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**S&P Global**

Commodity Insights

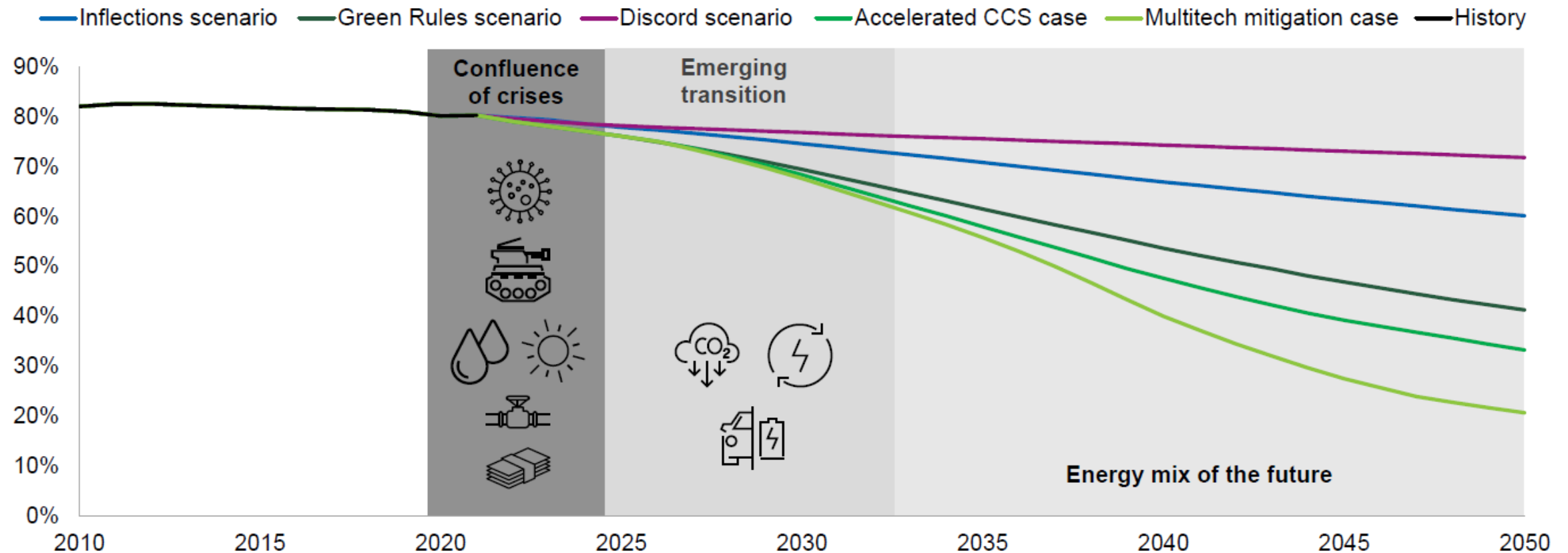
# Brazil goes greener amid global volatility

Brazil Energy Frontiers 2023

October 2023

# Fundamental transformations have reshaped the landscape of geopolitics, economics, and energy markets in recent times

## Fossil fuel share of global total primary energy demand, 2010–2050 (2022 outlooks)



Date compiled Oct. 10, 2023

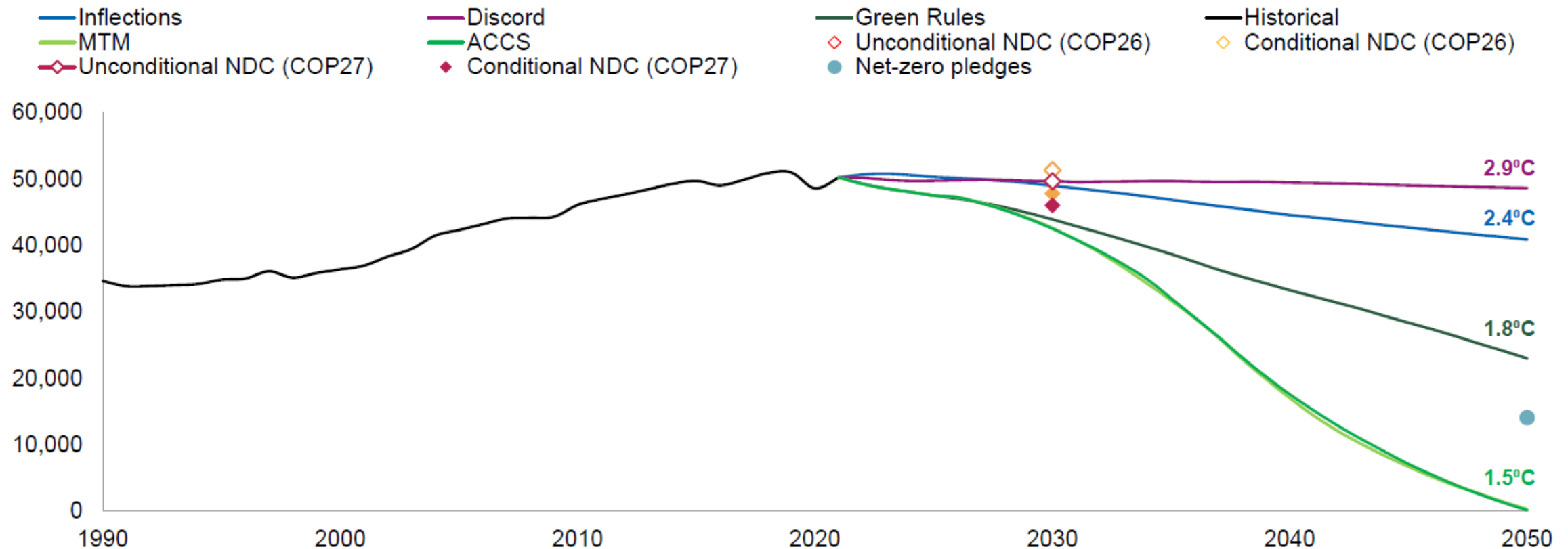
CCS = carbon capture and storage.

