



SYMPOSIUM

2024

JULY, 15 TO 18

RIO DE JANEIRO

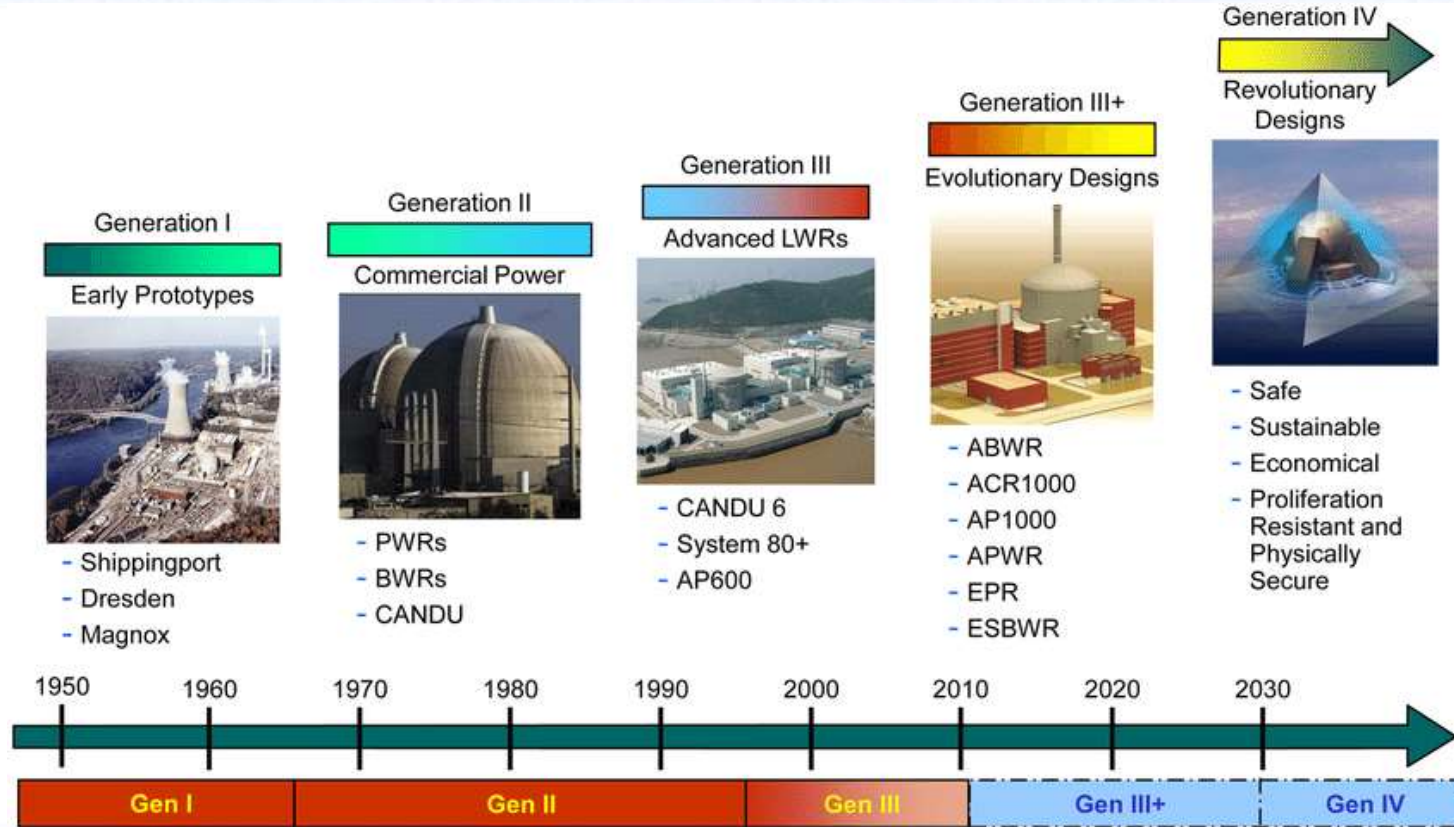
BRAZIL

ROUND TABLE 5: INDUSTRIAL SUPPORT FOR ENERGY TRANSITION

JOÃO DA SILVA
GONÇALVES

INB

NUCLEAR FUEL CYCLE



POWER DENSITY?



1KG		10t		20t
NATURAL URANIUM	=	CRUDE OIL	=	COAL

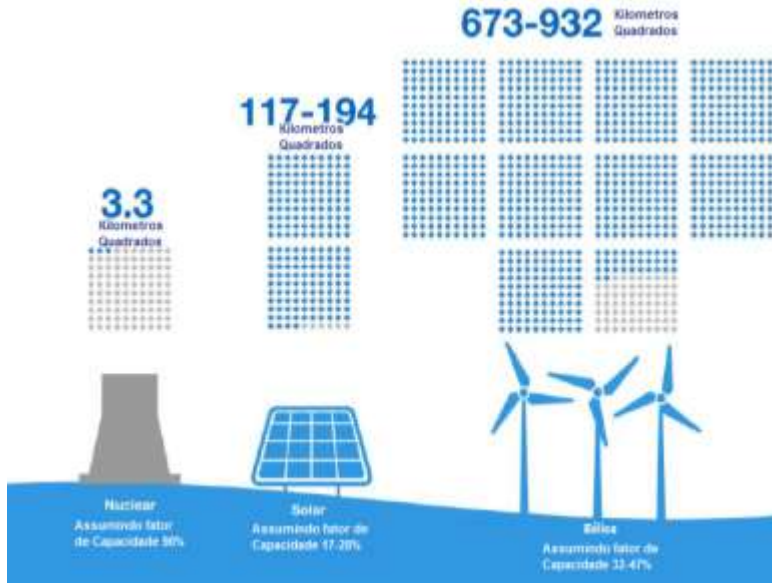


INDUSTRIAL SUPPORT TO JOINT TO!

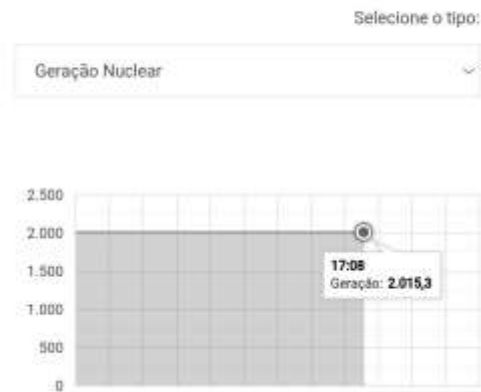


INDUSTRIAL SUPPORT TO JOINT TO!

