Empresa de Pesquisa Energética

LAS-ANS Symposium 2024
Nuclear Technology for the Energy Transition

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Rio de Janeiro, 15 de julho de 2024

MINISTÉRIO DE MINAS E ENERGIA

GOVERNO FEDERAL BRASIL UNIÃO E RECONSTRUÇÃO

EPE – Energy Research Office

Brief institutional description of EPE

Governmental body for energy planning studies

Supports the Ministry of Mines and Energy in its decision-making process, policy and market design

Established in 2004

Integrated approach to the energy sector

Biomass & Biofuels

Oil & Gas

Electricity

Others

Hydro, Wind, Solar, Nuclear, Bioenergy, Oil, Gas, Coal, hydrogen etc.

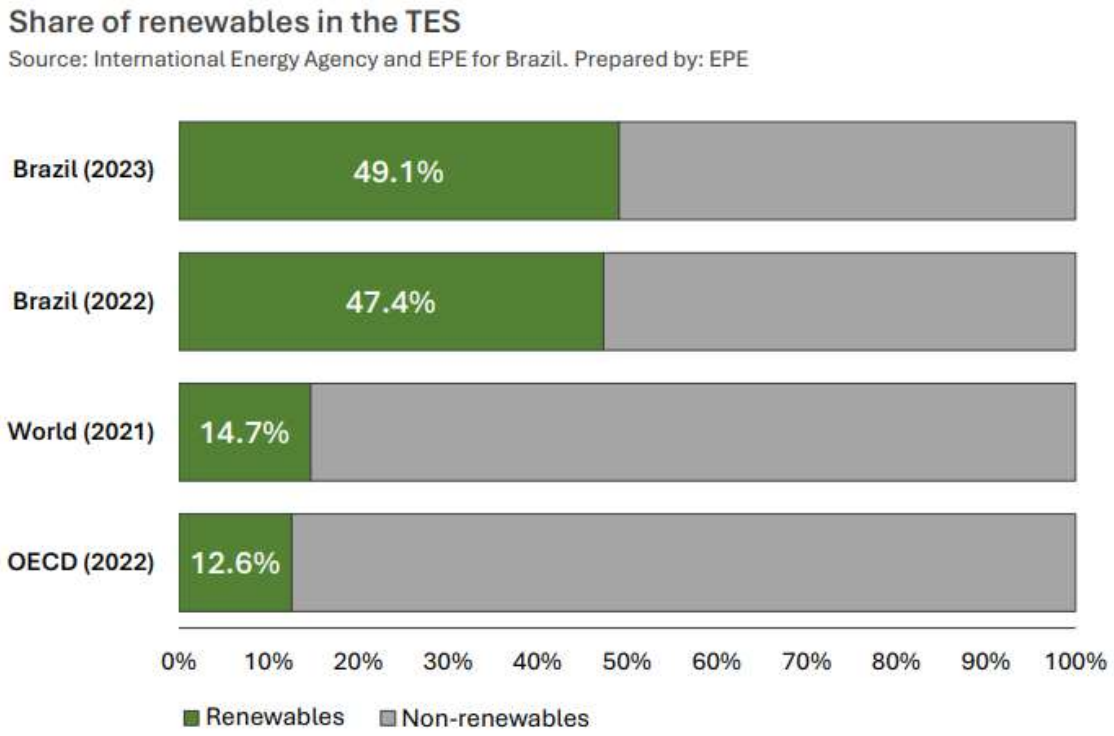
https://www.epe.gov.br/en

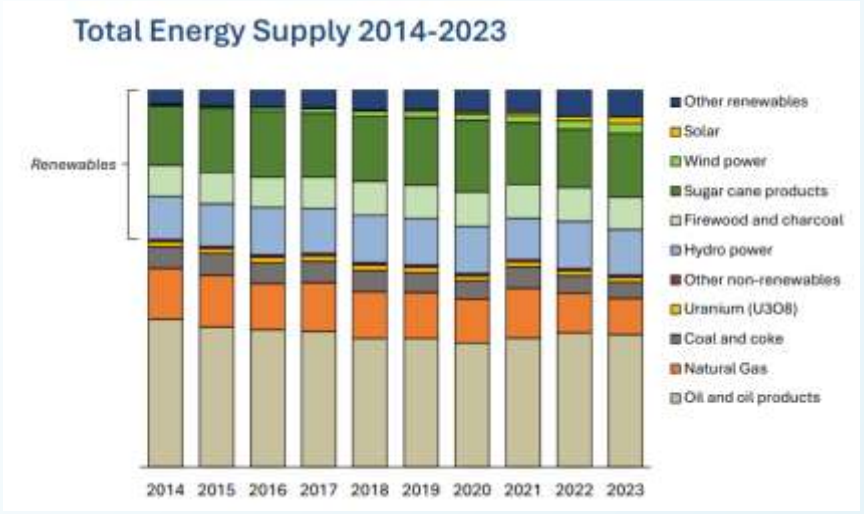
International reference to understand EPE

