

# SMRs in Brazil

Do small modular reactors (SMRs) have a role to play in the Brazilian energy mix and energy transition?





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# Agenda

1

Brazil Energy Outlook – Energy Mix

2

Nuclear Energy - Brazil

3

Small Modular Reactors (SMRs)

4

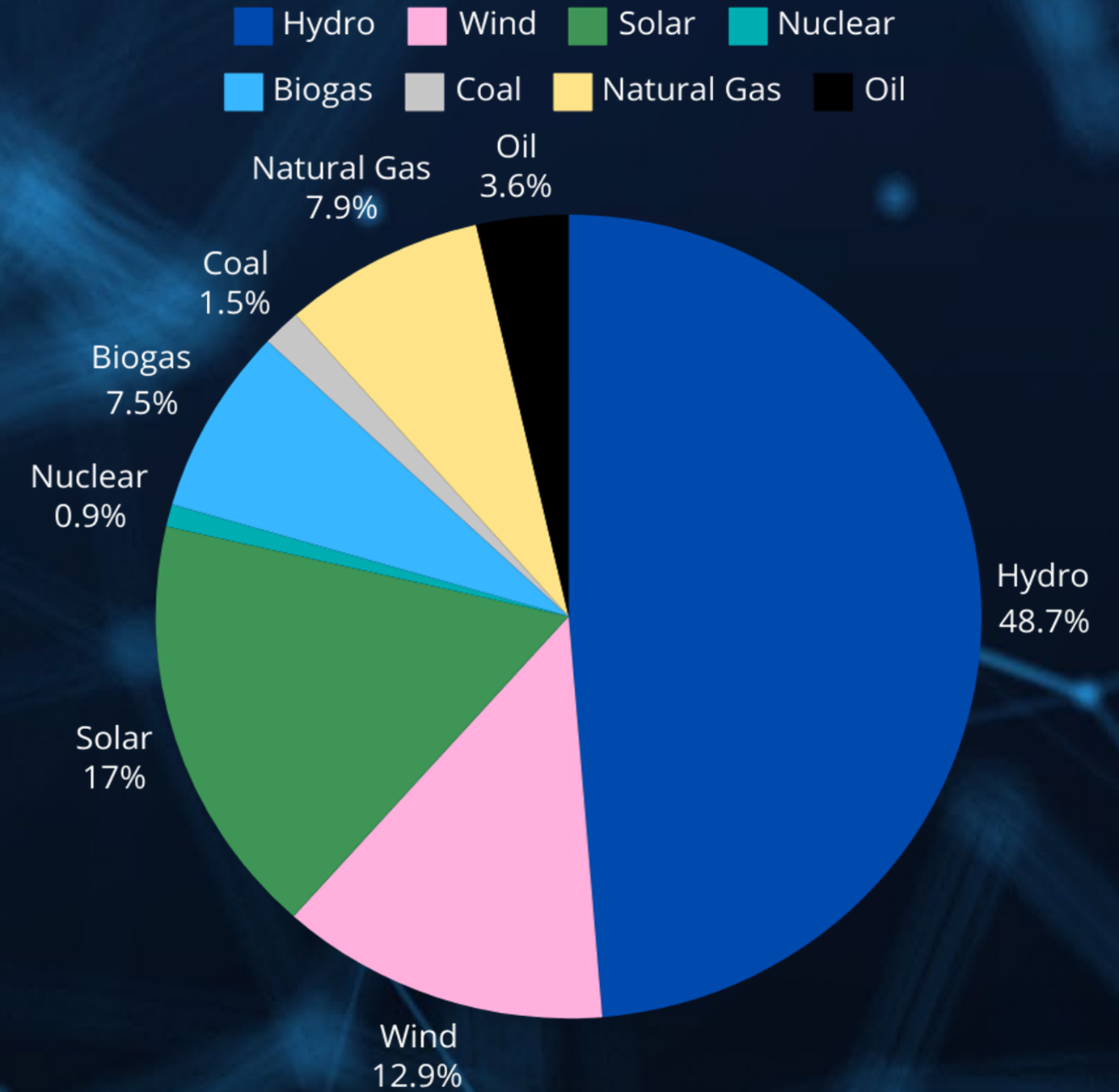
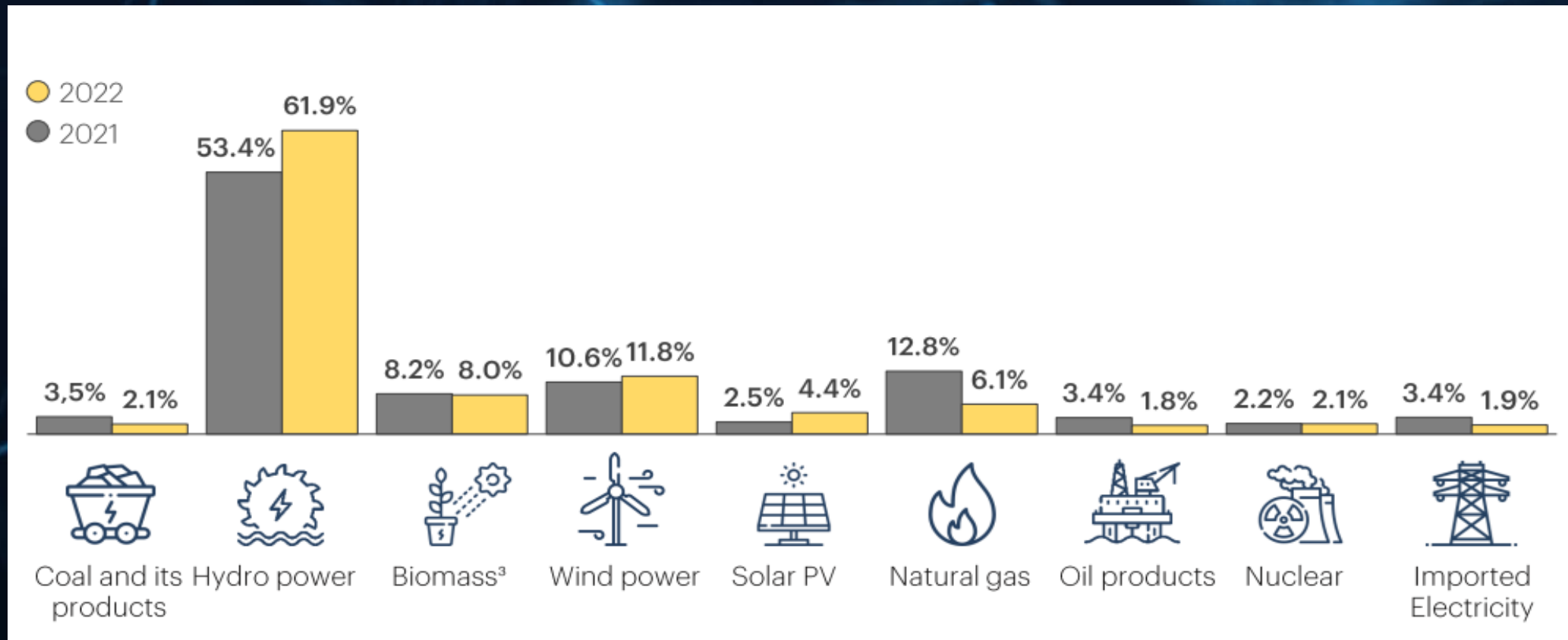
Small Modular Reactors (SMRs): Perspective application in Brazil