Area needed for 1 Gw generation [km²]

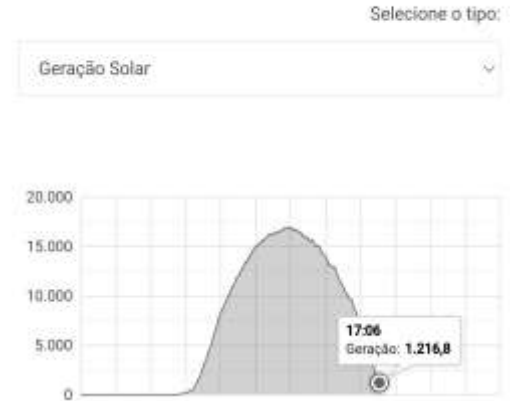


Curva de Geração (MW)



Steady Generation

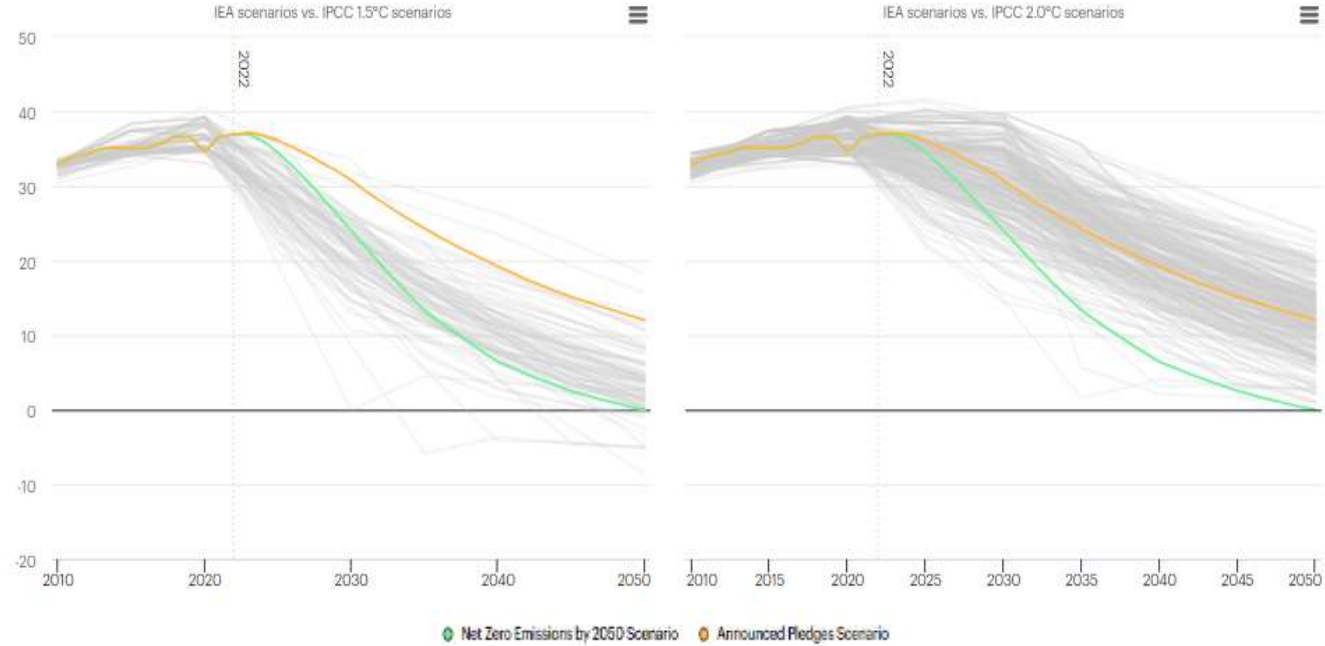
Curva de Geração (MW)



Unstable and Fickle Generation

STRAIGHT TO THE POINT!

Gt CO2



Intergovernmental Panel on Climate Change (IPCC)

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COP 28 – UAE DUBAI DECEMBER 2023

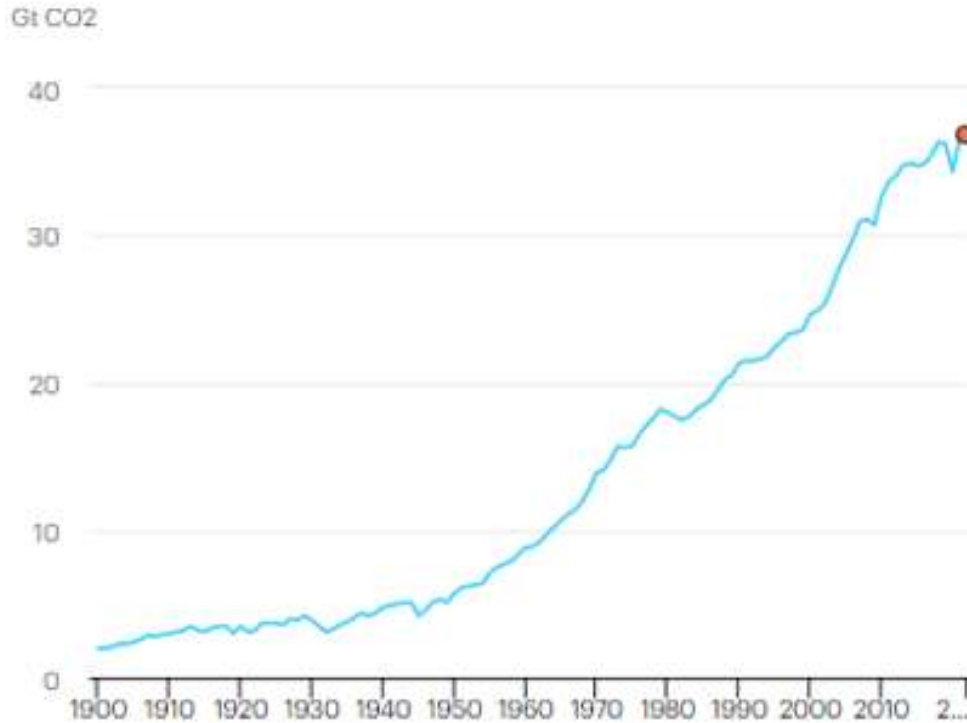


Plenária final da COP28, em Dubai, nos Emirados Árabes Unidos. Foto: Christopher Pike/UNFCCC

The COP28, the UN climate conference, ended in Wednesday (13/12) in Dubai, in the United Arab Emirates, place an agreement that proposes for the first time the **"transition towards the end of fossil fuels"**. The text requires countries to change their energy systems **"in a fair, orderly and equitable manner"**.

The document also urges the convention's 198 member countries to **"accelerate action in this critical decade to achieve carbon neutrality by 2050, according to science"**.

