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Sustainable Biofuels: Addressing Climate Emergency and Energy & Food Security

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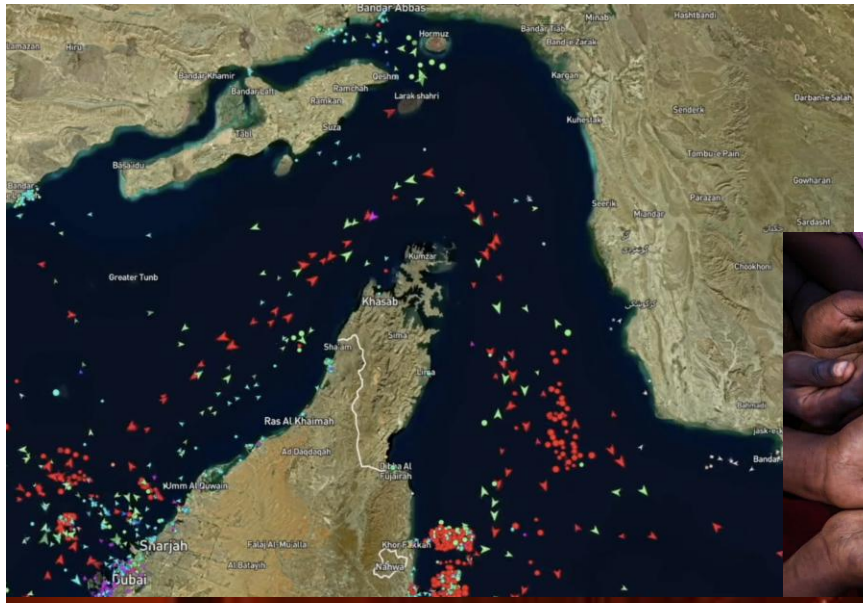
ISO MYM KENIA

International Sugar Organization Mid-Year Meeting
Mombasa, Kenya 2026
May 26, 2026

Three most pressing issues of current times

- Energy security
- Food security
- Climate emergency



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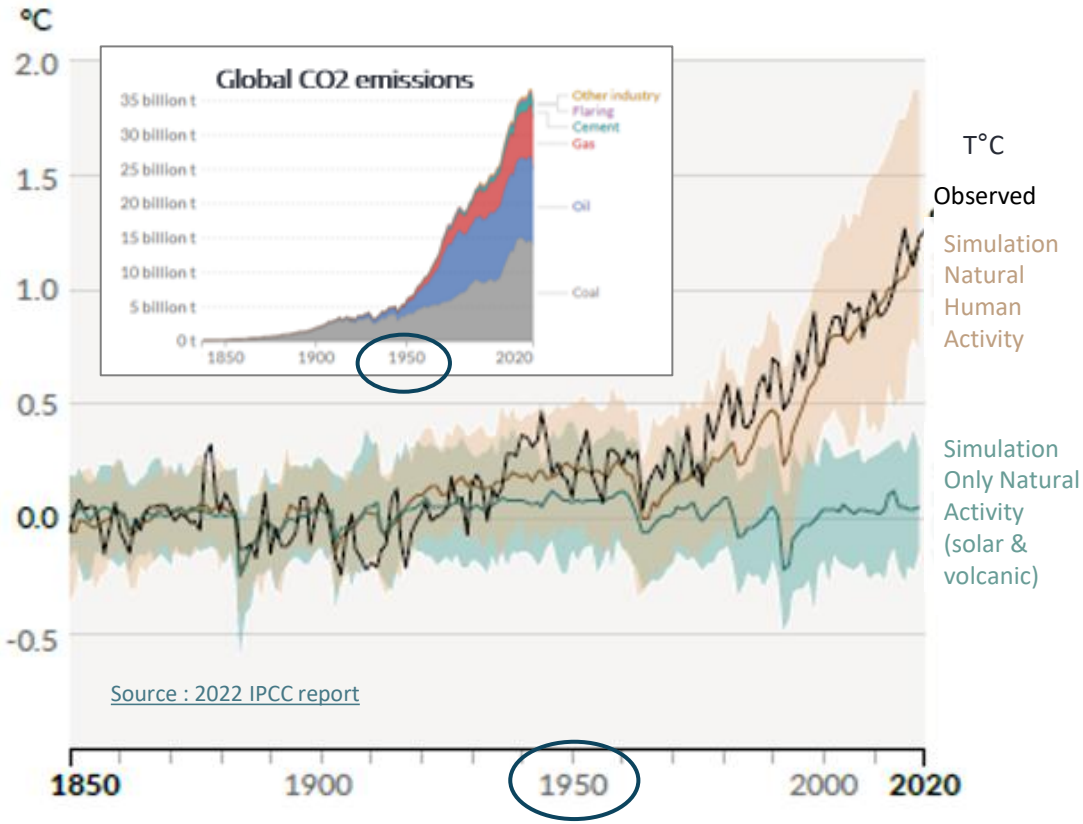
Climate Emergency: where are we headed to?

CHANGES IN SURFACE TEMPERATURE

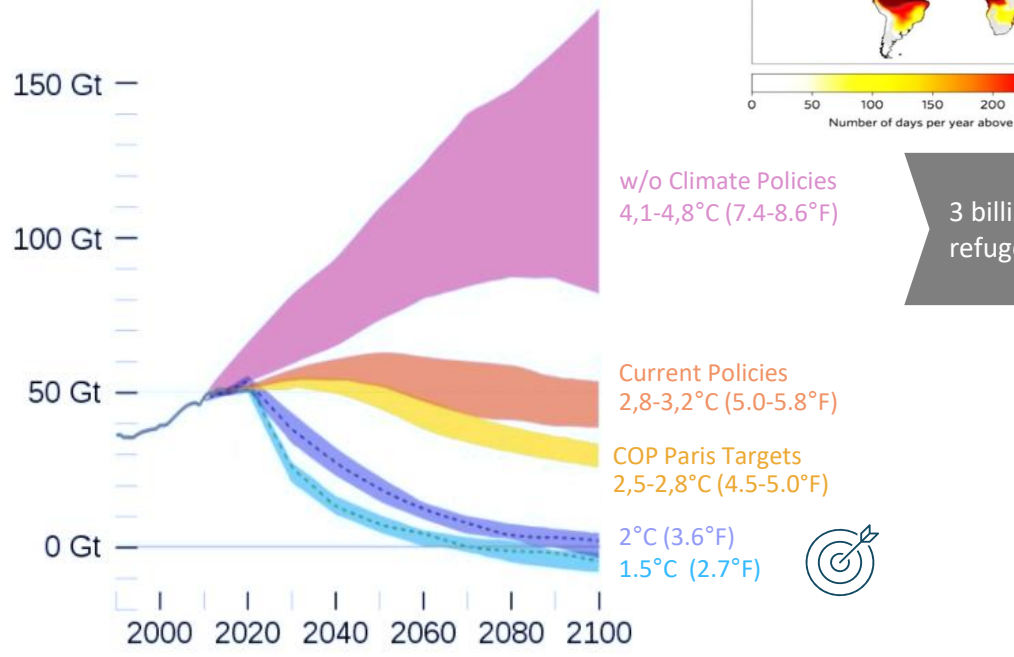


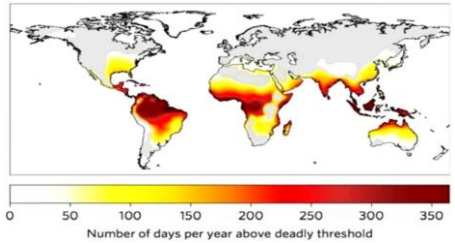
Source : 2022 IPCC report

Rise in temperature above 1.2°C during last 70 years;
Emissions have risen 7 times during last 70 Years.

SCENARIOS OF GREENHOUSE GAS GLOBAL EMISSIONS

GHG ANNUAL EMISSIONS
GIGA TONS OF CO_2 EQUIVALENT





3 billion climate refuges in 2100

Source : Our World in Data

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

Paris Agreement (COP21) is a compromisse amongst countries;
The objective is to limit global warming to maximum 2°C;
Unfortunately, until now efforts have been insufficient.

