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Sustainable Pathways for Brazil

Executive Findings
from the Net-Zero
Scenarios

ENERGY
TRANSITION
PROGRAM

PHASE 2

ENERGY TRANSITION PROGRAM

PHASE 2

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ENERGY TRANSITION SCENARIOS

BT Brazil Transition

Optimal cost pathway to reach Brazil's NDC, leveraging national competitive advantages such as abundant renewable energy, bioenergy, and reforestation potential.

AT Alternative Transition

Beyond reaching NDC targets, this scenario introduces factors that steer the transition along different technological and regulatory pathways, including carbon pricing, climate change impacts on hydropower and electricity demand, and stronger mandates for biofuels and electrification.

GT Global Transition

This scenario adopts a carbon budget aligned with the 1.5°C warming limit, based on a least-cost global allocation of emissions, demanding deeper and faster emission cuts.

OVERVIEW

**Brazil's climate targets are compatible
with sustained economic growth**

Emissions Neutrality by 2050

Across all scenarios, Brazil reaches greenhouse gas emissions neutrality by 2050, aligned with the national target established in its NDC.

GDP grows faster than historic average in Brazil

GDP growth ranges from 2.8% to 3.2% per year depending on the scenario — exceeding the historical average, driven by productivity gains and the expansion of new economic activities.

About 28 million jobs created until 2050

The transition has the potential to generate around one million jobs annually through 2050.

Reaching NDC targets requires short-term action




Decisions taken over the next decade will determine both the costs and the benefits of Brazil's energy transition.

OVERVIEW IN NUMBERS

BT Brazil
Transition

AT Alternative
Transition

GT Global
Transition

Cumulative emissions 2010–2050 (GtCO₂)	~11	~10	7.24
Year when climate neutrality is reached	2050	2050	~2045
Net emissions in 2050 (MtCO₂e/year)	≈ 0	≈ 0	-163
% of renewables in the energy mix in 2050	60%	72%	78%
Cumulative GDP growth (%) (2025-2050)	109%	124%	95%
Cumulative job creation (2025-2050)	24 million	28 million	22 million
Feasibility	High 	Average 	Low 

ENERGY MATRIZ

Multiple pathways lead from today's energy mix toward net-zero GHG emissions, with distinct costs, risks, and benefits

Predominance of renewables

Renewables account for 60—78% of Brazil's energy mix.

Importance of bioenergy, wind and solar

Bioenergy plays a leading role in hard-to-abate sectors.

Demand grows moderately through 2050

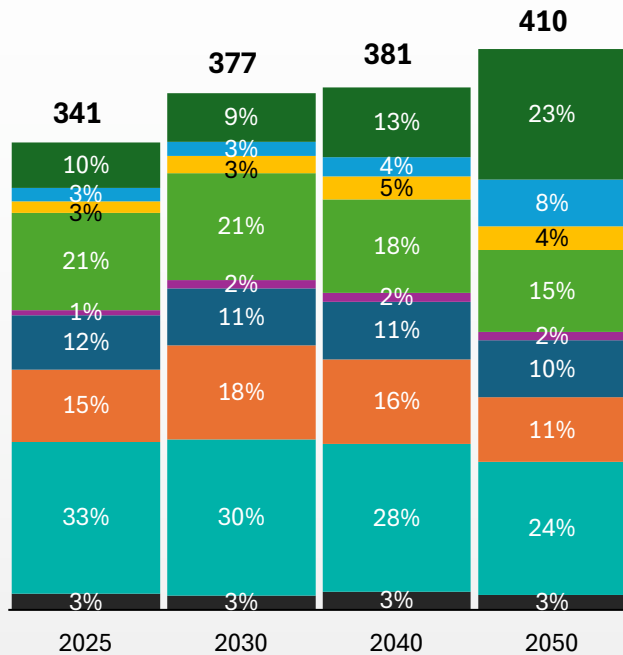
Total energy demand grows moderately through 2050, with slower expansion under the most ambitious scenario (GT).

ENERGY MATRIX IN NUMBERS

Primary Energy (Mtep)

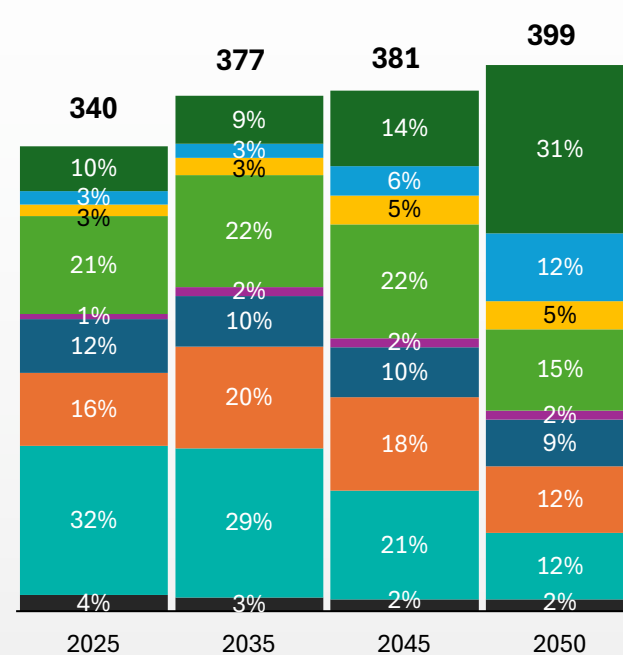
- Biomass
- Wind
- Solar
- Sugarcane
- Nuclear
- Hydro
- Natural Gas
- Oil
- Mineral Coal