CO₂ EMISSIONS IN 2022: GROWTH IN EMISSION



Global CO₂ emissions from energy combustion and industrial processes, 1900-2022

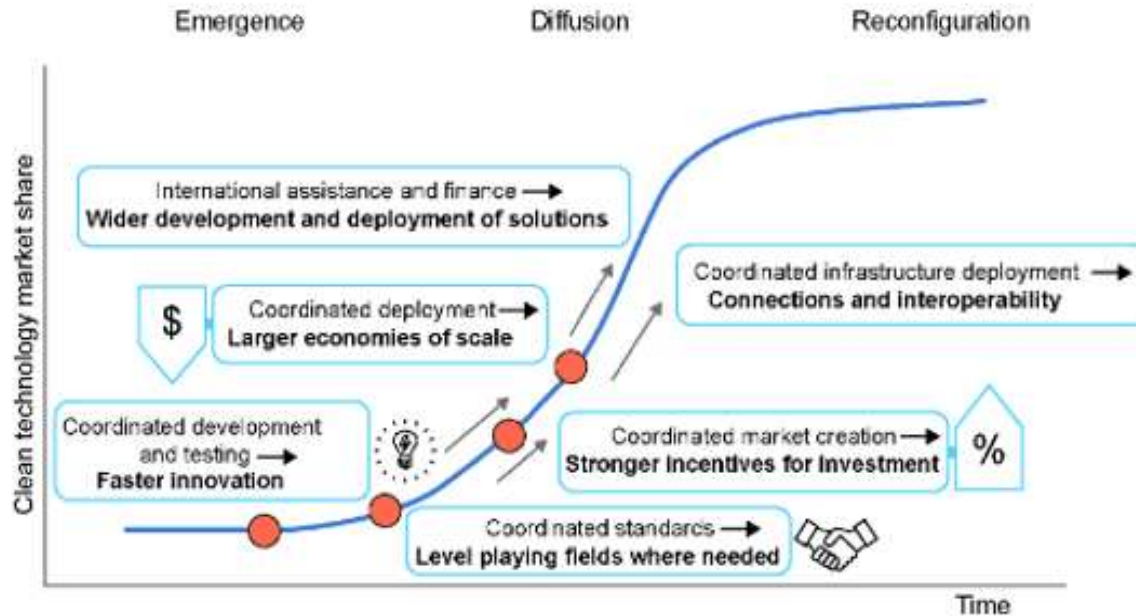
“...global growth in emissions was lower than feared, despite gas-to-coal switching in many countries. ...”

Global energy-related CO₂ emissions grew by 0.9% or 321 Mt in 2022, reaching a new high of over 36.8 Gt.

Emissions from energy combustion increased by 423 Mt, while emissions from industrial processes decreased by 102 Mt.

Increased deployment of clean energy technologies such as renewables, electric vehicles, and heat pumps helped prevent an additional 550 Mt in CO₂ emissions.

WHAT'S NEEDED!



“...Stronger international cooperation in high emissions sectors crucial to get on track for 1.5C climate goal

...”

In the past year, only modest progress has been made in strengthening international collaboration in the areas where it is most needed.

But much more progress is needed in **aligning policies to create demand for clean technologies, and in establishing dialogue on trade in sectors where this is likely to be critical to the transition.**

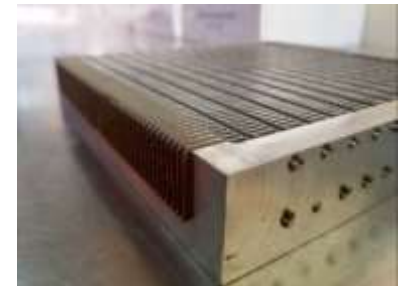
MATERIALS PRICES: THE TRENDS AND RECENT IMPACTS

Nickel 5Y Historical data



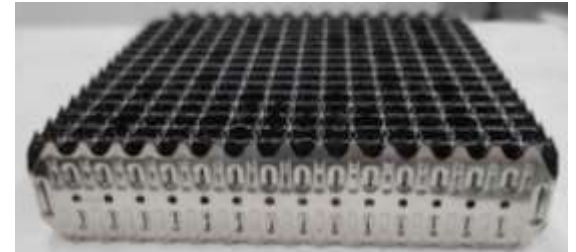
Work to install Rooppur 1's core barrel was completed in May 2023 (Image: Rosatom)