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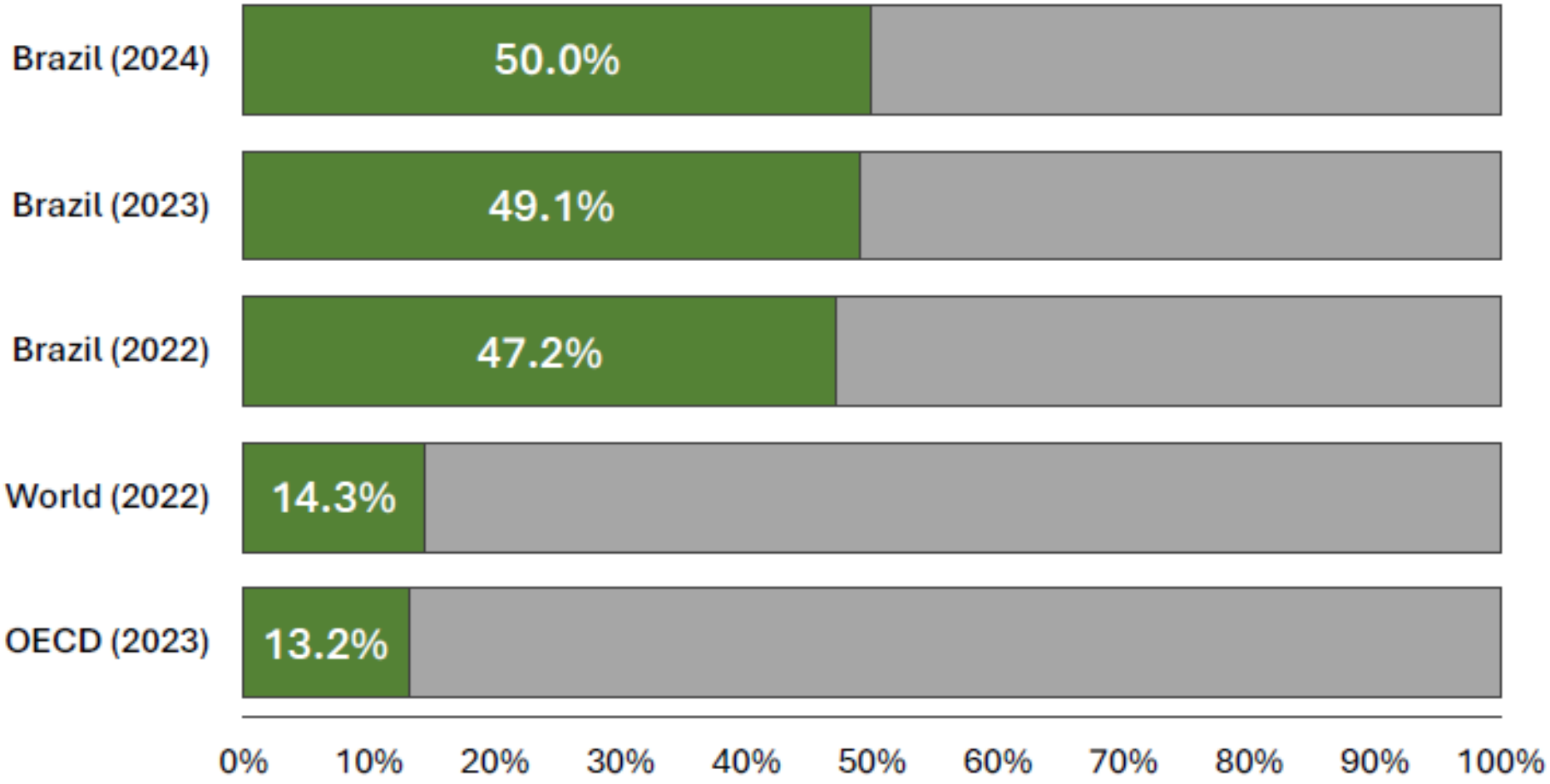
It is doable: Brazil's Energy Matrix is 50% renewable

Share of Renewables in Total Energy Supply



Source: EPE/BEN 2025.

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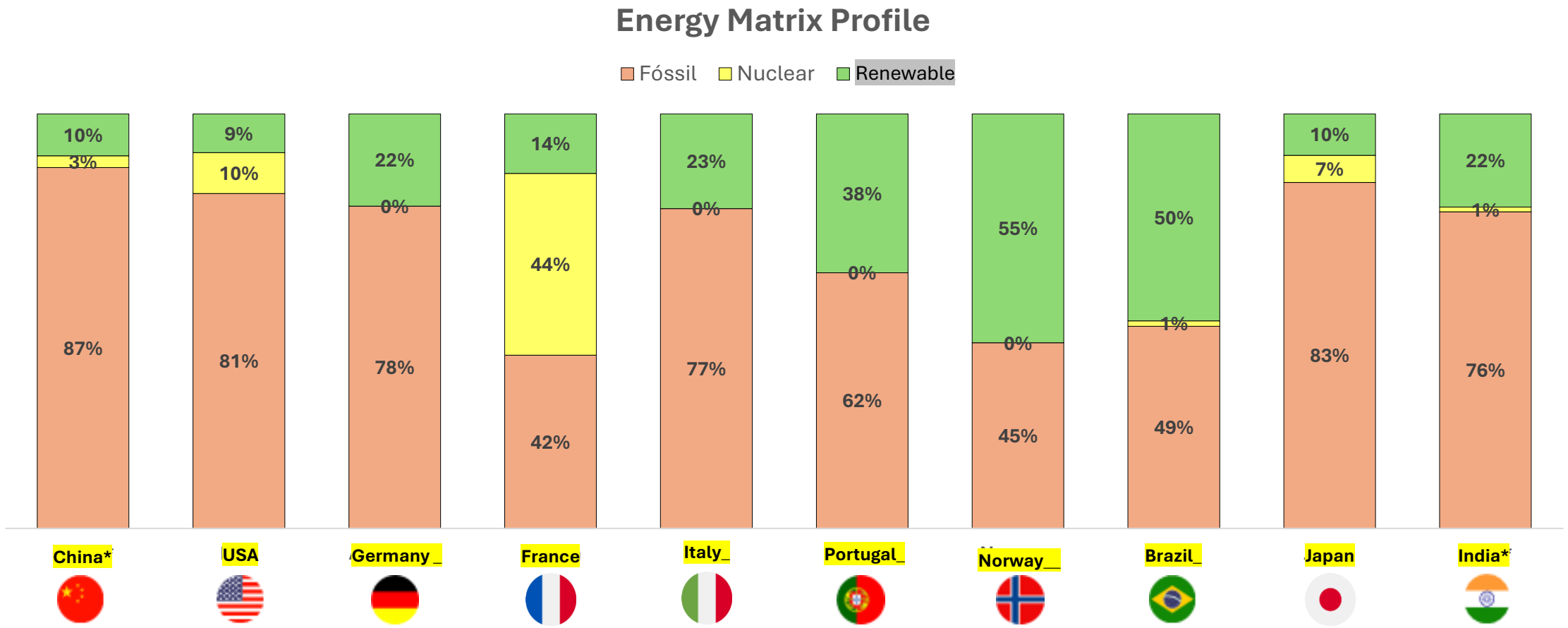
Profile of Global Energy Matrix, selected countries

COUNTRY COMPARISON – FOSSIL, NUCLEAR & RENEWABLE



Source: Data 2024 IEA (International Energy Agency)

* Data for 2024 not available, data for 2023

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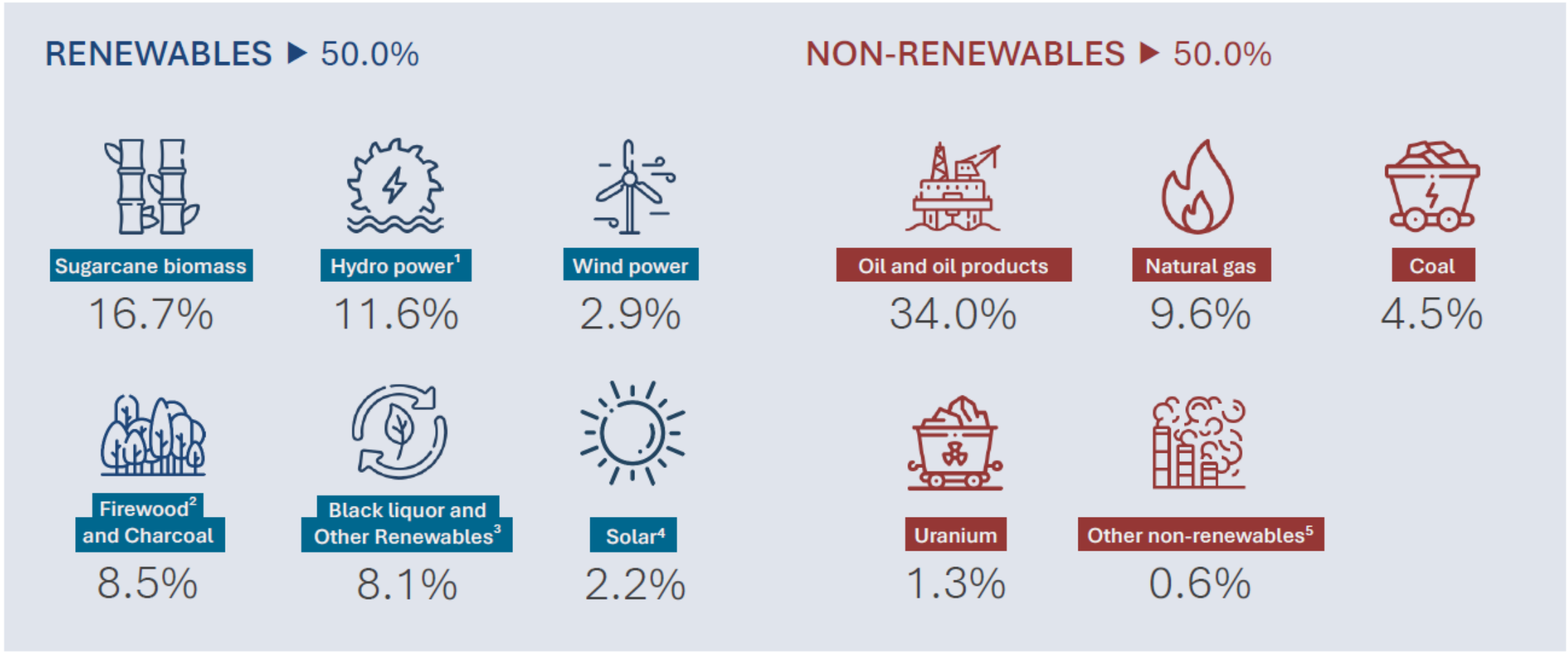
In Brazil, sugarcane is largest renewable source of energy

Breakdowns of Total Energy Supply (TES) 2024



Source: EPE/BEN 2025.

