



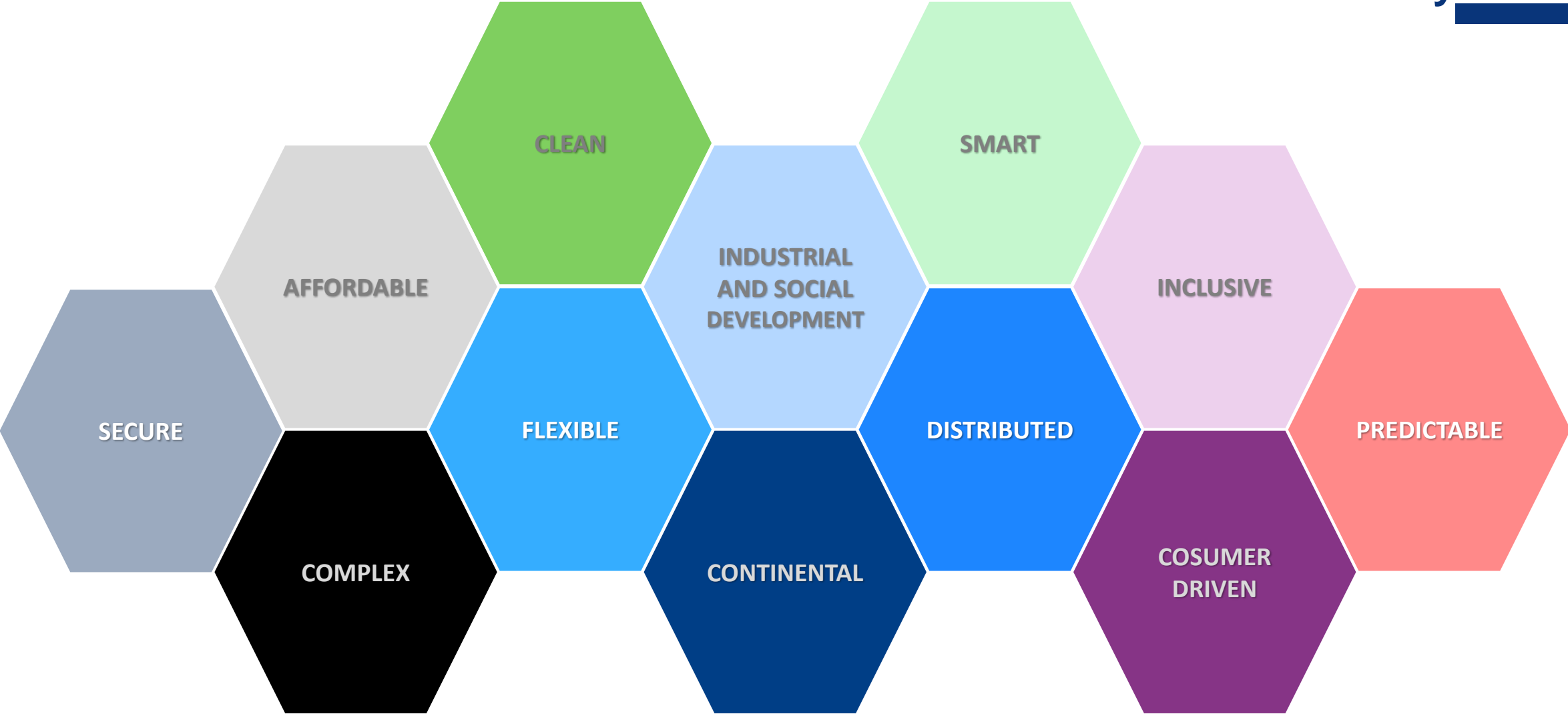
# **BRAZILIAN ELECTRICITY MATRIX**

**Challenges of the the Growth and  
insertion of CLEAN energy sources**

André Salgado

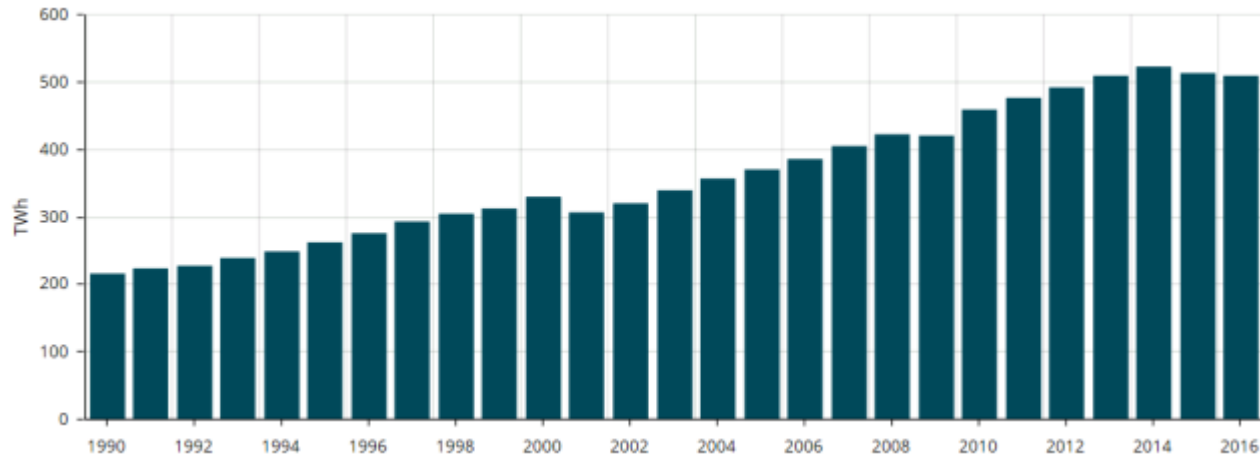
*August 2018*

# Global and Local challenges for the electricity sector

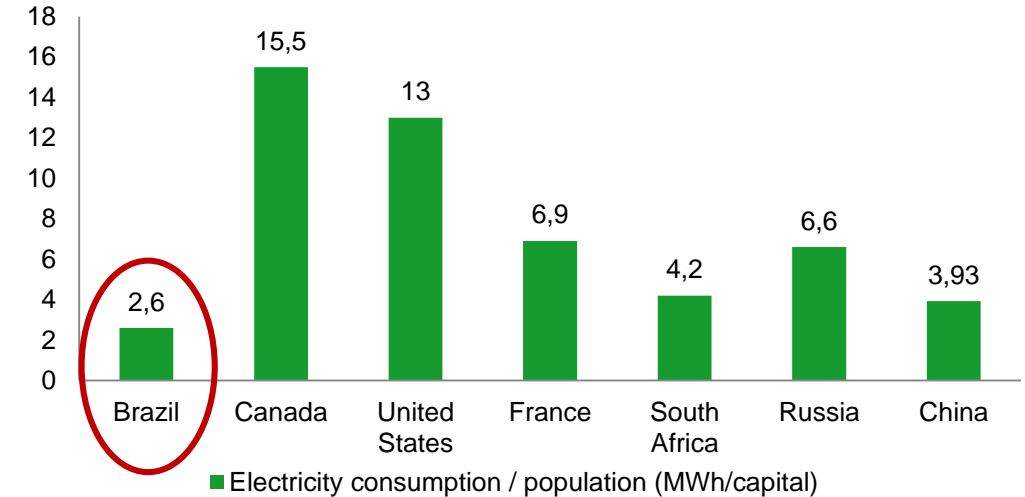


# Demand vs Social and Economical development

Brazil's electricity demand evolution (1990-2014)



