



Transiciones Justas

Renewable electrification: What does it mean for Colombia?

A national perspective on how scenarios can be translated into goals.



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A national perspective on how scenarios can be translated into goals.

Corporación para el Desarrollo de Políticas Energéticas para las Transiciones Justas, *Polen Transiciones Justas*

Línea Estratégica de Electrificación Renovable

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What is electrification?

Electrification is more than switching technologies



Fuente: Caracol



Fuente: Cambio



Fuente: MinEnergía



Move away from fossil fuels

Replace direct fossil-fuel use with efficient electric technologies where feasible, such as electric vehicles, electric heaters and boilers, induction stoves, etc.



Close the energy access gap

Advance universal, affordable and reliable energy access across Colombia's territories.



Power it with renewables

Planning renewable expansion to cover new demand and gradually replace fossil fuel generation, stronger grids, storage, and flexibility.





Colombia's economy still runs largely on fossil fuels.

Final energy consumption by energy source 2024

1,499 PJ



19%
is electricity



67%
are fossil fuels

Different starting points across sectors

Transport

579 PJ

final consumption



0,1 %
electricity

Industry

321 PJ

final consumption



20 %
electricity

Residential

285 PJ

final consumption



29 %
electricity

Commercial + public

83 PJ

final consumption



71 %
electricity

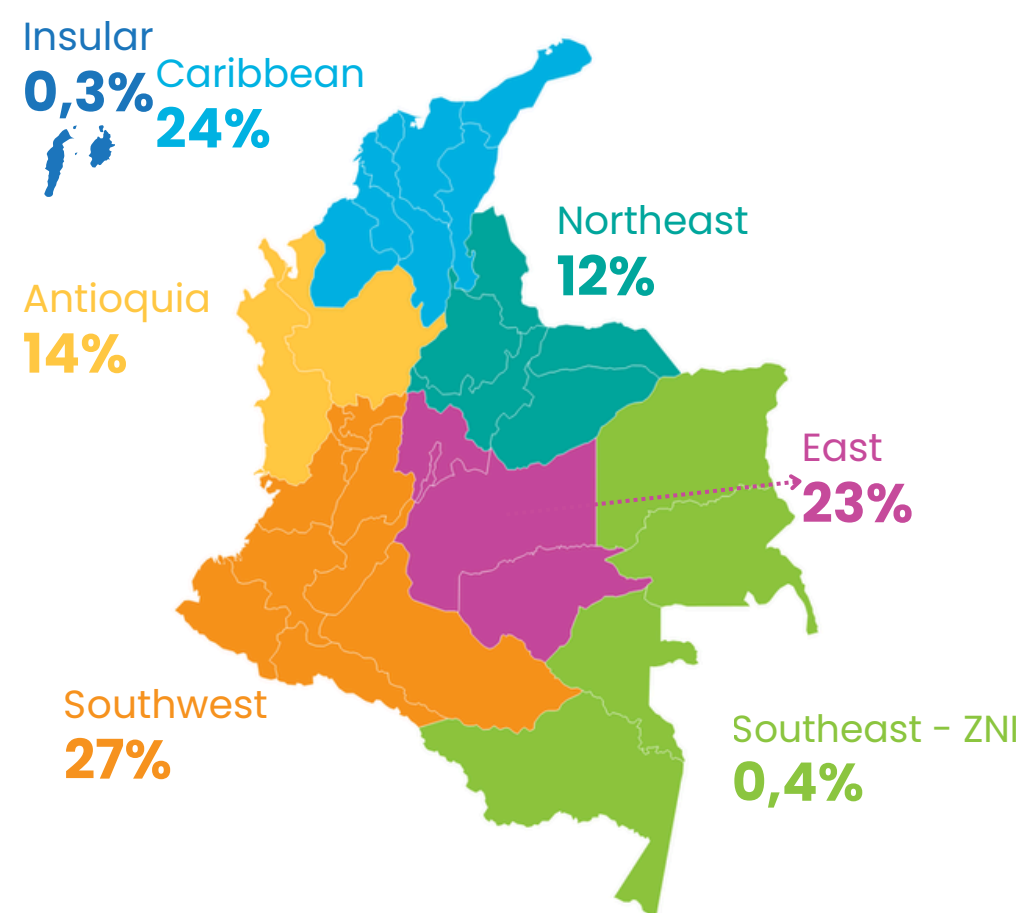




Why electrify?