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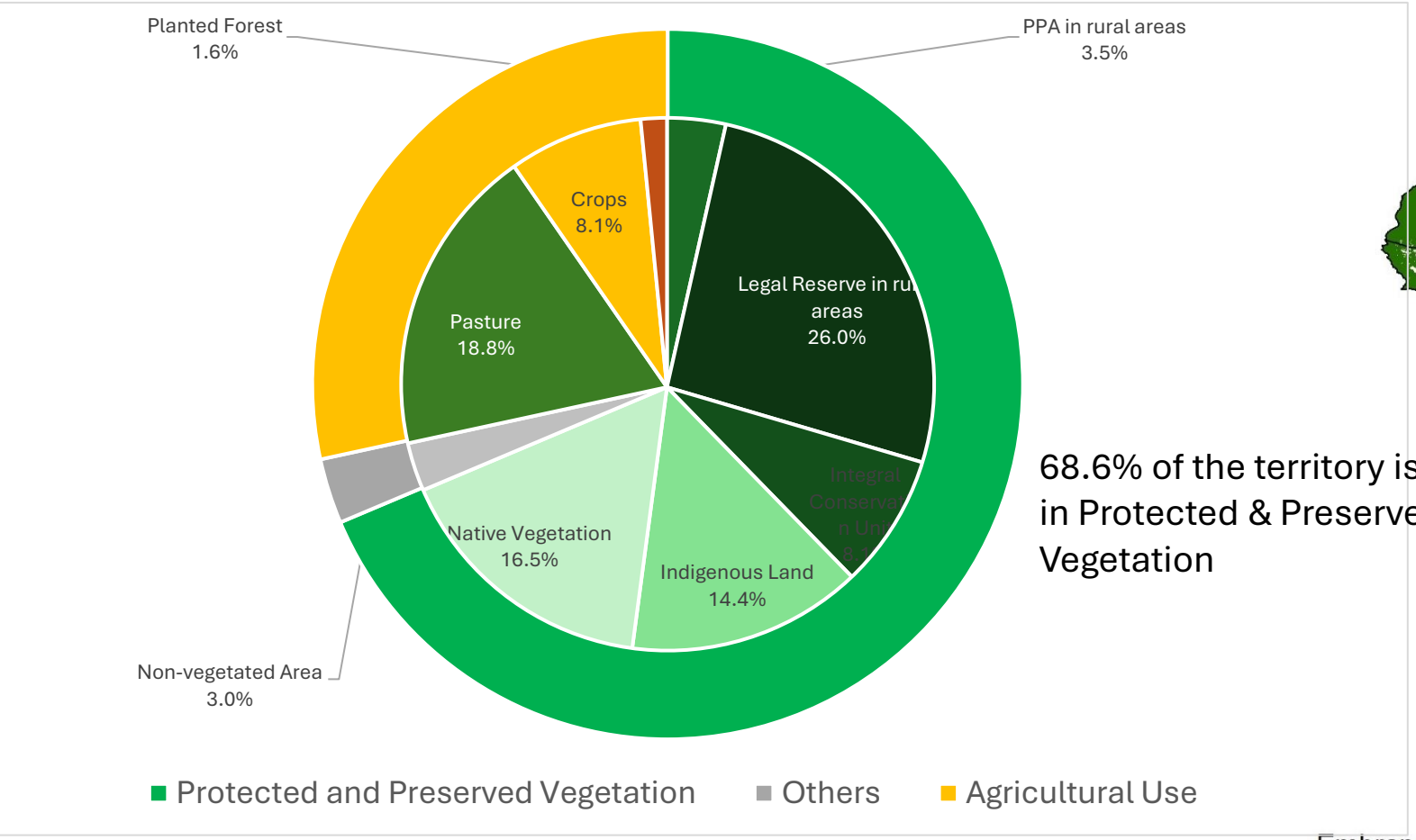
Land occupation in Brazil, 2024

Sugarcane for ethanol occupies only 4.5 mm ha, or ~0.5% of total territory.

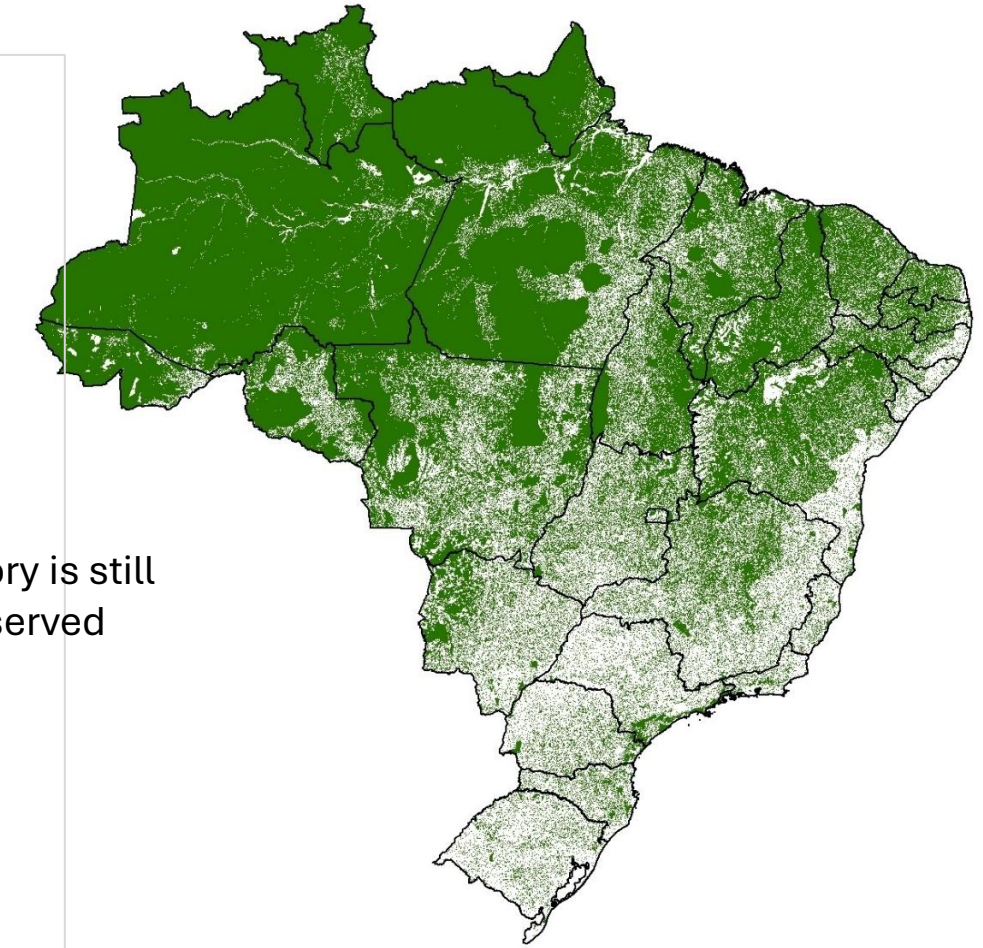
Land use in Brazil



68.6% of the territory is still in Protected & Preserved Vegetation

Source: Embrapa/CAR/MapBiomas/MAPA

Protected and Preserved Vegetation, 2024



Embrapa Territorial. 2021

Source: Embrapa/IBGE/MMA/FUNAI

Areas maintained as original native vegetation in Brazil are equivalent to the territory of 48 countries in Europe - 2024

The total area dedicated to preservation in Brazil, of 584.18 million hectares, is larger than the territory of 48 countries in Europe, or equivalent to 72.3% of the territory of continental USA.

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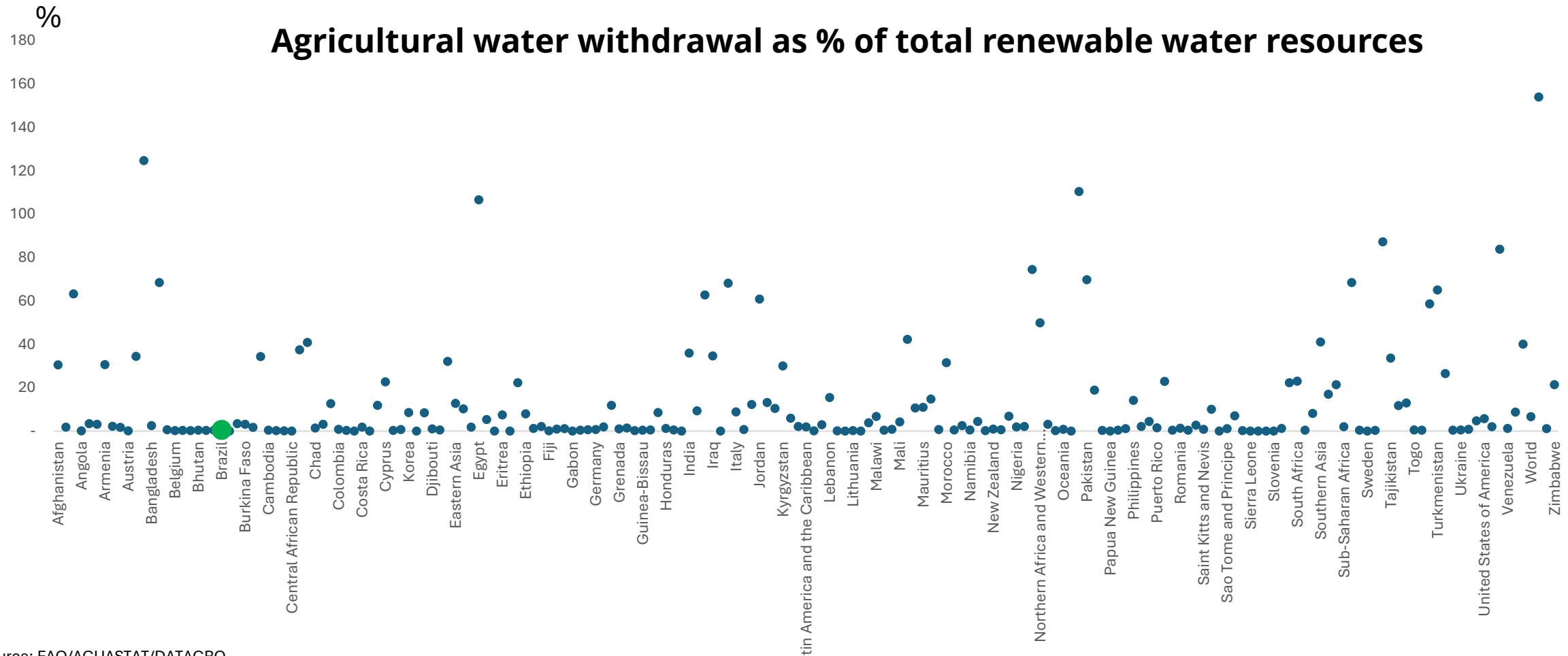
Brazil uses much less water for agriculture than world average

On average, world agriculture uses 6.6% of available water, while Brazilian agriculture uses only 0.48% !
In Europe, it averages at 2.10%, while in the U.S. 5.74%



Source: FAO/AGUASTAT/DATAGRO

*This indicator measures the proportion of available renewable water resources used for agriculture, providing critical insight into the sustainability of water use in the sector. High values of this indicator suggest a significant reliance on these resources for agricultural activities, which could indicate potential water stress, especially in regions prone to drought. By evaluating this metric, policymakers and researchers can identify areas at higher risk of water scarcity and develop targeted strategies to enhance water efficiency in agriculture, ultimately reducing drought vulnerability and ensuring sustainable water management practices.

