

# Geopolitics of Nuclear Energy

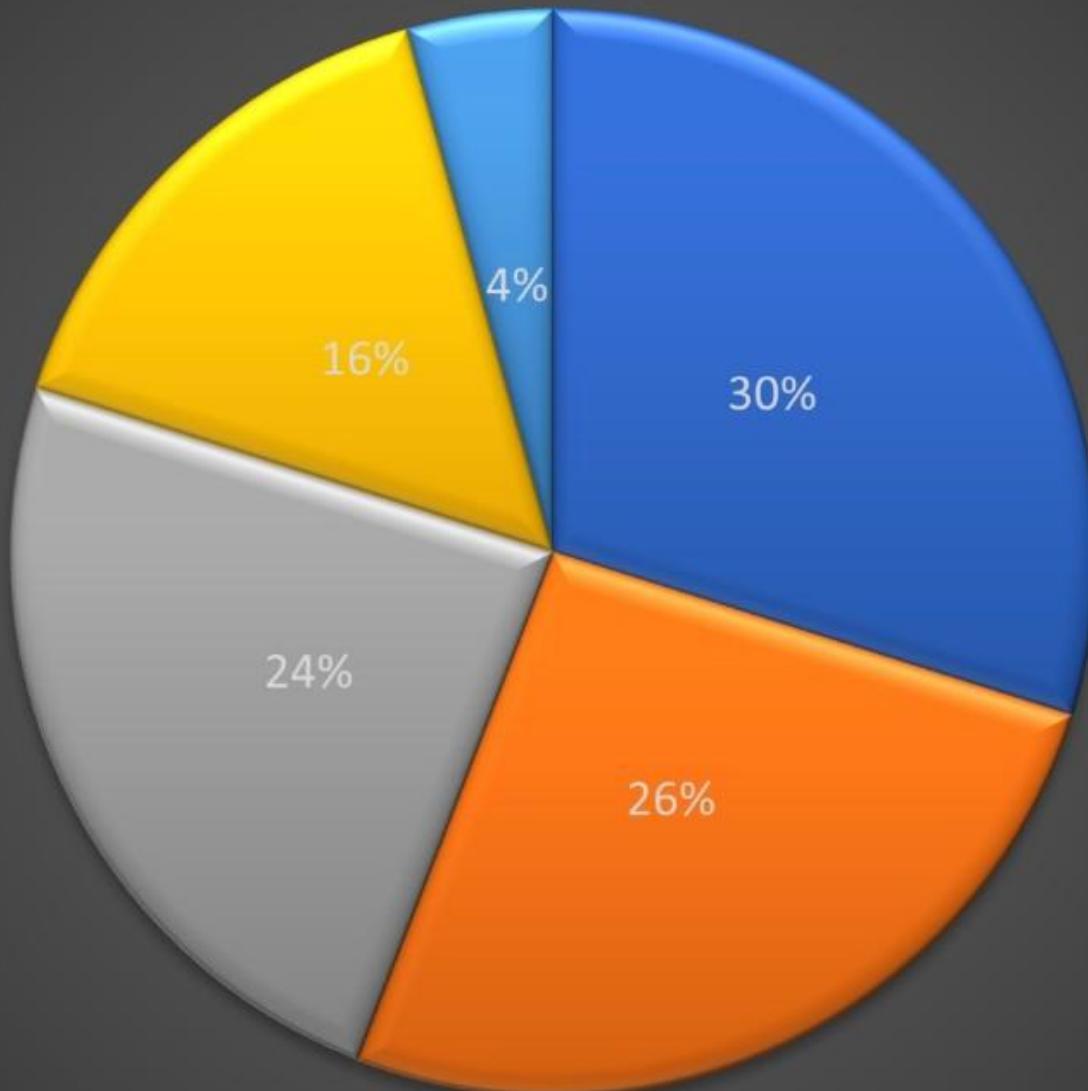
Professor Athanasios Platias

Department of International & European  
Studies, School of Economics,  
Business & International Studies, University of  
Piraeus



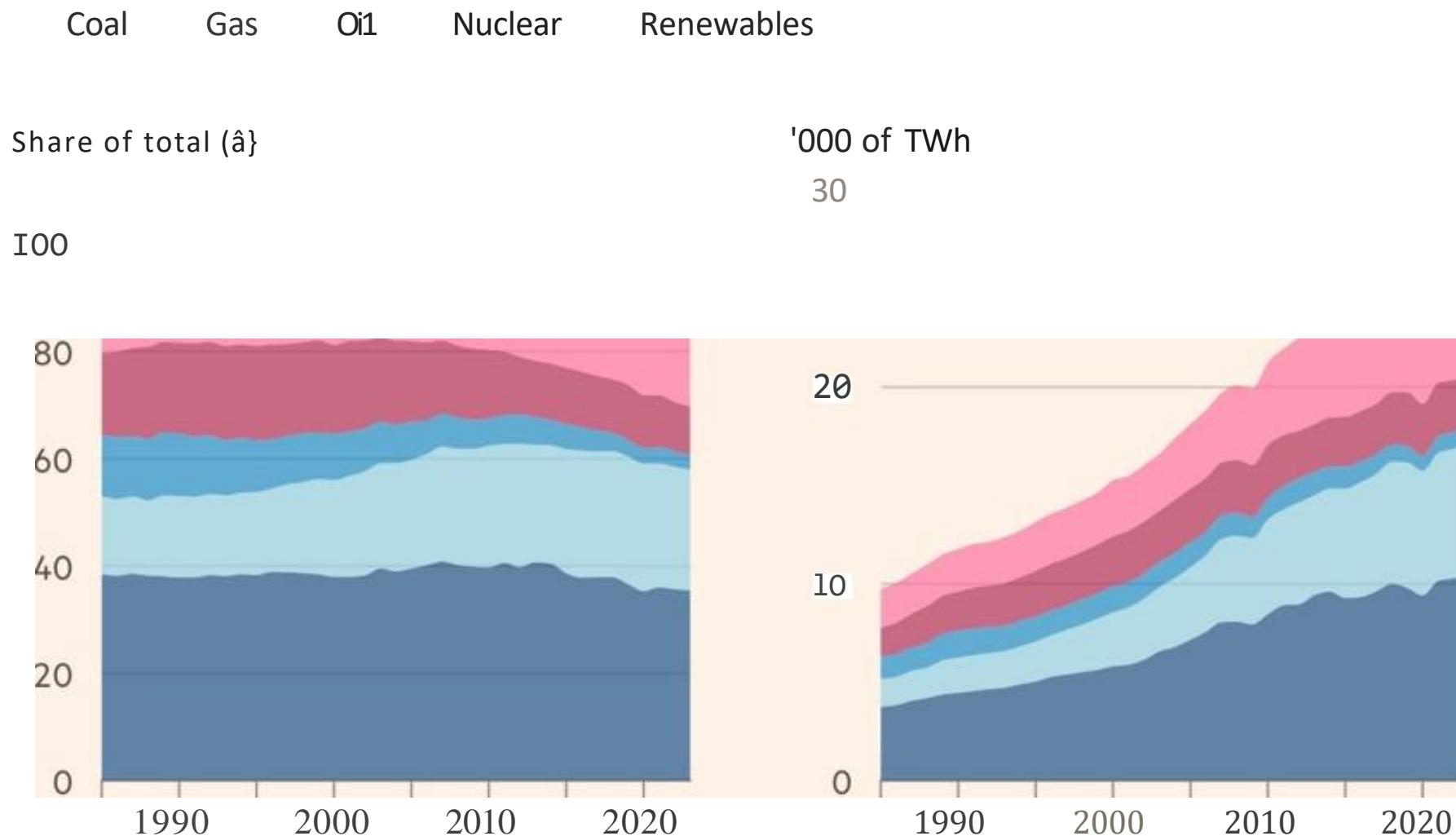
**Why has nuclear energy failed  
to meet initial expectations?**

