# 2023-2030 Electricity Balance

October 2023

GrupoEnergíaBogotá

We improve lives through
sustainable and competitive energy

# 2023-2028 Electricity Sector

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**2023-2030 Balance**

- Description of assumptions and sensitivities
- Energy balance
- Reliability balance

**Transportation Infrastructure**

- Overview of expansion in the transportation network
- Illustrative explanation of the operation within a system area
- Situation in the eastern area
- Situation in the southwestern area

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**Final Considerations**

- Mitigation measures and strengthening of the electricity sector
- Key elements for the long-term

# 1 2023-2030 Balance

# Summary of assumptions and sensitivities

| Demand scenarios |
|---|
| Middle Scenario (UPME) + 3% (used by the CREG in the 2025-2027 analysis) |
| Upper scenario, 95% Confidence Interval (CI) (UPME) |
| Middle scenario (UPME) |

| Case 1: Projects with obligation | Case 2: Massification of renewables | Case 3: Expansion without wind power | Case 4: Expansion without 2nd stage of Ituango or wind energy |
|---|---|---|---|
| Verified ENFICC of projects with assigned FEO and ENFICC with obligation in long-term contracts*.<br>▪ Includes Termocentro and Cartagena during the timeframe of the analysis.<br>▪ It does not take into account firm energy from operating solar plants that do not have FEO.<br>▪ Windpeshi is not taken into account, since Enel approved its indefinite suspension. | Case 1 + ENFICC of solar plants in operation that do not have FEO + ENFICC of projects included in the XM potential (with and without guarantees) | Case 2 - wind projects | Case 3 and the second stage of Ituango (1200 MW) are not included. |
| **+ 3,293 MW** | **+ 19,480 MW** | **+ 18,133 MW** | **+ 16,933 MW** |

| Capacity Factor: The amount of energy a plant can produce compared to the maximum amount it could produce if it were to operate at 100% capacity for one year. |
|---|
| The ENFICC Factor (Energy Factor at Critical Conditions): The maximum amount of energy a generation plant can provide continuously during a year, in extreme low hydrology situations compared to its maximum capacity if it were to operate at 100% all year round. |

| Hydroelectric | Wind | Solar |
|---|---|---|
| 55% (2017-2023 average) | 55% (XM study Flexibility) | 21% (XM study Flexibility) |
| The current ENFICC of Ituango is replicated for the second stage | 13% (taking into account the ENFICC assigned to La Mata, Sunnorte and la Union.) | 13% (taking into account the ENFICC assigned to Alpha, Beta, Casa Eléctrica and Apotolorru) |

ENFICC: Firm Energy for Reliability Charge. The maximum electricity a generation plant is capable of delivering continuously for one year under low hydrological conditions.
FEO: Firm Energy Obligation. Obligation acquired by a generator to generate a daily amount of energy during the Obligation Period, when the Exchange Price exceeds the Scarcity Price. This obligation is acquired in an auction and allows the company to receive compensation called the "Reliability Charge."
*Long-term contracts associated with renewable energy auctions mandated by the Ministry of Mines and Energy.

# Summary of Results

| ENERGY (Capacity Factor) | Projects with obligation | Massification of renewables | Expansion without wind power | Expansion without 2nd stage of Ituango or wind energy |
|---|---|---|---|---|
| Demand Middle Sc. UPME +3% | No deficit | No deficit | No deficit | No deficit |
| Demand Upper Sc. UPME CI 95% | No deficit | No deficit | No deficit | No deficit |
| Demand Middle Sc. UPME | No deficit | No deficit | No deficit | No deficit |

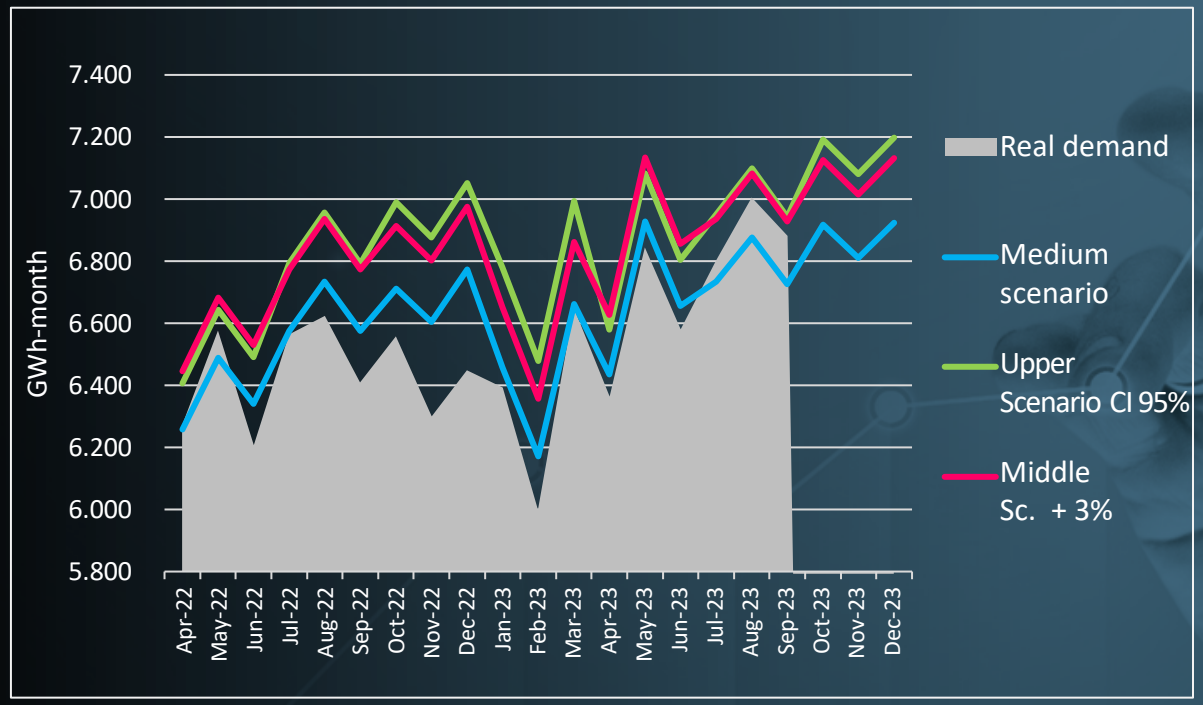
| ENFICC (Energy under critical conditions) | Projects with obligation | Massification of renewables | Expansion without wind power | Expansion without 2nd stage of Ituango or wind energy |
|---|---|---|---|---|
| Demand Middle Sc. UPME +3% | Deficit as of December 2025 | No deficit | No deficit | No deficit |
| Demand Upper Sc. UPME CI 95% | Deficit as of December 2024 | Deficit as of December 2029 | Deficit as of December 2029 | Deficit as of December 2027 |
| Demand Middle Sc. UPME | Deficit as of December 2027 | No deficit | No deficit | No deficit |

ENFICC: Firm Energy for Reliability Charge. The maximum electricity a generation plant is capable of delivering continuously for one year, under extreme conditions of low flow rates.
CI: Confidence interval

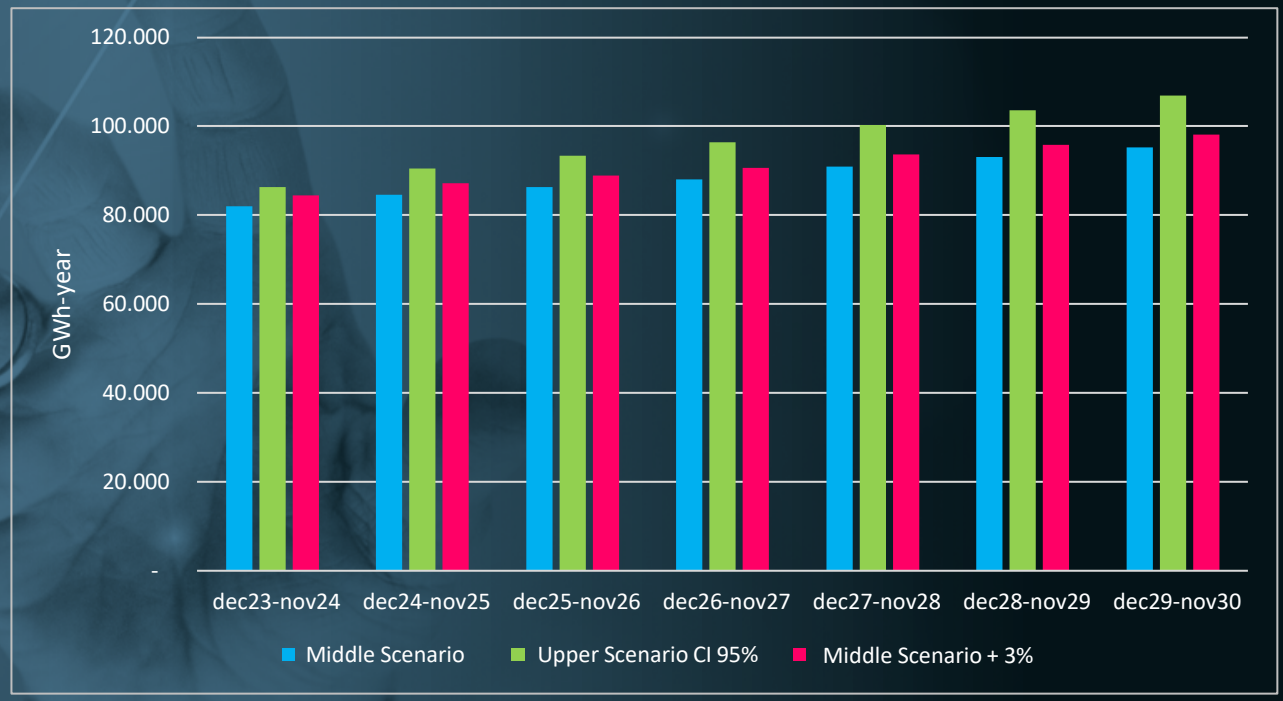
# Assumptions and Sensitivities

## Demand

Monthly Demand 2022-2023*




Projected annual demand December 2023 - November 2030




Source of information: XM & CREG.* The UPME 2022 Revision projection was used between April 2022 and March 2023. The revision of the demand projection published by UPME in 2023 has been used as of April 2023.