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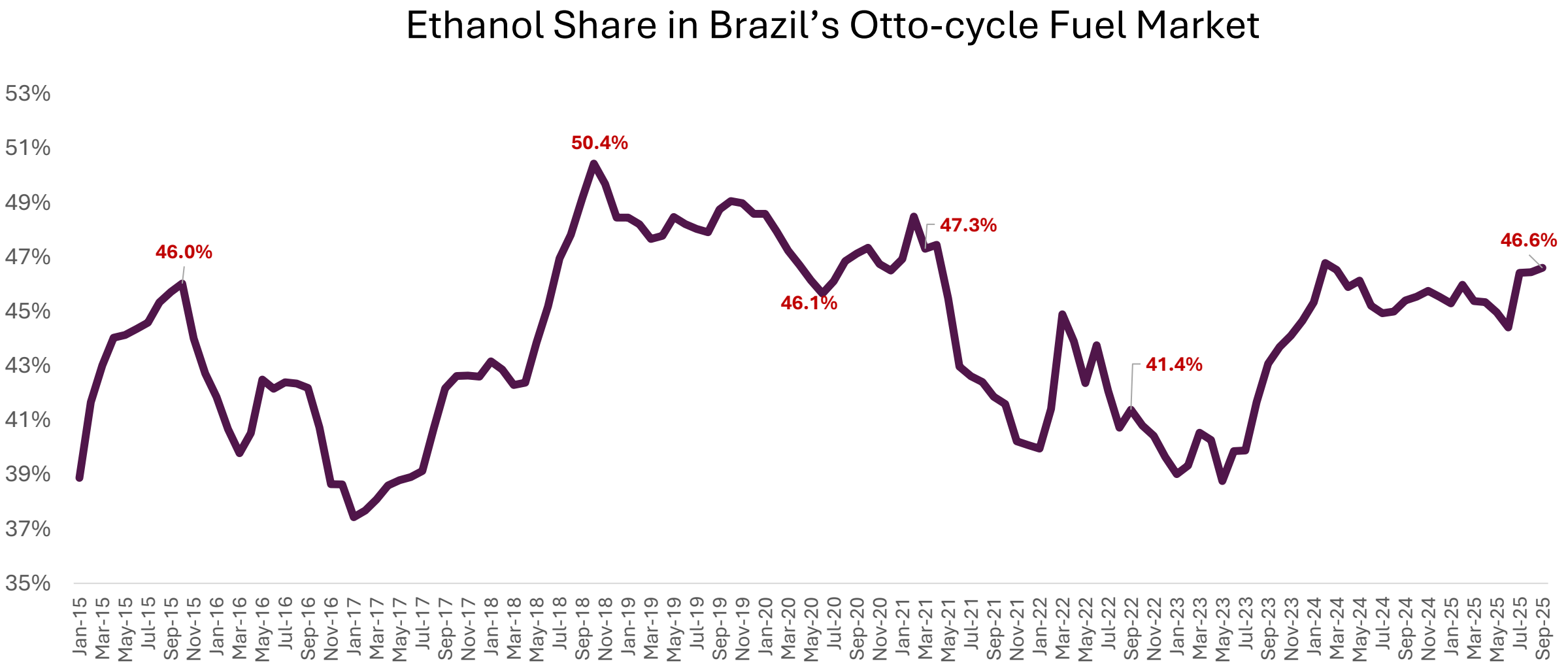
Ethanol is currently substituting 46.6% of all gasoline used in Brazil



Source: DATAGRO

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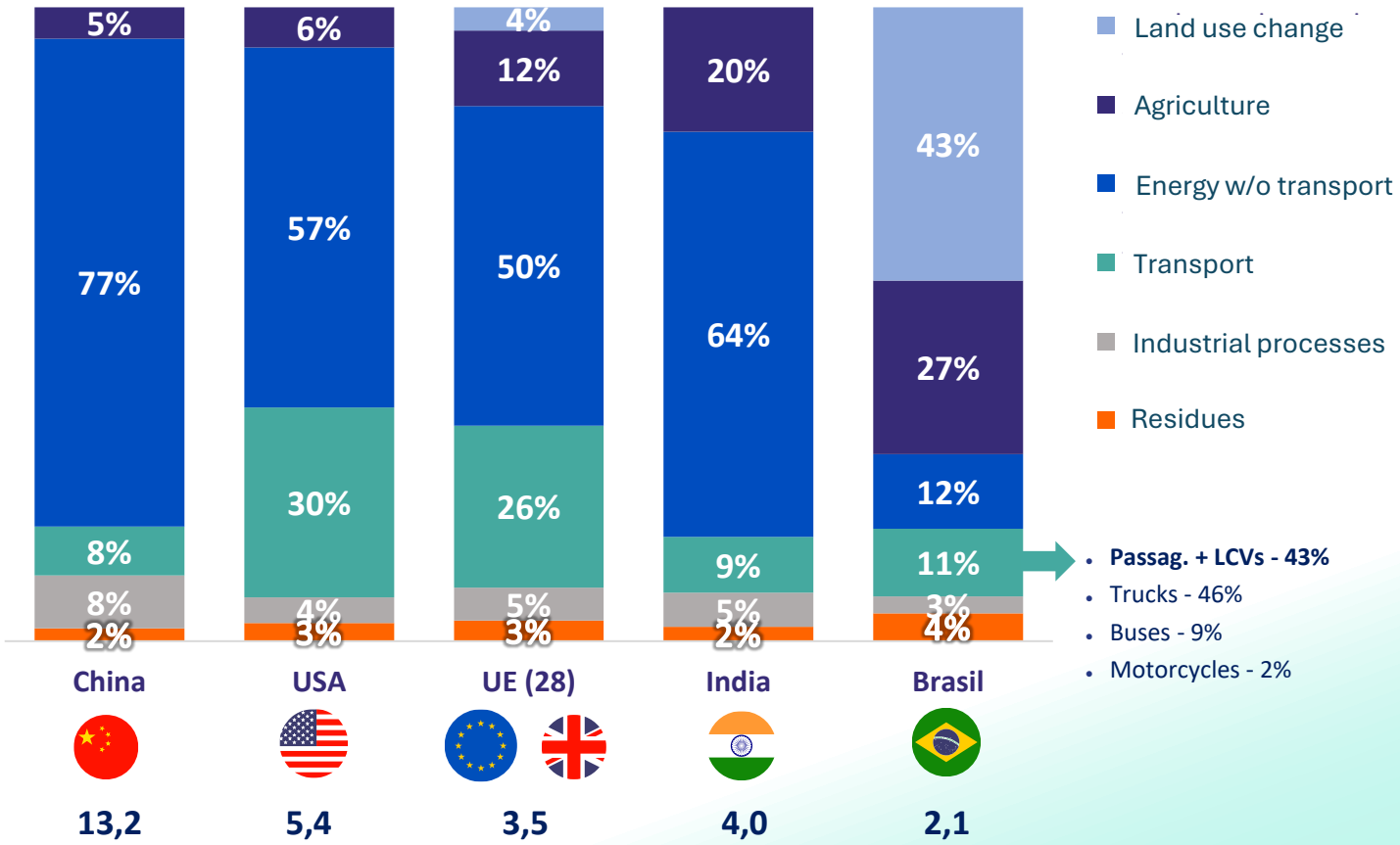
CO_2 Emissions by Sector, selected countries

GLOBAL COMPARISON – CO_2 EMISSIONS



TOTAL COUNTRY EMISSIONS (GtonCO2e) in 2023

TOTAL GLOBAL 51 GtonCO2e

Fonte: Climate Watch, SEEG

IN BRAZIL

TRANSPORT REPRESENTS 11% OF TOTAL EMISSIONS OF CO_2

- Low and different emission profile
- Large use of sustainable biofuels
- Focus is on fighting ilegal deforestation in public areas

TARGET CO2 EMISSION REDUCTION (ref. 2005)