Electricity consumption per capita 2015 (KWh)



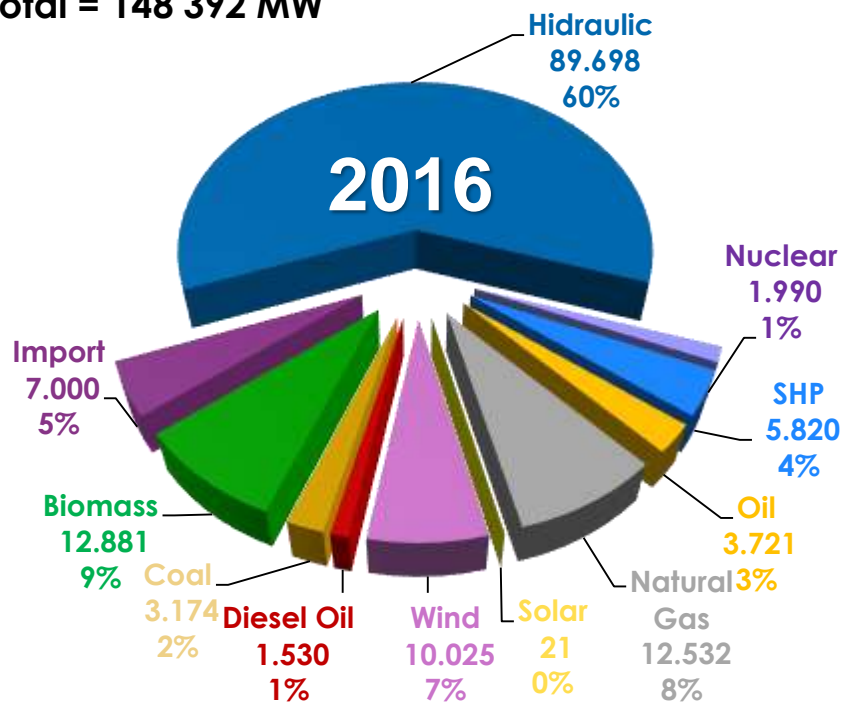
- Even if the economic slowdown of Brazil decreased the electricity consumption in 2015 & 2016, the **electricity demand doubled since 1990** and **will continue increase with the rebound of economic growth**;
- **Brazil still has a long way** to reach the electricity consumption levels of other developing or developed countries, and needs to get prepared for it;



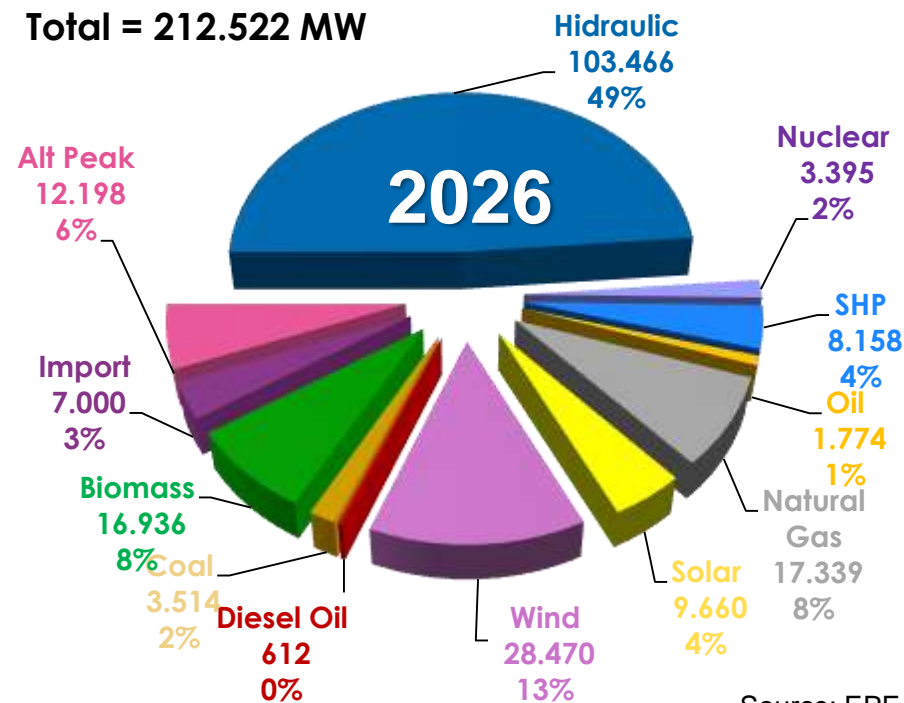
**Electricity consumption will grow driven by the economic and social development !**