# Assumptions and Sensitivities: Offer

**Case 1: Projects with obligation**

Verified ENFICC of projects with assigned FEO and obligation in long-term contracts.

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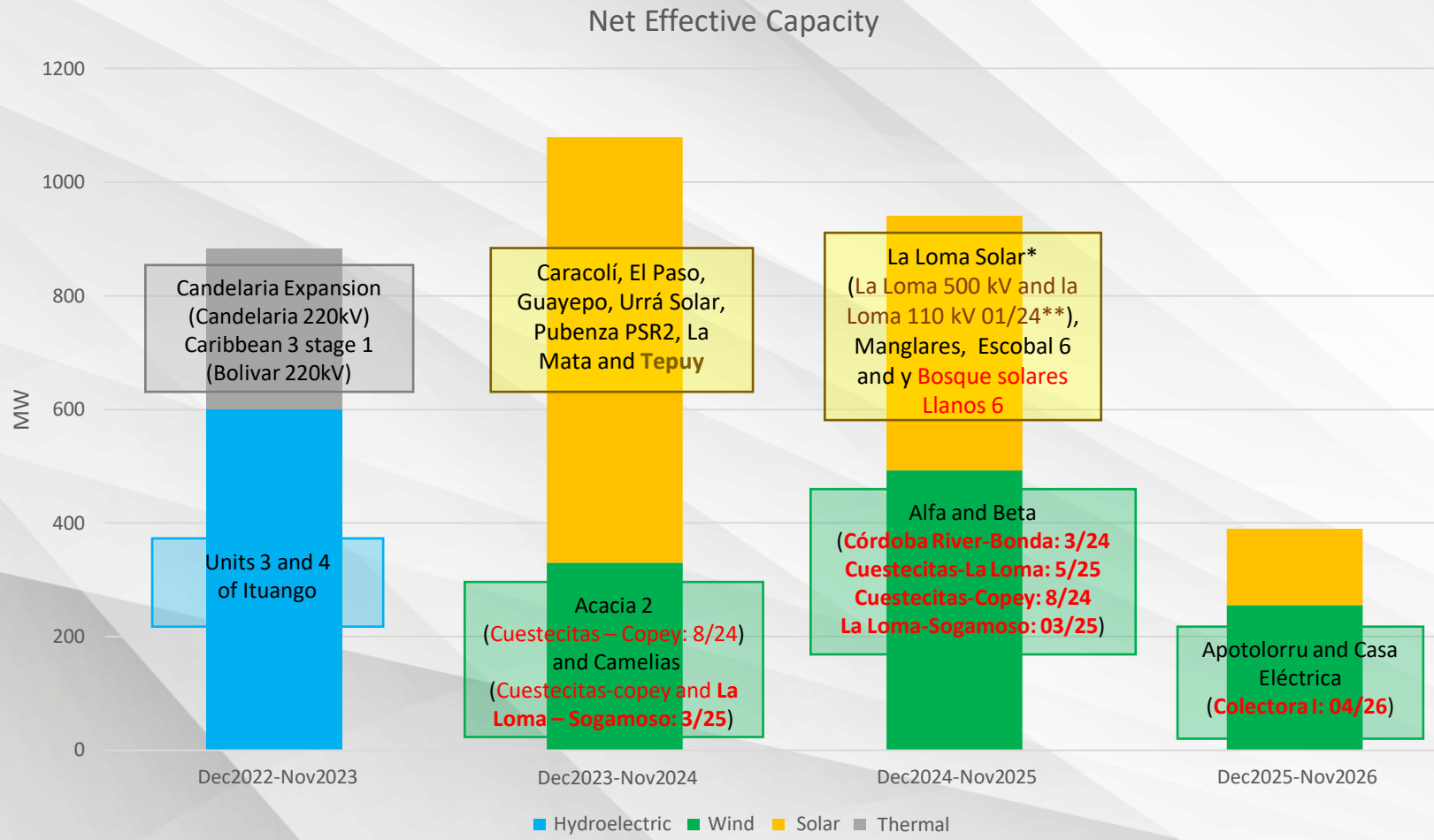
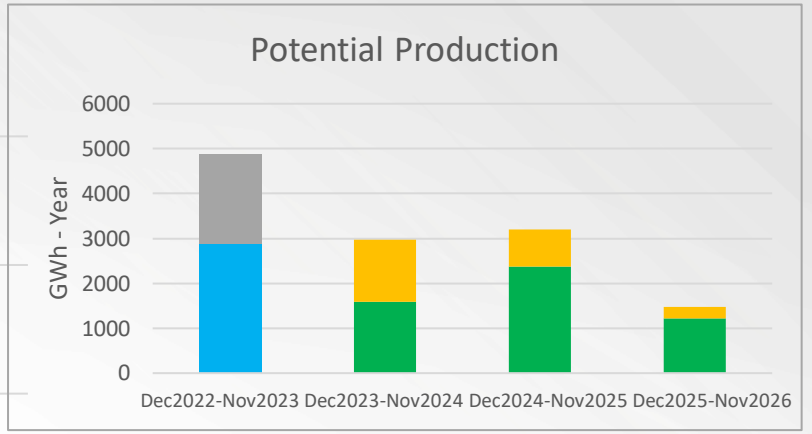
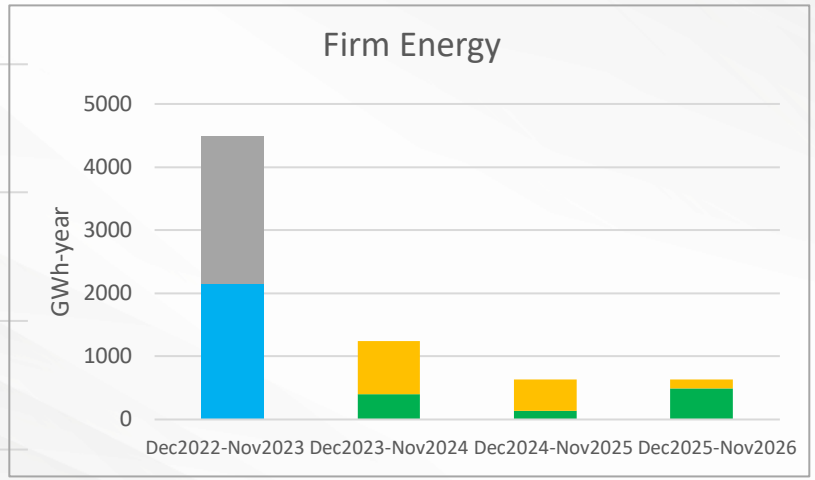