- Reduce 59%-67% emissions until 2035
- Net Zero emission by 2050

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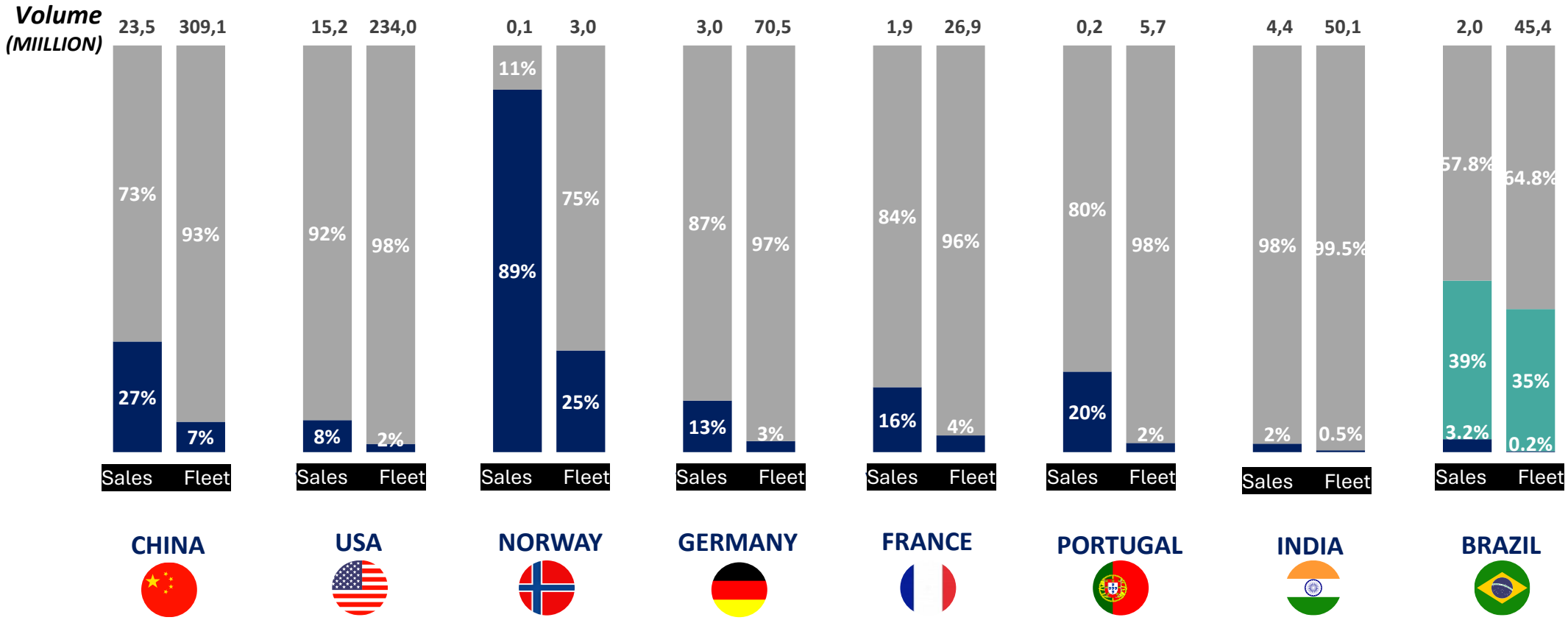
With Ethanol, Brazil has Largest Fleet of Low Carbon Emission Vehicles

SALES & FLEET – PASSENGER VEHICLES 2024



*Ethanol vehicles : estimate based on ethanol sale volumes by ANP (Agencia Nacional do Petróelo e Biocombustiveis)

Considering the renewable nature of ethanol, Brazil has the largest fleet of clean vehicles in the world considering the use of ethanol mixed in gasoline (E30) and ethanol used by the flex fleet which accounts for 83% of current fleet.

Source: IEA (International Energy Agency)

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Relevance of the Choice of Sustainability Criteria

Public policies may lead to unsatisfactory results if the choice of Sustainability Criteria is not approriate

Criteria for Sustainability in Transport

Tank-to-Wheel: is the simplest & most limited criterium in scope – measures only tailpipe emissions. Can lead to misleading results when energy used is not renewable.

Well-to-Wheel: this criterium takes into account emissions related to the sourcing and use of the energy used in transport. It is better than Tank-to-Wheel, but still not complete.

Cradle-to-Grave (or Life Cycle Assessment, LCA): it is the most complete & scientific based criterium. It includes emissions from mining of minerals, production of all vehicle components, their assembly, Vehicle use including source of Energy, and discharge at the end of life cycle.

Brazil provides a good example of Public Policies based on Science

Program Mover (Green Mobility & Innovation Program - PL 14.902/2024): legislation that defines efficiency and emission vehicle targets which include tailpipe & GHG emissions. Applauded by automakers for setting long term targets without determinig a technological choice. Adopts LCA as criteria.

Law Fuel of the Future (PL 14.993/2024): legislation that establishes médium to long term targets for the increased use of renewables in transport, through biofuels (ethanol, biodiesel, biomethane), hydrogen, SAF and Biobunker.

RenovaBio (National Biofuels Program - PL 13.576/2017): legislation that enables biofuel producers to be certified and in accordance with their Carbon Intensity (C.I.) request issuance of Decarbonization Credits which can be freely sold at B3 Exchange to fuel distributors to decarbonize their emissions. It includes a rigid Zero Deforestation criterium verified by independent surveyors. All certifications are submitted to public review and scrutiny, and audited by ANP. Adopts LCA for biofuel production efficiency and C.I.

Public Policies addressing efficiency & emissions in transport should NOT make a choice of technology but only define the medium-to-long term target(s). Innovation and market choice should determine the most appropriate and consumer-accepted technologies to achieve those targets.

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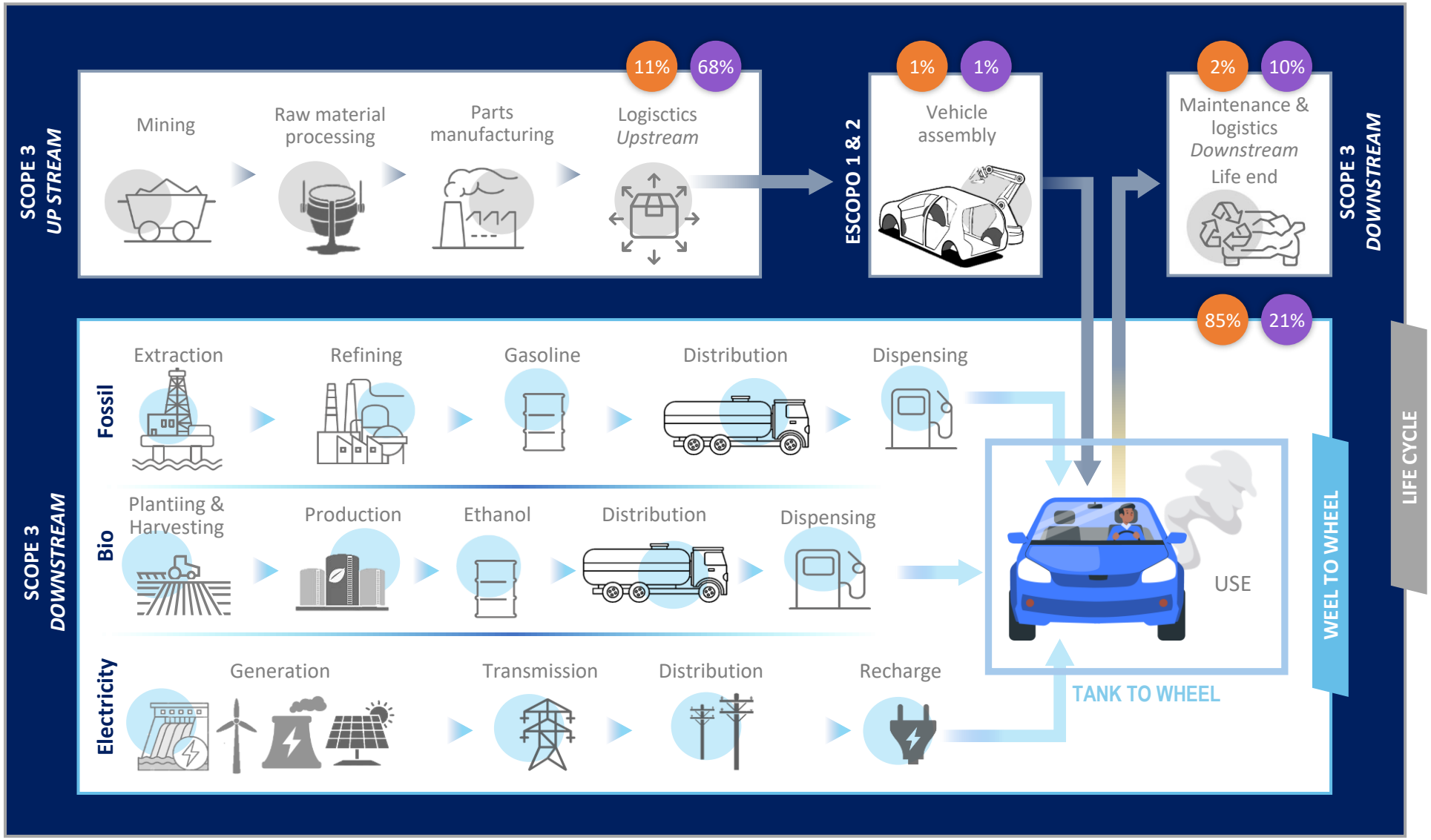
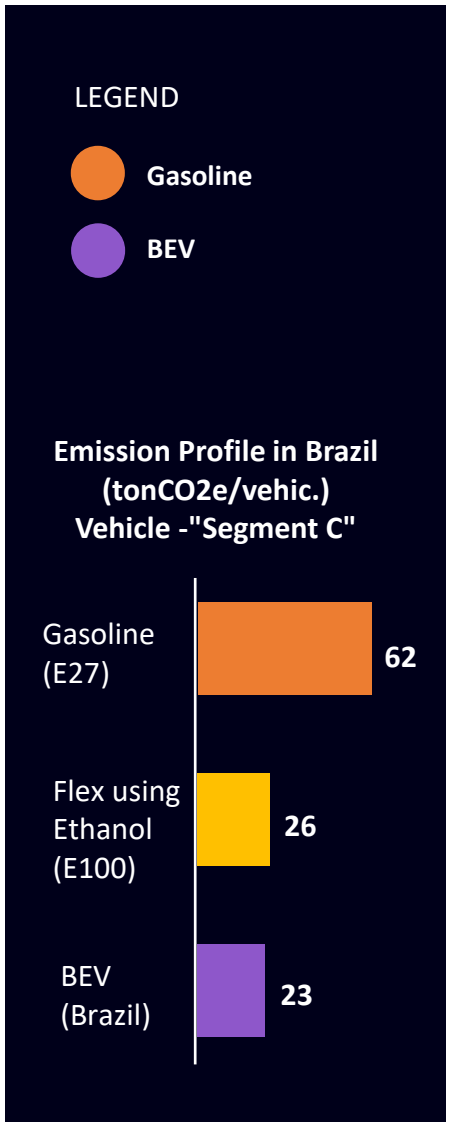
LCA (Life Cycle Analysis) of a Vehicle





Source: Stellantis.

