

Briefing session on the future of renewable energy in Brazil

Renewable Energy Outlook: Brazil

Power Sector and Biofuels

EUROCLIMA – COP25

Dec 11, 2019

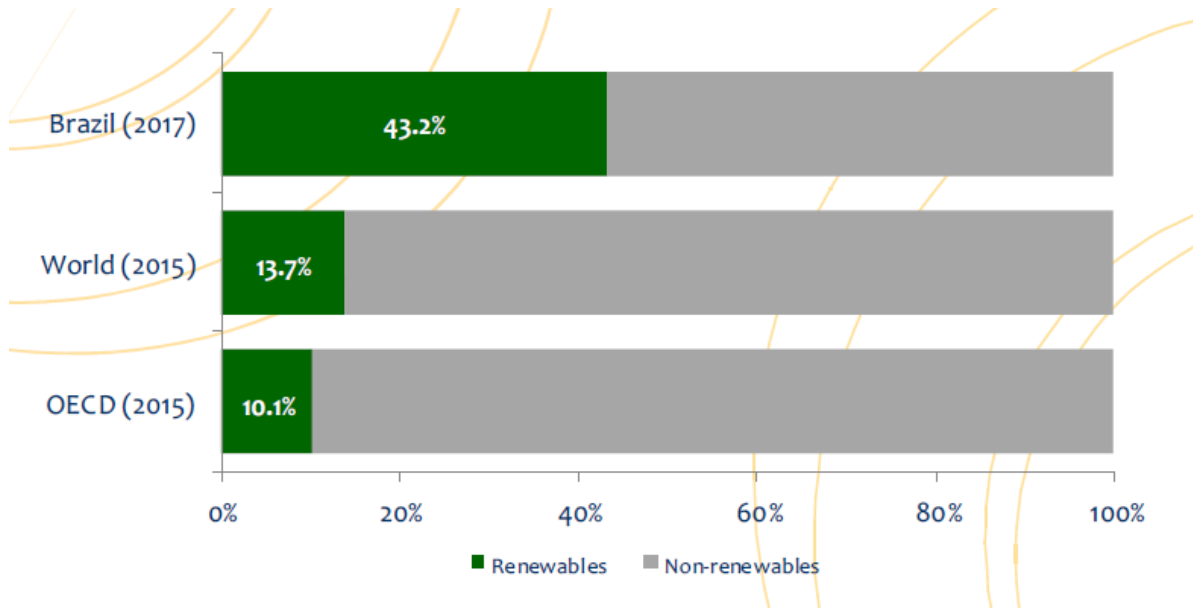
Renato D. Godinho

Head, Division for Energy Progress — Ministry of Foreign Affairs

Presentation credits also go to:

*Thiago Barral Ferreira, EPE, President, and Giovani Machado, EPE, Head of Department –
Natural Gas and Biofuels*

The share of renewables in the energy mix



RENEWABLES ▶ 43.2%

sugarcane biomass
17.4%



hydraulic¹
11.9%



firewood and charcoal
8.0%

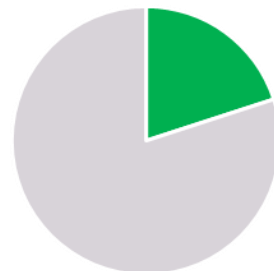


black liquor and other renewables
5.8%



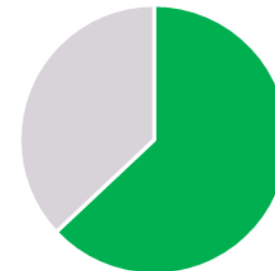
58%

Industry



20%

Transports



63%

Household

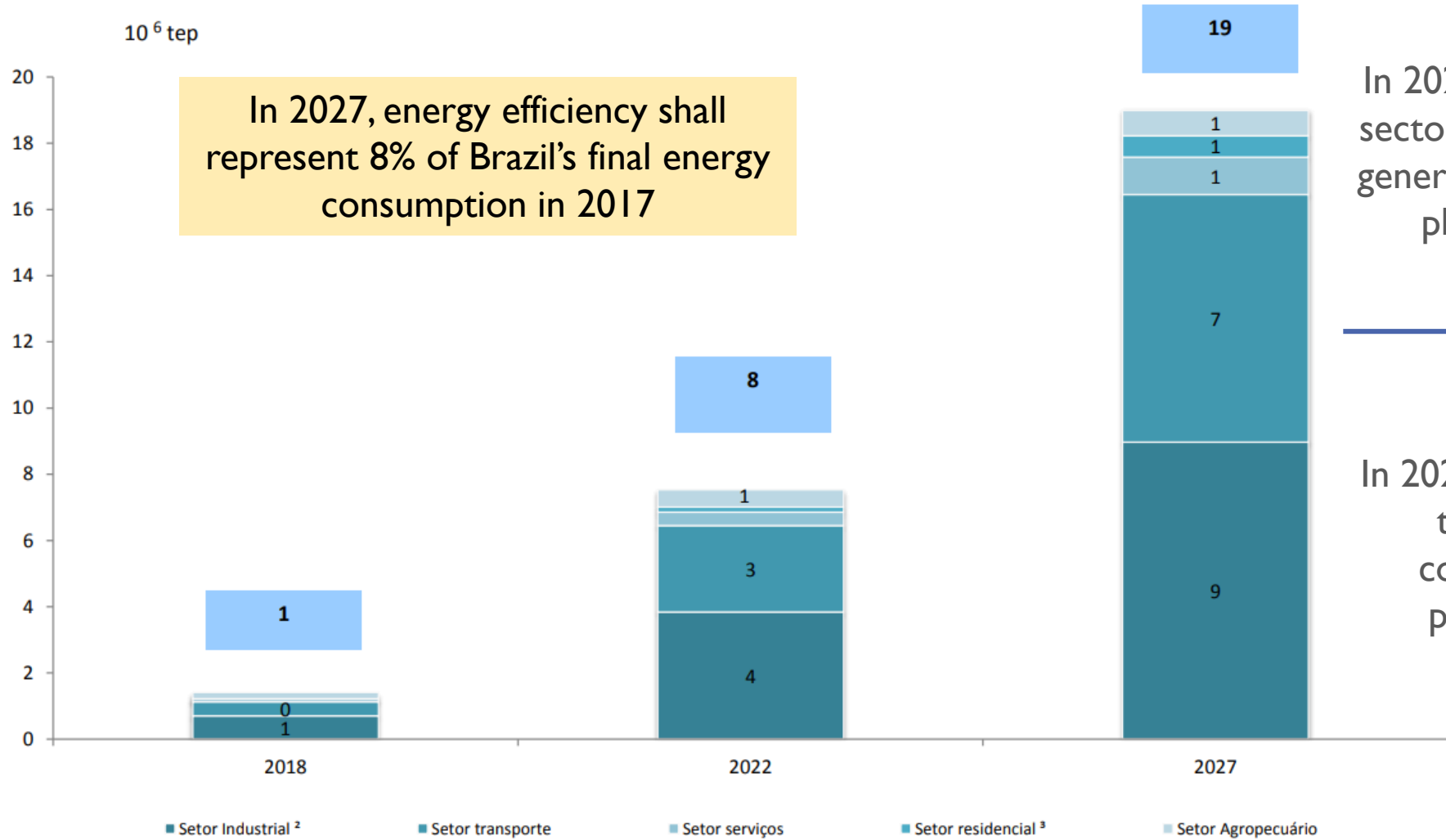
Source: EPE

Energy efficiency will lead to competitiveness gains

Total saved energy

10⁶ tep

In 2027, energy efficiency shall represent 8% of Brazil's final energy consumption in 2017

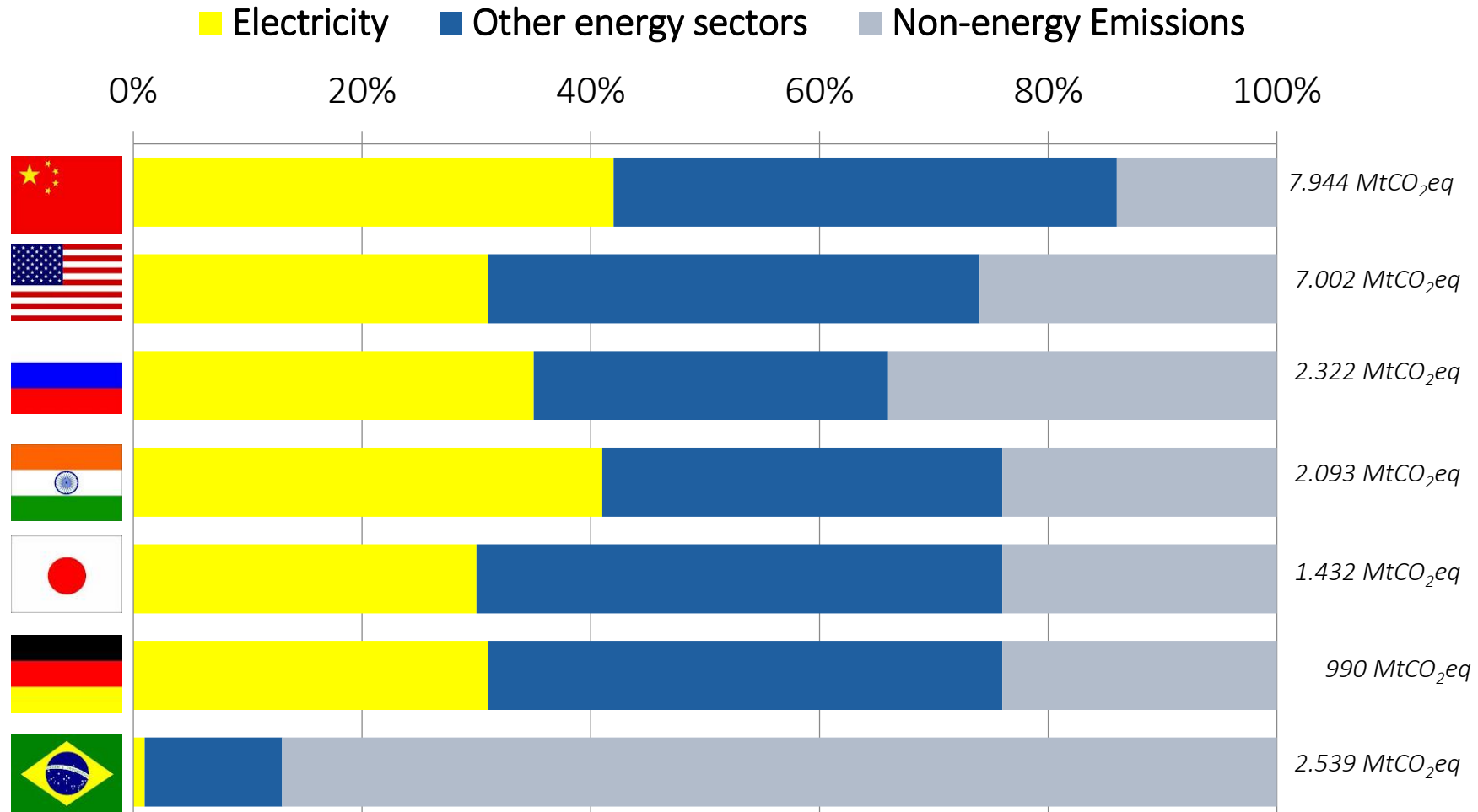


In 2027, saved energy in the power sector (41 TWh) will amount to the generation of a 10GW hydropower plant (83% of a Itaipu plant)

In 2027, the saved fuel volume (318 thousand barrels/day) will correspond to 11% of all oil produced in Brazil in 2016.