BT Brazil Transition



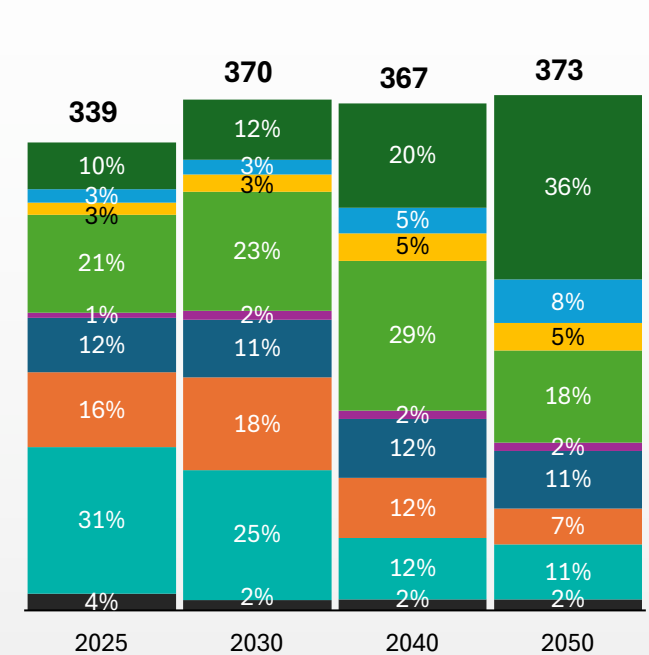
60% renewable

AT Alternative Transition



72% renewable

GT Global Transition



78% renewable

GHG EMISSIONS

**Emissions neutrality in Brazil
cannot be achieved without the
contribution of the AFOLU sector**

Most emissions originate from land use and agriculture

When considering Brazil's NDC target, the share of the AFOLU sector should already fall to ~50% by the end of the decade (down from around 70% in recent years) — requiring that mitigation measures be effectively implemented in the short term.

Negative CO₂ emissions by 2040

Achieving net-zero greenhouse gas emissions by 2050 requires reaching net-zero CO₂ emissions by 2040, further increasing the challenge of meeting Brazil's climate targets.

700 MtCO₂e removed per year

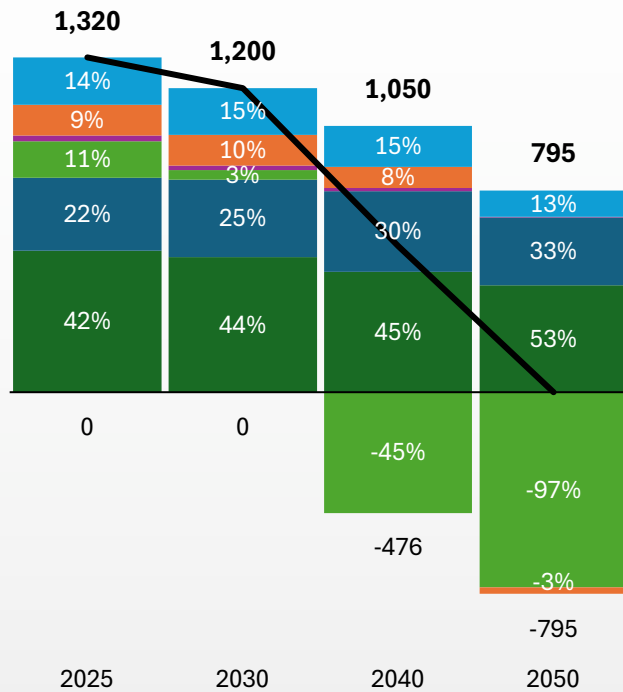
The AFOLU sector plays a fundamental role in offsetting emissions from other sectors of the economy, such as transport and industry.

GHG EMISSIONS IN NUMBERS

GHG Emissions (MtCO₂e)

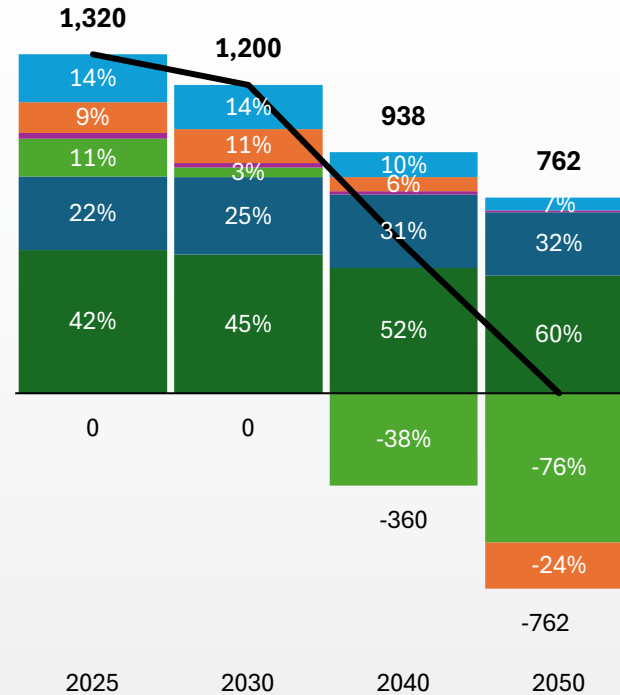
- Transport
- Energy Sector
- Buildings
- Industry
- Agriculture
- LULUCF (Land Use, Land-Use Change and Forestry)