MATERIALS PRICES: THE TRENDS AND RECENT IMPACTS



Programa Nacionalização INB

MATERIALS PRICES: THE TRENDS AND RECENT IMPACTS



Programa Nacionalização INB

MATERIALS PRICES: THE TRENDS AND RECENT IMPACTS



Tiras simples



Tiras duplas

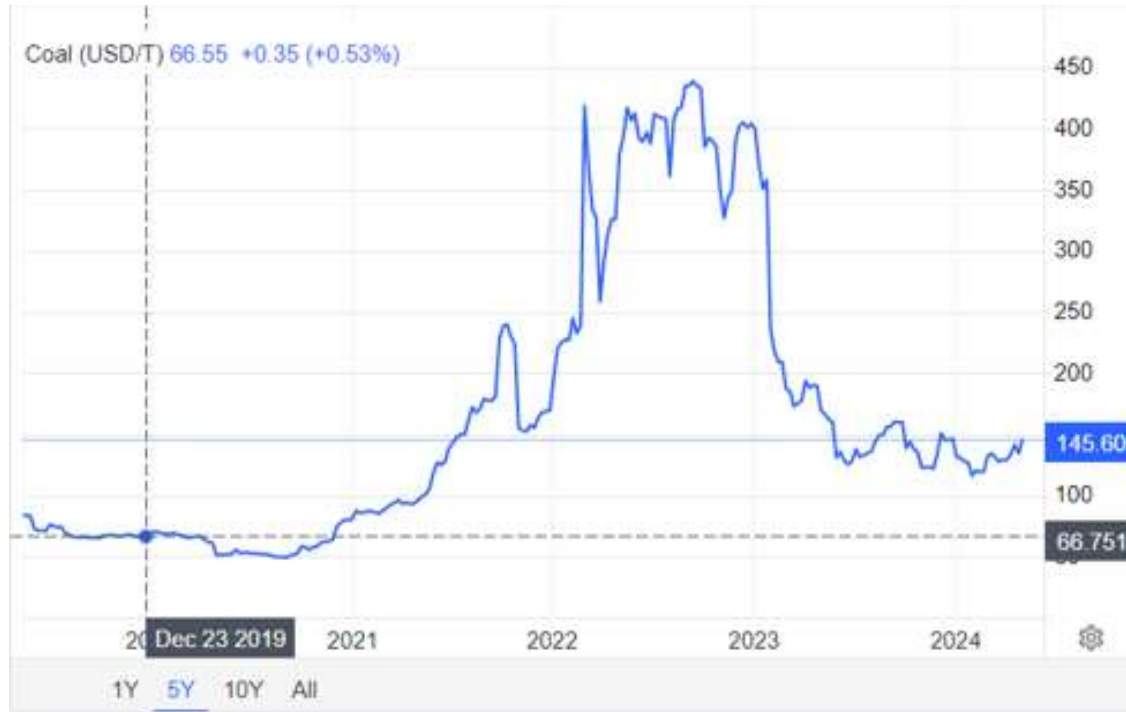


Grade



Programa Nacionalização INB

MATERIALS PRICES: THE TRENDS AND RECENT IMPACTS



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MATERIALS PRICES: THE TRENDS AND RECENT IMPACTS



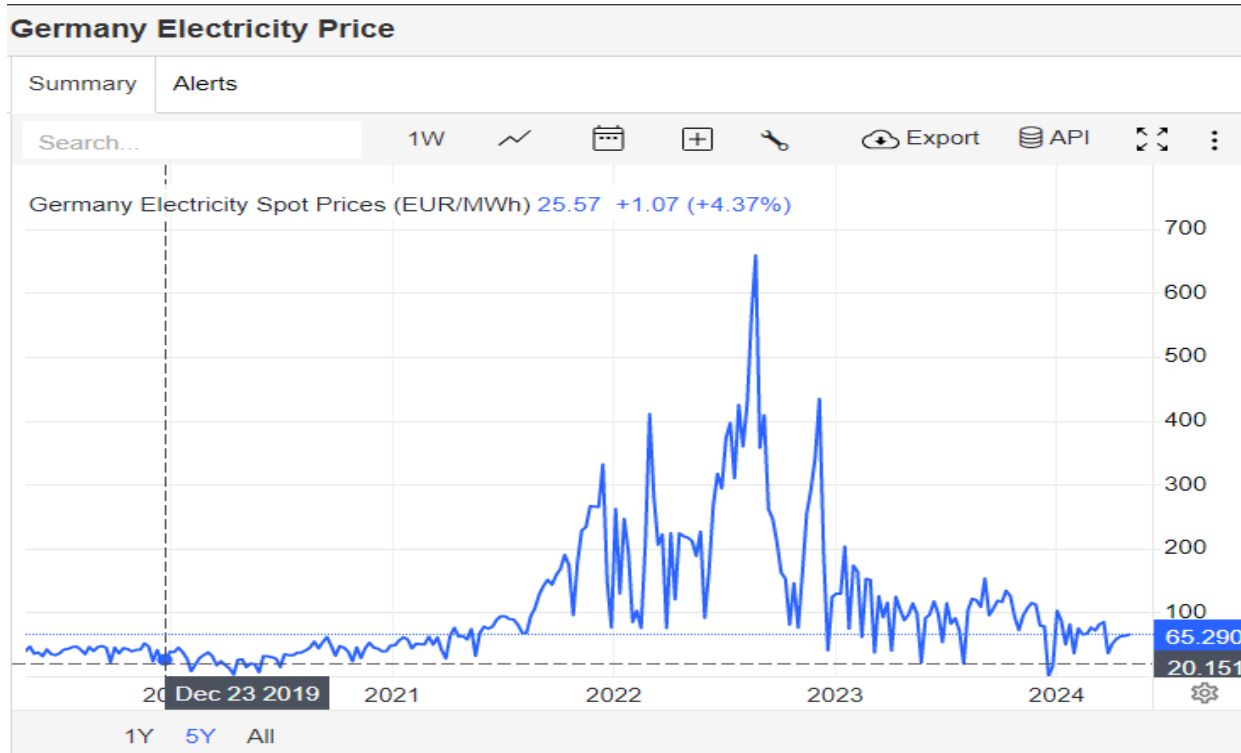
- Exploration Project
- ▲ Project under development
- ⚒ Operations
- ▲ Depleted Mine

(ref: internal INB reports)

Resources and Potential of Mineralization

Deposits	Tonnes of U ₃ O ₈		
	Measured & Indicated	Inferred	Total
Caetité	51,520	35,569	87,089
Santa Quitéria	75,010	4,614	79,624
Others	39,500	26,600	66,100
TOTAL	166,030	66,783	232,813
Potential of Mineralization: Pitinga/AM 150,000 t U ₃ O ₈			
Rio Cristalino/PA 150,000 t U ₃ O ₈			