\*Accelerated CCS (ACCS) Multitech mitigation (MTM) cases back-cast from global net-zero GHG emissions in 2050.

Source: S&P Global Commodity Insights

# Climate ambition is increasing in major economies, but Paris goals are still out of reach

**Total GHG emissions in scenarios and national NDC targets (emissions, MMtCO<sub>2</sub>e)**



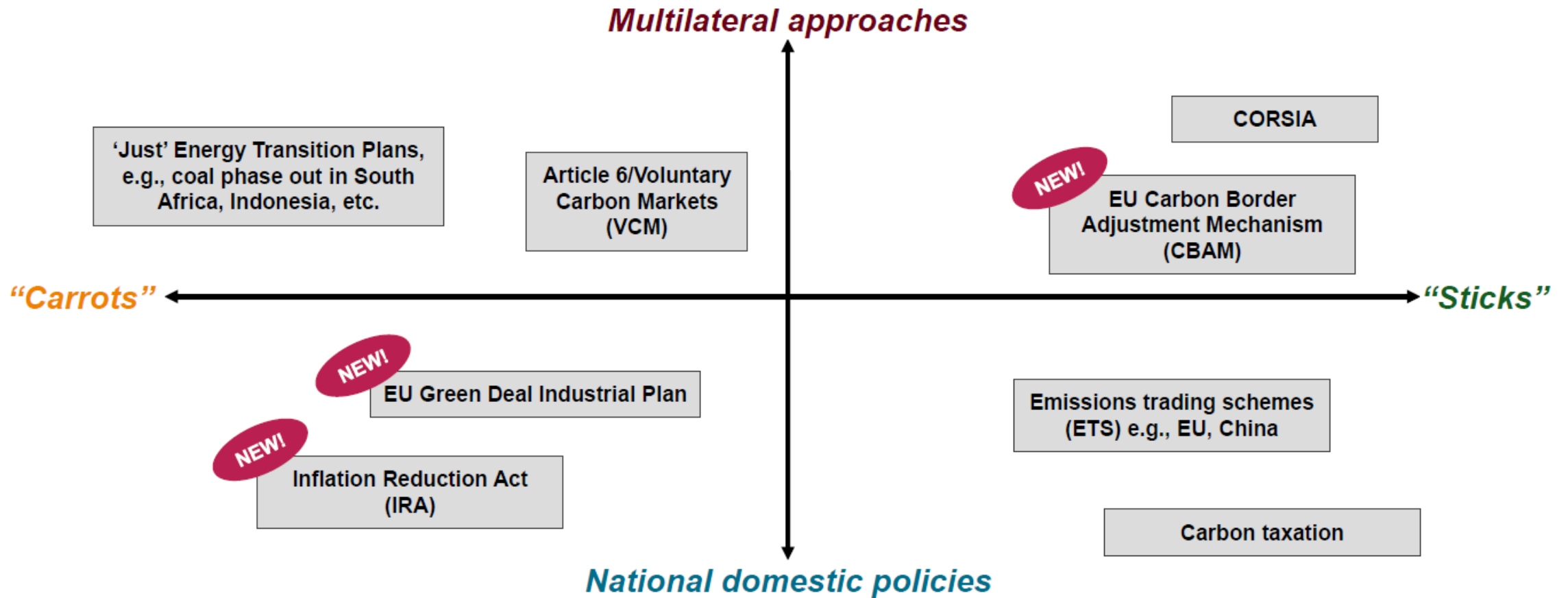
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# Key differences are emerging in approaches toward climate policy and carbon finance



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Source: S&P Global Commodity Insights

# Long-term outlooks for renewables further boosted by new energy transition policies in key markets that aim to translate targets into real investments

## China

- **14<sup>th</sup> Five Year Plan** for 2021-2025
- **“1+N” Policy Package** for peak carbon by 2030 and carbon neutrality by 2060