BT Brazil Transition



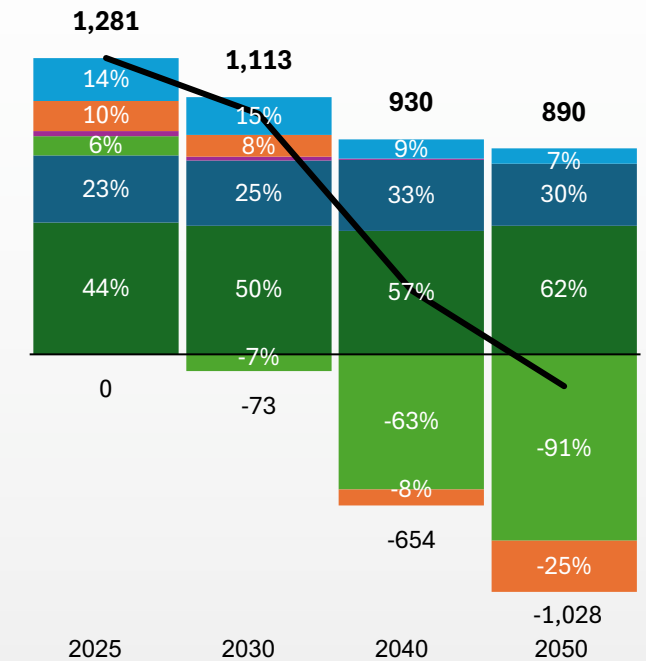
LULUCF captures ~770 MtCO₂e

AT Alternative Transition



LULUCF captures ~580 MtCO₂e

GT Global Transition



LULUCF captures ~720 MtCO₂e

AFOLU

The AFOLU sector accounts for
>80% of net emissions removals

Illegal deforestation needs to end within this decade

Achieving Brazil's NDC target requires ending illegal deforestation by 2030.

12 Mha restored

12 million hectares need to be restored by 2035.

Regional GDP gains

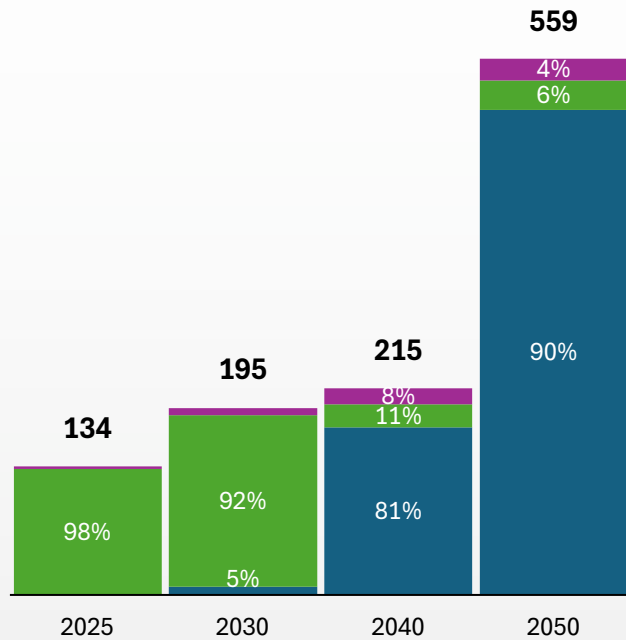
While regional differences remain marginal, Brazil's North and Northeast regions are expected to grow at approximately 3% annually between 2025 and 2050, along with the creation of new green jobs.

AFOLU IN NUMBERS

Carbon Removal (MtCO₂)

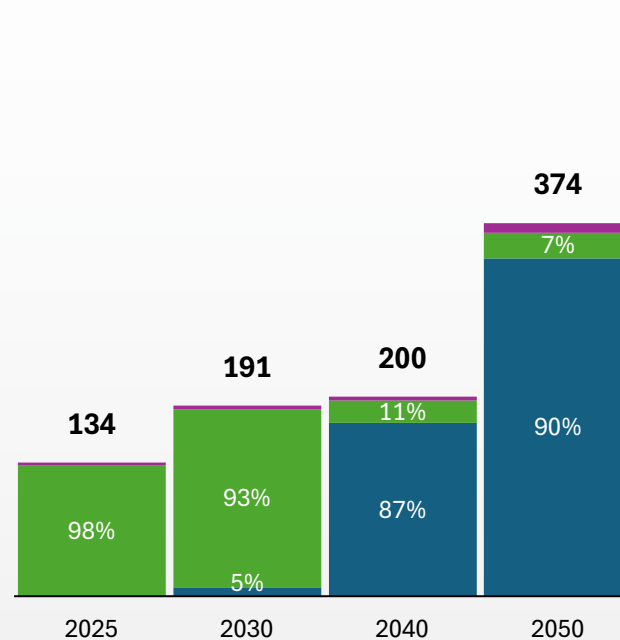
- Restoration
- Soil Management
- Agroforestry