# 2016 vs 2026: Energy Mix - Installed Capacity

Total = 148 392 MW



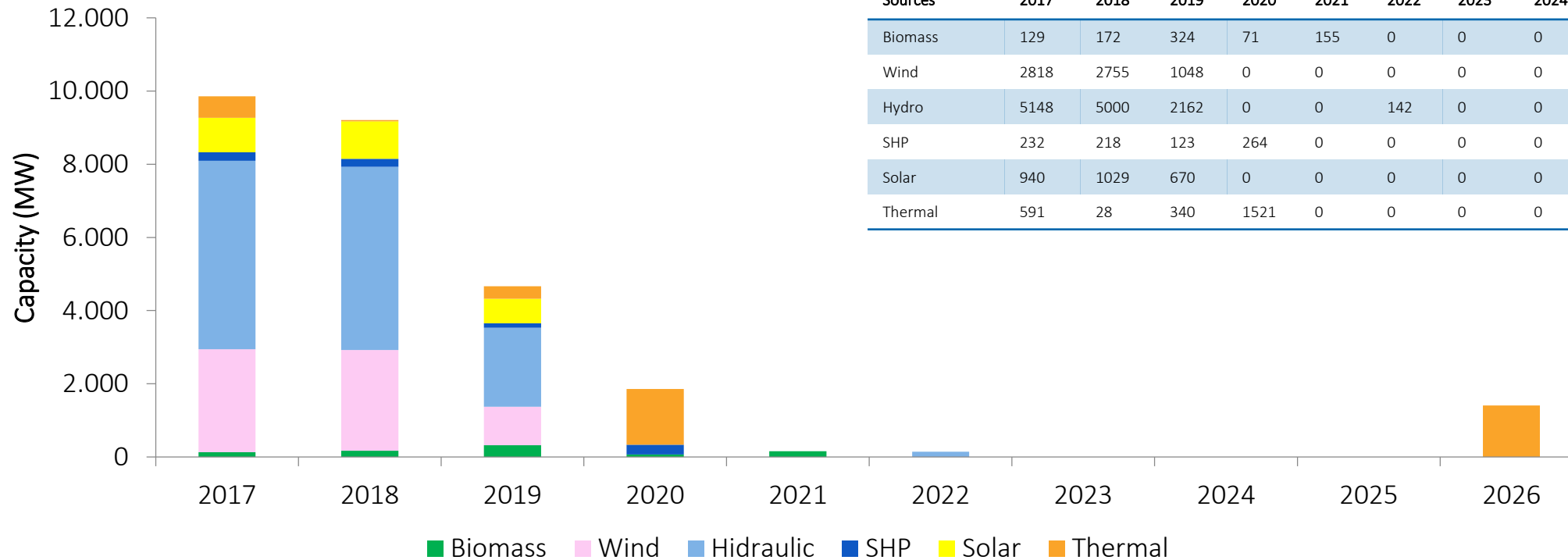
Total = 212.522 MW



Source: EPE PDE 2026

- Major contribution for the Growth coming from clean sources : Wind (18,5 GW), Hydro ( 13,7 GW) and Solar (9,6 GW);
- Fossil sources expected to grow 14,5 GW, from which 12,2 GW (6%) coming from “Alternative to peak” generation;

# Potencia Contratada / fonte



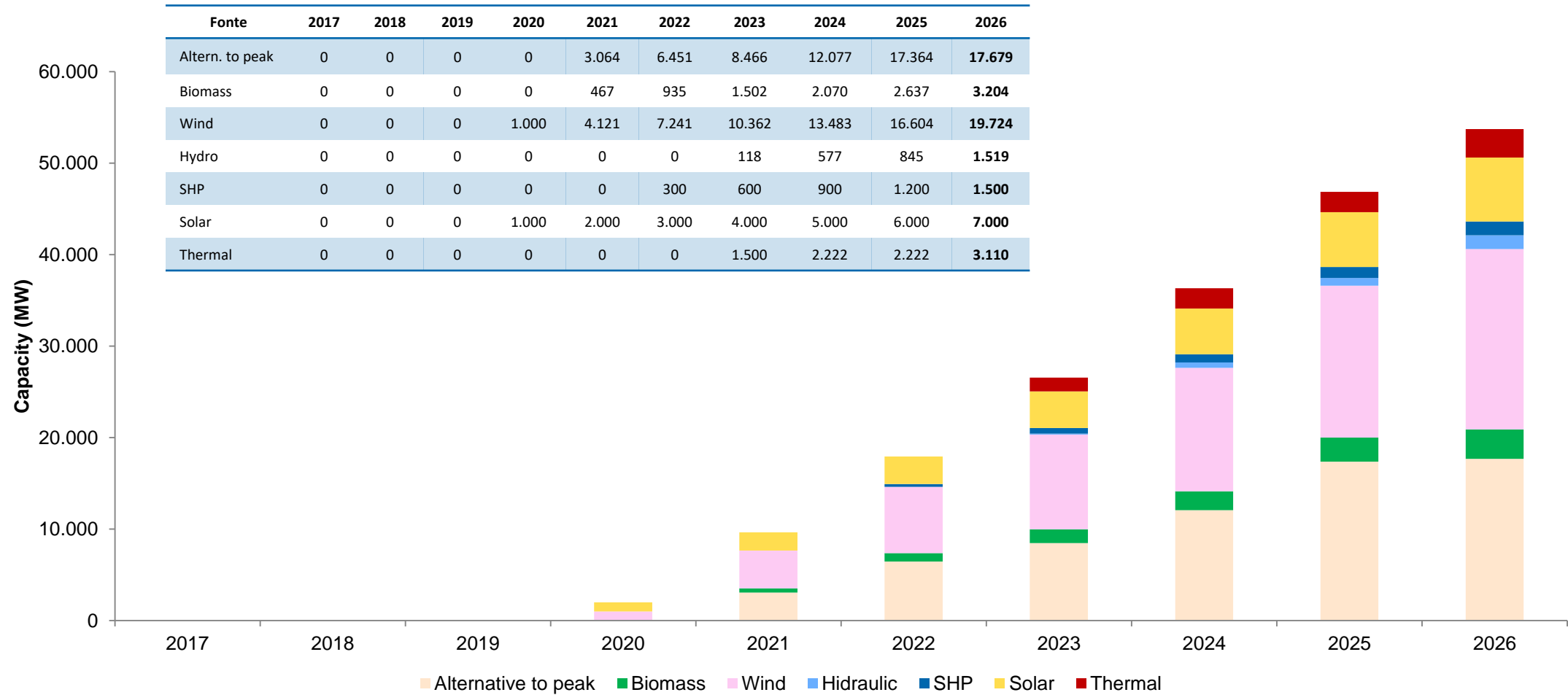
Sources	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	TOTAL
Biomass	129	172	324	71	155	0	0	0	0	0	<b>851</b>
Wind	2818	2755	1048	0	0	0	0	0	0	0	<b>6621</b>
Hydro	5148	5000	2162	0	0	142	0	0	0	0	<b>12452</b>
SHP	232	218	123	264	0	0	0	0	0	0	<b>837</b>
Solar	940	1029	670	0	0	0	0	0	0	0	<b>2639</b>
Thermal	591	28	340	1521	0	0	0	0	0	1405	<b>3885</b>