ENERGY PRICES: THE TRENDS AND RECENT IMPACTS

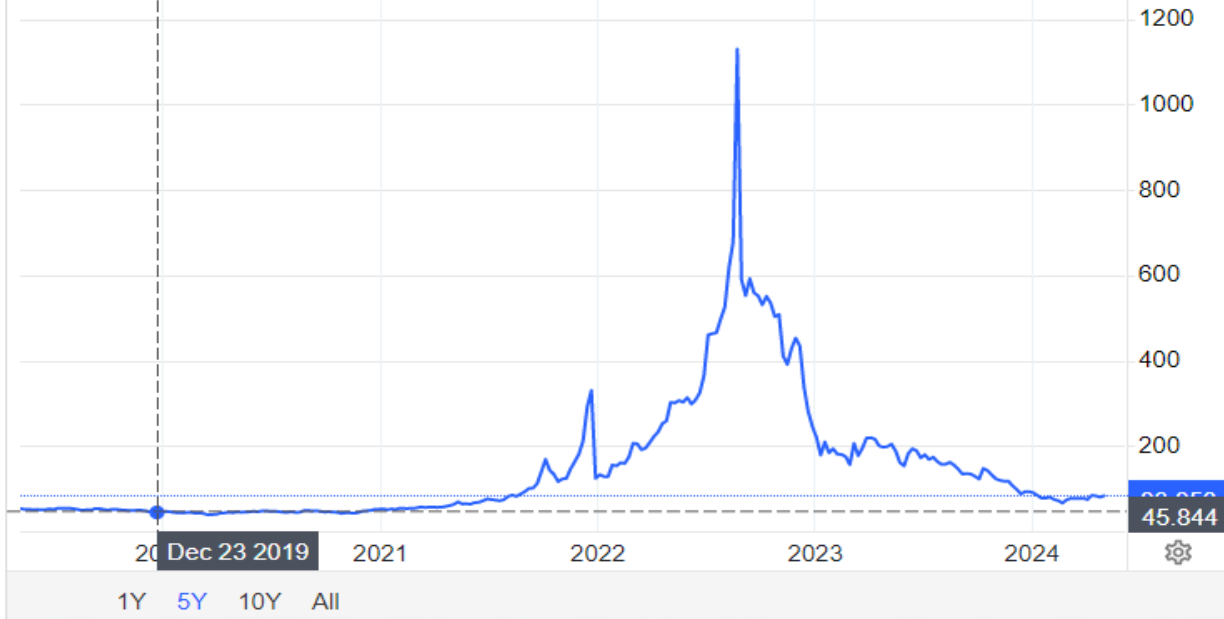


ENERGY PRICES: THE TRENDS AND RECENT IMPACTS

France Electricity Price

Summary Alerts

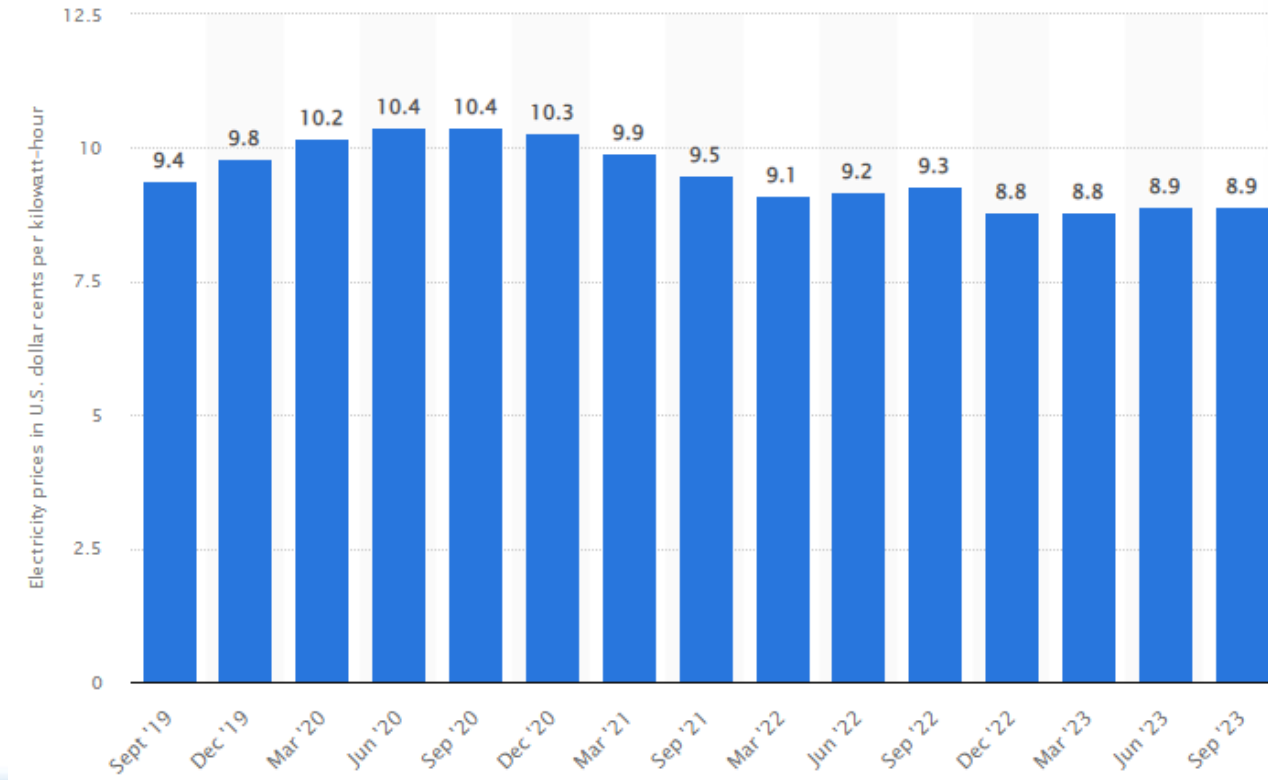
France Electricity Spot Prices (EUR/MWh) 44.06 -1.64 (-3.59%)



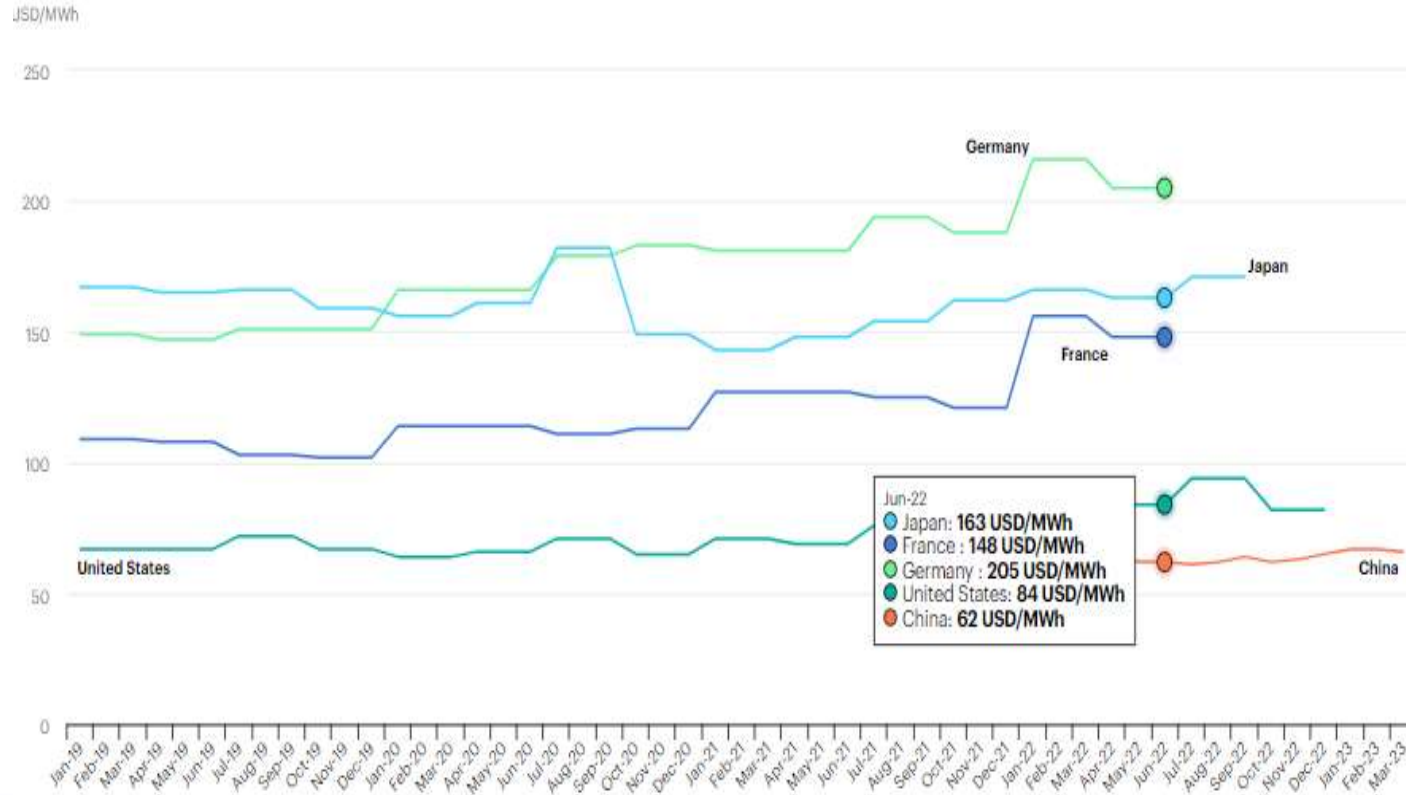
ENERGY PRICES: THE TRENDS AND RECENT IMPACTS