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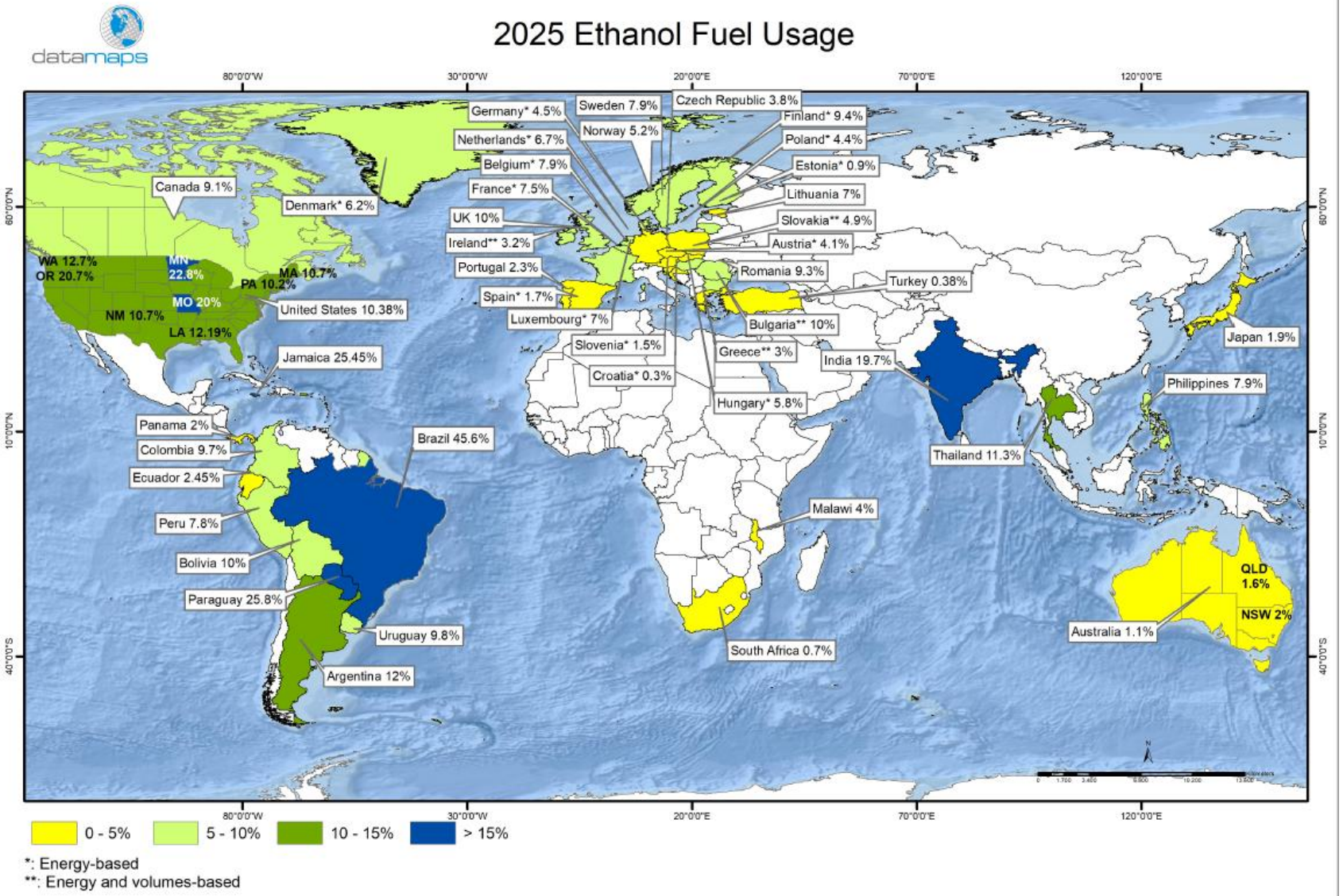
Ethanol production & use is spreading around the world

Ethanol is **replicable, scalable, allows immediate implementation, & has proven health & environmental benefits**. It **allows automakers to achieve the most restrictive emission targets**, and examples around the world show that **it leverages food production providing price stability and markets for farmer feedstocks.**



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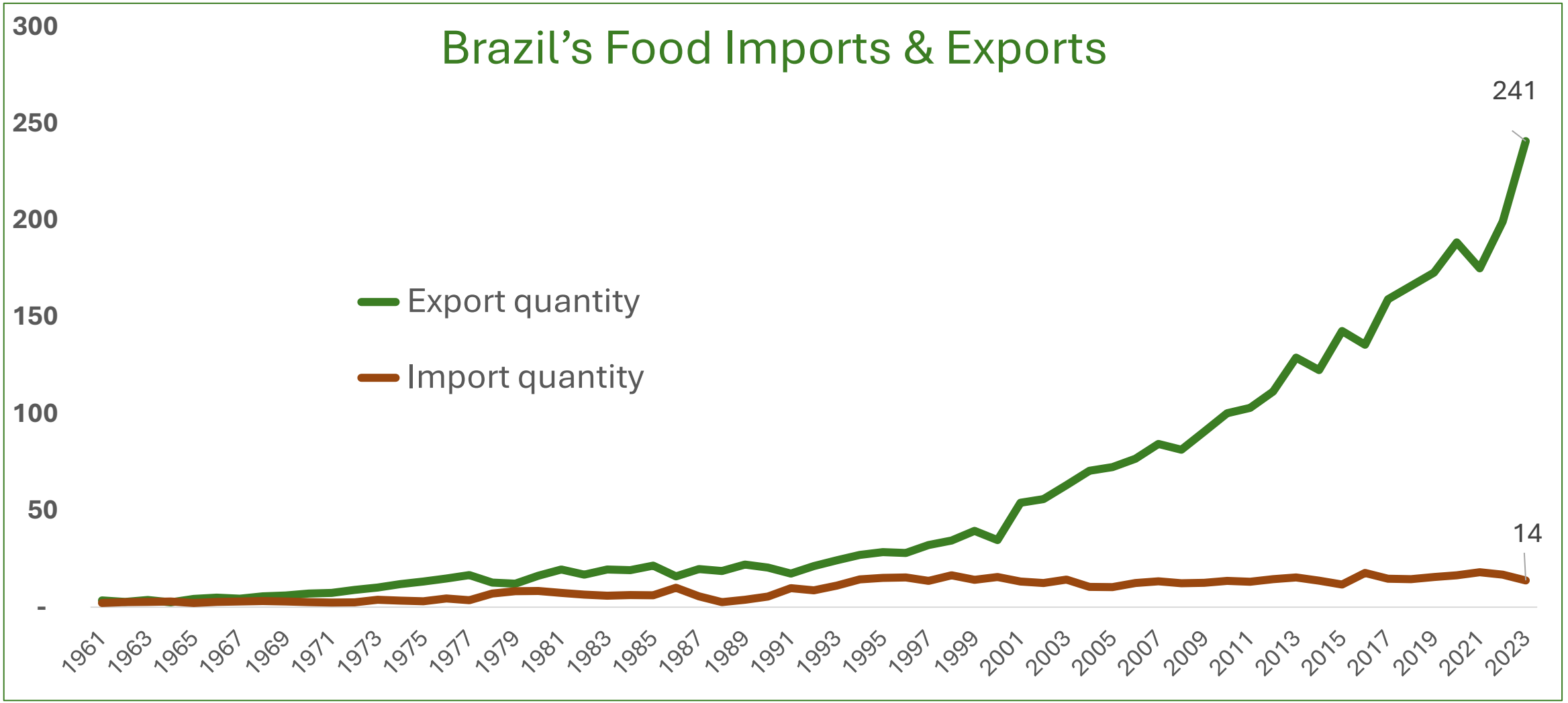
Brazil: from net food importer (1970's) to major food exporter

Through R&D and the development of Tropical Agriculture, Brazil transformed itself from Net Food Importer during the 1960´s, to a major food producer and exporter, at the same time it expanded biofuels production. Biofuel production leveraged food production and the same effect is being observed in the USA and India.

