Nuclear Energy in the U.S.

Jacopo Buongiorno

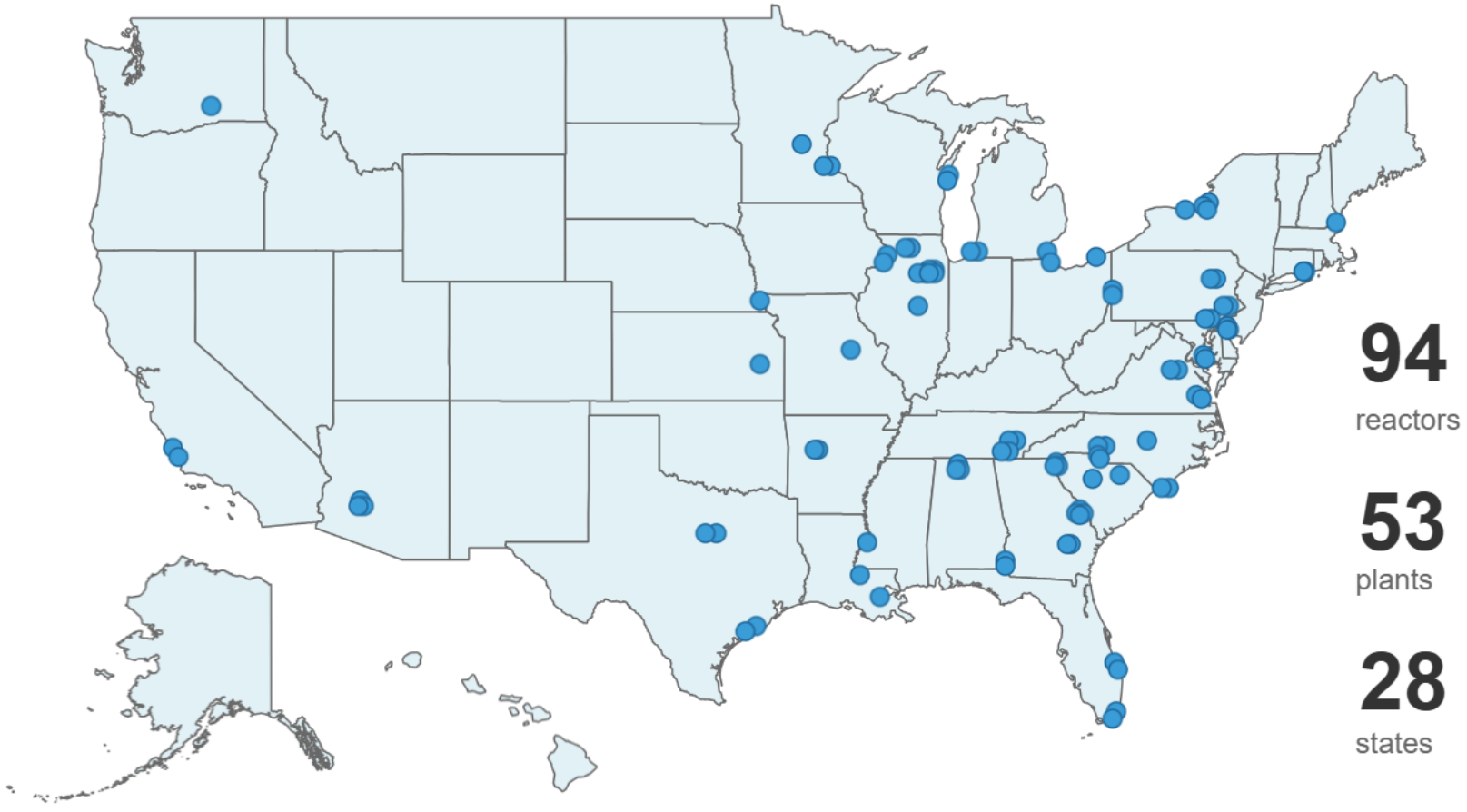
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THE EXISTING FLEET



- 96.9 GW capacity, 17.4% of total electricity generation (45.5% of carbon-free electricity in 2024).
- U.S. plants have run with an average capacity factor of 92.5% in 2025, up from 56% in 1980.