## Europe Union

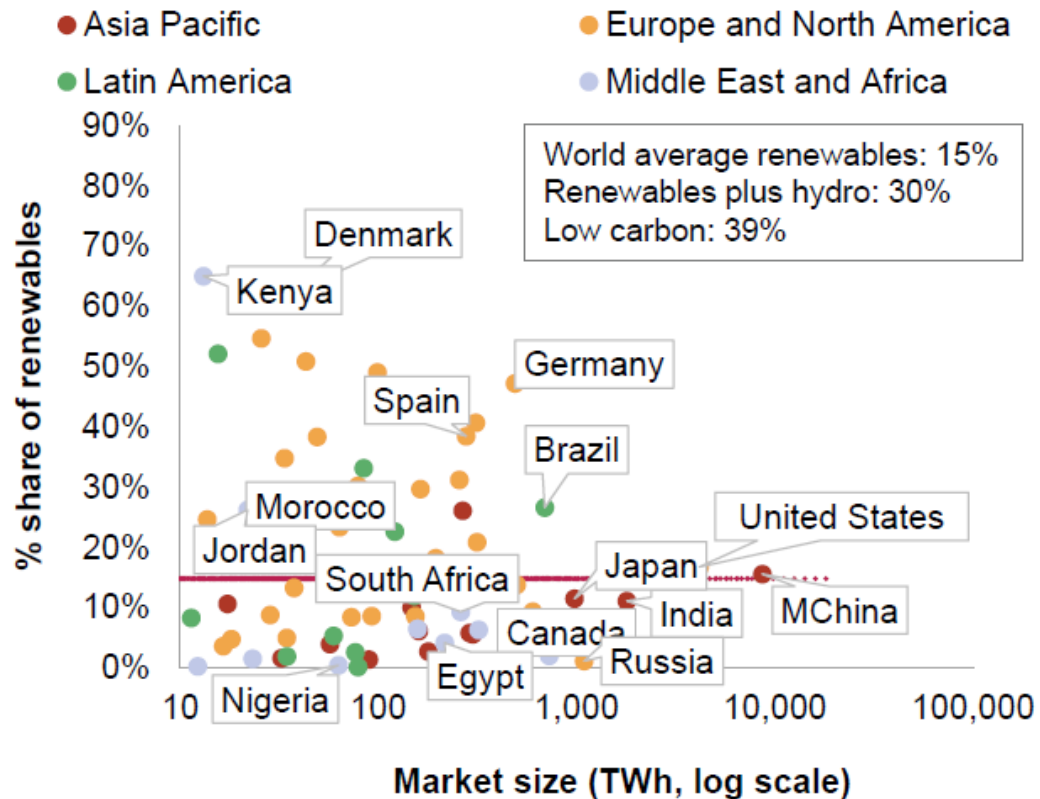
- **REPowerEU**
- **Fit for 55** to reduce emissions by 55% by 2030

## United States

- **Bipartisan Infrastructure Law** (a.k.a., Infrastructure Investment and Jobs Act)
- **Inflation Reduction Act**

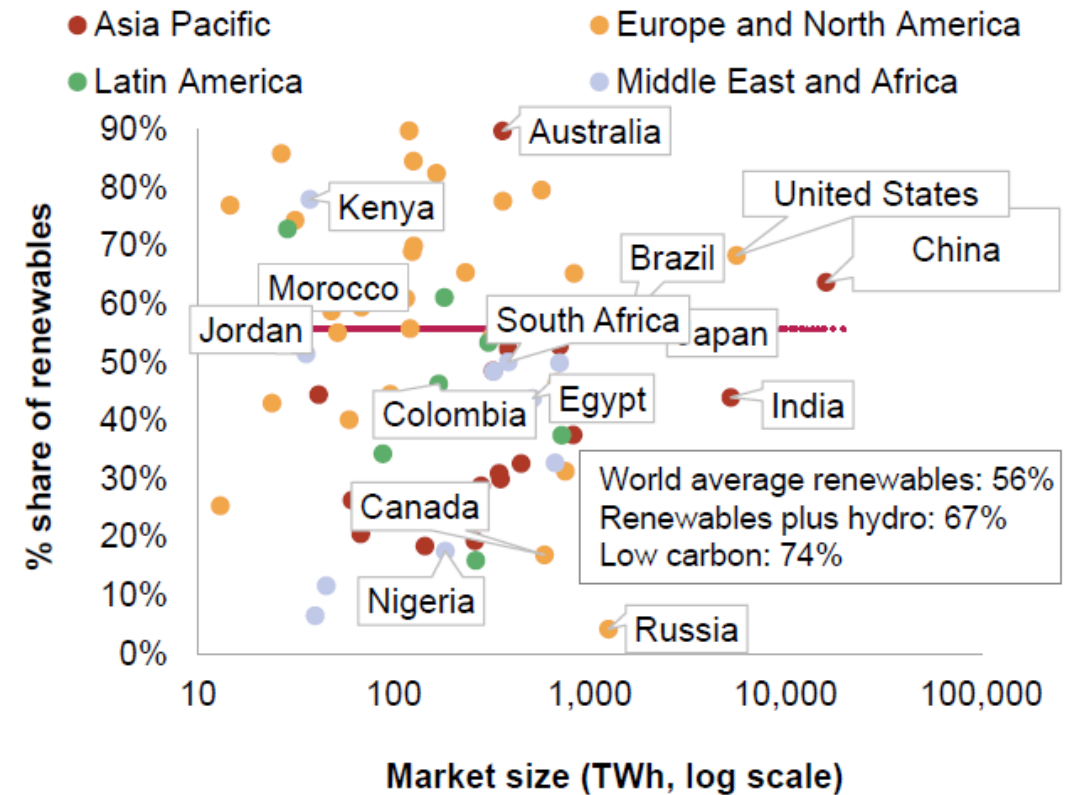
# Non-hydro renewables will reshape the global power mix and represent a substantial share of generation in the next decades

## Share of renewables versus total market size, 2022



Renewables excluding hydropower; dotted line represents world average. Low carbon = renewables, hydro, nuclear.