U.S. DEPARTMENT OF ENERGY ⟷ eia U.S. Energy Information Administration

MINISTÉRIO DE MINAS E ENERGIA ⟷ epe

Overview of Brazil's Energy Matrix

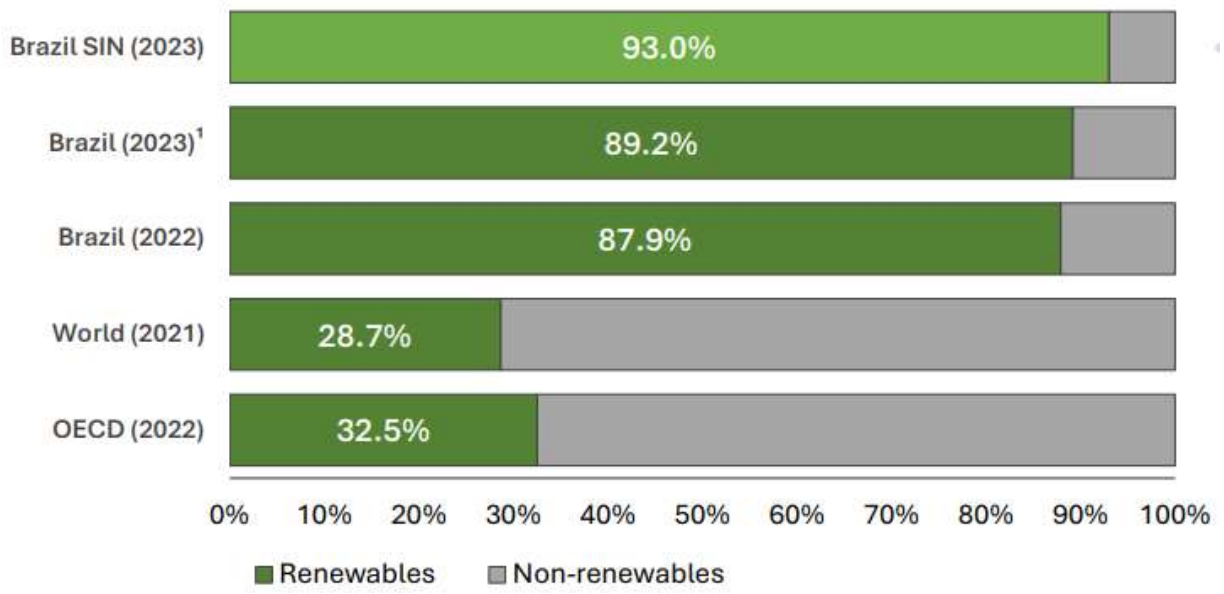




Fonte: EPE – Relatório Síntese – 2024

https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/balanco-energetico-nacional-2024