BT Brazil Transition



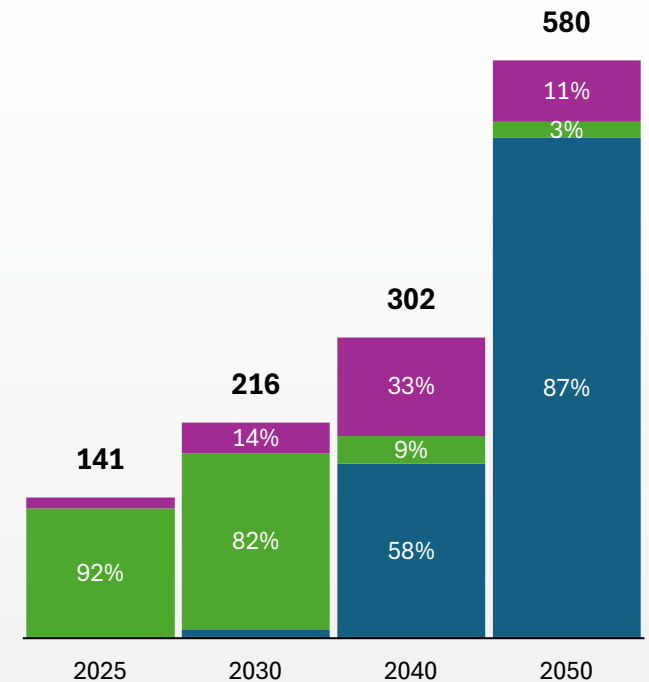
+559 MtCO₂ captured

AT Alternative Transition



+374 MtCO₂ captured

GT Global Transition



+580 MtCO₂ captured

INDUSTRY

Without green industrial policies, there is a risk of losing competitiveness

Energy transition requires innovation and new technologies

Energy-intensive sectors—such as cement, steel, and chemicals—require innovation and carbon-capture technologies.

Solutions emerge from Brazil's comparative advantages

Key solutions include biomass, electrification, and CCS — supported by robust industrial policies.

Potential for industrial growth

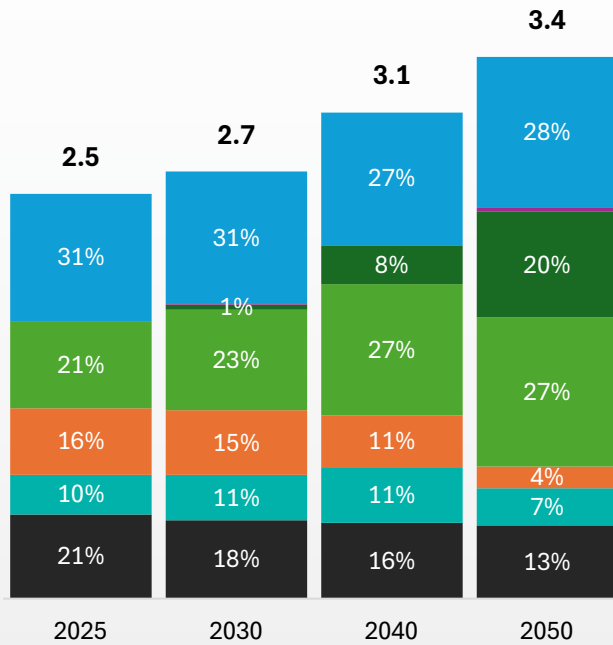
The AT scenario generates stronger industrial growth, driven by increased public investment and the modernization of Brazil's energy infrastructure, alongside industrial and technological development—and a strengthened biofuels sector.

INDUSTRY IN NUMBERS

Consumption in Industry (EJ)

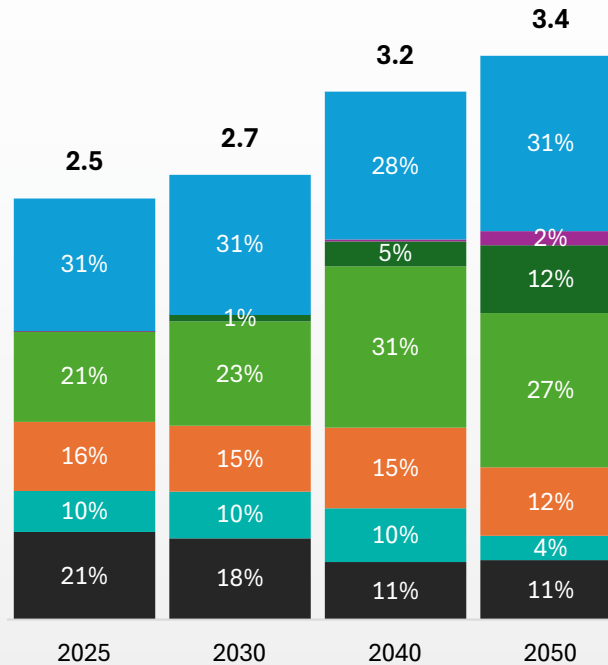
- Electricity
- Biofuels
- Biogas
- Biomass
- Natural Gas
- Petroleum Products
- Mineral Coal