# Global Energy Consumption (2022)



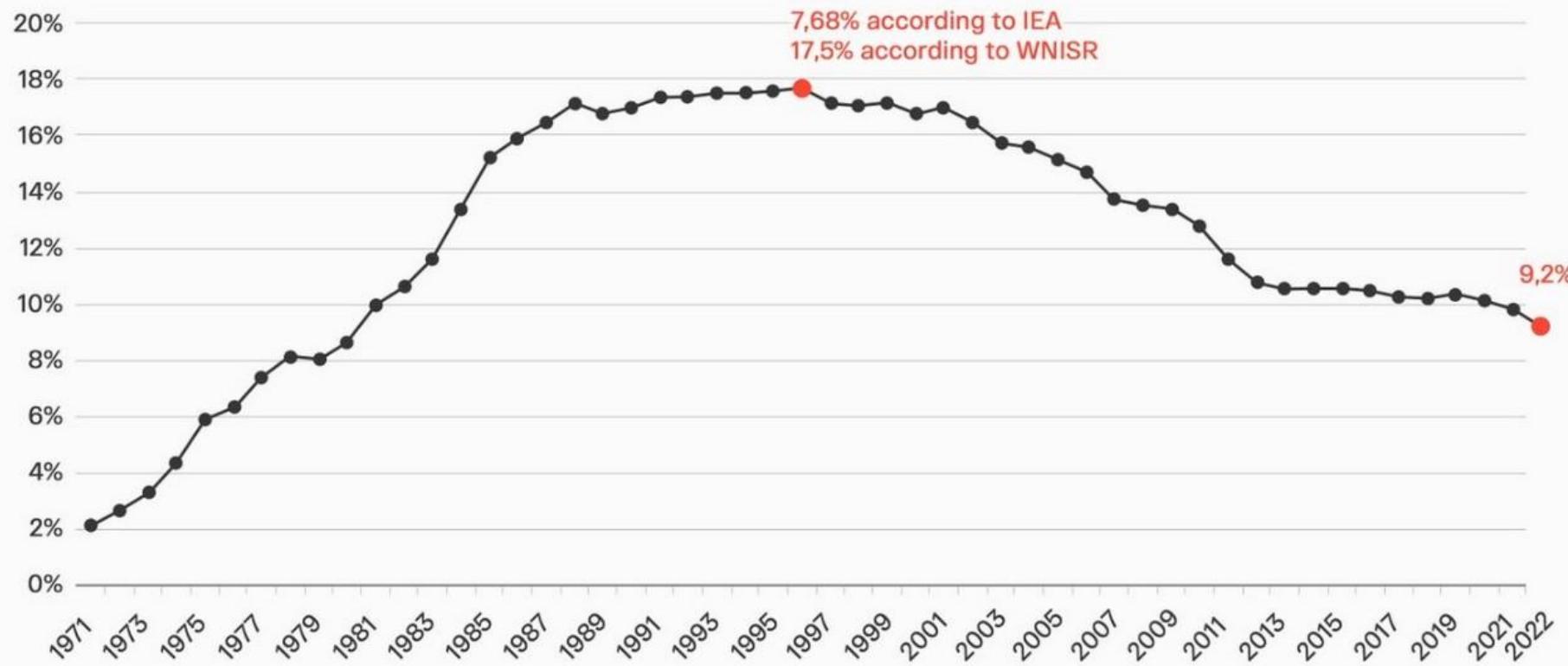
■ Liquid fuels ■ Coal ■ Natural gas ■ Other ■ Nuclear

# World electricity generation, by source, 1985 to 2023



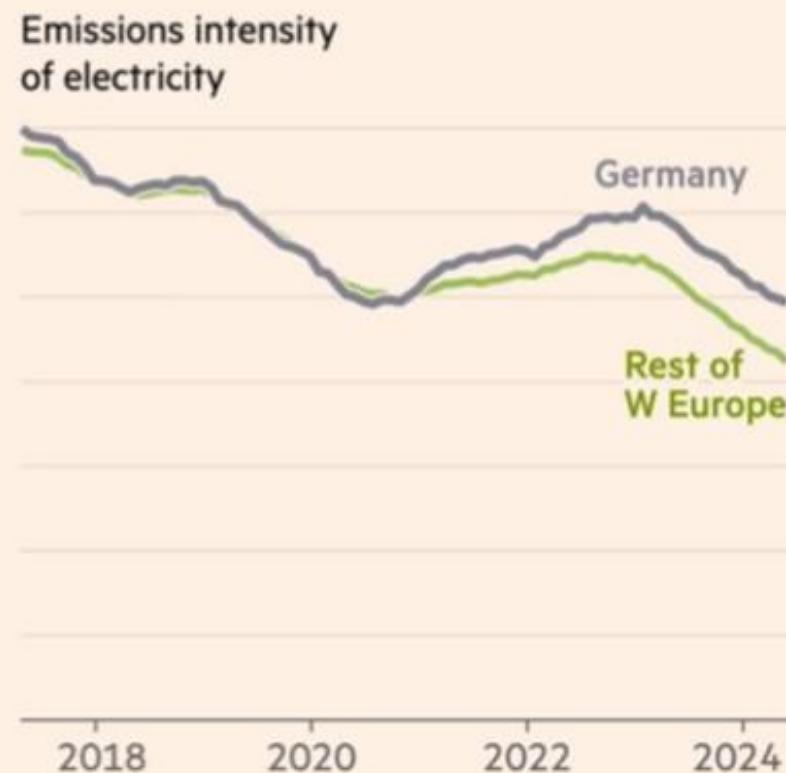
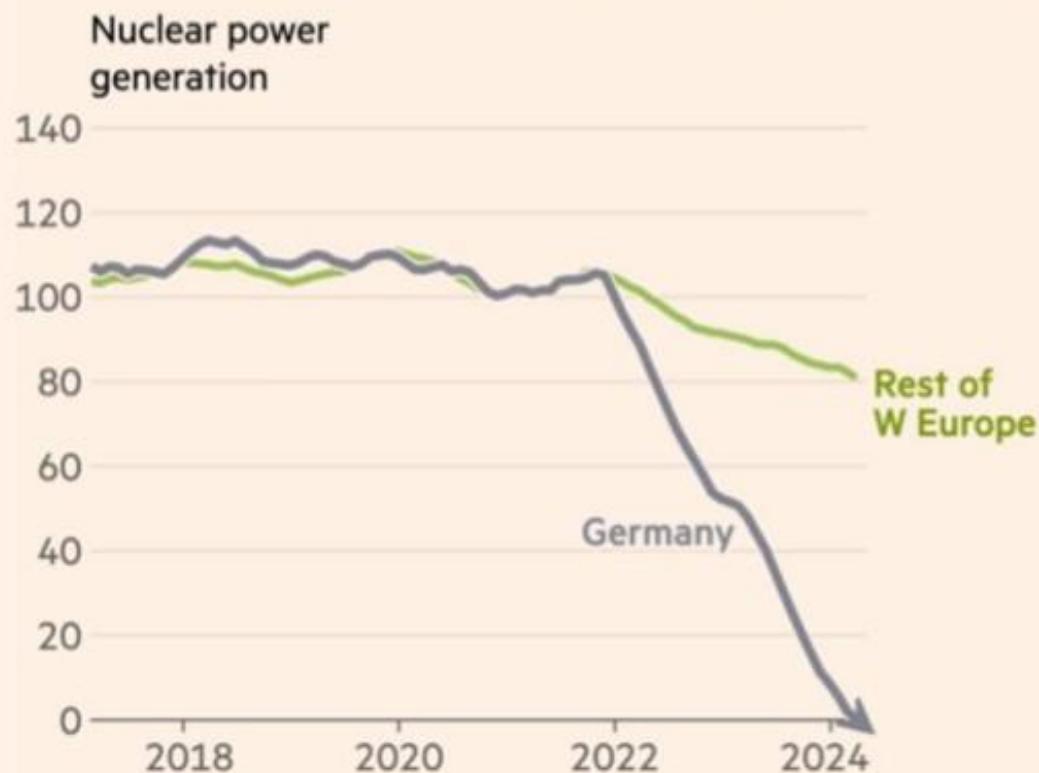
# THE SHARE OF NUCLEAR POWER PLANTS IN GLOBAL ELECTRICITY PRODUCTION