THE EXISTING FLEET (CONT.)

2025 Cost Summary ($/MWh)

Category	Plants / Sites	Fuel	Capital	Operating	Total Generating
All U.S.[2]	55	$5.95	$9.69	$20.82	**$36.46**
Revenue Source					
Merchant Market	23	$5.99	$5.15	$20.33	**$31.47**
Cost of Service Regulation	32	$5.93	$13.19	$21.19	**$40.31**
Type					
BWR	20	$5.55	$8.43	$22.49	**$36.46**
PWR	35	$6.16	$10.35	$19.96	**$36.46**

Source: EUCG

- 92 reactor licenses extended, from 40 years to 60 years of operation. Many are under going a second extension from 60 to 80 years.
- Nuclear industry safety accident rate is 0.01 per 100,000 worker-hours, much lower than most other U.S. industries like manufacturing, leisure, hospitality, finances, etc.
- Since the 1960s >30 reactors have been or are in the process of being decommissioned.

GET THE BALL ROLLING AGAIN DOMESTICALLY



Through the **Infrastructure Bill (2021)** and the **Inflation Reduction Act (2022)**, the Biden Administration committed substantial $$ to existing and new NPPs in the U.S.

Trump's Executive Orders (2025)

1. Reform the NRC. Limit license reviews to 18 months, reduce "un-necessary staff", get rid of LNT-based radiation regulations, etc.
2. Deploy pilot reactors at national labs, testing two before 4th of July 2026.
3. Build a fleet of small nuclear reactors for certain agencies (DOE, DOD, NASA) that can use nuclear for their core mission. Designate these assets as national security infrastructure.
4. Invest in uranium conversion/enrichment and fuel fabrication, facilitate power uprates, restart closed nuclear plants and strengthen the nuclear workforce pipeline, take a fresh look at fuel recycling.



https://www.whitehouse.gov/presidential-actions/executive-orders/

GET THE BALL ROLLING AGAIN DOMESTICALLY (cont.)

But is new nuclear construction happening in the U.S.?

- 3 restarts (TMI, Palisades, Duane Arnold)
- 8 GW of uprates
- 2 ARDP projects (Terrapower, X-energy)
- 1 test reactor for Kairos
- 6 microreactors (Aalo, Radiant, Valar, Antares, Oklo, Deployable) achieved criticality around the 4th of July
- 1 reactor for Project Pele

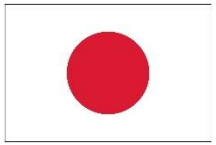
- Maybe 10 new AP1000s
- Maybe a few SMRs (GEH, Holtec)

COMPETE INTERNATIONALLY FOR NPP EXPORTS:

A NEW NUCLEAR ENERGY PARTNERSHIP AMONG STRATEGIC ALLIES?










What's needed to export NPPs:

FINANCE: U.S., U.K. and Canada capital markets, UAE sovereign fund

DESIGN & BUILD: Korea (KHNP, Doosan, Samsung, Hyundai), U.S. (Westinghouse, GEH, BWXT), Canada (Atkins Realis), France (EDF/Framatome)

OWN: either user country or partnership

OPERATE: Major nuclear utility (Southern/Constellation/Duke, KEPCO, EDF, OPG, ENEC, Fortum)

SUPPLY URANIUM: Australia, Canada

ENRICH AND FABRICATE FUEL: U.S. and E.U.