BT Brazil Transition



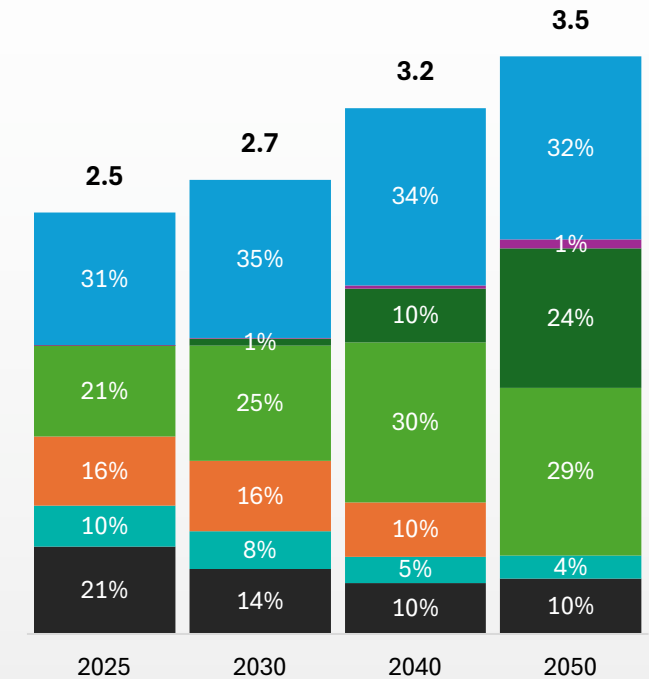
~75% clean energy

AT Alternative Transition



~72% clean energy

GT Global Transition



~86% clean energy

POWER GENERATION

**An almost 100% renewable
power system demands capacity,
storage, and flexibility**

Renewable expansion through 2050

Renewables will account for almost all energy expansion through 2050.

Risk of power capacity shortfall

Progress depends on appropriate price signals capable of reflecting the system's physical and operational requirements, while incentivizing the integration of new sources of capacity, flexibility, and storage.

Energy storage systems are increasingly important

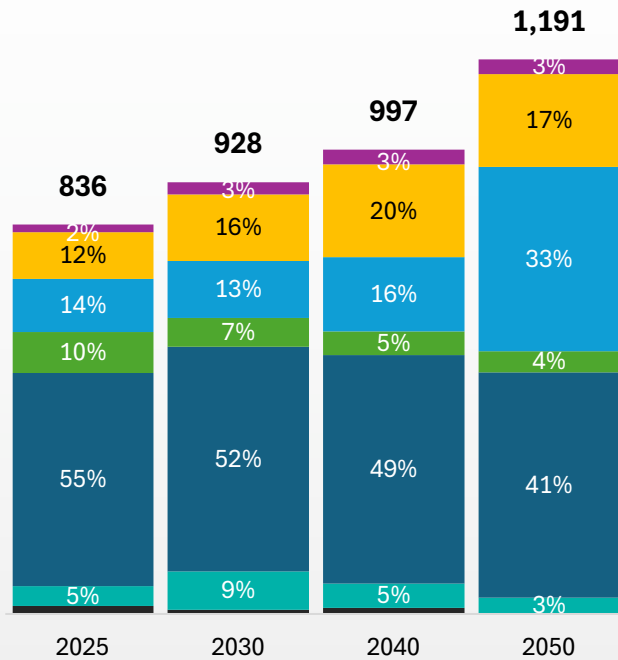
Key solutions include batteries, pumped-storage hydropower and demand response mechanisms.

POWER GENERATION IN NUMBERS

Power Generation (TWh)

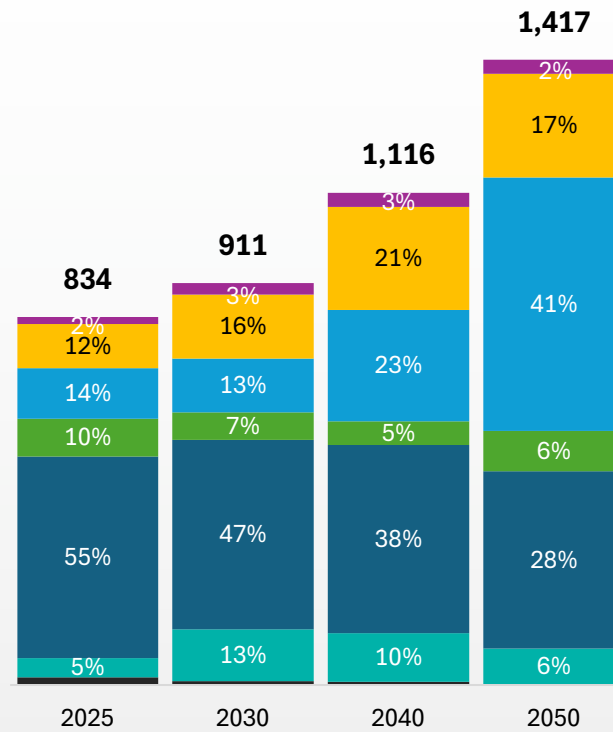
- Nuclear
- Solar
- Wind
- Biomass
- Hydro
- Oil and Gas
- Mineral Coal

BT Brazil Transition



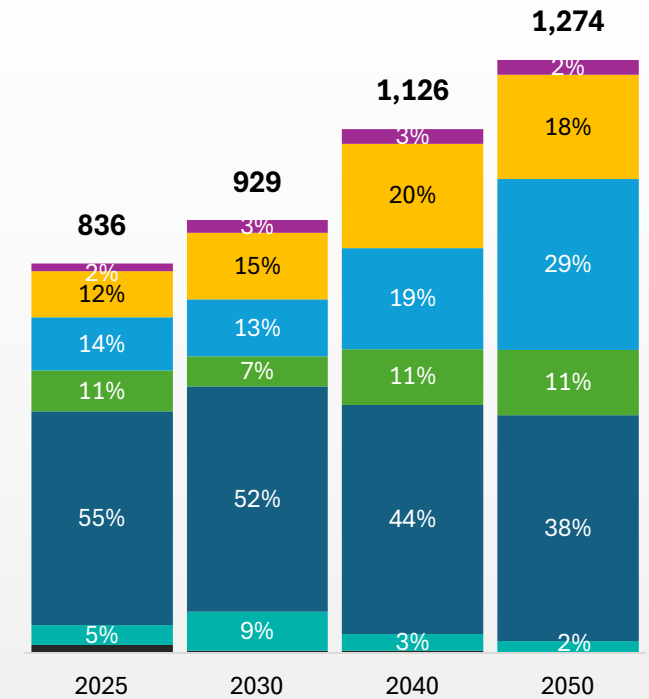
~95% renewable

AT Alternative Transition



~92% renewable

GT Global Transition



~96% renewable

TRANSPORTATION

Transport decarbonization is driven by a combination of different energy sources: there is no single solution

Electrification and biofuels play complementary roles

Electrification and biofuels are mutually reinforcing rather than competing solutions.