THE INSIDER



Source: IEA (2023), World Nuclear Report (2024)

Nuclear generation and emissions intensity of power sector (rebased, Dec 2020 = 100)



Source: Ember

FT graphic: John Burn-Murdoch / @jburnmurdoch

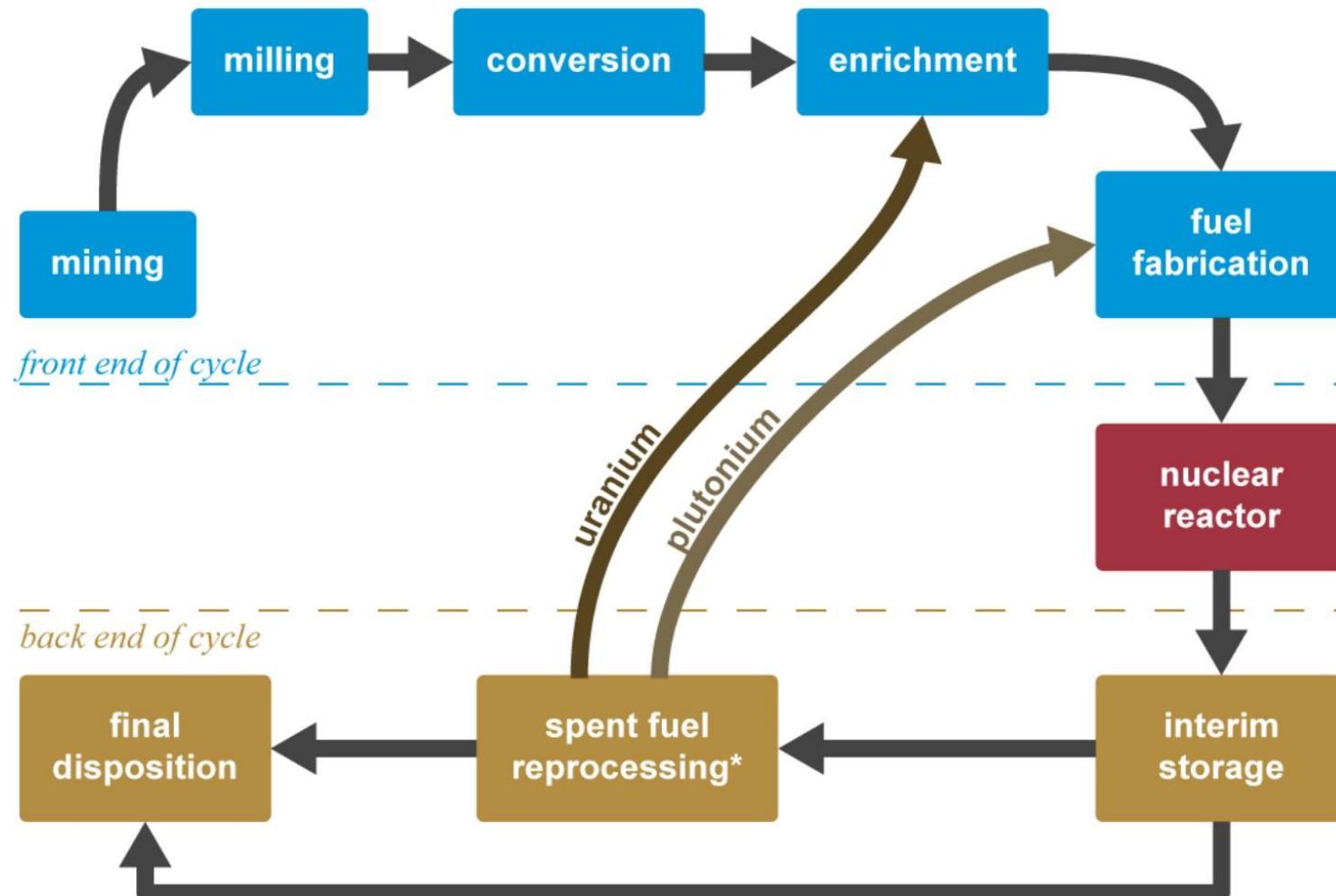
© FT

# For what reasons has nuclear power failed to meet initial expectations?

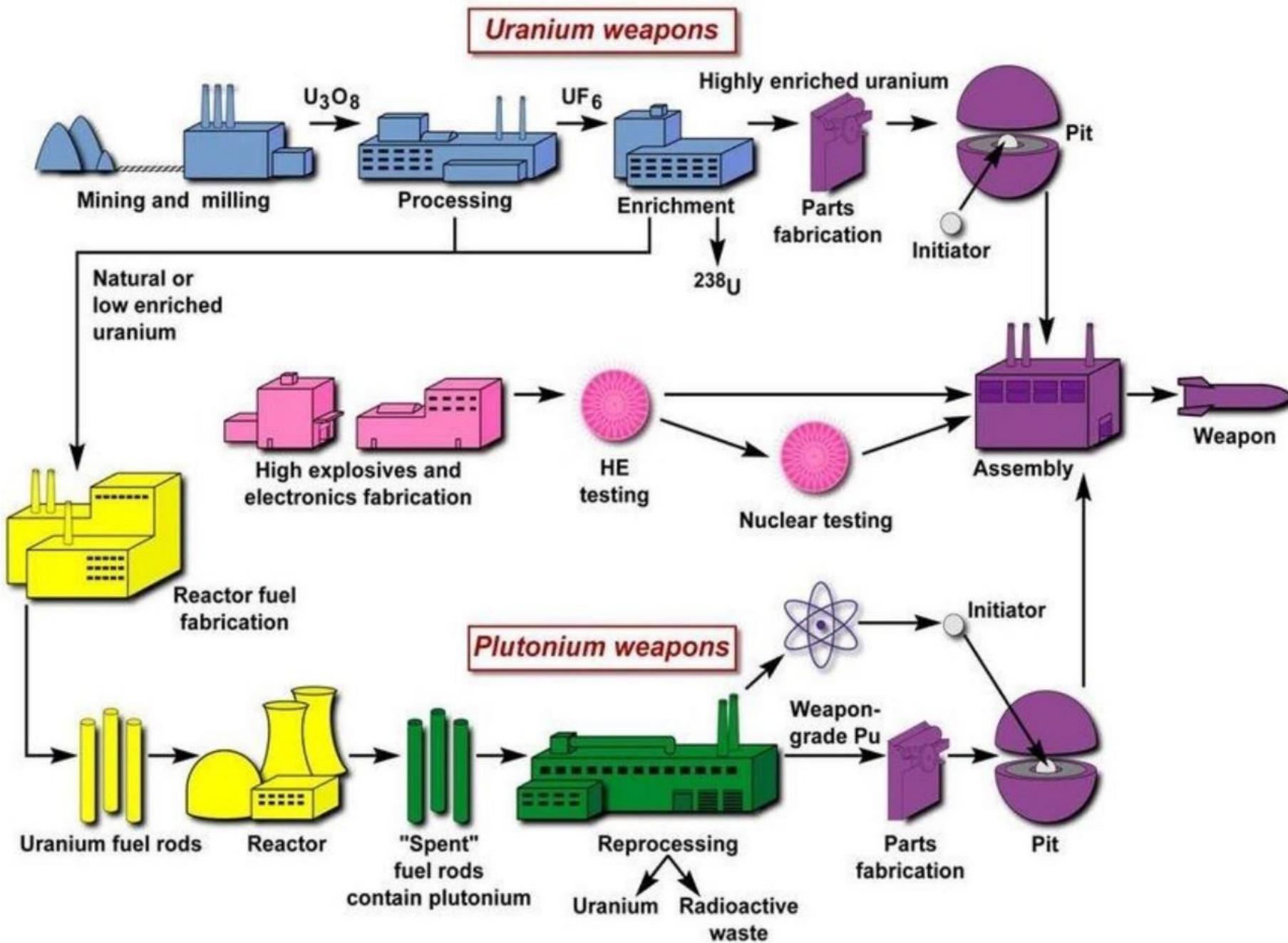
1

- Contribution to the proliferation of nuclear weapons.
- Countries such as Japan, South Korea and Germany are on the threshold of nuclearization.
- Countries with nuclear ambitions (Iran, Turkey, Saudi Arabia) intend to create a nuclear fuel circle.
- The geopolitical framework of limiting the spread of nuclear weapons (non-proliferation regime) has made nuclear energy less attractive.

# Nuclear fuel cycle



\*Spent fuel reprocessing is omitted from the cycle in most countries, including the United States.



2

## For what reasons has nuclear power failed to meet initial expectations?

- High initial investment with a long payback period.
- Discouragement of private investors.
- The development of nuclear energy is easier in countries that invest with strategic criteria (Russia, China) than in terms of economic efficiency.

## For what reasons has nuclear power failed to meet initial expectations?

3

- High, hidden costs due to
  - (a) long development time and
  - (b) changes in the regulatory framework towards stricter ones after a nuclear accident.
- The cost of decommissioning is extremely large but difficult to calculate.
- Such costs are not taken seriously by countries that invest in nuclear energy with a strategic rather than an economic rationale.

# Very late and over budget: Why newest large nuclear plant in US is likely to be the last



BUSINESS | FINLAND

## Finland's much-delayed nuclear plant launches

03/12/2022

Nuclear reactor Olkiluoto 3 has gone online in Finland some 12 years behind schedule and on a massively inflated budget. Finland now hopes to cut back on energy imports from Russia, Sweden and Norway.