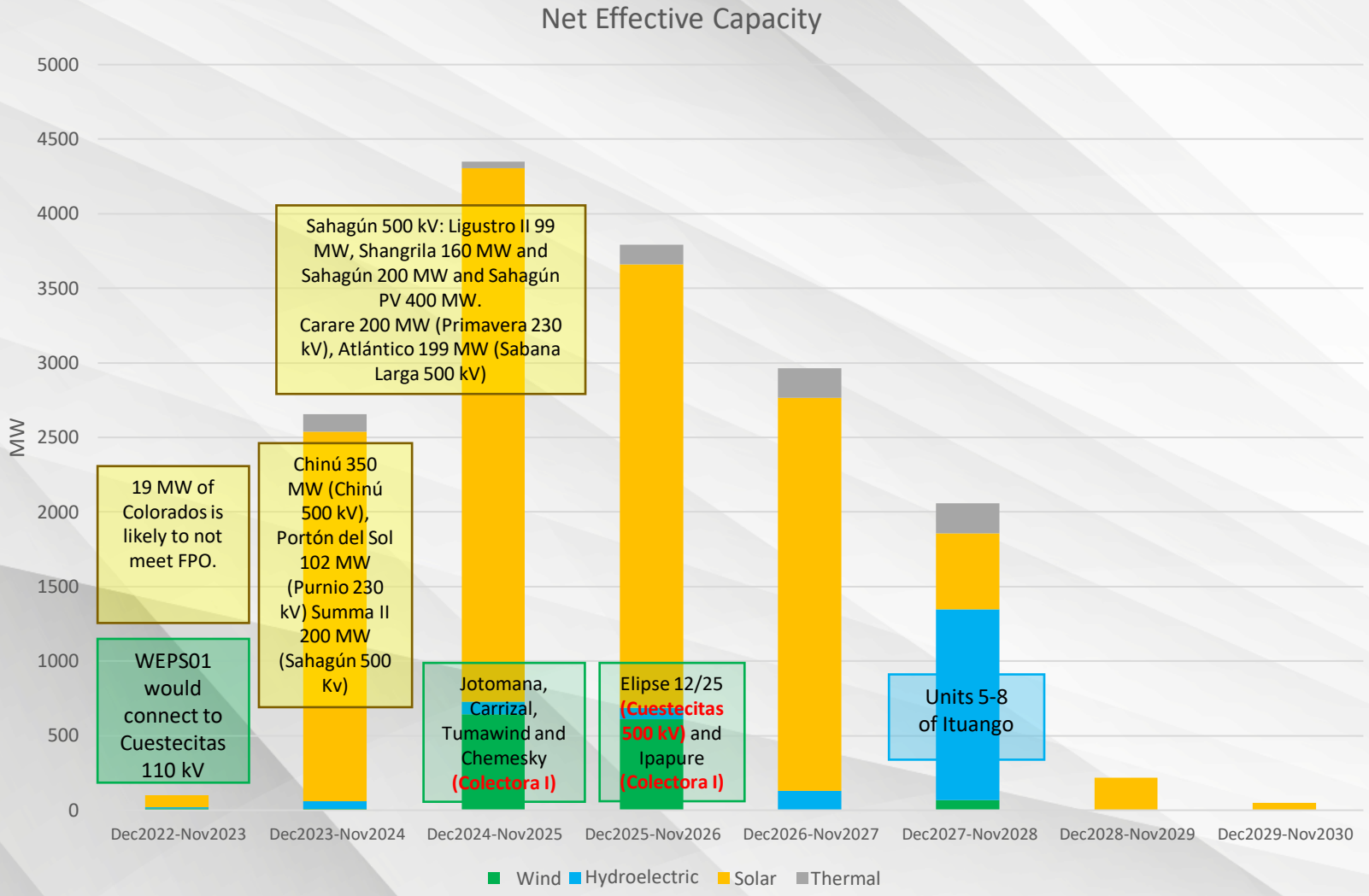

Source of information: Generation projects 13/10/23 XM, ENFICC verified October 2023 XM, Charge Takers 2022 XM, Auction Allocation 22-23 XM, XM project radar sep-23, CNO 718 & Generation project progress reports July 2023 UPME

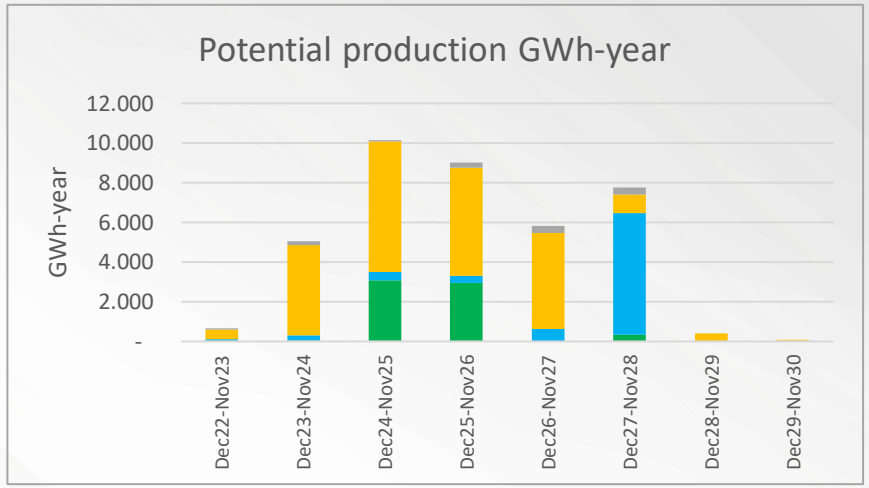
Note 1. With respect to the XM generation projects database, Tesorito, which is already in operation, is removed and La Loma is added, since it is included in the database of projects with Assigned FEO. Note 2. Regarding XM's database of projects with assigned FEO, Windpeshi is not taken into account because Enel approved its indefinite suspension. Note 3. Although Acacia 2 is included in the database of plants with FEO assigned through the charge taker system, it is assumed that it does not have FEO assigned because it is not included in the updated verified ENFICC database of projects with FEO assigned. Note 4. In the case of termocandelaria, the ENFICC published in the FEO allocation report associated with the cycle closure was used. Note 5. The capacity factor of the solar and wind plants in the middle hydrology case obtained in the 4th XM flexibility study was used. For hydro, the average capacity factor between 2017-2023 was used. The capacity factor used for the thermal plants was 80%. The ENFICC factor is taken considering the verified ENFICC of the assigned plants. *La Loma Solar has an allocation for 2022-23, but not for the 23-24 period (possibly due to an FEO assignment) ** Currently requested by Enlaza to the Ministry of Mines and Energy.

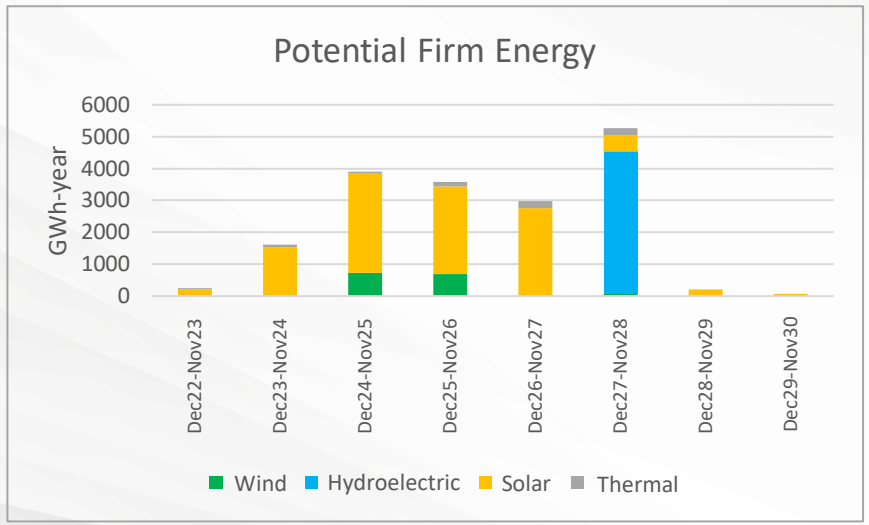
# Assumptions and Sensitivities: Offer

**Case 2: Massification of renewables**

Case 1+ ENFICC of solar projects in operation and other projects contemplated in the XM potential (with and without guarantees).