Electrification and efficiency gains accelerate

Increased electrification, especially in light-duty transport, combined with higher efficiency, reduces fossil fuel consumption in the transport sector.

Biofuels: SAF and biobunker emerge as competitive advantages

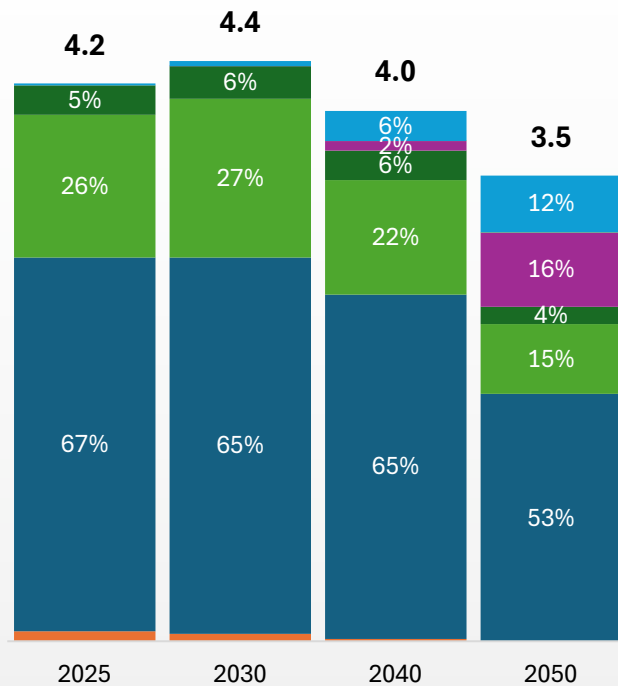
Advanced biofuels for heavy-duty, aviation, and maritime transport contribute to a strong downward trend in transport sector emissions.

TRANSPORTATION IN NUMBERS

Consumption in Transportation (EJ)

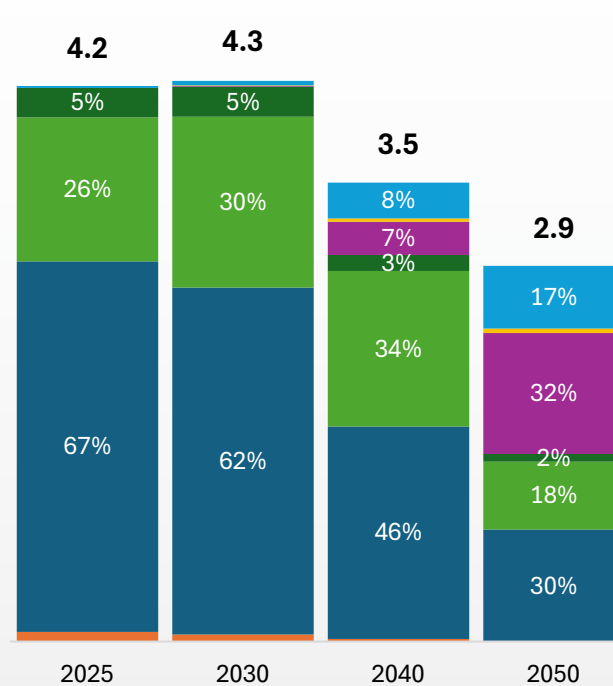
- Electricity
- Hydrogen
- Advanced biofuels
- Biodiesel
- Ethanol
- Petroleum Products
- CNG

BT Brazil Transition



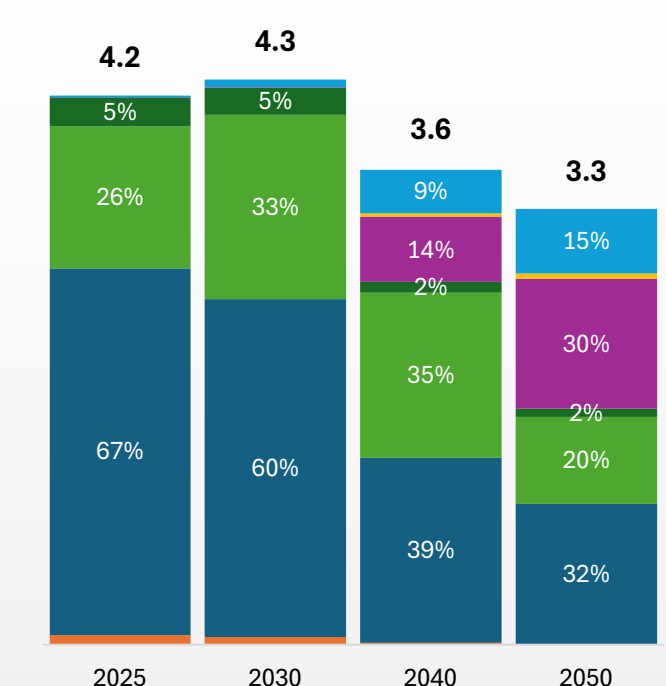
~14 percentage-point reduction in petroleum product consumption

AT Alternative Transition



~37 percentage-point reduction in petroleum product consumption

GT Global Transition



~35 percentage-point reduction in petroleum product consumption

CITIES

**Fossil fuels are almost entirely replaced
by renewable electricity and biofuels**

Energy demand grows

Strong demand growth
(2.0–2.4% per year).

