Japan Launch

The World Nuclear Industry Status Report 2024

(WNISR2024)

www.WorldNuclearReport.org

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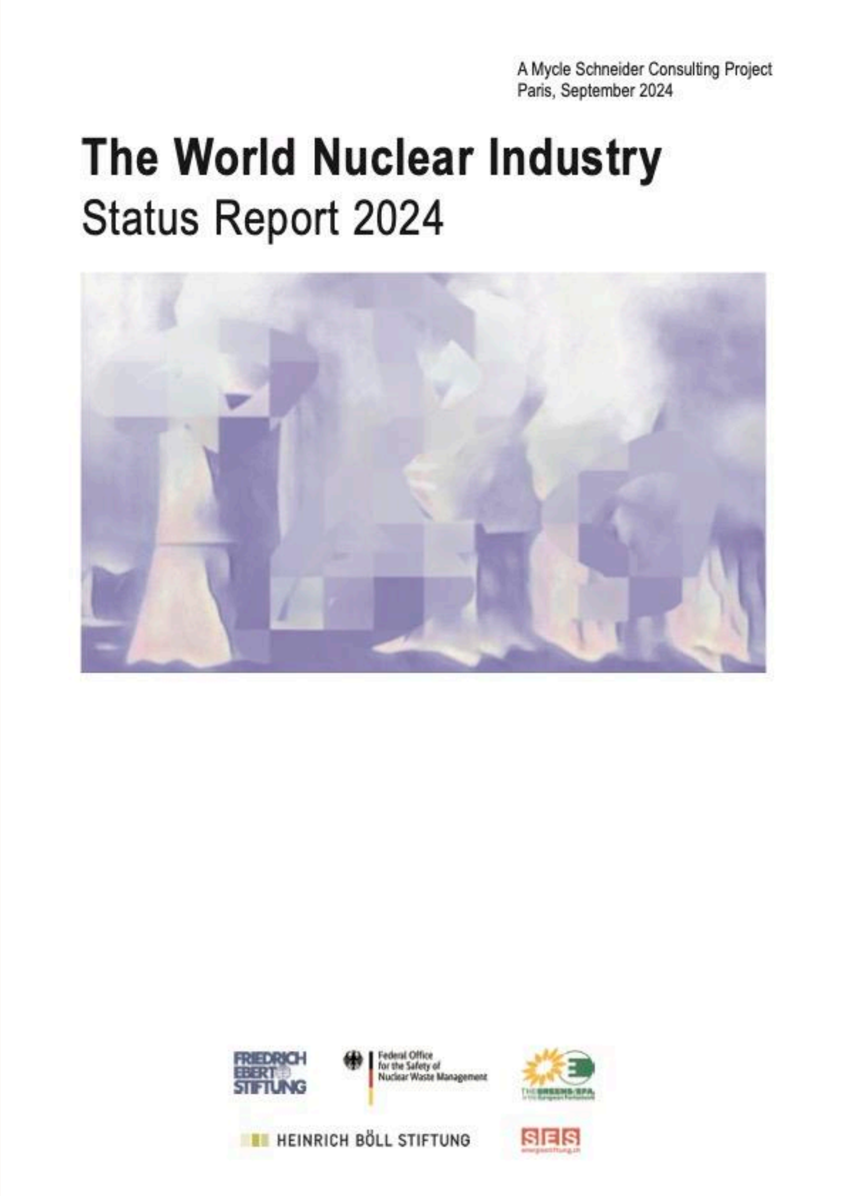
International, Interdisciplinary Team for a Multi-Indicator Analysis



The World Nuclear Industry
Status Report 2024

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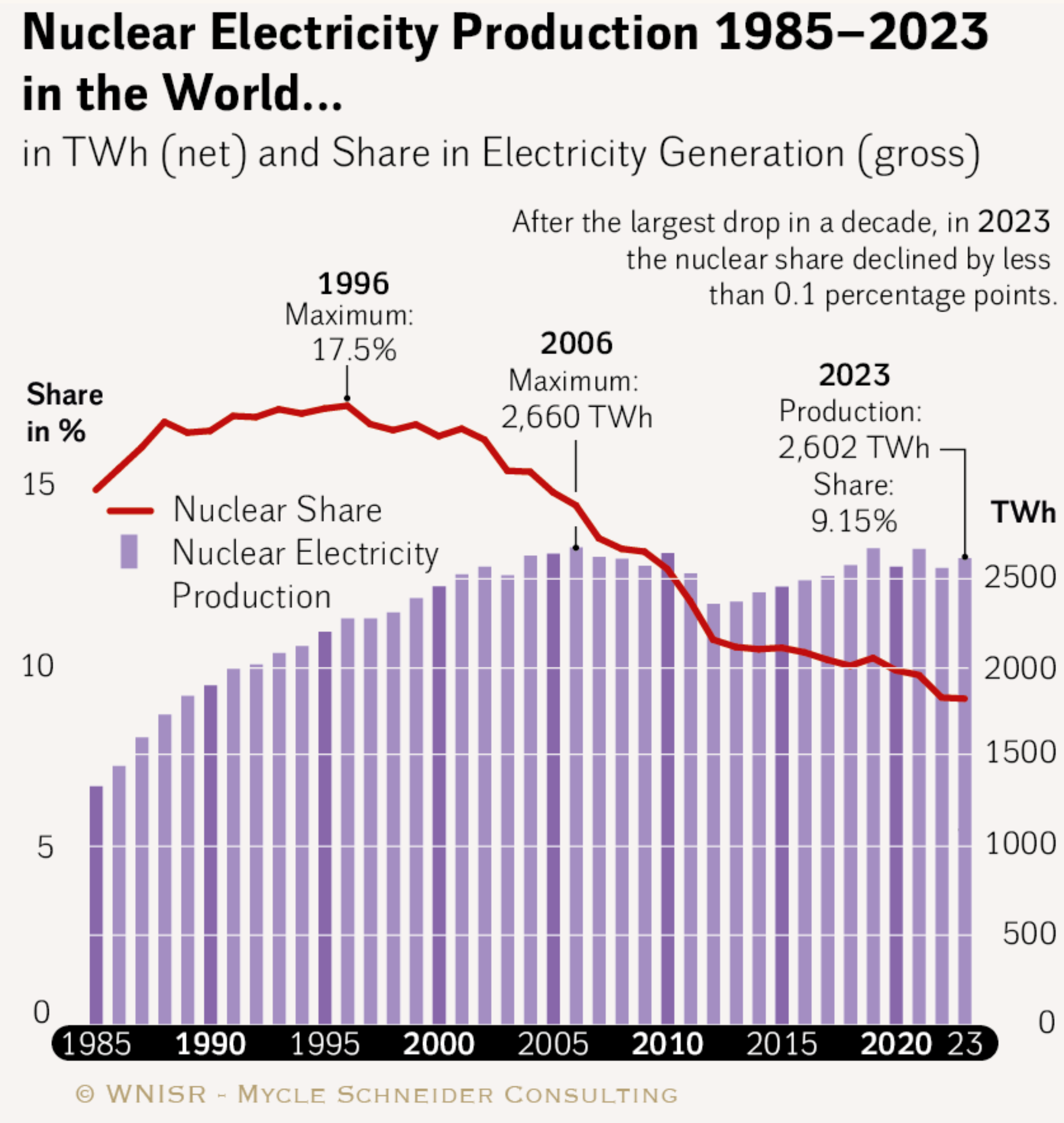
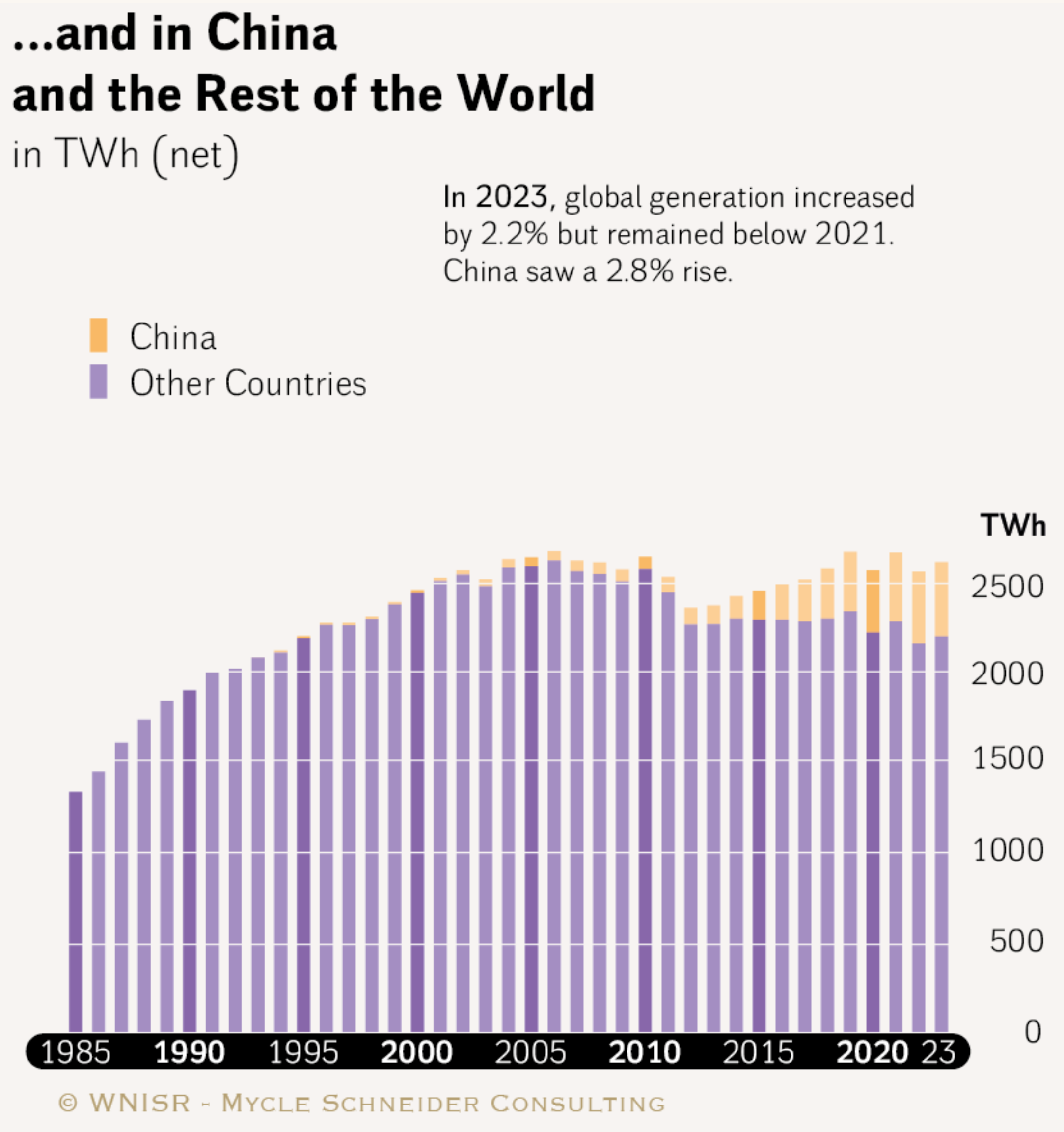
Mycle Schneider works as independent international consultant on energy and nuclear policy. He is the initiator, coordinator and publisher of the World Nuclear Industry Status Reports. He is a Founding Board Member and the Spokesperson for the International Energy Advisory Council (IEAC). He is a Founding Member of the International Nuclear Risk Assessment Group (INRAG) and a member of the International Nuclear Security Forum (INSF), based at the Stimson Center, USA. He is a member of the International Panel on Fissile Materials (IPFM), based at Princeton University, USA.

Between 2004 and 2009, he has been in charge of the Environment and Energy Strategies Lecture of the International Master of Science for Project Management for Environmental and Energy Engineering at the *Ecole des Mines* in Nantes, France.

From 2000 to 2010, he was an occasional advisor to the German Environment Ministry. 1998–2003, he was an advisor to the French Environment Minister's Office and to the Belgian Minister for Energy and Sustainable Development. Mycle Schneider has given evidence or held briefings at national Parliaments in 16 countries and at the European Parliament. He has advised Members of the European Parliament from four different groups over the past 30+ years. He has given lectures or had teaching appointments at over 20 universities and engineering schools in a dozen countries.

GLOBAL OVERVIEW – Role of Nuclear Power

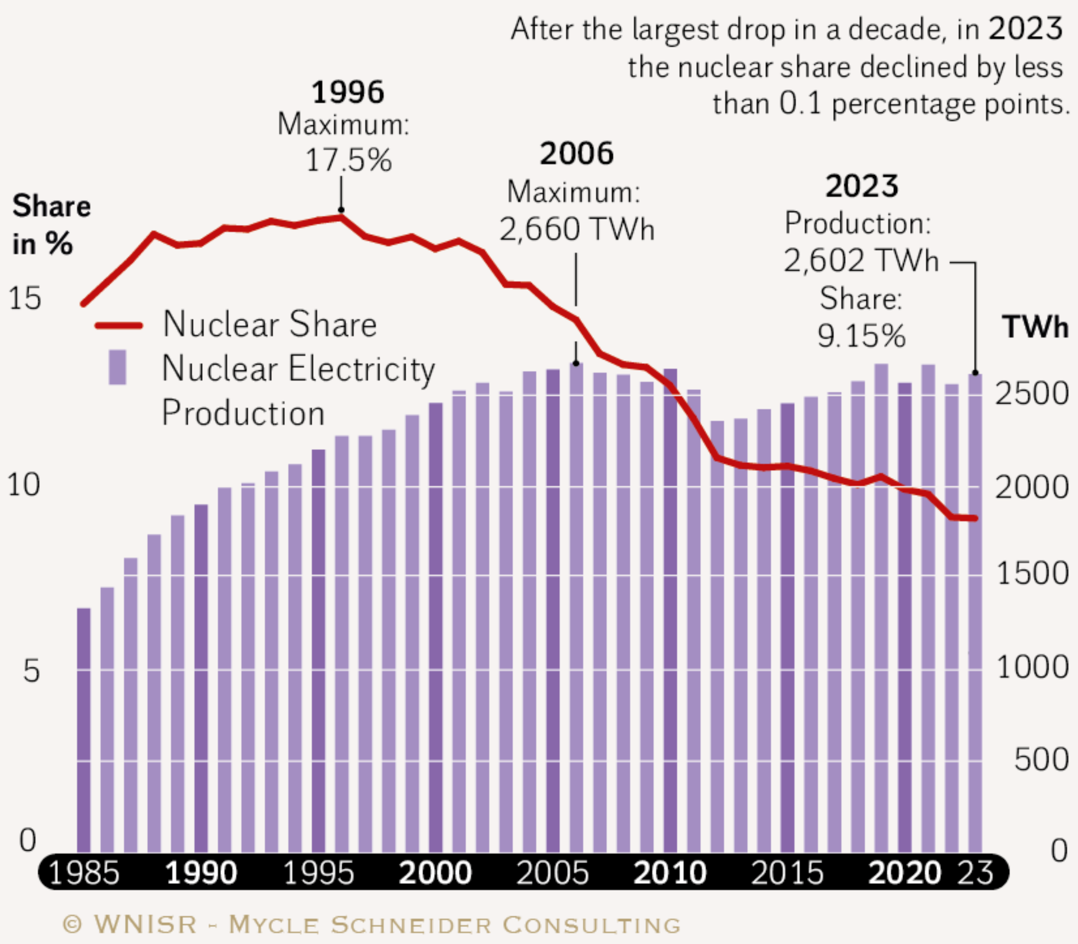




Sources: IAEA & Energy Institute, 2024

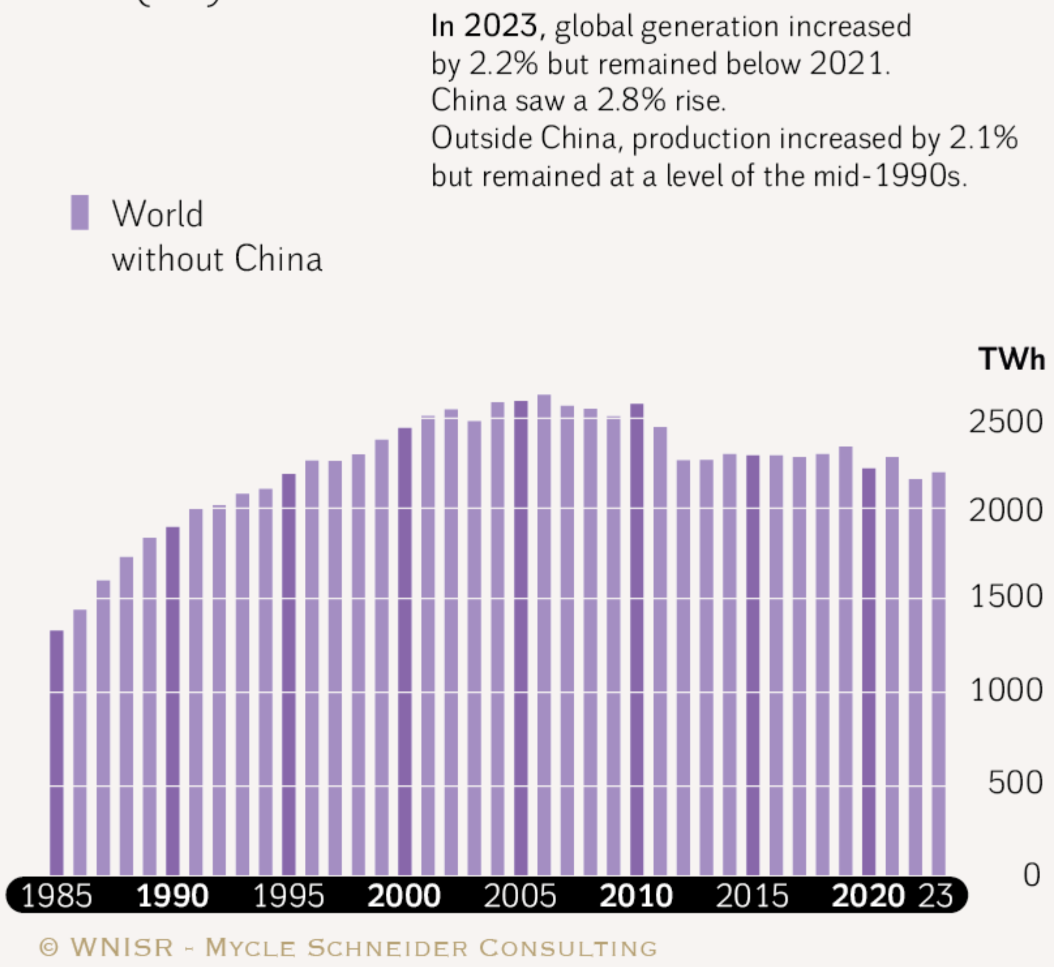
Nuclear Electricity Production 1985–2023 in the World...

in TWh (net) and Share in Electricity Generation (gross)



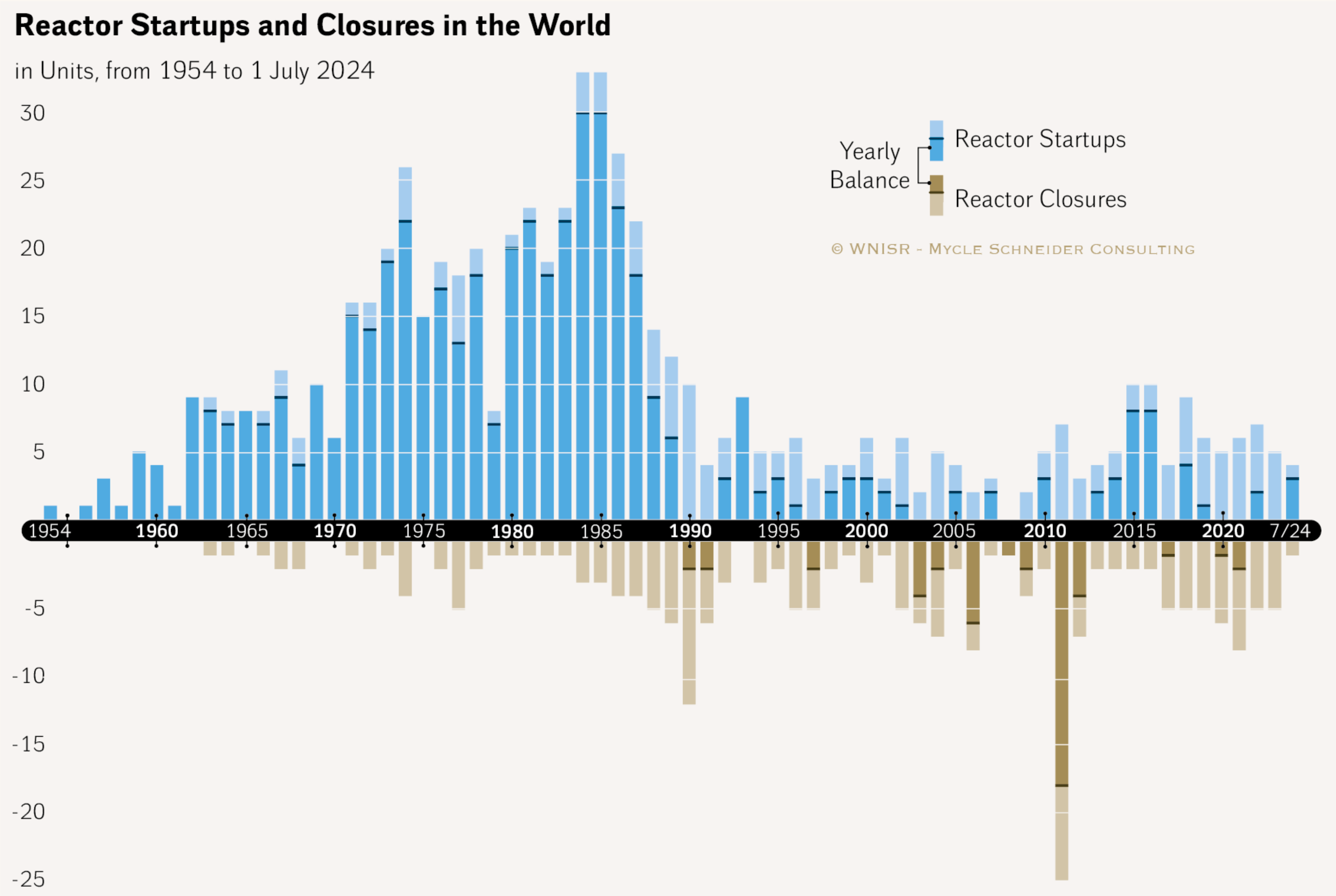
...and in China and the Rest of the World

in TWh (net)