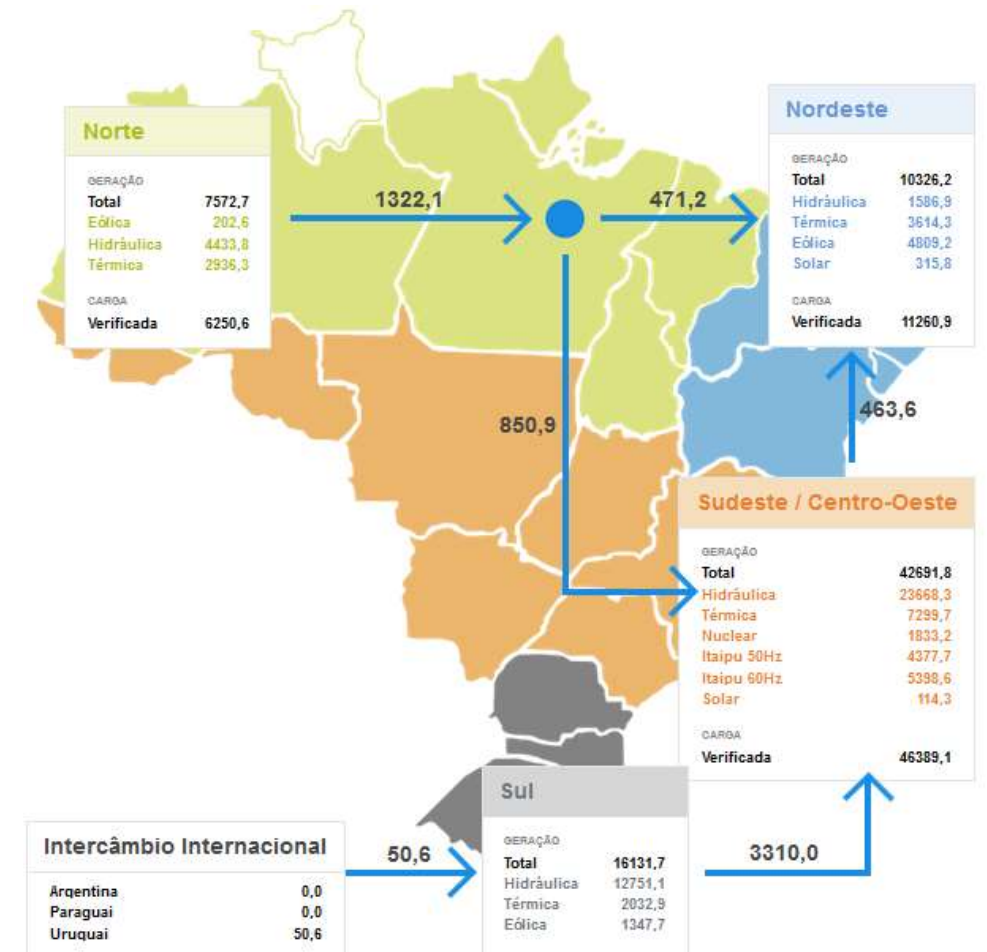
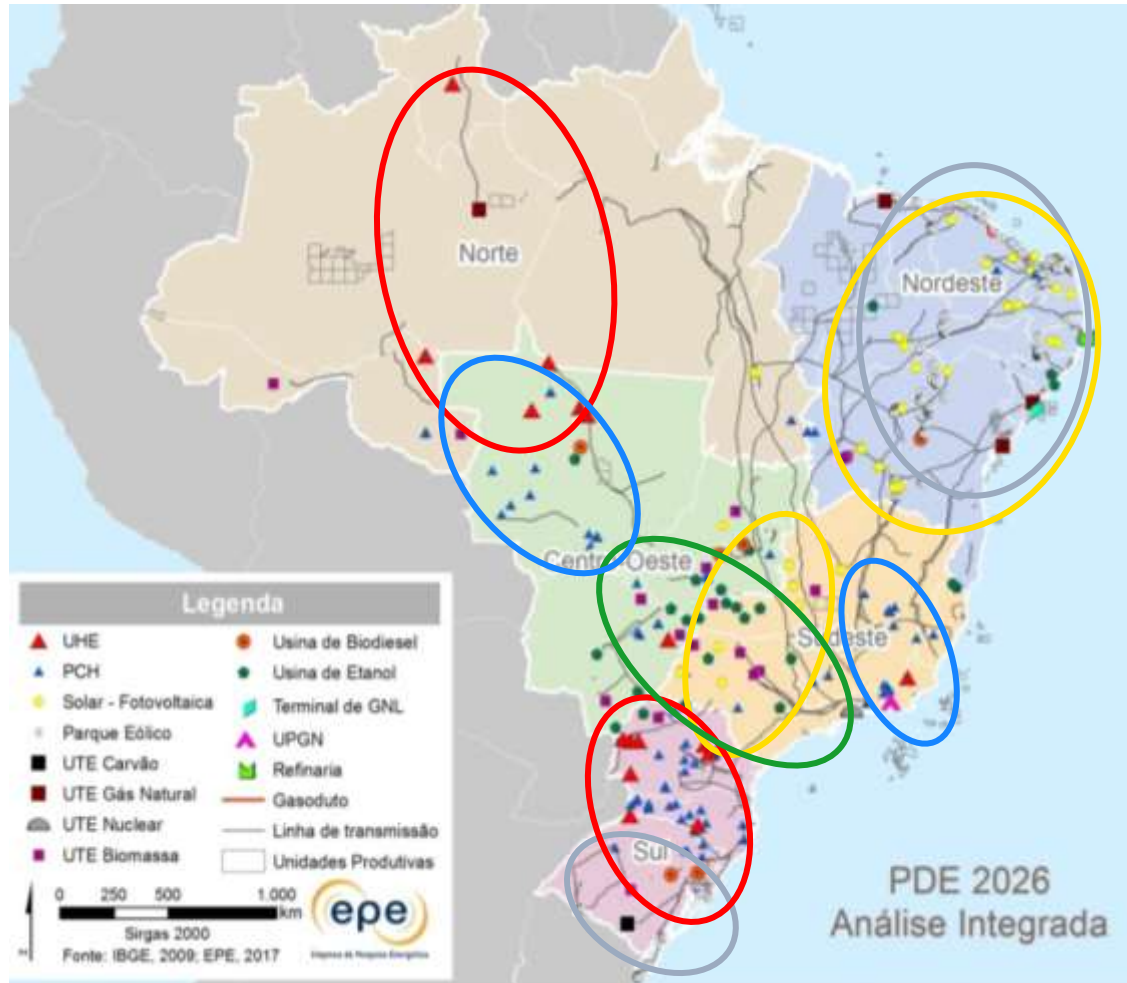
**3885 GW already contracted from the 64 GW forecasted Growth;**