f X ▼



The Olkiluoto 3 was developed and built by a joint venture between France's Areva and Germany's Siemens

Image: Antti Yrjonen/NurPhoto/picture alliance

## For what reasons has nuclear power failed to meet initial expectations?

4

- The cost of electricity production is more expensive than competing solutions (e.g., natural gas and RES).
- Countries that invest in nuclear energy with a strategic rather than economic rationale are favored.

## For what reasons has nuclear power failed to meet initial expectations?

5

- Fears about the safety of nuclear power plants after high-profile accidents (Chernobyl, Three Mile Island, Fukushima).
- Decreased social acceptance in many countries (e.g. Germany, Japan) and in local communities (USA).
- Such fears do not seem to deter investment in nuclear power in countries with centralized political systems where social pressure on decision-making is less.

# For what reasons has nuclear power failed to meet initial expectations?

6

- The consequences of the nuclear accidents were the relative deindustrialization in Western countries (USA, Germany, Japan).
- Leading nuclear energy companies either went bankrupt or changed their business sectors.
- This created a window of opportunity for companies from countries competing with the West (Russia, China).

# For what reasons has nuclear power failed to meet initial expectations?

7

- Failure to find a solution to the issue of nuclear waste management.
- Nuclear waste is highly toxic and has a long lifespan.
- Its temporary storage usually becomes permanent, which exacerbates the lack of social and political acceptance of nuclear energy in the West.

# For what reasons has nuclear power failed to meet initial expectations?

8

Supply chain management problems, which has favored countries with nuclear energy industrial infrastructure, such as Russia and China.

ANALYSIS

# U.S. Reactors Still Run on Russian Uranium

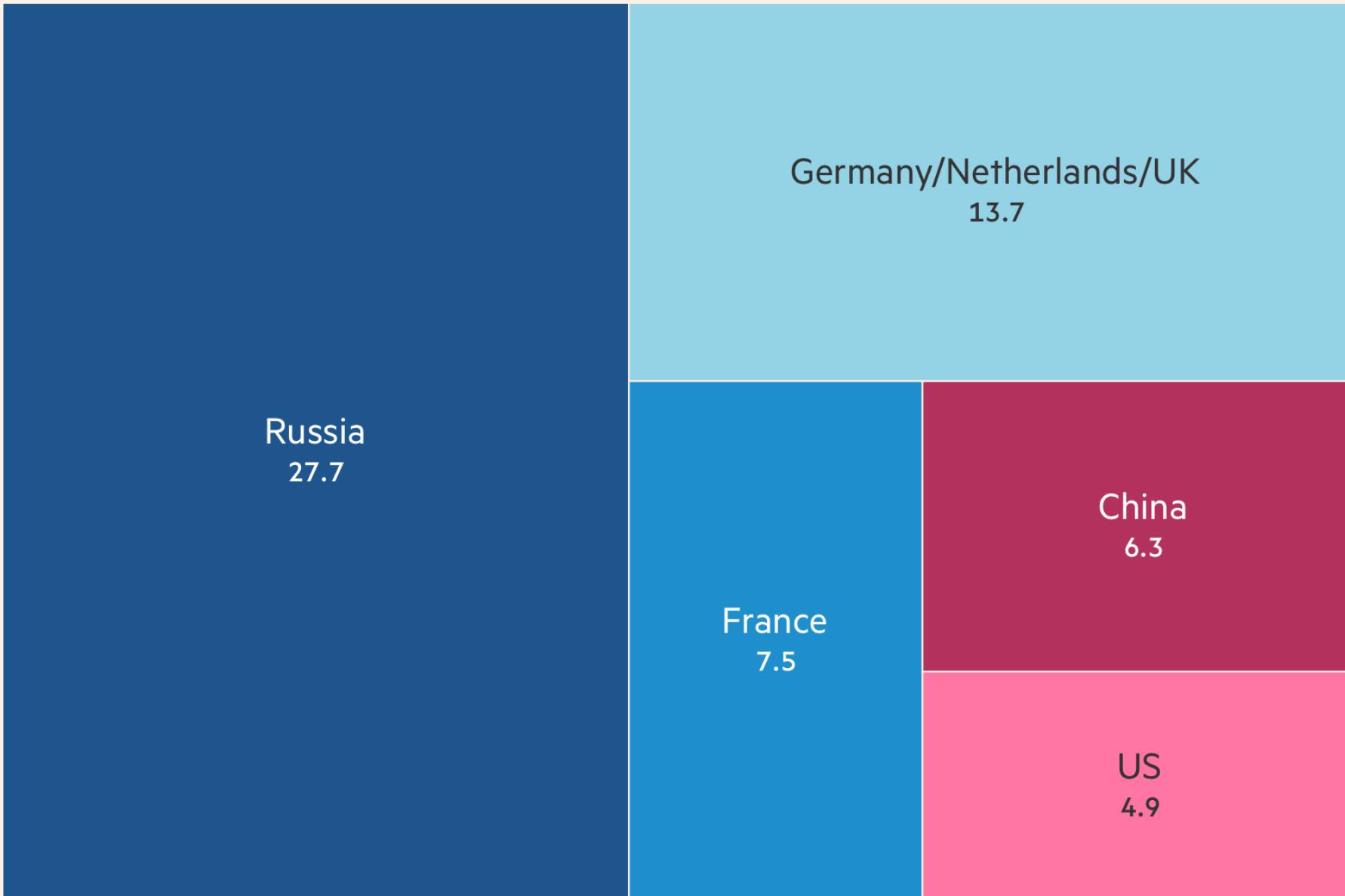
But Washington and its partners are working to change that.