Widespread electrification of buildings

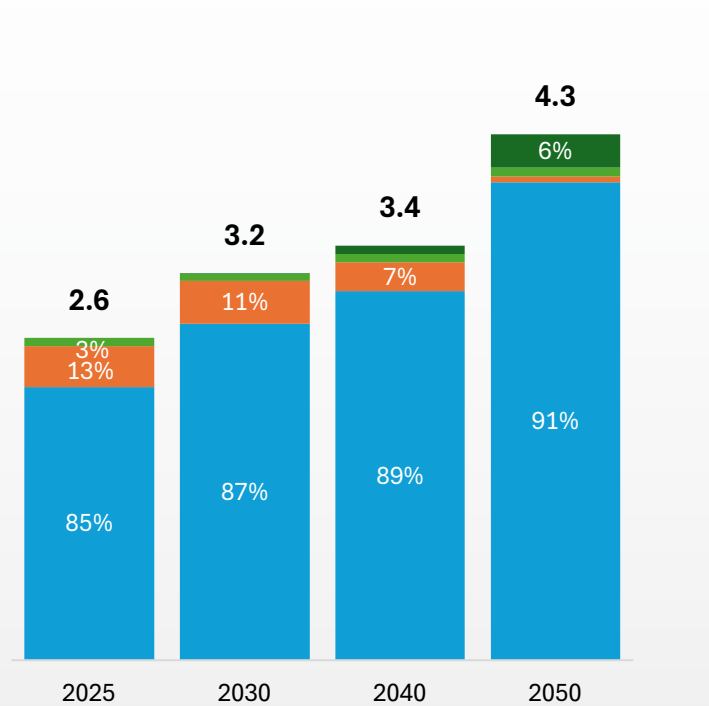
Electricity dominates energy
consumption in buildings.

CITIES IN NUMBERS

Consumption in Buildings (EJ)

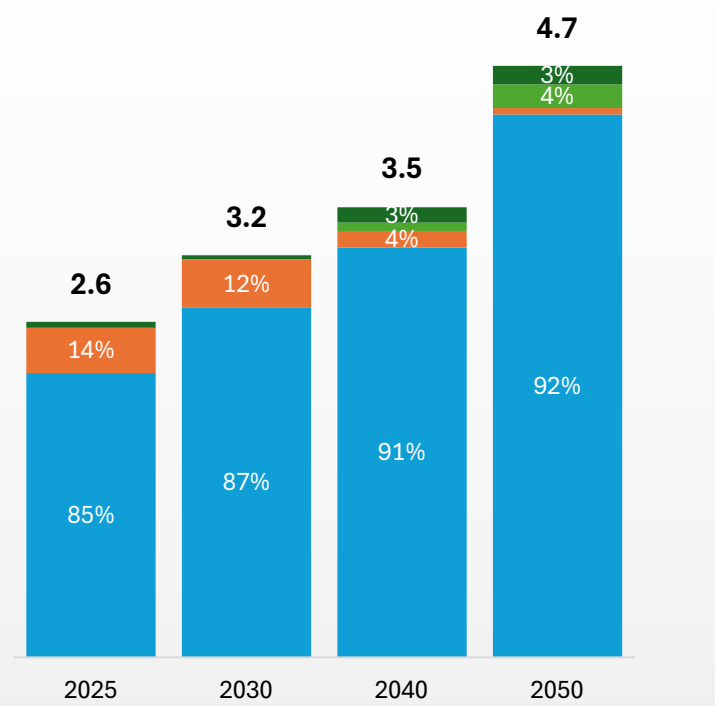
- LPG e Green NG
- Biomass
- LPG and fossil NG
- Electricity

BT Brazil Transition



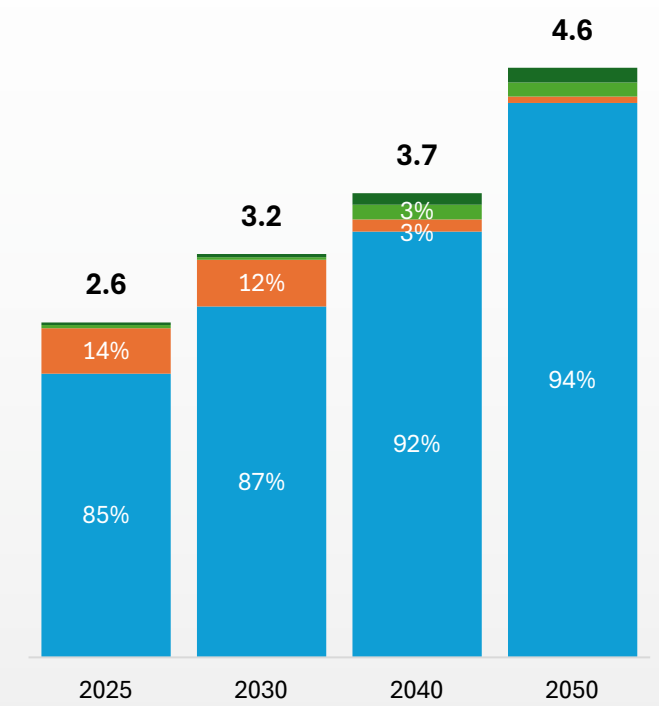
+ ~2 EJ in electricity demand

AT Alternative Transition



+ ~2,1 EJ in electricity demand

GT Global Transition



+ ~2,1 EJ in electricity demand

MACROECONOMIC IMPACT

**Energy transition can accelerate
GDP growth and generate jobs**

Economic gains

Scenarios with carbon pricing and industrial policy result in higher economic gains.