Opportunities and challenges are differentiated by territory

Share of final energy consumption by region – 2024



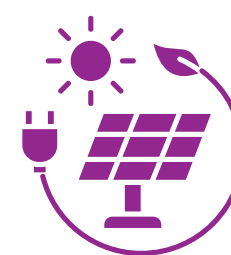
Regional definition: Five regions within Colombia's interconnected electricity grid (SIN), plus two Non-Interconnected Zones (ZNI): Insular and East.

ZNI: Territories not connected to the national electricity grid.

74%

of final energy consumption is concentrated in three regions

Southwest (27%), Caribbean (24%) and East (23%) account for nearly three-quarters of Colombia's final energy consumption. These regions are important starting points for sector-specific electrification strategies.



Renewable resources create different regional opportunities

Caribbean has strong wind and solar potential; Northeast stands out for utility-scale solar; and Southeast has opportunities for bioenergy.

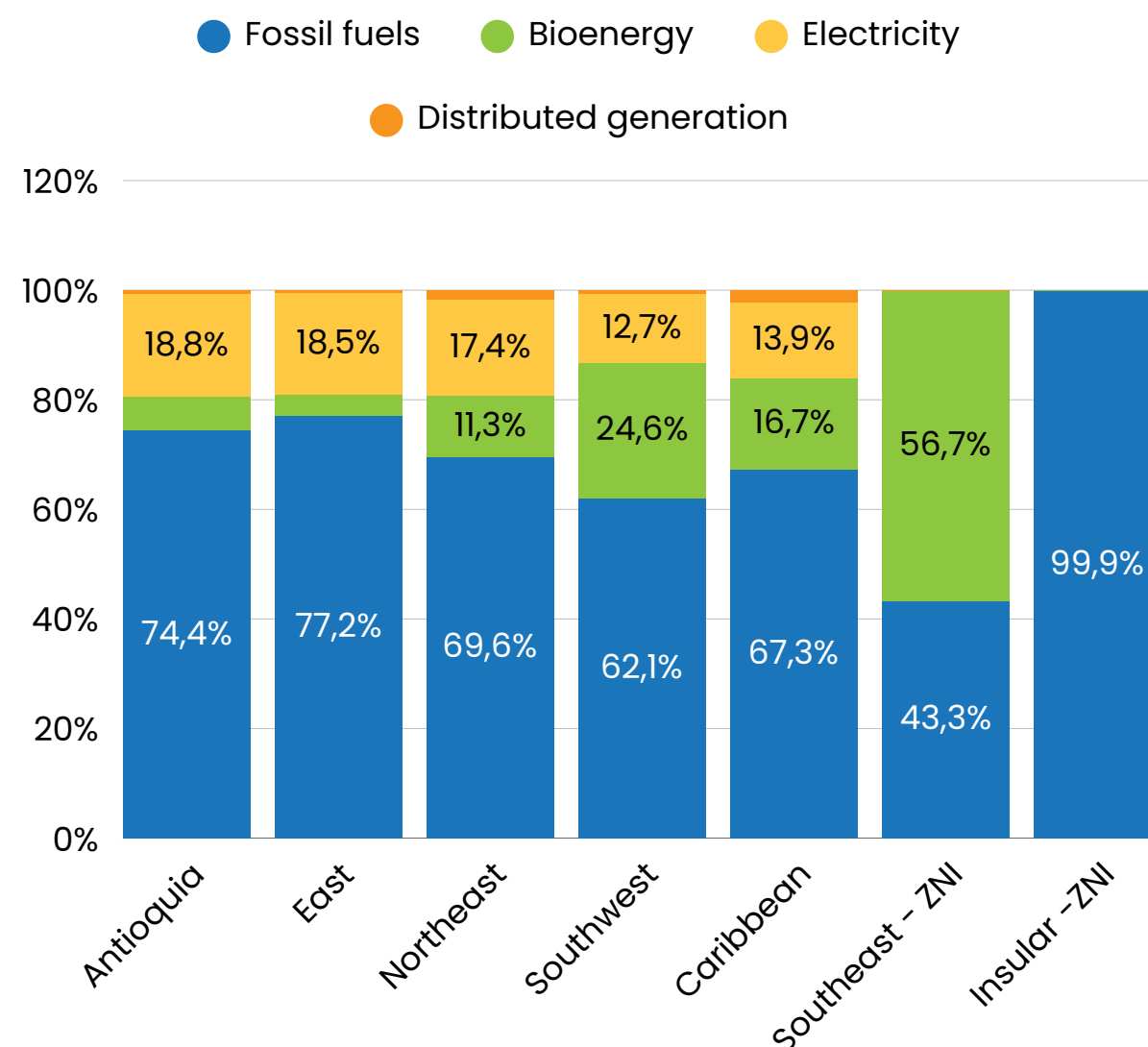


The ZNI require a different electrification approach.