Brazil's NDC: economy-wide 37% GHG reduction from 2005 levels by 2025, 43% by 2030.

GHG Emissions Sources, 2005



Fonte: AIE, EPE

The country will need huge amount of investments in renewable energy until 2027



**US\$ 20
billion**

Etanol and biodiesel,
production mills and
biofuel transport
infrastructure



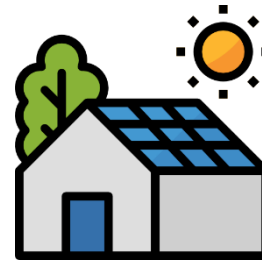
**US\$ 60
billion**

Centralized generation



**US\$ 29
billion**

Transmission



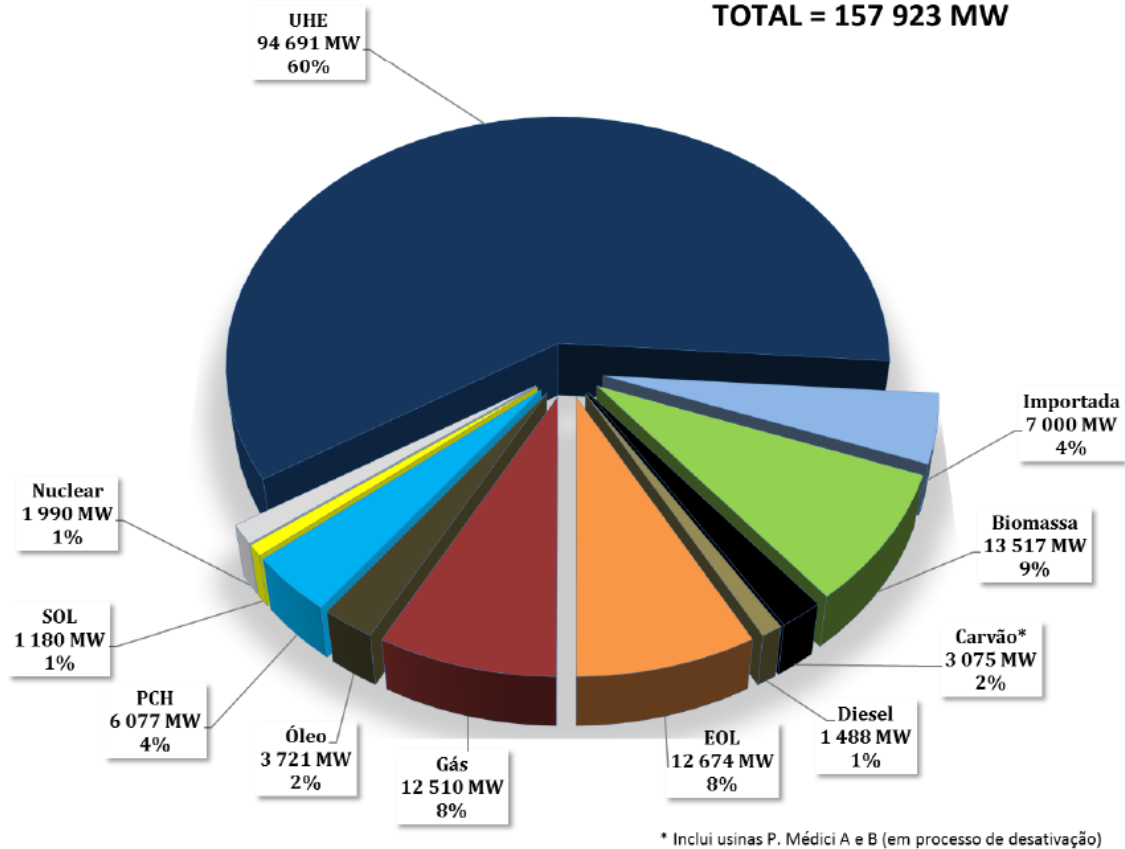
**US\$ 16
billion**

Distributed Generation

Power Sector

Still hydro-based, but other renewables leading expansion

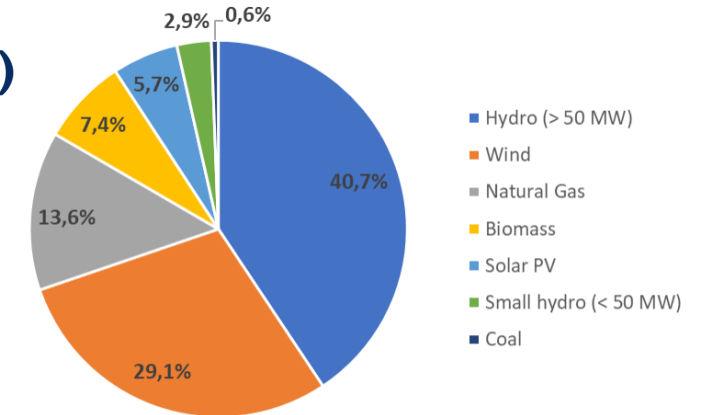
TOTAL = 157 923 MW



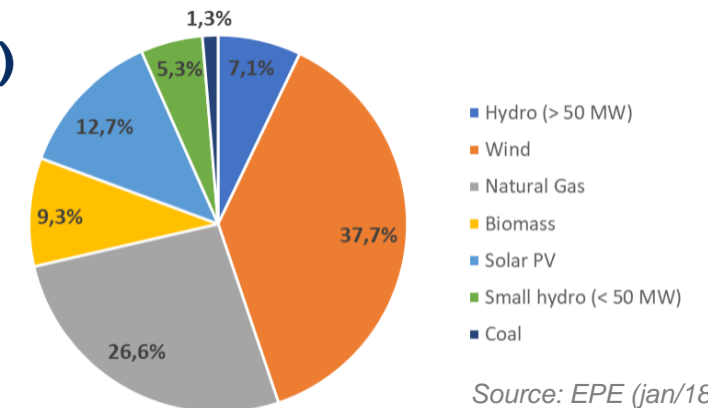
Source: EPE

Auctioned Installed Capacity

(2009-2017)

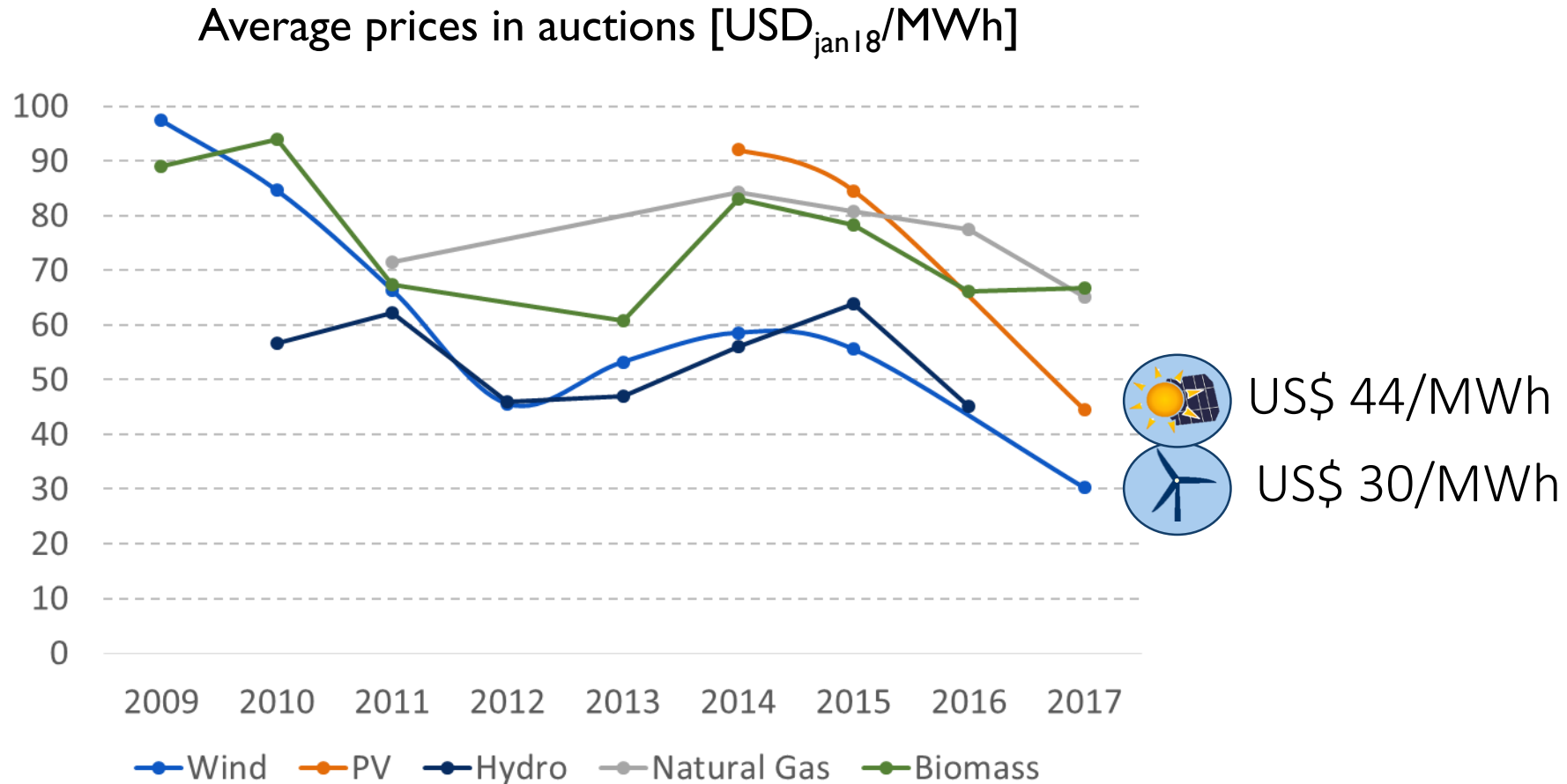


(2013-2017)