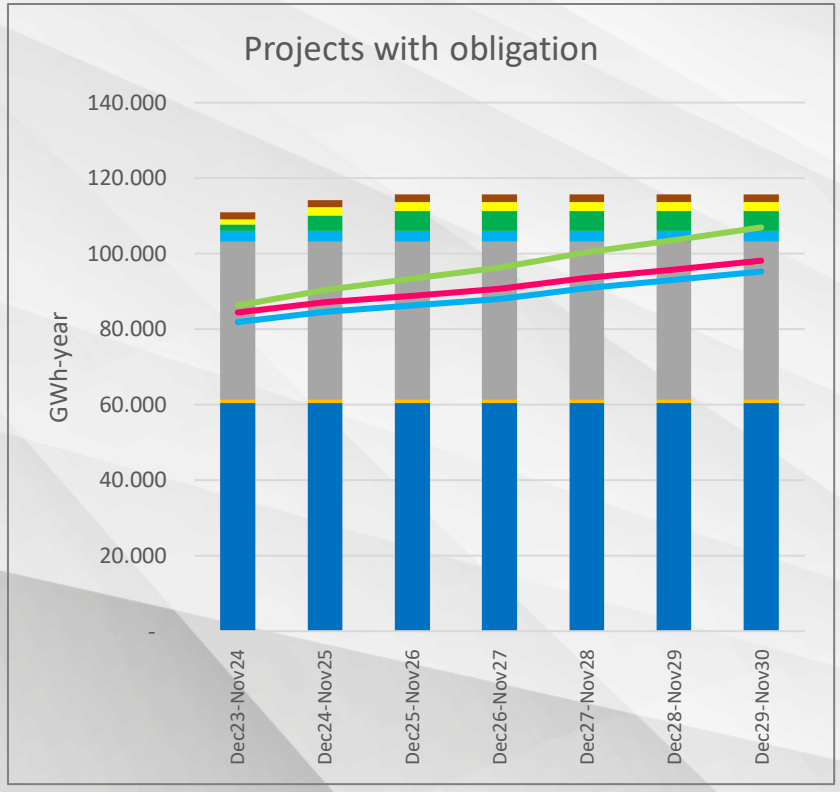



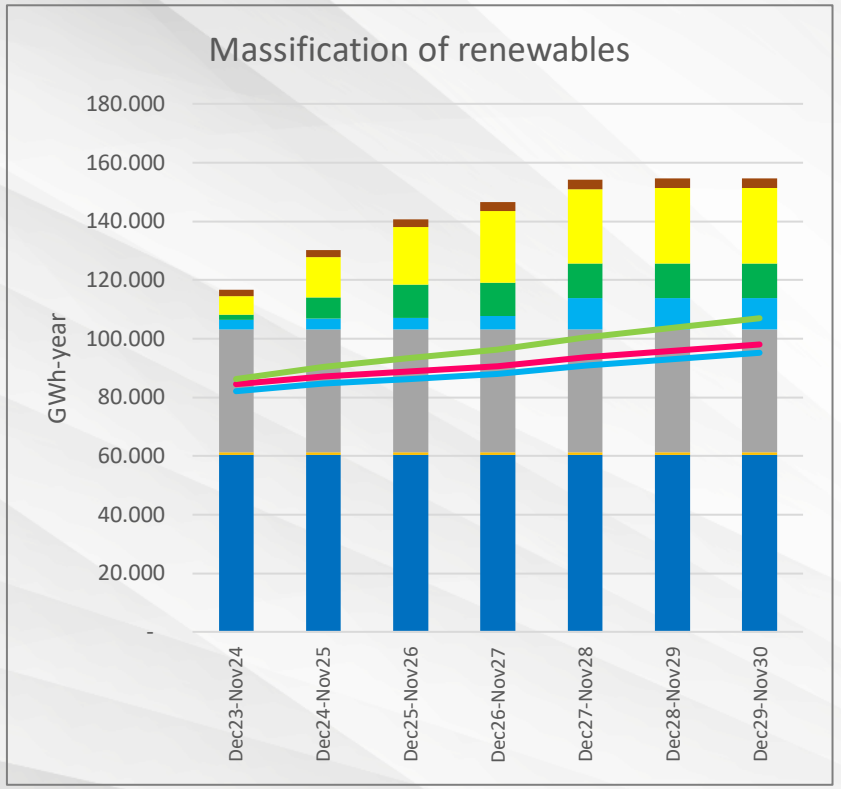

Source of information: Generation projects 10/13/23 XM, XM Project Radar Sept-23,
Note 1. The capacity factor of the solar and wind plants in the middle hydrology case obtained in the 4th XM flexibility study was used. For hydro, the average capacity factor between 2017-2023 was used. The capacity factor used for the thermal plants was 80%. The ENFICC factor is taken considering the verified ENFICC of the plants. Note 2. This scenario includes the second stage of Ituango, since it does not have an associated FEO. Note 2. The 1,200 requests received by UPME for capacity allocation are not included.

# 2023 -2030 Balance: Energy - Capacity Factor

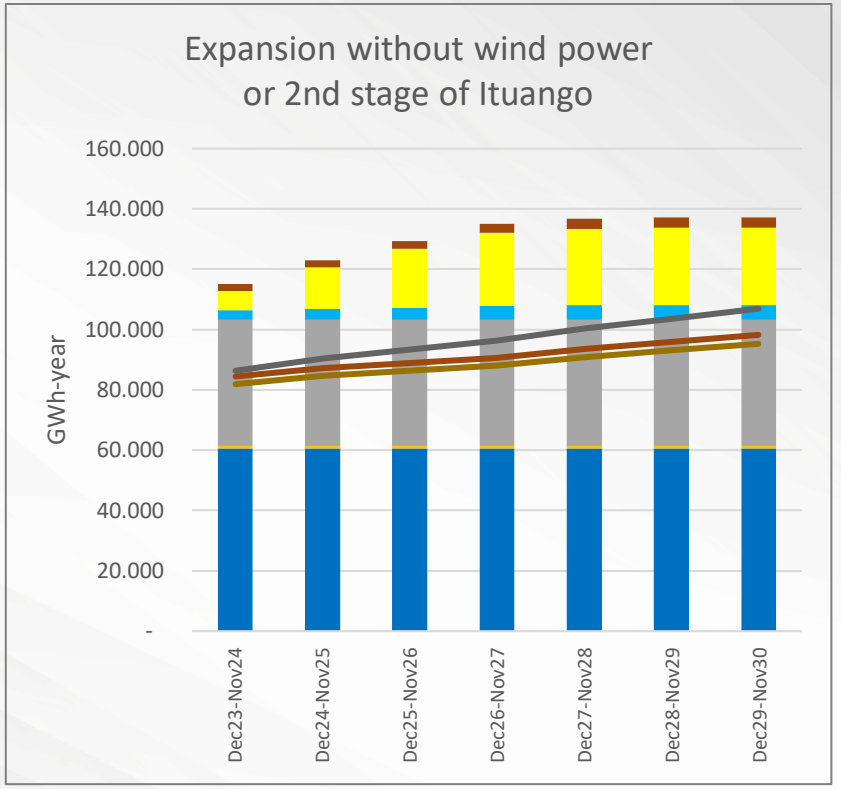
The amount of energy that can be produced by the plants is compared taking into account the capacity factor of each technology compared to the different demand scenarios. There is no deficit during the timeframe of the analysis.




No deficit




No deficit

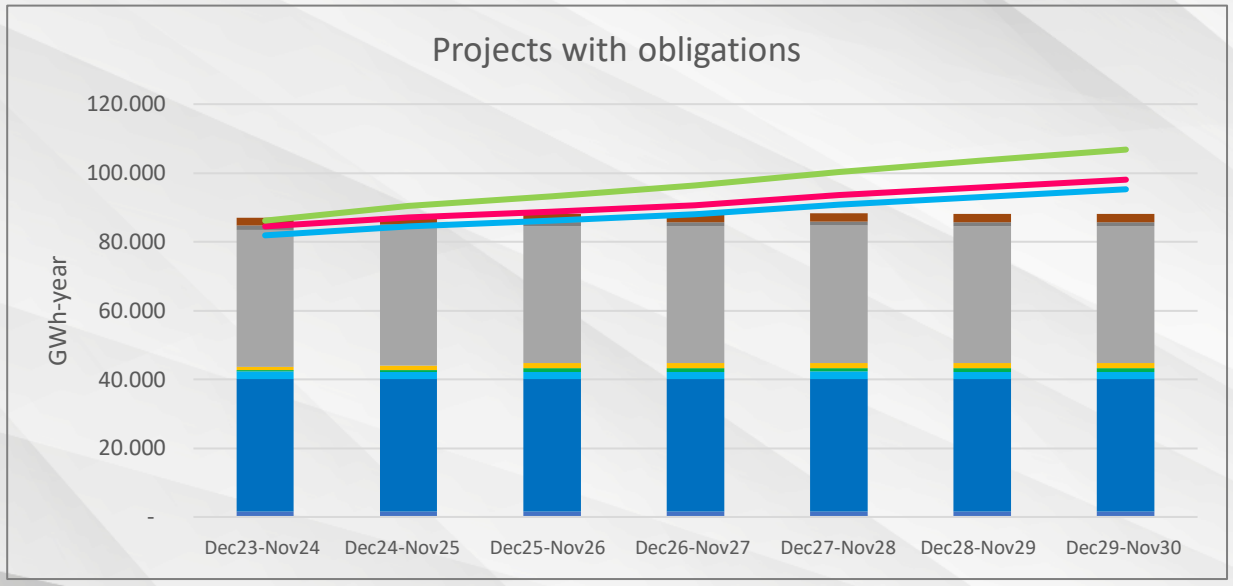


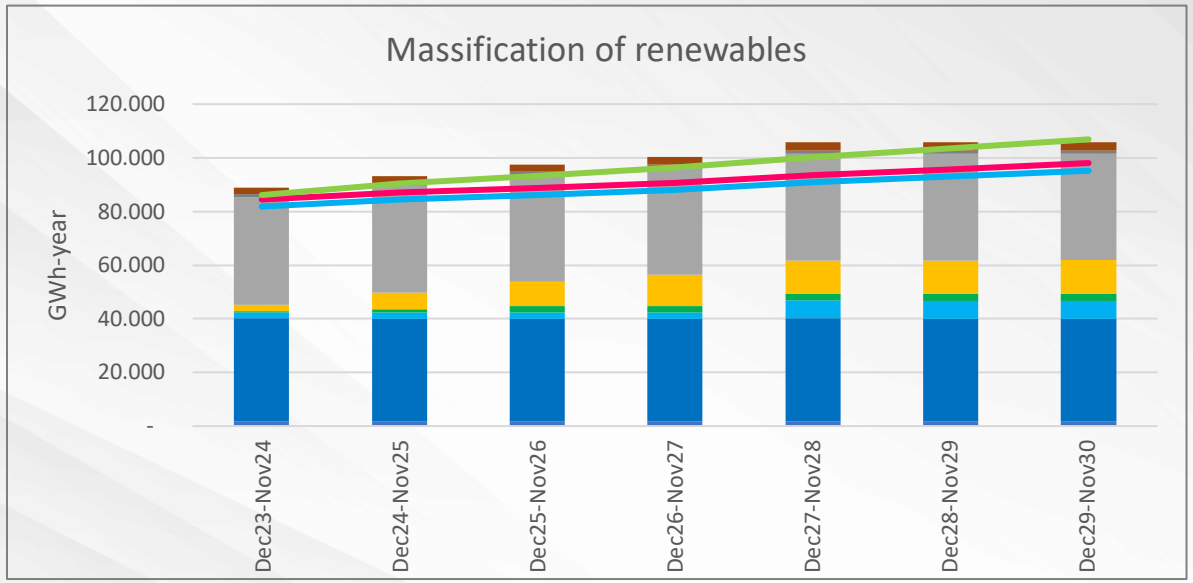

No deficit

Existing hydroelectric
New hydroelectric
New thermal
Existing solar
New wind
Demand Middle Sc. + 3%
Existing thermal
New solar
Upper Demand Sc. CI 95%