Southeast and Insular together account for less than 1% of final energy consumption and significant supply vulnerabilities in these regions. Decentralized renewables, storage and microgrids are relevant pathways to improve energy access and reliability.



Regional energy mixes reveal different barriers to electrification



Note: Data availability for ZNI is limited; reported electricity shares may vary, although electricity accounts for a small but non-zero share of final energy consumption.



Fossil fuels remain central to regional energy use

Transport is a major driver of fossil-fuel consumption across regions, while industrial activity reinforces this dependence in areas such as Caribbean and Antioquia.

- **Diesel dependence:** ZNI final consumption have historically relied on diesel power plants—a costly model that renewable alternatives could help transform, making energy security and cleaner local generation particularly relevant.



Bioenergy reflects both regional resources and energy-access gaps.

In the Southwest, its role is linked to the region's agricultural and sugarcane-processing activities. In the Southeast, high bioenergy consumption reflects widespread firewood use for cooking, highlighting the need for clean cooking solutions alongside renewable electrification.



Electricity demand reflects urbanization and productive concentration

Large cities, public services, buildings and industrial centres shape electricity use in regions such as Antioquia and East (Bogotá). In other territories, lower electrification or dependence on fuels and biomass means that the transition requires different priorities, from industrial process conversion to household energy access.



Renewable electrification is a systemic and economic transformation strategy, not only a technological shift.

Efficiency

Electrification is the most efficient way to consume energy.

Renewable potential

Colombia has a hydroelectric base and solar/wind potential that remains underutilized.

Security

Reduced exposure of final demand to fossil fuel prices and volatility.

Renewable energy can deliver a secure system

With the right investments in grids, storage and flexibility, renewables can reliably meet demand.

Economic development

Increased electricity can enable industry, mobility, digitalization, and new services.