By [Keith Johnson](#), a reporter at *Foreign Policy* covering geoeconomics and energy, and [Amy Mackinnon](#), a national security and intelligence reporter at *Foreign Policy*.



# Russia dominates uranium enrichment worldwide

Global capacity, operational and planned (2020, mn SWU\*)



# Advantages of SMRs that create optimism for nuclear renaissance

1. Necessary solution to achieve environmental goals (net zero) based on forecasts for a significant increase in electricity demand (global South, EV, data centers)
2. Lower initial investment compared to traditional reactors
3. Easier to build
4. Easier to expand when needs increase (modularity)
5. Significantly shorter construction time without cost overruns (on time, on budget)
6. Safer than traditional reactors

Department of Energy

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

DECEMBER 1, 2023

# Challenges that make nuclear renaissance difficult

# Challenges that make nuclear renaissance difficult

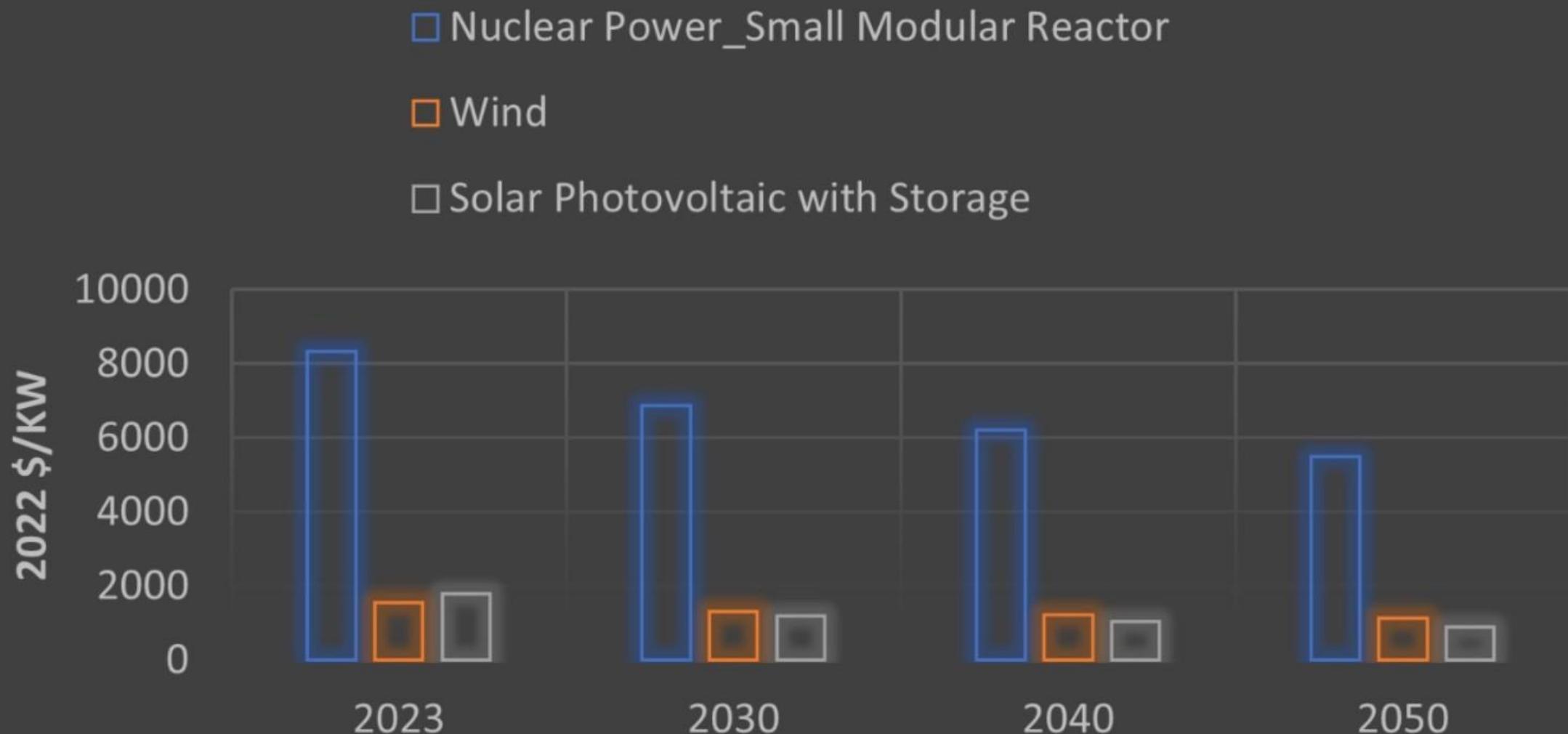
## Efficiency

The cost of SMRs per MVh is higher than the corresponding cost of traditional reactors such as LWRs.

The cost of SMRs per MVh is higher than the corresponding cost of renewable energy sources and natural gas.

The use of SMRs will become more efficient if economies of scale (standardization) are created.

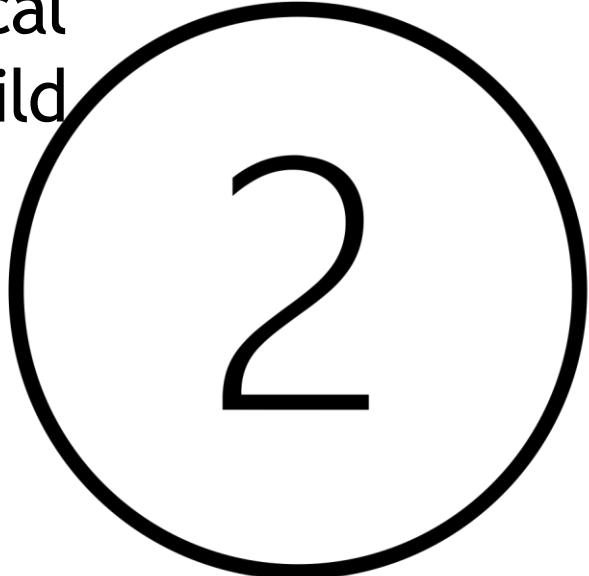
# US Overnight Capital Costs for New Electricity Generating Plants



# Challenges that make nuclear renaissance difficult

## Social and political acceptance

There remains the problem of social and political acceptance, which is made more acute by the need to build SMRs closer to cities.



2

# Challenges that make nuclear renaissance difficult

## Nuclear waste storage

The problem of storing nuclear waste, which is usually stored on the perimeter of the plant, has not been solved, while a solution for permanent storage is being sought.

=> Toxic waste risks remaining next to residential areas for a long time, as is currently the case in existing nuclear plants in the USA and Germany.

