



RENEWABLE ENERGY

TOWARDS A JUST ENERGY TRANSITION

SUSTAINABLE ENERGY TRANSITION

5 REASONS TO INVEST IN RENEWABLE ENERGIES

1 High potential to generate energy with non-conventional energy sources. The availability of resources exceeds the world average, such as sunlight, wind, water, biomass, and geothermal resources, to produce low-emission hydrogen.

2 Colombia's Reindustrialization Policy has as its main goal a fair, self-sustainable, quality and accessible energy transition, with the objective of increasing installed capacity in **renewable projects to 6 GW by 2026.**

3 According the decarbonization objectives, it will increase the share of cleaner energies in the energy matrix to achieve a **51% reduction in greenhouse gas emissions by 2030 and carbon neutrality by 2050.**

4 Fourth emerging market for renewable energy investment out of 107 countries¹.

5 Robust institutions and a sector-specific regulatory framework that includes **incentives** to promote foreign direct investment to **diversify the energy matrix and democratize access to clean energy.**

¹ClimateScope, BNEF, 2022.
²WEF 2021

INVESTMENT OPPORTUNITIES

1. High potential to develop **renewable energy generation projects**



Solar



Wind Power



SHPs



Biomass



Geothermal



Hydrogen

2. New expansion works of the **transmission and distribution infrastructure** to ensure reliability



Transmission expansion works



Smart grids



3. Development of **sustainable energy solutions** for Non-Interconnected Areas.



Individual photovoltaic systems



Battery storage

RICH POTENTIAL THANKS TO A DIVERSE GEOGRAPHY AND FAVORABLE CLIMATE CONDITIONS

SOLAR



Colombia surpasses the world average solar radiation by 60%, reaching **4.5 kWh/m²**.

WIND



Potential of **50 GW Onshore** and **50 GW Offshore**. In La Guajira, wind speeds are between **9 – 12 m/s**, double of the world average.

HYDRO



More than 740,000 watersheds and a multiannual flow of 52 m³/s. **65 GW** hydropower potential capacity. **67%** of the energy is produced by hydroelectric power.

BIOMASS



Potential of more than **500,000 TJ** of biomass per year.

GEOTHERMAL



Potential of more than **1.5 GW**.

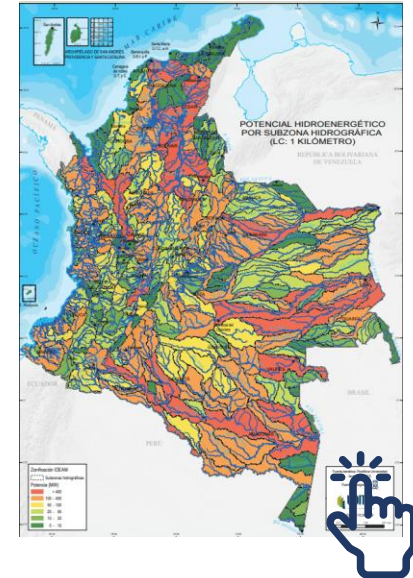
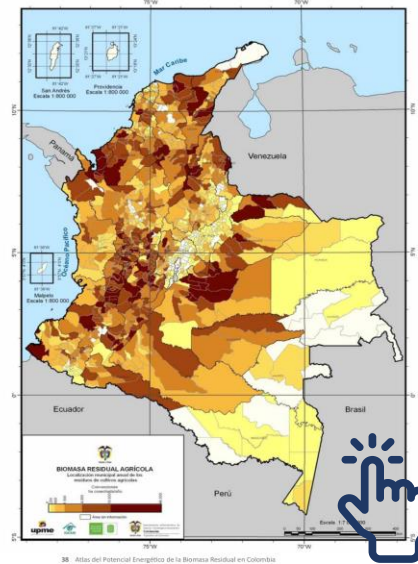
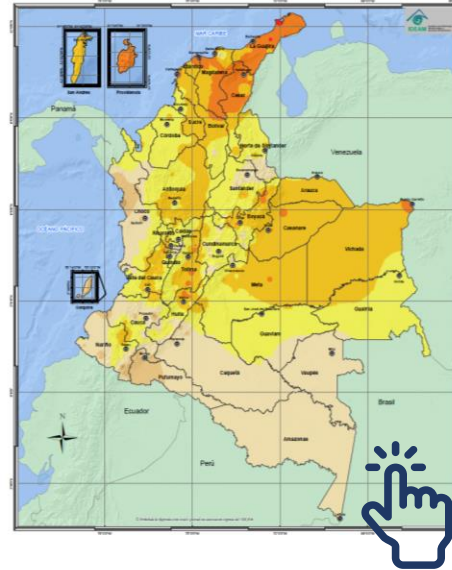
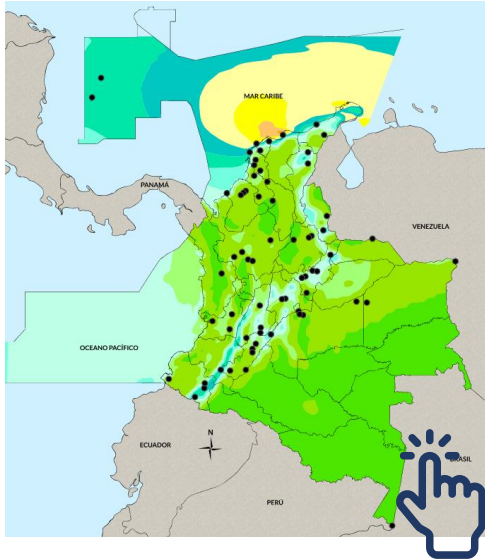
GREAT POTENTIAL TO DEVELOP RENEWABLE ENERGY PROJECTS