TAKE SPENT FUEL BACK: Finland, U.S., Australia, Canada

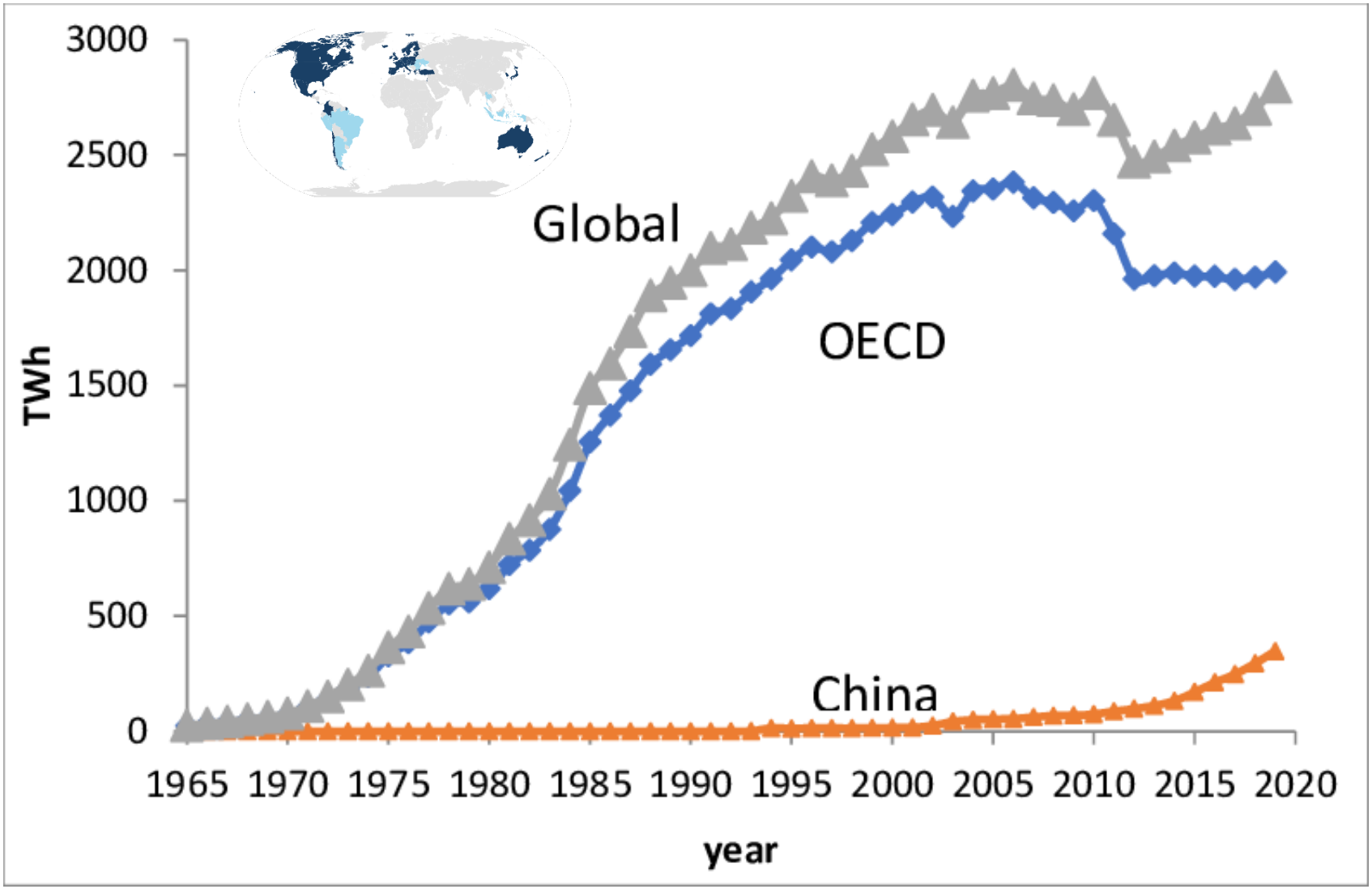


ABOUT THE SPEAKER

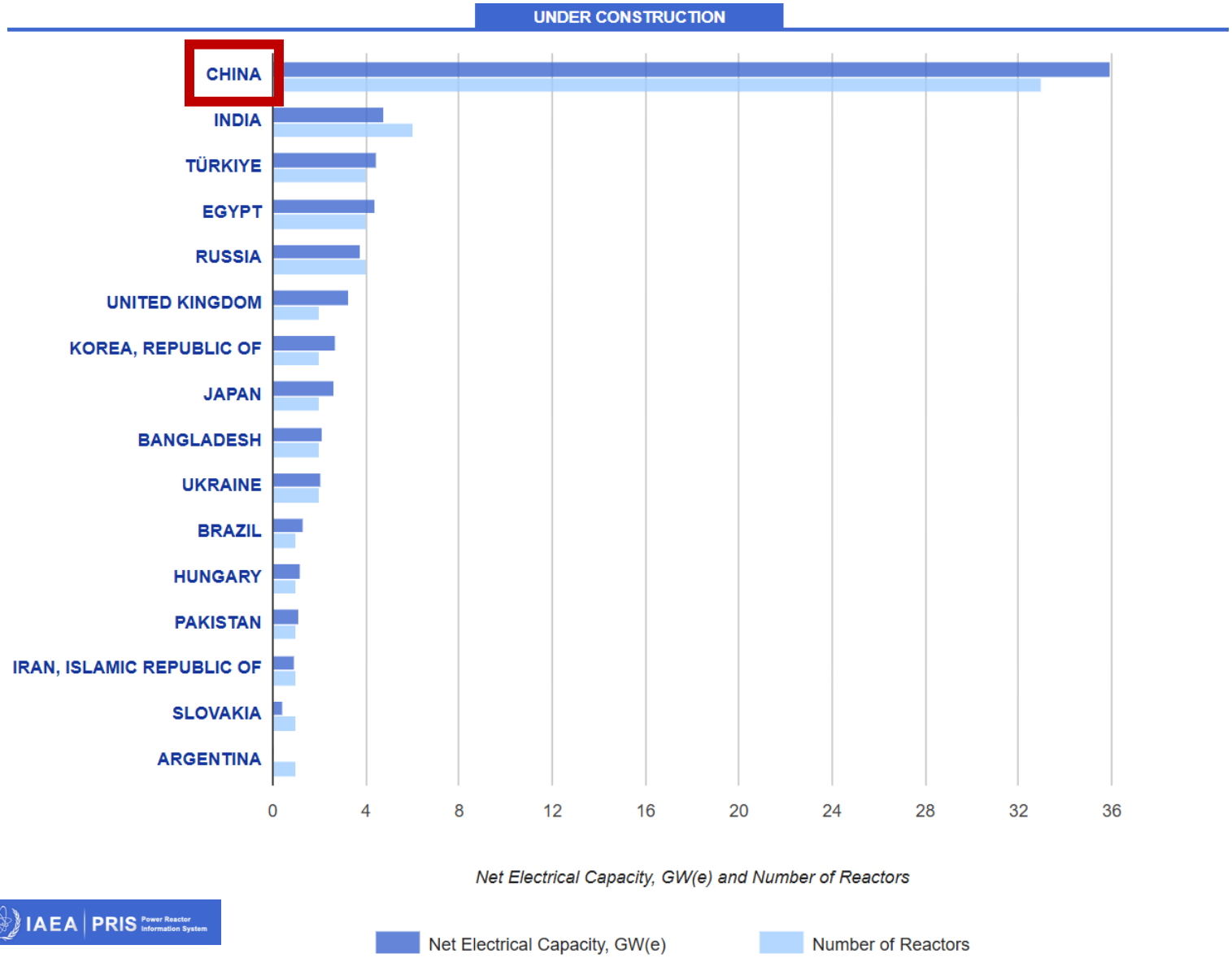
Jacopo Buongiorno is the Battelle Energy Alliance Professor in Nuclear Engineering at the Massachusetts Institute of Technology (MIT), the Director of Science and Technology of the MIT Nuclear Reactor Laboratory, and a member of the US National Academy of Engineering. He teaches a variety of undergraduate and graduate courses in thermo-fluids engineering and nuclear reactor engineering. Jacopo has published over 100 journal articles in the areas of reactor safety and design, two-phase flow and heat transfer, and nanofluid technology. For his research work and his teaching at MIT he won several awards, among which an ANS Presidential Citation (2022), the ANS Outstanding Teacher Award (2019), the MIT MacVicar Faculty Fellowship (2014), the ANS Landis Young Member Engineering Achievement Award (2011), the ASME Heat Transfer Best Paper Award (2008), and the ANS Mark Mills Award (2001). Jacopo is the Director of the Center for Advanced Nuclear Energy Systems (CANES). In 2016-2018 he led the MIT study on the Future of Nuclear Energy in a Carbon-Constrained World. Jacopo is a consultant for the nuclear industry in the area of reactor thermal-hydraulics and safety, and a member of the Advisory council of the Institute of Nuclear Power Operations (INPO). He is also a Fellow of the American Nuclear Society (including service on its Special Committee on Fukushima in 2011-2012), a Fellow of the NUclear Reactor Thermal Hydraulics (NURETH) conference, a member of the American Society of Mechanical Engineers, past member of the Naval Studies Board (2017-2019), past member of the Secretary of Energy Advisory Board (SEAB) Space Working Group, past member of the Accrediting Board of the National Academy of Nuclear Training (2011-2025), and a participant in the Defense Science Study Group (2014-2015).