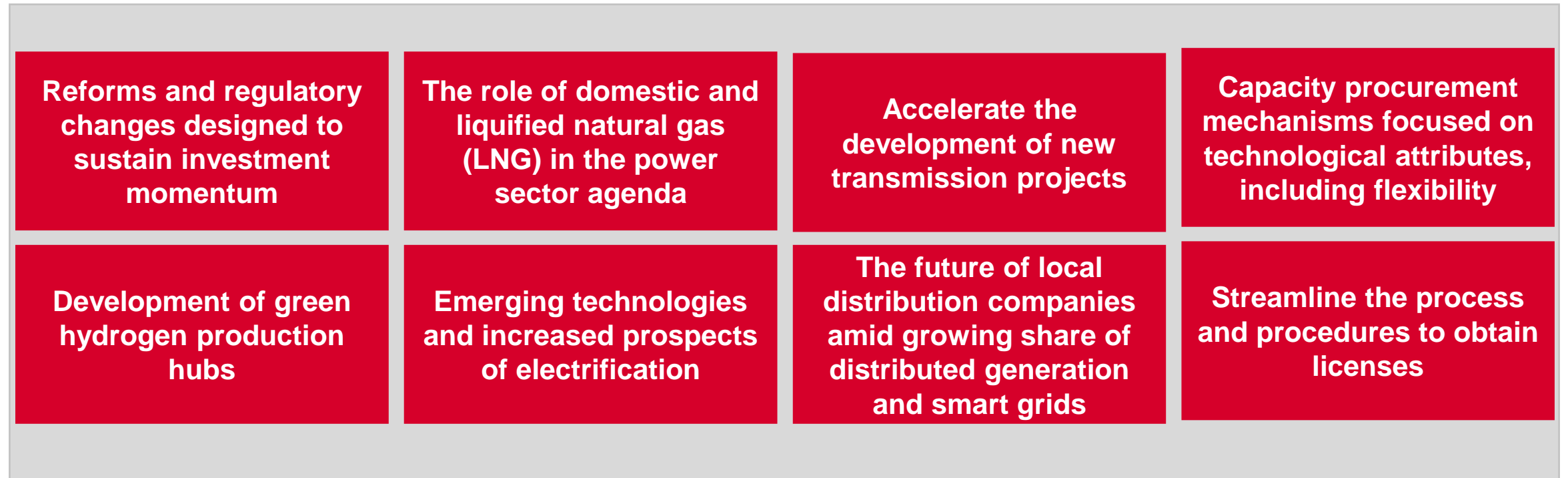
## Share of renewables versus total market size, 2050



Renewables excluding hydropower; dotted line represents world average.

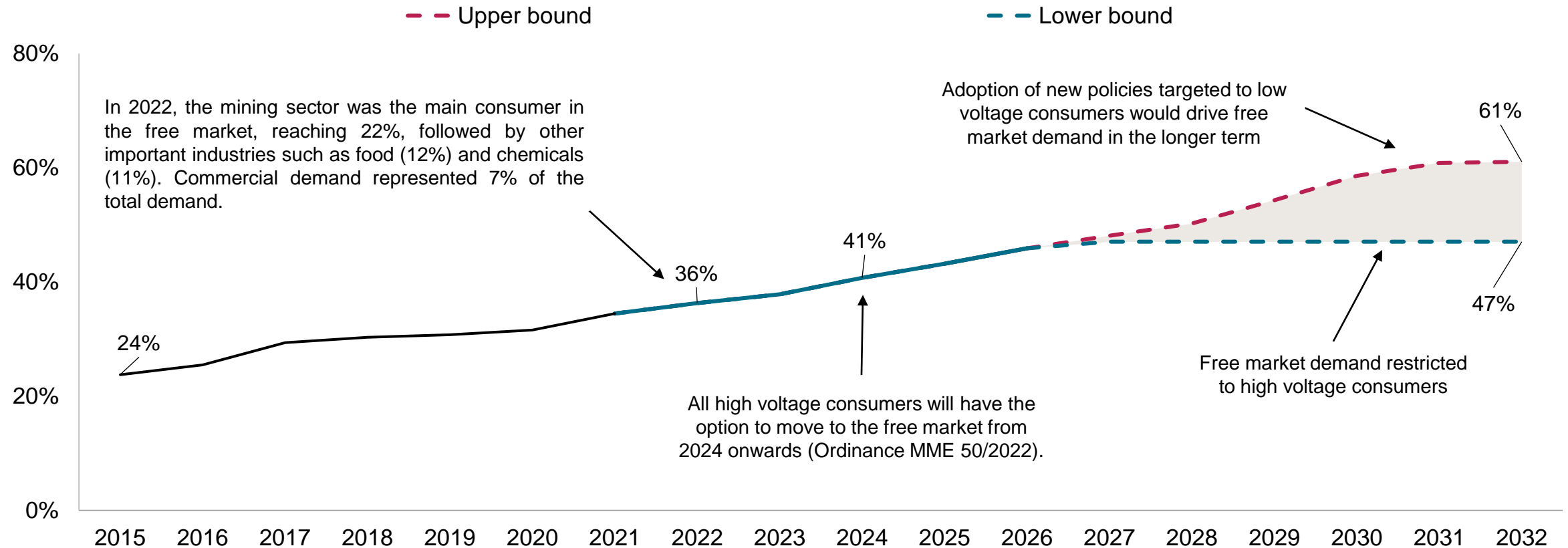
Source: S&P Global Commodity Insights

# Shifts in business models and technologies are reshaping the Brazilian power sector and will lead to substantial changes in the existing framework