Source: EPE - PDE 2026

# Expansão prevista/fonte

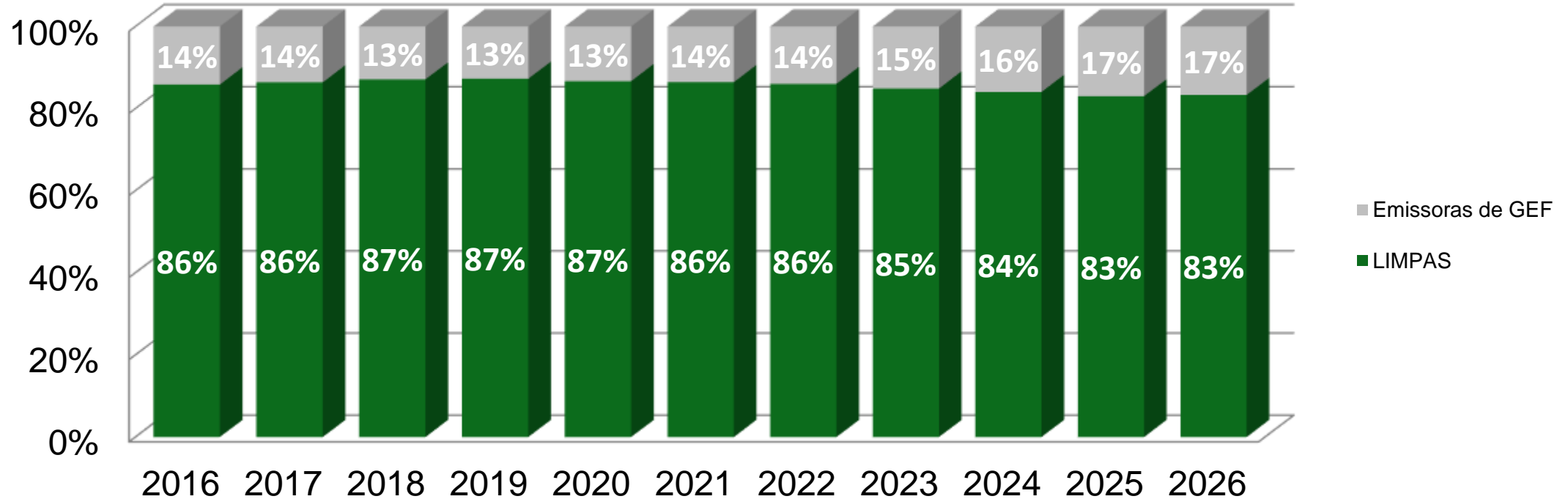


# Regional “potentials” / Energy Flow



Source: ONS

# Participação Fontes LIMPAS

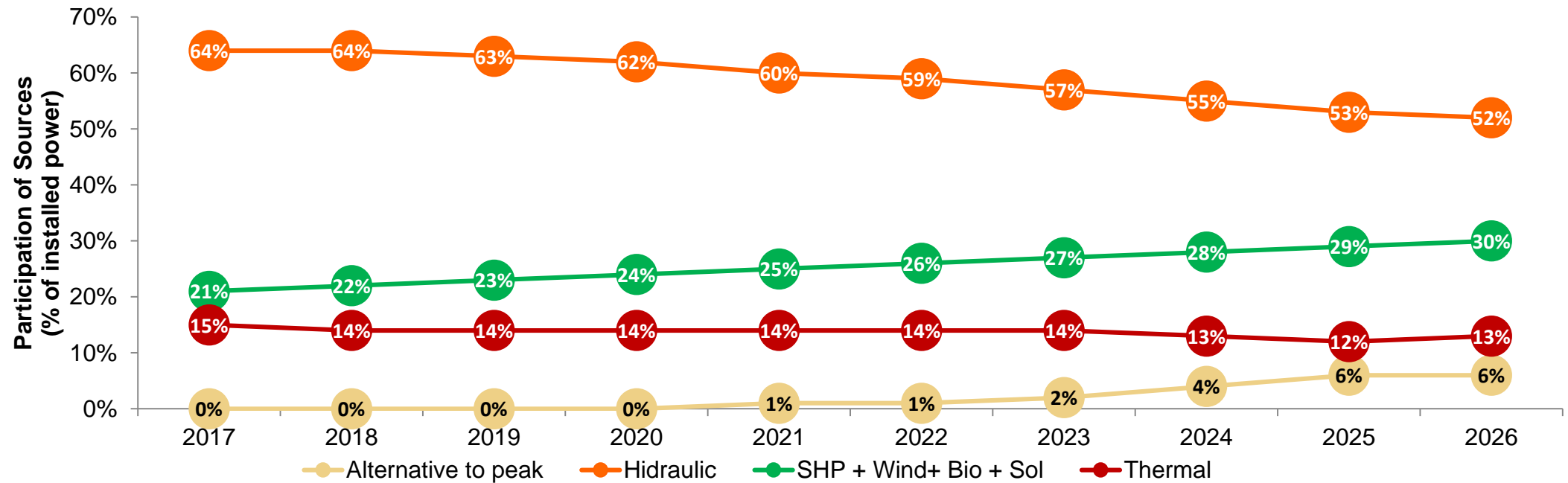


Stability of CLEAN Sources in the Matrix !