Brazilian electricity matrix



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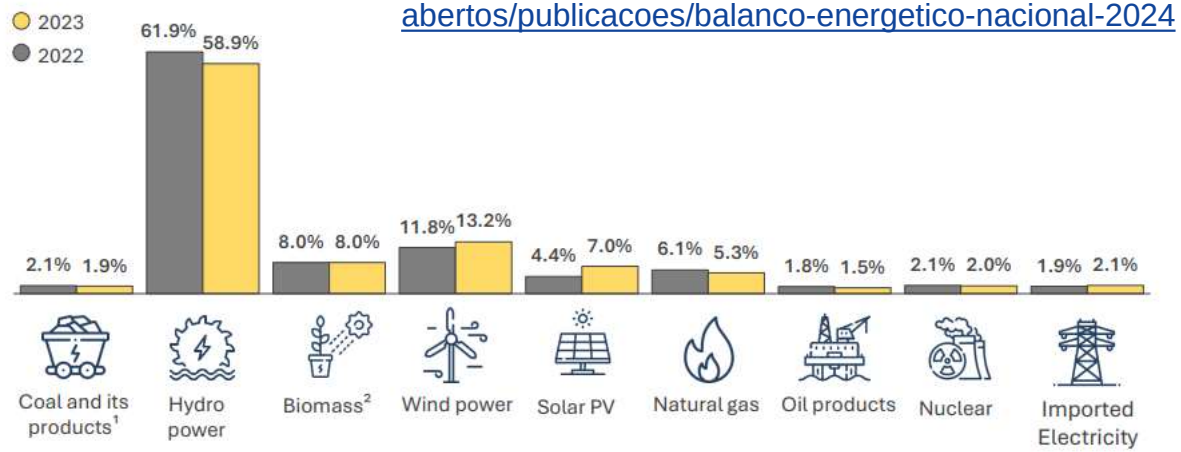
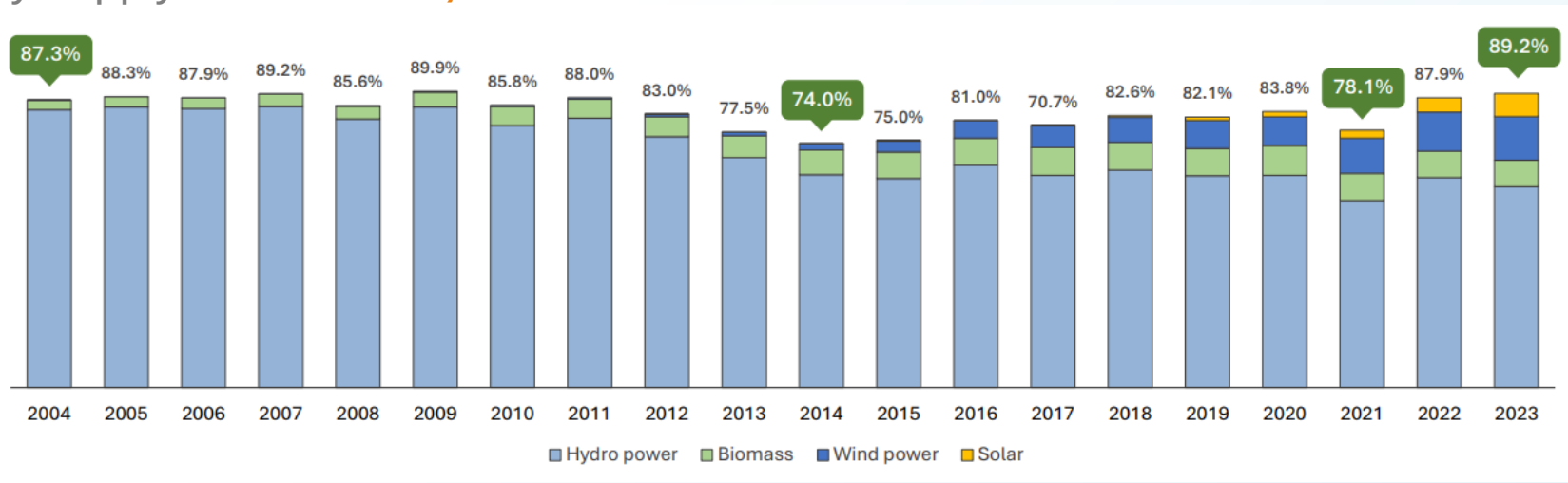
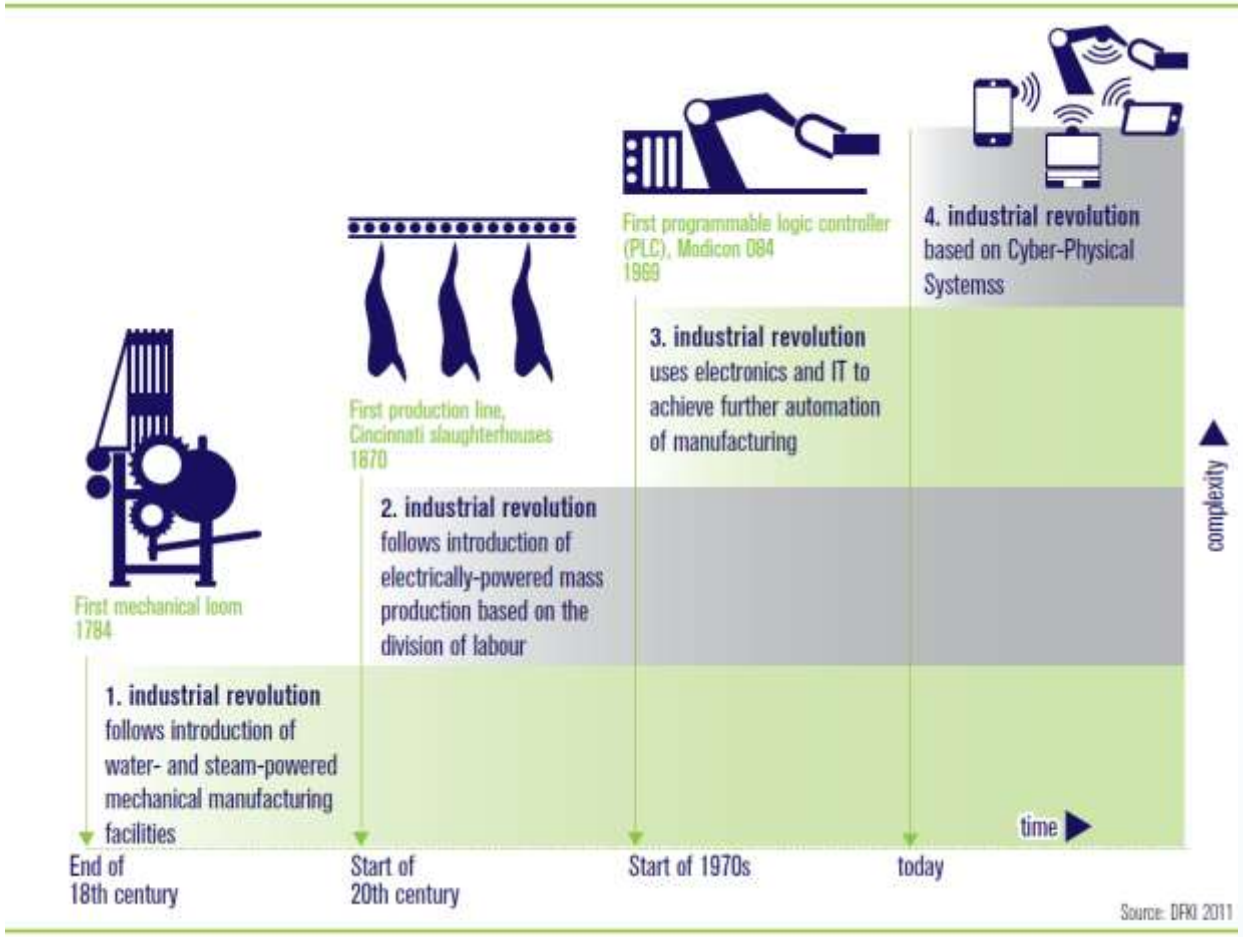
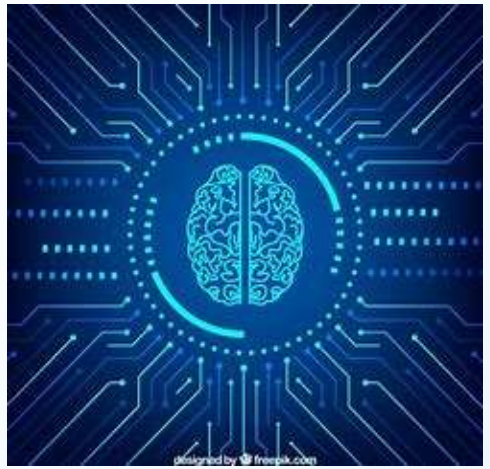