Scenarios show different levels of ambition for electrifying Colombia

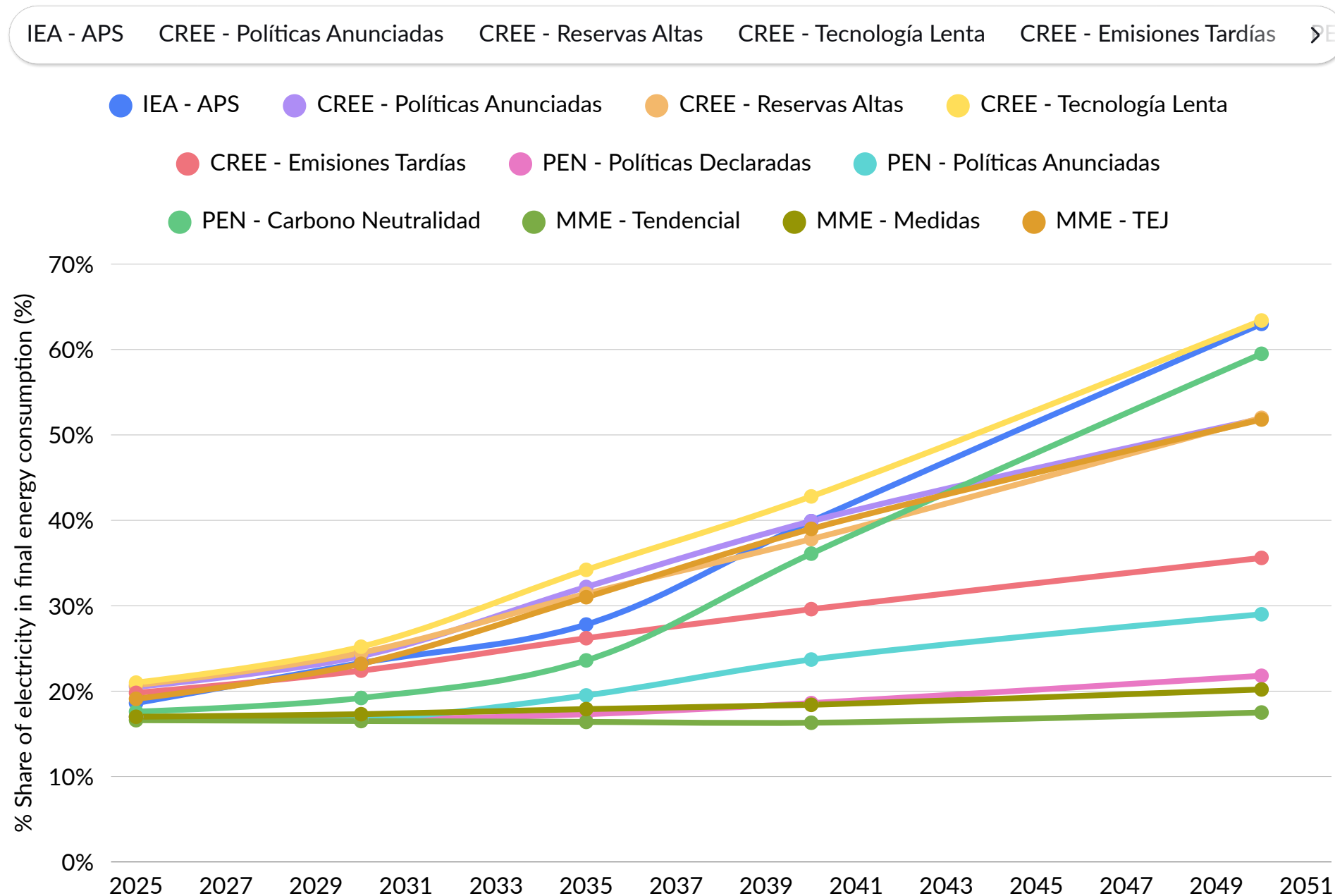
Study	Model Used	Final Energy Demand Sectors Modeled	Scenarios Considered
IEA – An Energy Sector Roadmap to Net Zero Emissions in Colombia	Global Energy and Climate Model (GEC Model).	Transport, industry, and buildings (residential and services).	Announced Pledges Scenario (APS), Stated Policies Scenario (STEPS), Net Zero Emissions Scenario (NZE).
CREE – Study for Colombia's Energy Transition Roadmap to 2050	TIMES-COL, a long-term energy system optimization model.	Transport, industry, residential, commercial and services, agriculture, mining, and other end uses.	Announced Policies, High Reserves, Slow Technology, Delayed Emissions.
UPME – National Energy Plan 2025–2055	OSeMOSYS (Open Source Energy Modeling System), a linear optimization model, with SAND for data parameterization.	Transport, industry, residential, services, agroforestry, construction, coke plants, and mining.	Declared Policies (PD), Announced Policies (PA), Carbon Neutrality (CN).
MME – National Just Energy Transition Scenarios	LEAP (Low Emissions Analysis Platform), complemented by NEMO for electricity generation optimization.	Transport, industry, residential, services, mining, construction, refineries, coke plants, agriculture, and fishing.	Business as Usual (BAU), Measures Under Implementation, Just Energy Transition (JET).





How much?