Source: EPE PDE 2026



# Reference Scenario – Generation Expansion

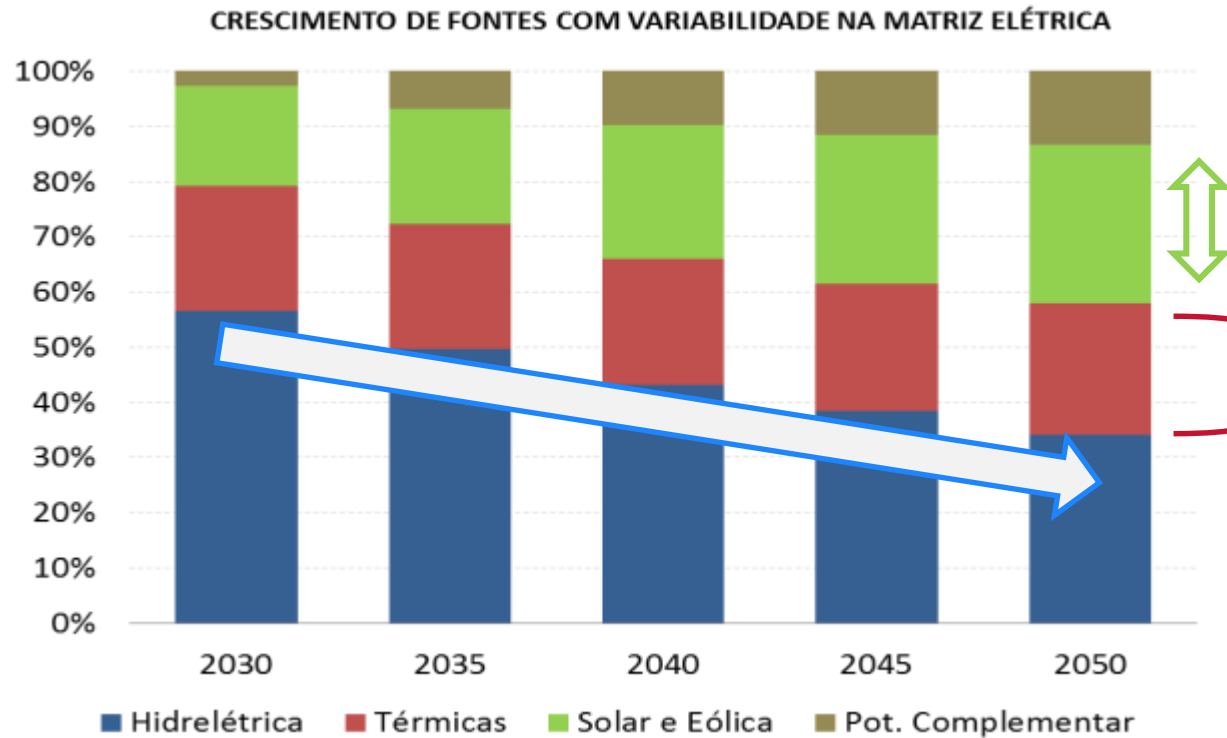


- Growth in share of the Intermittent sources and reduction of the Hydro share;
- Hydro storage capacities are also reducing;
- Thermal capacity remains approximately constant;

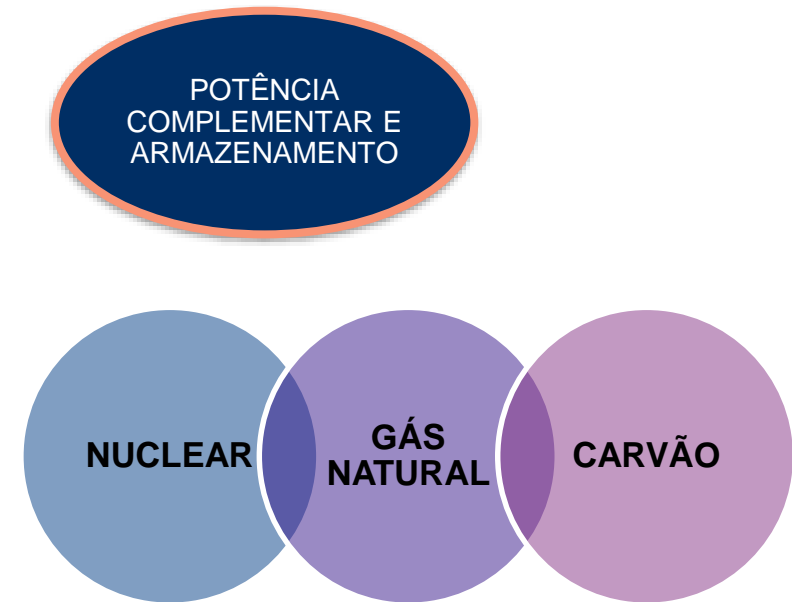
➤➤ **Need of Thermal sources to act as Base Load !!**

Source: EPE PDE 2026

# Perspectivas de Longo Prazo



Fonte: EPE



**Crescente necessidade de geração de base e complementar !**

# WHY NUCLEAR ?

NUCLEAR  
is ...

***Strategic***

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***Affordable / Competitive***

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***Reliable***

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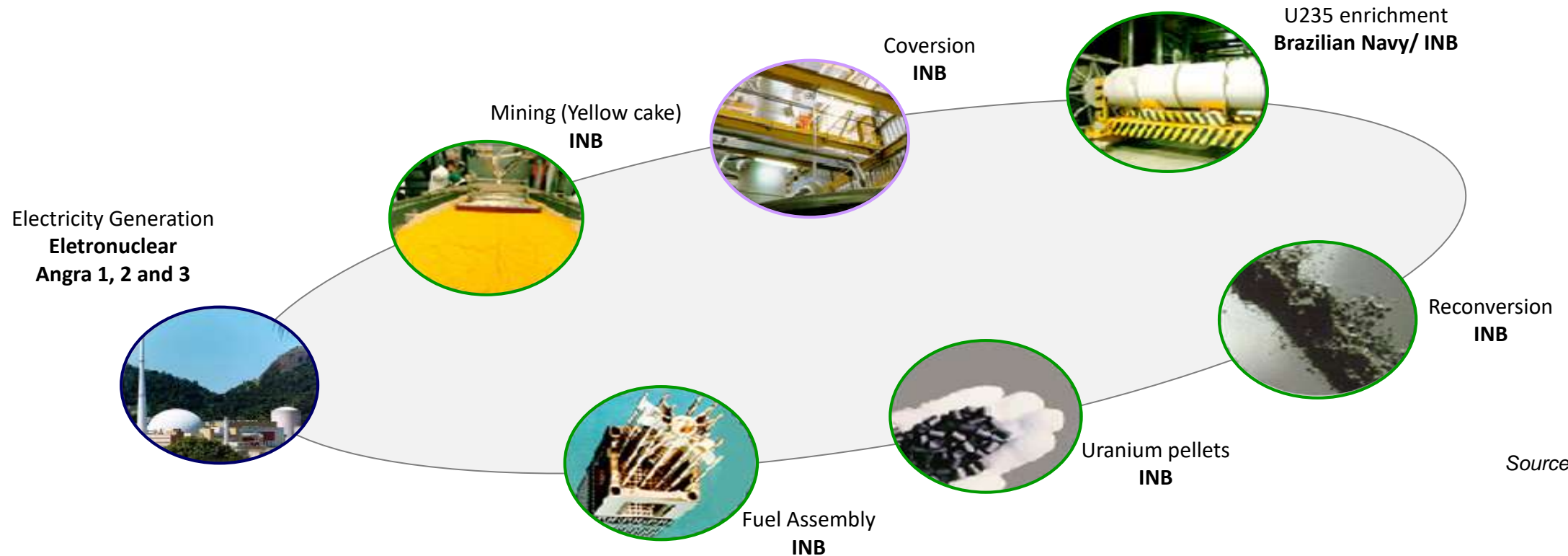
***Safe***

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***CLEAN***

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# Brazil masters the nuclear cycle for Power Generation