Electricity supply in 2023: **723,2 TWh**



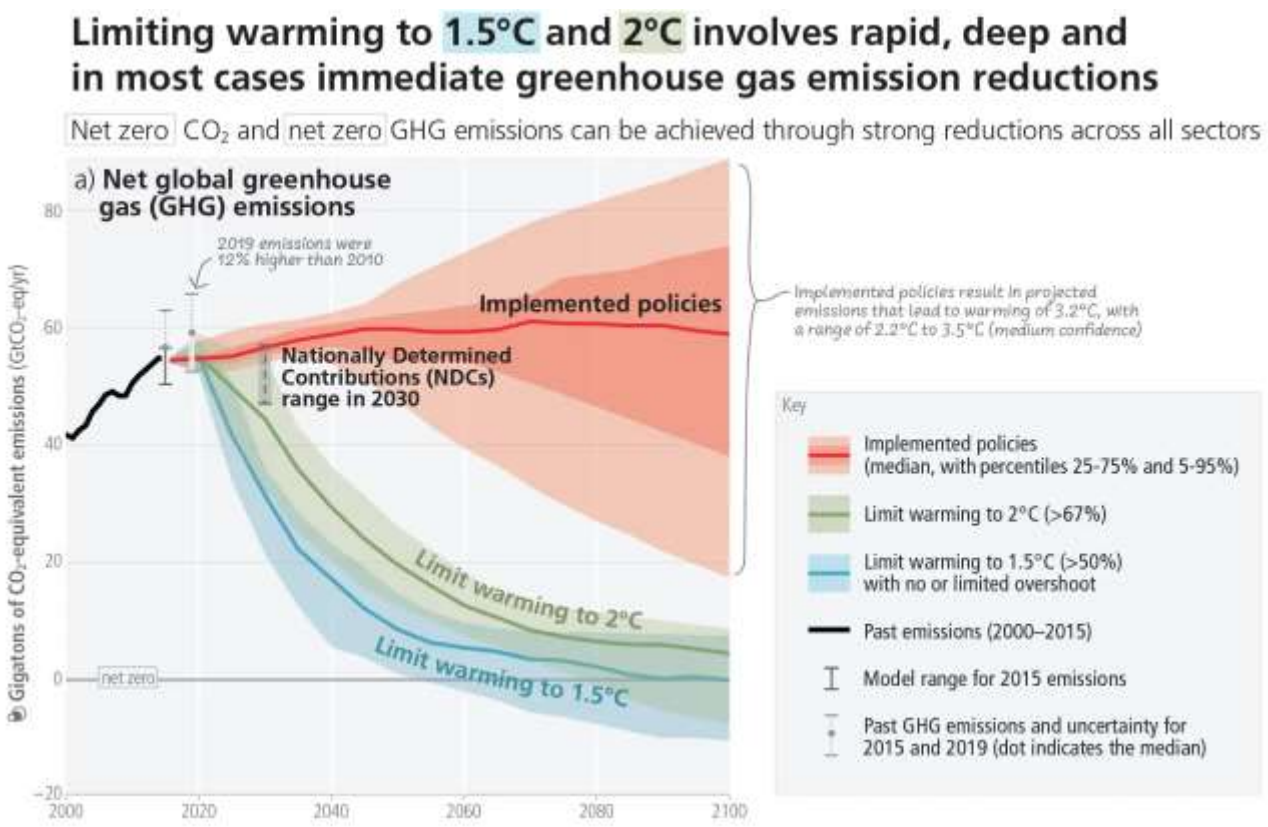
Energy Transition is not only about energy ...





3Ds of Energy Transition ⇔ Decarbonization, Decentralization & Digitalization

The climate change is a development issue...



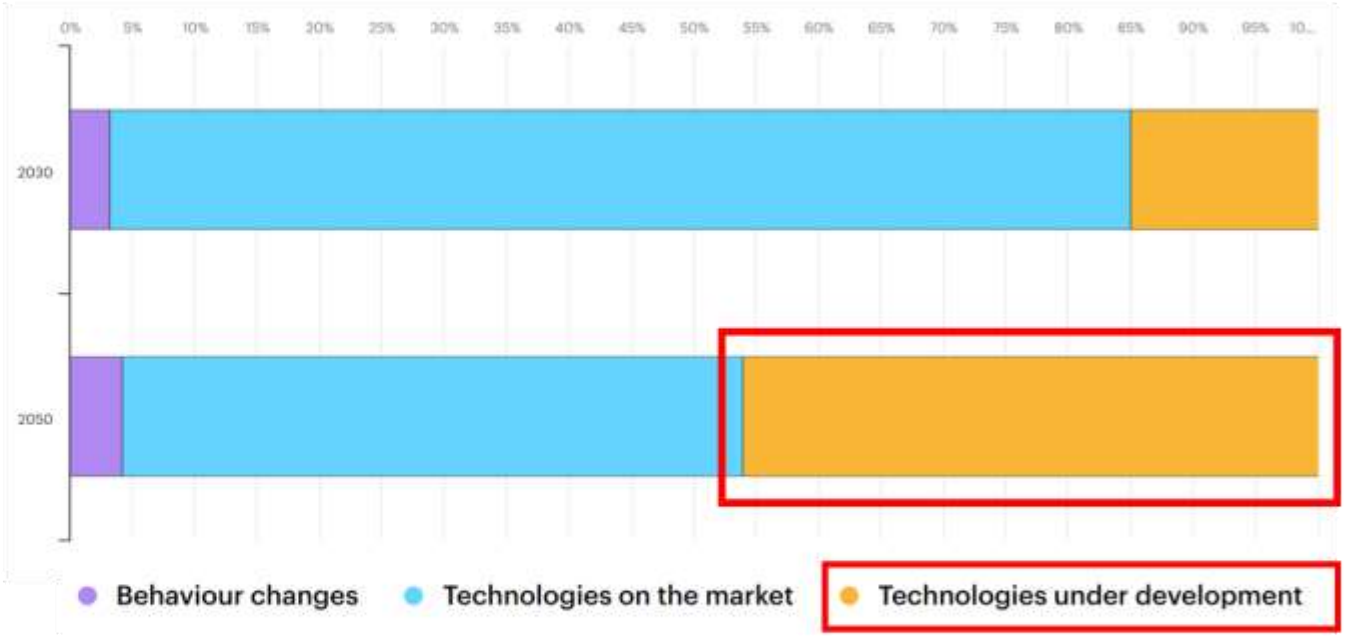
The energy transition to a low-carbon economy is an essential part of the fight against climate change.