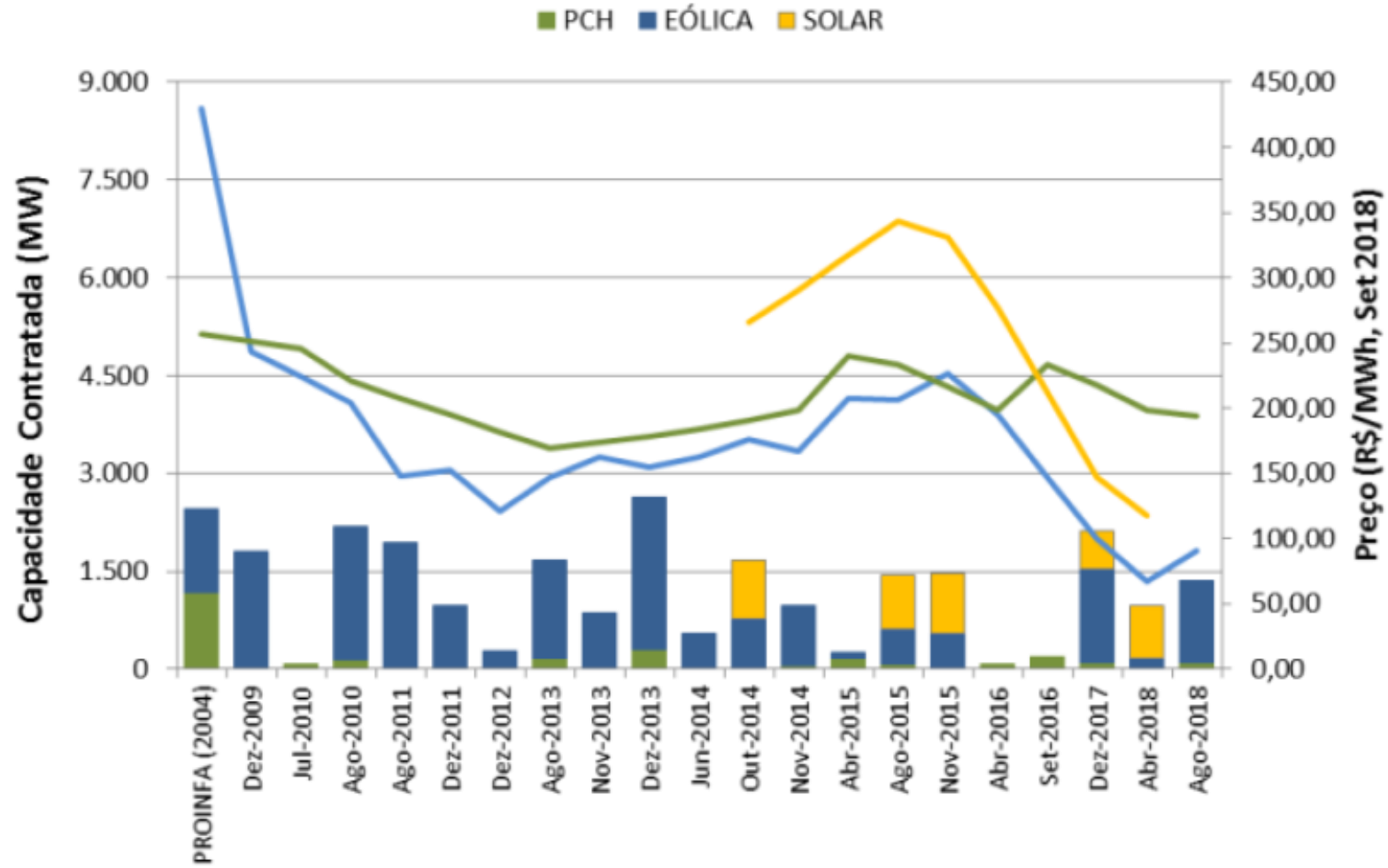
Source: EPE (jan/18), based on data from CCEE

Cost reductions are driving the increase of wind and PV in our mix

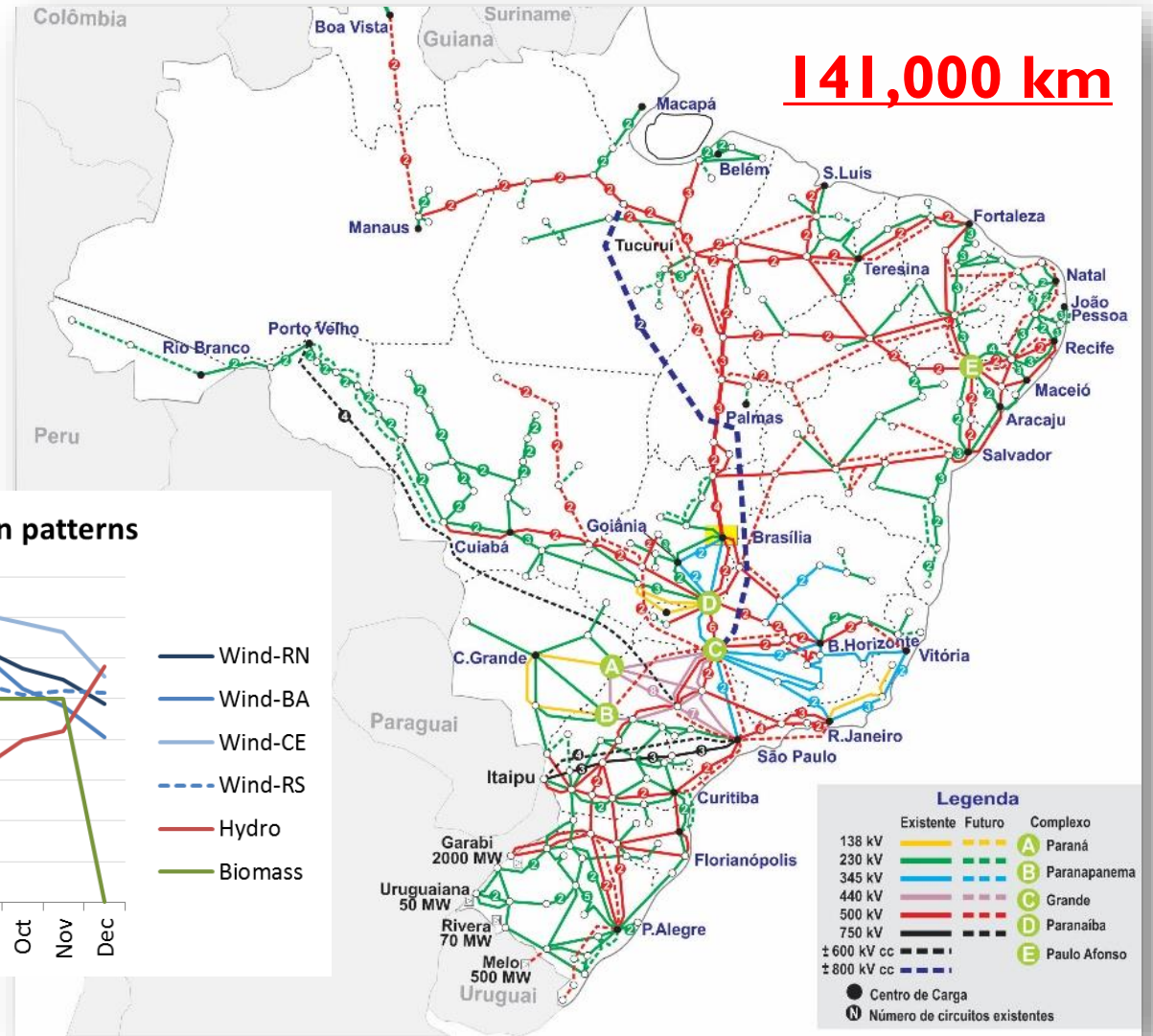


CCEE data

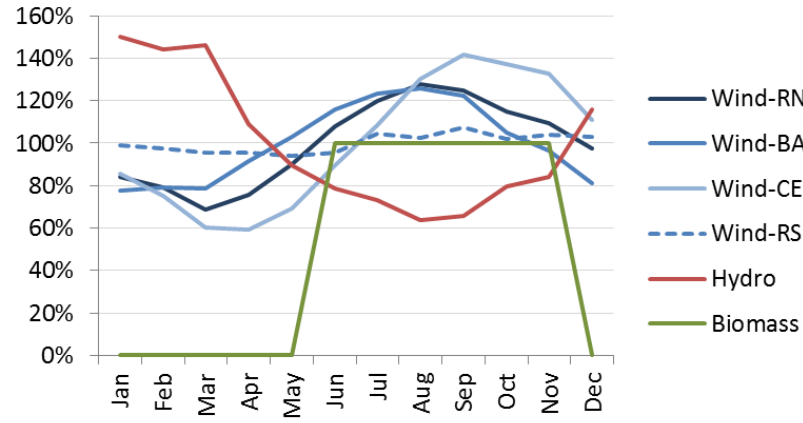
Cost reductions are driving the increase of wind and PV in our mix



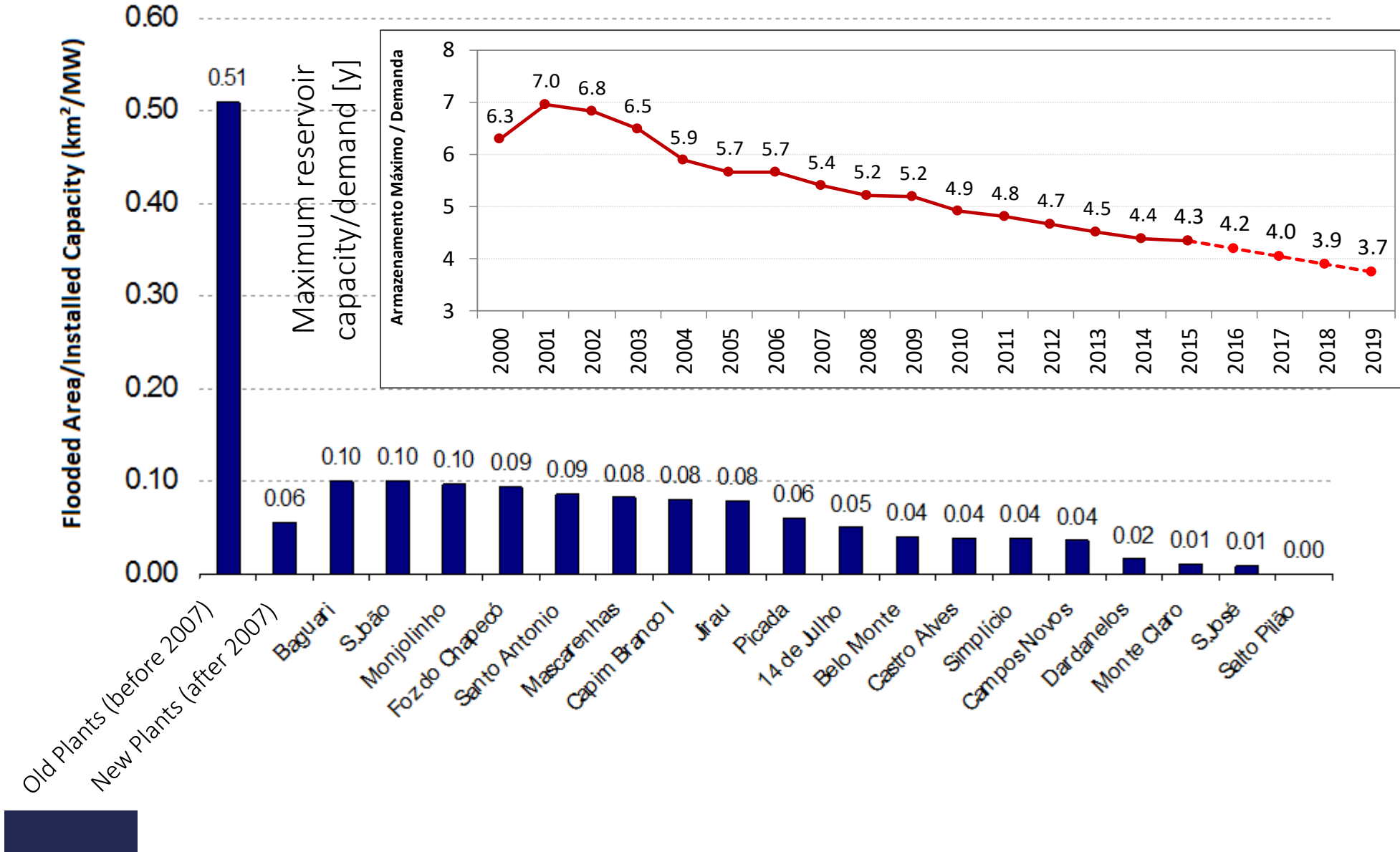
Integration of hydro, solar, wind and bioelectricity