million metric tons



Source: DATAGRO/USDA/FAO

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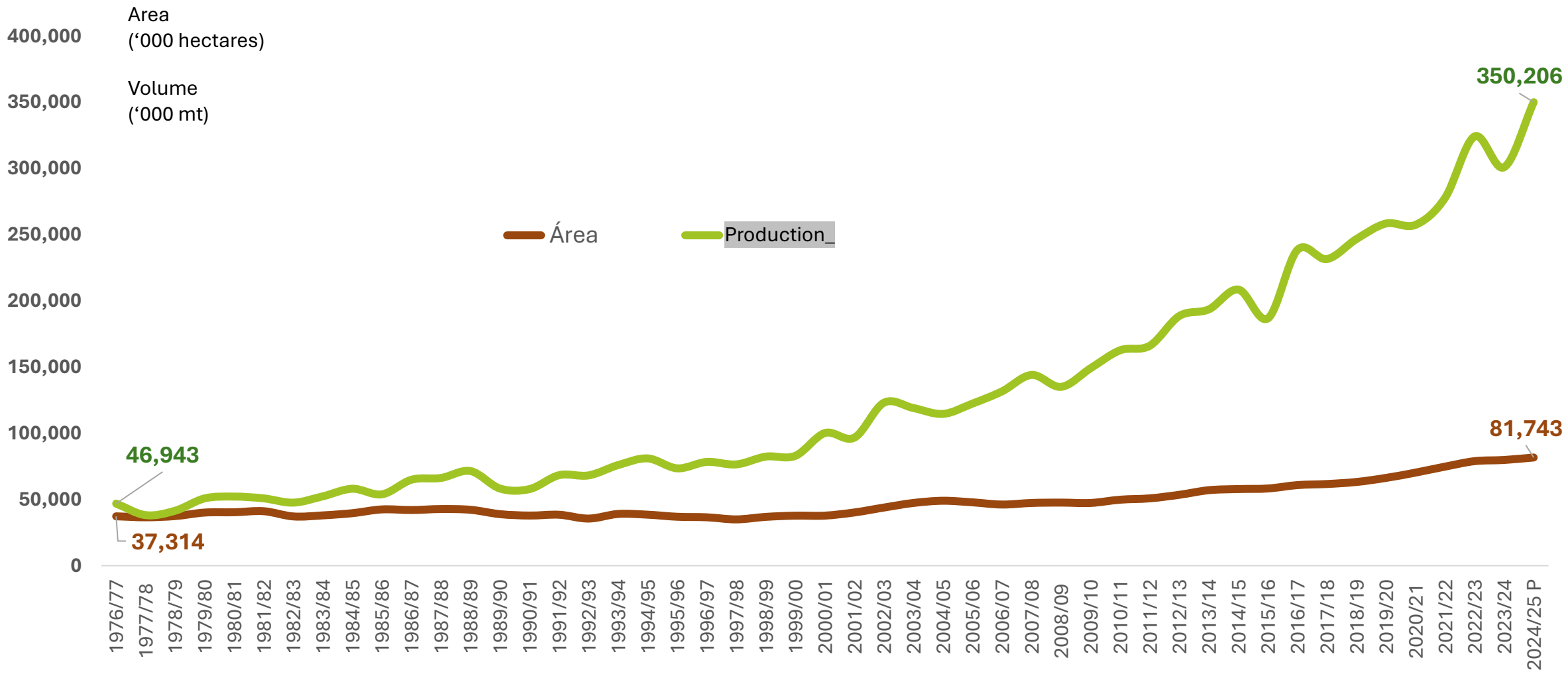
Brazil: since 1975, grains production grew from 47 mmt to 350 mmt

The area cultivated with grains grew from 37.3 mm ha in 1975, to 81.7 mm ha in 2025.
In other words, agricultural productivity grew consistently 2.6% per year (CAGR) during the past 50 years.



Source: CONAB

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Brazil's rank as world food producer and exporter, 2024

In 2024, Brazil was the largest producer of soybeans, coffee, orange juice, and sugar; the second largest producer of beef and chicken; the third largest producer of corn and cotton; and the fourth largest producer of pork. It is also 1st or 2nd largest exporter of most products listed.

Product	World Producer	% world production	World Exporter	% world exports
Soybean	1o.	40%	1o.	58%
Coffee	1o.	38%	1o.	31%
Orange Juice	1o.	70%	1o.	71%
Sugar	1o.	24%	1o.	58%
Beef	2o.	19%	1o.	28%
Chicken	2o.	15%	1o.	36%
Corn	3o.	10%	2o.	24%
Cotton	3o.	14%	1o.	30%
Pork	4o.	4%	4o.	14%

Source: DATAGRO/USDA/CNA

Biofuels utilize available feedstocks in many parts of the globe without threatening food supplies

- **Brazil:** since August/2025, ethanol blend in gasoline rose from 27% to 30%. Now government announced blend rise to 32% starting anytime soon. Flex fleet capable of using E100 accounts for 83% of light vehicle fleet. There are over 42,000 retail stations selling E100 & E30. With reform of ethanol for H2, these retail stations are considered as currently available Hydrogen distribution points.
- **India:** achieved 20% ethanol blend in gasoline in 2025, and now plans to raise it to 27% or 30% -- 72.5% of ethanol production comes from grain (damaged rice & corn). Corn use for ethanol is incentivizing additional corn production, and as result India is projected in two years to overcome Argentina as 4th largest world corn producer.
- **USA:** EPA allowed E15 to be used during Summer, and Lower House in Congress approved legsilation to allow it year-round – now sent to the US Senate.
- **EU:** is revising policy towards biofuels and vehicle efficiency & emission targets (adopting LCA and defining CI reduction targets) which can provide fundamental outlay for the systemic crisis of its grain and beet markets, and simultaneous revive its automobile industry. Ursula von der Leyen proposed 20% ethanol blend (E20) in Europe.
- **Indonesia:** approved E5 mandate starting July 2026.
- **Japan:** target to blend 10% ethanol in gasoline by 2030, and 20% by 2040.
- **Argentina:** allowed ethanol blend to rise from 12% to 15%.
- **Guatemala:** implemented E10 in June 2026.
- **Paraguay:** recently rose its blend mandate from E25 to E30.

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For Producers, ethanol increases income to farmers & industries

PRODUCT	SUGARS COMING OUT OF FACTORY	PRICED AS SUGAR	TYPICAL REVENUE	REVENUE WITH DIVERSIFICATION
SUGAR	87.0%	100.0%	87.0%	87.0%
MOLASSES	13.0%	30.0%	3.9%	13.0%
TOTAL (1)	100.0%		90.9%	-----
LOSS IN FERMENTATION	----	----	----	-1.3%
TOTAL (2)	----	----	----	98.7%

Source: DATAGRO

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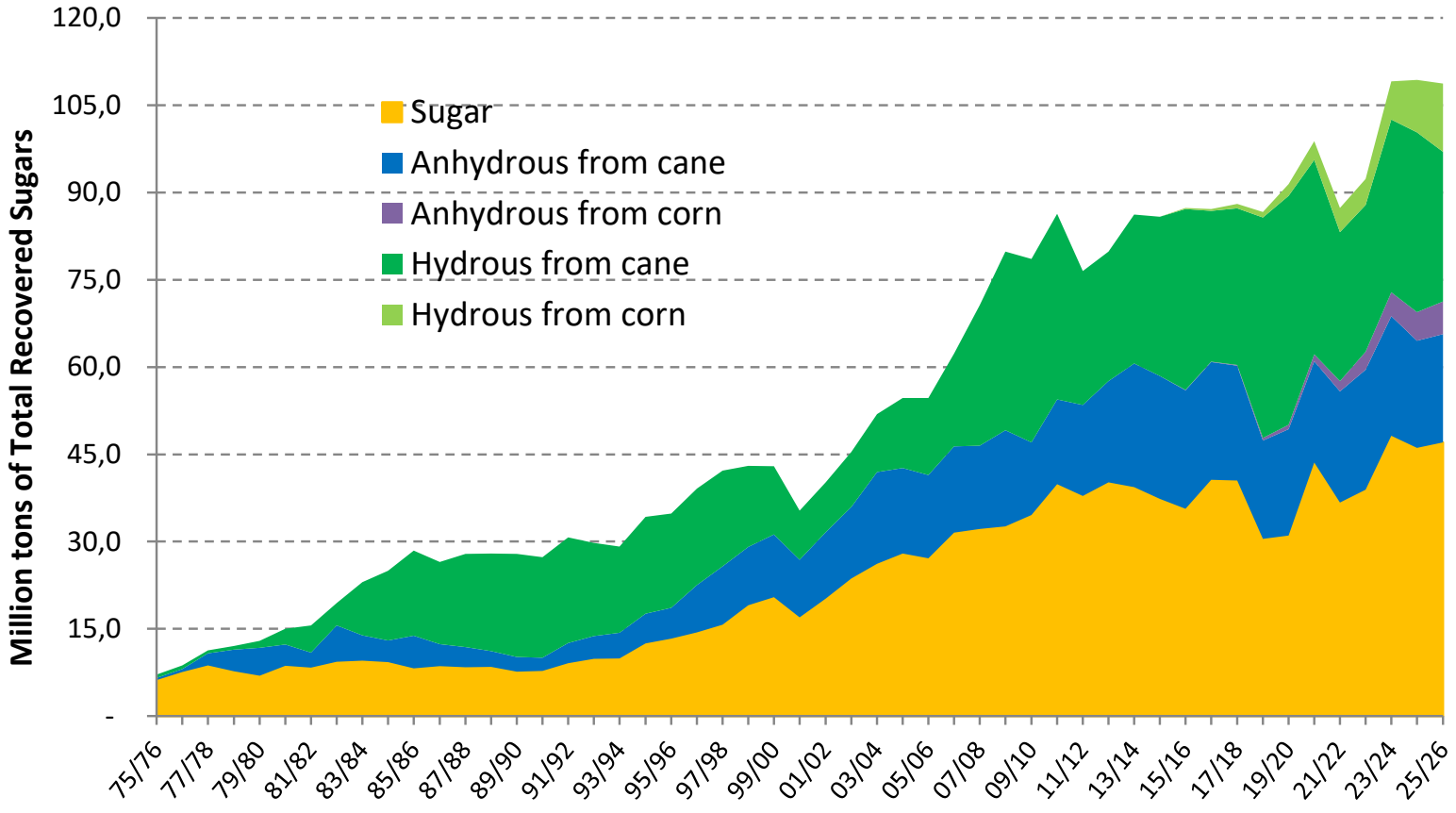
Diversification to Ethanol enabled production growth in Brazil



Source: DATAGRO

- Diversification towards ethanol enabled production of sugar & ethanol to rise from 7.1 mmt of Total Reducing Sugars (TRS) in 1975/76, to 108.1 mmt in 2025/26.
- % of TRS going to ethanol rose from 13.2% in 1975/76, to 51.8% in 2025/26.
- Industrial flexibility allowed industry to adapt more efficiently to changing market conditions.
- Sugar exports of 34.65 mmt in 2025/26 account for only 33.5% of TRS supply.

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For Governments, ethanol adoption contributes to

- Modernize agricultural sector
- Leverage food production
- Increase farm income
- Generate farm jobs
- Utilize existing feedstocks
- Boost productivity
- Integrate small-scale farmers into sustainable, low-carbon value chains
- Promote energy security and lower dependence on oil product imports
- Improve trade balance
- Promote circular economy
- Increase fiscal revenue

Appropriate regulation is needed to enable it…

Ethanol adoption requires ...