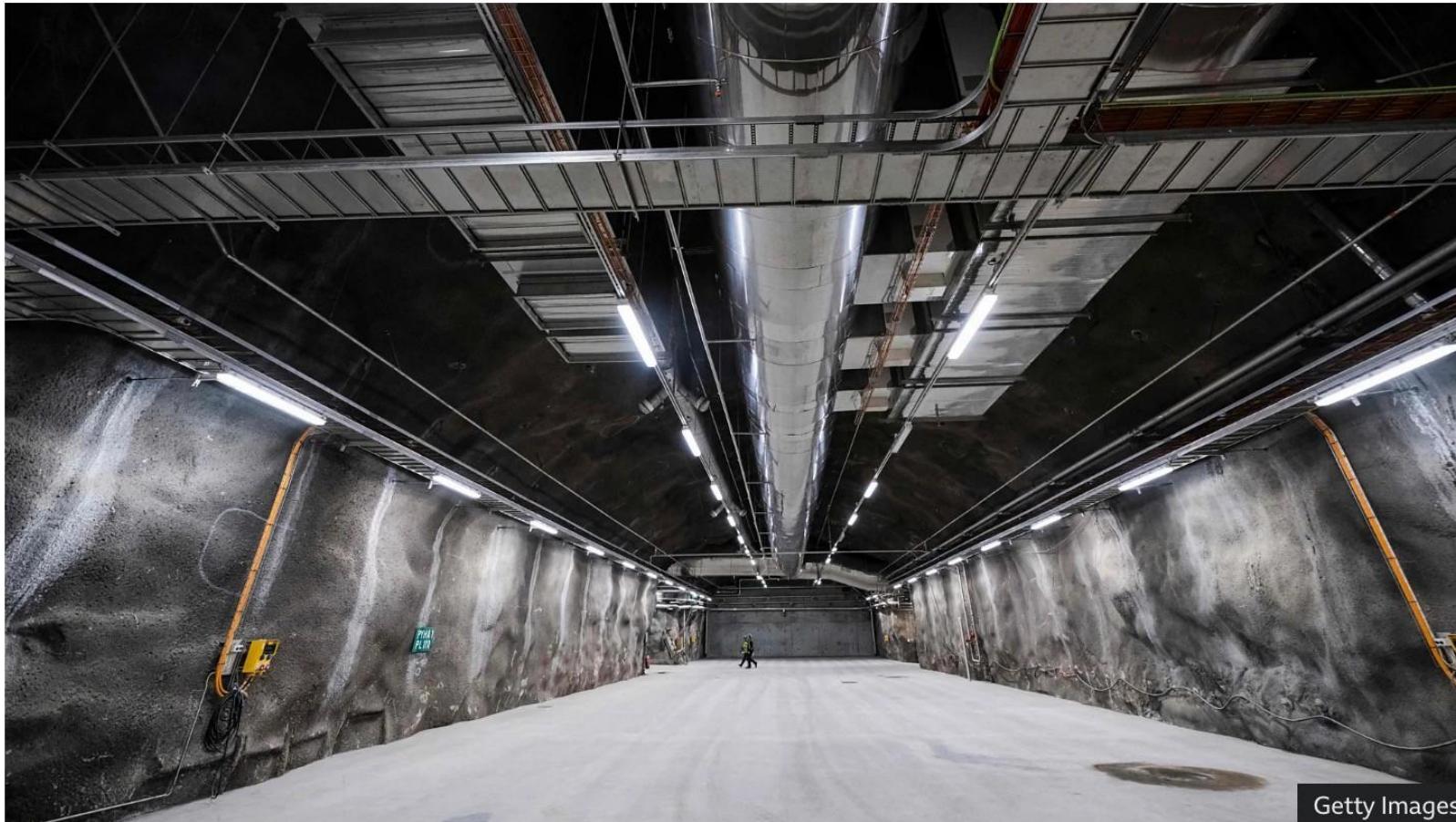
# Finland's plan to bury spent nuclear fuel for 100,000 years

14 June 2023

Share 

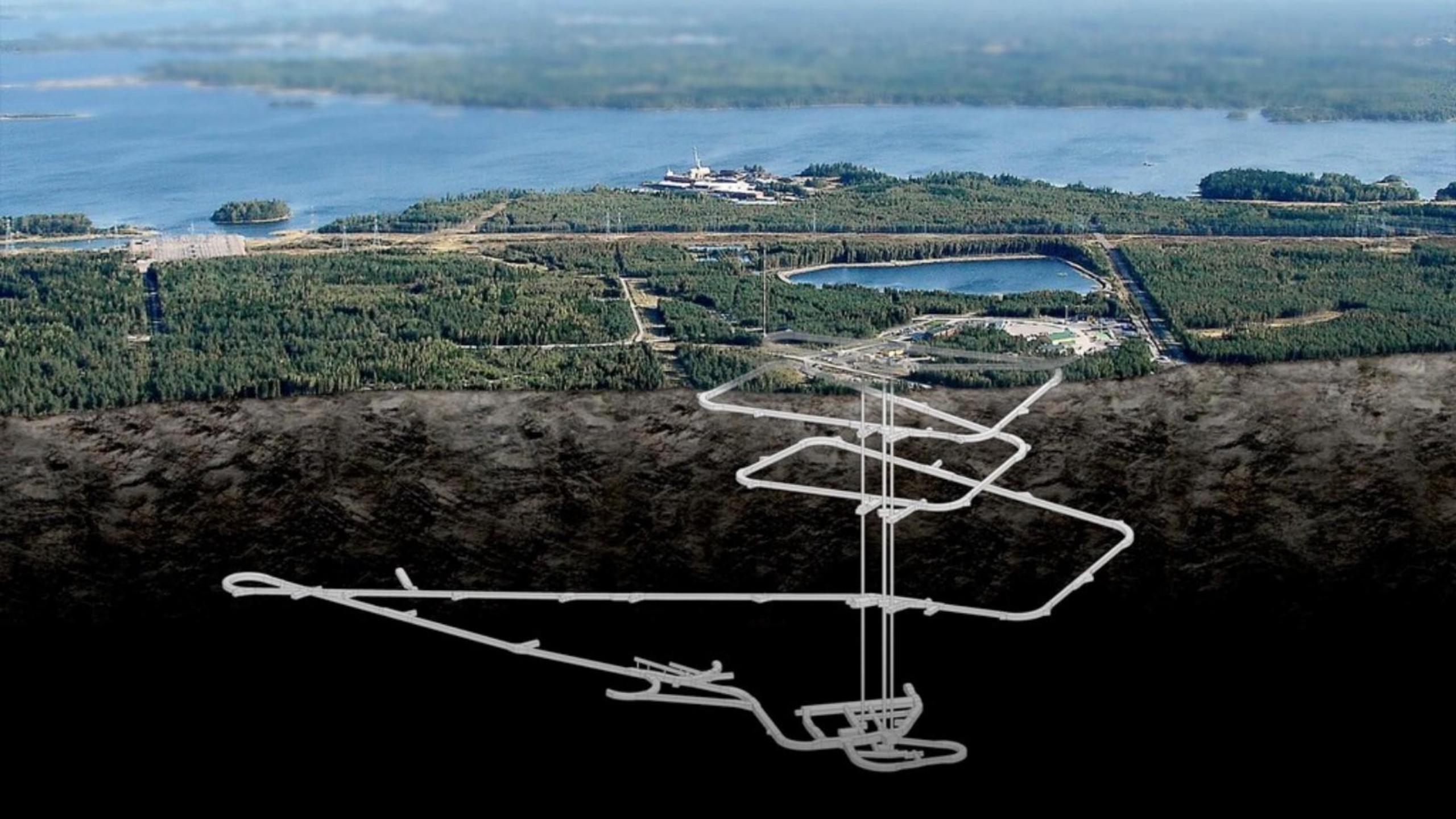
**Erika Benke**

Features correspondent



Getty Images

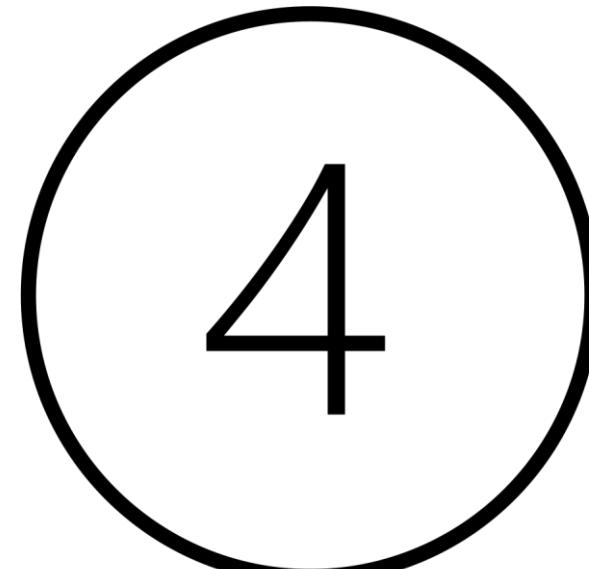
Finland plans to permanently bury its nuclear waste deep below the ground at its Onkalo site on an island near its coast  
(Credit: Getty Images)



# Challenges that make nuclear renaissance difficult

## Supply Chain

There is no reliable supply chain in the Western world that supports the operation of SMRs (uranium enrichment, fuel fabrication).