Seasonal generation patterns

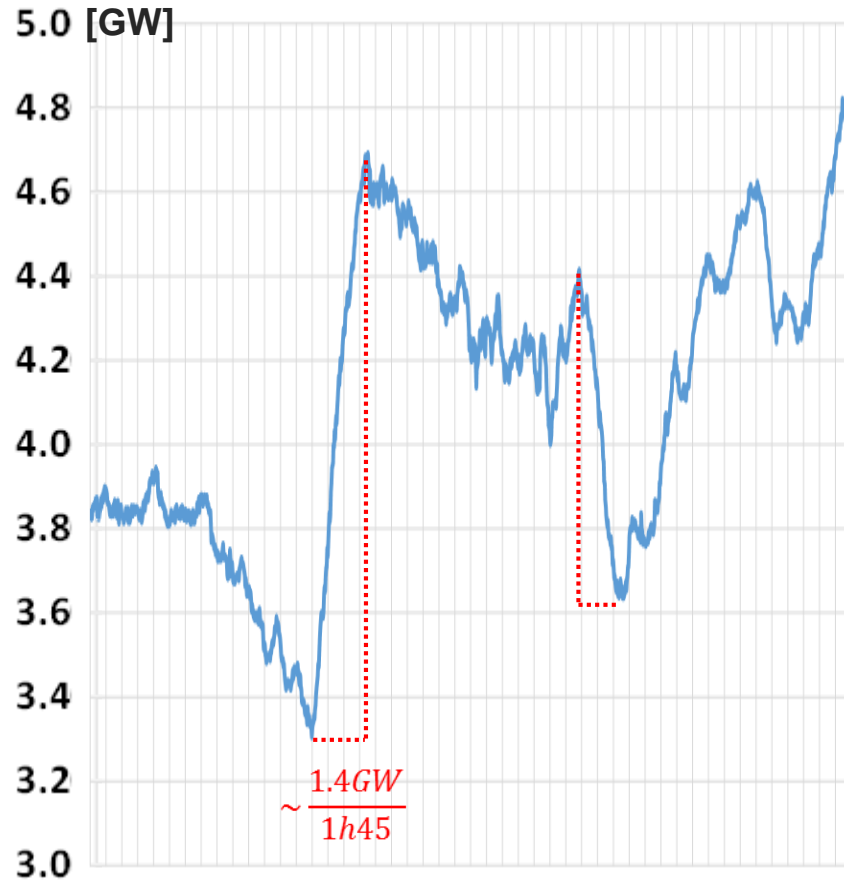


Our relative storage capacity is decreasing

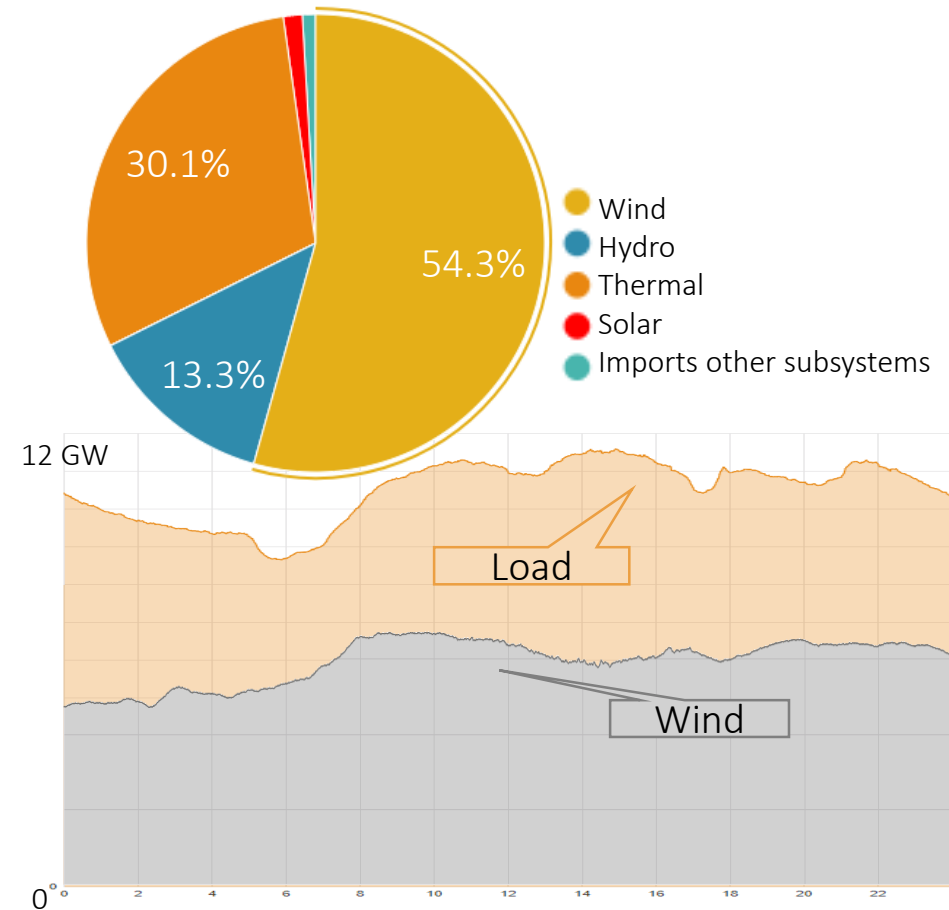


The Northeast has been giving samples of challenges ahead

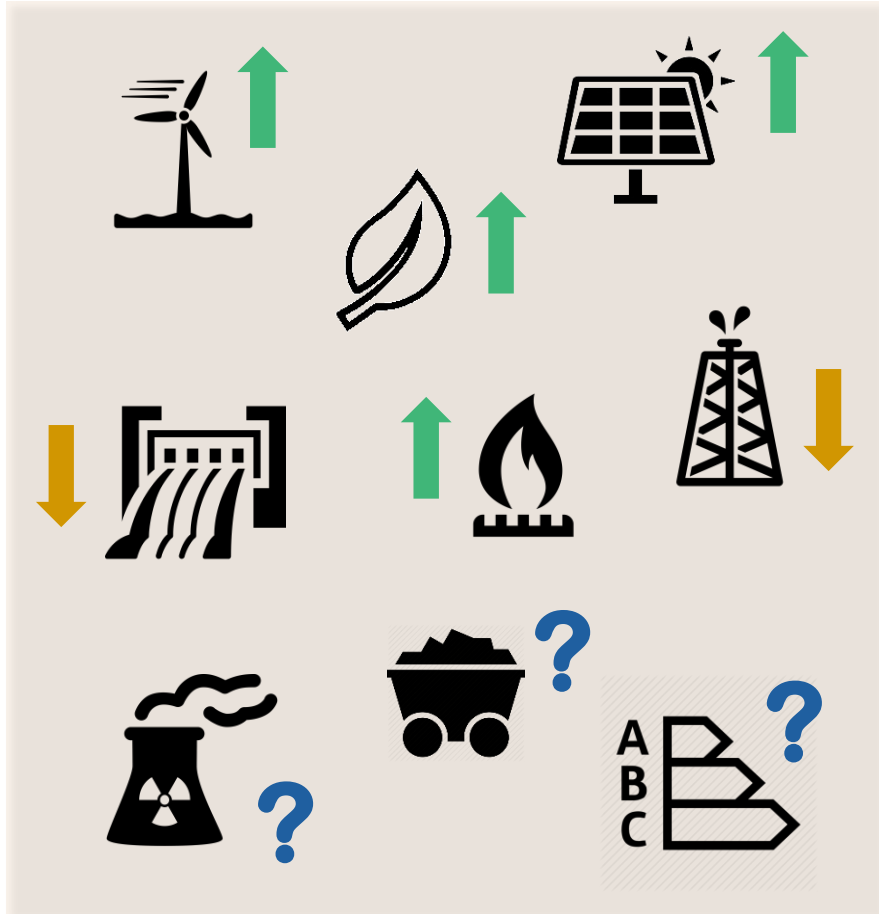
- Ex.: wind gen. NE (June 26, 2017):



- Daily supply mix in Northeast (Oct/4)



Brazil has plenty of energy resources...



\$/MWh
Renewables are
already cost-
competitive with
conventional
resources

However...

Incomplete signal: doesn't
represent the correct
value for the system



Mix \neq System optimum



Centralized decisions:
picking technologies



Innovation less incentivized

A system in transition...

System Planning

- Recognize the diverse attributes of the technologies
- Assess what attributes are scarce in the system
- Identify the mix and the total cost, including T and DG
- Proactive T planning (decision under uncertainty)

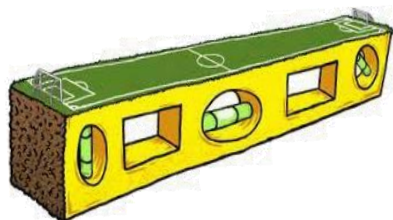


Firm energy
Firm capacity
Flexibility
Reserves
GHG emissions...