THE CHALLENGES

THE USE OF NUCLEAR ENERGY IN OECD COUNTRIES HAS DECLINED SIGNIFICANTLY IN THE PAST 20 YEARS

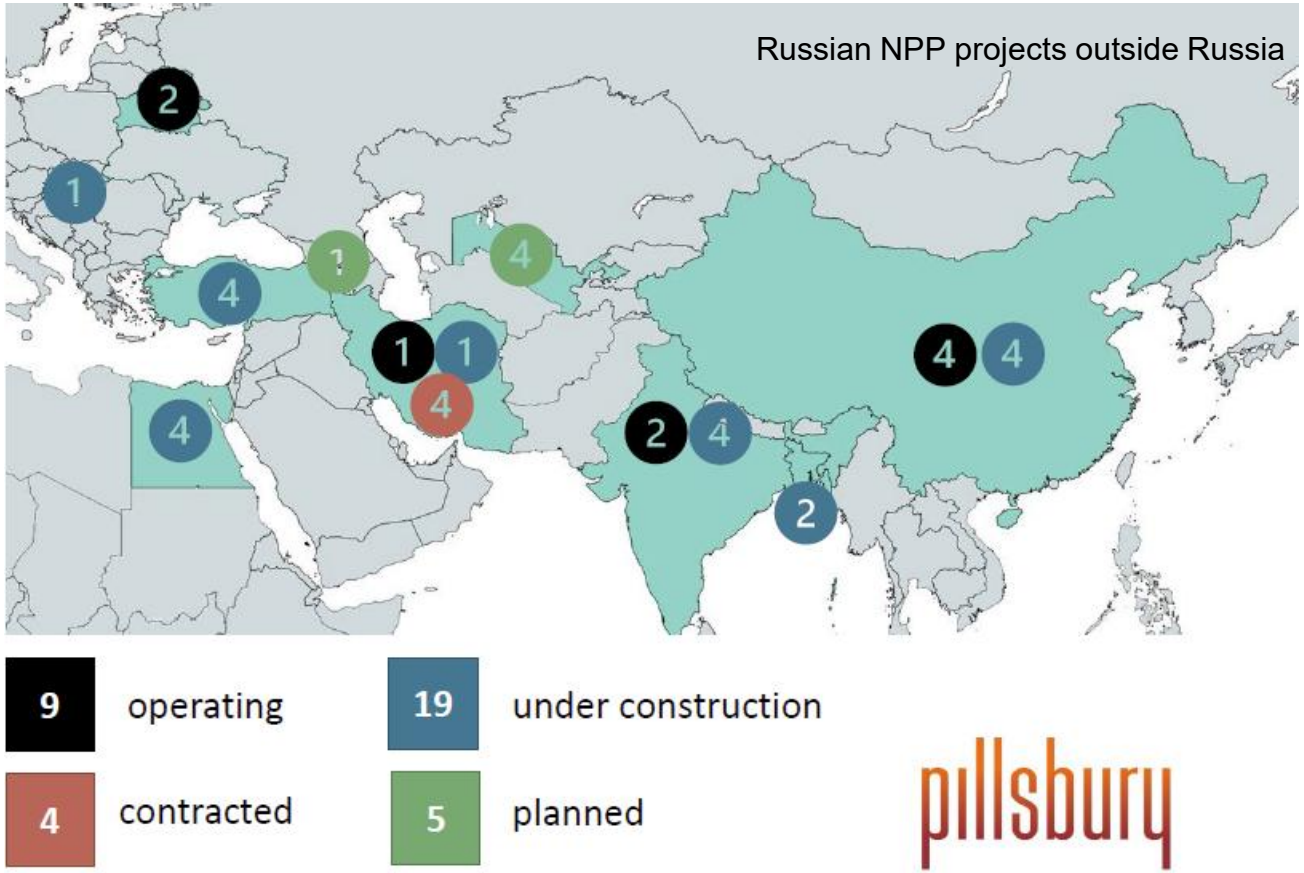


WHO IS BUILDING NPPs?



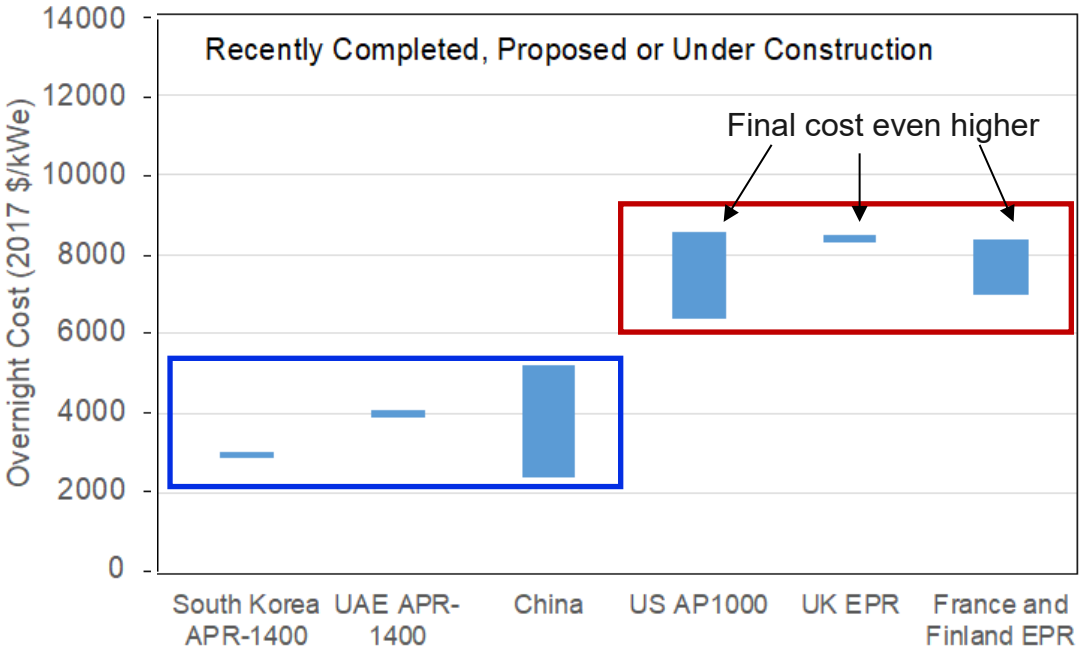
WHO IS SELLING NPPs?

- Russia dominates nuclear exports to new and established nuclear countries
- China, South Korea and France are a distant second
- No NPP currently under construction by the U.S. overseas



Nuclear energy is a strong tool of geopolitical influence

THE NUCLEAR INDUSTRY IN THE U.S. AND EUROPE HAS LOST THE ABILITY TO BUILD NPPs EFFICIENTLY



MIT Future of Nuclear study, 2018

Korea and China

- >90% detailed design completed before starting construction
- Proven NSSS supply chain and skilled labor workforce
- Fabricators/constructors included in the design team
- A single primary contract manager
- Flexible regulator can accommodate changes in design and construction in a timely fashion

U.S. and Europe

- Started construction with <50% design completed
- Atrophied supply chain, inexperienced workforce
- Litigious construction teams
- Regulatory process averse to design changes during construction

THE NUCLEAR INDUSTRY IN THE U.S. AND EUROPE HAS LOST THE ABILITY TO BUILD NPPs EFFICIENTLY (cont.)