# The approval of the power reform bill may provide upsides to the pace of the growth of the Brazilian free market

## Free market demand share outlook

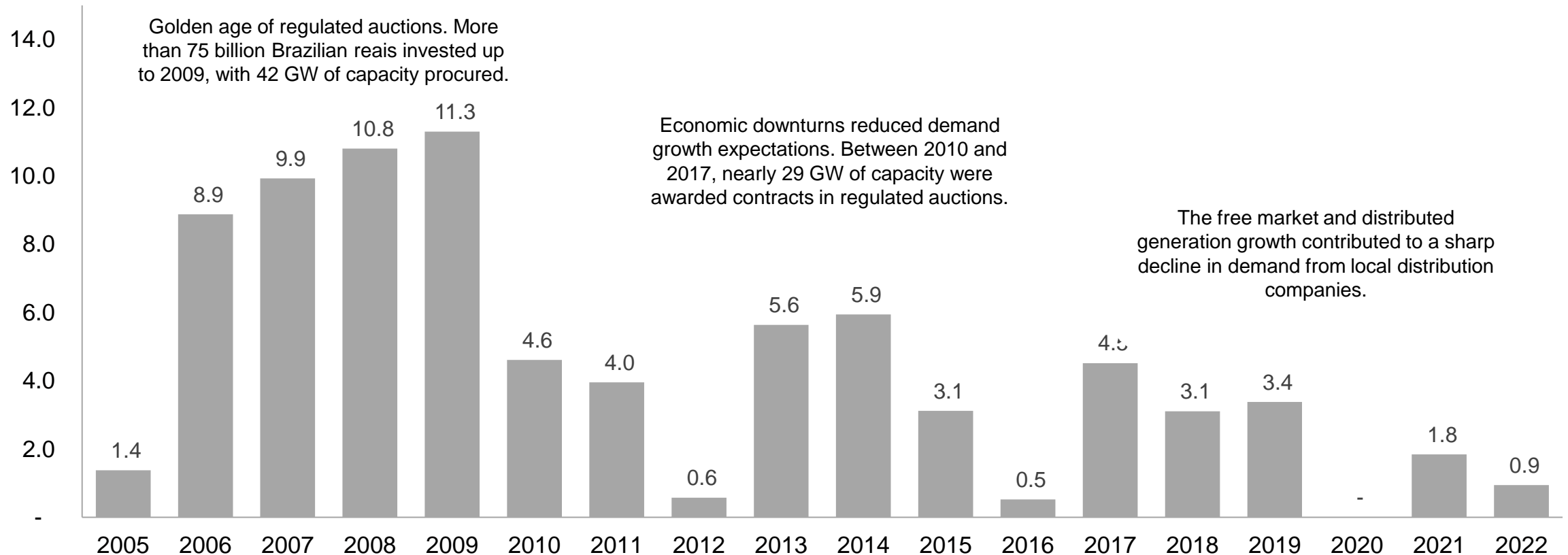


Note: Considering that low voltage non-residential consumers will be able to migrate after 2027 and residential consumers only after 2029. Roughly 80% of high voltage consumers are migrating to the free market by 2030 in both scenarios (lower and upper bound).  
Source: CCEE, S&P Global Commodity Insights



# Regulated auctions are losing momentum after a decade driving capacity additions

## Capacity procured through regulated auctions by year (GW)

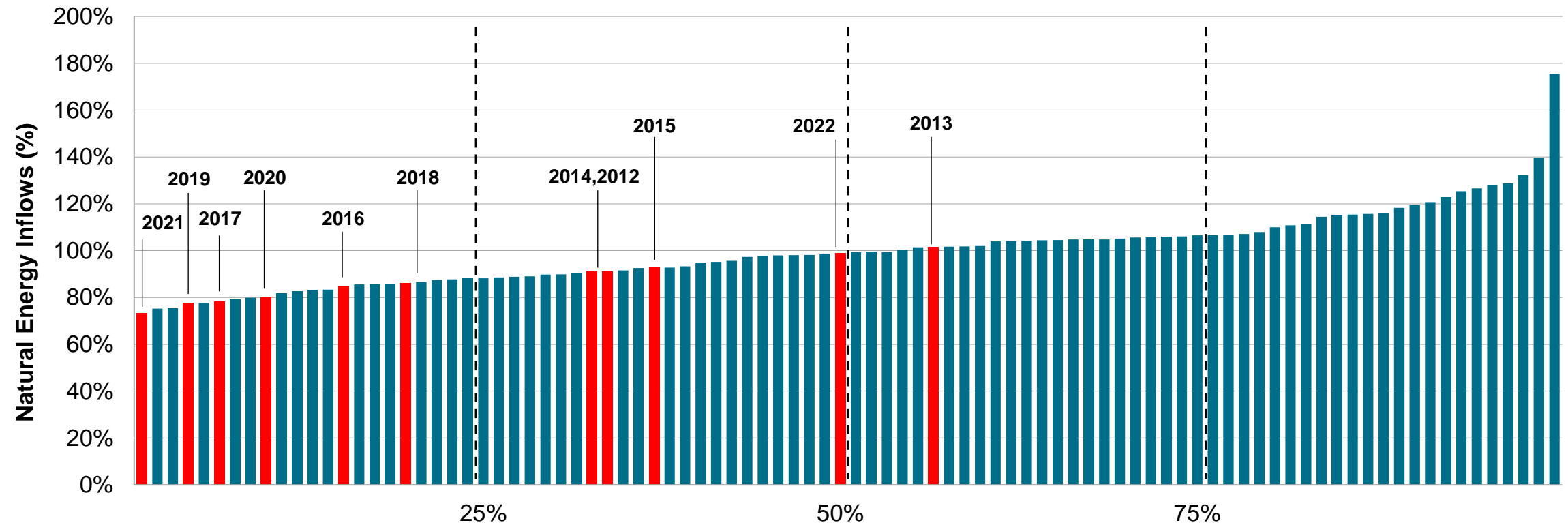


Note: Estimates considering new energy auctions (LEN). Reserve auctions are not included in the chart.