Market Design

“level playing field”



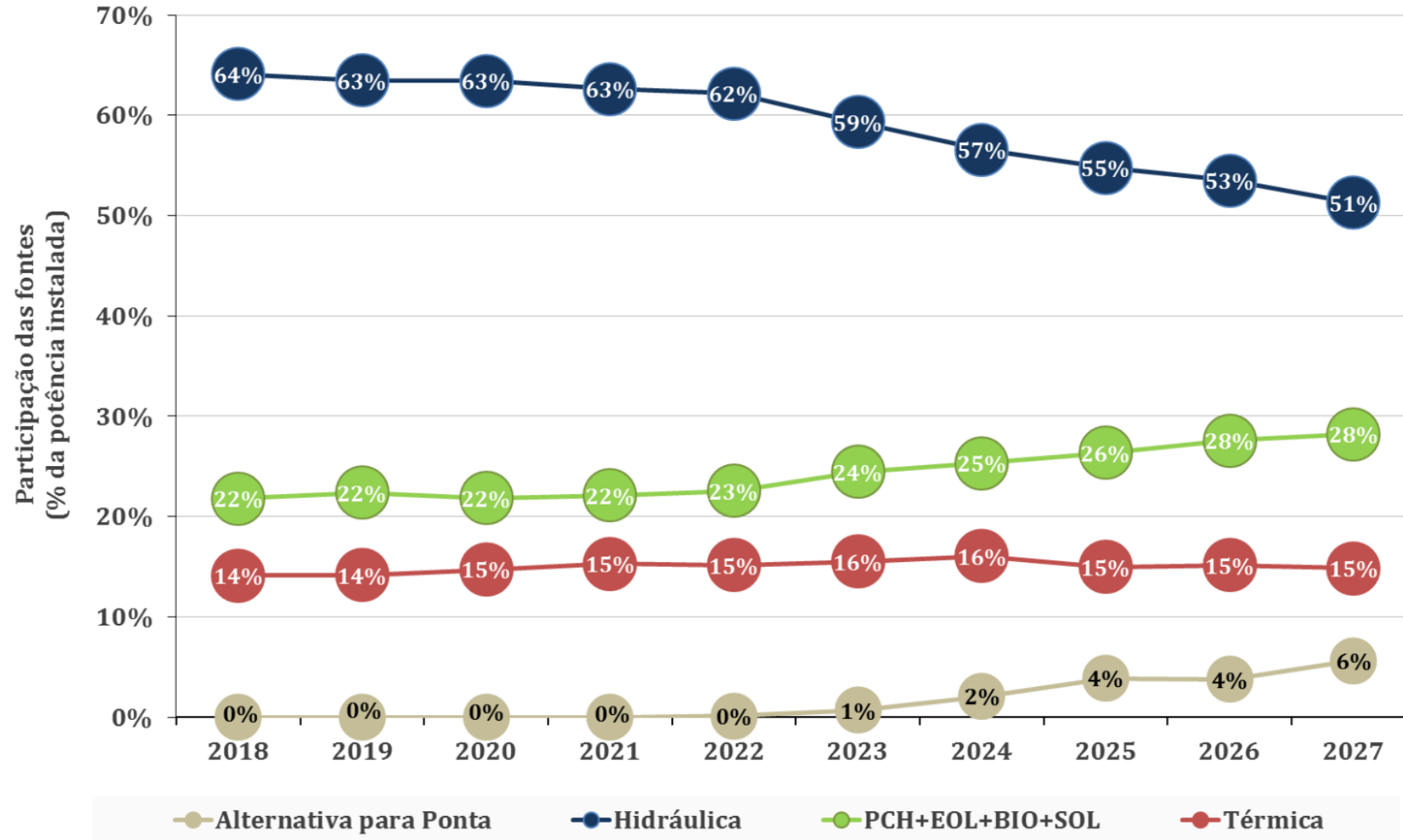
Wholesale

- Procurement process
- Pricing (more granularity)
- Risk allocation and management
- Subsidies reduced
- Internalize environmental attributes
- Long-term financing

Retail

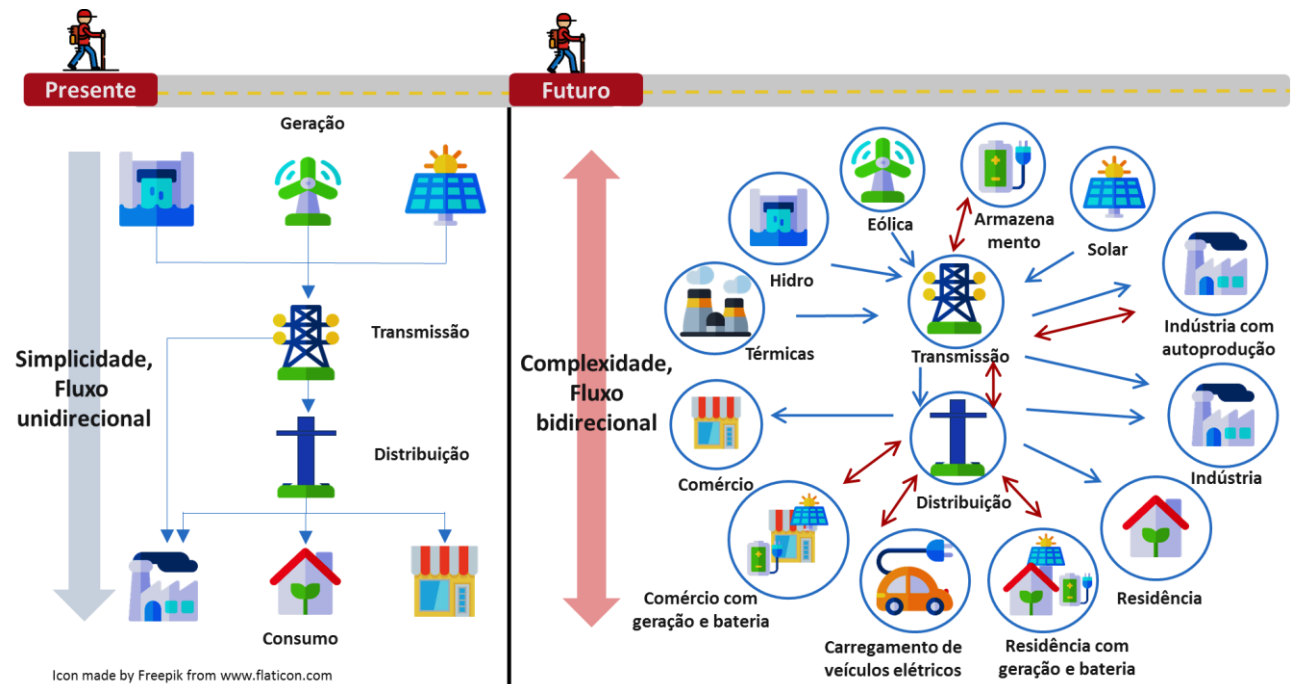
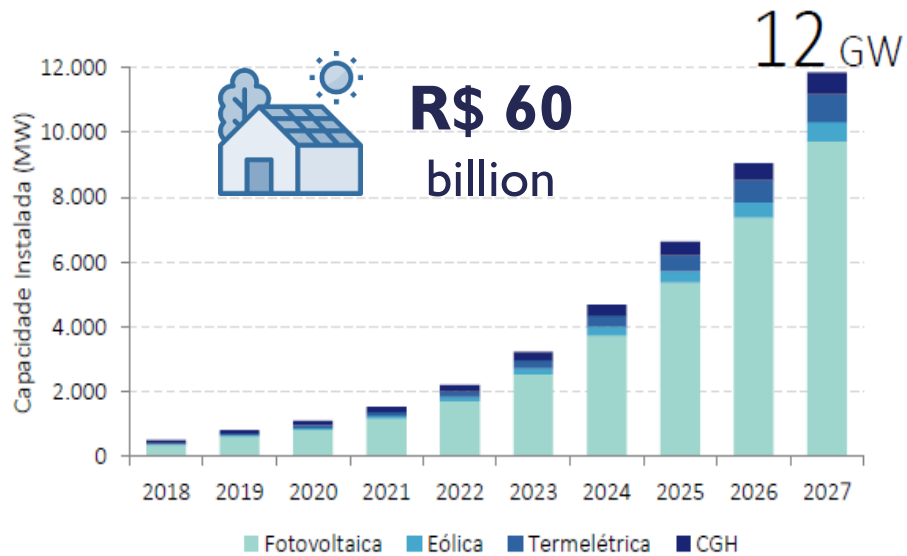
- A new role for the distribution utility
- DER competing with utility-scale
- Innovative business models

How might we look like in 8 years?



Source: EPE

The Power system in transformation



- Tiered tariffs
- Model for micro and mini distributed generation
- Demand response, etc.

Already present in sectoral agenda: **Planning, Policy and Regulation**

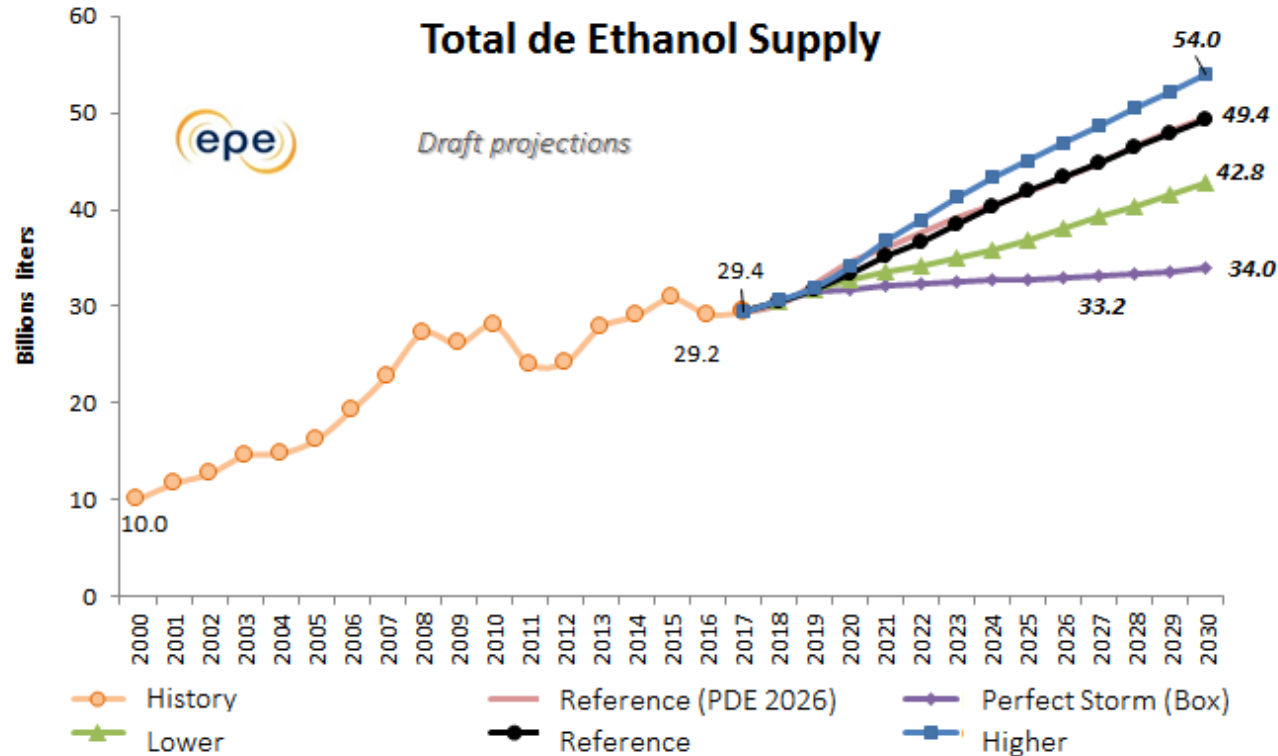
Main takeaways

- Brazil is already very renewable and will continue to be
- The value of hydro reservoirs is huge for the integration of wind and solar → flexibility and storage → System integration is essential!
- There's evidence of the need for peak capacity or abatement (flexibility to be further investigated)
- Natural gas can help handle renewables, but open to alternative solutions (untapping flexibility from existing assets and enable by technologies)
- Reform market framework, adjust pricing and tariff structure → imperative in the short/medium term
- Margins are tight → innovation and financing are keys for success

Biofuels

HISTORY AND forecast OF TOTAL ETHANOL SUPPLY

scenarios to 2030



Sources: EPE (2018)

- RenovaBio and other public policies will contribute to improve business environment in ethanol industry in Brazil at different paces.