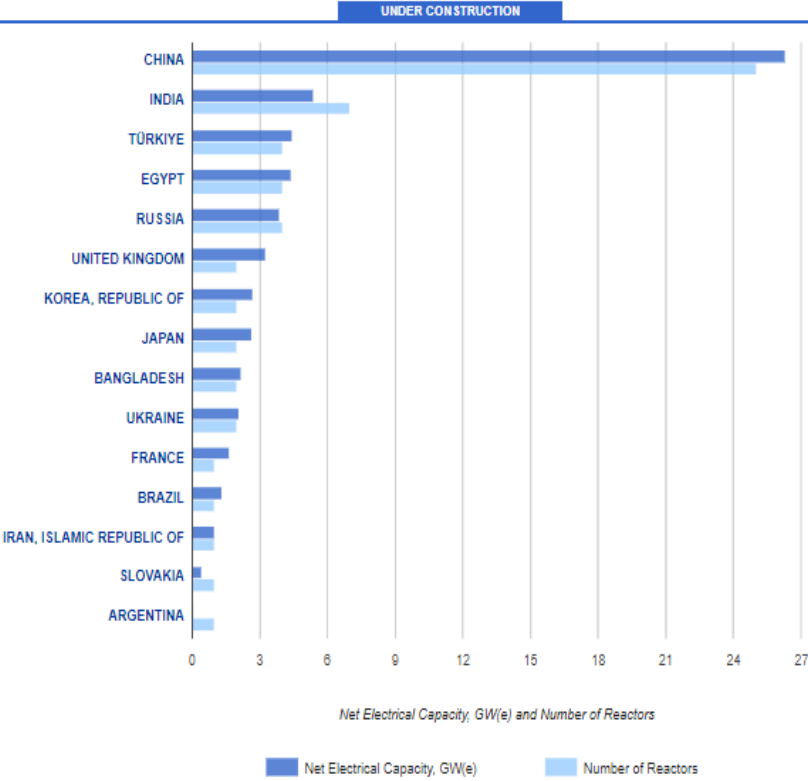
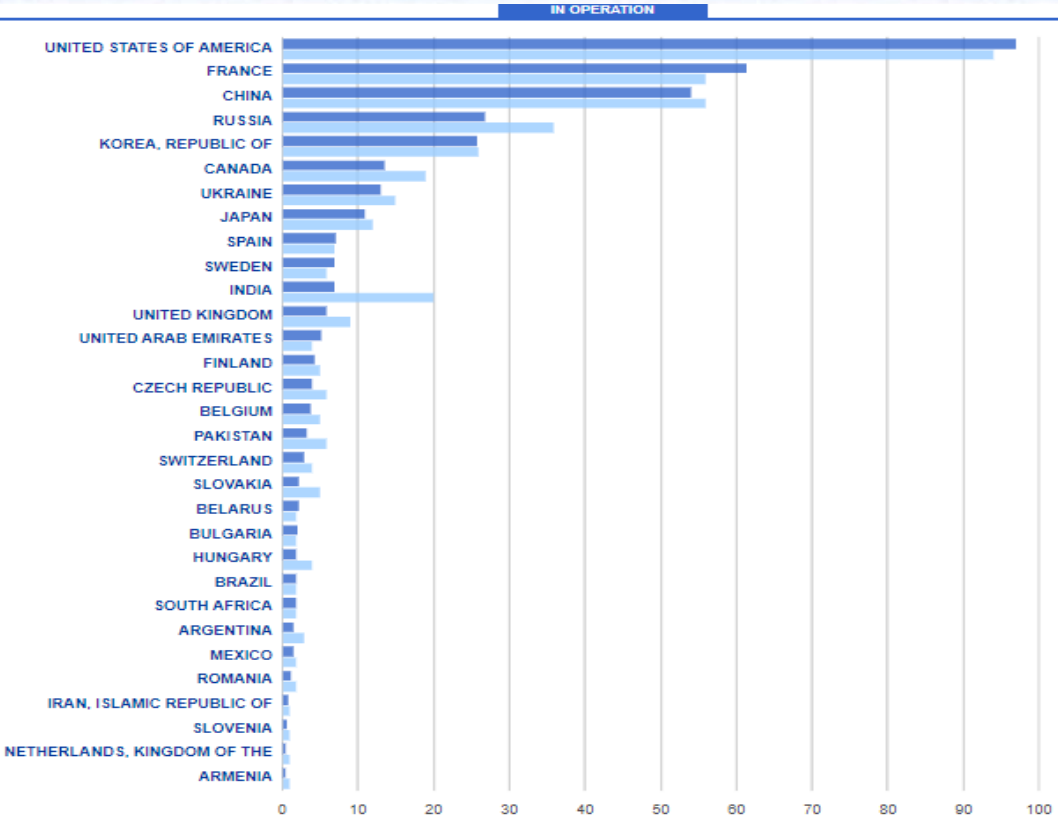
ENERGY PRICES: THE TRENDS AND RECENT IMPACTS



