



Empresa de Pesquisa Energética

Building the Net Zero Pathway of Brazil: the role for bioenergy and H₂

Hydrogen-based and Bio-based Pathways to Climate Neutrality in Brazil and Europe: Healthy Competition or Contradictory Developments?

Giovani Machado

Director for Energy Economics and Environmental Studies | EPE

14 October 2021

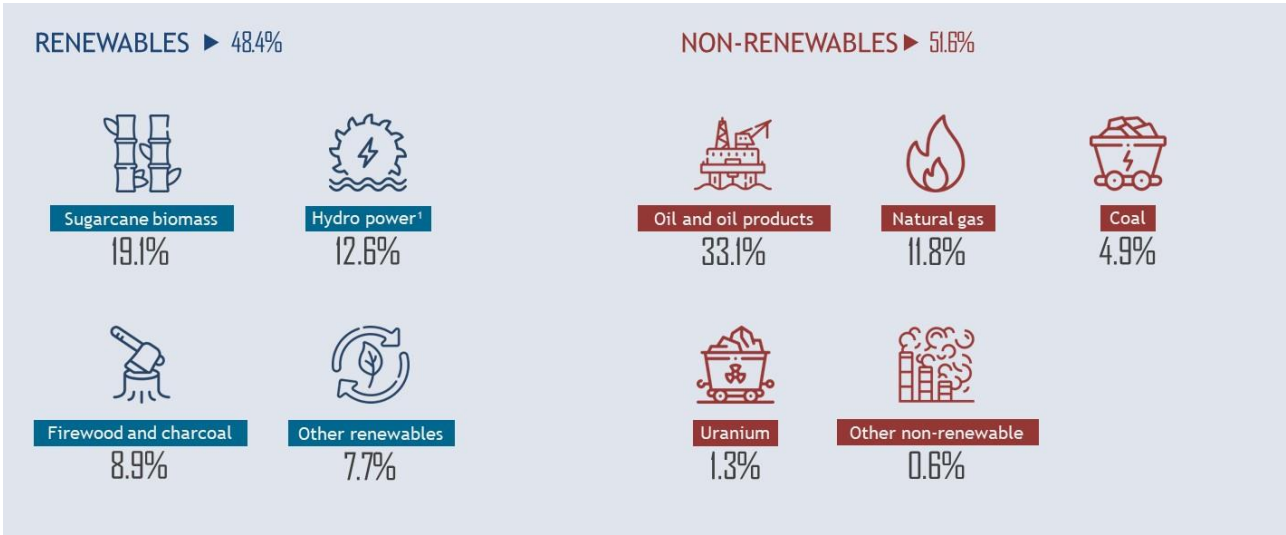
MINISTÉRIO DE
MINAS E ENERGIA



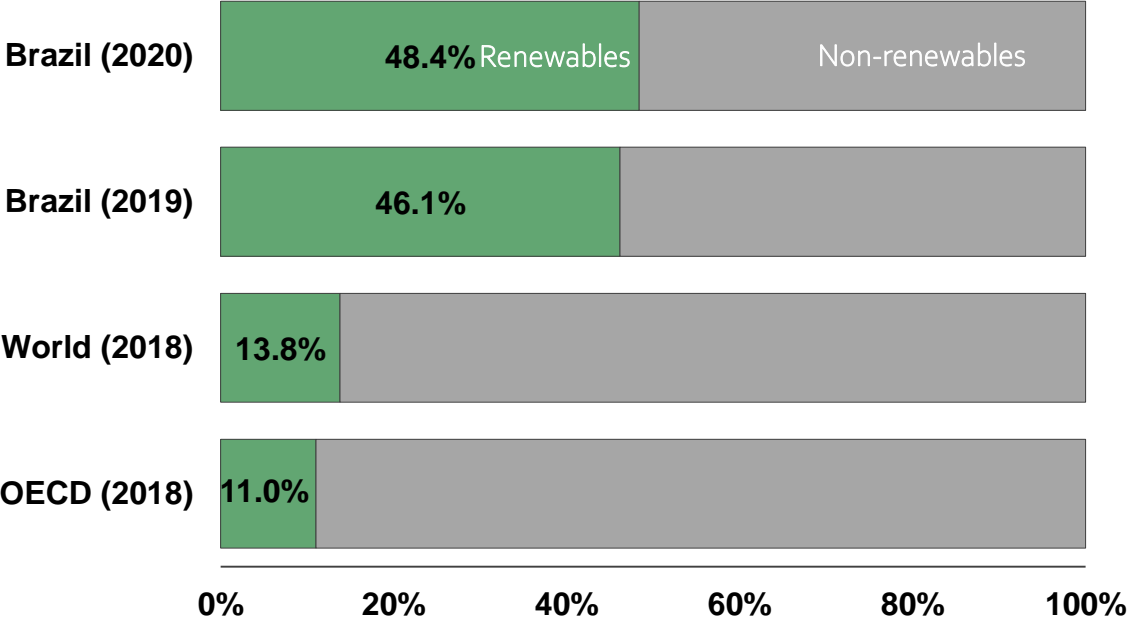
General Figures of Energy Sector in Brazil