The world needs public policies, investment and innovation.

Renewable electricity is important, but it won't be enough

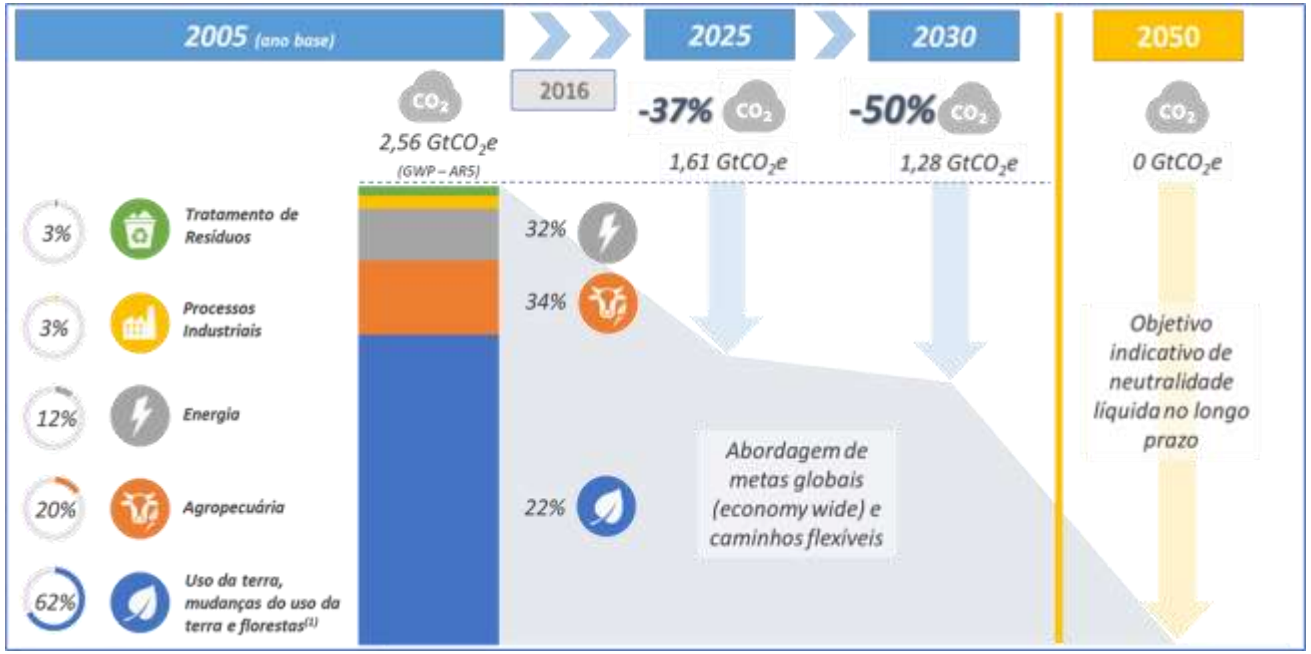
IEA NZ 2050

Annual CO2 emissions savings in the net zero pathway, 2030 and 2050, relative to 2020



Decarbonization scenarios identify the need to develop biofuels, low-carbon hydrogen, carbon capture, SMR, digitalization

GHG emissions in the energy sector & mitigation in Brazil



SEEG (2022):
In 2020, Land Use & Forest 46%, Agriculture & Livestock 27%, **Energy 18%**, Industrial Processes 5% and Waste 4%.

Power sector

- Only 3% of total emissions of Brazil
- Potential for reduction not high (renewables & reliability)
- High share of renewables is competitive in Brazil
- Afforestation & reforestation in hydrological basins will enhance climate resilience, hydrological regime and carbon dioxide removal

Disruptions in the energy sector will require structural changes, time and high costs. Pathways & actions:

- Biofuels and efficiency
- Electrification (several technological routes)
- Changes in mode of transportation

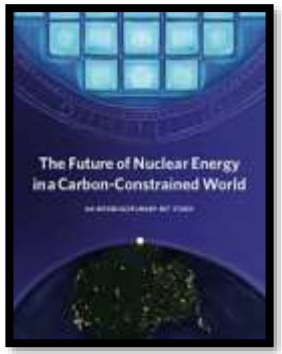
- Higher energy efficiency standards & processes
- Firstly, natural gas, renewables, electrification
- Transition to low carbon hydrogen in hard to abate sectors

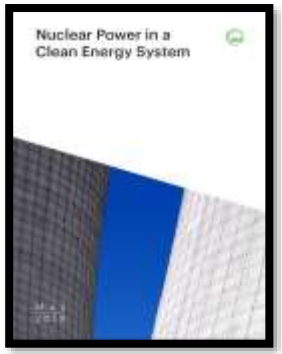
- Higher use of biomass
- Biogas/biomethane & waste
- Carbon Dioxide Removal, including BECCS

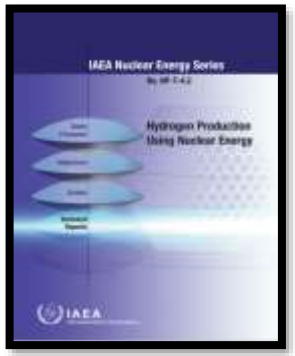
- Transition to energy company
- Changes on business portfolio towards renewables;
- Emission reductions in processes and products
- Mitigation of methane fugitive emissions
- CCUS → carbon storage in geological structures or industrial use

Nuclear energy will play a key role in the energy transition

Energy security, system reliability, decarbonization, market coupling and spillovers