# 2023-2030 Balance: ENFICC - Energy under critical conditions

It compares the maximum amount of energy the generation plants could provide continuously during one year in low hydrology situations, compared to different demand scenarios.
In the absence of new projects or increases in demand, a deficit may occur or be anticipated.




| Deficit Period | |
|---|---|
| Demand Middle Sc. +3% | December 2025 - November 2026 |
| Demand Upper Sc. CI 95% | December 2024 - November 2025 |
| Demand Middle Sc. | December 2027 - November 2028 |

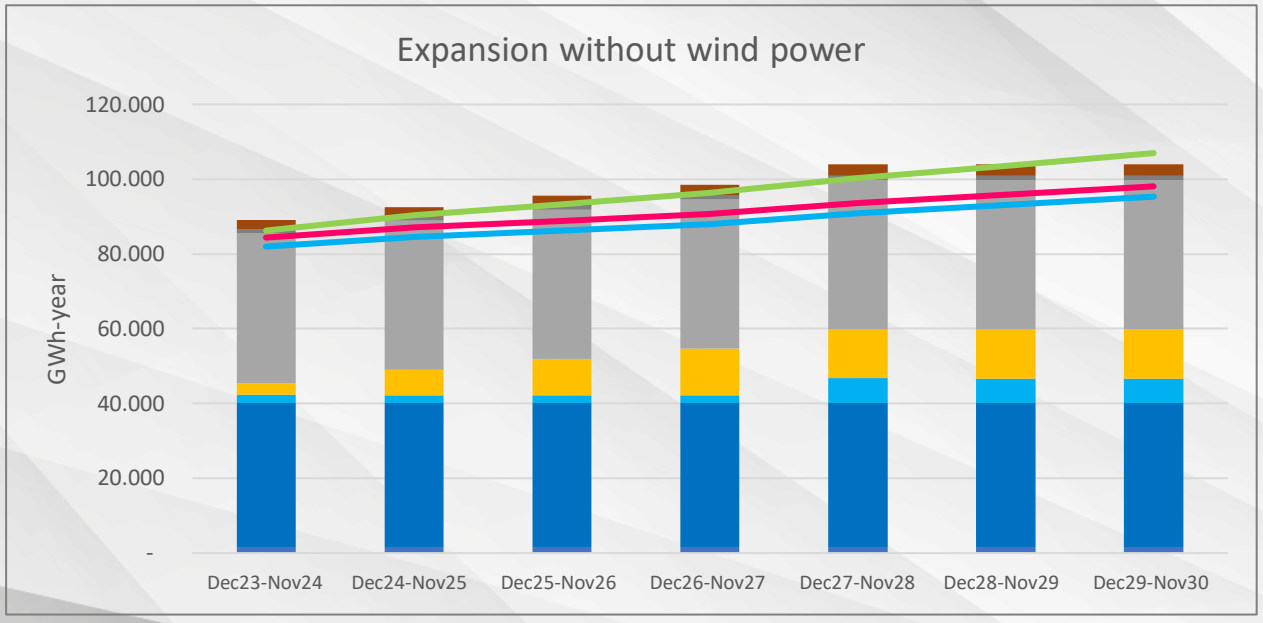
| Deficit Period | |
|---|---|
| Demand +3% | None |
| Demand CI 95% | December 2029 - November 2030 |
| Demand Medium | None |

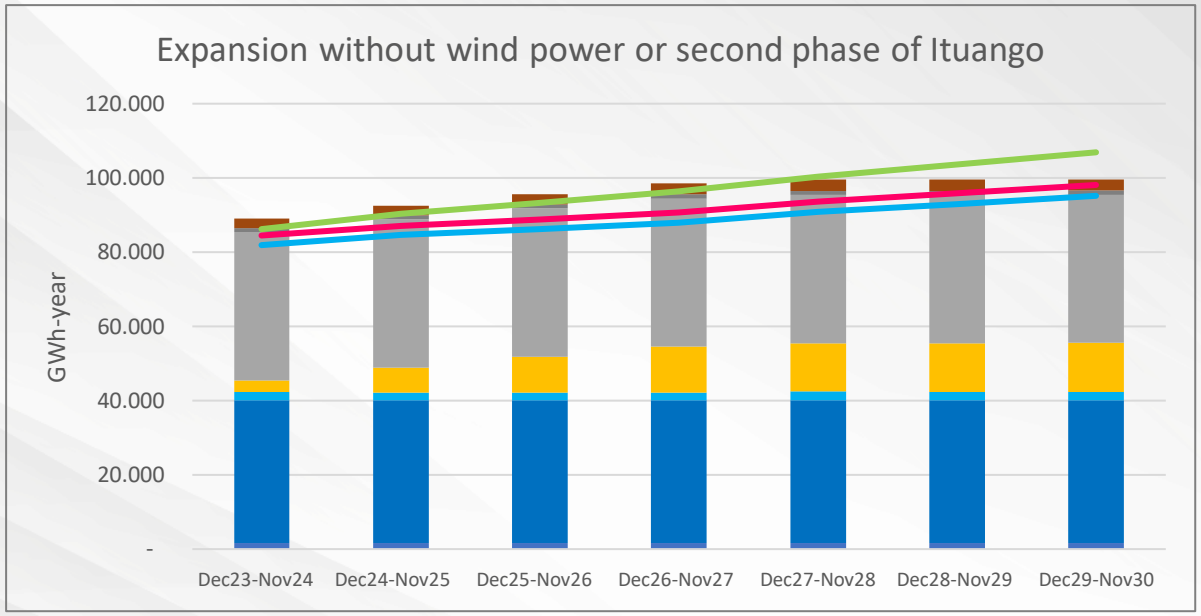
PNDC (Existing) | Existing hydroelectric | Hydroelectric (Expansion) | Wind (Expansion)
Solar (Expansion) | Existing thermal | Termocentro | Thermal (Expansion)
Demand Middle Sc. +3% | Upper Demand Sc. CI 95% | Demand Middle Sc.

*PNDC: Plants not dispatched centrally. ENFICC: Firm Energy for Reliability Charge. The maximum electricity a generation plant is capable of delivering continuously for one year under low hydrological conditions.

# 2023-2030 Balance: ENFICC - Energy under critical conditions

It compares the maximum amount of energy the generation plants could provide continuously during one year in low hydrology situations, compared to different demand scenarios. In the absence of new projects or increases in demand, a deficit may occur or be anticipated.




| Deficit Period | |
|---|---|
| Demand +3% | None |
| Demand CI 95% | December 2029 - November 2030 |
| Demand Middle Sc. | None |

| Deficit Period | |
|---|---|
| Demand Middle Sc. +3% | None |
| Demand Upper Sc. CI 95% | December 2027 - November 2038 |
| Demand Middle Sc. | None |

PNDC (Existing) | Existing hydroelectric | Hydroelectric (Expansion) | Wind (Expansion)
Solar (Expansion) | Existing thermal | Termocentro | Thermal (Expansion)
Demand Middle Sc. +3% | Demand Upper Sc. CI 95% | Demand Middle Sc.

*PNDC: Plants not dispatched centrally. ENFICC: Firm Energy for Reliability Charge. The maximum electricity a generation plant is capable of delivering continuously for one year under low hydrological conditions.