The Brazilian energy sector is low carbon

Breakdown of total energy supply - TES in 2020



Brazil's TES in comparison to world



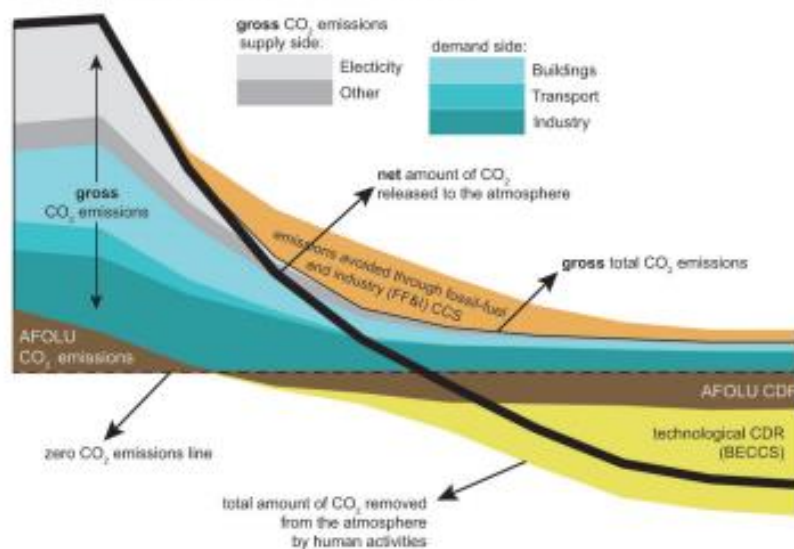
Renewables reached 85% in the Brazilian electricity mix in 2020, in comparison to 23% in World and 27% in OECD (2018-2019).

Brazil's per capita carbon emissions related to energy is 1/3 of European Union and China and 1/7 of USA

How to take benefits from existing competitive advantage?