SOLAR POWER POTENTIAL

WIND POWER POTENTIAL

BIOMASS POWER POTENTIAL*

WATER POTENTIAL**



Click on the map and explore the potential by region

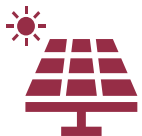
*The map shows the municipal location of agricultural waste. Colombia also has biomass potential in the livestock and urban organic solid waste sectors.

** National Water Study- IDEAM- Annual map of annual runoff for a typical wet year, year 2018.

Source: UPME National Mining and Energy Planning Unit

ENERGY MATRIX PROJECTIONS

Projects in Operation



+60* Solar Projects



1 Wind Farm



Roadmaps published for offshore wind and hydrogen

Connections granted*:
23,867.6 MW*



68% 16,329.71 MW



11% 2,527.55 MW



4% 1,018.84 MW



17% 3,991.5 MW

Expected Installed Capacity
by 2032: **42,737 MW***



39% 16,626.57 MW



35% 15,976.7 MW



17% 7,024.67 MW



9% 4,009.92 MW






* Source: UPME, March, 2024

** (Q1, 2023)
* Source: UPME

* Source: UPME

COLOMBIA HAS A DYNAMIC MARKET OF RENEWABLE ENERGY GENERATION PROJECTS

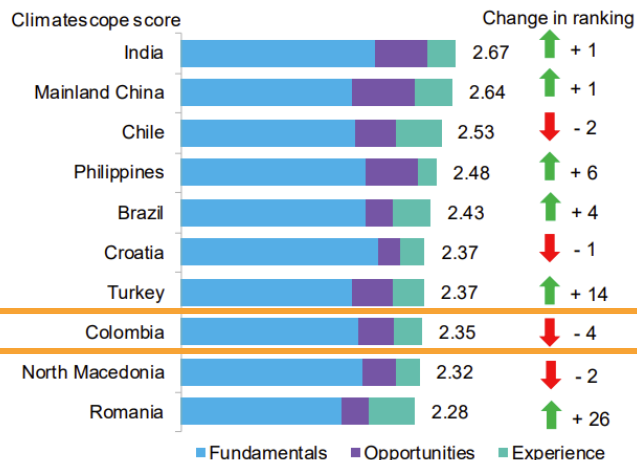
ENERGY GENERATION PROJECTS - UPME REGISTRY

		Installed Capacity (MW)		# of Projects					
Solar		Phase 1	4,554.78	99	SHPs		Phase 1	196.08	22
		Phase 2	6,803.17	108			Phase 2	255.14	13
		Phase 3	149.10	6			Phase 3	21.97	2
		Total	11,507.05	213			Total	520.8	42
Offshore Wind		Phase 1	5,134.90	12	Biomass		Phase 1	17.70	3
		Total	5,134.90	12			Phase 2	25	1
Onshore Wind		Phase 1	1,310.50	9	Total		Total	42.70	4
		Phase 2	1,597.00	10			20,065.34	288	
		Total	2,907.50	19					

Phase 1: Pre-feasibility; Phase 2: Feasibility; Phase 3: Detailed Engineering

THIRD INVESTMENT DESTINATION IN RENEWABLE ENERGY IN THE AMERICAS

Top 10 emerging markets in the power sector, by Climatescope score



- Investment in clean energy in Colombia was around USD 1,178.4 million in 2022, an increase of 23.66% from 2021 (USD 952.95 million).