4

# Challenges that make nuclear renaissance difficult

## Workforce

There is no workforce in the Western world that can support the revival of the nuclear industry, especially at a time when it is facing competition from the need of Western nuclear powers to modernize and expand their nuclear arsenals.

A large black circle containing the number 5, positioned on the right side of the slide.

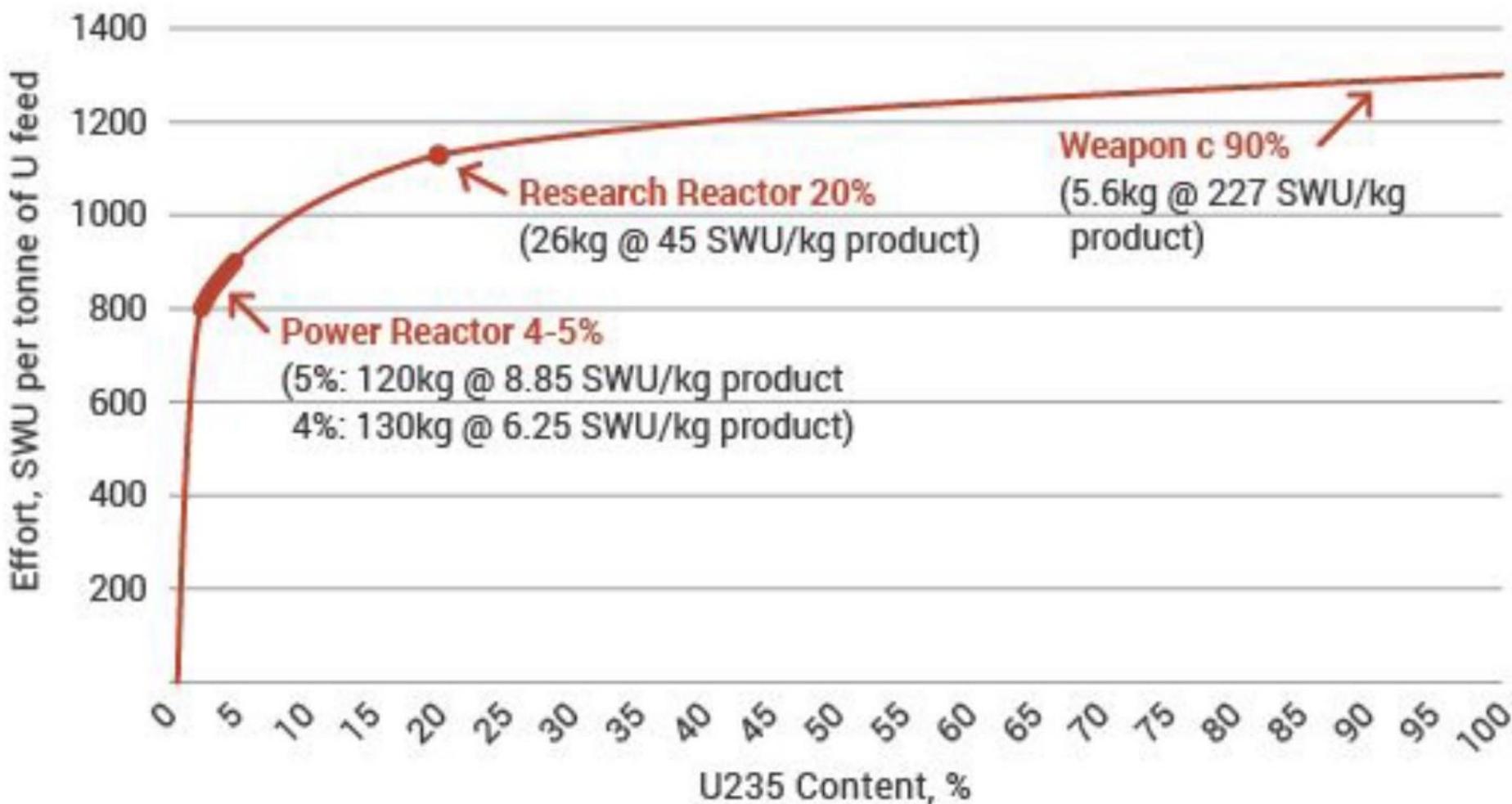
# Challenges that make nuclear renaissance difficult

## Nuclear weapons proliferation

The risks are greater because SMRs require more enriched uranium to operate efficiently than traditional LWRs.

It is also easier to provide security to a few large reactors than to many smaller reactors scattered across the country.

## Uranium Enrichment and Uses



# Challenges that make nuclear renaissance difficult

## Financing

Private financiers are reluctant to finance nuclear facilities without government subsidies and guarantees.



# Challenges that make nuclear renaissance difficult

## Environmental challenge of operation

Most SMR reactors require large amounts of water for cooling (water-cooled) in an era when water supply is limited (water scarcity).

# Challenges that make nuclear renaissance difficult

## Regulatory framework

Installing SMRs near cities or on commercial ships (e.g. containers) creates additional safety requirements that complicate the work of regulatory authorities (e.g. port access permits).