Scenarios show different levels of ambition for electrifying Colombia



By 2035

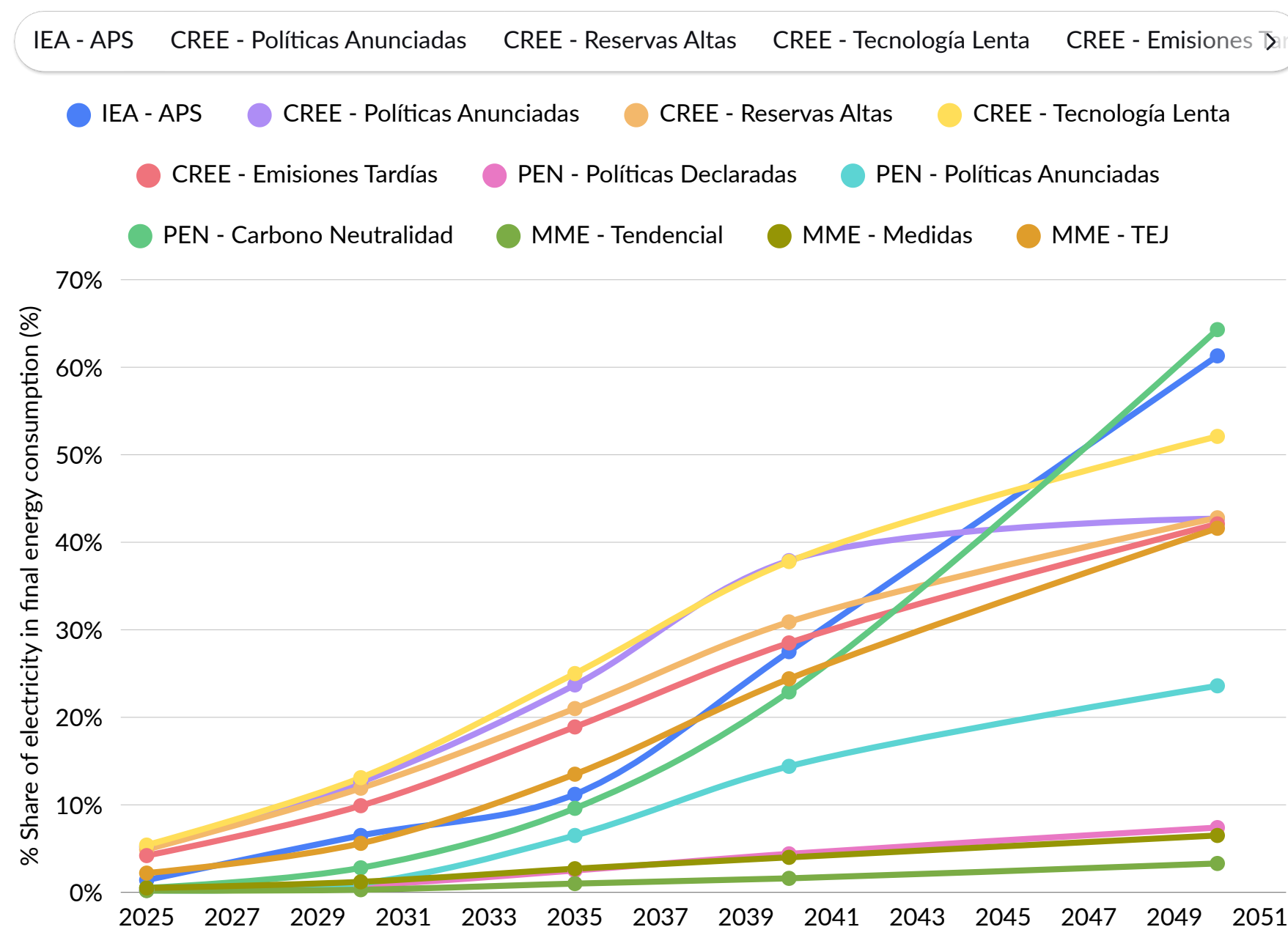
- **Tendential scenarios:** Electrification remains close to current levels, reaching only 16–18%.
- **Announced policies:** Implementing planned policies could raise electrification to around 20–32%, although results vary across scenarios.
- **Climate-aligned pathways:** Additional sectoral measures could raise electrification to 24–34%.

Note: 2025 values vary across models because they were developed and published at different times.



How much?