ENERGY MARKET OUTLOOK IN COLOMBIA



Colombian energy sector policy's general objective is to achieve a Just Energy transition, promoting **Non-Conventional Energy Sources** - (FNCER in Spanish) and guaranteeing equal access to such sources.



Electricity generation, transmission, distribution and commercialization activities are considered **public utilities** to be provided under Colombia's authority and supervision.



Governed by the **constitutional principles** of free economic activity, free private initiative, free competition, and private ownership.

The Colombian electricity sector is divided into the **National Interconnected System** (SIN in Spanish) and the **Non-Interconnected Zones** (ZNI in Spanish).

The **Colombian Electricity Wholesale Market** (MEM in Spanish) aims to sell and purchase large blocks of electricity, either in the spot or contract markets.



ENERGY SECTOR IN COLOMBIA: KEY FACTS

In 2022, energy generation, effective capacity and demand grew by 4.02%, 5.73% and 3.31% respectively.



**Energy Generation
(GWh)**



**Effective Capacity
(MW)**

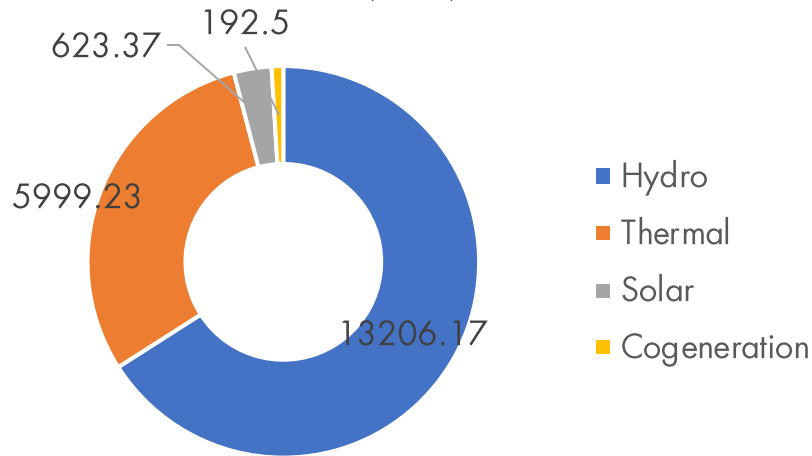


**Energy Demand
(GWh)**

	Energy Generation (GWh)	Effective Capacity (MW)	Energy Demand (GWh)
2022	76,905	18,777	76,654
2021	73,934	17,759	74,117
2020	69,324	17,484	70,422
2019	70,114	17,462	71,925

COLOMBIA HAS A GREEN ENERGY MATRIX

Effective capacity 2024* by Source
(MW)



Total 2024* effective capacity was **20,039.69 MW**, of which more than **70.06%** was green, mainly with hydropower plants, and the remaining **29.94%** is non-renewable.



TWO ROADMAPS FOR NEW TECHNOLOGIES

BOOSTING THE FUTURE OF ENERGY TRANSITION

HYDROGEN

USD 5.5 BILLION OF INVESTMENT IN H2 PRODUCTION AND DEMAND PROJECTS BY 2030

GOALS 2030

PRODUCTION



1-3 GW*

Electrolysis capacity between 1.5 - 4 GW of NCRE



1.7 USD/kg LCOH* green



50 kt* H2 – 2.4 USD/kg

Blue hydrogen production

DEMAND



1,500 – 2,000

Light-duty fuel cell vehicles

1,000 – 1,500

Heavy-duty fuel cell vehicles



50 – 100

Public access hydrogen fueling stations



40% low carbon H2 (Green and blue) of total industry consumption



Demand 2030: 120 kt per year

Demand 2050: 1,850 kt per year

CROSS-SECTORIAL



Between **7,000 - 15,000** direct and indirect jobs



0.7 Mton CO2 avoided annually



The main trade destinations will be **South Korea, China, Japan, and the United States.**

30-YEARS ROADMAP



Scan to download

- With the support of the Interamerican Development Bank – IDB and the UK Government the [Colombia's hydrogen roadmap](#), launched in 2021.
- **Colombia is updating its strategy** in alliance with GIZ – German Cooperation.