5

What to expect?

Depends on hydroelectric dispatch over the course of the year

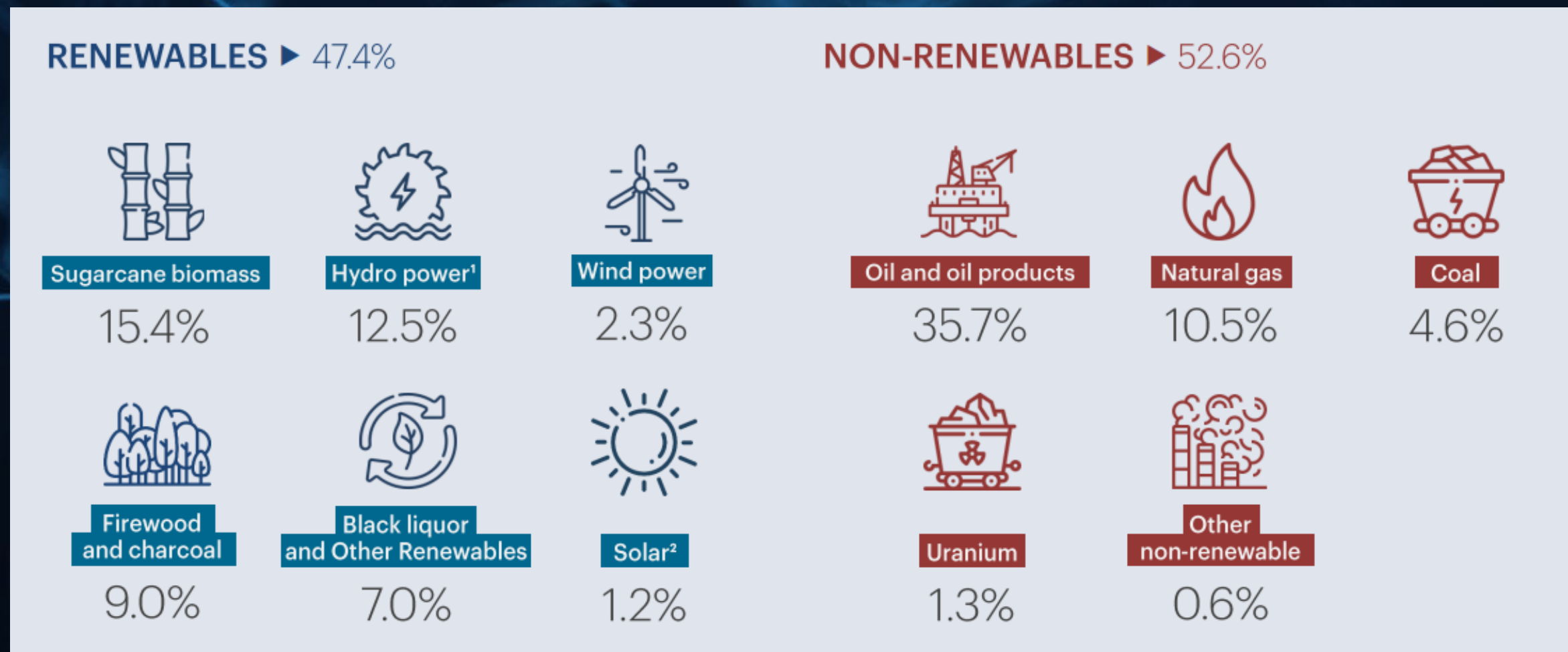
2024 : increase VRE – Solar – Biogas



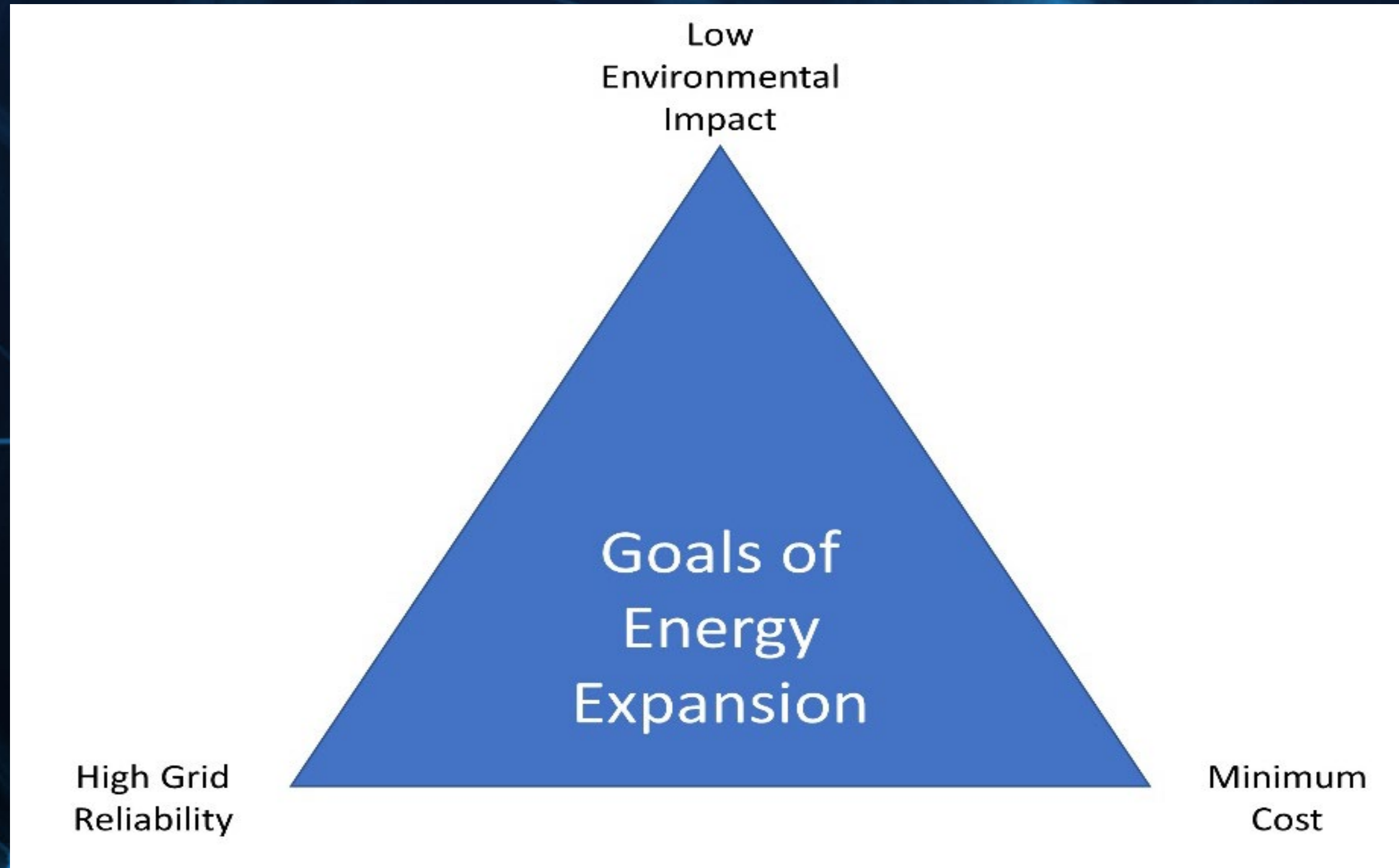


# Breakdown of total energy supply

Energy Balance 2023

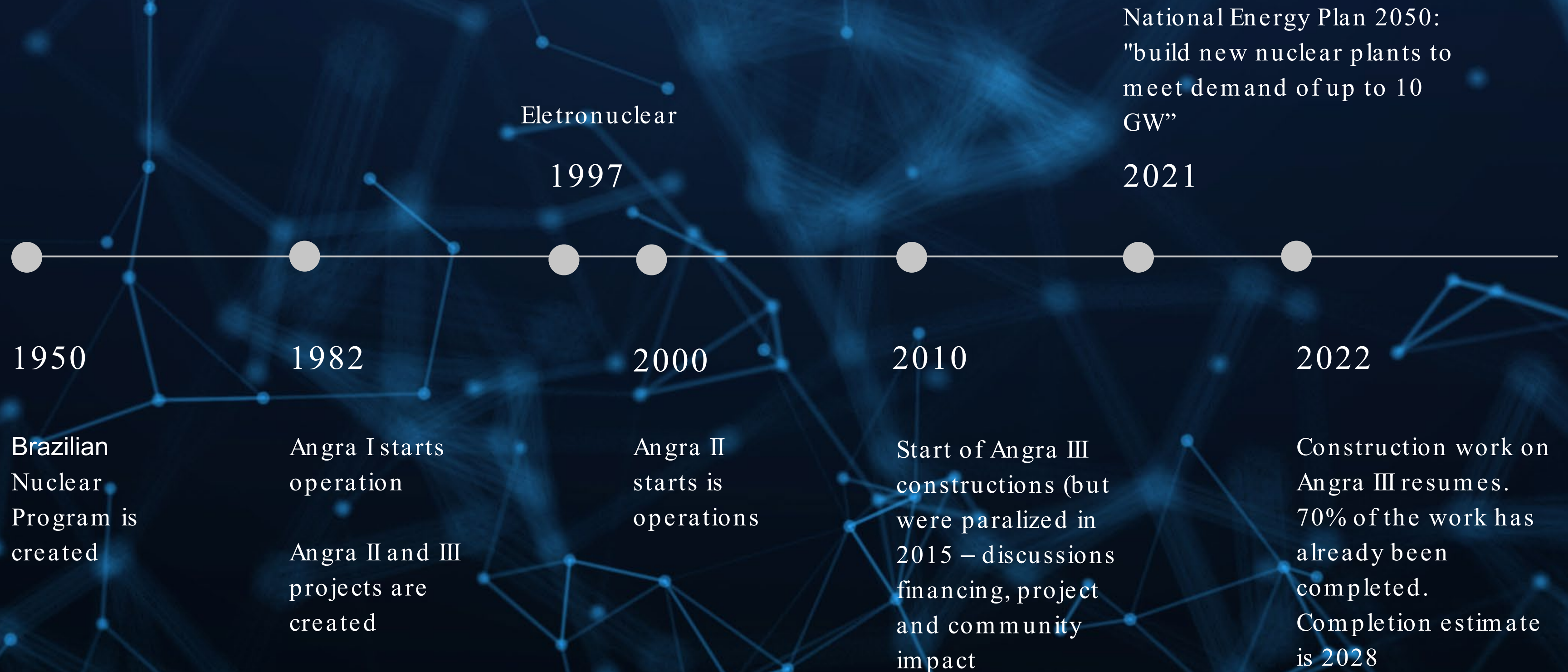


# Energy Expansion : Often-conflicting Goals





# Nuclear Energy in Brazil - History



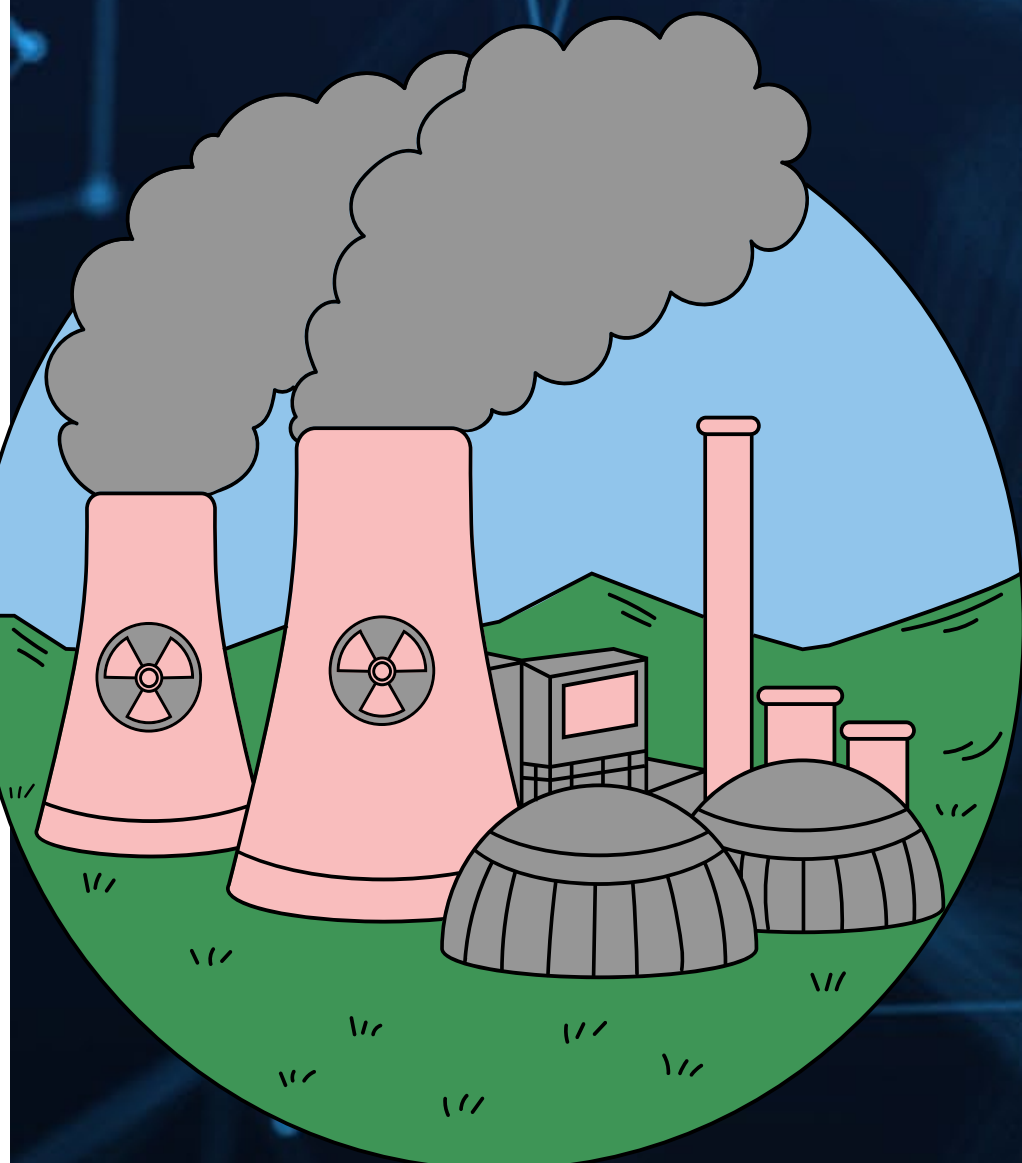


# Nuclear . some numbers

Brazilian Nuclear Share (World)

2.5% of the world production

7th biggest- Global reserves Uranium



Reactors Generation capacity