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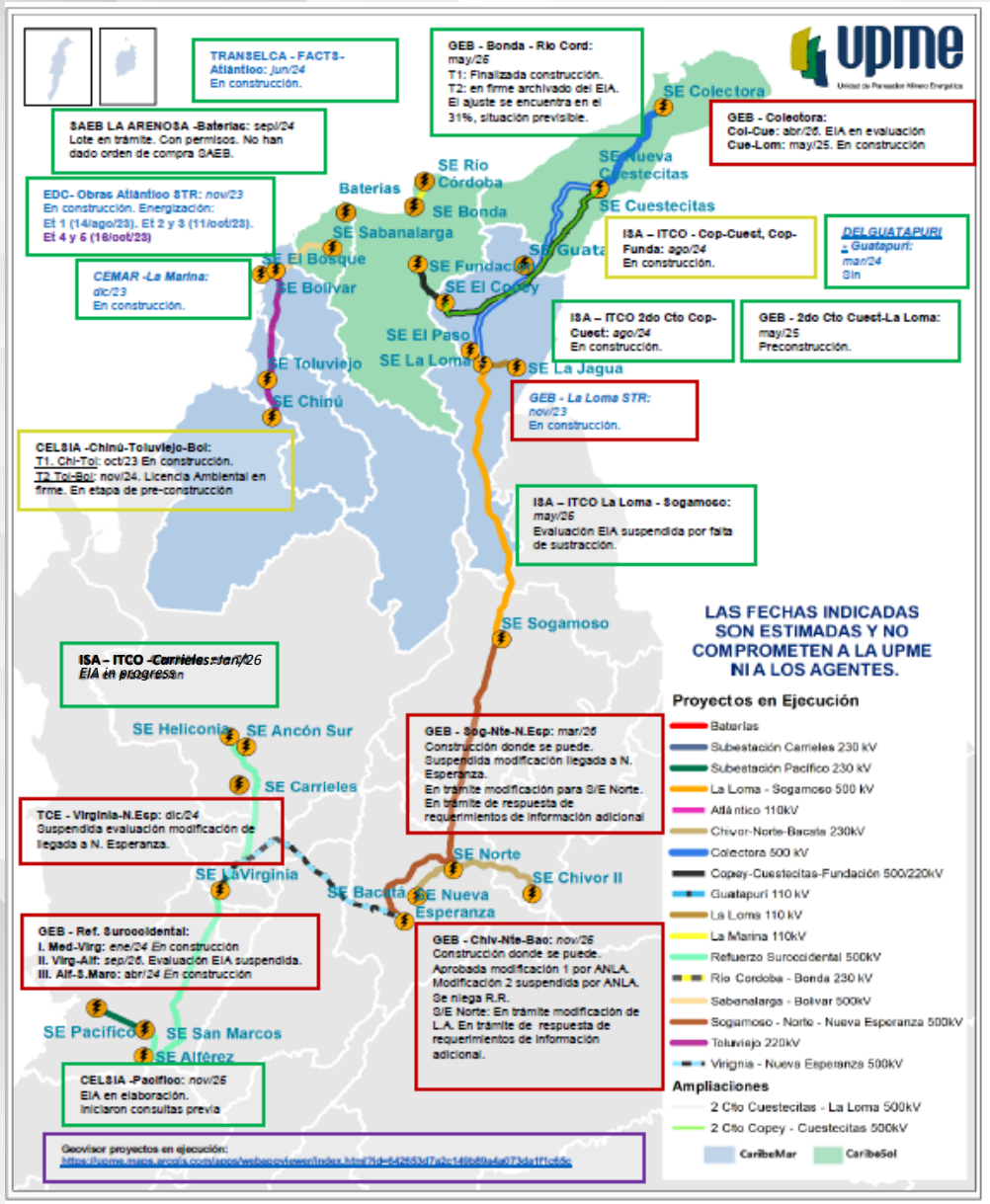
# 2 Transportation Infrastructure

# Overview of expansion in the transportation network

Developing the necessary grid infrastructure is essential to evacuate the high generation available in the Caribbean area and receive energy in the eastern area. If the transmission works are successful, the transmission system is flexible. Otherwise, the Energy Transition will not materialize.




### Caribbean

Córdoba River-Bonda, la Loma STR and Colectora make the start-up of operations of the wind farms with a connection point at the Cuestecitas 500 kV and Colectora 500 kV substations feasible.

### Southwestern

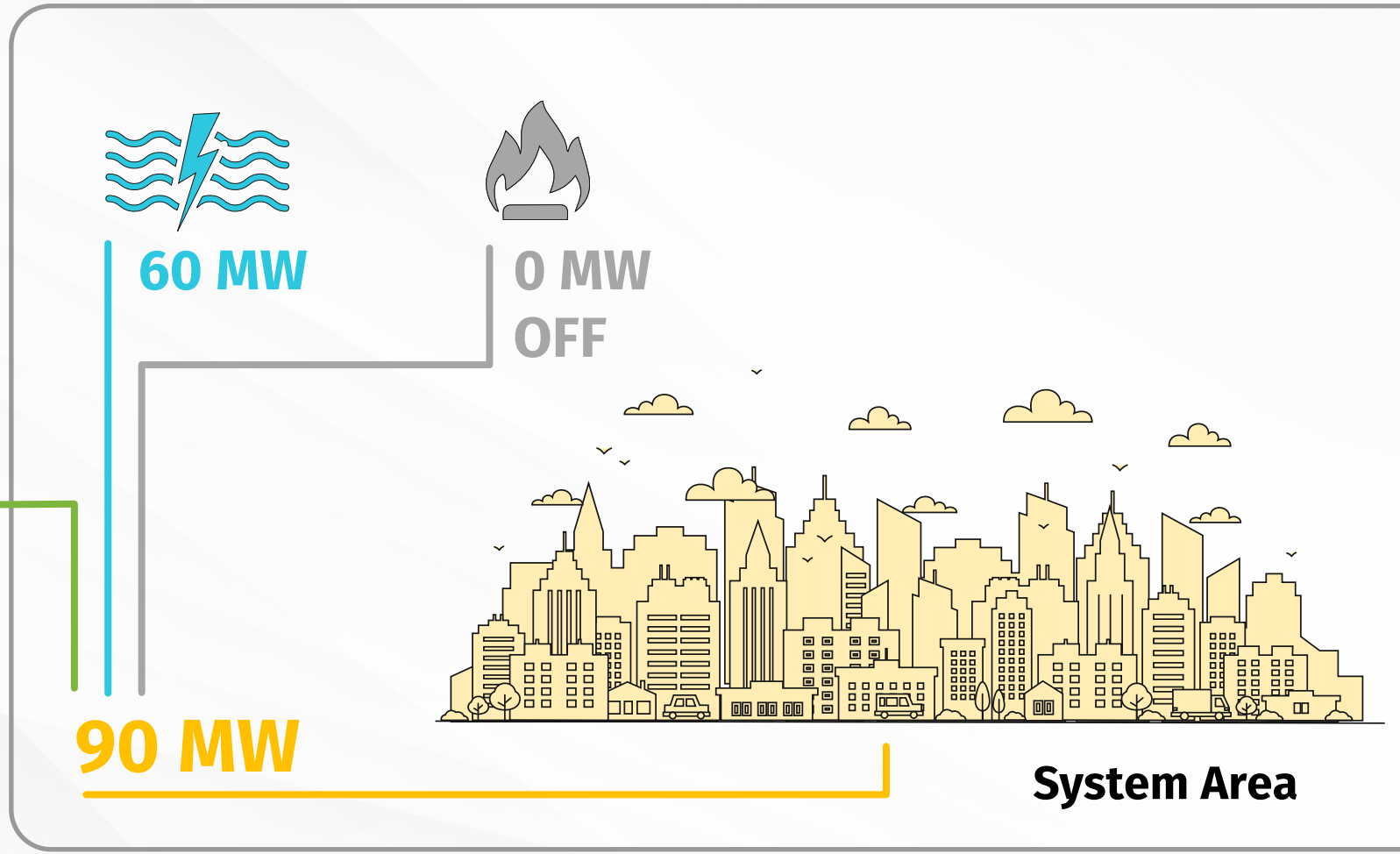
The start-up of operations of Refuerzo Suroccidental 500kV and Tesalia - Alférez 230 kV helps increase the amount of electricity we can import into the region by about 600 MW of additional electricity, reaching a maximum of approximately 1,250 MW.

### Eastern

The Virginia - Nueva Esperanza 500 kV and Sogamoso-Norte- Nueva Esperanza 500 kV projects eliminate grid constraints and guarantee a 100% probability of having the required units for voltage support, even for demands above 3,500 MW.

# Illustrative explanation of the operation within a system area

In the ideal dispatch, the hydroelectric power plant generates 60 MW and imports 30 MW.




**Demand:**
90 MW

**Ideal dispatch:**
60 MW Hydroelectric

**Import:**
30 MW

# Illustrative explanation of the operation within a system area

If the line importing the missing energy goes out of service, 30 MW must be generated with the thermal plant.