Sources: IAEA & Energy Institute, 2024

GLOBAL OVERVIEW – Startups and Closures in the World



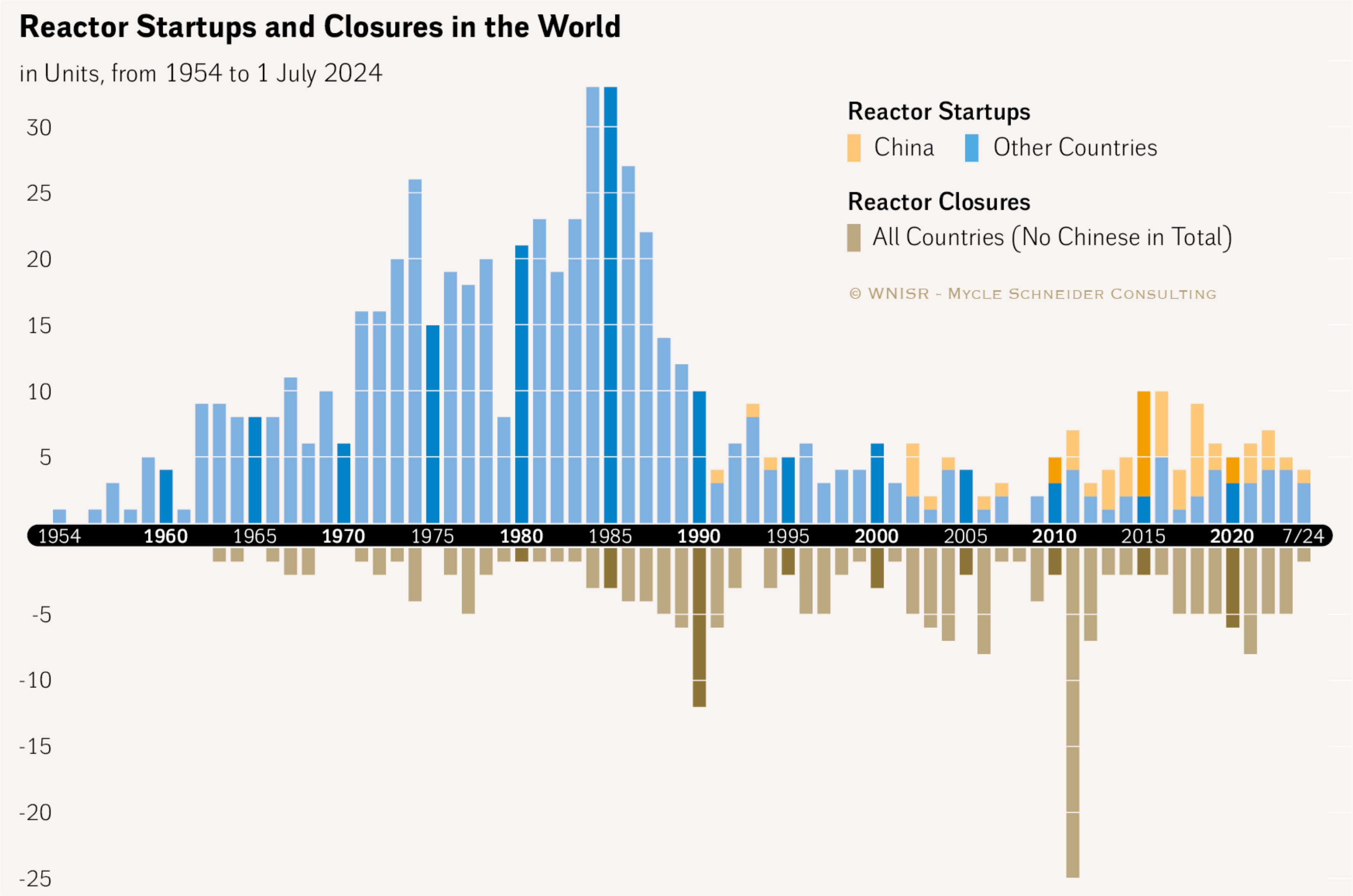
Sources: WNISR and IAEA-PRIS, 2024

2004–2023

World

- 102 Startups
- 104 Closures

GLOBAL OVERVIEW – Startups and Closures, World and China



Sources: WNISR and IAEA-PRIS, 2024

2004–2023

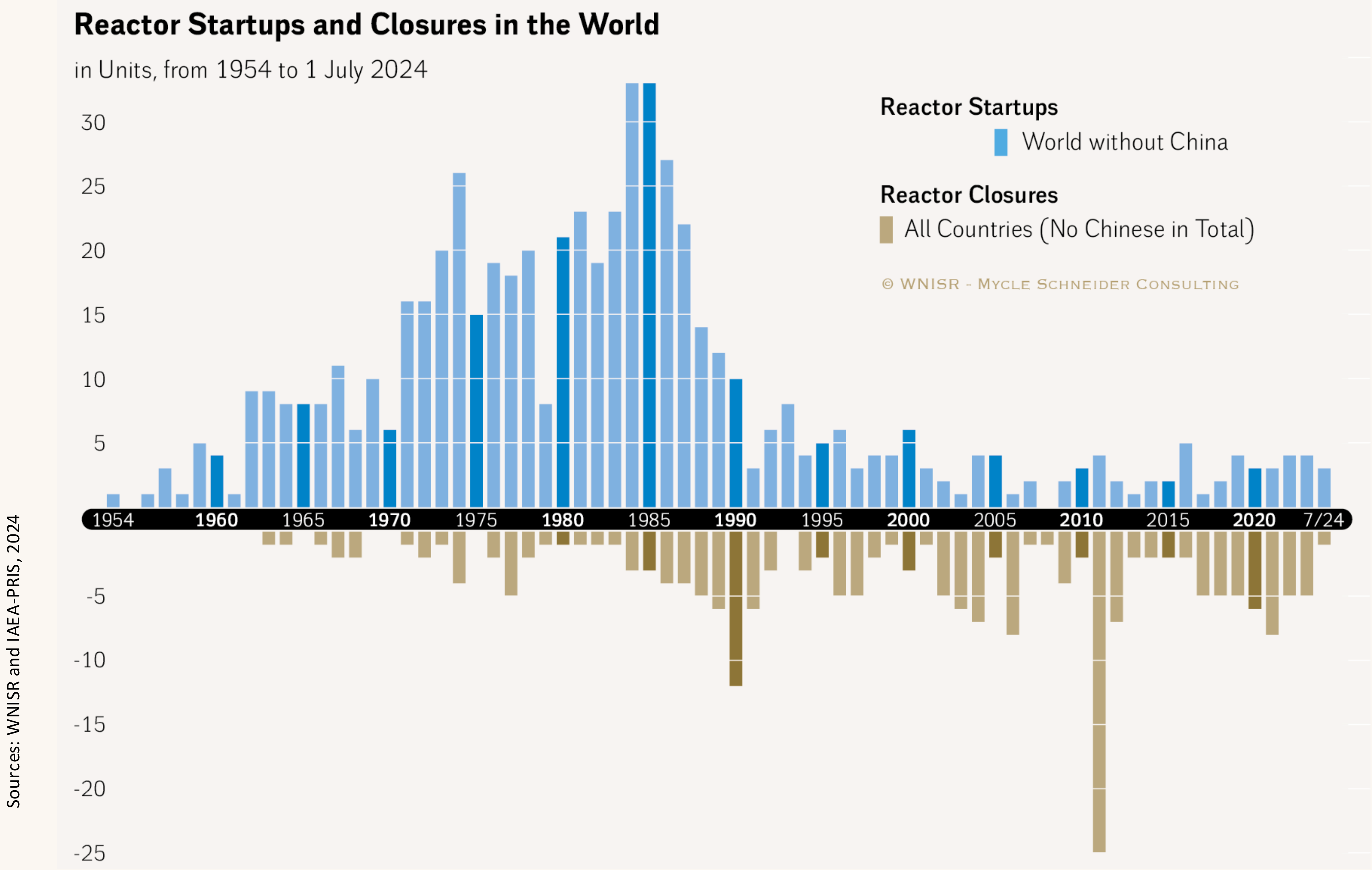
World

- 102 Startups
- 104 Closures

China

- 49 Startups
- No Closure

GLOBAL OVERVIEW – Startups and Closures, World Without China



2004–2023

World

- 102 Startups
- 104 Closures

China

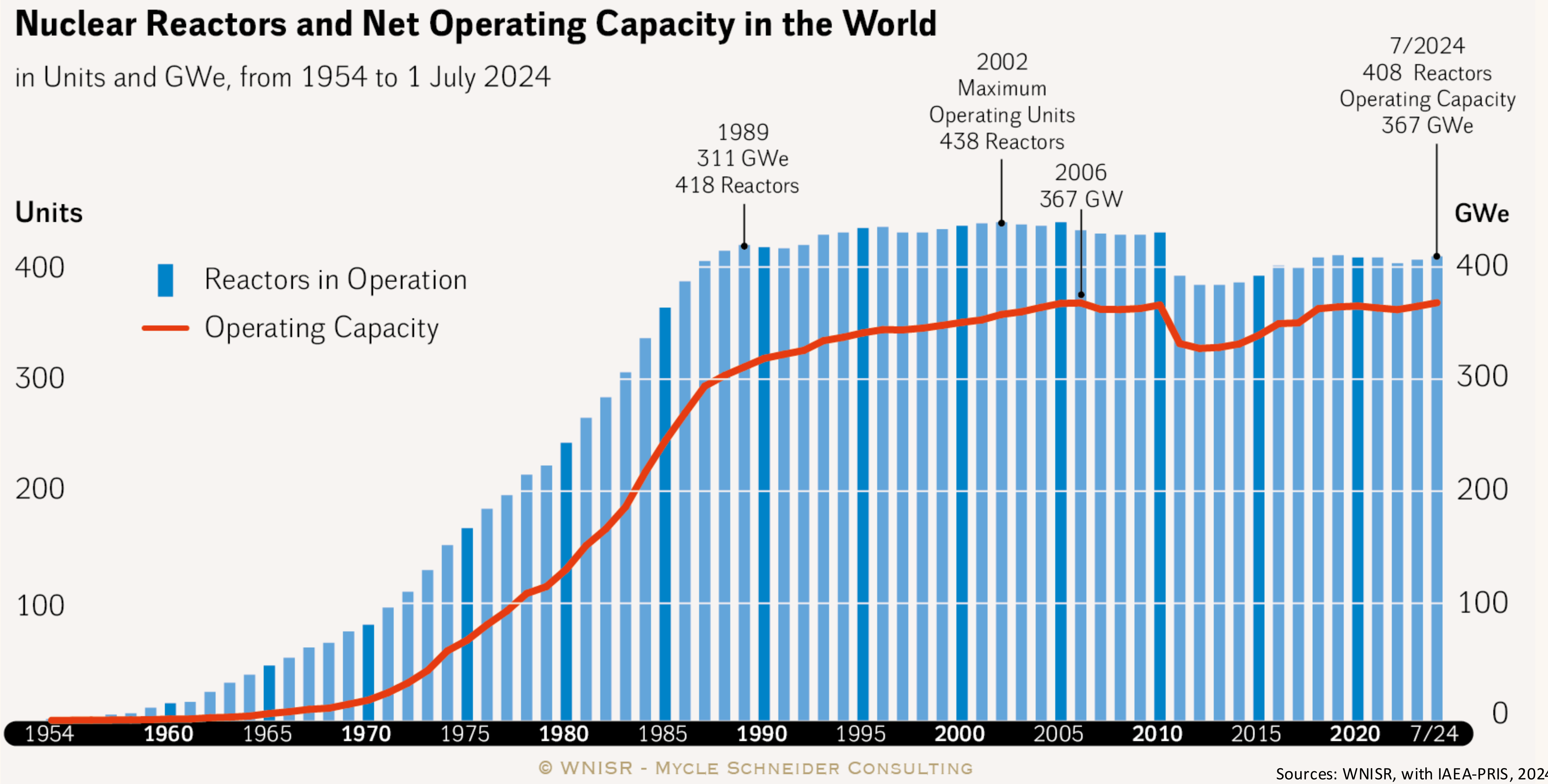
- 49 Startups
- No Closure

World Outside China

- 53 Startups
- 104 Closures

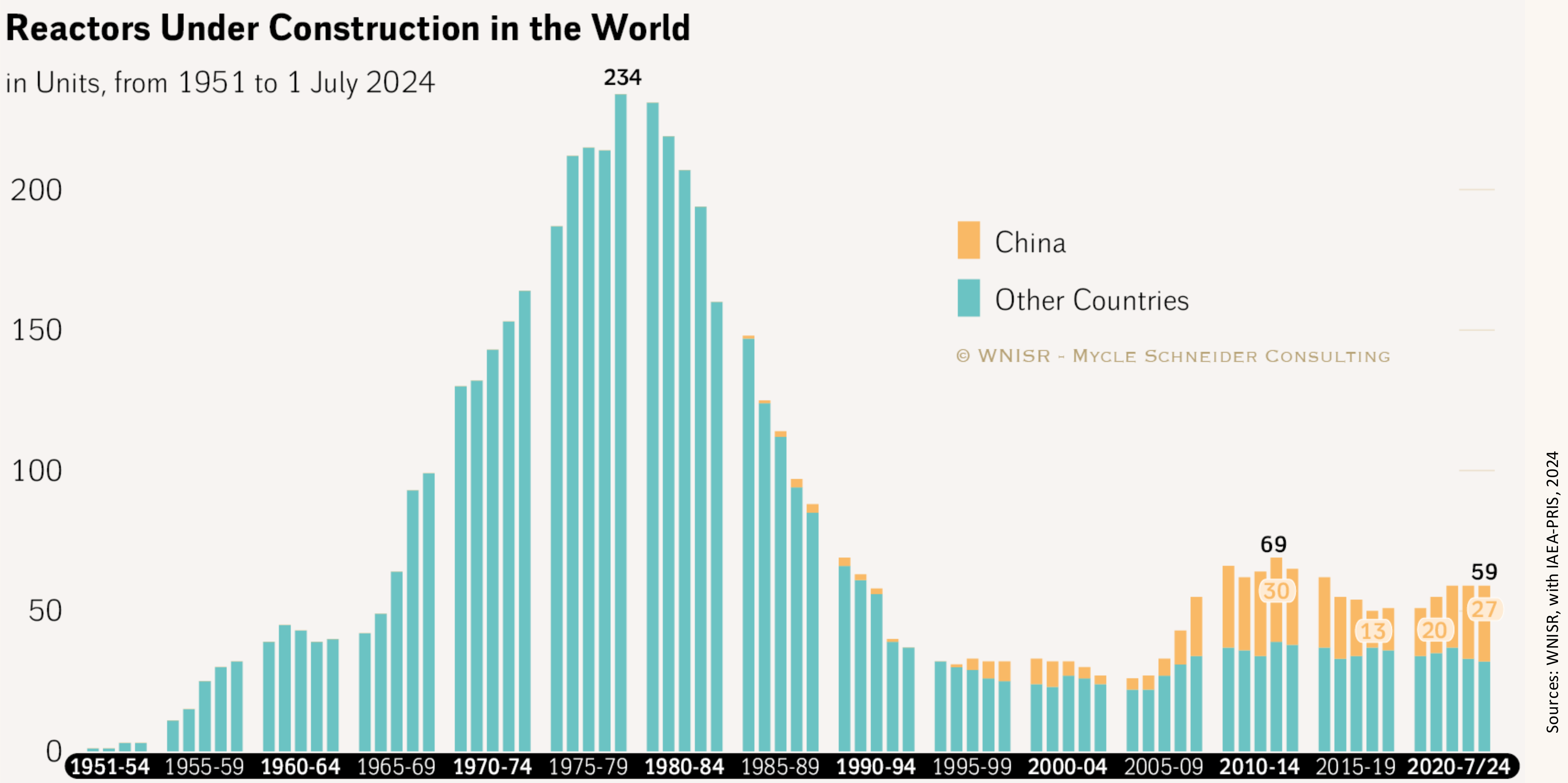
Net Balance -51

GLOBAL OVERVIEW — Evolution of World Fleet

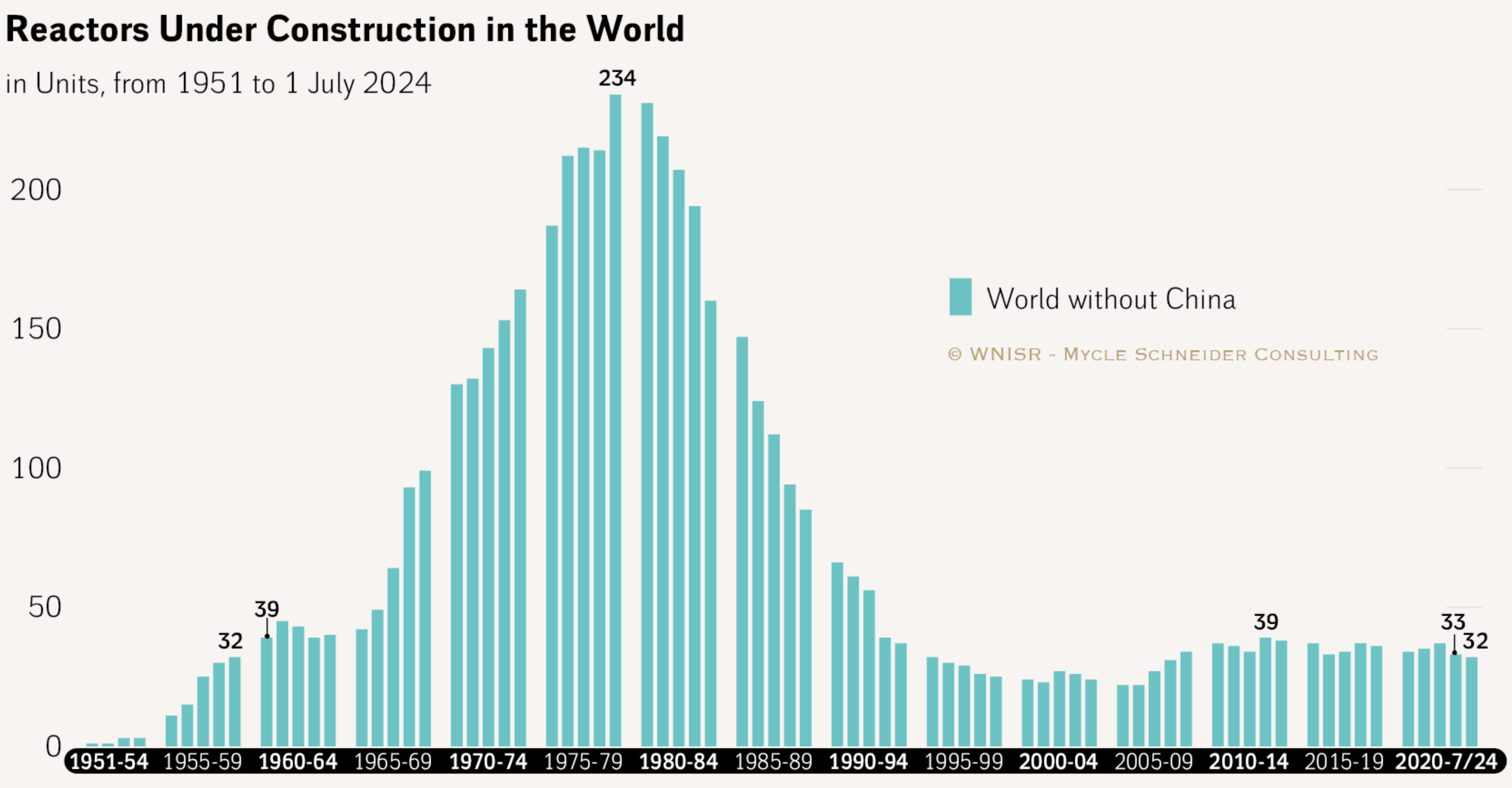


Sources: WNISR, with IAEA-PRIS, 2024

GLOBAL OVERVIEW — Constructions in China and Elsewhere