Total ethanol supply will start a new cycle based on public policy and on a more favorable business environment (overcome of corporate indebtedness, efficiency gains, GHG Policies, etc.).

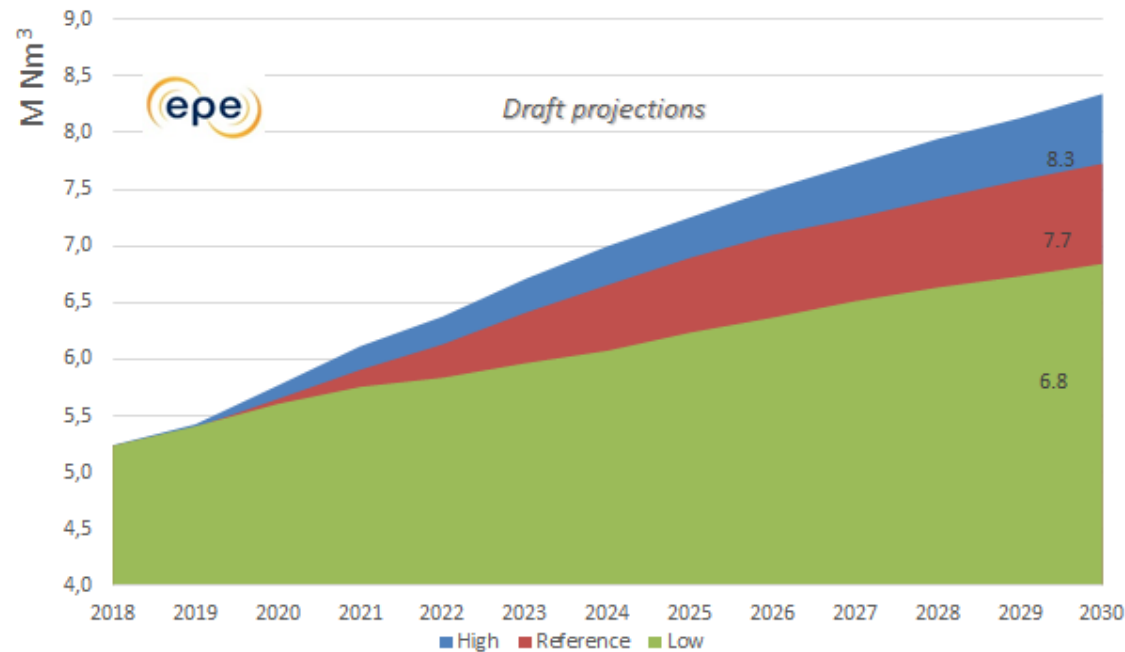
Hydrous ethanol will become competitive to Gasoline C (demand), driving total ethanol supply growth.

Anhydrous ethanol is kept 27% of Gasoline C blend.

forecast OF biogas from Vinasse and cake filter

scenarios to 2030

- Biogas opportunities and challenges
 - Input availability vs. economics



Sources: EPE (2018)

1 ton of sugar-cane

↘ 30 - 40 kg cake filter

1 ton of cake filter

↘ 90 - 120 Nm³ biogas

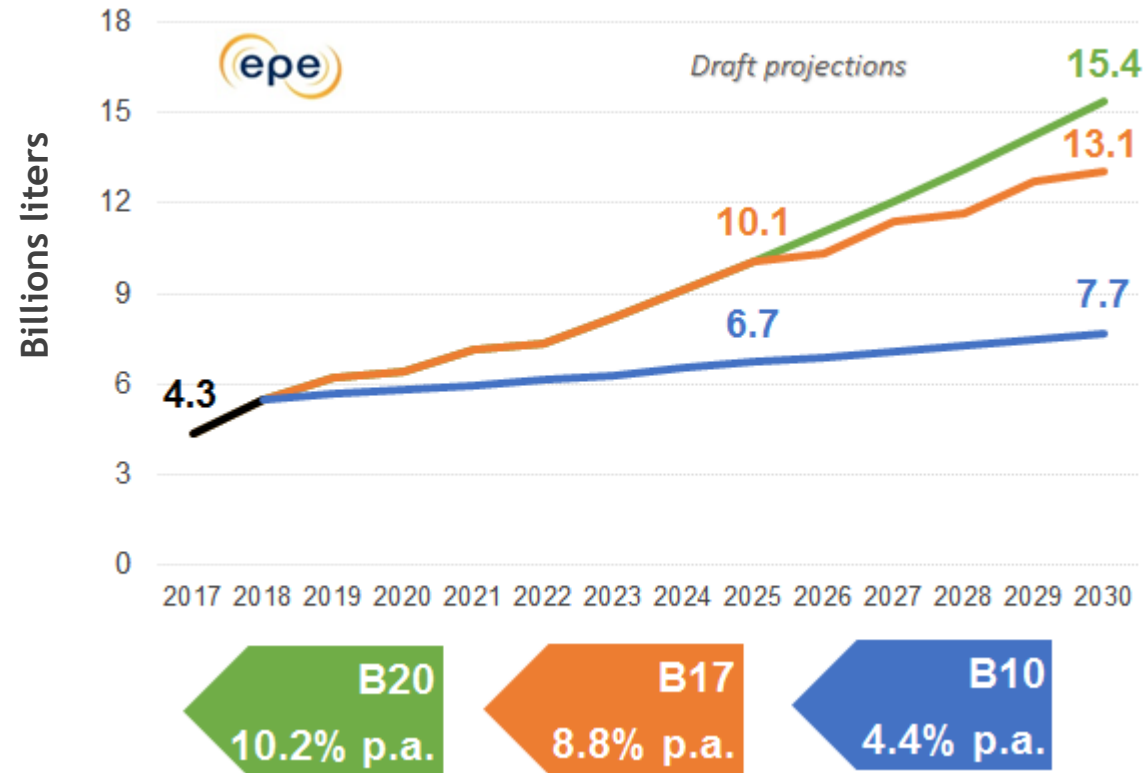
1 l ethanol

↘ 10 - 12 l vinasse

1 l vinasse

↘ 12 - 25 Nm³ biogas

HISTORY AND forecast OF BIODIESEL demand scenarios to 2030



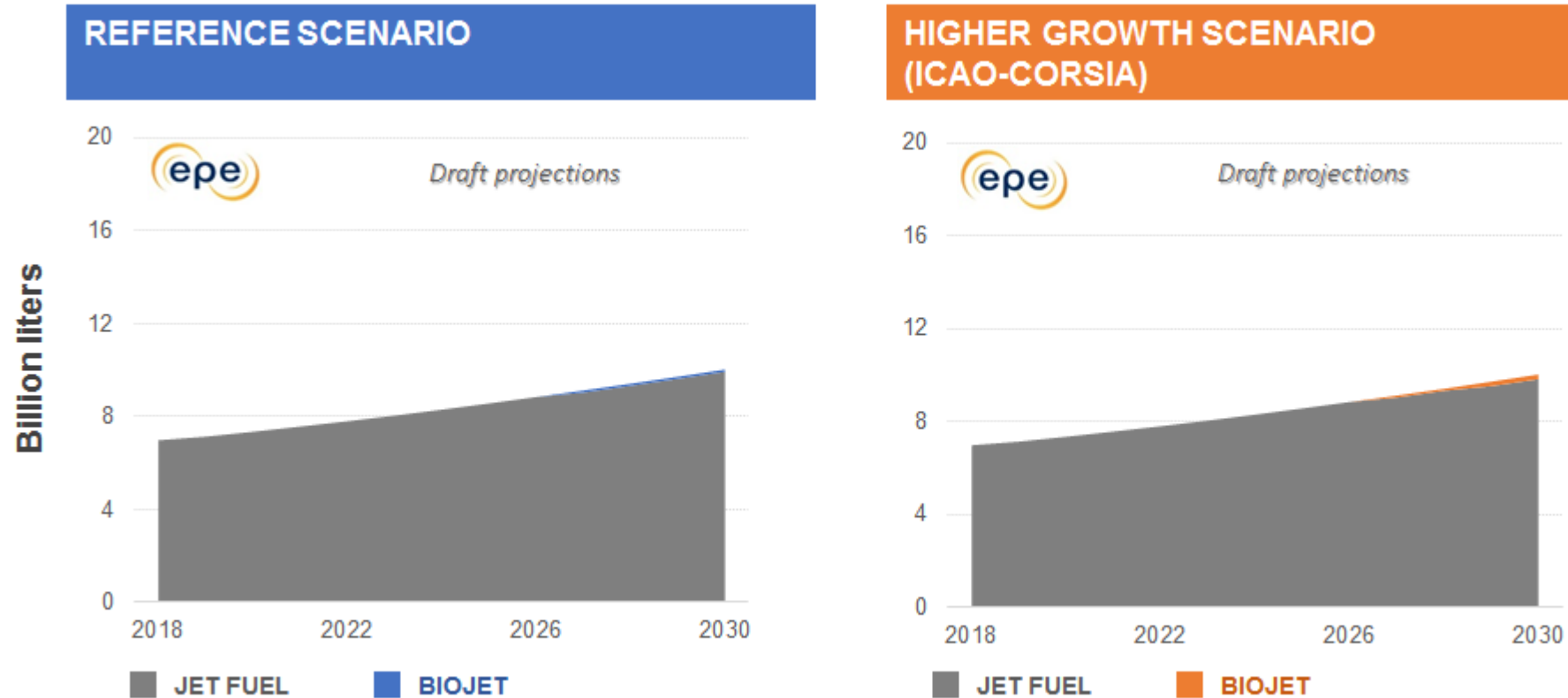
- Blend Mandate will increase based on Law n° 13,263/2016 and CNPE Resolution n° 11/2017, which is consistent with NDC of Brazil
 - Mandatory blend additions up to: 8% by 2017, 9% by 2018, 10% by 2019 (anticipated to 2018) and 15% after testing, according to CNPE.
 - Voluntary blend additions up to: 20% for road captive fleet; 30% for rail, agriculture and industrial; 100% for experiments, specific and others.
- Feedstock will continue concentrated on soy bean oil, but there is potential to diversify.