Source: S&P Commodity Insights; CCEE.

Hydro underperformance in 9 out of 11 years since 2012 created vulnerabilities for the power system, with implications for investment and trading

### Brazil's historical natural energy inflows between 1931 and 2022



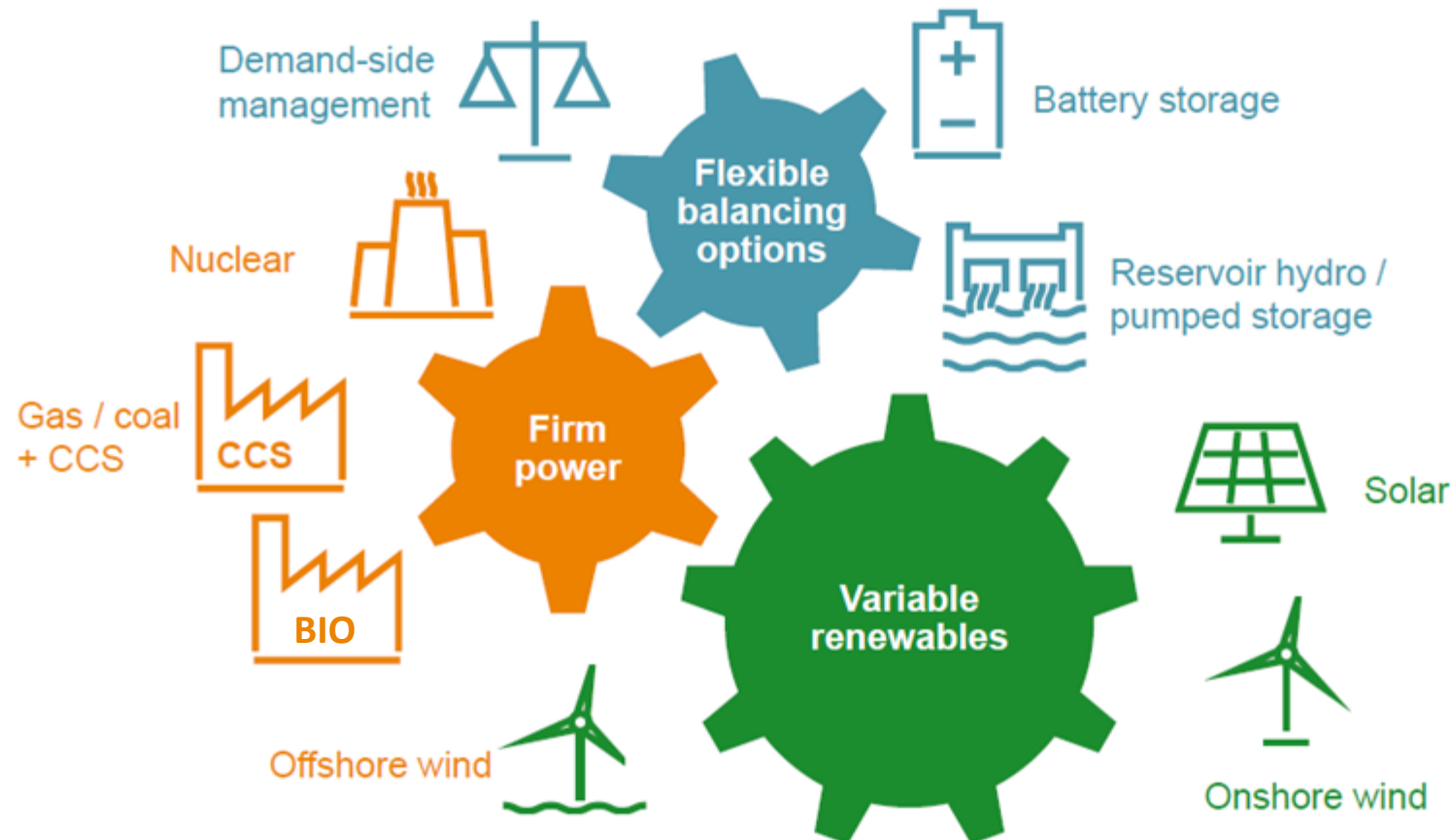
Note: Natural Energy Inflows (ENA) shown in percentage terms of the long-term historical average (1931-2022).

Source: S&P Global Commodity Insights, ONS.