# New Geopolitical Order in the Age of Nuclear Rebirth

Three major suppliers

Russia



China



USA



**TABLE 1: Civilian Nuclear Power Sector Comparison: The United States, Russia, and China**

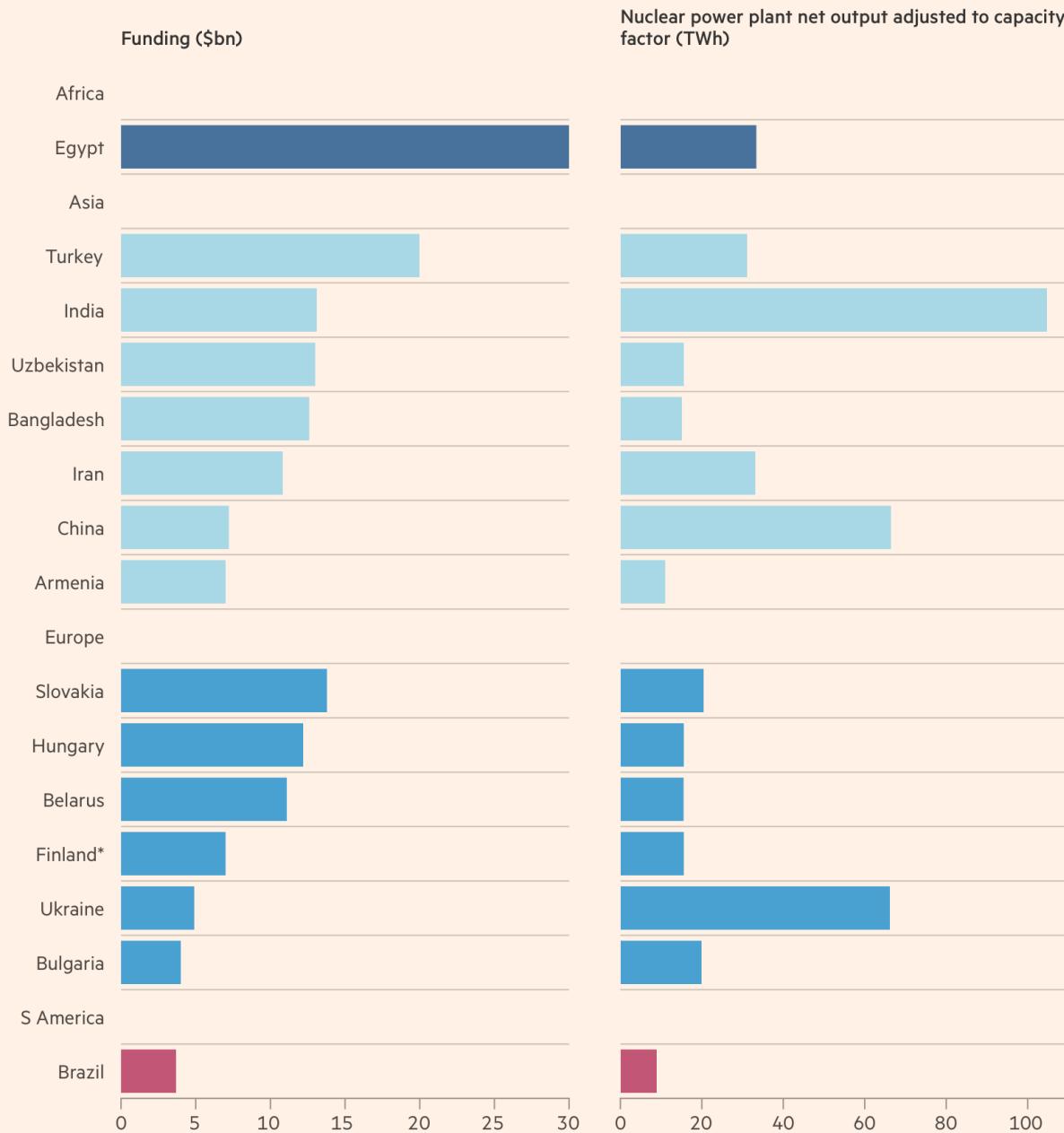
COUNTRY	REACTOR UNITS (DOMESTIC)		INSTALLED CAPACITY	NUCLEAR SHARE IN NATIONAL POWER SUPPLY (2018)	FUTURE NET INSTALLED CAPACITY	SECTOR STRUCTURE	EXPORT UNITS UNDER CONSTRUCTION	PUBLIC FINANCING FOR NUCLEAR EXPORT
	ONLINE	UNDER CONSTRUCTION						
USA	96	2	98 GW	19.32%	92 GW <sup>1</sup>	Multiple private companies	None	Loan terms per OECD restriction; no equity
Russia	38	4	28 GW	17.87%	44 GW <sup>2</sup>	Vertically and horizontally integrated under 1 state corporation	7 (Belarus, India, Bangladesh, Turkey)	Loans & equity
China	48	11	45 GW	4.22%	120-150 GW <sup>2</sup>	Vertically integrated under 3 state corporations	2 (Pakistan)	Loans & equity

Source: "Reactor Database," World Nuclear Association, HYPERLINK "[https://urldefense.com/v3/\\_https://www.world-nuclear.org/information-library/facts-and-figures/reactor-database.aspx](https://urldefense.com/v3/_https://www.world-nuclear.org/information-library/facts-and-figures/reactor-database.aspx)"; [!!KRhing!NJduRuozGelokCC-SZ2urQCauracicX9lwSGOCISJKRfoXIY8EeK2Z\\_oOWmP\\$](https://www.world-nuclear.org/information-library/facts-and-figures/reactor-database.aspx)"<https://www.world-nuclear.org/information-library/facts-and-figures/reactor-database.aspx>. The sources for Future Net Installed Capacity are "Annual Energy Outlook 2020," U.S. Energy Information Administration; "Nuclear Power in Russia," World Nuclear Association; and various media reports for the China figure.

<sup>1</sup> Projected for 2025 (EIA)    <sup>2</sup> 2030 target

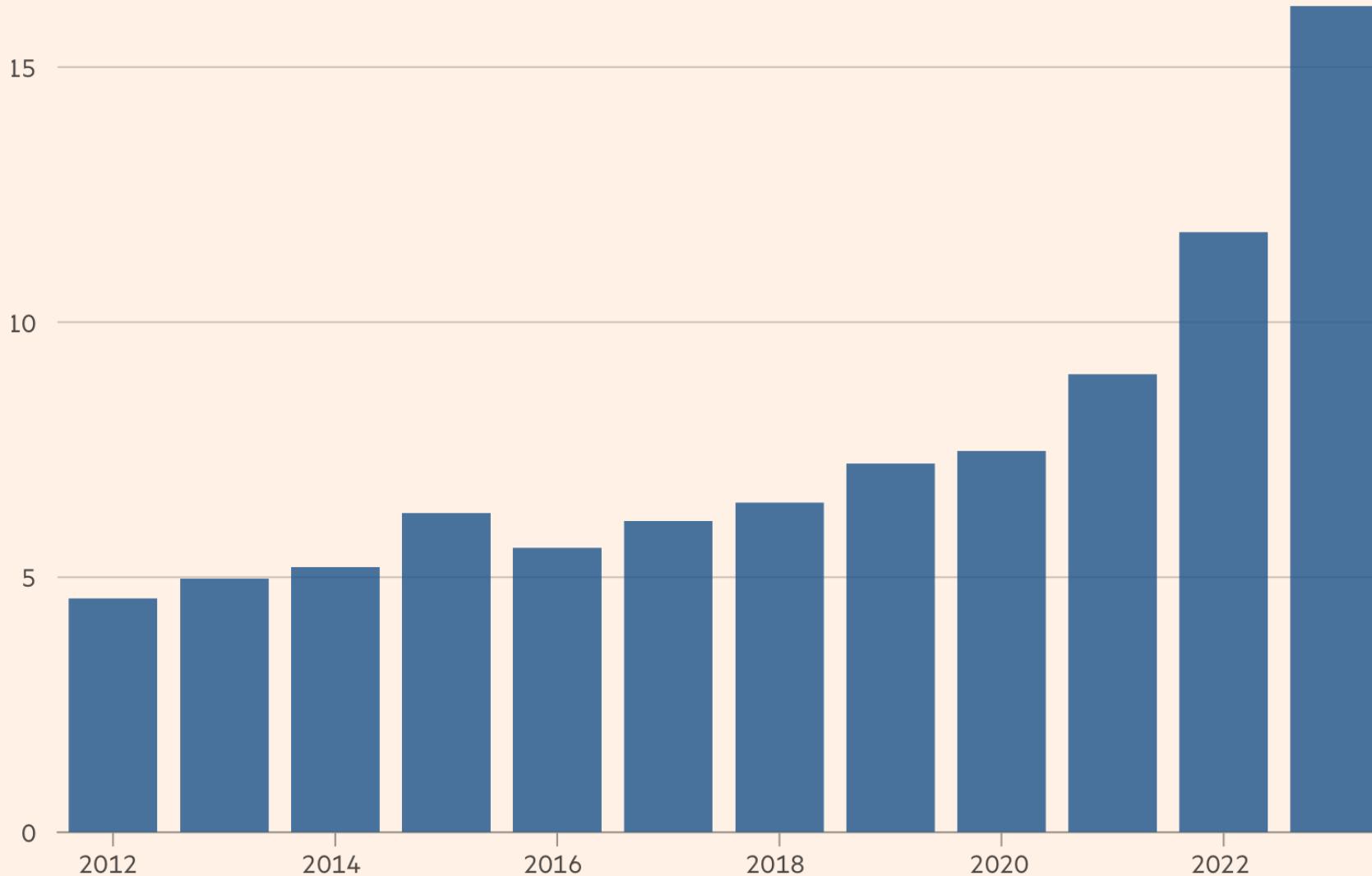
# The breadth of Russia's nuclear energy empire

By country



# Rosatom has seen a surge in its overseas revenue

Revenue from foreign projects (\$bn)



## Operable nuclear power capacity