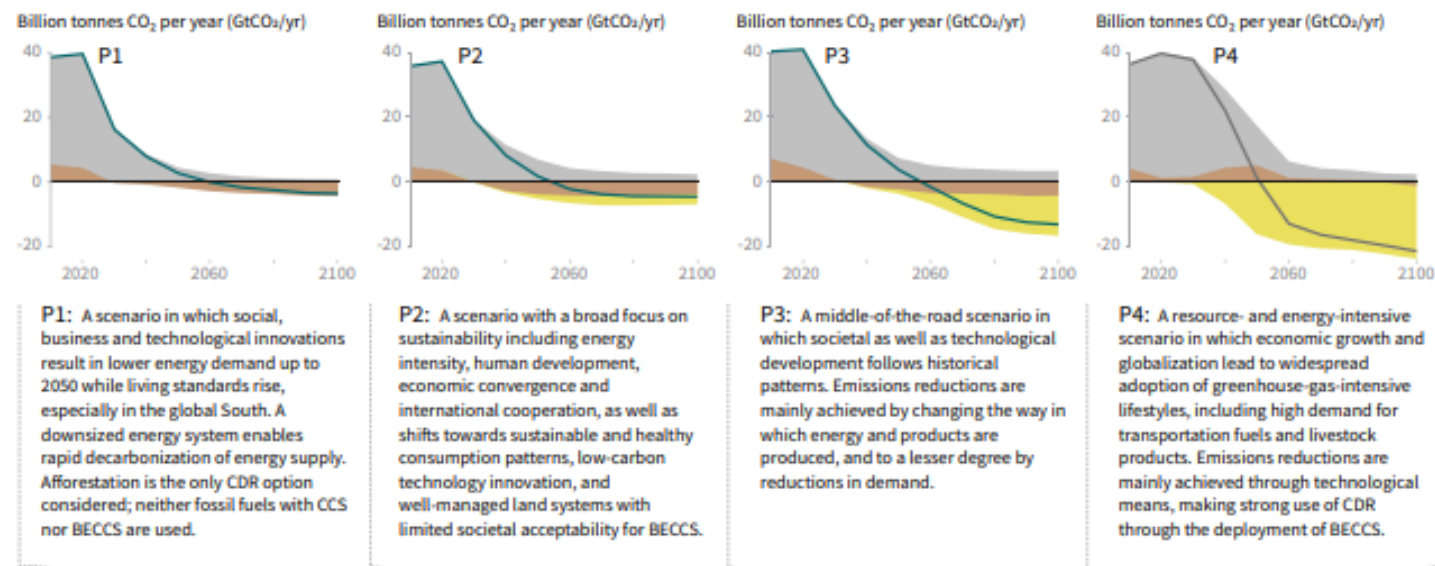
Principle of “common but differentiated responsibility and respective capabilities”

LEGEND: EMISSION CONTRIBUTIONS



Breakdown of contributions to global net CO₂ emissions in four illustrative model pathways

● Fossil fuel and industry ● AFOLU ● BECCS



<https://www.ipcc.ch/sr15/>

Special Report - Global Warming of 1.5 °C

Different pathways to Net Zero: opportunities to bioenergy, hydrogen, CCUS, BECCS, afforestation & reforestation to build new competitive advantages in Brazil

Bioenergy and hydrogen: neither competition nor contradiction, but coexisting & complementary technological paths to Net Zero



Static versus dynamic comparison – time and costs matter

From Biofuel Mills to Biorefinery



NISSAN MOTOR CORPORATION

Home > CRAFTSMANSHIP > Technology > Technology Archive > Future Technology > e-Bio Fuel-Cell

e-Bio Fuel-Cell

A fuel cell system that generates electricity from bioethanol to power a vehicle

e-Bio Fuel-Cell is a fuel cell system that generates electricity through the power to the vehicle.

Bioethanol is made from renewable CO₂. Because the plants that achieve a "carbon neutral cycle."

In countries where bioethanol

Toyoda terá Prius flexível e testará Mirai no Brasil

Prius será o primeiro híbrido flexível do mundo e Mirai poderá ter célula a etanol

BOSCH BETS ON ETHANOL IN ELECTRIC CAR

BRAZIL SHOULD EXPORT ETHANOL FUEL CELL, SAYS VOLKSWAGEN LATIN AMERICA CEO

May 26, 2021 | Posted by Ruth Holland

For Volkswagen Latin America CEO Pablo Di Si, Brazil should be an exporter of ethanol technologies, such as the fuel cell, both to neighboring countries and to the European continent and emerging powers like China and India.

Shares will depend on economics and diffusion, which will be different according to income level, prices and infrastructure for each country and/or market segments.

Competition, contradiction or cooperation? It depends...

Biomethane from ethanol co-products (vinasse & filter cake) for green ammonia production



Sep, 20, 2021 – Raizen (JV Cosan-Shell) announced a 5-years deal with Yara to sell biomethane (20 thousands m³/d) for hydrogen and green ammonia production.



Carbon Offsetting and Reduction Scheme for International Aviation



Current technologies, maximum blend allowed and most common feedstocks for drop-in SAFs as defined under standard ASTM D7566

Technology	Maximum blend (%v/v)	Feedstocks
FT & FT-SKA	50	Wastes (MSW, etc.), coal, gas , sawdust
HEFA (Hydroprocessed Esters and Fatty Acids)	50	Vegetable oils: palm, camelina, jatropha, used cooking oil.
SIP (Synthesized Iso-Paraffin)	10	Sugarcane, sugar beet
ATJ (Isobutanol and Ethanol)	50	Sugarcane, sugar beet, sawdust, lignocellulosic

Source: IATA (2018). Sustainable Aviation Fuels - Fact Sheet 2. SAF Technical Certification

Only a small share of land is used for biofuels in Brazil, which have to comply with agro ecological zones to be eligible to issue CBIO. Biorefinery and 2nd Gen are at the corner...