Transport requires greater electrification ambition



By 2035

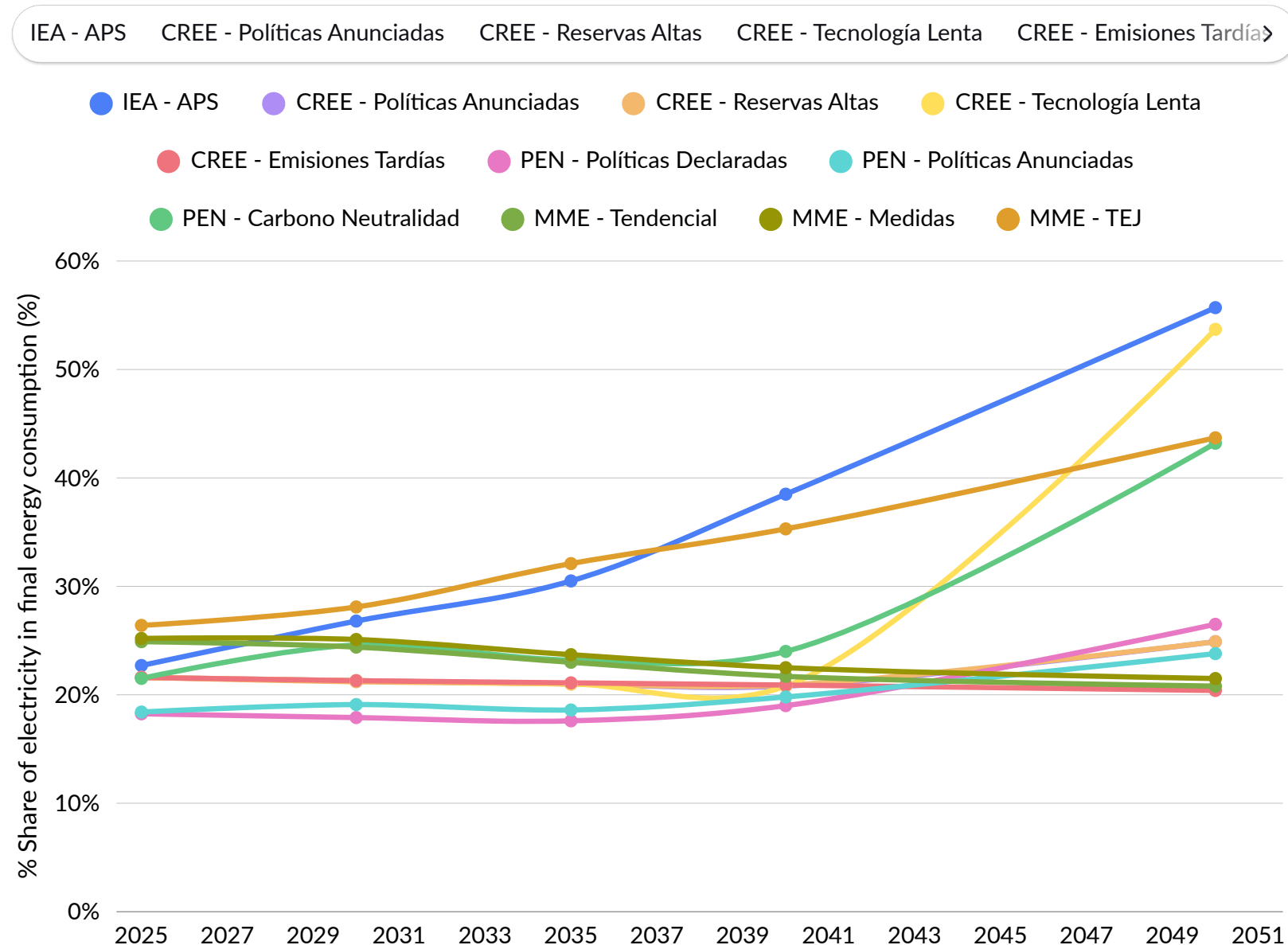
- **Tendential scenarios:** Transport electrification remains below 2%.
- **Announced policies:** Electrification could reach 3–7%, depending on the scenario.
- **Climate-aligned pathways:** More ambitious pathways could raise transport electrification to 19–25%, requiring stronger action across the sector.

Note: 2025 values vary across models because they were developed and published at different times.



How much?

Industrial electrification can boost competitiveness, but requires greater ambition and investment.



Note: 2025 values vary across models because they were developed and published at different times. Also, it shows that different starting values and declining electrification in several scenarios reveal potential data limitations.