Primavera

0 MW

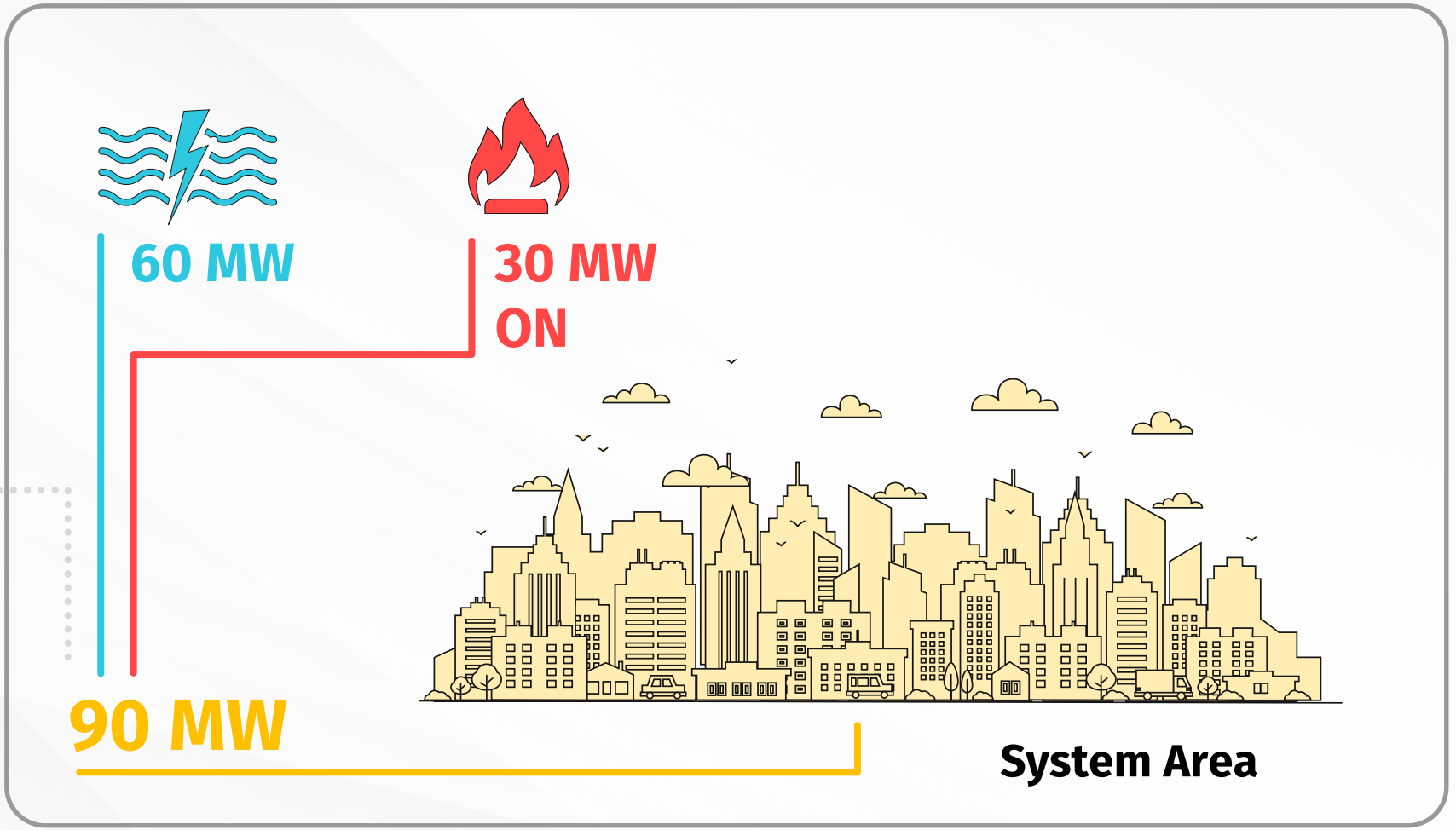
Bacatá

X

**Border line exit**

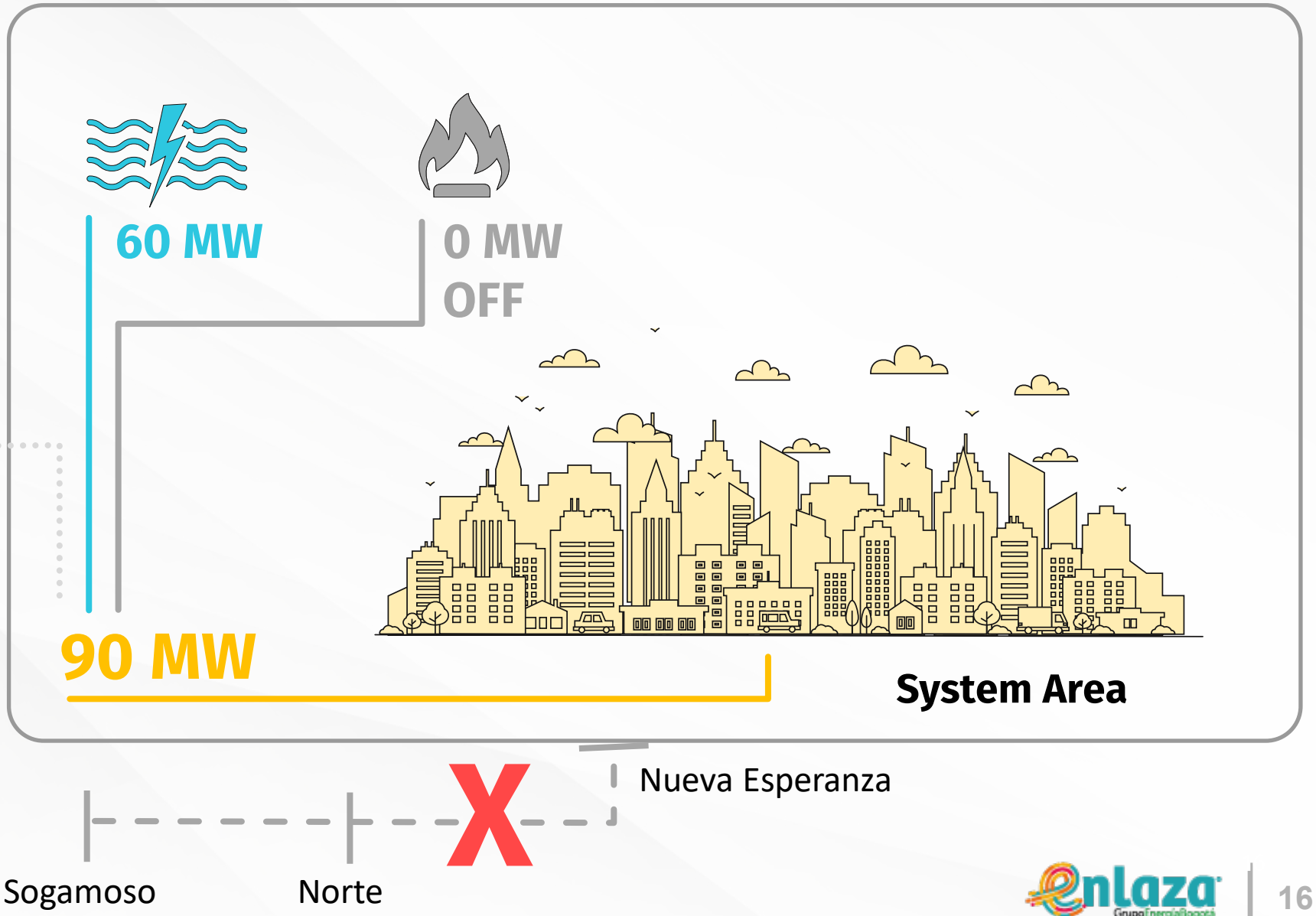
**Demand:**
90 MW

**Dispatch:**
60 MW Hydroelectric
30 MW Thermal

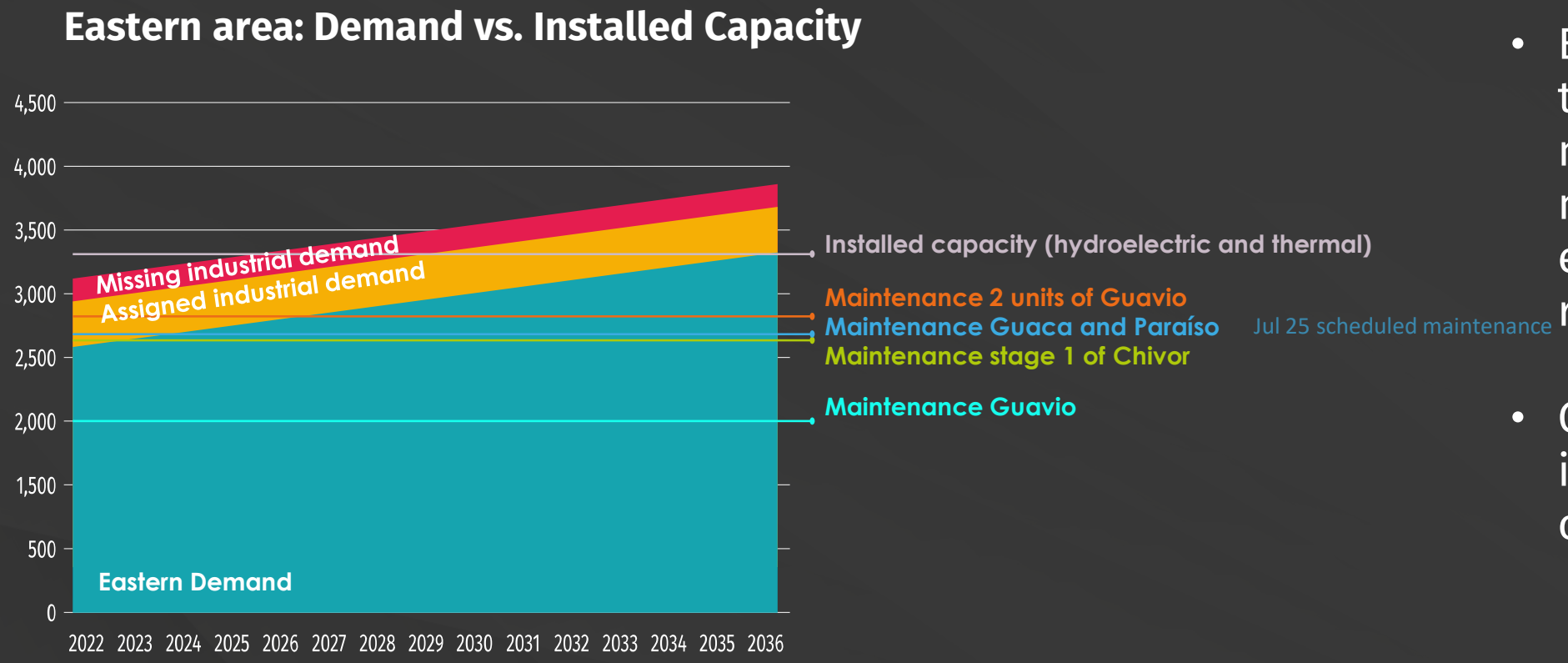


# Illustrative explanation of the operation within a system area

If the thermal plant is undergoing maintenance, it is not possible to meet all the demand due to the disconnection of the interconnection line.