Source: Ministry of Mines and Energy

NCRE: Non-Conventional Renewable Energy *LCOH: The levelized cost of hydrogen. Kt: kilotons, a unit of energy

HYDROGEN AND PTX INITIATIVES AND PERSPECTIVES

FIRST PILOT PROJECTS



Industrial feedstock
(Refinery)



Injection into the natural
gas network



Sustainable
Mobility



First Hydrogen
Hub
(Launched in July 2023)

NEXT STEPS



Refineries
(large-scale
Green H₂)
60 MW each
(COD: 4Q 2025 – 1Q 2026)

PTX Production Pilots
Ammonia, methanol e e-fuels (2025)

Blue
Hydrogen
Residue Gasification
(2030)

Barrancabermeja
\$ 1.4-3 BUSD

- Distributed H₂
- Centralized H₂
- LOHC
- Ammonia
- E-fuels

Cartagena

\$137-155 MUSD



Barrancabermeja

\$135-152 MUSD



195 Kton/Year

55%
Refinery
Consumption

45%
Derivatives
Production

2.3 Mton/Year

CO₂ Captured,
available for long-term
sequestration

93% CO₂
Capture rate

Waste to Energy:

- H₂
- SynGas
- Liquid Fuels

OFFSHORE WIND

OFFSHORE WIND PROJECTS DEVELOPMENT

Enerxía and **BlueFloat Energy** are advancing in the development of **Vientos Alisios Project**. The project has: i) approved prefeasibility before DIMAR for the maritime concession; and ii) approved connection to the Bolívar 500kw substation.



Capacity: 200 MW



Location: Barranquilla

Barranquilla, Colombia: **MOU with Copenhagen Infrastructure Partners' (CIP) New Market Fund I K/S**, to develop the megaproject.



Capacity: 350 MW



Location: Barranquilla



Investment: Up to 1 Billion

Atlantic Energy Group is currently development in a prefeasibility phase **three offshore wind projects** that will be located at both sides and in the Magdalena River mouth and will aim at using the generated energy to produce green hydrogen and export it.



Added Capacity: 1.1 GW



Location: Barranquilla and Sitionuevo

PIONEERS IN OFFSHORE WIND ENERGY, TAKING ADVANTAGE OF WIND SPEED IN THE CARIBBEAN

With the support of the World Bank, the British Government and Renewables Consulting Group, the final report of the Offshore Wind Roadmap for Colombia was launched on April 5th.



Scan to download

“Low” Scenario: Colombia could have 200 MW of offshore wind power by 2030; 500 MW by 2040; and 1.5 GW by 2050.

“High” Scenario: Colombia could have 1 GW of offshore wind power by 2030, 3 GW by 2040 and 9 GW by 2050, but a significant procurement program and coordinated transmission development is required.

2050 **20%** Of the installed capacity
244 Million Tones CO2 emissions avoided



Potential: 50 GW
(2.8 times the current installed capacity)



Areas: 13 in the Northern coast (Atlantico, Bolivar, Magdalena and La Guajira).



Fixed Technology: 6,800 km²
Floating Technology: 5,400 km²



Wind speeds: Greater than 10 m/s in some areas. In La Guajira offshore wind speed exceeds 12m/s.



Water depths: below 70 m along most of the coastline.



Expected Investments by 2050: USD 27 Billion.



Expected new jobs by 2050: 50,000.

GEOHERMAL

GEOTHERMAL ENERGY PILOTS IN DEVELOPMENT

Parex Resources, the Universidad Nacional de Colombia in Medellin, and the National Government developed the first two pilot projects for hydrocarbon cogeneration from the use of the calorific potential of oil well fluids.



In March 2021, Parex Resources launched its first geothermal power generation pilot at the Maracas field.



Production: 100 kW - 72,000 kWh



Location: San Luis de Palenque, Casanare



Impact: replaces 5 % of the energy generated from fossil fuels and reduces up to 550 tons of CO2 equivalent per year.

The main purpose of the Campo Rumba is to take advantage of the high temperatures and volumes of water produced in the extraction of hydrocarbons to generate electric energy with heat exchange and electric generation equipment.