By 2035

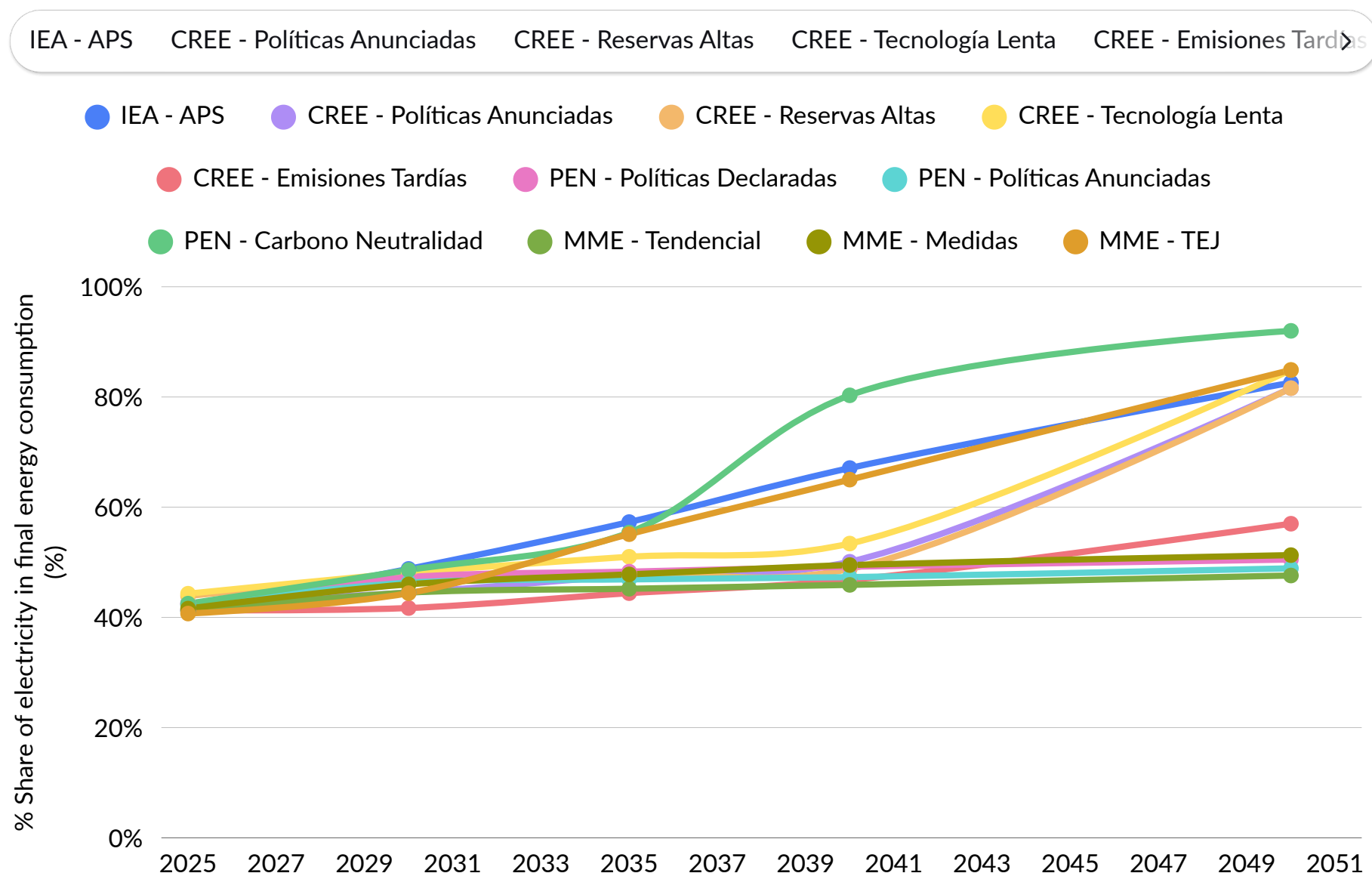
- **Tendential scenarios:** Industrial electrification remains around 17–23%
- **Announced policies:** Electrification reaches approximately 19-23%, depending on the scenario.
- **Climate-aligned pathways:** More ambitious pathways raise industrial electrification to 23-32%. A significant electrification gap remains to meet climate commitments.



How much?

Buildings start from a higher electrification base — but pathways diverge after 2035

Buildings include residential, commercial and public energy use.



By 2035

- **Tendential scenarios:** Industrial electrification remains around 45-48%.
- **Announced policies:** Electrification reaches approximately 48-57%, depending on the scenario.
- **Climate-aligned pathways:** More ambitious pathways raise electrification to 55-57%.

Note: 2025 values vary across models because they were developed and published at different times.
Buildings is the sector with the most comprehensive information available, providing a stronger basis for assessing electrification pathways.



How?

A just electrification strategy is not measured only by how much we electrify, but by who benefits from the transformation.



UNIVERSAL

Close gaps in access, affordability, quality and reliability, especially across territories starting from greater energy gaps.



CLEAN + JUST

Electrify with renewables and phase down fossil fuels, while protecting workers, communities and territories.



PRODUCTIVE

Make electricity a platform for development and productive transformation, not only a source of energy consumption.