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# Reliability during the transition and the quest for short-term and long-term dispatchable resources

## Resource roles in a decarbonized power grid

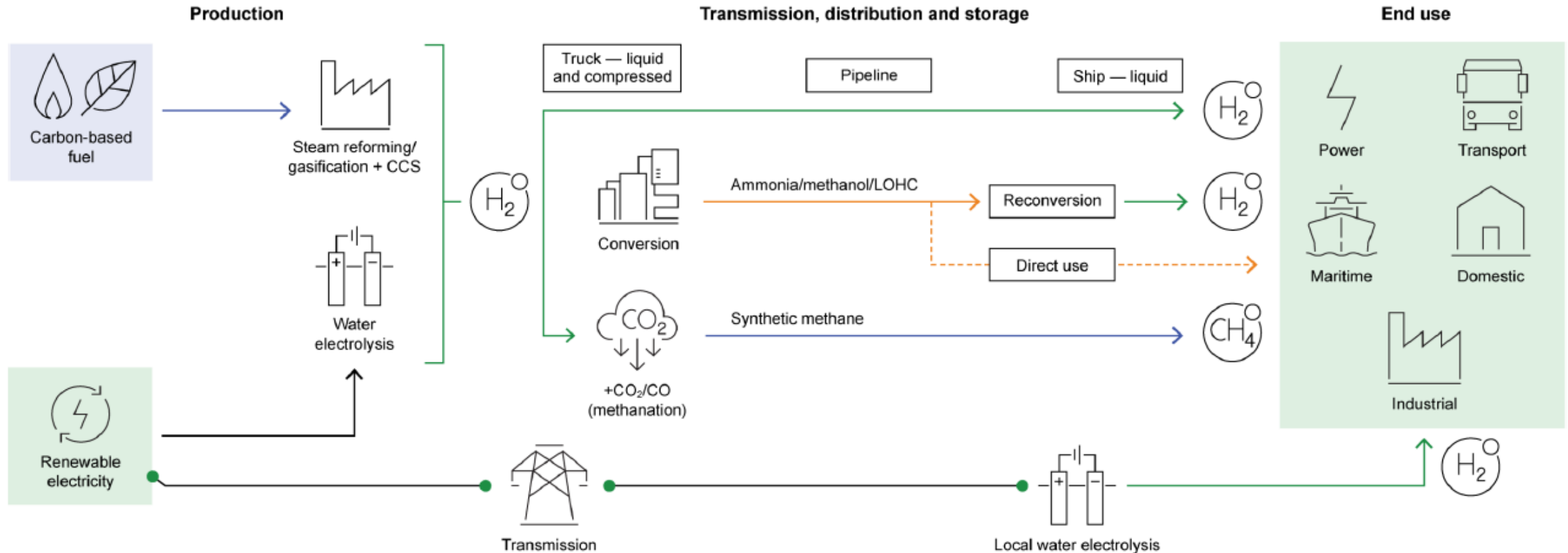


# Hydrogen production process

## The role of indirect electrification in the energy transition

### The value chain of low-carbon hydrogen

→ Carbon-based fuel → Electricity → Low-carbon hydrogen → Hydrogen derivative

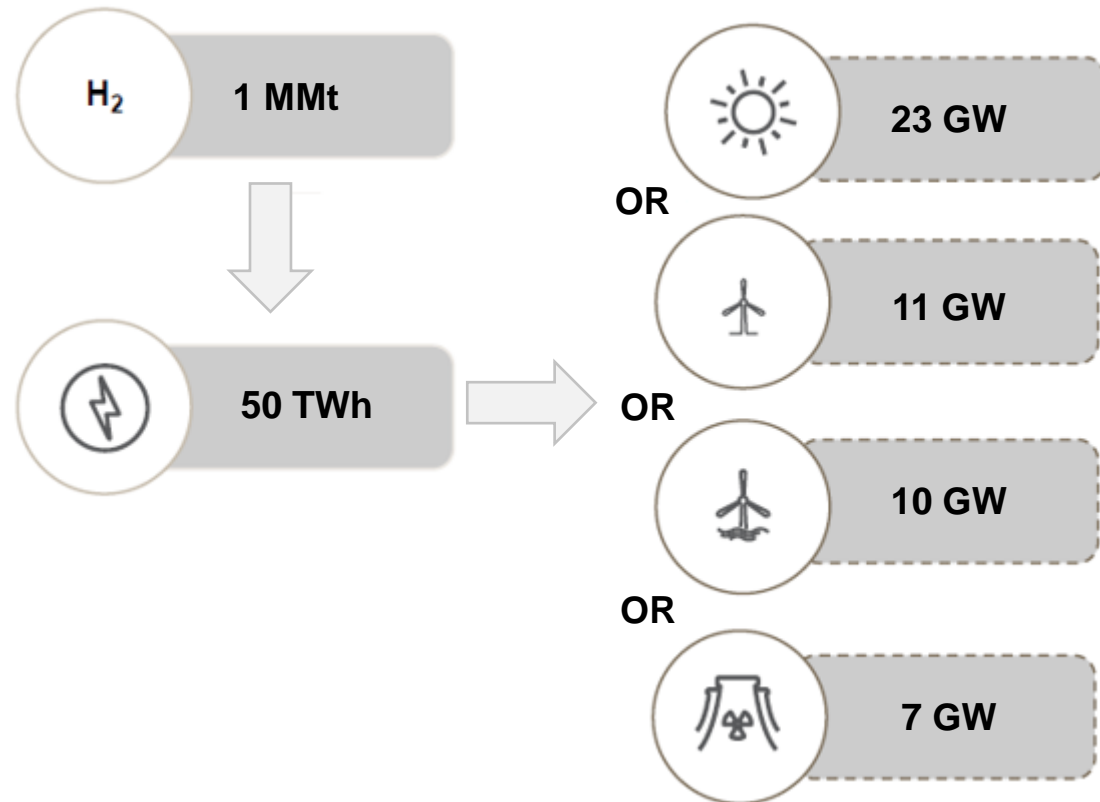


LOHC = liquid organic hydrogen carriers; CCS = carbon capture and storage.