GLOBAL OVERVIEW — Constructions in the World Without China

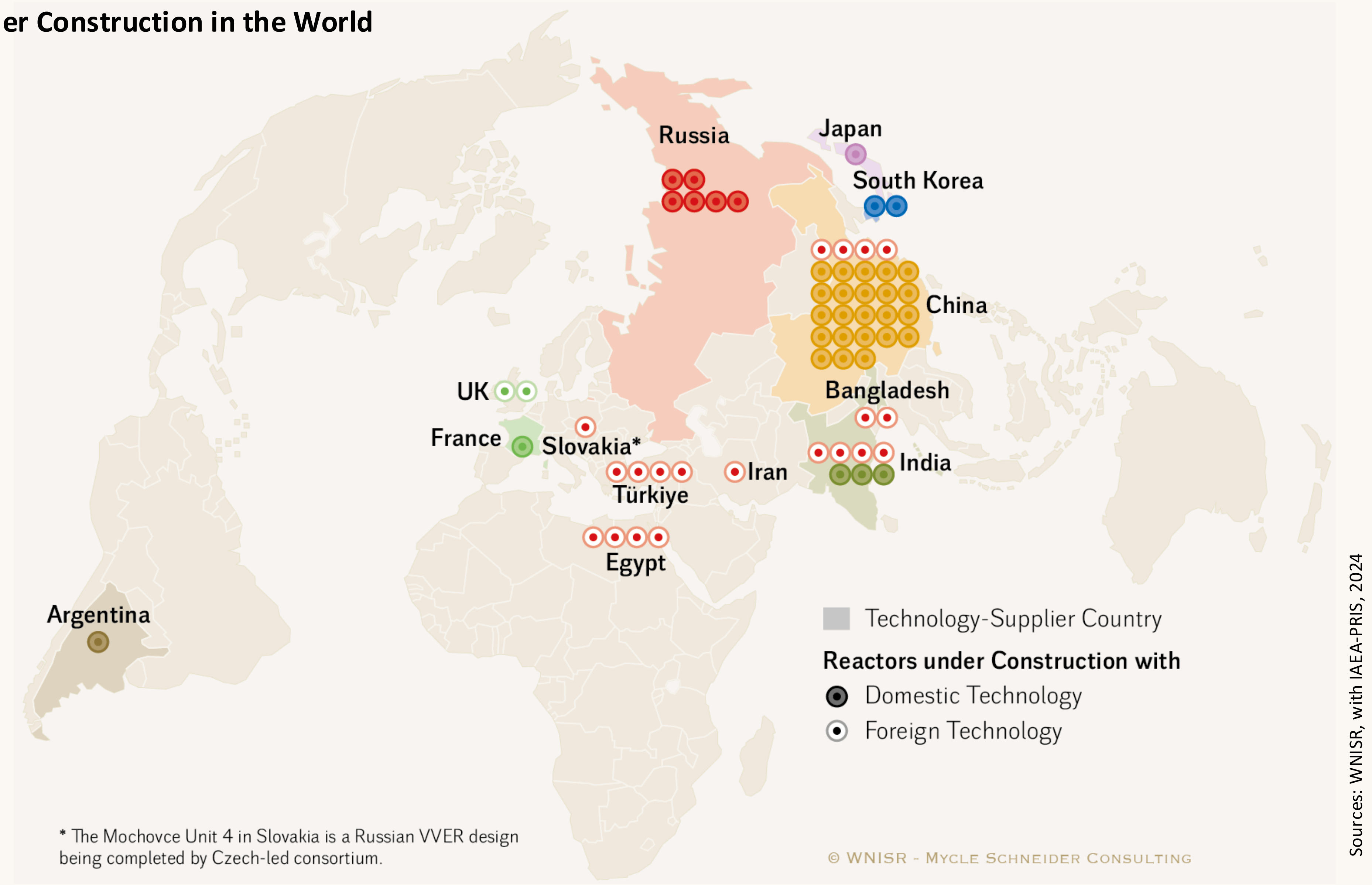


Sources: WNISR, with IAEA-PRIS, 2024

GLOBAL OVERVIEW — Constructions

Nuclear Power Reactors under Construction in the World

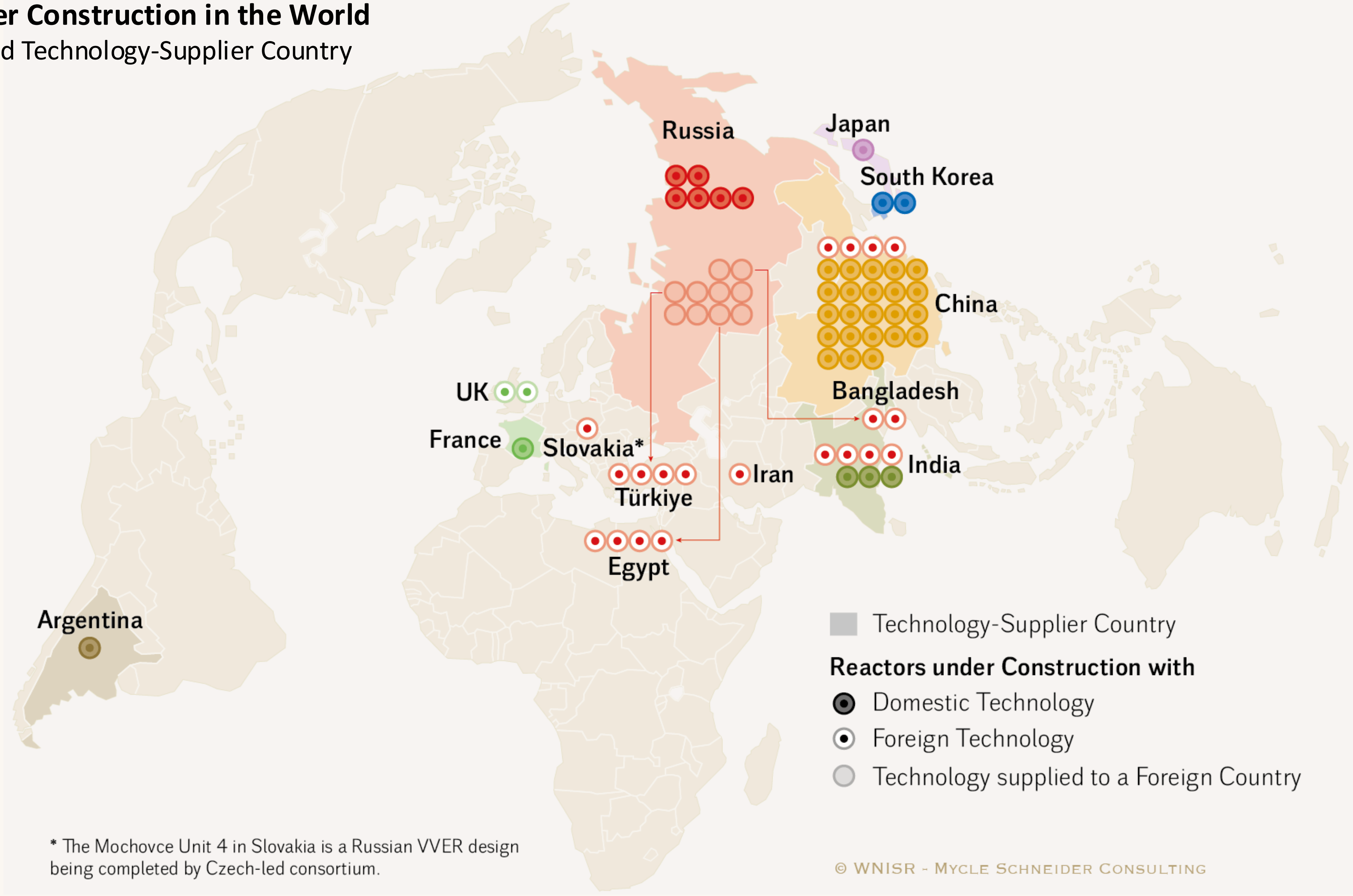
Units by Construction Country
as of 1 July 2024



GLOBAL OVERVIEW — Who Is Building?

Nuclear Power Reactors under Construction in the World

Units by Construction Country and Technology-Supplier Country
as of 1 July 2024



* The Mochovce Unit 4 in Slovakia is a Russian VVER design being completed by Czech-led consortium.

Sources: WNISR, with IAEA-PRIS, 2024

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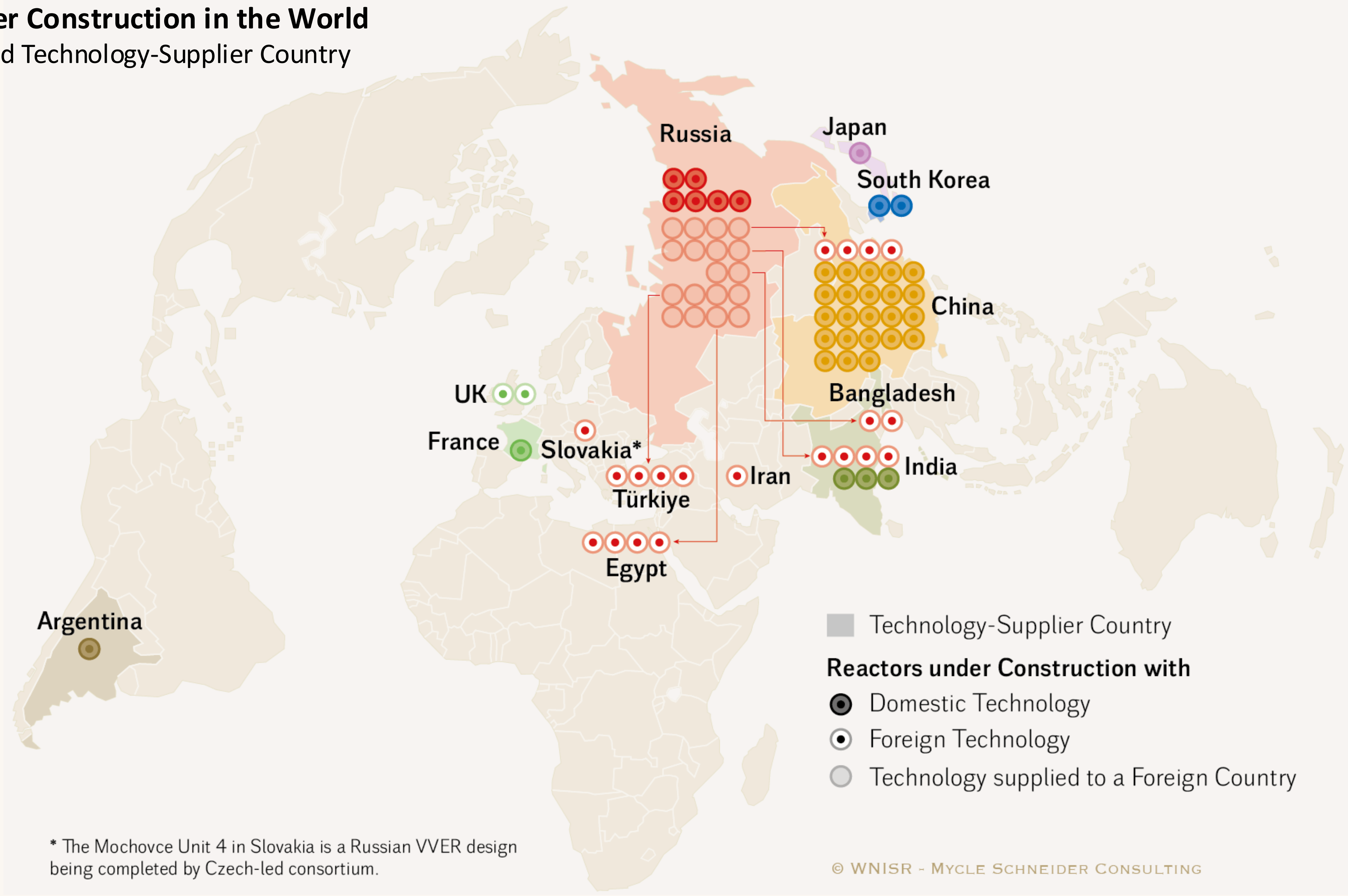

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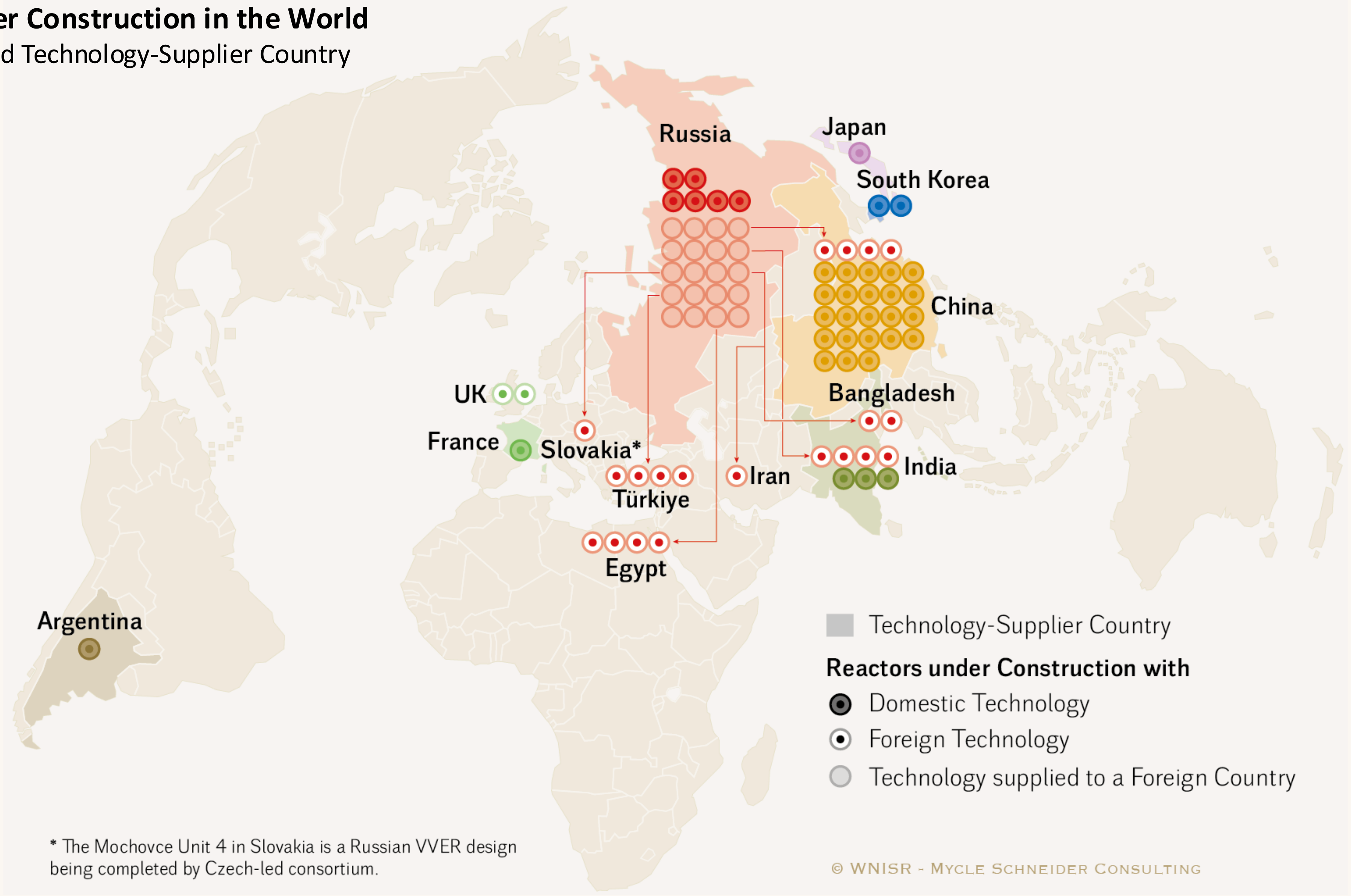

Sources: WNISR, with IAEA-PRIS, 2024

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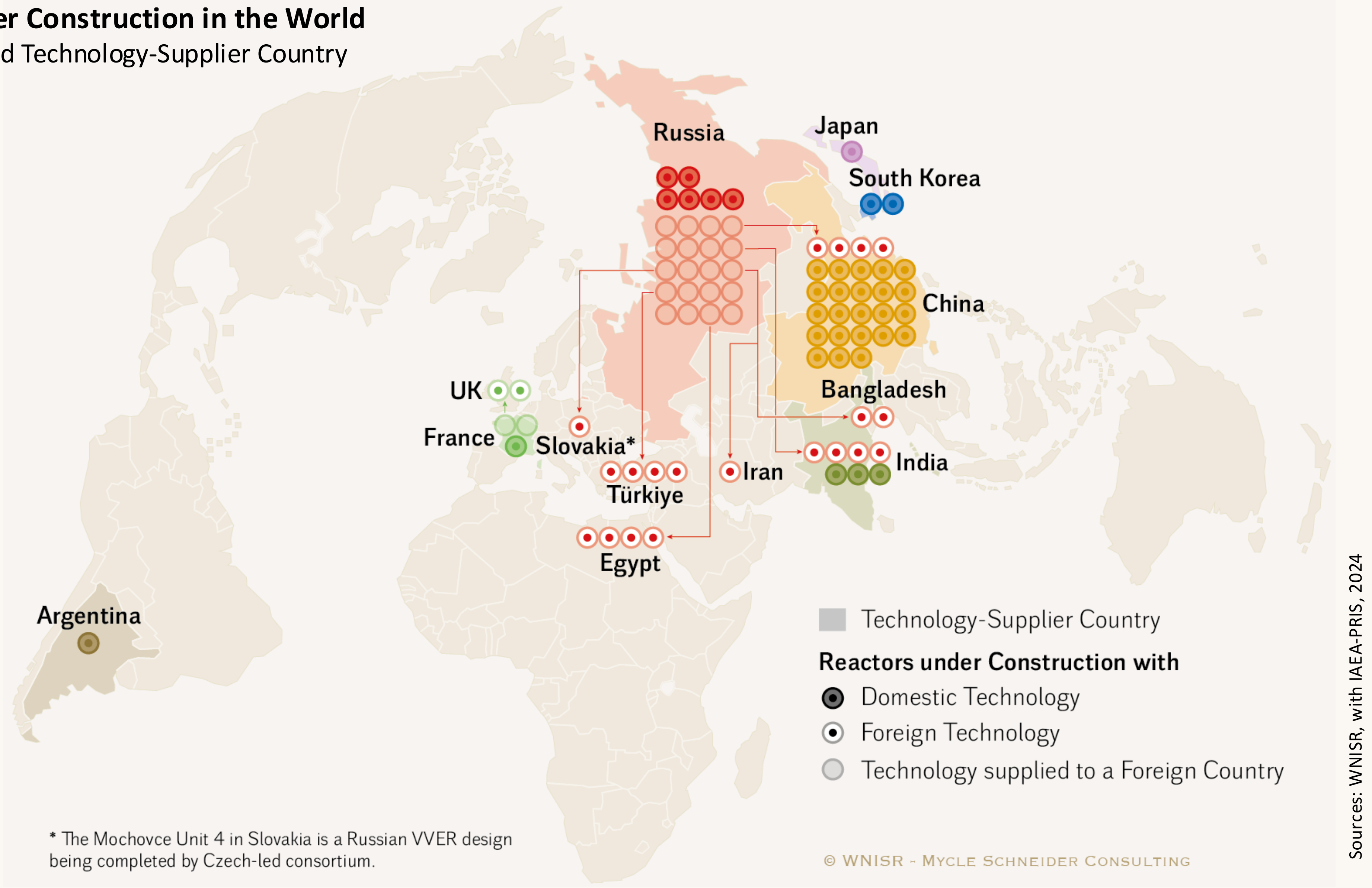