Angra I 640 MW

Angra II 1350 MW

Angra III

expected 1405 MW

Brazil's National Energy Plan to 2050:

to add 10 GW of nuclear capacity in the next 30 years



# Nuclear energy in Brazil Legislation Highlights

1

The exploration of nuclear energy is exclusive to the Union

Art 49 (exclusive competence of the National Congress). XIV: approve Executive Branch initiatives relating to nuclear activities

Art 177 (constitute a Union monopoly). V: research, mining, enrichment, reprocessing, industrialization and trade of ores and nuclear minerals and their derivatives, with the exception of radioisotopes whose production, commercialization and use may be authorized under a permit regime

Art. 225 (Environment). 6º: Plants that operate with a nuclear reactor must have their location defined in federal law, otherwise they cannot be installed

2

Law No. 4,118/1962 National Nuclear Energy Policy + Legal Monopoly

3

In 2022, control of Eletronuclear passed to Empresa Brasileira de Participações em Energia Nuclear e Binacional S.A. (ENBPar)



# Small Modular Reactors (SMRs)

SMRs are defined as new generation reactors designed to generate electrical energy up to 300 MW.

Each module is independent and can be turned off without affecting other modules

Installation may be nearby to users = can reach remote locations

Demands lower initial capital investment

Demands lower fuel consumption => less generation of radioactive waste

Units and be installed underground or underwater => more protection against natural or human-made hazards



# SMRs: Perspective Application in Brazil

March 2019: Brazil – US : bilateral  
cooperation initiative US-Brazil Energy  
Forum (USBEP).

Evaluation SMRs application in Brazil,



Source: [EPE, 2023](#)