Sources: History based on BEN (EPE, 2017a), forecast based on PDE 2026 (EPE, 2017b) and EPE own elaboration (sensitivities)

forecast OF biojet

scenarios to 2030

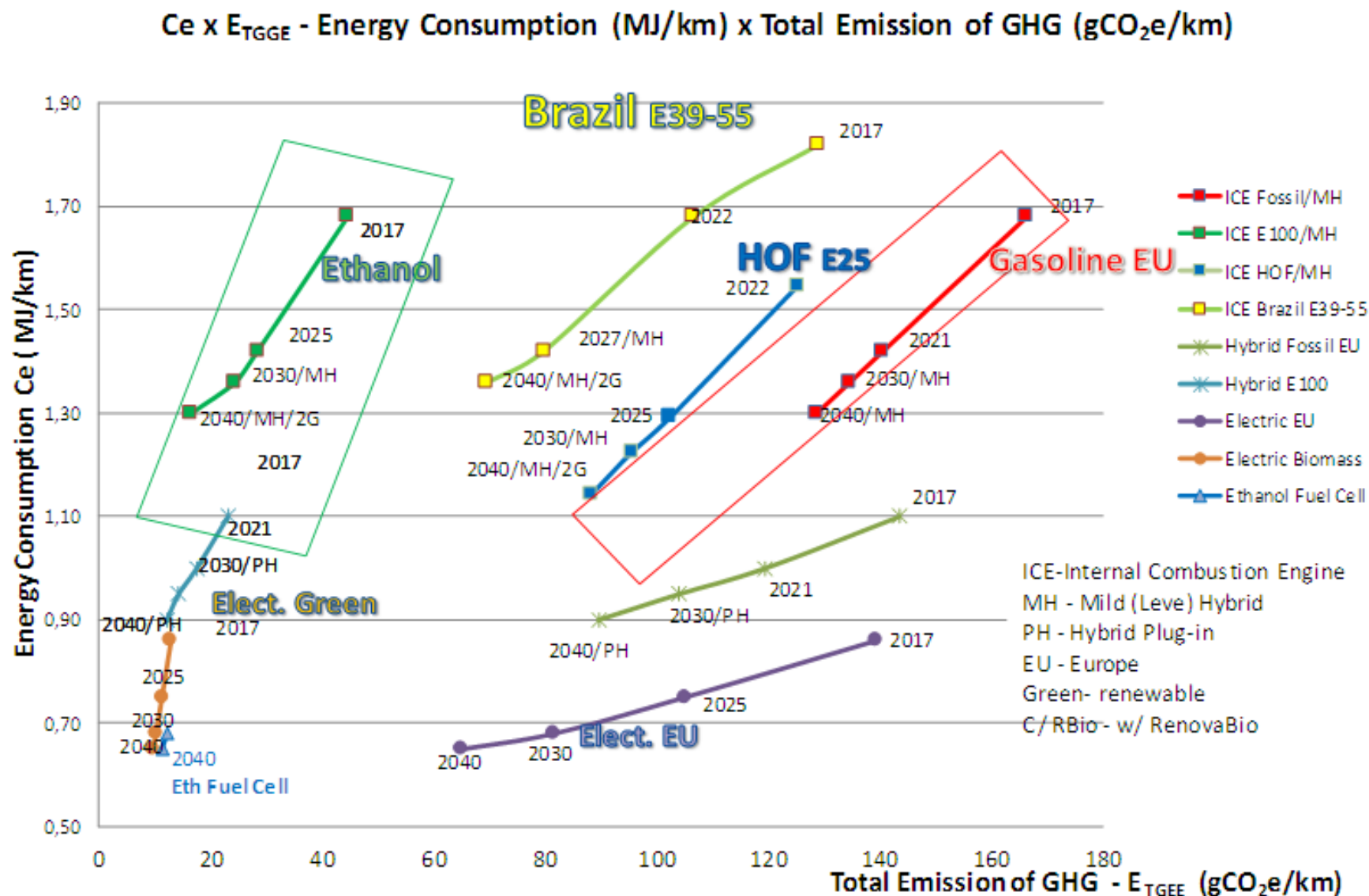
- Biojet opportunities and challenges
 - Drop-in, Input availability, ASTM certification (HEFA, FT, ATJ, and SIP) vs. economics



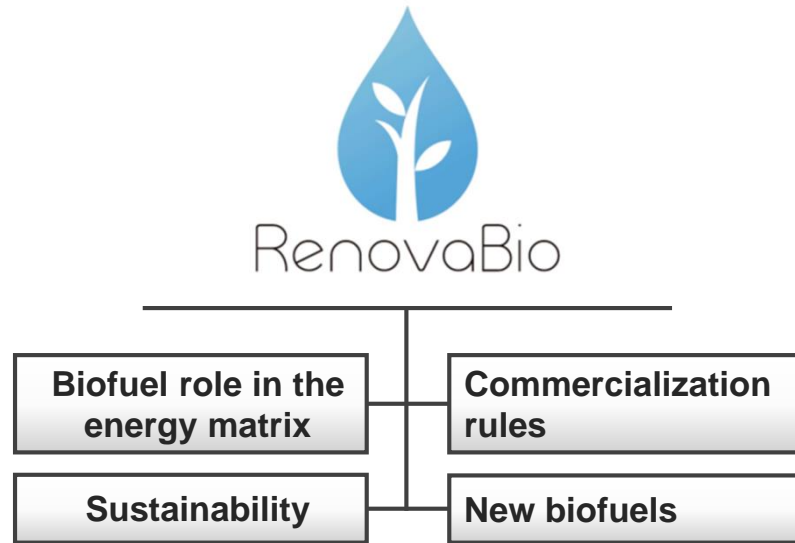
Sources: EPE

Notes: HEFA: Hydro-processed Esters and Fatty Acids; FT: Fischer-Tropsch; ATJ: Alcohol to Jet; SIP: Synthesized Iso-parafins

Challenging myths: different paths to vehicle electrification



Initiatives and Projects



Purpose

To ensure **the expansion of biofuel production** according with Brazilian commitment at COP21 and compatible with market growth



MISSION INNOVATION
Accelerating the Clean Energy Revolution

Purpose

Mechanism for policy and collaboration among countries, organizations, academy and the private sector, aware of the need to accelerate development and expansion of **modern sustainable low carbon alternatives**.

Purpose

Develop ways to **produce in large scale advanced biofuels** and make them widely available for transport and industrial application.

RenovaBio Concept



**Creating Emissions'
Reduction Target
for Fuel Market**



**Potential Demand
for Biofuels**



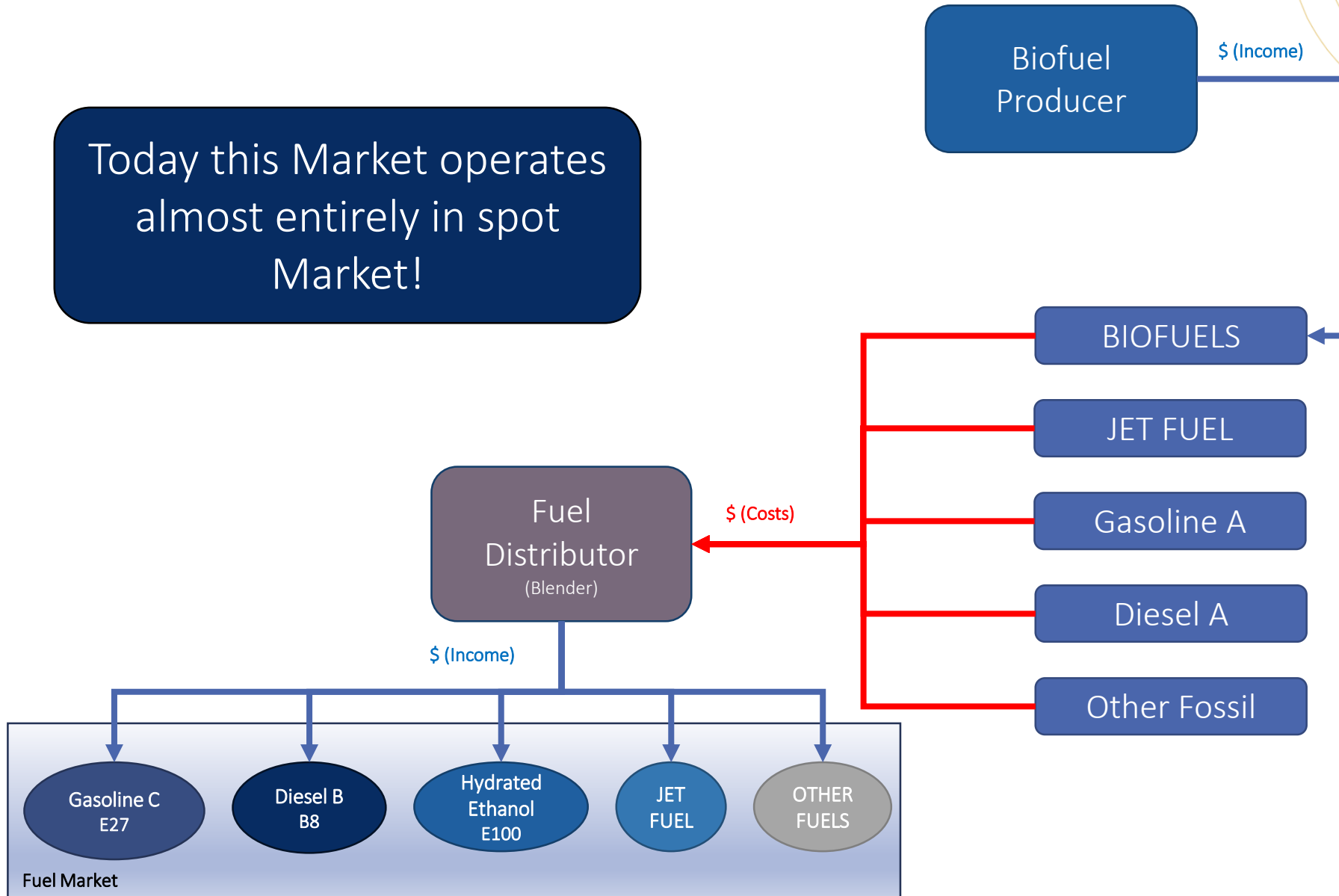
**Certification
of Biofuels'
Production**