Potential Cost Reduction in New Nuclear Deployments Based on Recent AP1000 Experience, INL/RPT-25-84701, June 12, 2025

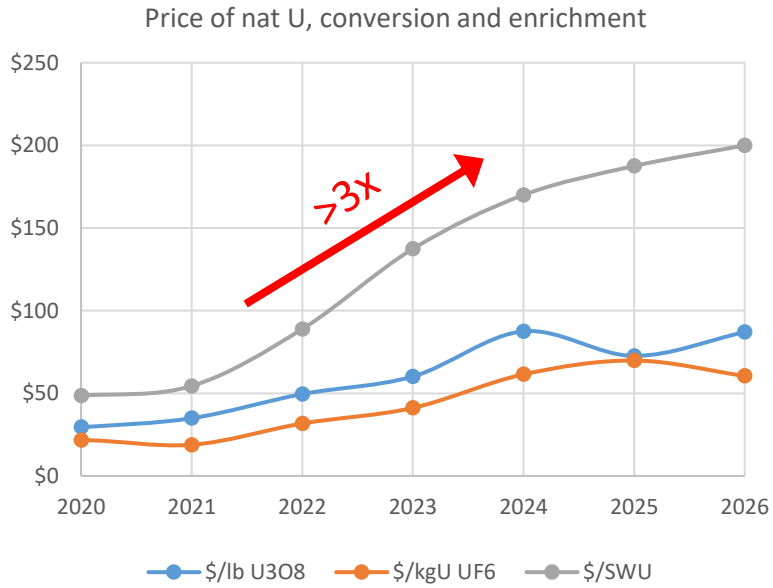
WE ALSO HAVE A FUEL PROBLEM NOW

Good old days (1960-2020)

- All power reactors used the same LEU UO_2 pellet fuel
- Demand was more or less stable
- Cheap LEU came from enrichment facilities in the U.S., Europe and Russia, and
- Weapon HEU down-blending (Megatons to Megawatts)

The ugly new reality (2020-present)

- Advanced reactors often require HALEU
- Vendors like expensive fuel forms (TRISO, metallic, hydride)
- Imbalance between projected demand and capacity for enrichment, conversion and fabrication is pushing up fuel costs
- Phasing Russia out of U.S. and European markets exacerbates the trend



Data courtesy of J. Hinze, U_xC, Feb 2026

THE SOLUTION?

TECHNOLOGIES

Electric output
NOAK Construction cost
NOAK Construction duration
Vendors

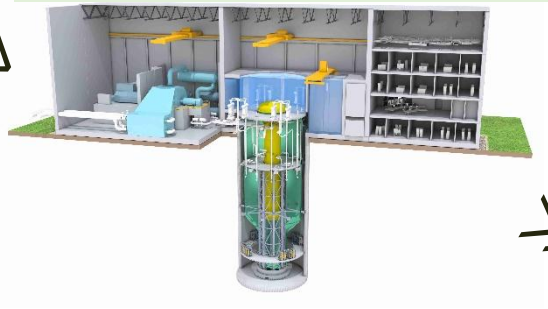
Large Reactors (LWRs)



~1000-1600 MW_e
~$3-10B
5-10 yrs

Westinghouse, KHNP, Rosatom, CNNC, CGN, EDF, GEH

Small Modular Reactors (SMRs)



~70-300 MW_e
~$1-3B
3-5 yrs

GEH, Westinghouse, Rolls Royce, EDF, Holtec, Nuscale, X-energy, Kairos, Terrapower, KHNP, Oklo, etc.

Microreactors (Nuclear Batteries)



~1-10 MW_e
<$0.2B
<1 yr

Westinghouse, BWXT, Radiant Nuclear, Aalo, Valar, etc.