- **Long-term approach:** main policy goals & instruments must be maintained overtime
- **Blend mandate,** not simple authorization
- **Support to innovation** in automobile technology adapted for ethanol use, through fiscal incentives to automaker´s improvements in efficiency
- **Legal framework to support private investment in expansion** of distillation capacity
- **Price parity** between ethanol & sugar
- Legislation regulating **disposal of vinasse** – valuable resource for fertirrigation, provided disposed in proper way.

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Brazil also implemented regulation to reward carbon capture from the use of biofuels

RenovaBio

- **RenovaBio:** legislation that places innovation and efficiency in fuel production & use is at center of Brazil´s strategy for the use of low carbon sources of energy.
- RenovaBio is **not subsidy, nor carbon tax**
- System of **voluntary certification** of biofuel producers for their **energy-environmental efficiency**, based on life-cycle assessment (LCA), which will determine ability to request issuance of Decarbonization Credits (CBios)
- **Market-driven carbon pricing mechanism** (endogenous, not exogenous determination), rewarding achievement of individual efficiency, not a common or equal coverage.
- **Unleashes market forces** to implement and drive innovation for increased competitiveness in biofuel/bioenergy production.

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Advantages of Ethanol for Energy in Transport & Environment

- **Drop-in** solution for mid-level blends: does not require built-up of new fleet or infrastructure
- Enables **immediate implementation & results**
- **Replicable:** no technical barrier for implementation
- **Scalable:** can grow overtime using available feedstocks, including organic residues for cellulosic conversion into ethanol
- Very effective and proven **environment & health benefits**
- **Affordable** in price to consumers
- Promotes **jobs & local income** to farmers
- Ethanol´s high octane **complements gasoline** well & enables use of lower cost blend feedstocks
- Provides **sustainability & longevity for the use of traditional sources of energy**
- Enables automakers to meet the most restrictive **emission targets**

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Basis for Adoption of Ethanol Production & Use Regulation

- Vision that **it is possible to enlarge the use of high-density low-carbon liquid fuels**, stimulating **higher energy efficiency and lower environmental footprint**
- **Using** largely **available biomass feedstocks** without compromising food security
- **Complementing** in a virtuous way **renewable and traditional fuels**
- **Using** the **existing infrastructure**, and
- **Promoting local technologies in fuel production and** in **automobile technology**
- Enabling simultaneous **social, economic, environmental & health benefits**

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A Developmental Vision of Energy in Transport

- **Various forms of motorization will cohexist** in the pursuit of higher ENERGY EFFICIENCY & LOWER CARBON EMISSIONS
- **Electrication is a tendency**, from the higher efficiency of electric engines
- But Battery Electric Vehicles (**BEVs) are not the only mode** of electrification
- BEVs can be **considered clean only if the source of energy is renewable under LCA**
- Batteries have low energy density
- **ELECTRIFICATION WITH ETHANOL (Hybrids & SOFCs) is the way forward** for countries with recharge infrastructure challenges:
  - Affordable to consumers
  - Uses a high-density liquid fuel with low carbon footprint
- Desired evolution:
  - Otimization of ICEs using Ethanol (higher blends in gasoline)
  - Hybrids
  - Fuel Cell Vehicles using Ethanol

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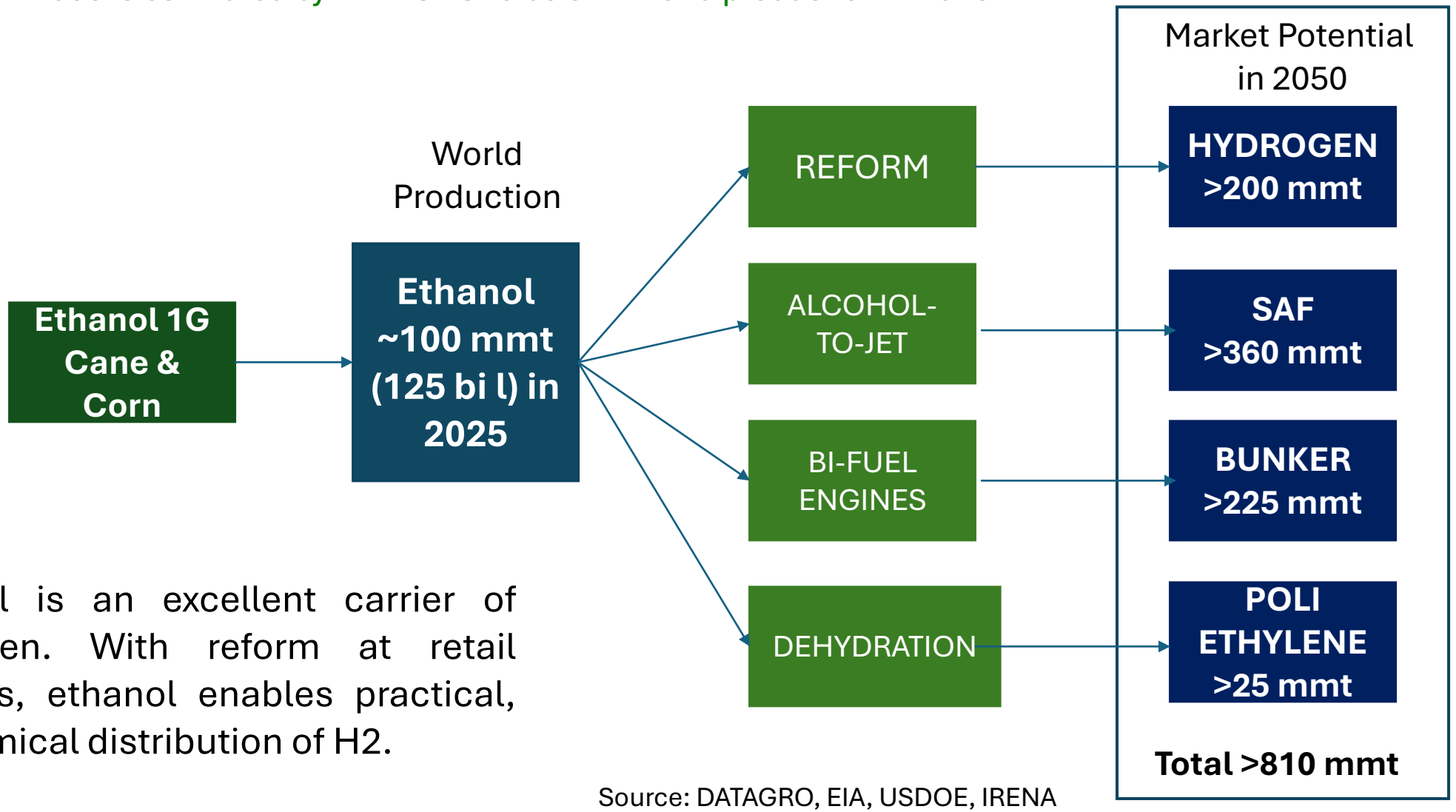
Ethanol has enormous new market opportunities

Market potential in 2050 is estimated by DATAGRO to be 8.1x world production in 2025



Ethanol is an excellent carrier of Hydrogen. With reform at retail stations, ethanol enables practical, economical distribution of H2.

Source: DATAGRO, EIA, USDOE, IRENA

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Ethanol is modern & sustainable solution

- Ethanol is the transition energy source for reaching Hydrogen solutions in the future: practical, safe, economical way of producing, storing, distributing H2.

- Has no technological barrier, generates jobs & income, reduces energy dependence & improves environmental profile.

- Ethanol leverages food production by providing price stability for the use of available feedstocks.

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The world recognizes Brazil's strategic value of ethanol

The Economist

Weekly edition | World in brief | United States | China | Business | Finance & econo

The Americas | Liquid courage

Brazil has a secret weapon against oil shocks

Biofuels will help the country fend off the effects of conflict in the Middle East

Share

PHOTOGRAPH: GETTY IMAGES

Mar 26th 2026 | SÃO PAULO | 3 min read

- Blending of ethanol in gasoline has contributed to lower gasoline (E30) prices.
- E100 is much cheaper than gasoline E30:
- Price of E100 is currently fetching R$ 3.79-4.09/liter (US$ 0.76-0.82/liter) vs. gasoline (E30) at R$ 6.09-6.49/liter (US$ 1.22-1.30/liter).
- During past 50 Years, ethanol substituted >4 billion barrels of gasoline in Brazil, country with 17.5 billion barrels of proven oil reserves (2026).
- Value of gasoline substituted by ethanol during the period is over US$ 740 billion, in constant dollars of Dec/25.
- Twice the amount of Brazil's total foreign currency reserves on May 22,2026 (anchor of the economy): US$ 369 billion.

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History repeats itself...

DATAGRO Archives:

- Campaign idealized in Brazil in 1979 (47 years ago), after 2nd Oil Shock caused by Iranian Revolution, when Strait of Ormuz was first blocked.
- Title: “The alcohol in your car does not pass through here.”
- Subtitle: “Proálcool: those who have it, do not depend on anyone.”
- In 2026, ethanol will substitute in Brazil over 530,000 bpd of gasoline.

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Calendar of Events

July 23-26, 2026
GLOBAL AGRIBUSINESS FESTIVAL SORRISO 2026
Sorriso, Mato Grosso, Brasil

August 20, 2026
7th DATAGRO Opening of Crop Soy, Corn and Cotton
Goiânia, Brasil

September 16, 2026
6th Forum Livestock Brazil
Clube Atlético Monte Líbano – São Paulo

September 17, 2026
Beef Dinner 2026
Clube Atlético Monte Líbano – São Paulo

October 01-02, 2026
XP CORTEVA GLOBAL AGRIBUSINESS FESTIVAL 2026
Allianz Parque - São Paulo, Brasil

October 26-27, 2026
26th DATAGRO International Conference on Sugar & Ethanol
Grand Hyatt São Paulo - São Paulo, Brasil

December 01-02, 2026
35th International Sugar Organization (ISO) Seminar
Church House, Westminster, London

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