Hydrogen domestic market & market potential in Brazil



Existing and new markets

By 2030, 65% of carbon emissions in the Brazilian Energy Sector (484 MtCO₂e) will be in Industry and Transport (EPE - PDE 2030)



Fertilizers



Refinery



Methanol



Mining & Metallurgy



Food & Others



Energy Storage



FC Forklift



Transport



SFAs



Biorefinery

Local & global
players / suppliers



Transport

Biorefinery

Government support to Hydrogen R&DI is not new...



Long-term commitment to hydrogen brought results

Programs, Plans, White Papers, Resolutions

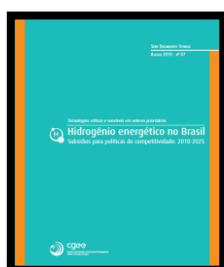
MCTI 2002



MME 2005



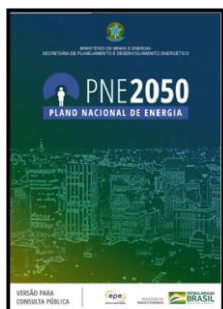
MCTI 2010



MCTI 2018



MME-EPE
2020



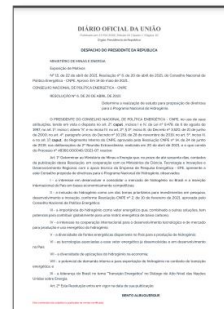
EPE 2021



CNPE nº 2
2021



CNPE nº 6
2021



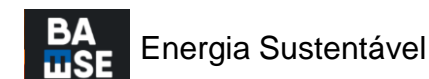
Capacity building



Public and public oriented investments
R&DI reached R\$ 200 millions – 1% of
energy R&DI (1999-2018)

CNPE Resolution nº 2, Feb, 10, 2021
Guidelines for energy R&DI public & public
oriented funds to allocate resources in
priority areas, which includes **hydrogen**.