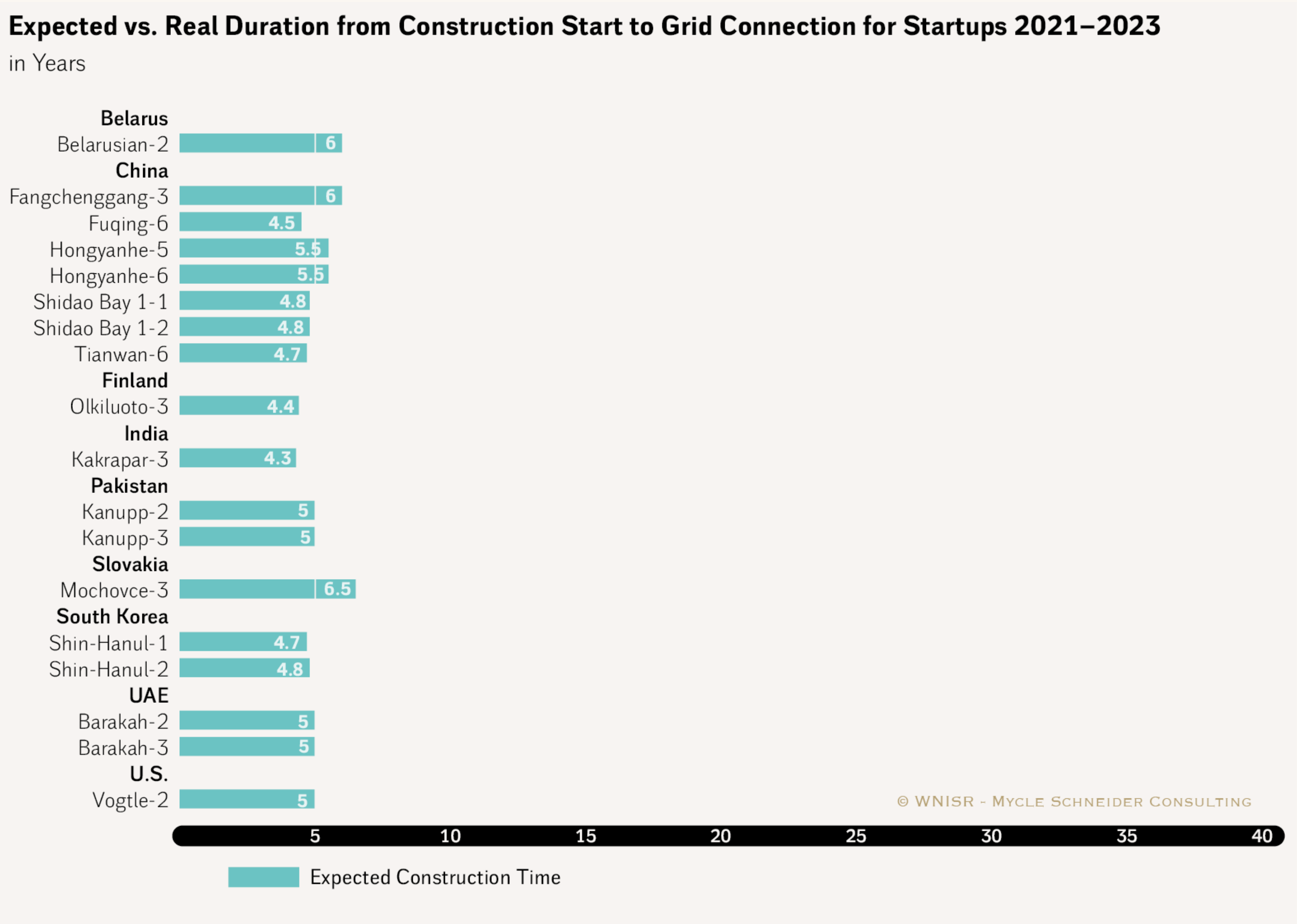
GLOBAL OVERVIEW — Constructions, Russia Dominates

Nuclear Reactors Under Construction (as of 1 July 2024)

Country	Units (Domestic Design)	Other Vendor	Capacity (MW net)	Construction Start	Grid Connection	Units Behind Schedule
China	27 (23)	Russia: 4	29 101	2017 – 2024	2024 – 2029	1
India	7 (3)	Russia: 4	5 398	2004 – 2021	2024 – 2027	5
Russia	6 (6)	–	3 960	2018 – 2024	2025 – 2030	2
Turkey	4 (0)	Russia: 4	4 456	2018 – 2022	2025 – 2028	4
Egypt	4 (0)	Russia: 4	4 400	2022 – 2024	2028 – 2031	-
South Korea	2 (2)	–	2 680	2017 – 2018	2024 – 2025	2
Bangladesh	2 (0)	Russia: 2	2 160	2017 – 2018	2024 – 2025	2
U.K.	2 (0)	France: 2	3 260	2018 – 2019	2030 – 2031	2
Argentina	1 (1)	–	25	2014	2028	1
France	1 (1)	–	1 630	2007	2024	1
Iran	1 (0)	Russia: 1	974	1976	2028	1
Japan	1 (1)	–	1 325	2007	2030	1
Slovakia	1 (0)	Russia: 1[b]	440	1985	2025	1
Total	**59**		**59 809**	**1976 – 2024**	**2024 – 2031**	**23**
Total per Vendor Country: Russia: 26 - China: 23 - India: 3 – South Korea: 2 - France: 3 - Argentina: 1 - Japan: 1						

Sources: WNISR, with IAEA-PRIS, 2024

GENERAL OVERVIEW — CONSTRUCTION TIME



Sources: Various, compiled by WNISR, 2024

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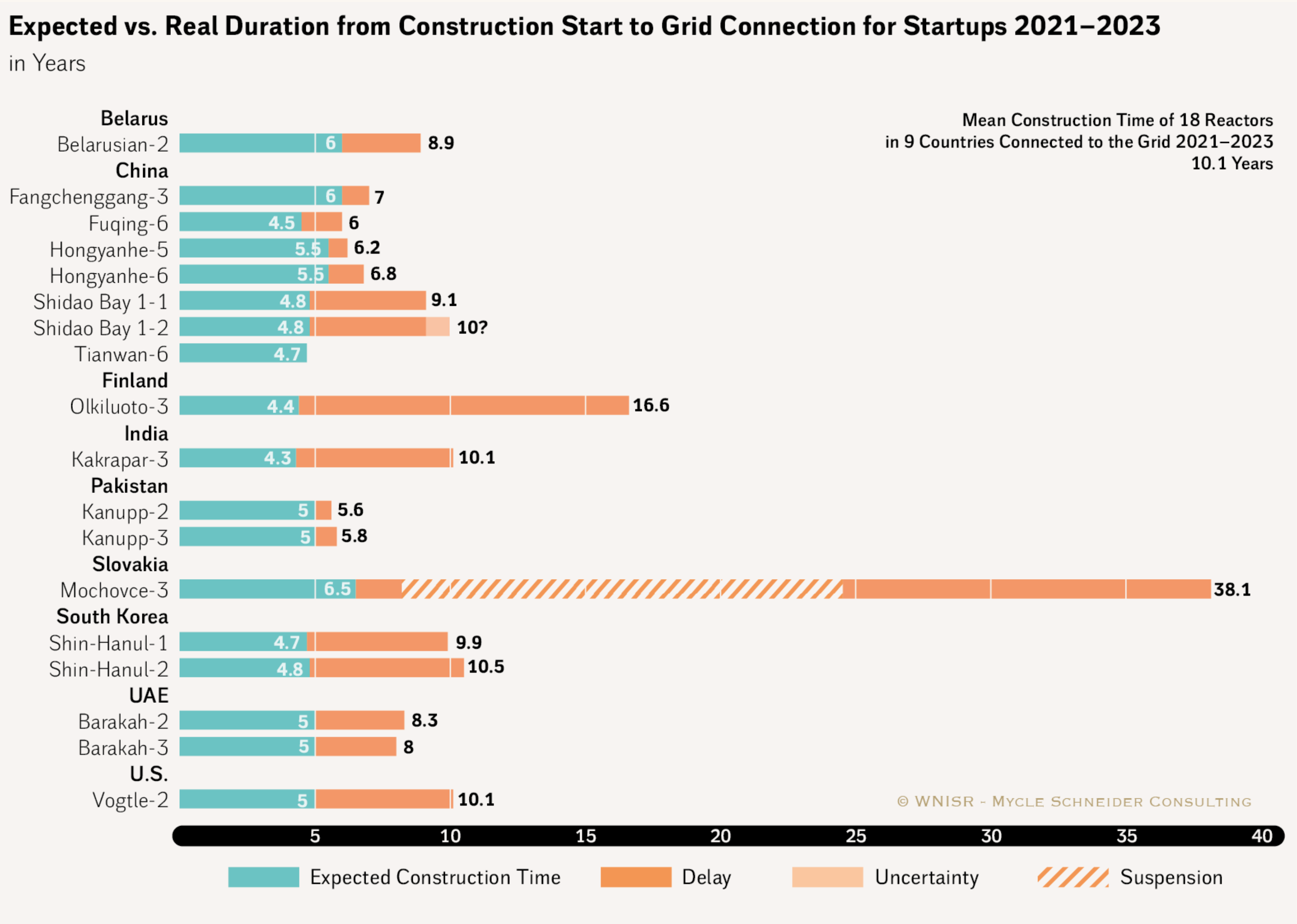
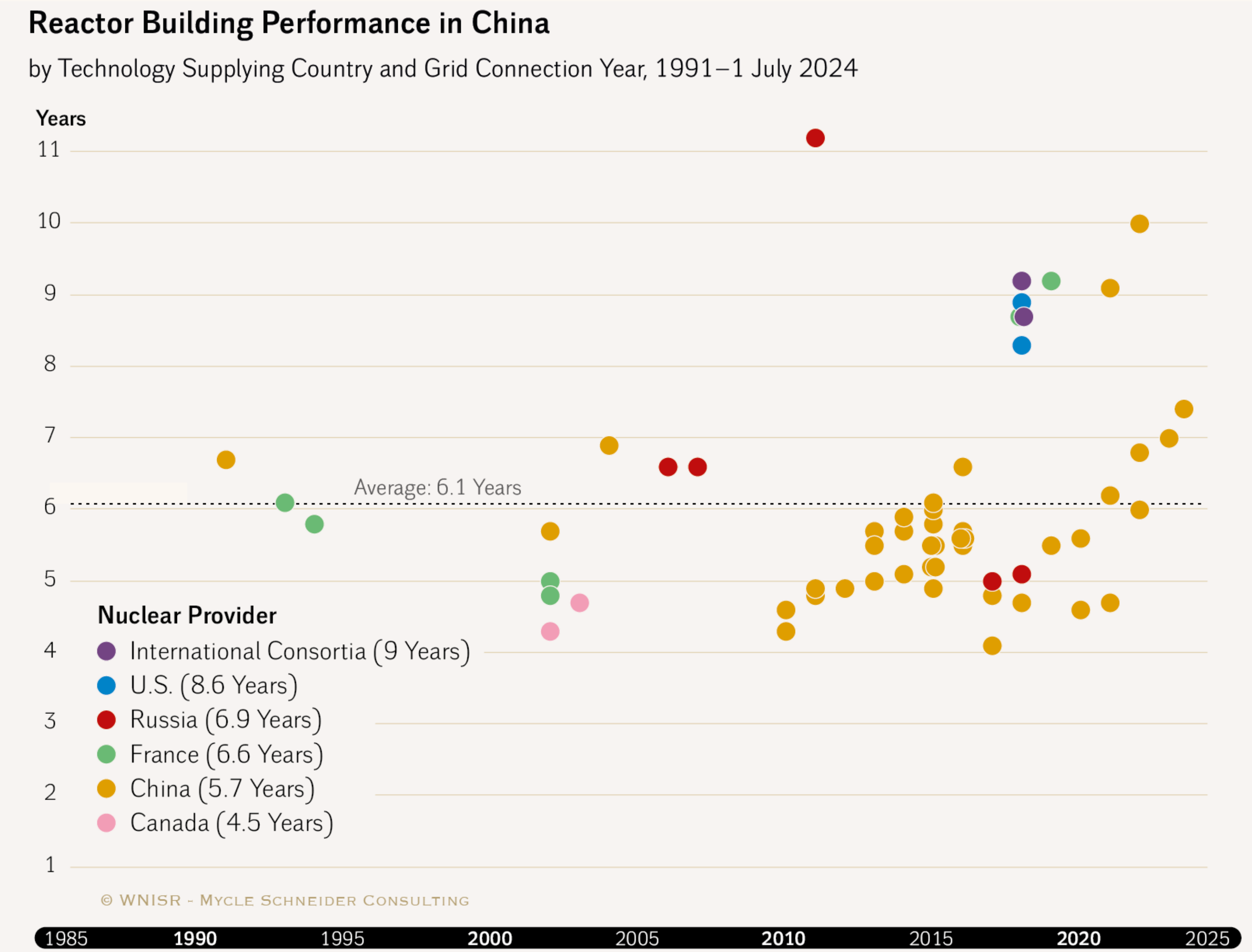


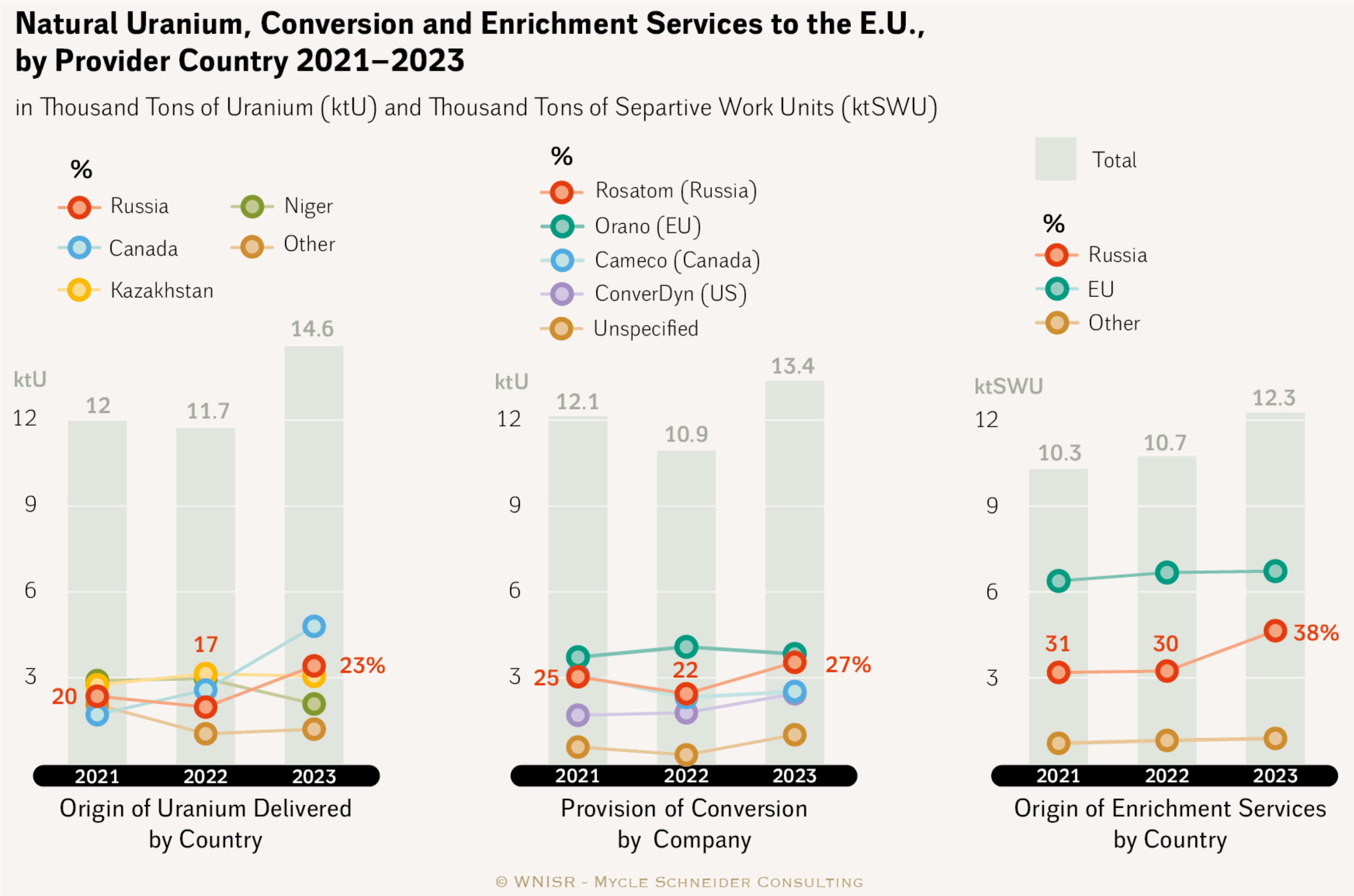
Sources: Various, compiled by WNISR, 2024