ENERGY PRICES: THE TRENDS AND RECENT IMPACTS



REACTORS FLEET

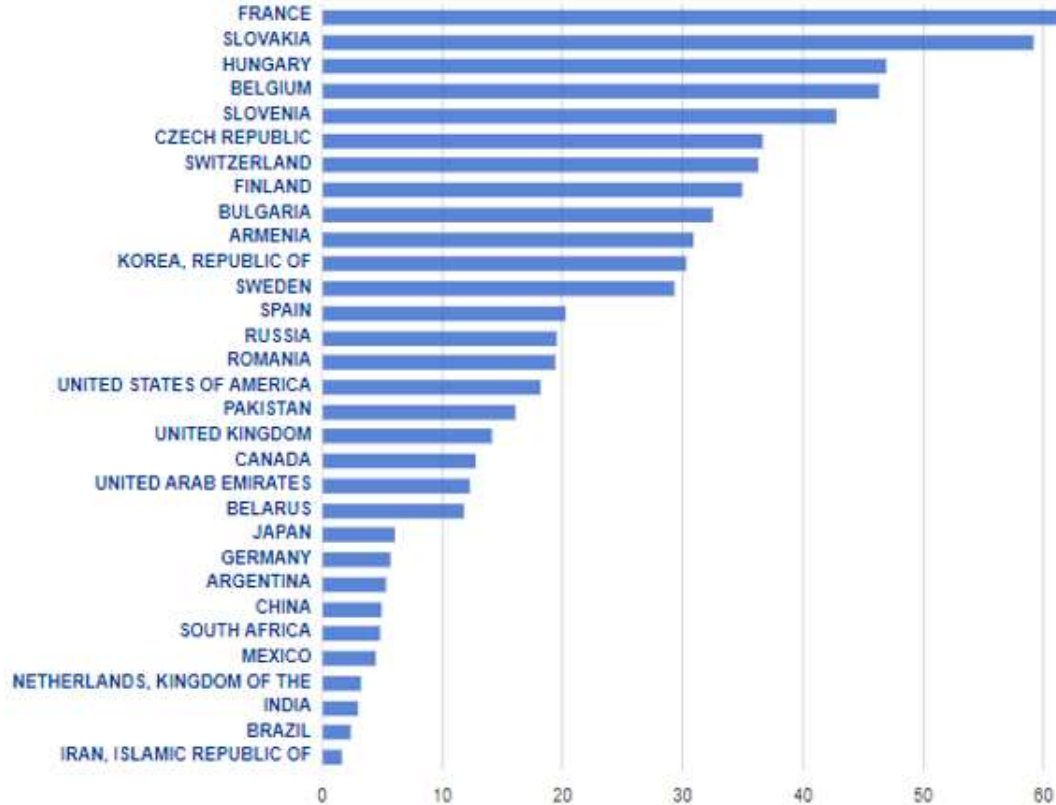


Net Electrical Capacity, GW(e) and Number of Reactors

Net Electrical Capacity, GW(e) Number of Reactors

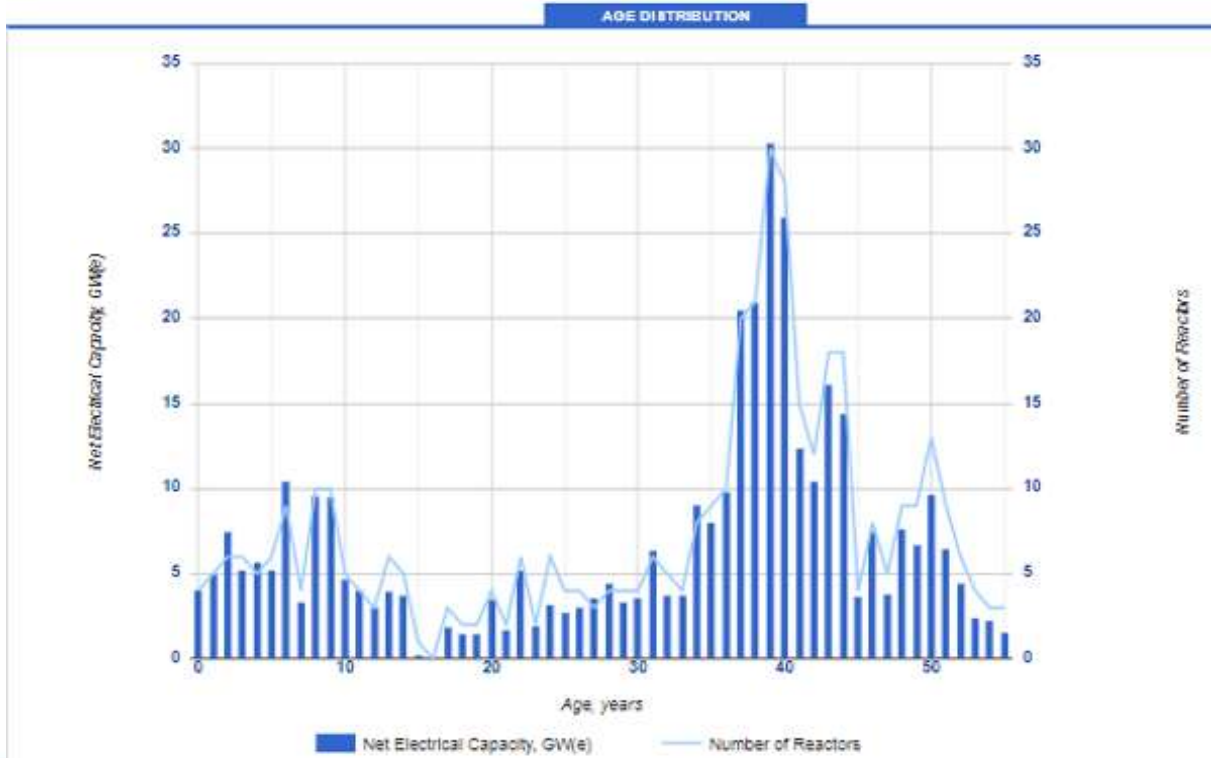


NUCLEAR SHARE



NUCLEAR SHARE

Age Distribution



INB – REACTOR FLOOR SERV

South Texas



Angra 1 e 2



Comanche Peak



Prairie Island



Beaver Valley



Vogtle



INB – ICL SERVICES



Vogtle 4

Nuclear Market Review

The source for uranium prices & analysis since 1968



The Market

MarketWatch

Weekly U₃O₈ Spot Price Indicator*

\$92.15 (↑ Up \$4.80)

Daily U₃O₈ Spot Price Indicator*

\$92.15 (↓ Down \$0.35)

Mid-Term U₃O₈ Price Indicator*

\$95.00 (04/30/24)

Long-Term U₃O₈ Price Indicator*

\$80.00 (04/30/24)

Production Cost Indicator*

\$56.90 (04/30/24)

* US\$ per pound U₃O₈ equivalent

The Market This Week...

- Fifteen transactions in the spot uranium market.
- No transactions and no new demand in the term uranium market.
- No transactions and new demand in the conversion market.
- No transactions and new demand in the enrichment market.

Uranium

The past week saw a dramatic shift in the nuclear fuel market with the US Senate passing by unanimous vote the Prohibiting Russian Uranium Imports Act (H.R. 1042) on Tuesday, April 30 (*In Focus*, p.5).

The Act will bar imports of Russian nuclear fuel into the USA 90 days after enactment once President Joe Biden signs it into law. It does allow temporary waivers under certain circumstances, which include: 1) no alternative viable source of low-enriched uranium is available to sustain the continued operation of a nuclear reactor or a US nuclear energy company, or 2) importation of the uranium is in

the national interest. Any waiver must terminate by January 1, 2028. The ban ceases on December 31, 2040.

Upon announcement that the Senate had passed the bill, the spot uranium price increased by \$2.00—from \$90.00 to \$92.00 per pound U₃O₈—with four transactions closing at that level. Sellers continued to increase their offer prices the following day with prices moving to \$92.50 on May 2.

Today, two transactions were concluded at \$92.50 per pound U₃O₈; one earlier in the day and one an hour prior to the close of business. Within the last 30 minutes of business, one seller

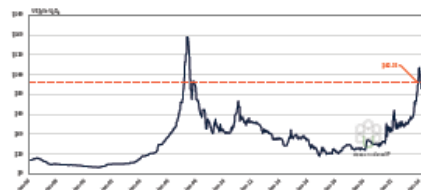


Figure 1 TradeTech Uranium Spot Price, 1996 – 2024

URANIUM MARKET

Uranium

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URANIUM MARKET

Monthly Market Values

	04/30/24	Units
NUEXCO* Exchange Value	\$90.00	US\$/lb U ₃ O ₈
UF ₆ Value	\$295.00	US\$/kgU as UF ₆
Loan Rate	5.60	Percent / annum
Conversion Value		
– North American	\$59.00	US\$/kgU as UF ₆
– European	\$59.00	US\$/kgU as UF ₆
SWU Value	\$166.00	US\$/SWU
Transaction Value	\$93.95	US\$/lb U ₃ O ₈
Mid-Term U ₃ O ₈ Price Indicator	\$95.00	US\$/lb U ₃ O ₈
Long-Term U ₃ O ₈ Price Indicator	\$80.00	US\$/lb U ₃ O ₈
Production Cost Indicator	\$56.90	US\$/lb U ₃ O ₈
Mid-Term Conversion Price Indicator		
– North American	\$55.00	US\$/kgU as UF ₆
– European	\$55.00	US\$/kgU as UF ₆
Long-Term Conversion Price Indicator		
– North American	\$36.00	US\$/kgU as UF ₆
– European	\$36.00	US\$/kgU as UF ₆
Mid-Term SWU Price Indicator	\$166.00	US\$/SWU
Long-Term SWU Price Indicator	\$158.00	US\$/SWU

TradeTech SWU Value (spot)



BACK TO THE BUSINESS 1!