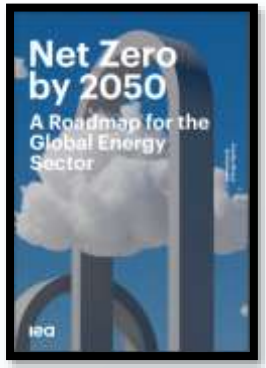




IAEA
International Atomic Energy Agency

Net zero needs nuclear power.
IAEA Statement on Nuclear Power at COP28 | IAEA

At COP28, Countries Launch Declaration to Triple Nuclear Energy Capacity by 2050, Recognizing the Key Role of Nuclear Energy in Reaching Net Zero



""*We have a **viable alternative in nuclear** ... This is one of the ways in which we can achieve net-zero. **We don't get to net zero by 2050 without nuclear power in the mix.***" In news conference at the COP27 climate summit in Egypt.
US Special Climate Envoy John Kerry

"*Canada can be a world leader in this promising, innovative, zero-emissions energy technology, and this is our plan to position ourselves in an emerging global market. **There is no path to net-zero without nuclear power**.*"
Natural Resources Minister of Canada Seamus O'Regan

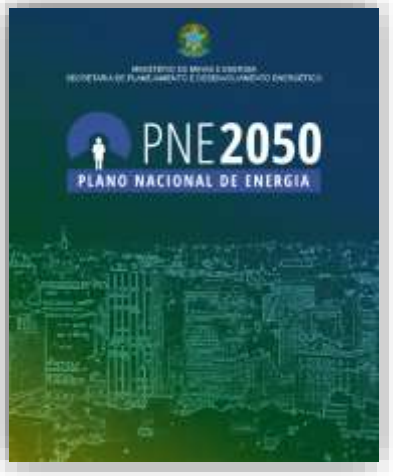
"*So, from offshore wind, to **nuclear**, to a revolution in our energy infrastructure (…) We'll now have a more pragmatic, proportionate, and realistic approach that eases the burdens on families. **Pragmatism, not ideology**. *"
UK Prime Minister Rishi Sunak

"*One of the facts in that report is in my view very pertinent. **In order to reach energy and climate goals nuclear generation needs to double compared to today***"
Fatih Birol – Executive Director of IEA

LTES developed by EPE in Brazil

- **10-Year Energy Plans**
  - Annual Editions
  - Projected emissions
  - Under guidelines of the Ministry of Mines and Energy

- Reference Scenario
- Two additional Scenarios of economic and energy demand growth (Upper and Lower)
- What-if Scenarios (sensitivity analysis)

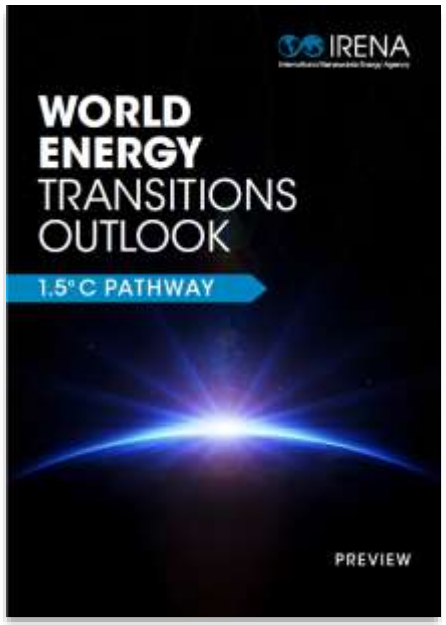


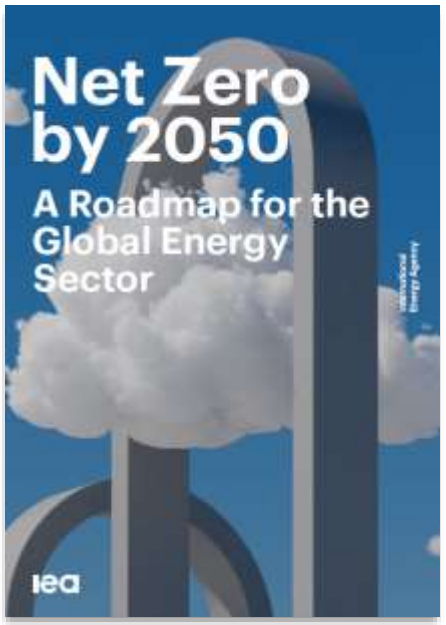
- **National Energy Plan 2050**
  - +30-year perspective
  - New editions Every 5 Years
  - Under guidelines of the Ministry of Mines and Energy

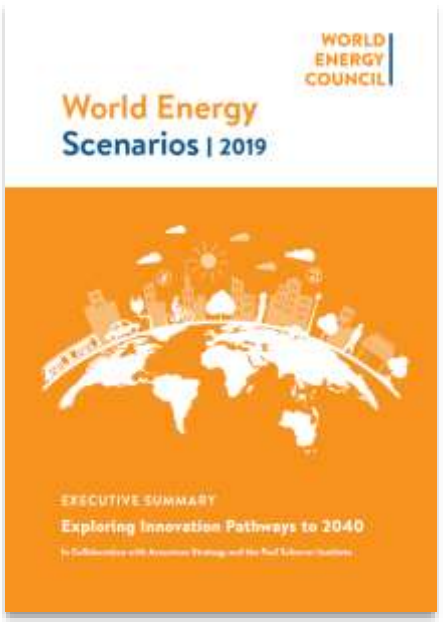
- No Reference Scenario
- Two Scenarios: "Growth Challenge" and "Stagnation"
- +60 sensitivity analysis for power generation mix

Examples of energy scenarios...