INDUSTRIAL

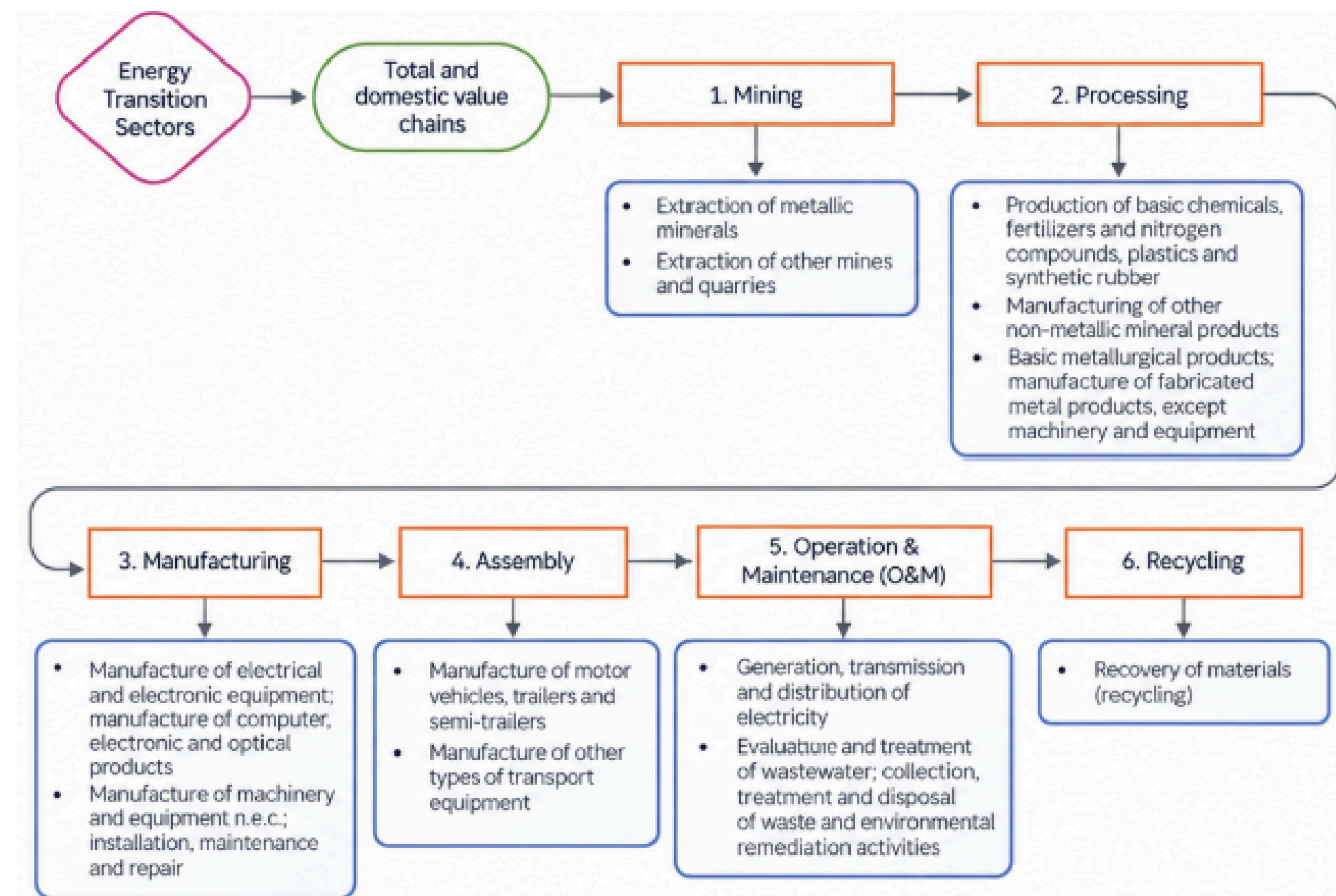
Turn electrification into skills, jobs, knowledge and value added in Colombia.





For what?

Electricity can be a driver for a greener, more competitive and inclusive reindustrialization in Colombia



+6,5%
economic growth



+3,9%
total employment



+10,5%
electricity consumption

Higher industrial activity and electrification of productive process

Fuente: PolenTJ, 2026



Key challenges for renewable electrification

Electrification must advance alongside renewable diversification, grid expansion and system flexibility.

Hydrothermal vulnerability

Hydrological variability and fossil fuel price exposure threaten affordability and energy security, requiring a comprehensive revision of market rules and water resource management.

Grid constraints

Transmission and distribution bottlenecks delay renewable integration and electrification, making it necessary to perform detailed technical grid and transmission system analyses to ensure the timely implementation of required network reinforcements.

Flexibility and storage

Limited system flexibility could constrain renewable integration and system reliability, highlighting the need to harness technological complementarity across diverse energy sources to enhance grid flexibility and overall reliability

Renewable supply gaps

Renewable deployment may lag behind growing electricity demand.

Emerging electricity demand

Data centers, electric mobility and industrial electrification require coordinated supply and grid expansion.

Financing the shift

Phasing out fossil fuel subsidies while securing financing to make clean, efficient end-use technologies affordable and accessible.

What does this mean for Colombia?

Electrification is a strategic choice about the energy system we want to build.



35 by 35 is a global benchmark.
Colombia's own scenarios point to 30%+ by 2035.

More electrification requires a system ready to deliver it and aligned financing.
Renewable supply, grids, storage and flexibility must grow alongside demand — especially as climate risks and new loads increase.

Electrification can be a driver of Colombia's economic transformation.
It can enable industrialisation, jobs, local value creation and energy security.

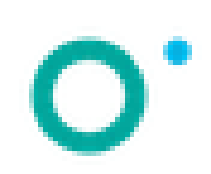
The benefits of electrification must be designed, not assumed.
Access, affordability, territories, workers, ownership and value creation need to be part of the transition from the start.



A decorative purple arc is in the top left corner, and a 4x4 grid of teal dots is to its right.

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