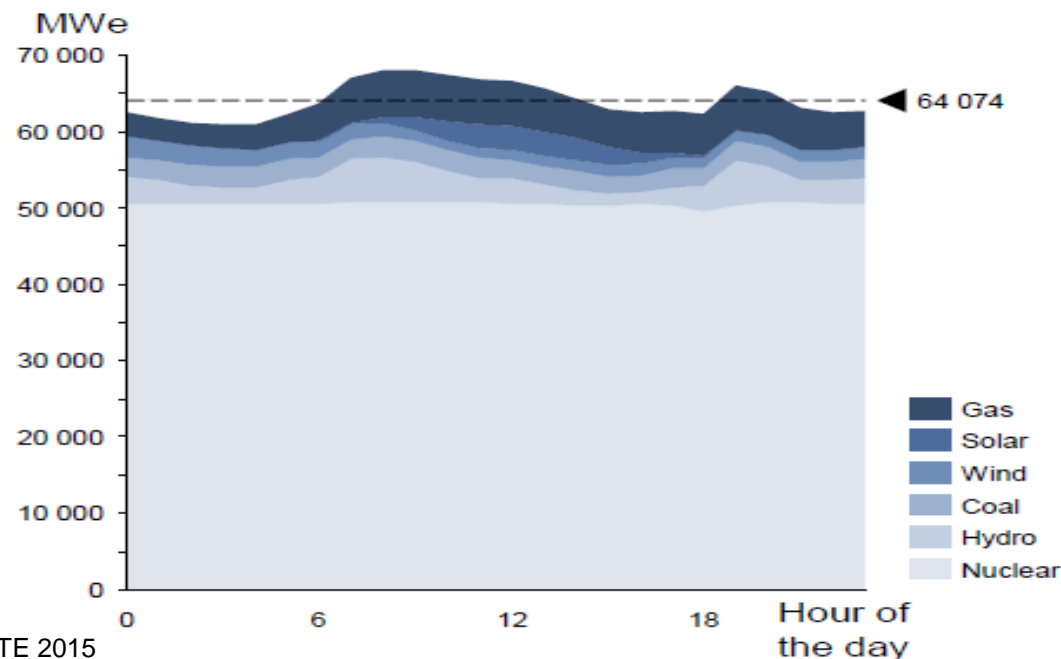


Source: INB

- 6th highest resources of Uranium in the world and only 30% of the territory has been prospected;
- Expertise along the whole uranium value chain for Power Generation;

# Nuclear power allows security of the grid by covering baseload needs

## Typical daily electricity production in France



Source: RTE 2015

## Key facts

- Nuclear energy provides stable and predictable electricity production, on a large scale
- Nuclear capacities allow to cover baseload needs
  - Nuclear energy does not depend upon regular fuel supply or climate conditions, and has an excellent plant availability factor
  - Once reloaded, a nuclear plant can run non stop up to 24 months before outage for reload
  - Modern nuclear power plants have short outage durations

- France which has the highest part of nuclear, has the lowest price of electricity in Europe;
- Nuclear allows economic and workforce development by creating 3 times as many local jobs as competing technologies.



**Nuclear can also operate in Load Follow !**

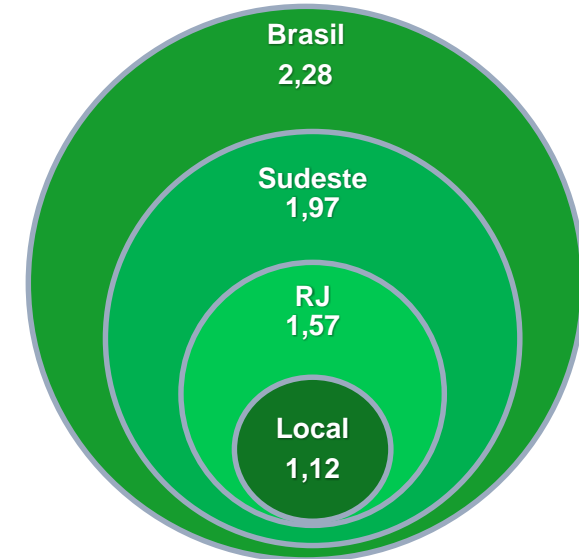
# FGV study – Impacts of a New NPP

Resultados ao Nível Nacional (R\$ Milhões)

	Variáveis	Direto	Indireto	Induzido	Total	Multiplicador
Orçado	PIB	4.496	2.364	3.356	10.216	2,27
	Impostos*	509	322	423	1.253	2,46
	Salários	1.505	692	1.053	3.249	2,16
	Emprego (vagas)	214.263	101.743	199.138	515.144	2,4
Realizado	PIB	1.197	640	894	2.731	2,28
	Impostos*	135	88	112	335	2,48
	Salários	395	188	281	863	2,18
	Emprego (vagas)	58.098	27.287	53.105	138.490	2,38

Fonte: Elaboração FGV.

\*Líquido de subsídios às empresas; não inclui contribuições previdenciárias



Multiplicadores do PIB

- In 2015 FVG prepared a study that evaluates the impact of the construction of 1 New Nuclear Power Plant in Brazil – Angra 3 has been used as the case study;
- Huge impacts in jobs creation and in the GDP compared with other sources;



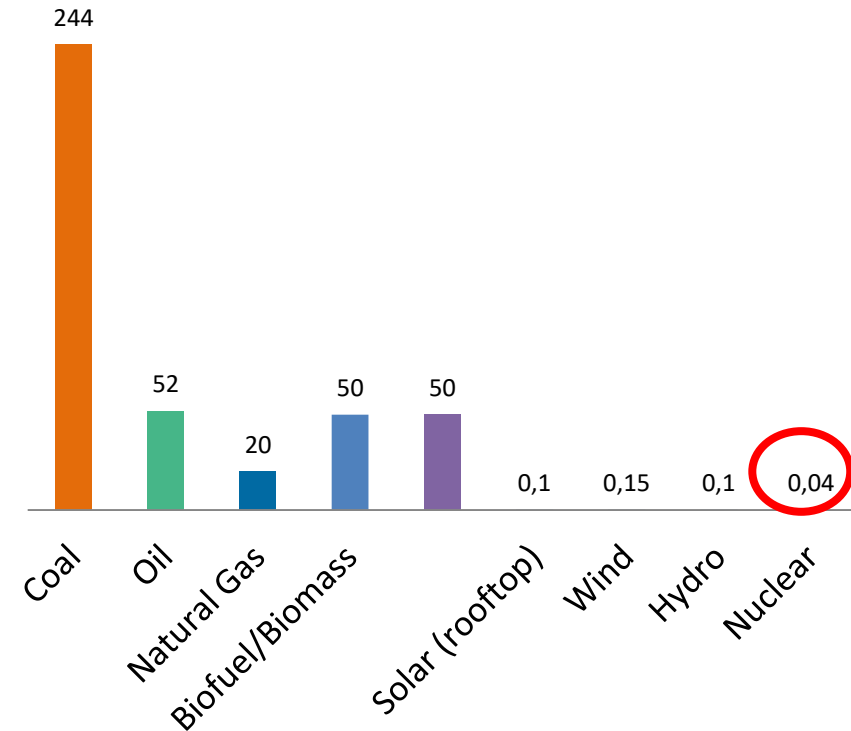
Investing in Nuclear will maintain the Expertise, create jobs and bring economical development !