Production: 100 Kw – 672 kWh/day



Location: Casanare



Impact: replaces 8 % of the energy generated from fossil fuels and reduces up to 550 tons of CO2 equivalent per year.

A PRIVILEGED GEOGRAPHICAL POSITION AND A FAVORABLE GEOLOGY



Geothermal Potential: more than **1,182 MW**.



Regions: **Caldas, Risaralda, Tolima and Nariño**



Excavation required for evaluations and modeling:
1.5 to 3 km



Local interested companies: **Ecopetrol, EPM, Enel, Gensa, Sierracol y Parex.**

The geothermal potential is evident in areas adjacent to volcanoes



Volcanoes with High-enthalpy geothermal: **Nevado del Ruiz, Chiles Cerro Negro, Cerro Machín, Cerro Bravo, Paramillo de Santa Rosa, Santa Isabel, Paipa, Puracé, San Diego, Doña Juana, Galeras, Azufral y Huila**



Sedimentary basins: **Llanos Orientales, Valle Medio del Magdalena, Cordillera Oriental, Catatumbo, Caguán- Putumayo.**

NON-INTERCONNECTED AREAS

53% OF THE NATIONAL TERRITORY, BY MUNICIPALITY, NEED TO DEVELOP GREEN ENERGY SOLUTIONS

➤ *Non-interconnected zones (ZNI) are municipalities, localities, townships and hamlets not connected to the National Interconnected System*. They represent:*

18 Departments | **76** Municipalities

239,000 Total users | **1,769** Localities

Total Installed Capacity of **307 MW**,
of which **41.7** MW from Non-Conventional Renewable Energy Sources



Sources: IPSE, 2022

* Public electricity service providers located in the ZNI can develop, in an integrated manner, the activities of generation, distribution and commercialization.

TRANSMISSION PROJECTS

5 agents have a 73.5% share of the country's energy transmission and distribution networks

Agent	Total Kms.	Share
 isa INTERCOLOMBIA	13.569,92*	45,92%
 epm	2.725,44	9,22%
 Grupo Energía Bogotá	2.356,50	7,97%
 CELSIA	1.898,64	6,42%
 enel	1.173,41	3,97%
Otras	7.829,86	26,49%
Total	29.553,77	100%

* Includes Transelca, a company of Grupo ISA.

Source: [Paratec-XM](#), March 11, 2024

ENERGY TRANSMISSION INFRASTRUCTURE TO ENSURE A JUST TRANSITION

IN 2023

15 | **Transmission Public
calls will be launched**

12 | National Transmission Projects (STN)

3 | Regional Transmission Projects (STR)

Including substations, transmission lines, and
Transformers

2 | **Public Calls
Officially Open**

Sahagun, Bolivar

Further information available at **UPME**

INSTITUTIONAL AND MARKET SCHEME

THE COUNTRY HAS A WELL-ESTABLISHED INSTITUTIONAL FRAMEWORK



These mechanisms ensure investment security, establish clear rules for all players and reduce uncertainty.

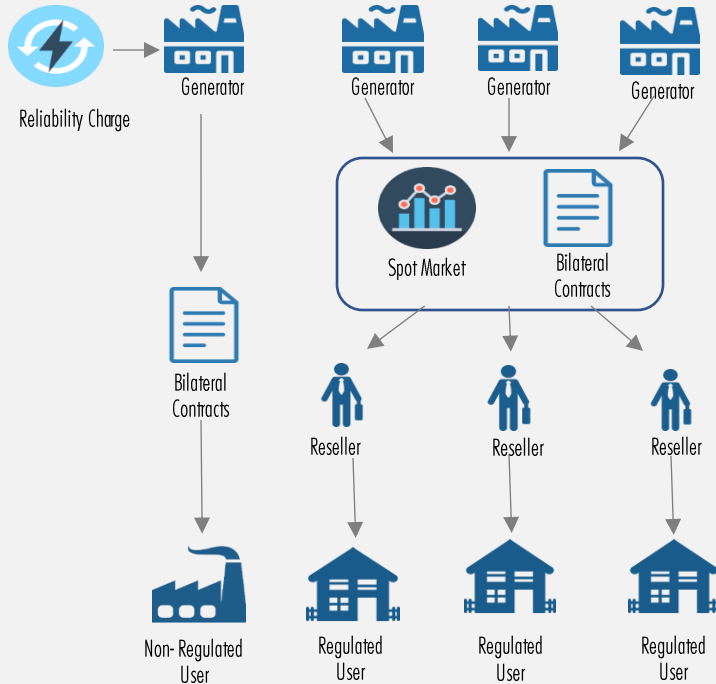
3 ADDITIONAL KEY ACTORS !