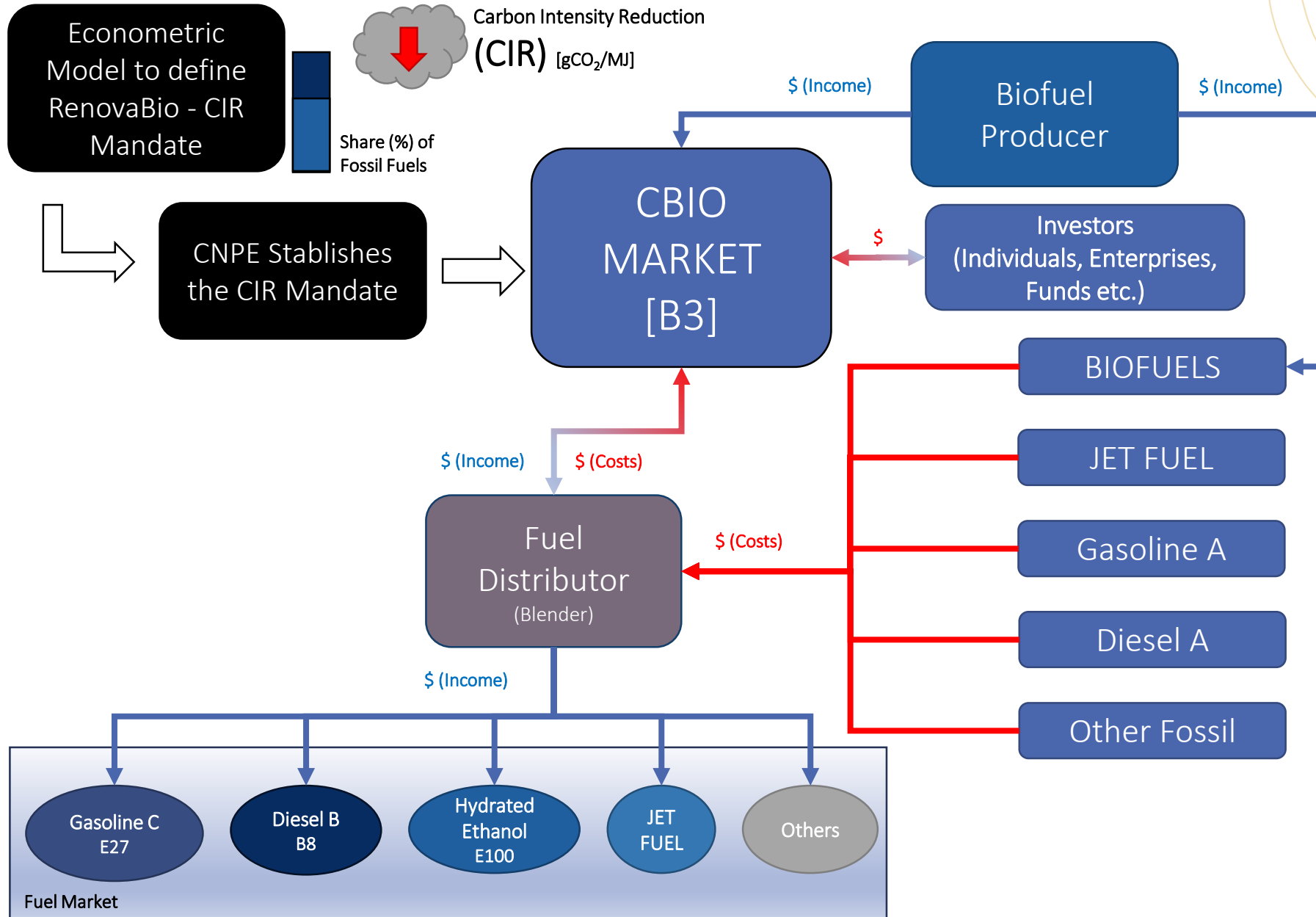
Efficient Production
↑energy ↓CO_{2eq}

How Fuels Market Works today?

Today this Market operates almost entirely in spot Market!

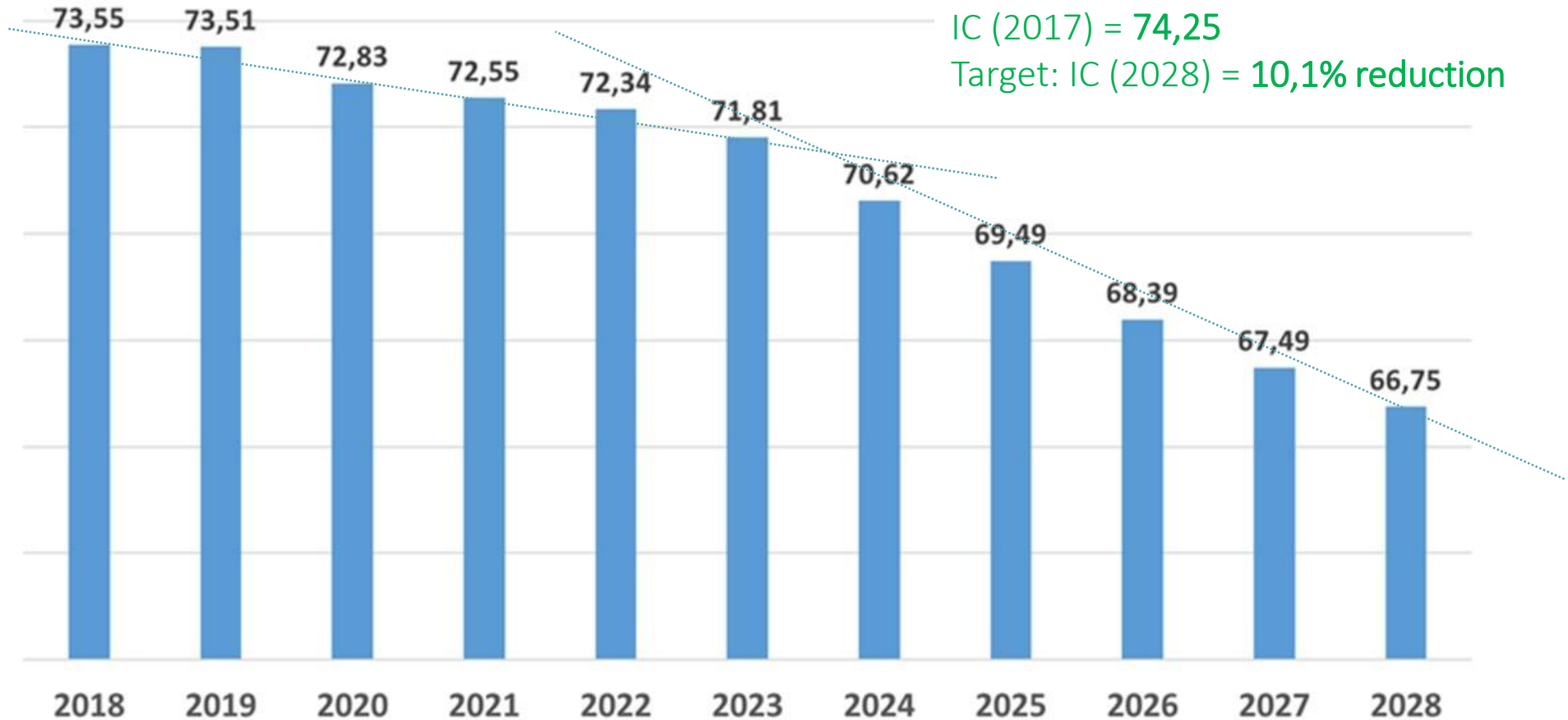


RenovaBio Innovation



RenovaBio Targets

Average Carbon Intensity of Fuel Mix (gCO₂e/MJ)

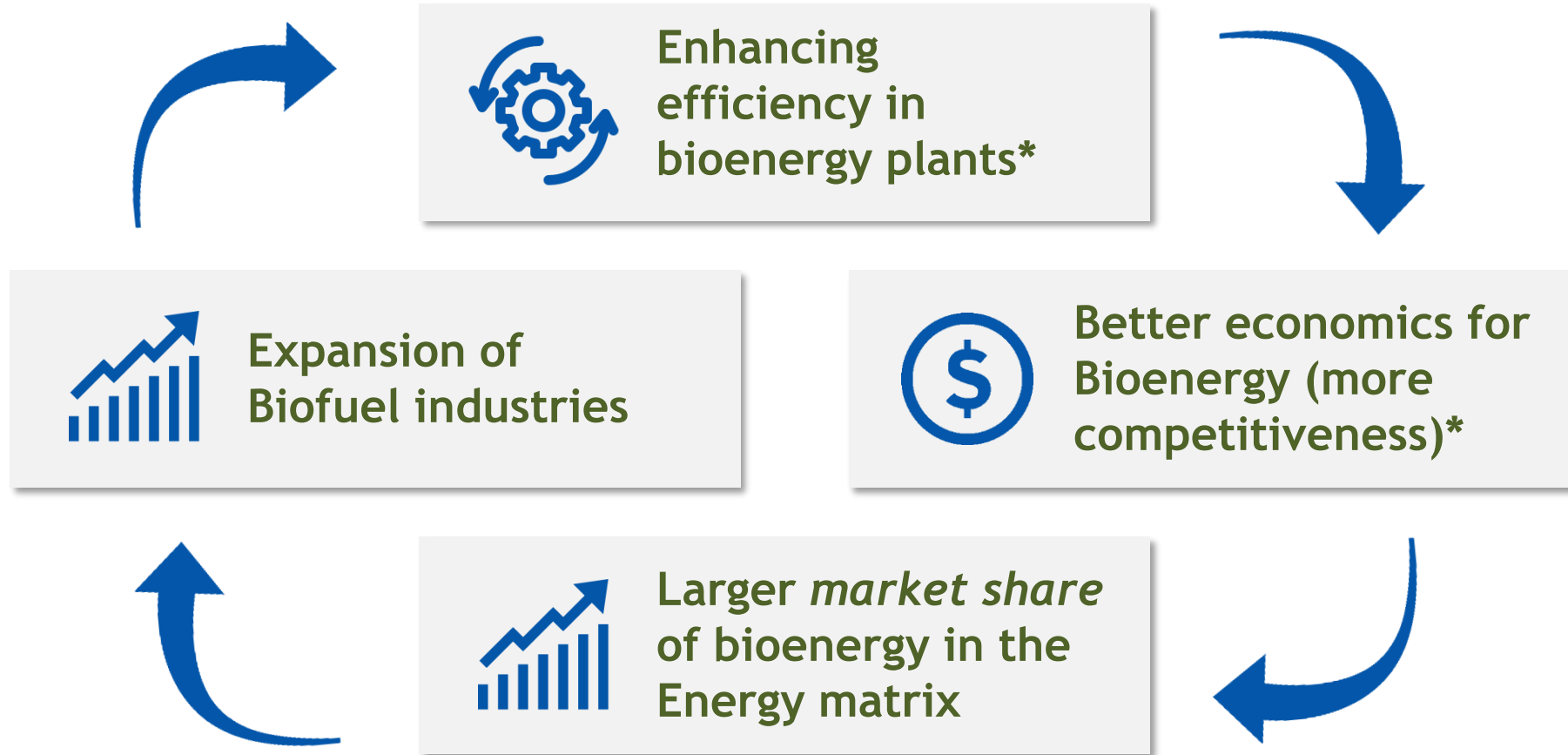


BIOFUELS NATIONAL POLICY (RENOVABIO)



-  **Dec, 2017** Law n° 13,576 (December, 26, 2017)
-  **Mar, 2018** Presidential Decree n° 9,308 (Mar, 15, 2018) and Ministerial Ordinance MME n° 103 (Mar, 22, 2018)
-  **May, 2018** Public Consultation n° 46 (May, 04 to 20, 2018) about Targets for Reducing Carbon Intensity of Fuel Use in Brazil
-  **Jun, 2018** Set of Fuel Decarbonizing Targets for Brazil by CNPE
Resolution CNPE n°5, 2018
Target of -10% in 10 years
from 74.25 g CO₂/MJ 2017 to 66.75 g CO₂/MJ in 2028
-  Regulations, certification, establishing Market of Certificates (CBIO) and model's development and improvements
-  **Dec, 2019** Enforcement of Fuel Decarbonizing Targets

EXPECTED DYNAMICS OF RENOVABIO FOR BIOENERGY IN BRAZIL



* Renovabio applies a life cycle assessment to better evaluate the carbon footprint.