CHINA FOCUS – Building Performance



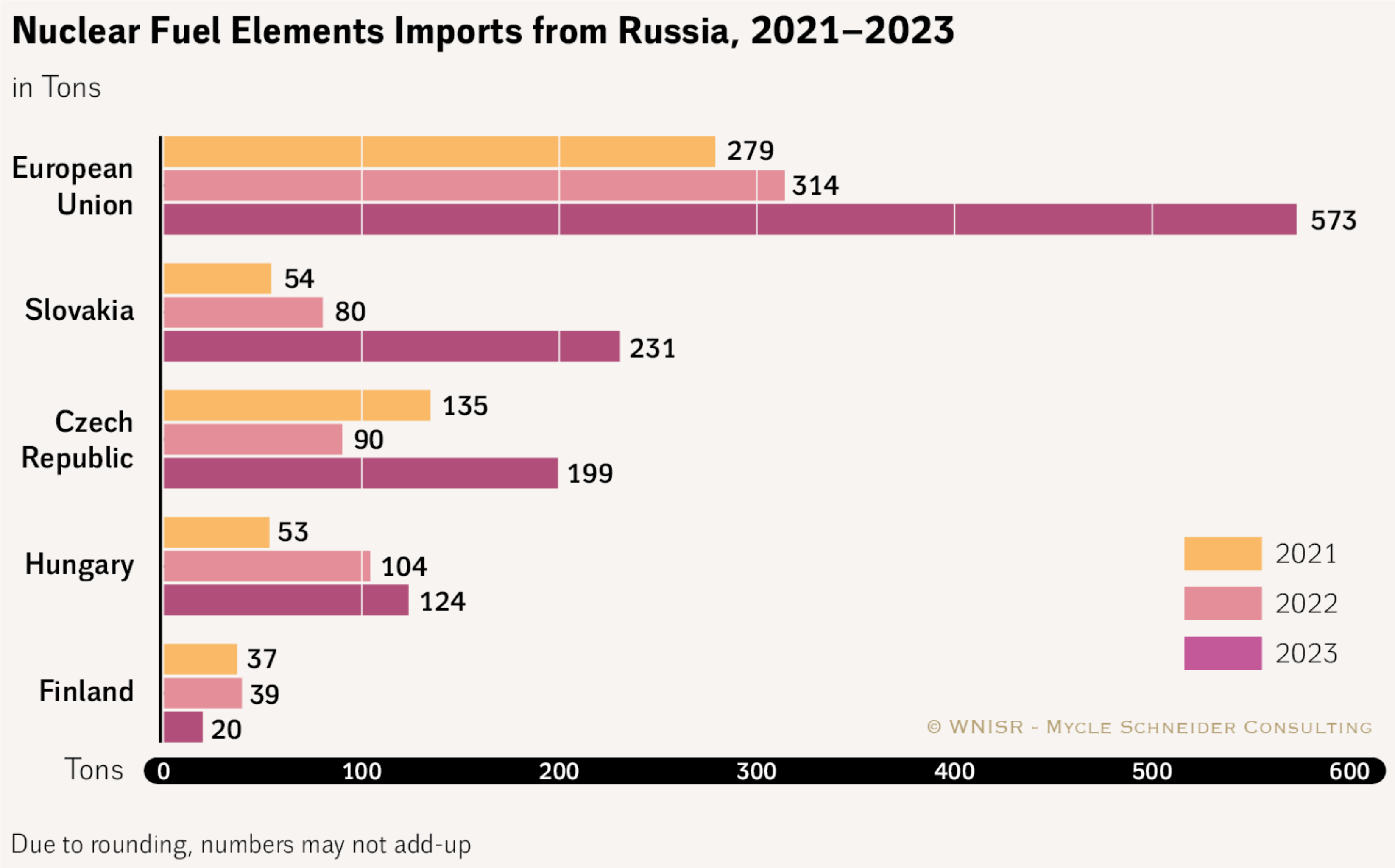
Sources: WNISR and IAEA-PRIS, 2024

RUSSIA DEPENDENCIES – Nuclear Fuel Services to the European Union



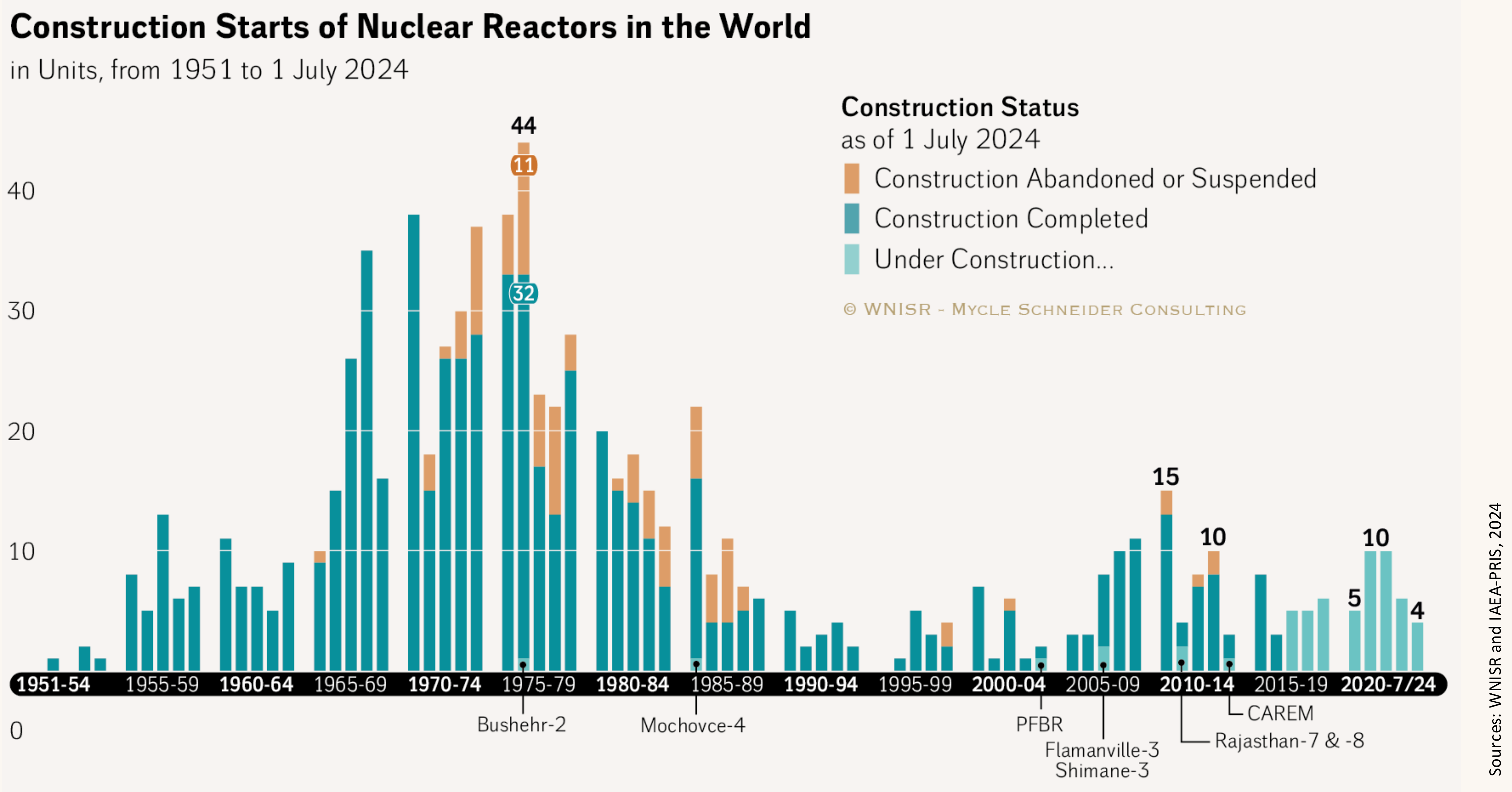
Source: ESA, 2022 and 2024

RUSSIA DEPENDENCIES – Nuclear Fuel Assembly Imports

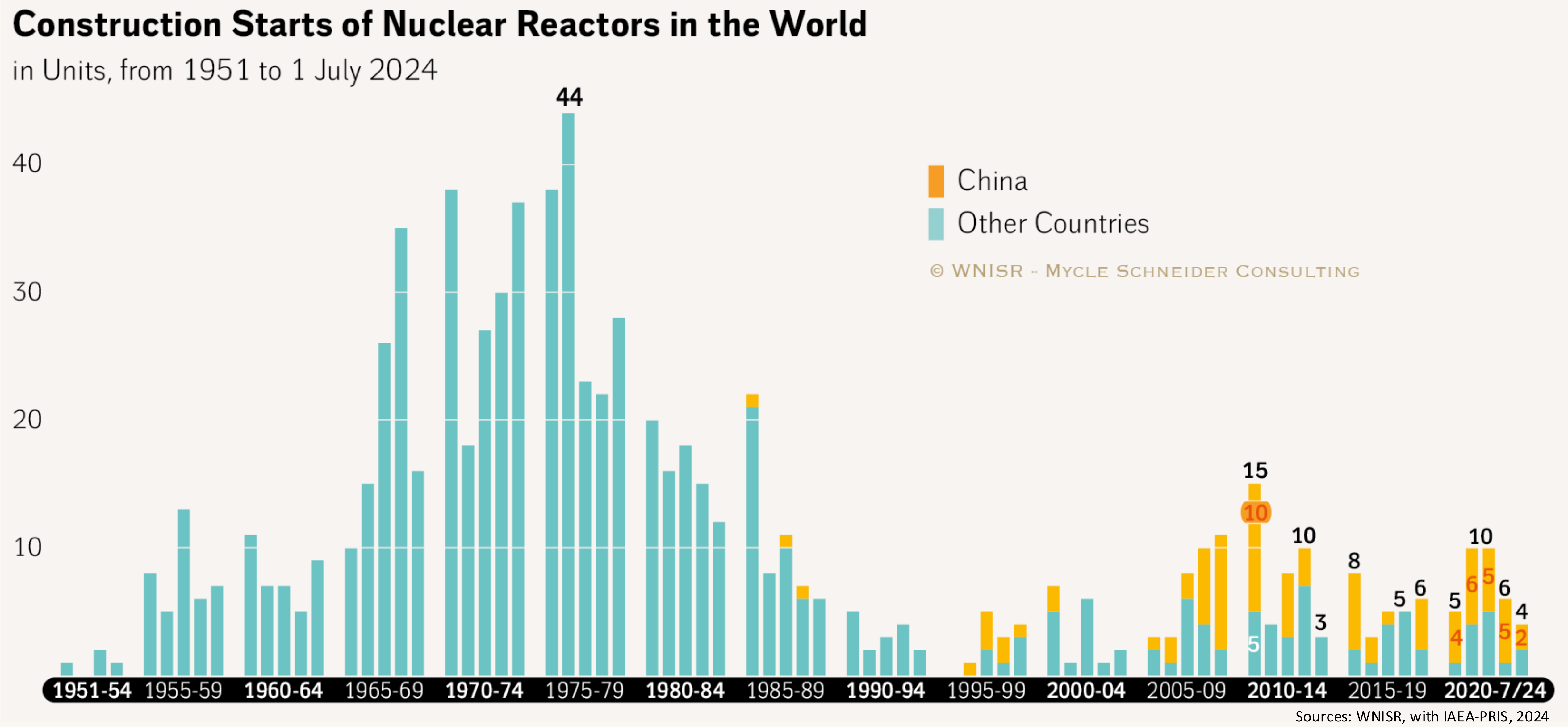


Source: Comtrade Database, 2024

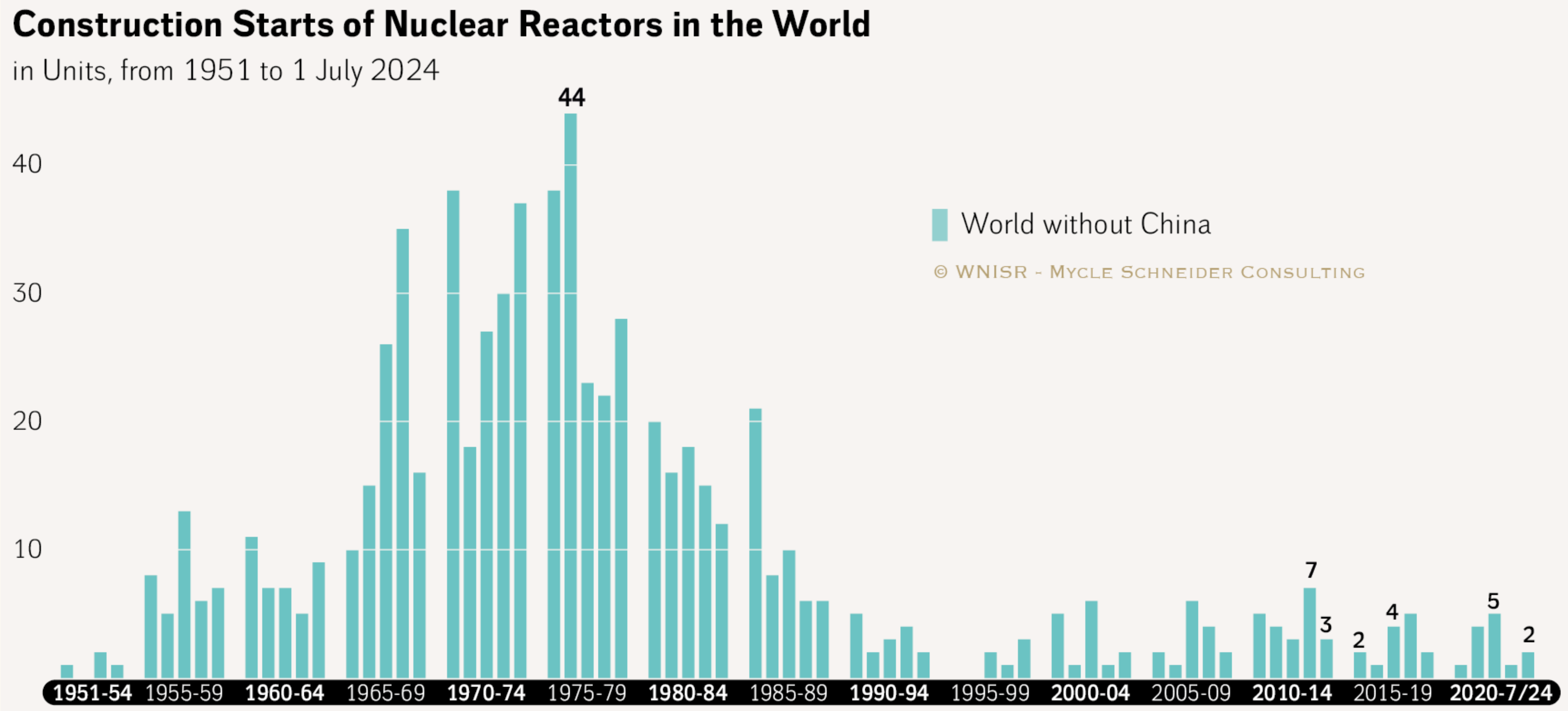
GENERAL OVERVIEW — Construction Starts in the World



GENERAL OVERVIEW — Construction Starts in China and Elsewhere

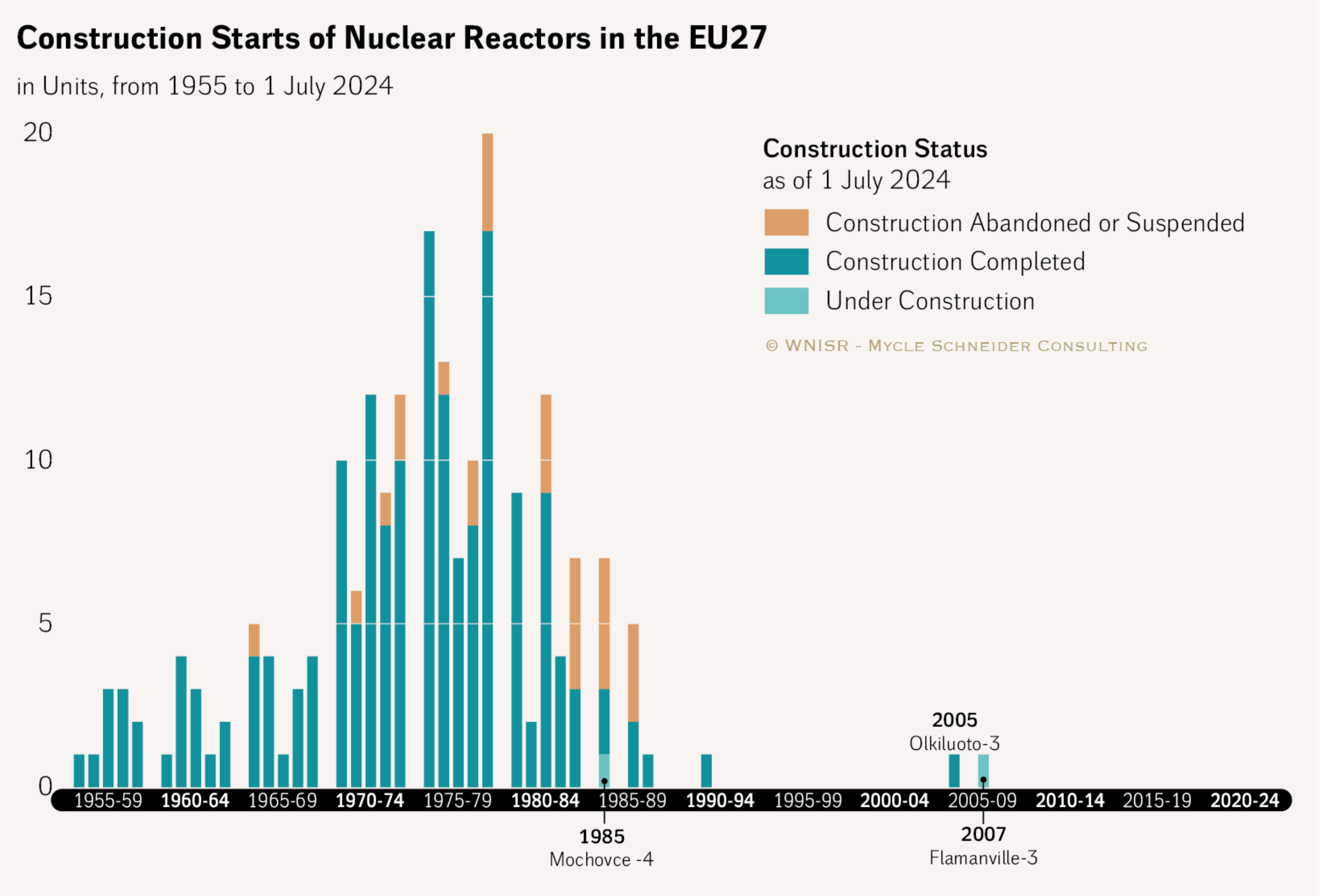


GENERAL OVERVIEW — Construction Starts, World without China



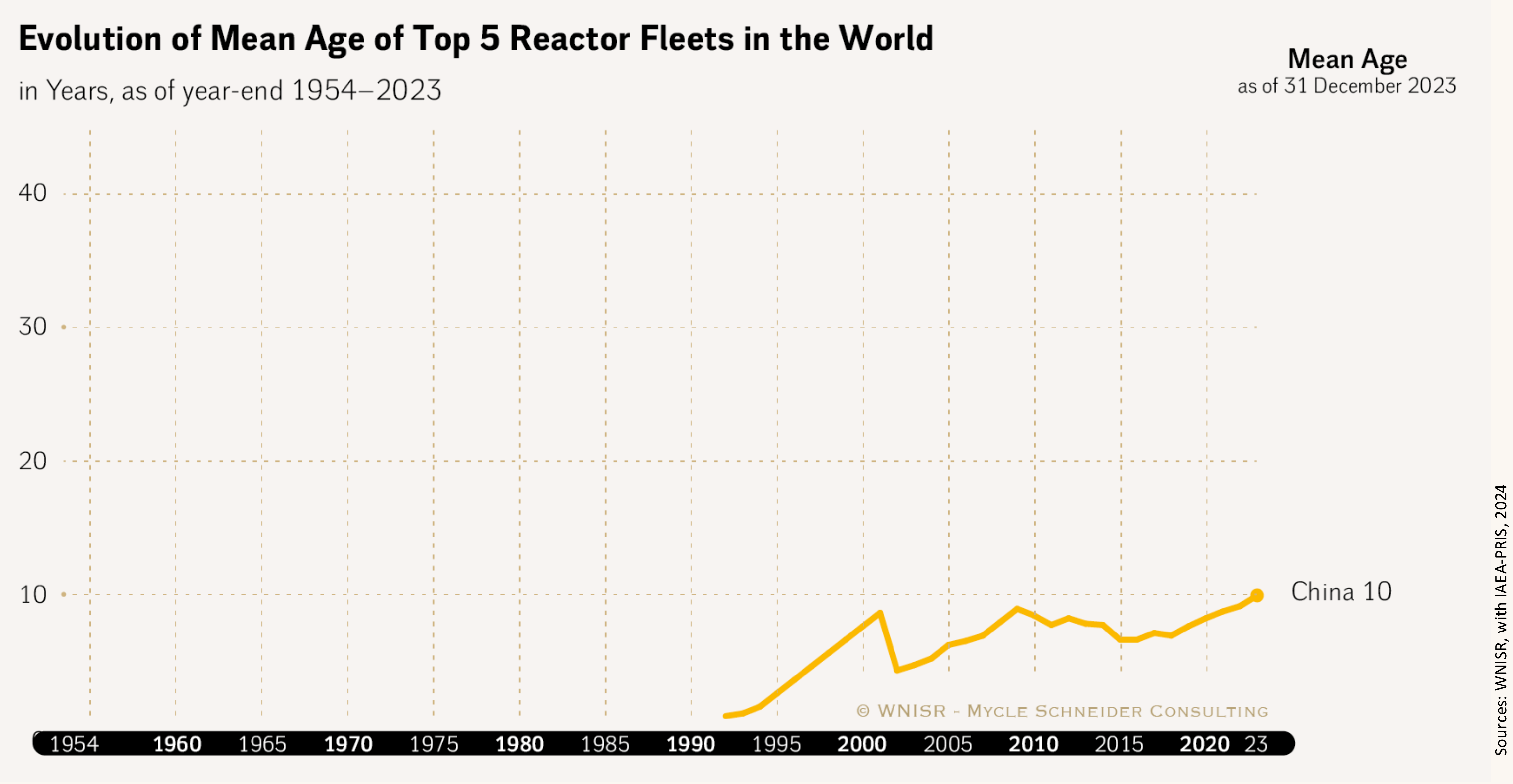
Sources: WNISR, with IAEA-PRIS, 2024

EUROPEAN UNION (EU27) – Constructions



Sources: WNISR and IAEA-PRIS, 2024

GLOBAL OVERVIEW – Nuclear Fleets Age



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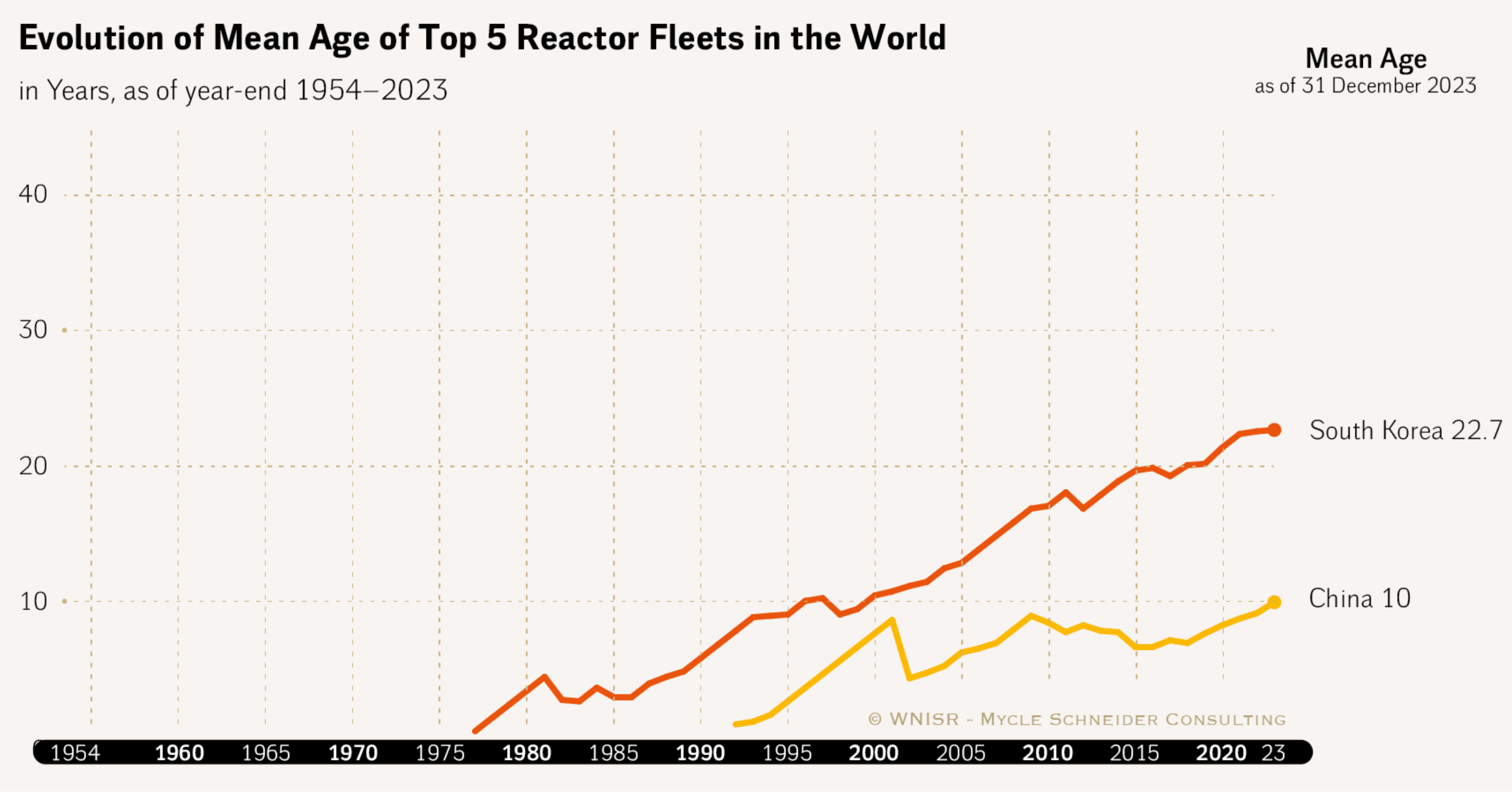