# SMRs: Positive and Negative Aspects in Brazil



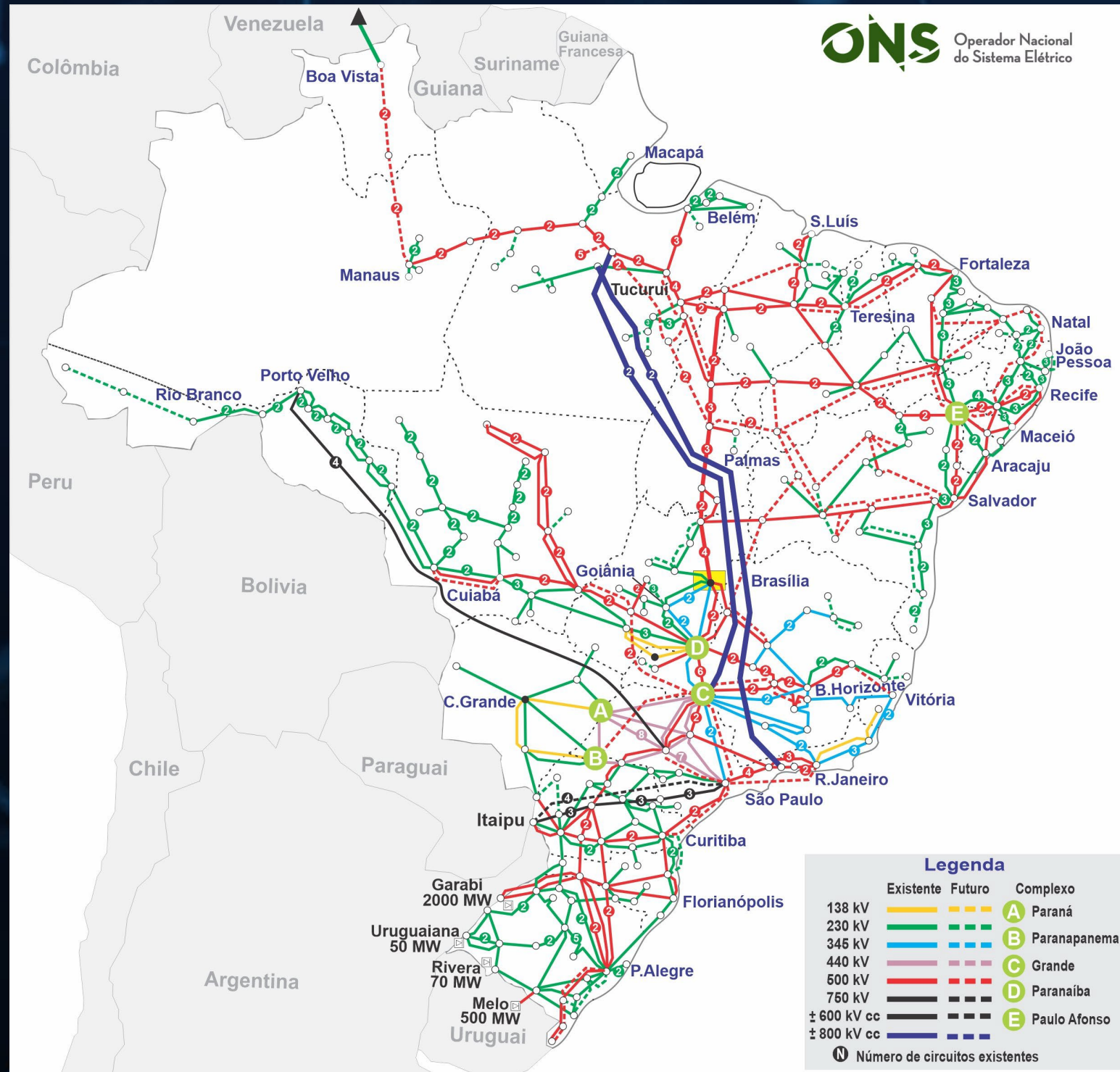
- National Energy Demand and Physical Infrastructure (grid capacity )
- High urbanization rate = SMR good fit size, operation requirements, ability to serve more urban markets
- Sustainable solution for isolated systems (reducing the use of diesel generators)
- Climate Change = meet Brazil's NDC and national 2050 energy plans
- Energy Security = High penetration renewables – wind solar + Less reliability Hydro
- domestic uranium sources - economically extractable