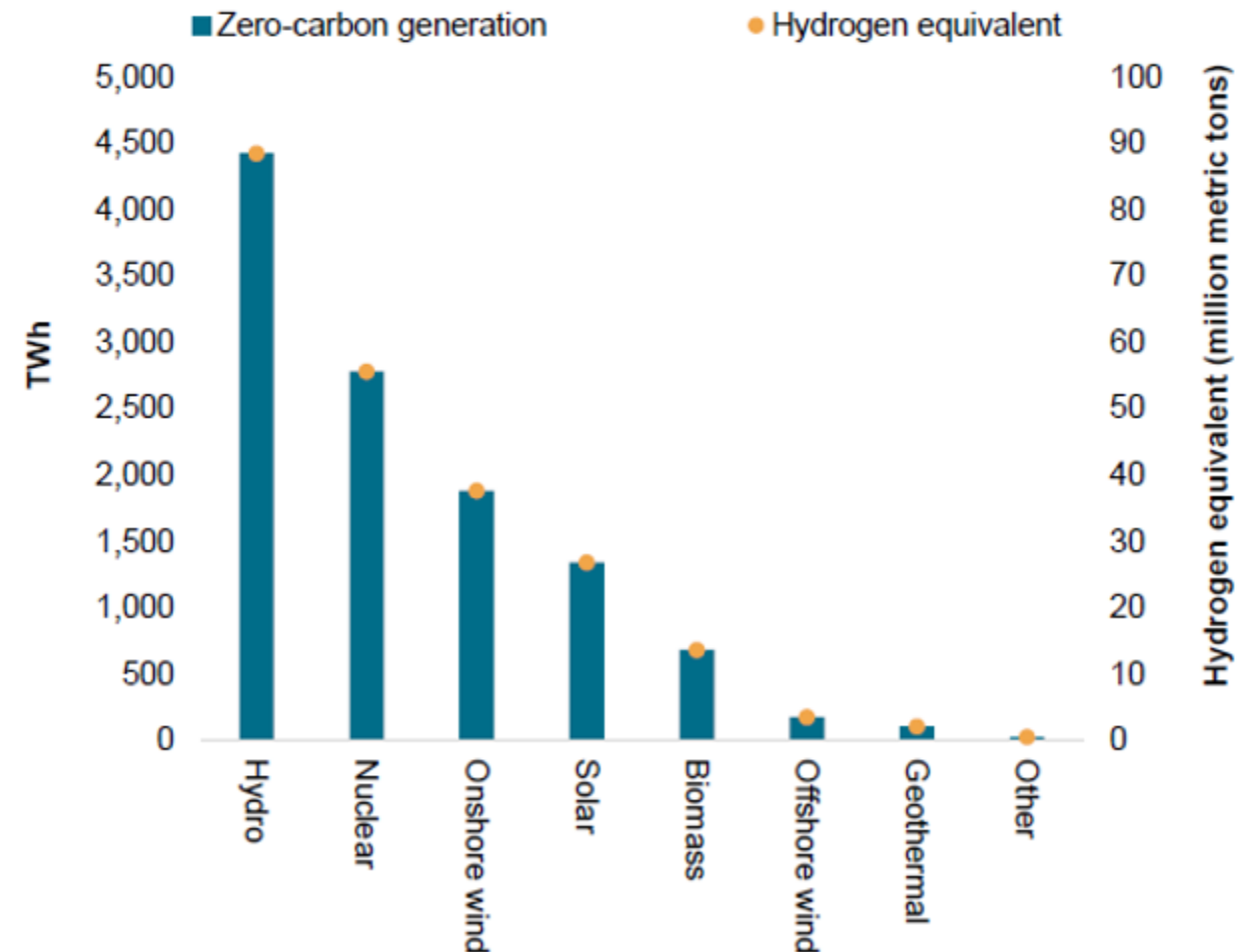
Source: S&P Global Commodity Insights

# Green hydrogen production may imply significant capacity additions of clean energy technologies in the decades ahead

Electricity demand and installed capacity using typical capacity factors in Brazil



Global zero-carbon electricity production (2022) in hydrogen equivalent units



Source: S&P Global Commodity Insights

# Global markets are exploring different approaches to foster the growth of low-carbon hydrogen

## Cost reduction

Low carbon hydrogen is currently more expensive than competing fuels

- Opportunities for cost reductions include economies of scale and R&D
- Supportive policies aiming to scale up the low-carbon industry, such as IRA, European Hydrogen Bank, etc.

## Build demand

Convert existing uses to low-carbon and expand use into new areas

- Project developers require further clarity on government support measures before final investment decisions
- US Infrastructure Act

## Availability of renewables

Hydrogen projects are in competition with end consumers for renewable power

- Green hydrogen imports from regions with high quality resources
- Accelerated permitting

## Infrastructure development

Need to develop production capacity, transport infrastructure and storage

- Policies aiming to support infrastructure development (Infrastructure Act, European Projects of Common Interest)
- Leverage existing infrastructure assets to accelerate the development of the industry

# Key issues to watch

- Brazil's power sector stands at a critical juncture, faced with the need to implement significant measures that will have far-reaching implications over the coming years
- The emergence of low-cost renewables and new technologies have added complications to reform processes
- What will be the role of governments and policymakers versus companies and investors in the operation and evolution of energy markets
- Brazil has the potential to harness opportunities in the global energy transition, but achieving this requires the establishment of a conducive business environment and the implementation of a robust set of policies to accelerate investments

# Thank you

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