Institute for Planning and Promotion of Energy Solutions for Non-Interconnected Zones (IPSE in Spanish)

National Authority for Environmental Licenses (ANLA in Spanish)

National Prior Consultation Authority (Ministry of the Interior)

ENHANCED BY A RELIABLE WHOLESALE MARKET FOR ENERGY TRANSACTIONS



Wholesale Energy Market (WEM) Transactions

Spot Market

- Generation companies declare availability of energy and bid prices at daily auctions
- XM dispatches supply orders to plants with an effective capacity >20 MW

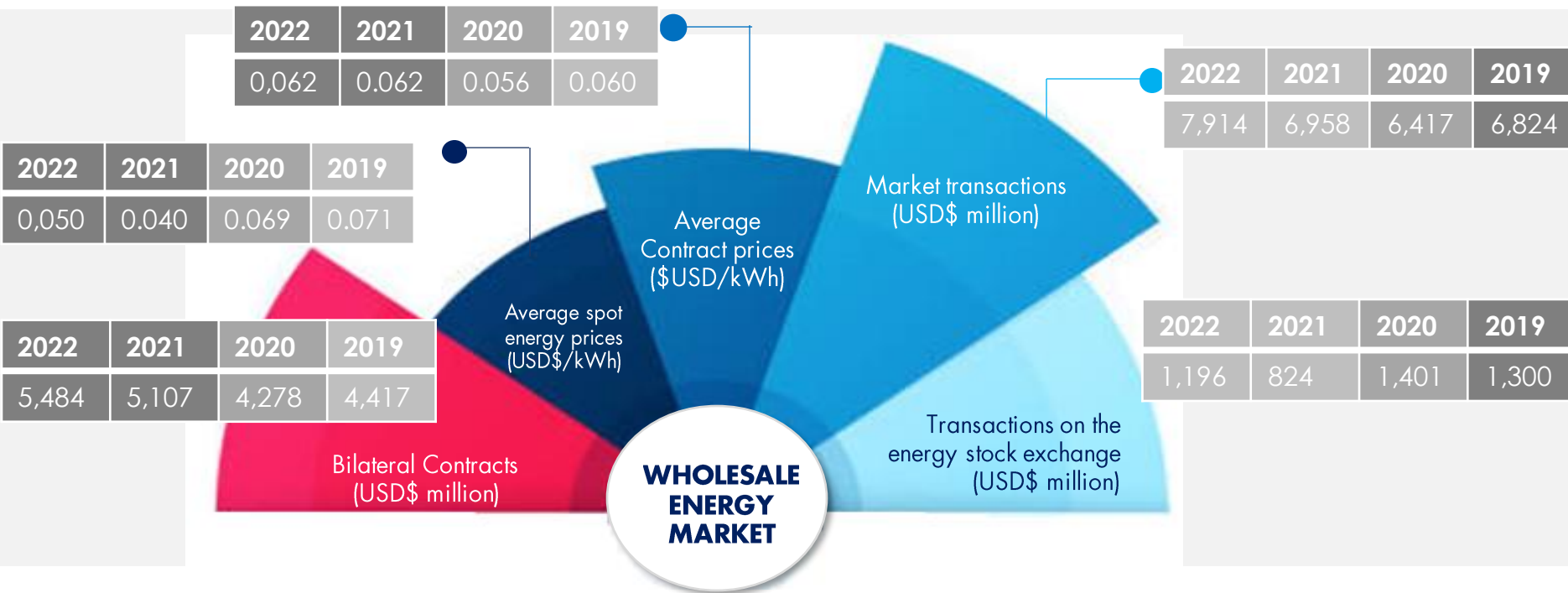
Bilateral Contracts

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

Reliability Charge (Firm Energy Obligations – OEF in Spanish)

- Mechanism for securing generation capacity
- Pays a stable amount to the generation company
- Commitment to generate power in times of scarcity