- **Global scenarios** to give a broad perspective of challenges and opportunities
- **National and regional scenarios** for better strategy customization and analysis for integration to global value chains







Nuclear energy in the 2050 Brazilian Energy Planning

Energy Plans indicate challenges and recommendations

PNE 2050
Nuclear Energy

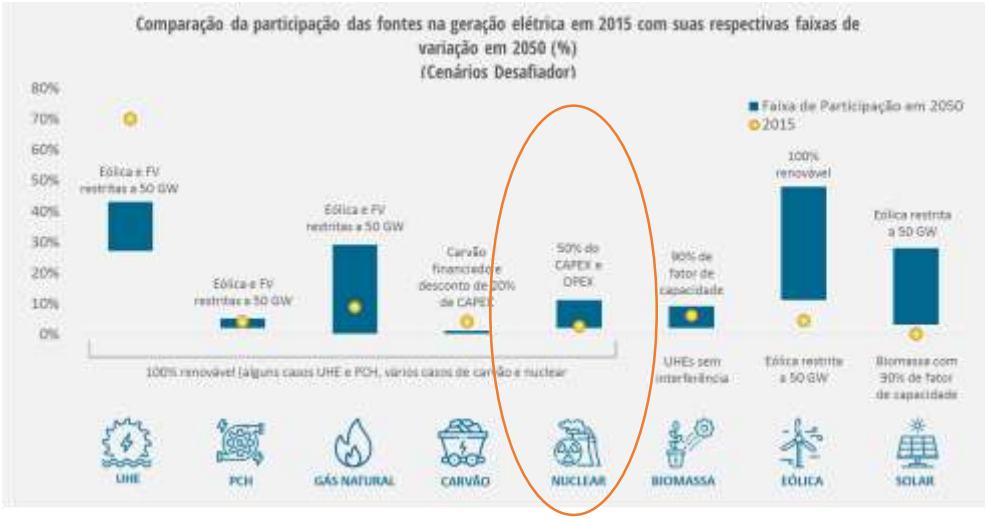
Main challenges:

Communication; improvements on institutional, legal and regulatory arrangements; implementing the National Nuclear Policy; Security & Safety; useful life and decommissioning of facilities; knowledge on related minerals resources.

Recommendations:

To enhance communications with Brazilian society; To improve regulation framework; To estimate benefits related to spillovers and economies of scope; **To standardize projects to get scale and learning economies**; To seek synergies in public policies; To assure good housekeeping of waste and used fuel; To improve culture on security and safety; To guarantee fuel supply; To evaluate implications of expanding useful life.

***After 2030**, **new projects may be based on** PWR, **SMR** and fourth-generation reactor technologies, if the latter reach technological maturity and competitiveness.*



Simulations for the Brazilian Power Market

Two basic cases for nuclear in 64 simulations:

1. Significant cost reductions (CAPEX and/or OPEX) for nuclear power plants
2. Public policy establishes nuclear power plants expansion of 8 GW to 10 GW

Small Modular Reactor - SMR

Opportunities:
Standardization, simplicity, security & safety, construction time & cost reduction, flexibility of supply, etc.

Challenges:
Technological uncertainties, many reactor concepts being proposed, quite diverse range of technological alternatives, comparisons, etc.

IAEA Coordinated Research Project – CRP
"Economic Assessment of the Potential for Small Modular Reactors on a National Level"

ABDAN Permanent Forum on SMR

USBEF Study on SMR

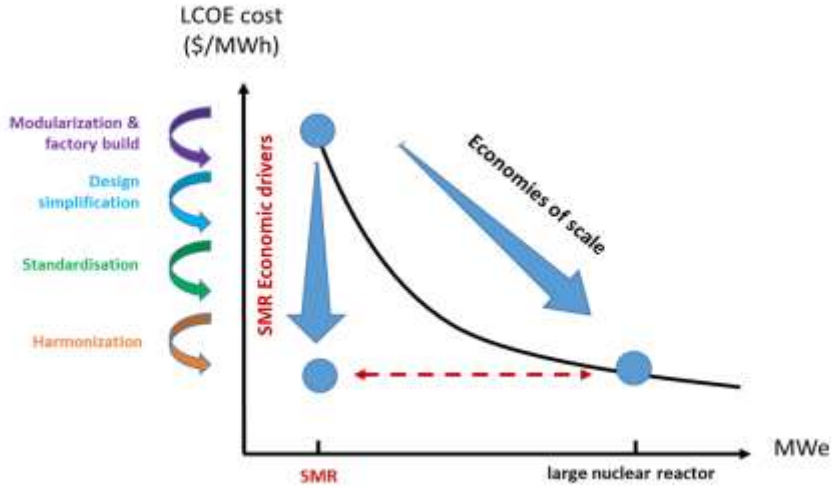
Nuclear energy is in the 2050 Brazilian Energy Planning

Challenges on costs & construction time and opportunities for Small Modular Reactor

PNE 2050
Nuclear Energy

Recommendations:

To standardize projects to get scale and learning economies; To seek synergies in public policies;



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USBEF Study on SMR

The role of energy planning - EPE

- **Energy transition -> world priority** – > importance of clean energy in this context; **Decarbonisation.**
  - Important Nuclear Energy Issues:
    - Large uranium reserves -> Opportunities for the national industry.
    - Reliability and security;
    - Non-electrical applications: nuclear medicine, radioisotopes, food irradiation, pest control, H2 generation, process heat, defense, transportation;
- **SMR Scenario:**
  - SMRs seek to bring solutions: Reduce costs, risks and duration of projects;
  - Diversity of designs, sizes and characteristics;
  - Technical, economic and regulatory challenges.
- **The role of EPE:**
  - Reduce information asymmetry;
  - Produce studies to support the positions and decision-making of the MME and other ministries;
  - Constant adaptation and improvement of energy planning studies related to nuclear energy.