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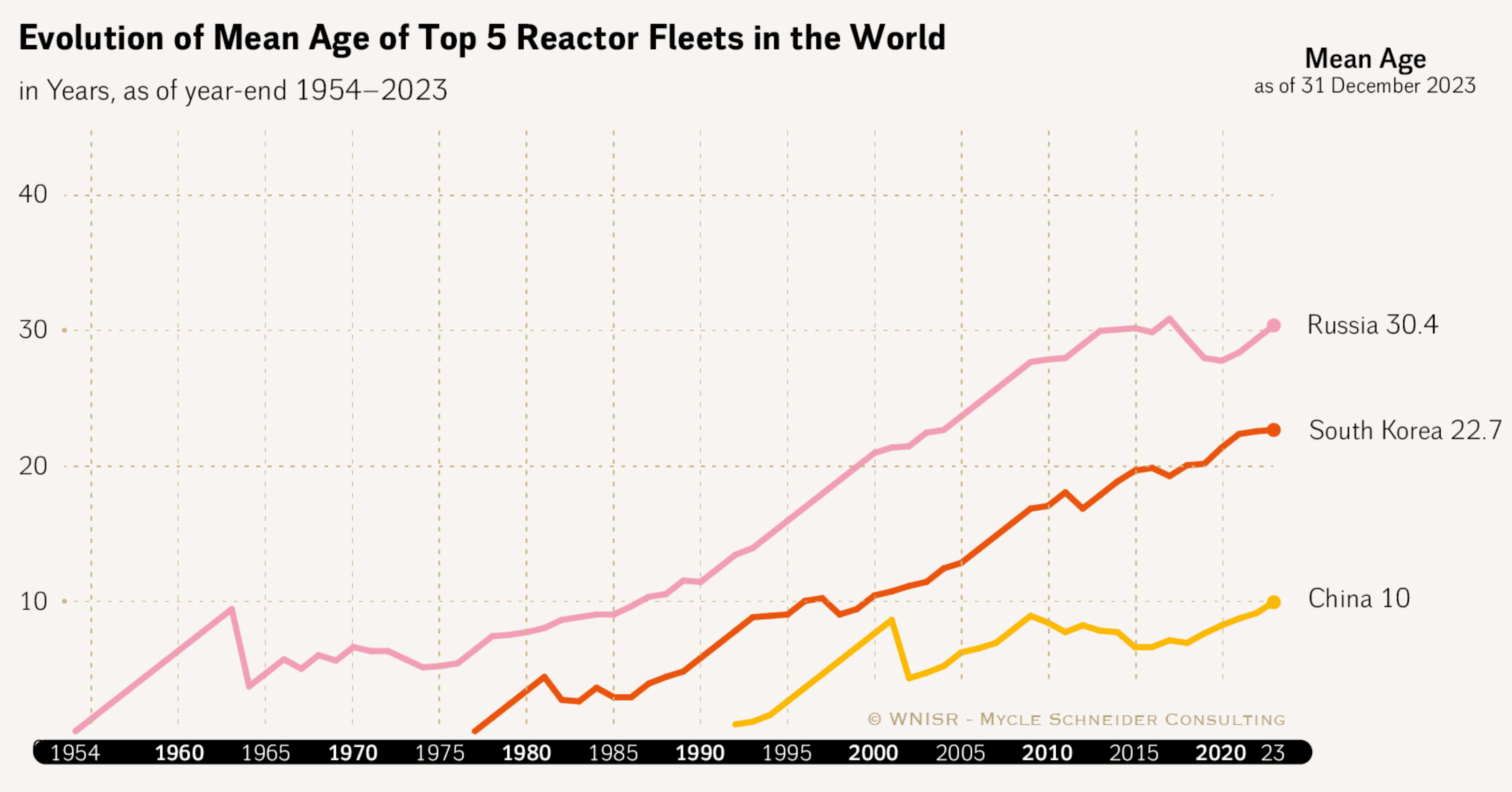

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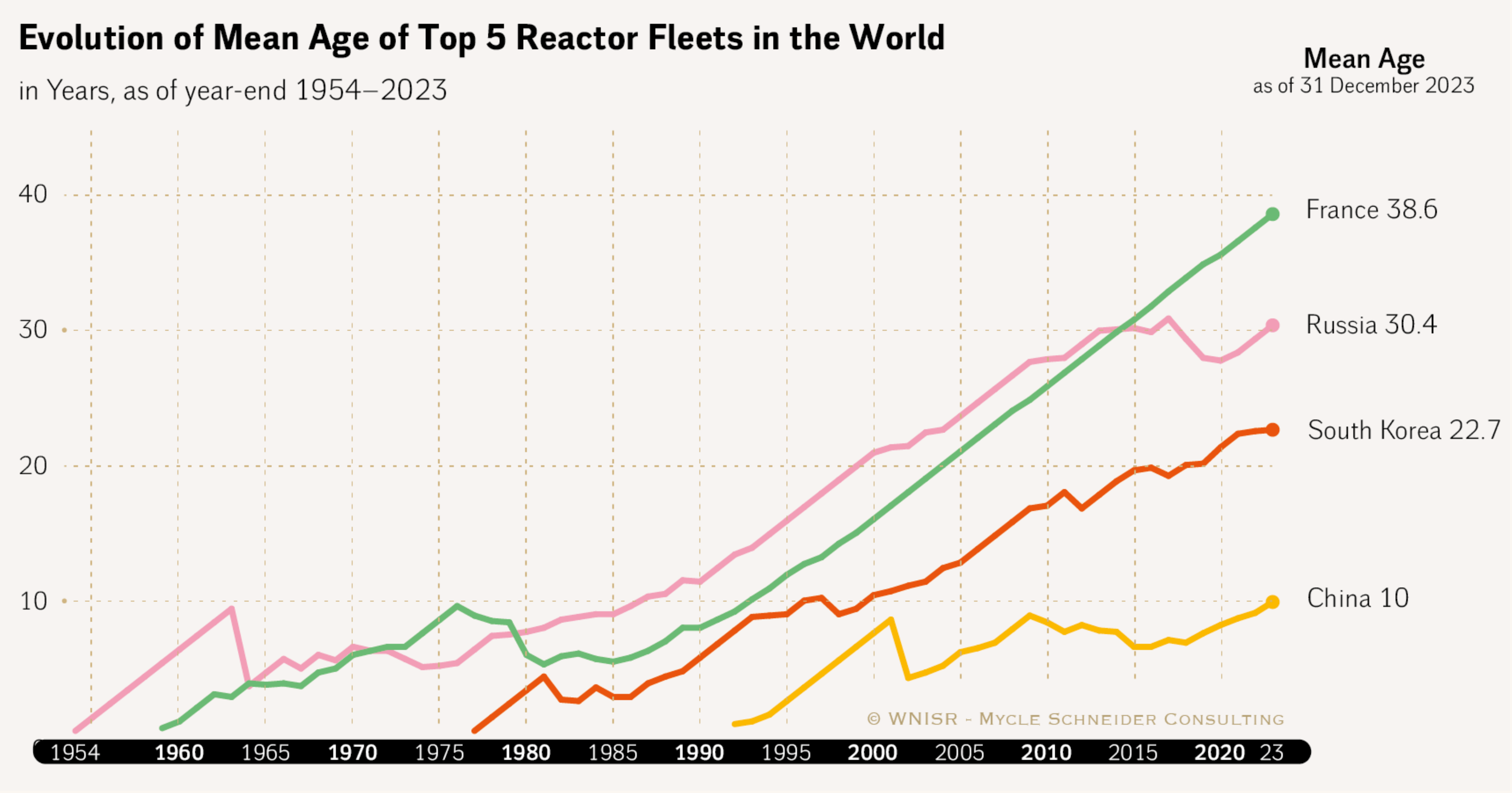

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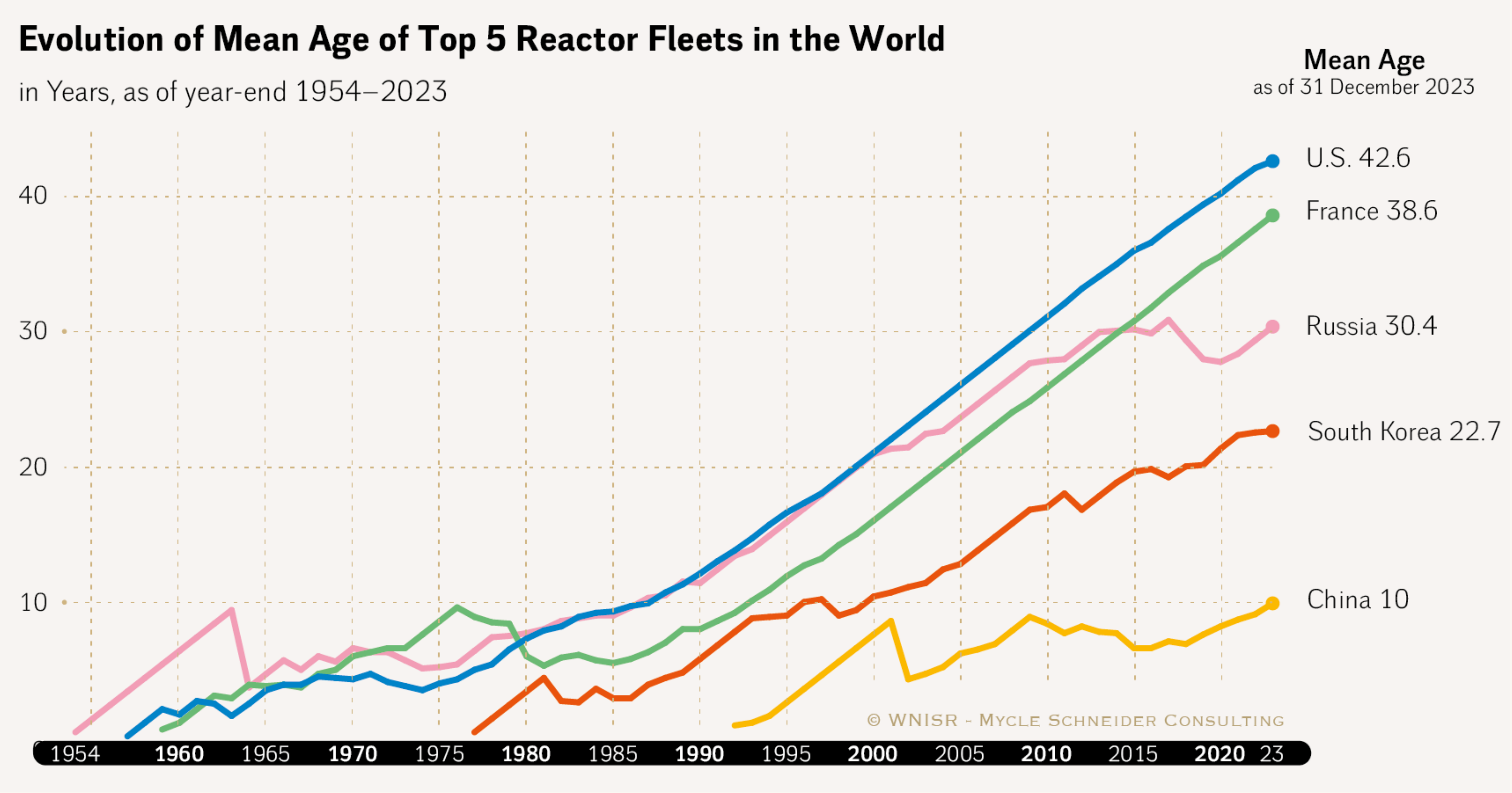
GLOBAL OVERVIEW – Nuclear Fleets Age



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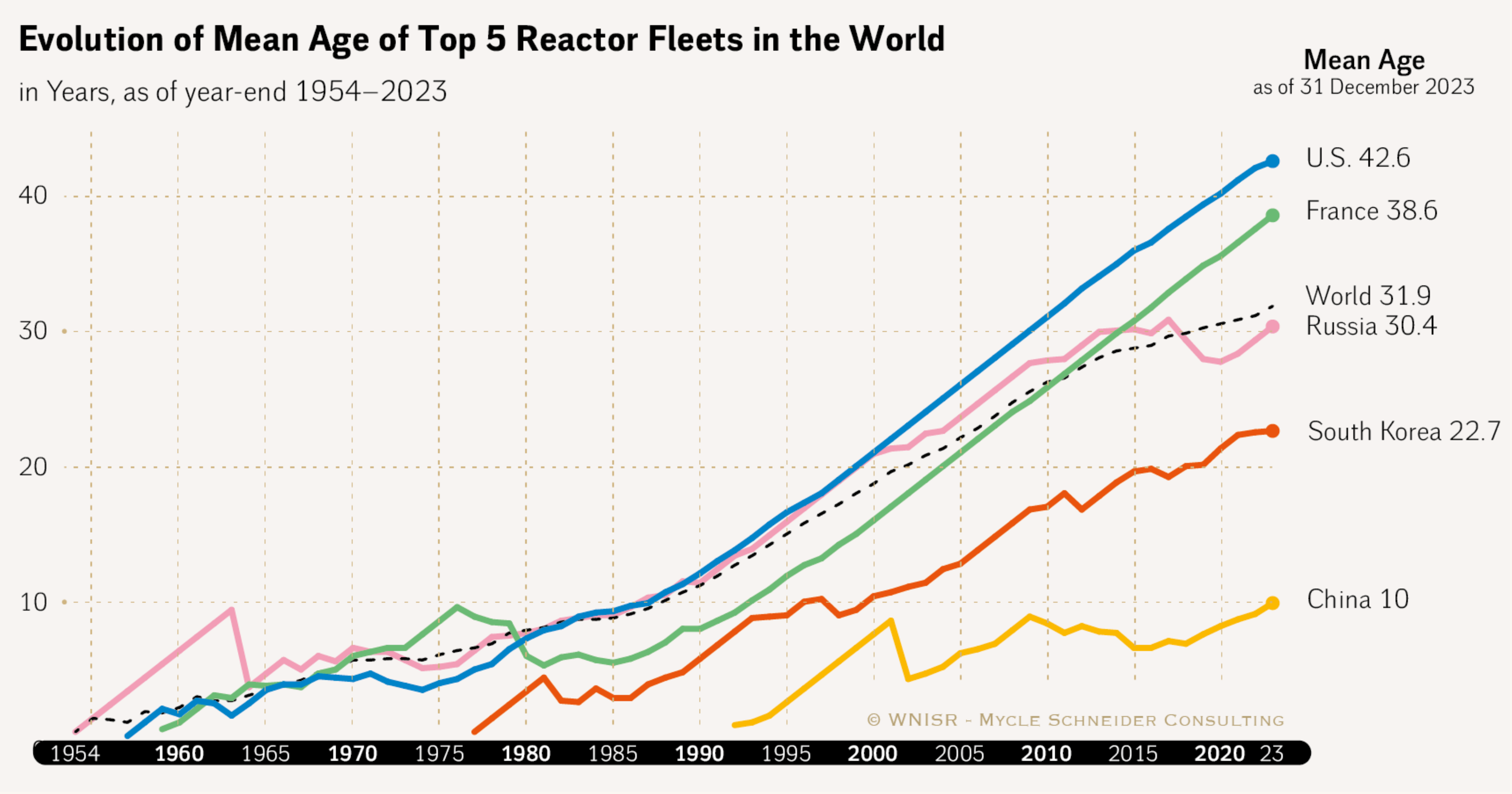

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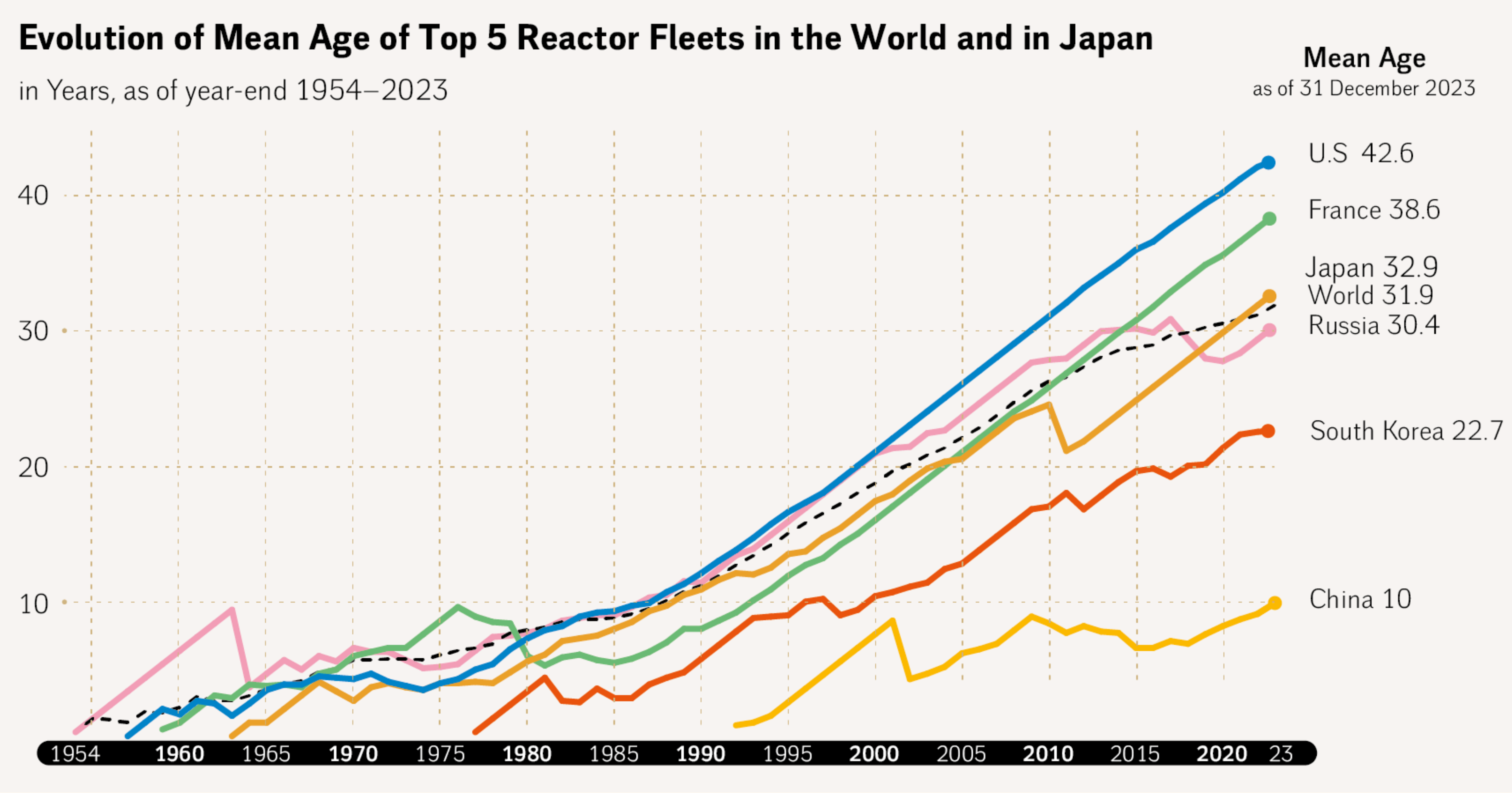
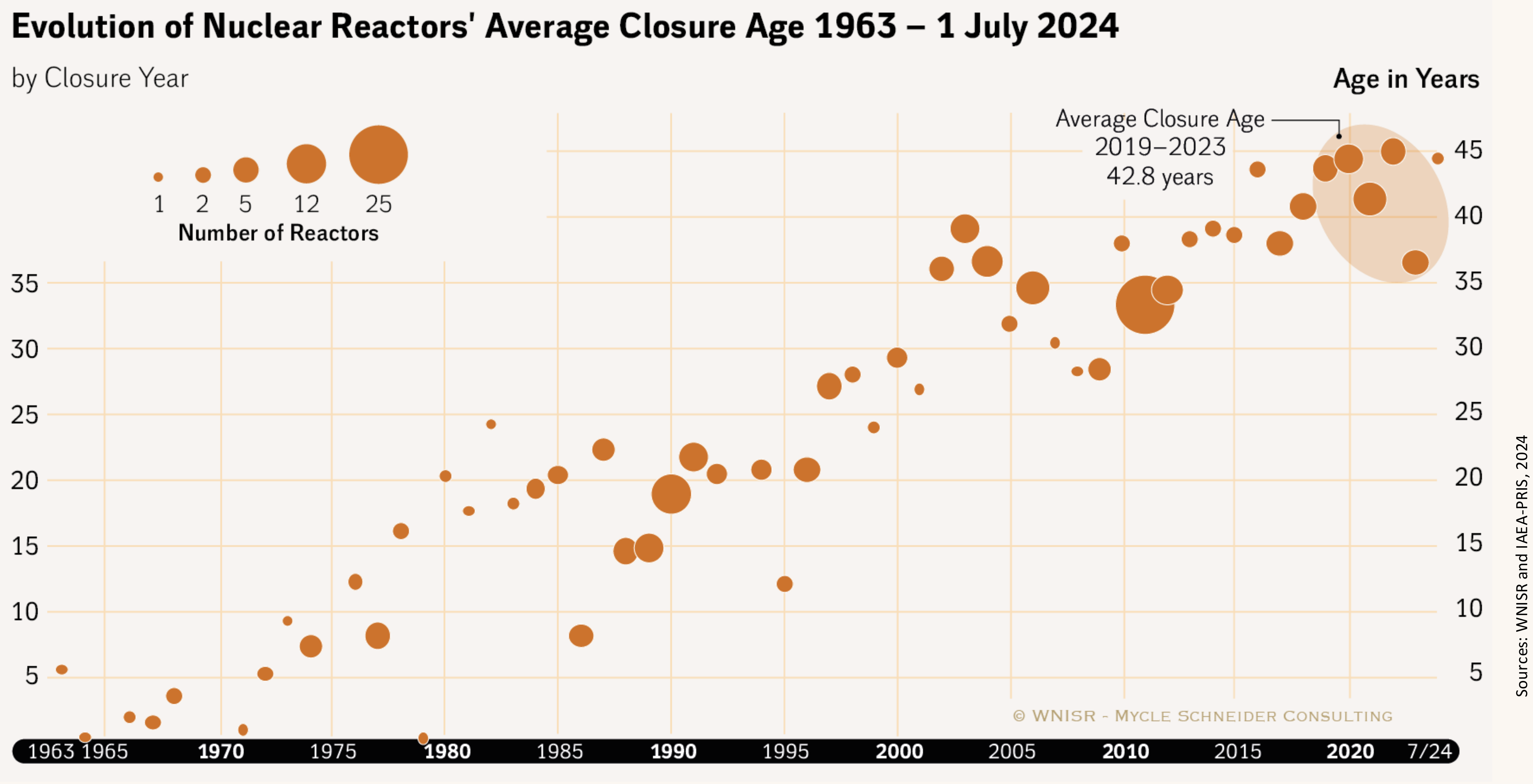
GLOBAL OVERVIEW – Nuclear Fleets Age

