÁNTICO, BOLIVAR	2020	36.782.130
STN- Transformer Sogamoso 500/230 kV	SANTANDER	2019	15.618.679



STN- Transformer Sogamoso 500/230 kV



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Description

- Transformer 500 / 230kV of 450MVA in the existing substation in Betulia.
- Transformation bay at 500kV.
- Transformation bay 230kV.

Objective

To guarantee reliability (continuity) and security of the service in Santander, Cesar and La Guajira. • Increase limits of energy transfer between areas.

Departament
SANTANDER

Date of entry into operation
2022

Estimated (USD)
15.618.679

Award hearing
dic-17

STN- Sabanalarga – Bolívar 500 kV



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Description

- 500kV transmission line between Sabanalarga (Sabanalarga, Atlántico) and Bolívar (Santa Rosa, Bolívar) of approximately 50km.
- 500kV bay in Sabanalarga.
- 500kV bay in Bolívar.

Objective

To guarantee reliability (continuity) and security of the service in the Atlantic.

Departament

ATLANTICO, BOLIVAR

Date of entry into operation
2020

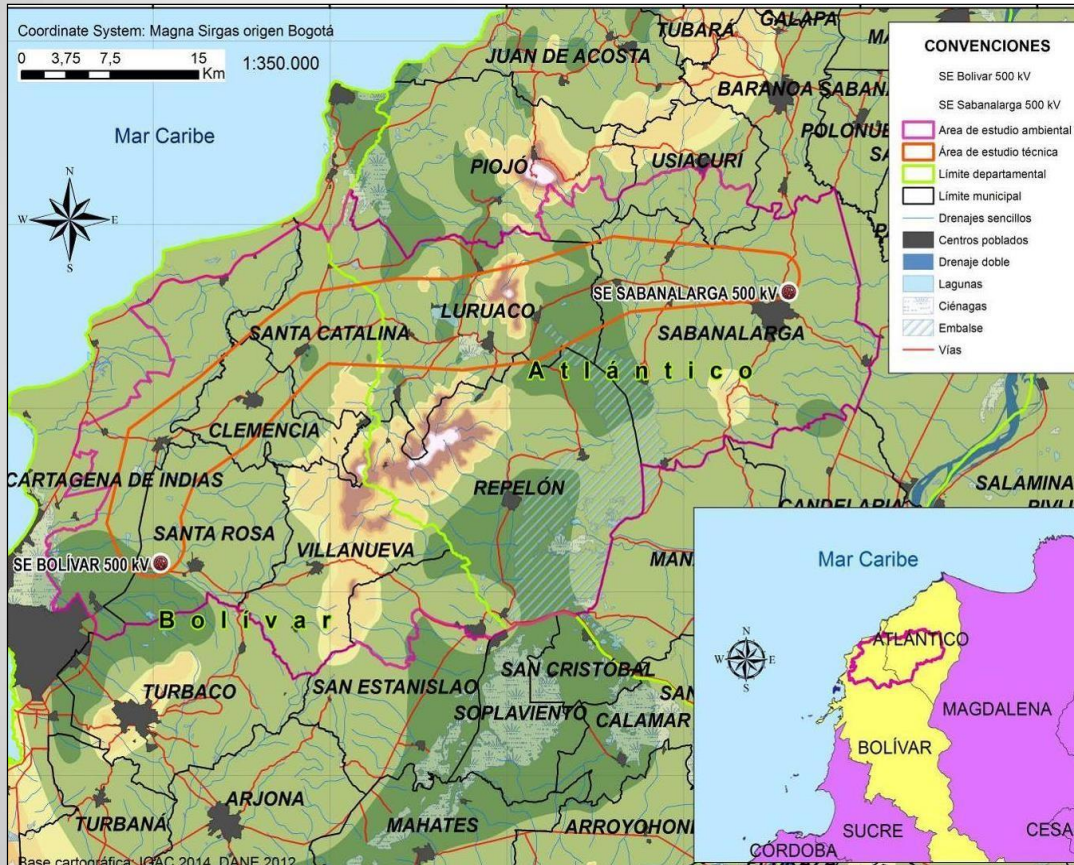
Estimated (USD)
36782130

Award hearing
oct-17

STN- Wind conection 500 kV



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Description

- Transformer 500 / 230kV of 450MVA in the existing substation in Betulia.
- Transformation bay at 500kV.
- Transformation bay 230kV.

Objective

To guarantee reliability (continuity) and security of the service in Santander, Cesar and La Guajira. • Increase limits of energy transfer between areas.

Departament
SANTANDER

Date of entry into operation
2022

Estimated (USD)
15.618.679

Investors that Trust in Colombia



PROCOLOMBIA
EXPORTS TOURISM INVESTMENT COUNTRY BRAND



Spain

endesa

Endesa, a subsidiary of the Italian Enel Group, acquired a shareholding in the Emgesa and Betania power generation companies with an installed capacity of 2,895 MW.



Italy

enel

Between 2017 and 2019, the Italian multinational Enel will invest around USD 561 million in energy projects in Colombia.



United States

 **AES**

Colombian subsidiary of the AES Corporation (Applied Energy Services). Chivor is one of the largest power generation companies in the country with an effective installed capacity of 1,000 MW.



Germany

steag

The low-grade coal thermal power plant, Termopaipa, located in Paipa, was the first foreign power plant planned, funded and built by STEAG.

TAIKU PALDIES EΥΧΑΡΙΣΤΩ TANAN благодаря
SHUKRAN DANKE TERMA KASSIH DÍKY
GRATIAS 감사합니다 MATONDO MAAKE NANNI DIAKUIU
HVALA GRACIAS MOCHCHAKKERAM DIOLCH
TÄNAN DIAKUIU MERCI SPASIBO дякую FALEMINDERIT

THANK YOU

הודות ASANTE CHOKRANE ESKERRAK MISAOTRA GRAZIE
谢谢 OBRIGADO ARIGATO VINAKA
SULPÁY SPASIBO
DIOLCH ACIU DIOLCH WELALIN TAK KÖSZÖNÖM
EKELE NGIYABONGA MATUR NUWUN KIITOS DZIEKUJĘ