"The energy industry has the ability to develop the technologies for a future net-zero energy system. But we need to move from rhetoric to action."

Christian Bruch
CEO Siemens Energy

1- Expanding renewables (clean?)

[...the use of renewable energies must be massively increased worldwide. ...]

2- Transforming conventional power (SMR?)

[...we cannot and should not overlook the infrastructure that already exists. This can and should be used as a bridge to carry out the transition. ...]

3- Strengthening electrical grids

[...The increasing share of renewables and increasing electrification require larger, more robust grids that can handle the fluctuations of this type of energy. ...]

4- Driving industrial decarbonization

[to conserve energy wherever possible! Efficiency?]

5- Securing the supply chain and necessary minerals

[More materials and minerals are needed for the energy transition. ...]

BACK TO THE BUSINESS 2!



BACK TO THE BUSINESS !

PDE 2032 | Como evolui o consumo de eletricidade na rede?



Consumo rede (TWh)
Por cenário

- Cenário Superior
- Cenário Referência
- Cenário Inferior



O consumo de eletricidade na rede cresce à taxa média de 3,4% ao ano no cenário de referência, enquanto no cenário superior o crescimento anual é de 4,1% e no cenário inferior de 2,8%.

IS THE NUCLEAR TECHNOLOGY AND DESIGN REALLY SAFE?



IS THE NUCLEAR TECHNOLOGY AND DESIGN REALLY SAFE?



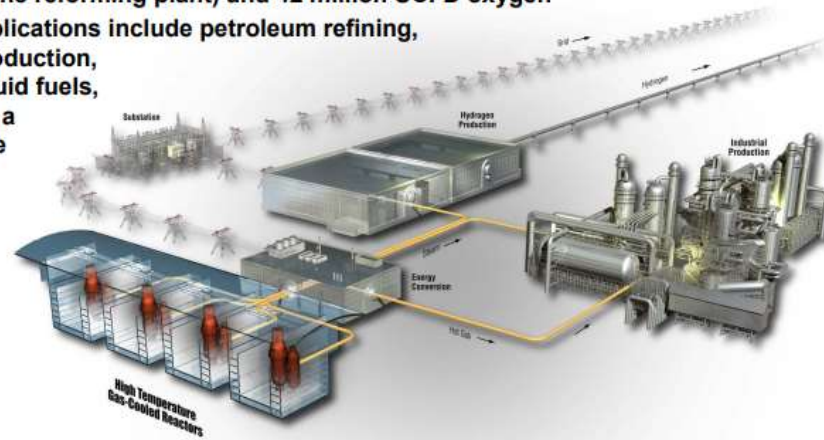
BACK TO THE BUSINESS 4!



NGNP / HTSE Conceptual Design

NGNP Concept for Large-Scale Centralized Nuclear Hydrogen Production based on High-Temperature Steam Electrolysis

- Direct coupled to HTGR reactor for electrical power and process heat
- 600 MWth reactor could produce ~85 million SCFD hydrogen (similar to a large steam methane reforming plant) and 42 million SCFD oxygen
- Potential applications include petroleum refining, ammonia production, synthetic liquid fuels, hydrogen as a direct vehicle fuel



INB – USICON AND UCEU PROJECTS – MASTER PLAN



CHANGE OUR MINDS!

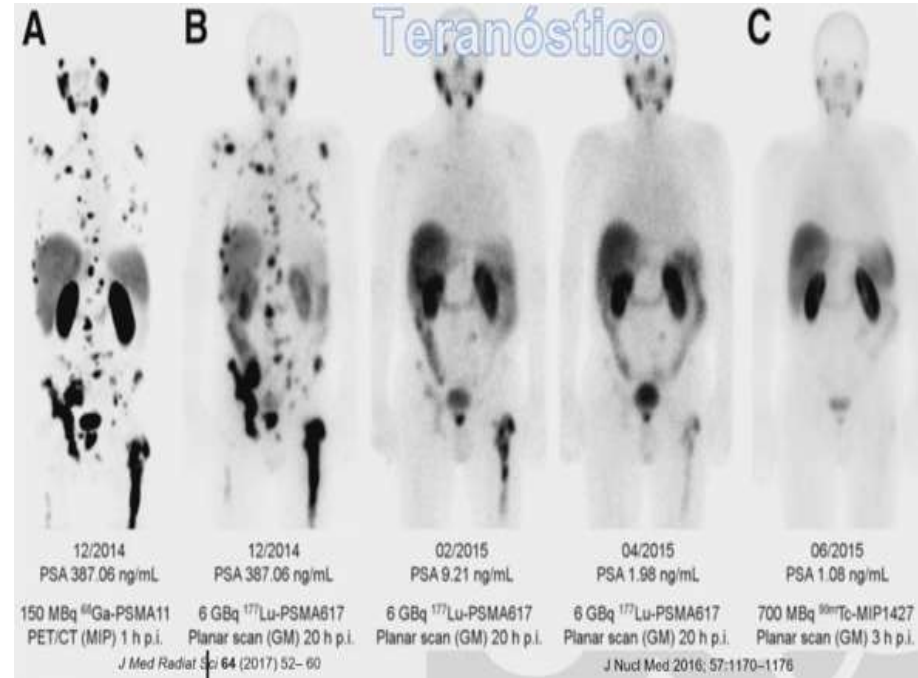
Energia Nuclear é segura?

IRD



-a energia nuclear ainda é mais segura do que a hidrelétrica;
- ✓ duas vezes mais segura que a eólica;
 - ✓ seis vezes mais segura do que solar; e
 - ✓ mais de 200 vezes mais segura que a mais segura e menos poluidora das indústrias de carvão...

A energia nuclear como alternativa a produção “livre de Carbono”



“...Stronger international cooperation in high emissions sectors crucial to get on track for 1.5°C climate goal ...”.



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2024

JULY, 15 TO 18

RIO DE JANEIRO

BRAZIL

ROUND TABLE 5: INDUSTRIAL SUPPORT FOR ENERGY TRANSITION

JOÃO DA SILVA
GONÇALVES

INB

THANK YOU!

JOAOGONCALVES@INB.GOV.BR