2022, YEAR OF HIGHEST TRANSACTION VOLUMES IN THE WHOLESALE ENERGY MARKET WITH A GROWTH OF 12%



Source: XM, 2023

*Average Exchange Rate 2022: 4326.77 COP/USD. 2021: 3,747.24 COP/USD. 2020: 3,693.36 COP/USD. 2019: 3,282.39 COP/USD

REGULATORY FRAMEWORK AND INCENTIVES

AN ATTRACTIVE FRAMEWORK FOR ENERGY INVESTMENTS

Incentives for generation with renewables / GEE

- **Deduction from income tax 50% of investment, up to 15 years** from the year following the one in which investment came into operation.
- **VAT exclusion** on imports, national acquisition, of equipment, elements, machinery, and of national / imported services.
- **Exemption of import duties** for machinery, equipment, materials, supplies, without national production.
- **Accelerated depreciation up to 33.33% as global annual rate** for machinery, equipment, civil works for pre-investment, investment and operation, acquired and / or built.

Incentivos GEE / CCUS

- **Income Discount up to 25% of investment**, without prejudice to 50% special deduction. Only investments to reduce consumption / energy efficiency that correspond to environmental goals.
- **VAT Exclusion – GEE* and CCUS**** Only GEE investments that correspond to environmental goals for equipment, elements, national or imported for construction, installation, assembly, operation, control and monitoring systems, to comply with provisions, regulations, and environmental standards.

Alternative incentive / RPO***

- **Exempt Income from sales of energy generated with renewables for 15 years from 2017.**
- **Starting in 2023, wholesalers will guarantee that at least 10% of annual purchases to serve end users come from renewables**, through long-term contracts within the framework of market mechanisms, with supply periods equal to or greater than 10 years.

*GEE: Efficient Energy Management. **CCUS: Carbon Capture-Use-Storage. ***RPO: Renewable Purchase Obligation

THE COUNTRY HAS DESIGNED A MODERN RENEWABLE ENERGY AUCTION PROGRAM.



The objective is to maximize the benefit to consumers through efficient long-term pricing.



The auction is aimed at energy generation projects with non-conventional sources. The auction seeks to diversify the energy matrix, improve energy security and reduce dependence on oil price volatility.



The type of auction is two-sided, with voluntary participation of buyers and sellers.



The auction is open to any trading agent in the Wholesale Energy Market, regardless of whether it participates in the regulated market, the non-regulated market or both.



The result of the auction is a financial contract, of the " payment according to contract" type, with an hourly price equal to the sale price; with a duration of 15 years.

SUCCESS STORIES

WORLD MAIN ENERGY COMPANIES ARE INVESTING IN COLOMBIA

A diversified resource base and a strategic location in the Americas



ITALY

Present in Colombia through EnelEmgesa, with 15 hydroelectric and solar power plants that amount to 3.4 GW of installed capacity; and through EnelCodensa, the energy trading company with the largest coverage in the country.



CHINA

In 2018, Trina started in Colombia with a portfolio of 100 MW projects. In addition, a portfolio of 500 MWp, of which 300 MWp will be built in the next year. By 2027, Trina plans to add 1GW of solar parks to the matrix



UNITED STATES

AES advances in Jemeiwaa Ka I, a wind farm complex consisting of 6 parks that will add up to more than 1,000 MW of installed capacity. The company currently has an installed capacity of 1,128 MW and generates over 4,600 GW/h. Furthermore, it consolidates its position as a leader in self-generation in the country.



SPAIN

Enerfin is the wind power arm of Elecnor. In Colombia, Enerfin is developing a portfolio of more than 1,200 MW of wind and solar projects.

RENEWABLE ENERGY AUCTIONS RESULTS

	Projects	Installed capacity	Investment (USD)	Price* (USD/MWh)	# of Jobs	# of Companies
2019	14 (Solar and Wind)	1,300 MW	2.25 billion	Wind: 28.31 Solar: 28.40	6,000	9 Power Generation 22 utilities
2021	11 (Solar)	796.3 MW	875 million	41.53	4,800	9 Power Generation 53 utilities

COLOMBIA AWARDED 1.39 GW OF WIND AND SOLAR IN RELIABILITY CHARGE AUCTION (CONTRACTS FOR 2022-2023)



15.1

USD/MWh

Wind power plants have secured 1.16 GW capacity and 238 MW has been awarded to solar. But most of the winning projects were hydroelectric and thermoelectric.

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THANK YOU