Start-ups

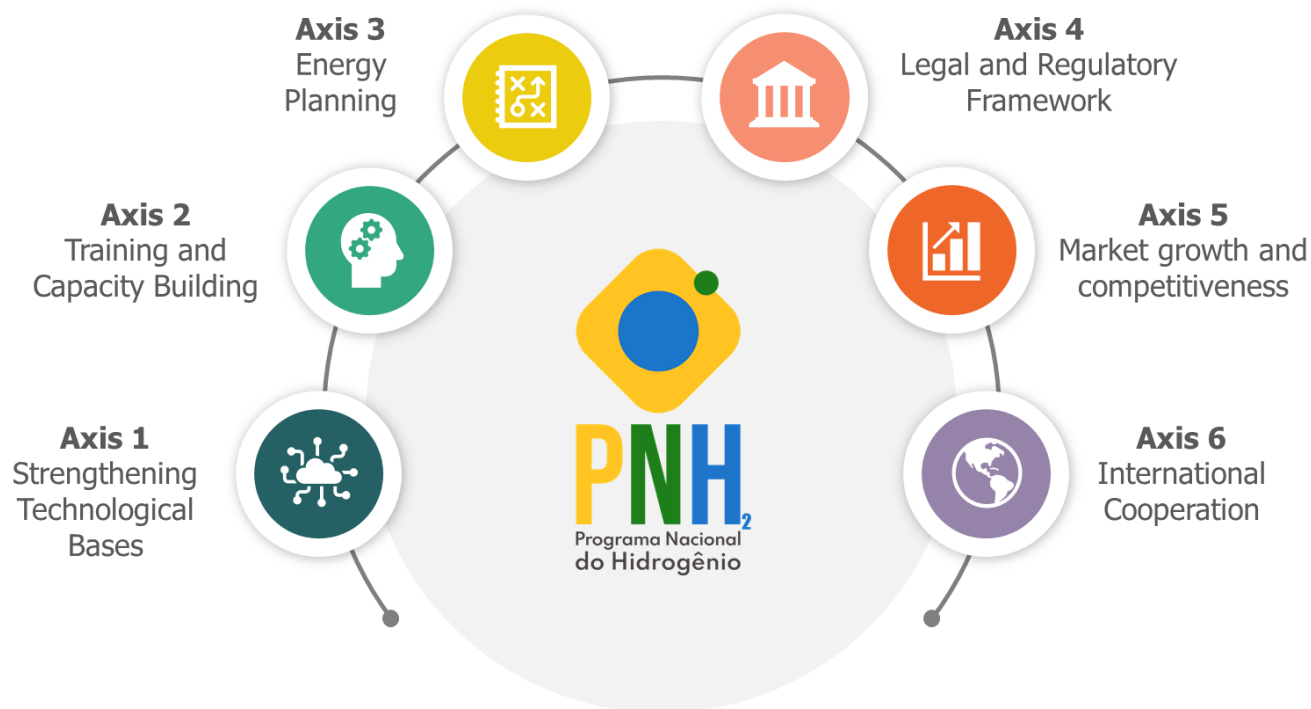


Brazil's National Hydrogen Program – PNH₂



CNPE Resolution nº 6, April, 20, 2021

MME must present proposal for Directives on the **National Hydrogen Program**, in collaboration with MCTI, MDR and support of EPE.



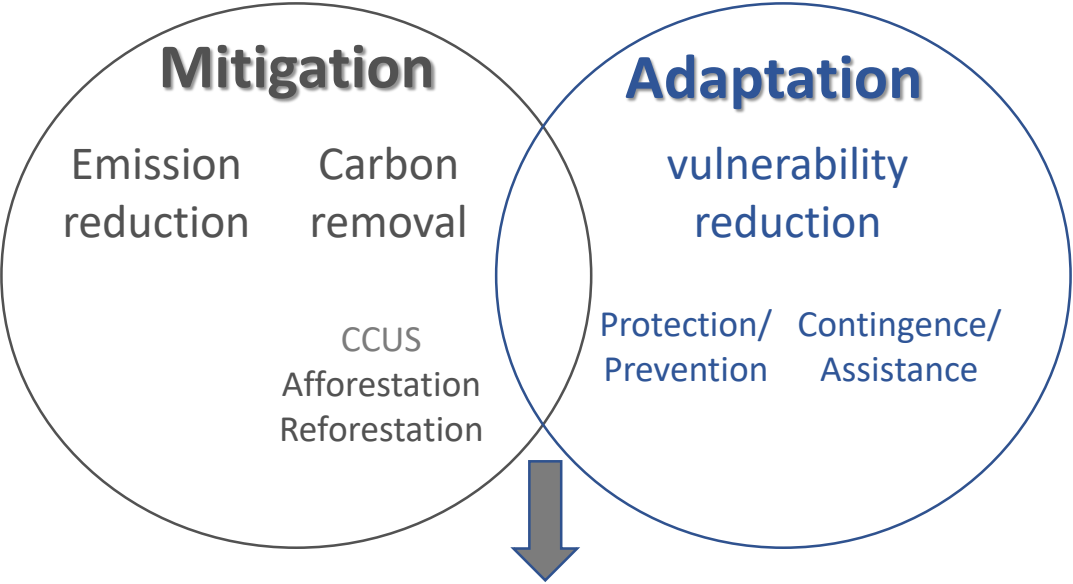
PNH₂ (August, 2021)

Designed to mobilize public and private sectors, as well as academia, together with international cooperation, to accelerate the development of a comprehensive and competitive hydrogen market.