Nuclear energy & energy transition in Brazil

Energy security, system reliability, decarbonization, market coupling and spillovers

https://agenciagov.ebc.com.br/noticias/202311/alexandre-silveira-destaca-a-importancia-da-pluralidade-de-fontes-energeticas-do-pais-durante-evento-do-setor-nuclear

"***Developing and adapting the wide range of low-carbon technologies to local realities is the great challenge of energy planning.*** *This, in fact, is one of the main objectives of my tenure at the Ministry: to stimulate the plurality of sources, without technological lock-up and seeking the best energy costs for our population. We will foster a market that is always looking for new opportunities, helping the country to follow a path that focuses on energy transition and security.*

We must keep a firm eye on ensuring the security of service, with a plan based on the supply of clean, cheap, safe and accessible energy for all. ***And nuclear power is part of that scenario.*** *Because there is no universal recipe or a single set of technological solutions.*

Building consensus is not easy*. But it is what we pursue day and night, listening to everyone, dialoguing, acting with pragmatism and rationality.* ***And our development of the sector has shown that the mastery of nuclear activities and technologies can generate great advances for our country in the field of peaceful use.*** *We work to ensure that our actions are part of a broad spectrum of consistent energy policies, with an efficient energy transition, based on security, predictability and transparency.*

Alexandre Silveira, Minister of Mines and Energy of Brazil

[Speech at Nuclear Legacy 2023, Brasilia - Brazil]

Brazil is seeking engagement of stakeholders, communication with civil society and International Cooperation on Nuclear

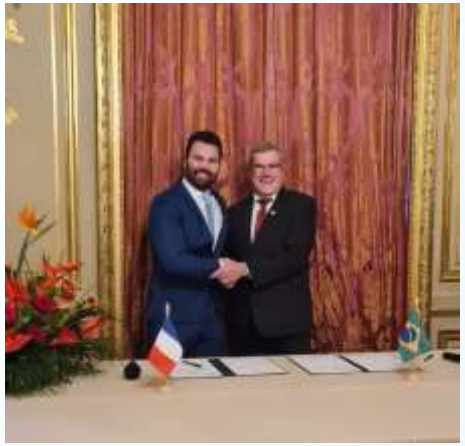
Nuclear projects need wide consensus to increase social acceptability

Lula recebe Macron em Brasília no último dia da visita do líder francês ao Brasil — Planalto (www.gov.br)

Presidents Lula and Macron signed key deals in 2024

https://veja.abril.com.br/coluna/radar/deputado-apresenta-plano-nuclear-brasileiro-na-franca/

Brazilian Congressman Julio Lopes in the World Nuclear Exhibition



https://agenciagov.ebc.com.br/noticias/202311/brasil-e-franca-avancam-em-dialogos-para-consolidar-parceria-no-campo-das-geociencias

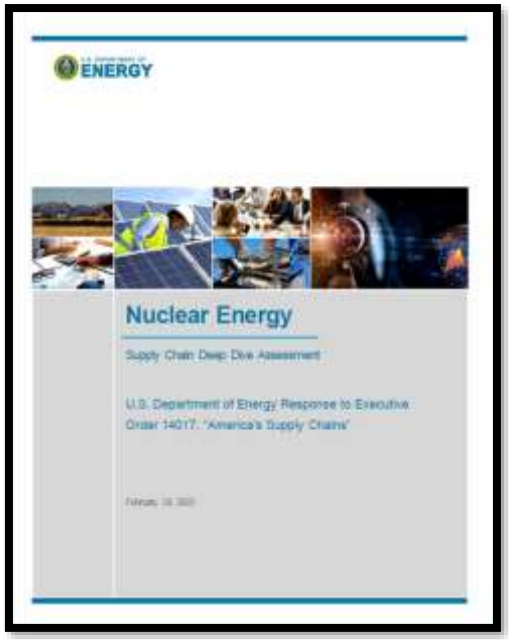
President-Director of Geologic Survey of Brazil Inácio Melo in the WNE

New Action Plan of the Brazil-France Strategic Partnership

IX – Cooperation in energy and mining: 49. The two countries wish to deepen their cooperation lin the areas of energy transition, **notably civil nuclear energy,** critical minerals, renewable energy sources, decarbonised hydrogen, eectricity grids, energy efficiency, low-carbon transport as well as essential services of the sustainable city, notably in the areas of urban infrastructure, public-private partnerships and concessions low-carbon mobility).

Overcoming challenges for nuclear in energy transition & net zero

Do not underestimate supply-chain role for economics and stakeholders' engagement!



EERE Technical Report Template (energy.gov)

Strategic autonomy and the future of nuclear energy in the EU | Think Tank | European Parliament (europa.eu)

DOE (2024): ***The nuclear energy supply chain is vast and diverse*** *covering everything from uranium extraction and enrichment to general construction of buildings at a reactor site to the equipment and components required for operation.* ***The current supply chain is global*** *and relies on companies and materials located throughout the world.*

EU (2023): *Acknowledges the* ***European nuclear fuel supply chain as a strategic asset*** *and recognises the important role it will play in supporting the evolution of the next generation of reactor technology; Emphasises that a* ***robust, capable and reliable EU-based supply chain is critical for the success of producing SMRs****; recalls that the EU remains dependent on imported uranium, which poses inherent risks for its strategic sovereignty and security of supply;*

Key messages

- ✓ **Energy transition is a marathon**, not a 100 meters running
- ✓ Energy transition and net zero in Brazil based on **bioenergy**, **renewables, energy efficiency** & **low carbon hydrogen. Nuclear and natural gas will play key roles.**
- ✓ **Nuclear role in energy transition**
  - ✓ Energy security, system reliability, decarbonization and spillovers
  - ✓ Possibility of coupling to other markets (carbon market, industrial heat, hydrogen, etc.)
- ✓ Particularly, **SMR brings new opportunities to nuclear industry**
  - ✓ Standardization, simplicity, security & safety, construction time & cost reduction, flexibility of supply, etc.
  - ✓ Market coupling: electricity, industrial heat, hydrogen, carbon, etc.
- ✓ **Energy planning, legislations and CNPE resolutions are dealing with challenges for nuclear in Brazil**

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Thank you!