Regional policy

Without regional industrial policy, inequalities persist and constrain the benefits of the transition.

Coordination across sectors

Effective coordination across the AFOLU, energy, and industrial sectors is essential to promote economic growth.

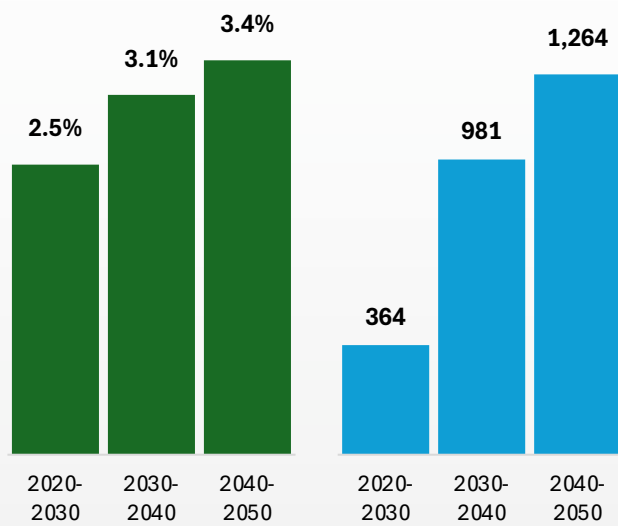
GDP and employment

Average GDP growth ranges from 2.8% to 3.2% per year, with employment gains of ~1 million jobs annually.

MACROECONOMIC IMPACT IN NUMBERS

● Average GDP growth (% per annum - p.a.) ● Jobs created (thousand/year)

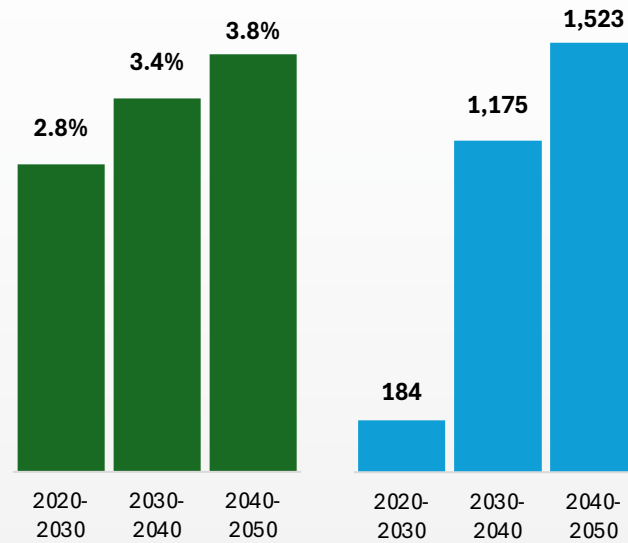
BT Brazil Transition



~145%
Cumulative growth

26M
Jobs created

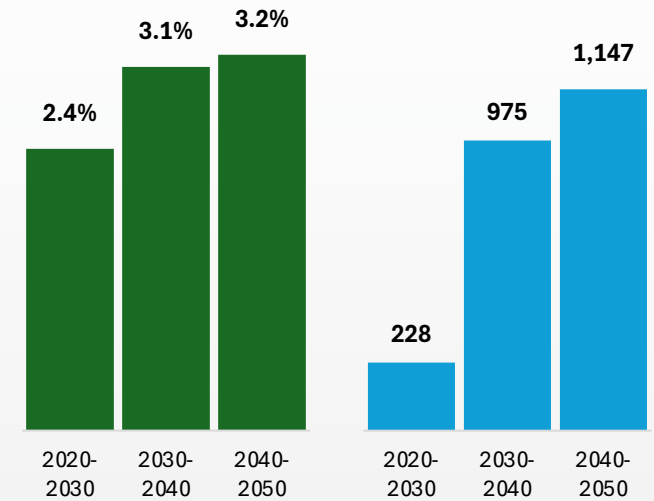
AT Alternative Transition



~165%
Cumulative growth

29M
Jobs created

GT Global Transition



~135%
Cumulative growth

23M
Jobs created

RECOMENDATIONS

Immediate strategic actions for Brazil to become a global leader in energy transition

Accelerate
infrastructure
investments

Coordinate energy transition
and existing industrial policies
to potentialize regional
opportunities and reduce
inequalities

Stimulate
partnerships and
new business models

Make use of natural
leadership in
low-carbon energy to
achieve global influence

Implement a Just Transition
plan for vulnerable sectors
and regions

Improve Brazil's
carbon market

Brazil has abundant **natural resources**, including renewables, bioenergy, and forests.

Effective governance, coordination, and clear economic signals will be critical to the success of the transition.

Existing technologies can support the transition, provided they reach sufficient cost competitiveness to scale.

The next decade will determine the **costs and benefits** of the energy transition.

Brazil can lead the low-carbon economy
— if it acts now.

ENERGY TRANSITION PROGRAM

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