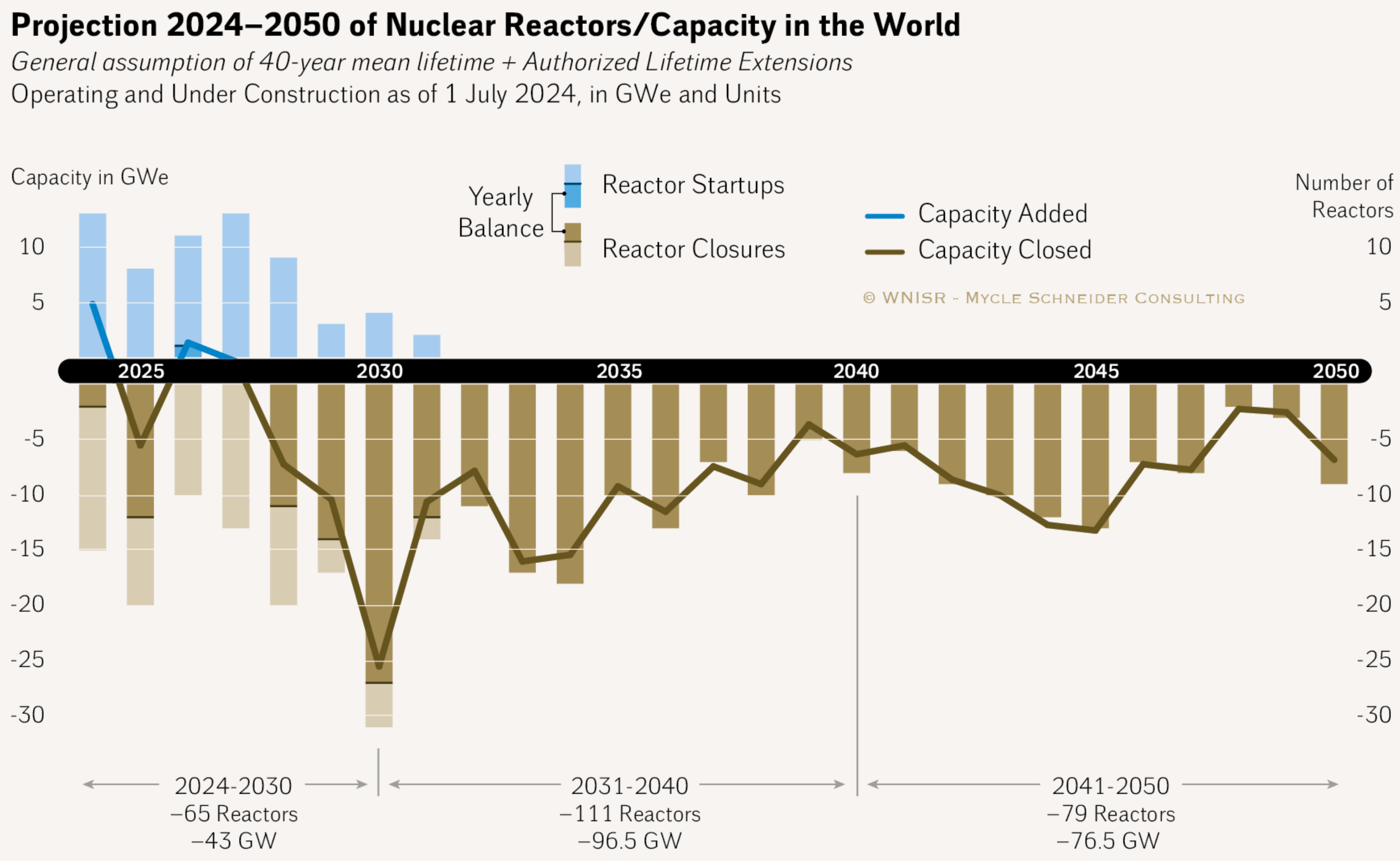


Sources: WNISR, with IAEA-PRIS, 2024

GLOBAL OVERVIEW – Age at Closure



PROJECTIONS – THE PLEX Projection



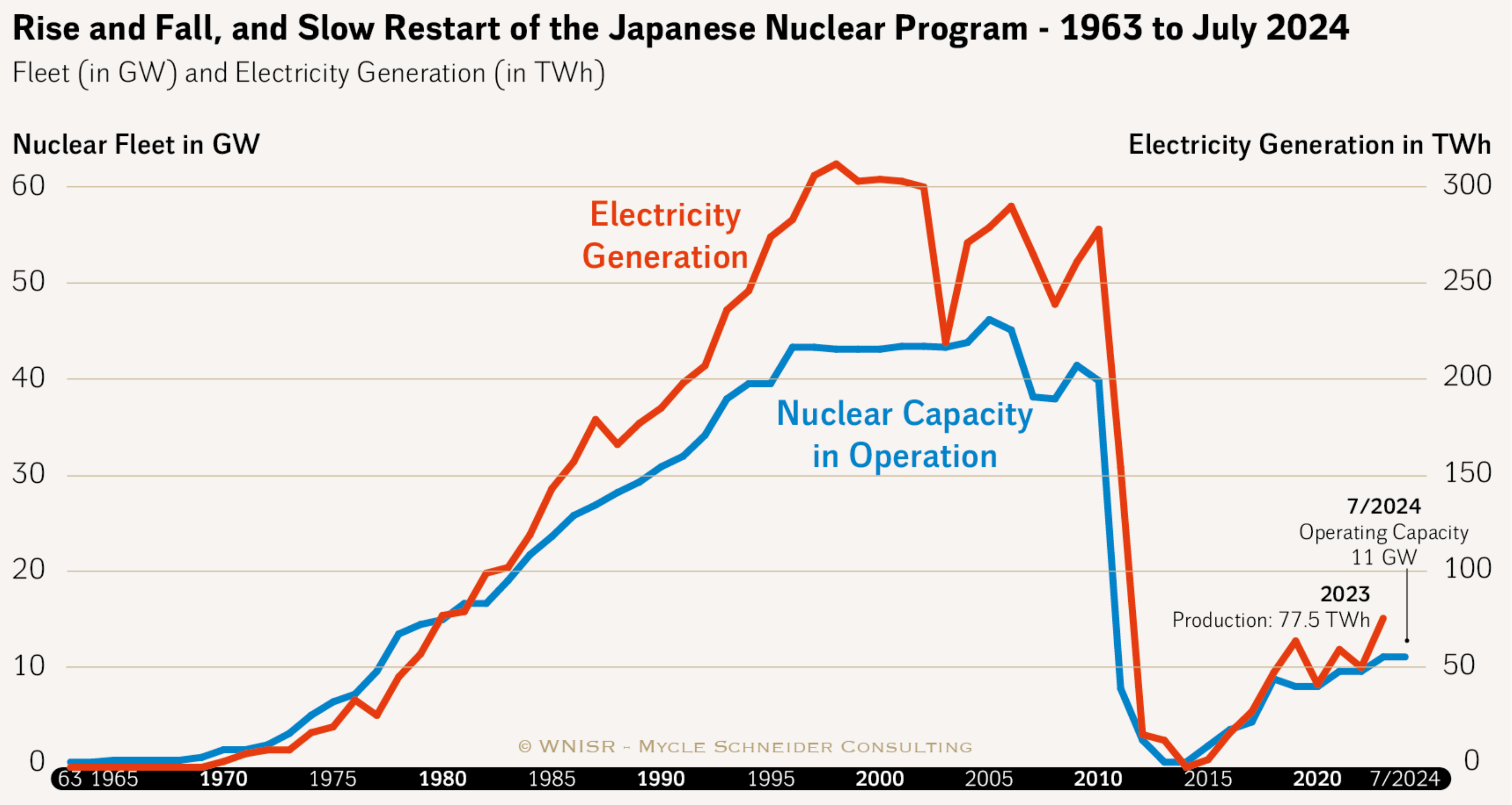
Sources: WNISR and IAEA-PRIS, 2024

Tatsujiro Suzuki, Nagasaki, Japan — suzukitatsu@nagasaki-u.ac.jp

Tatsujiro SUZUKI is Professor at the Research Center for Nuclear Weapons Abolition at Nagasaki University (RECNA), Japan. Before joining RECNA, he was Vice Chairman of the Japan Atomic Energy Commission (JAEC) of the Cabinet Office from January 2010 to March 2014. Until then, he was Associate Vice President of the Central Research Institute of Electric Power Industry in Japan (1996-2009), Associate Director of MIT's International Program on Enhanced Nuclear Power Safety from 1988-1993 and a Research Associate at MIT's Center for International Studies (1993-95).

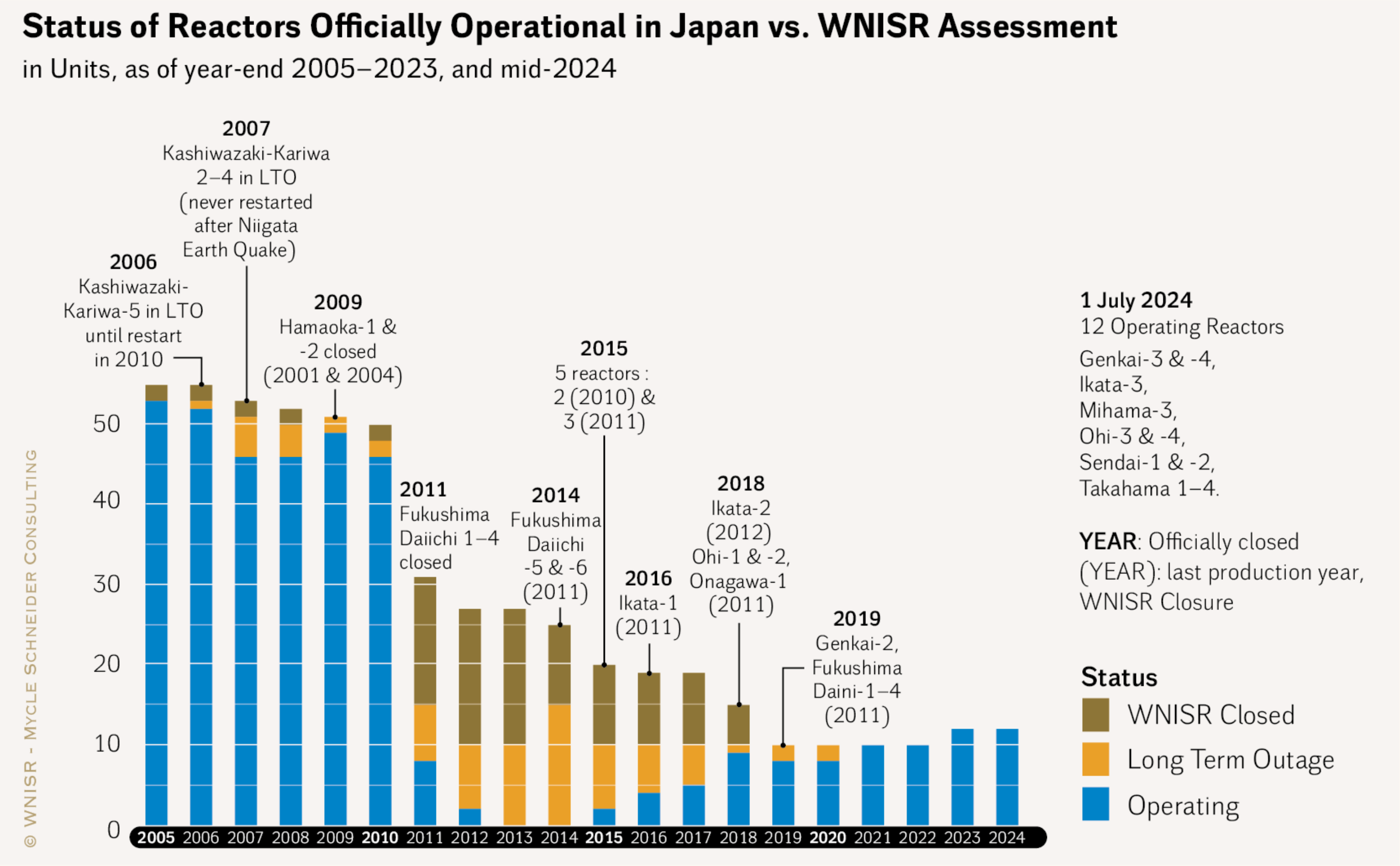
He is a member of the Advisory Board of Parliament's Special Committee on Nuclear Energy since June 2017. He is also a Council Member of Pugwash Conferences on Science and World Affairs (2007-09 and from 2014~). Dr. Suzuki has a PhD in nuclear engineering from Tokyo University (1988).

JAPAN FOCUS — Rise and Fall… and Slow Restart



Sources: WNISR with IAEA-PRIS, 2024

JAPAN FOCUS – 10 Years After Zero Nuclear, Only 12 Reactors Restarted



Sources: Various, compiled by WNISR, 2024

JAPAN FOCUS – Restart Application Rejected, Newbuild Envisaged

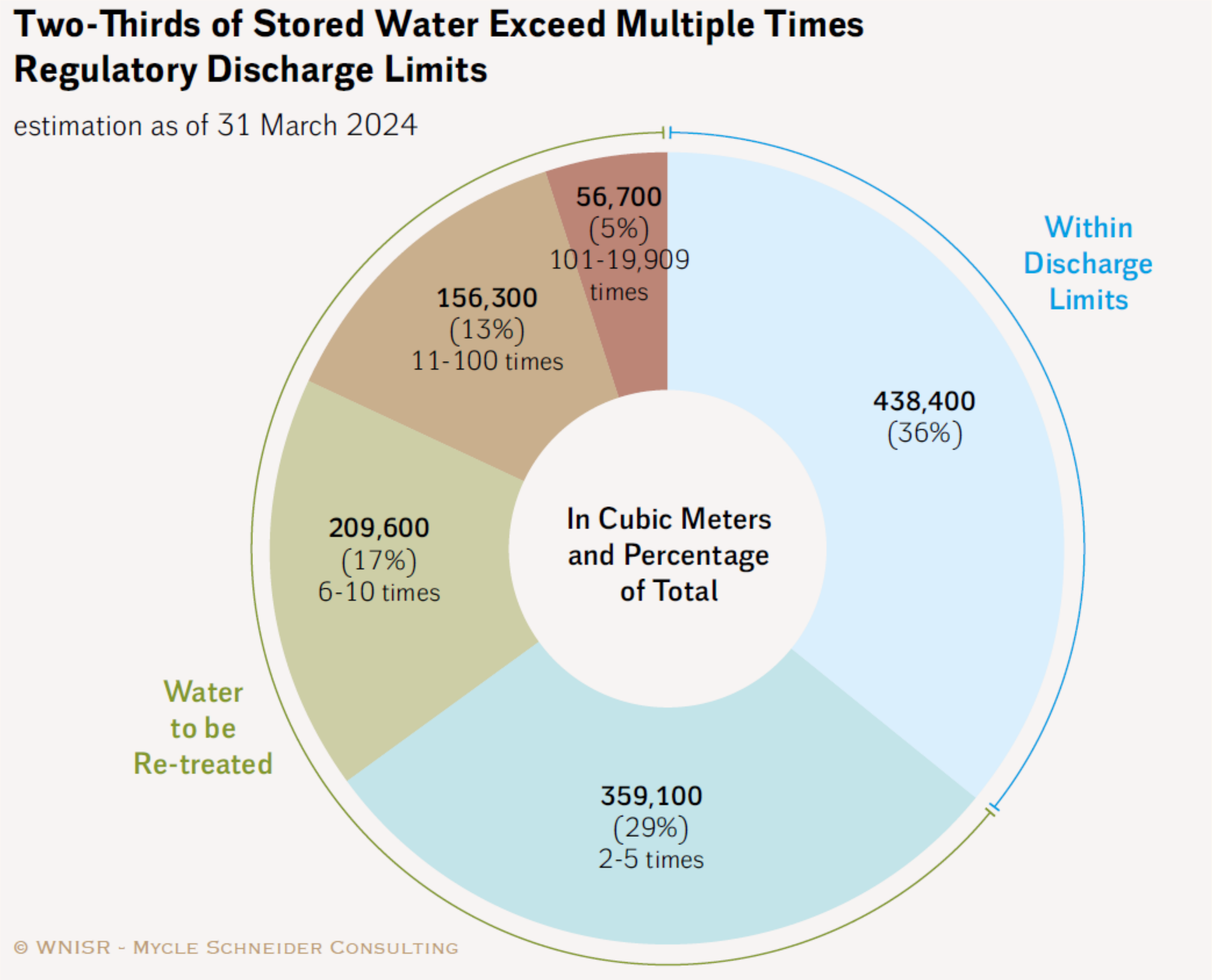
- **Noto Peninsula earthquake** (1 January 2024, magnitude 7.6):
  Enormous damage to local community;
  Shika nuclear power plant, shut down since 2011, also affected.
  The earthquake raised concerns about evacuation planning of NPPs.

- **Nuclear Regulation Authority (NRA) rejected Japan Atomic Power Company's application to restart Tsuruga-2** as it failed to meet new safety rules established after the Fukushima accidents. First time NRA effectively declined to approve a license application because it did not satisfy the new regulatory standards.

- **In 2024, the Seventh Strategic Energy Plan to be formulated**, and the role of nuclear power generation to be redefined.In May 2024, METI published its policy to allow for the **replacement of existing reactors at a given site**. First time that METI defines its policy change to move towards newbuild since the Fukushima nuclear accidents.

- The **new nuclear energy policies introduced under the GX (Green Transformation) laws represent major shift** as they explicitly state a policy for the construction of new reactors. They also amend nuclear regulation laws to allow for lifetime extensions beyond 60 years.

FUKUSHIMA STATUS REPORT: Status of Contaminated Water Treatment



FUKUSHIMA STATUS REPORT – Little Progress / Compensation at US$71 bn

- **Decommissioning work:** no significant progress in in the past year since WNISR2023.
- **Spent fuel removal:** has not started at Units 1 and 2 and is currently planned for the FY2027–2028.
- **Contaminated (treated) water release:** TEPCO released about **31,000 tons of** in four rounds during fiscal year through March 2024. Draft plan for FY2024 includes seven releases for a total of approximately 55,000 tons and total amount of tritium of approximately 14 trillion Bq. IAEA task force carried out two review missions in October 2023 and April 2024, during which it "did not identify anything that is inconsistent with the requirements in the relevant international safety standards."
- **Fuel debris removal:** TEPCO announced on 30 May 2024 that it would begin trial retrieval operations at Unit 2 at some point between August and October 2024. (The operation has been postponed due to an operational incident during preparation in late July.)
- **Evacuees:** As of 1 May 2024, **25,959 (27,020 as of May 2023) residents** of Fukushima Prefecture are still living as evacuees. The number of evacuees stood at 164,865 in May 2011.
- **Court rulings:** since Supreme Court decision in 2022, **several lower court decisions in 2023** also ruled out government responsibility.
- **Compensation:** TEPCO paid total compensation of ¥11trillion (~US$71 billion), as of 31 May 2024.

SMALL MODULAR REACTORS (SMRs) – Continued Government Support

United States

- Feb 2024: Kairos Power “up to US$303 million from DOE” for Hermes thermal reactor
- April 2024: DOE awarded US$148.5 million tax credit to X-energy for building a fuel fabrication facility
- June 2024: US$900 million to support the deployment of light-water SMRs; US$800 million for “up to two first-mover teams of utility, reactor vendor, constructor, and end-users or power off-takers committed to deploying a first plant while at the same time facilitating a multi-reactor, Gen III+ [Generation III+] SMR orderbook”
- NuScale has already received US$560 million from DOE
- U.S. Department of State advocating “for NuScale internationally, advancing prospective customer conversations globally.”