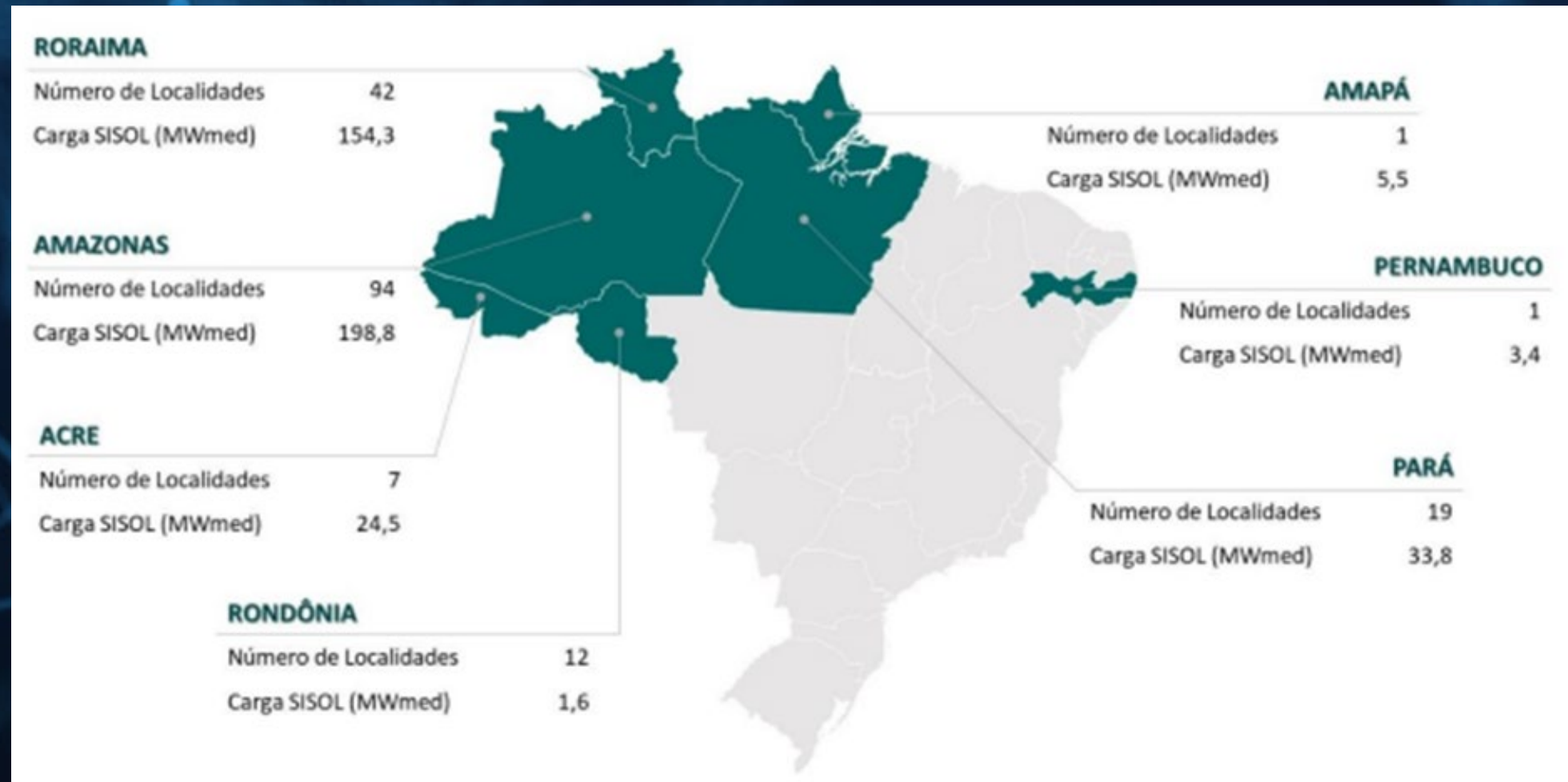
- Financing : Current credit rating of the Brazilian government bonds – Government Financial budget : financing SMR may present a challenge.
- Low energy imports –Low Risk of disruptions - external factors (Ukraine War)
- Alternative Sources: Biogas



## SIN: National Interlinked System



## Isolated Systems



- Low demographic density vs. 40% of the national territory
- 0.6% of Brazilian consumption
- There are currently 176 isolated locations in Brazil
- The North of Brazil consumes 12 billion reais of diesel per year to run isolated systems in the Amazon.



# Amazon Decarbonization Program

- The National Secretariat for Energy Transition and Planning of the Ministry of Mines and Energy.
- Aim: reduce fossil fuels in the generation of electricity
- **Ethanol and biofuels - paths to decarbonization.**
- Increase mix ethanol in gasoline
- Promote Sustainable Aviation Fuel – SAF production, combined with Green Diesel.





# Biogas

“Brazil’s biomethane market value could reach **USD 15 billion by 2040**, taking advantage of waste and by-products from five main industries: **sugarcane, cattle ranching, dairy farming, pork raising, as well as urban waste and sewage.**”

McKinsey & Company (2022),

1

## The potential

Largest biogas potential in the world, ( 84.6 billion Nm<sup>3</sup> of biogas per year.

Potential to supply almost 40% of national electricity demand or replace 70% of Brazilian diesel consumption. ( Abiogas)

2

## Favorable Legislation :

Biofuel of the future Program Renovabio

3

## Current Production

There are **currently 936 plants** in Brazil producing 3,46 bi Nm<sup>3</sup>/year. Largest concentrations are in the States of Paraná , Santa Catarina and São Paulo



# To Consider:

- Should Brazil expand investment in Nuclear ?
- SMR : Direct, indirect, induced and multiple effects
- Reliability issues : Baseload capacity
- Alternative to remote areas?
- Technology investment ?
- Optional sources ?



# What to expect?

## NOTE:



- Coupling nuclear energy to markets other than electricity, such as industrial process heat, hydrogen production, and desalination
- Bilateral cooperation agreements between companies or countries with extensive nuclear experience (USA and France, i.e)



# THANK YOU

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