Carbon Removal opportunities, offsets & synergies



EPE-BNDES partnership for forest offsets

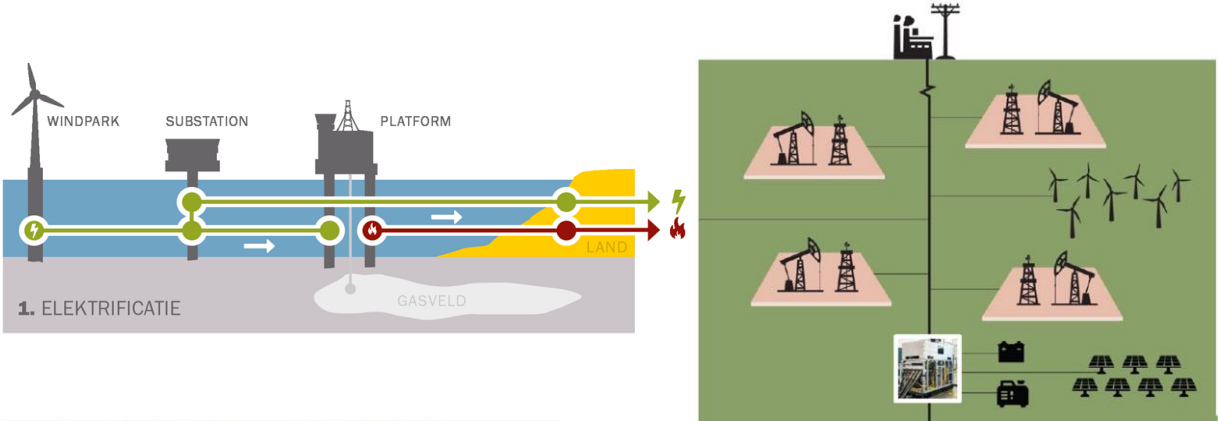


Benefits for hydrological cycle



https://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Galerias/Convencia/Restauracao_Ecologica/noticias/destaque_noticias/goias

Lower footprint by emission reduction and carbon removal – benefits in the market (premium price) and for the society



Petrobras inicia nova etapa do Plano de Restauração Florestal do Comperj
Publicado em: 27/03/2013 16:19:02



FOTO STÉFERSON FARIA

https://www.agenciapetrobras.com.br/Materia/ExibirMateria?p_materia=975150



COMPROMISSO COM A BIODIVERSIDADE

A Shell Brasil é signatária do Compromisso Empresarial Brasileiro para a Biodiversidade, do CEBDS, que estabelece nove metas ambientais até 2030. A assinatura do acordo reforça o papel da companhia na jornada pela transição energética.

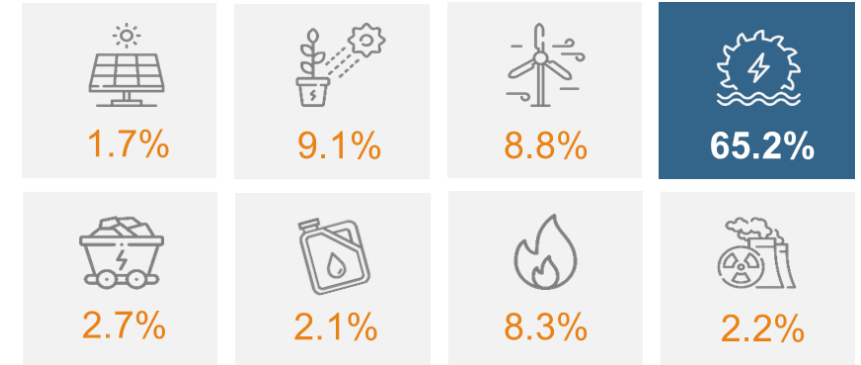
<https://www.shell.com.br/sustentabilidade/meio-ambiente/compromisso-com-a-biodiversidade.html>

Potential to be a key player in low carbon global markets



- ✓ Huge **natural endowment** for bioenergy & hydrogen
- ✓ **Government commitment** to bioenergy & hydrogen
- ✓ Sound **regulation & business environment** in energy sector
- ✓ Fair **human capital, technological skills & logistics** to key international markets
- ✓ Policies to get benefits from **national competitive advantages**, while **creates new ones**
 - ✓ **Bioenergy is strong basis for decarbonization**
 - ✓ **Renewables are blue-chip for hydrogen**, but natural gas and nuclear also matters (zero-carbon + CCUS)
- ✓ **Existing Markets** and **market potentials**
- ✓ Wide **international partnerships**

Electricity supply in 2020: **645.9 TWh**



Brazilian Aquarelle



www.epe.gov.br

MINISTÉRIO DE
MINAS E ENERGIA



PÁTRIA AMADA
BRASIL
GOVERNO FEDERAL

Thank you