# Situation in the eastern area (including the Bogotá region)



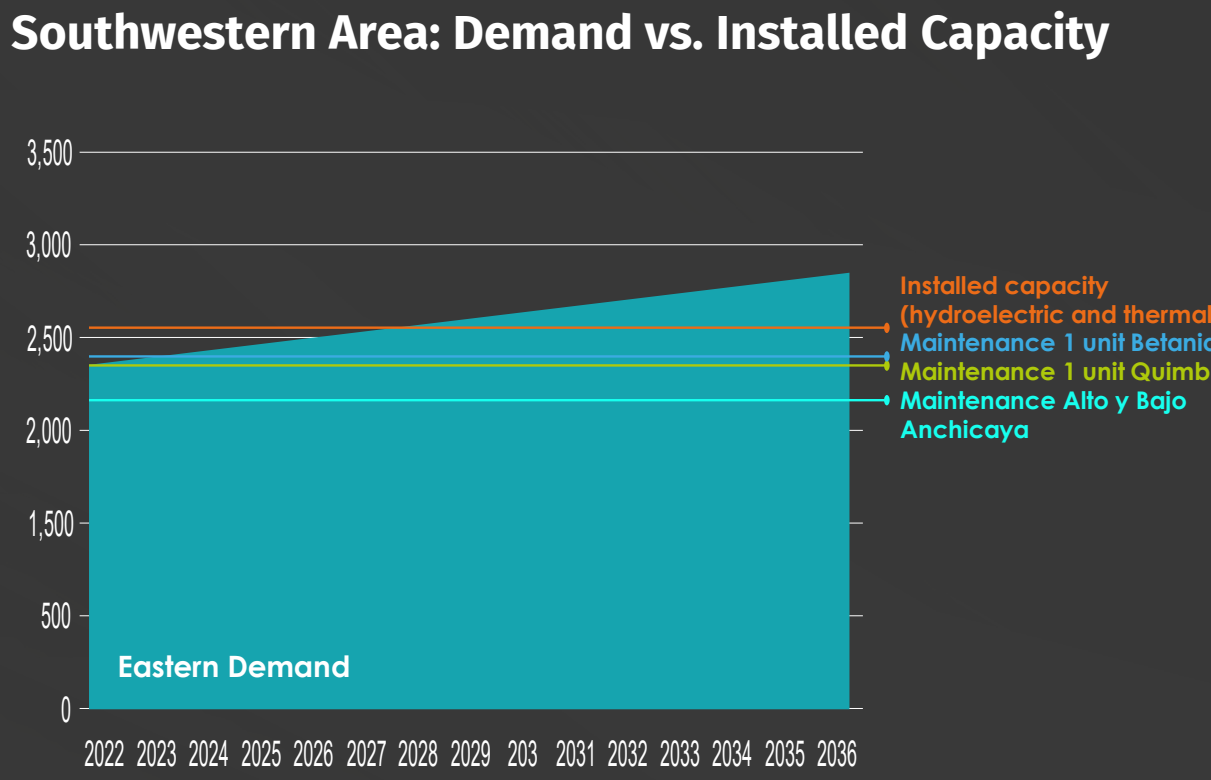

- Between 2025 and 2027, the area's generation will no longer be sufficient to meet demand, and energy imports will be required.
- Generation maintenance increases dependence on import links.

Source: Enlaza 2023

It is essential to achieve effective coordination between the MME and ANLA, and to create mechanisms to expedite the environmental evaluation processes of the EIA of the Norte substation, as well as the two environmental procedures currently being evaluated by the ANLA to make the pending sections of lines feasible. This approach will allow us to move towards developing key transition projects and avoid operational constraints and risks for the Eastern Area, which includes the country's capital.

# Situation in the southwestern area (including Cali)

- Between 2025 and 2027, the area's generation will no longer be sufficient to meet demand, and energy imports will be required.
- Generation maintenance increases dependence on import links.




Source: Enlaza 2023

It is essential to achieve effective coordination between the Ministry of Mines and Energy and ANLA and to create mechanisms to expedite the environmental processes associated with the environmental licensing of Section 2 of the Southwest Reinforcement. It is also important to make the proportionality test feasible to be able to develop projects and a fair benefit for the communities. This approach will allow us to move towards developing key transition projects and avoid operational constraints and risks for the Southwest of the country.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# Final Considerations

# Mitigation measures and strengthening of the sector

Short term

Long term

## DEMAND

### Energy efficiency

El Niño Phenomenon Energy Efficiency Campaign ★

Implementing tariffs that vary according to the time of day in which power is consumed.

### Tariff Stabilization

Tariff stabilization fund to recover the accumulated balances of the tariff option with signs of rational use of electricity. ★

## GENERATION

### Strengthen Bid Control

Apply CREG Resolution 101-018 of 2023 and publish the results of the evaluations via ASIC. Perform an ex-post evaluation of the evaluation tool.

### Increase Supply on the Stock Exchange

- Adjust clause 1 of section c of article 7, article 8 and 10 of CREG Resolution 11 of 2015.

✓ Limit Exports to Ecuador ★

Define the ENFICC of batteries and efficient demand management (Demand Response and energy efficiency projects) to promote their incorporation.

### Decrease Stock Market Exposure

Adjust CREG Resolution 130 of 2019 to enable the contractual modality to pay for what is generated and carry out an auction mechanism that aggregates supply and demand. ★

### Promoting the Contractual Bid and Long-term Contracting

- Coordination led by the Ministry of Mines and Energy to develop projects under execution that will allow energy capable of offering contracts at efficient prices to enter.
- Review the evolution of public calls for bids to evaluate the elimination of Mc (weighted average contract price) and alpha factor.

★ Measures with the greatest impact in the short-term.

★ Measures with the most impact in the short-term and easier implementation.

# Mitigation measures and strengthening of the sector

Short term → Long term

TRANSPORTATION INFRASTRUCTURE

## Expedite environmental procedures to achieve project execution.

- **Lead (MME) the coordination among the various government entities to promote developing the national infrastructure necessary to carry out the energy transition.**

Rio Córdoba-Bonda, la Loma STR and Colectora 1

Sogamoso 500kV, Norte 230kV and Virginia-Nueva Esperanza 500kV

Refuerzo Suroccidental 500kV and Tesalia – Alférez 230 kV

- Ongoing working groups between MME-ANLA-MADS to seek mechanisms to streamline environmental processes.
- Optimize the processing and decision times of a reserve subtraction.
- Government - Company synergy to manage continuous engagement with the communities.
- Make the proportionality test feasible as a last-resort mechanism to help develop the necessary projects for a just energy transition and a fair benefit for the communities.

## Expediting bidding processes for the expansion defined as being necessary to be be executed in a timely manner.

### Installation of FACTS distributed in the Eastern Area

Promptly defining the implementation of distributed FACTS (DFACTS) as an expansion in the short-term in one or more of the following corridors: Purnio-Noroeste 230 kV double circuit, San Felipe - La Mesa 230 kV double circuit and Guavio - Torca 230 kV double circuit. These solutions allow for increased flexibility in the area's operation in view of the backlog of 500 kV line projects. The UPME must promptly define their feasibility and execution system.

### Series reactors at the Guavio 230 kV substation

Decreasing the short circuit level in the Guavio substation and avoiding the activation of the Chivor-Guavio 230 kV cut-off, increasing flexibility in the area's operation.

### Sopo Substation 230/115 kV and Corzo 500/115 kV

Carrying out the UPME's analysis of SE Corzo, adopting the Sopó Substation in the Expansion Plan and awarding it in the first quarter of 2024.

**Flexibility - Voluntary Disconnectable Demand**

**Repowering of the north line**

Structural solutions

High-impact mitigation measures required while projects are in the pipeline.

Measures to strengthen the network needed in conjunction with projects.

FACTS: Flexible Alternating Current Transmission System

# It is essential to address the current situation without neglecting the long-term vision of a just energy transition.

**Key policy, regulation and planning elements for modernizing the electricity sector.**

### National Policy

- Promoting the electrification of transportation and other economic sectors to take advantage of the entrance of renewables.
- Promoting the role of prosumers, demand aggregation and digitalization.
- Flexible regulation that evolves through regulatory sandboxes, avoiding volatile policies or long-term regulatory stagnation.

### Expansion

- Advance planning, incorporating behind-the-meter businesses and increased coordination with the gas sector.
- Promoting a favorable environment for incorporating batteries in the transmission grid, the interconnection with Panama and the market with Ecuador.
- Collaborating jointly in executing generation and transmission projects, overcoming the challenges that may arise.

## Current Situation: Increasing Demand; Standby Generation and Transmission