# Nuclear is safe ...



- Nuclear is the power generation technology with the **lowest number of death/TWh produced** and is the most controlled power generation technology:
  - IAEA Safety standards: framework for protecting **people** and **environment**;
  - Key sensitive topics overseen by international conventions;
  - The support of IAEA at each step of a nuclear program ensure the **highest level of safety**.

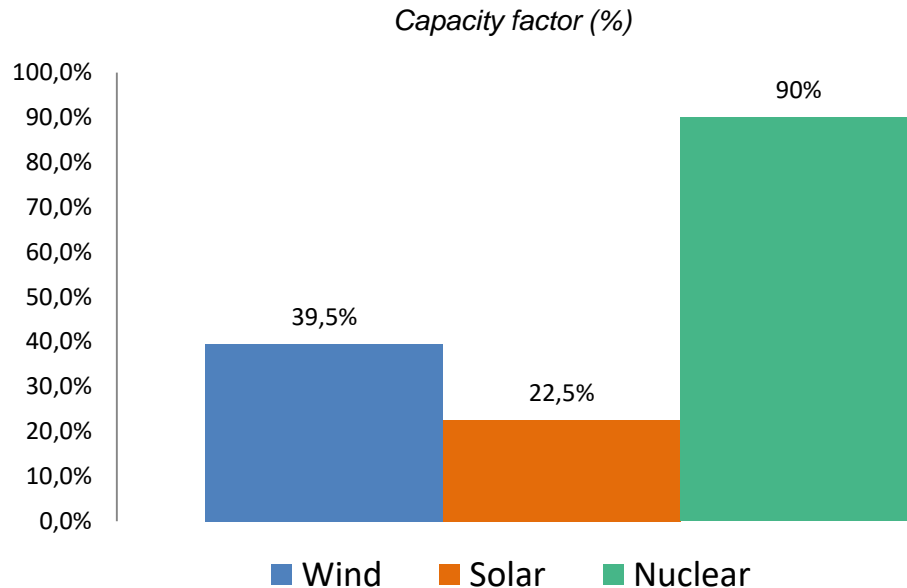
Number of deaths per TW/h produced per energy production



Source: The Next Big Future, 2016

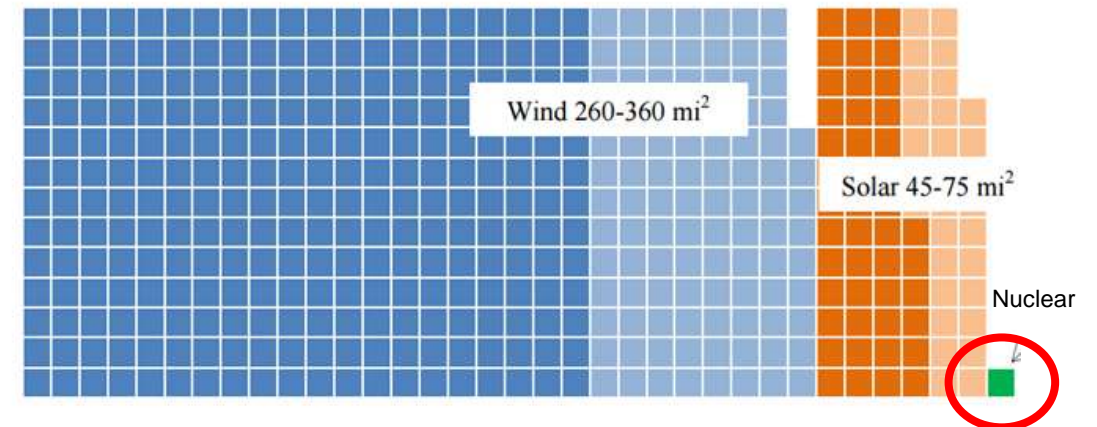
# Nuclear is sustainable and...

...Effective



...for low land use

The graph summarizes the approximate land required by wind and solar technologies to match the electricity produced annually by a 1.000-MW nuclear plant

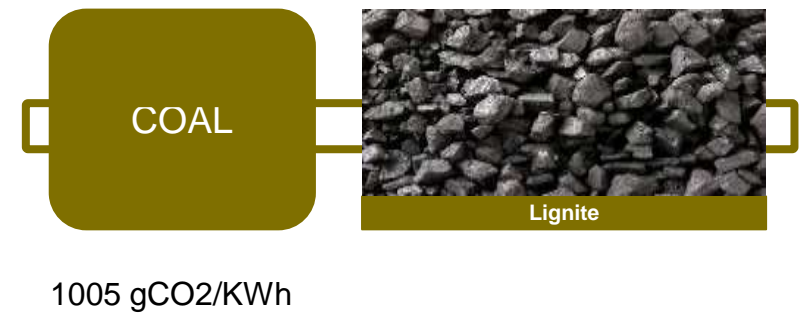
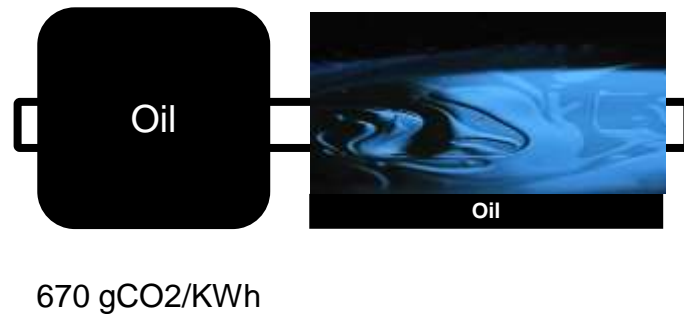
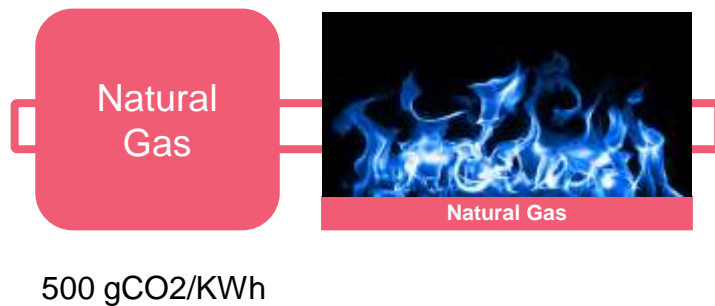



Source: NEI Data

- In opposition to other clean energy sources, **nuclear does not depend on weather** and register a **much higher capacity factor** that could compensate hydropower seasonality in Brazil;
- Compared to Solar and Wind, nuclear technologies use very few land and **can be installed close to consumption centers**.



# Nuclear is CLEAN





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