SMALL MODULAR REACTORS (SMRs) – Continued Construction Delays

Argentina

- CAREM (Central Argentina de Elementos Modulares) reactor design under development since the 1980s; construction started in February 2014; projection at that time was "cold testing in 2016… first fuel load in the second half of 2017"
- May 2024: head of National Atomic Energy Commission told *Reuters* that construction had been halted because of budget cuts
- Current anticipated start date: 2028

India

- Advanced Heavy Water Reactor (AHWR) under development since the 1990s; Bhabha Atomic Research Centre official announced that construction would start in late 2007
- 2024: no sign of start of AHWR construction starting

SMALL MODULAR REACTORS (SMRs) – Operating Units Underperform

China

- HTR-PM declared as grid-connected in December 2021 and commercially operating in December 2023;
- 2024: power output lowered from 200 MW to 150 MW; no cause mentioned
- Produced 112 GWh in 2023 = one month of full power operations at 150 MW or effective capacity factor of just 8.5 percent

Russia

- Two KLT-40S SMRs loaded on barge Akademik Lomonsov
- 2023 load factors of 26.6 and 43.4 percent: lifetime factors of 32 and 28.2 percent

SMALL MODULAR REACTORS (SMRs) – Mismatch Between Hype and Reality

United States

- June 2024: Bill Gates poses with shovel in Wyoming at "start of construction" of Natrium reactor; claims "will soon be the bedrock of America's energy future" and "soon be home to the most advanced nuclear facility in the world"
- March 2024: Nuclear Regulatory Commission responded to construction permit application with nearly 50 items to be addressed (i.e., application needs a lot of work)
- No ready access to High-Assay Low-Enriched Uranium (HALEU) fuel for core

United Kingdom

- May 2024: Westinghouse announced signing "agreement with Community Nuclear Power… to deploy the U.K.'s first privately-financed small modular reactor fleet"
- Community Nuclear Power balance sheet (16 October 2024): 125 shares of £1 each

SMRs – Community Nuclear Power Assets September 2023: 100 £

COMMUNITY NUCLEAR POWER LIMITED **Registered Number 14337637**

Balance Sheet as at 30 September 2023

	2023
	£
Called up share capital not paid	100.00
Current assets	
Cash at bank and in hand	0.00
Net assets	**100.00**
Issued share capital	
100 Ordinary Shares of £1.00 each	100.00
Total Shareholder funds	**100.00**

SMRs – Community Nuclear Power Capital Increase October 2024: 25 £

Companies House

SH01 (ef)

Return of Allotment of Shares

Company Name: **COMMUNITY NUCLEAR POWER LIMITED**

Company Number: **14337637**

Received for filing in Electronic Format on the: **18/10/2024**

XDDYYE77

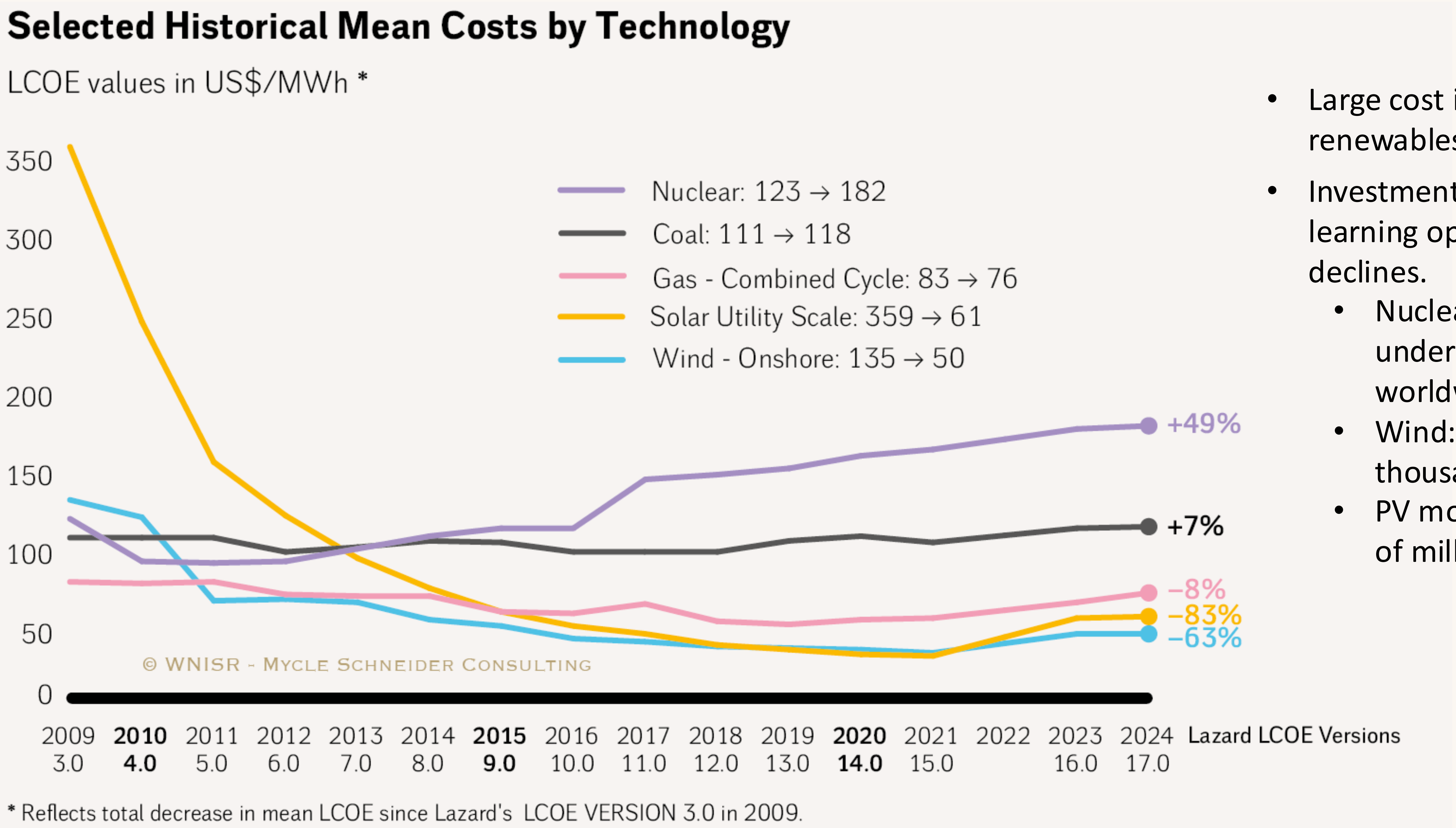
Shares Allotted (including bonus shares)

Date or period during which shares are allotted	From	To
	16/10/2024	

Class of Shares:	**ORDINARY**	Number allotted	**25**
Currency:	**GBP**	Nominal value of each share	**1**
		Amount paid:	**1**
		Amount unpaid:	**0**

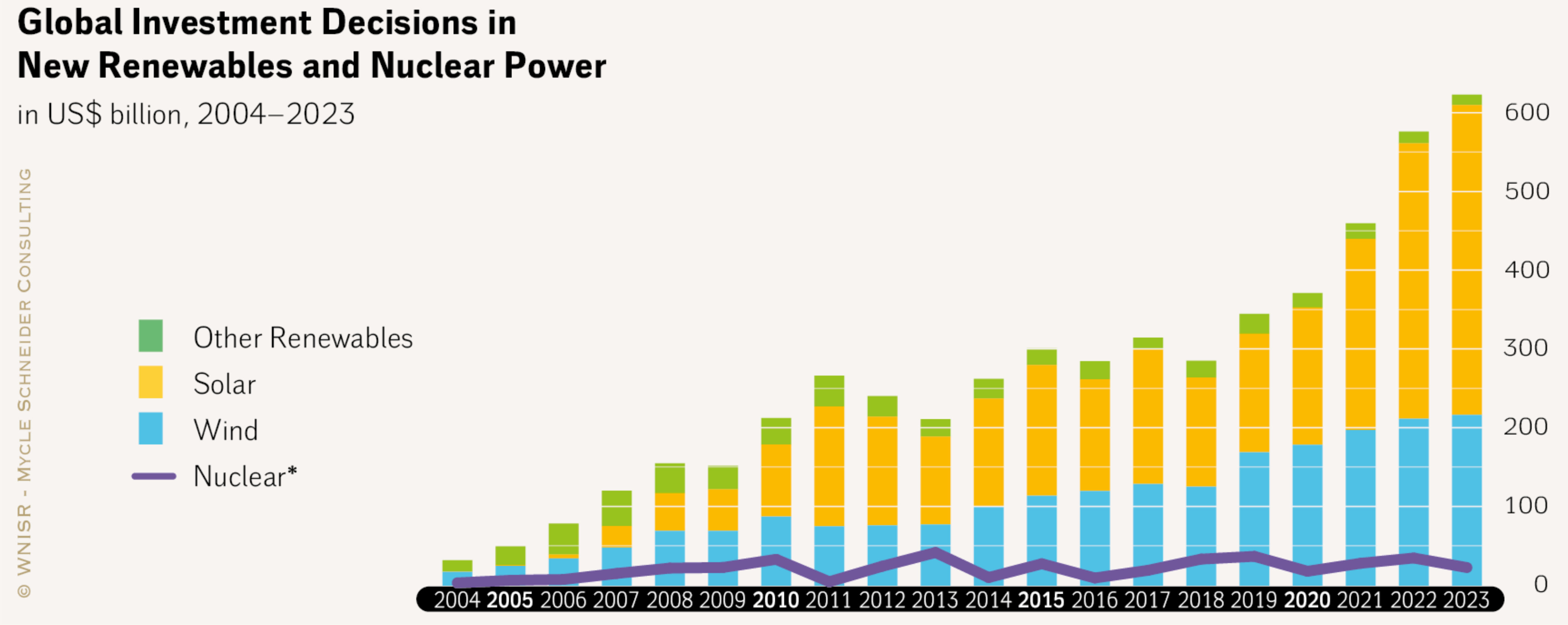
No shares allotted other than for cash

NUCLEAR POWER VS. RENEWABLES – Competitors Outperform Nuclear



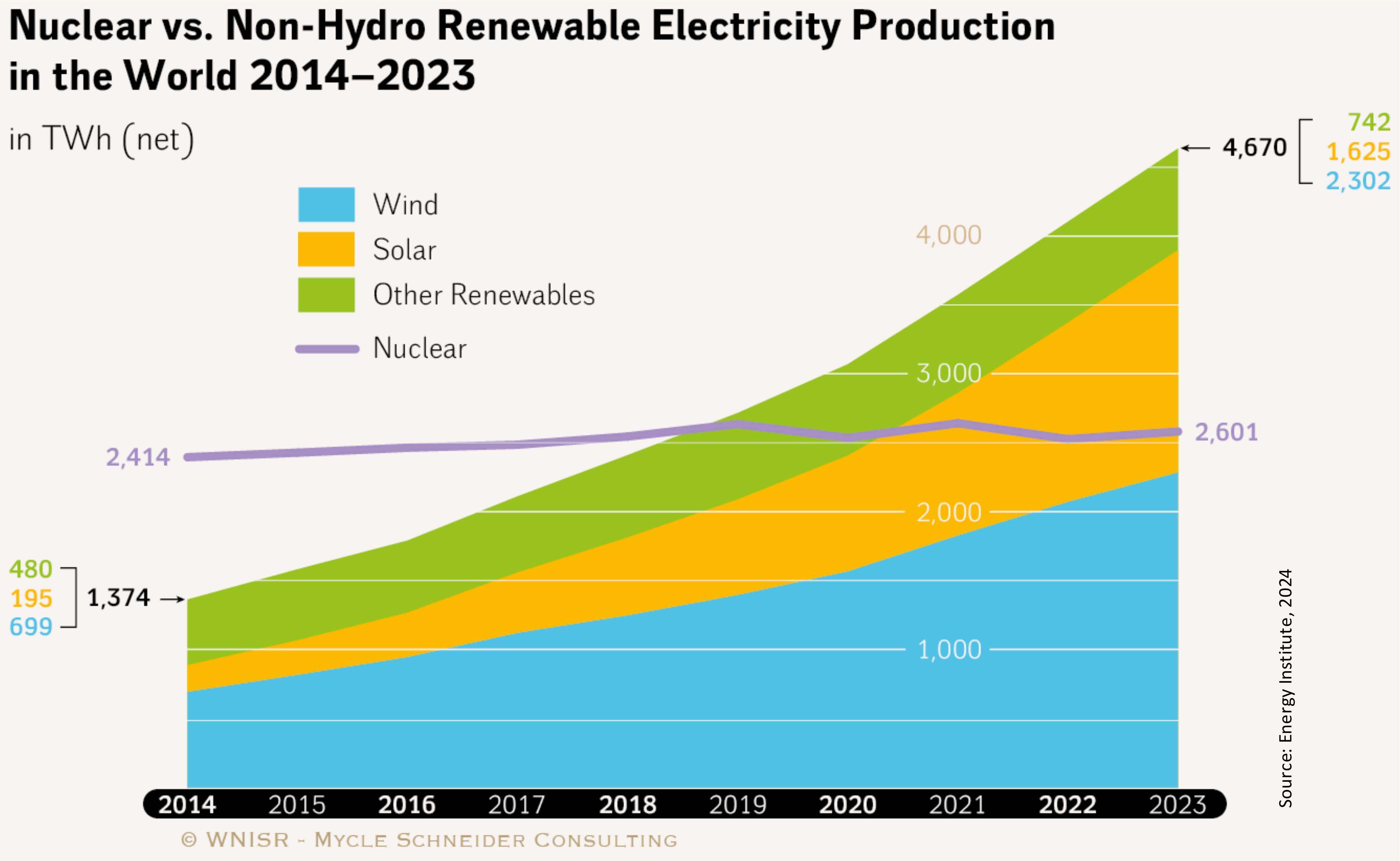
- Large cost improvements in renewables vs. nuclear
- Investment scale drives learning opportunities, cost declines.
  - Nuclear: 59 reactors under construction worldwide (5–10/yr).
  - Wind: tens of thousands/year.
  - PV modules: hundreds of millions/year.

NUCLEAR POWER VS. RENEWABLES – Investment Decisions

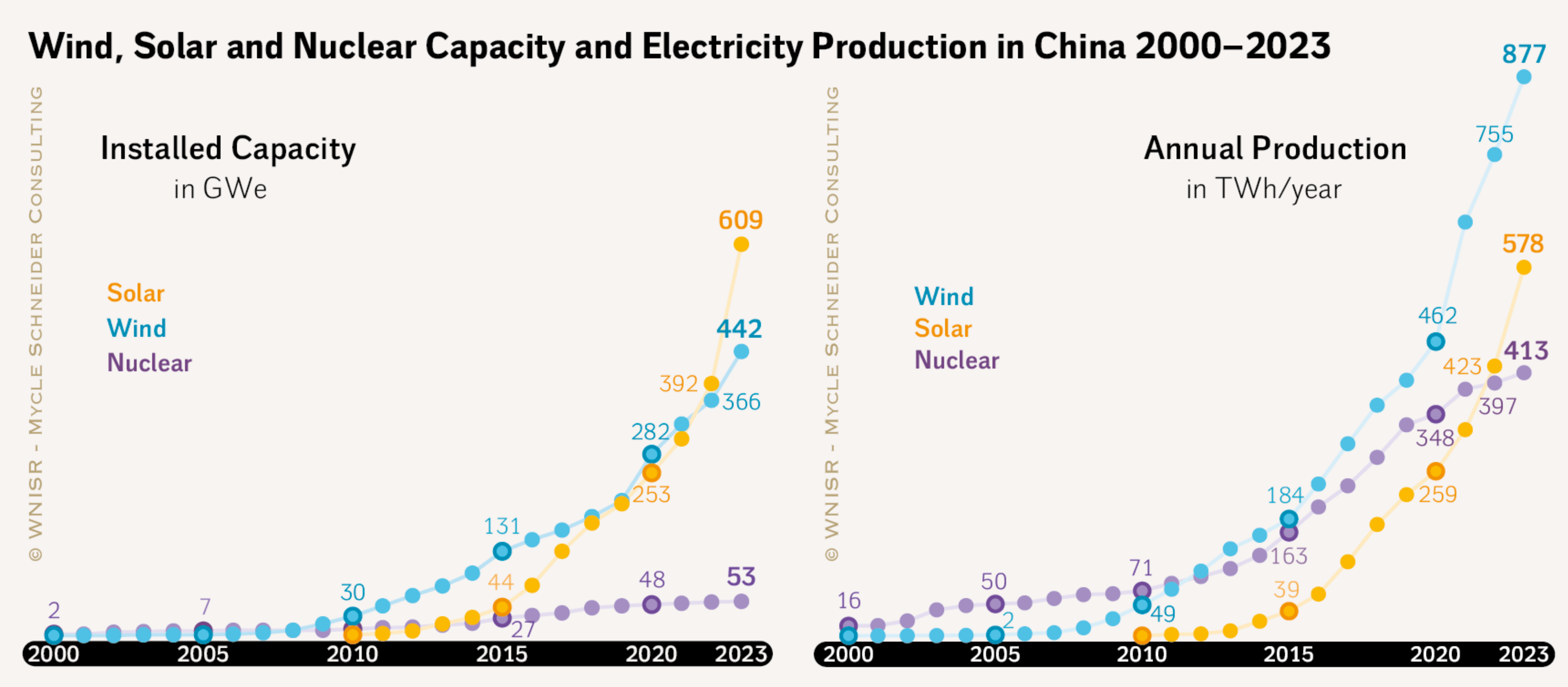


Sources: BNEF, 2023 and 2024 and WNISR Original Research, 2024

NUCLEAR POWER VS. RENEWABLES DEPLOYMENT – World

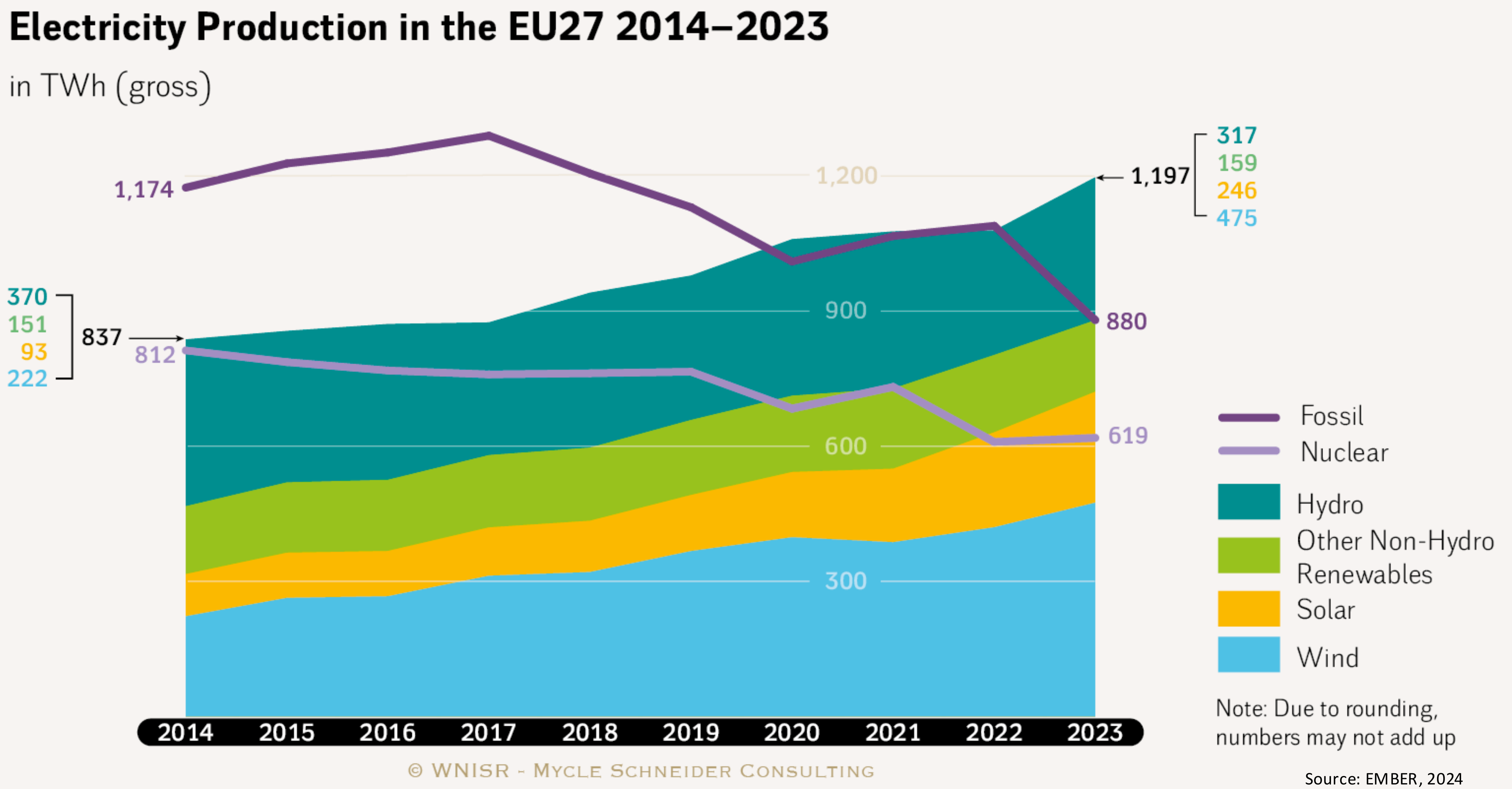


NUCLEAR POWER VS. RENEWABLES DEPLOYMENT – China



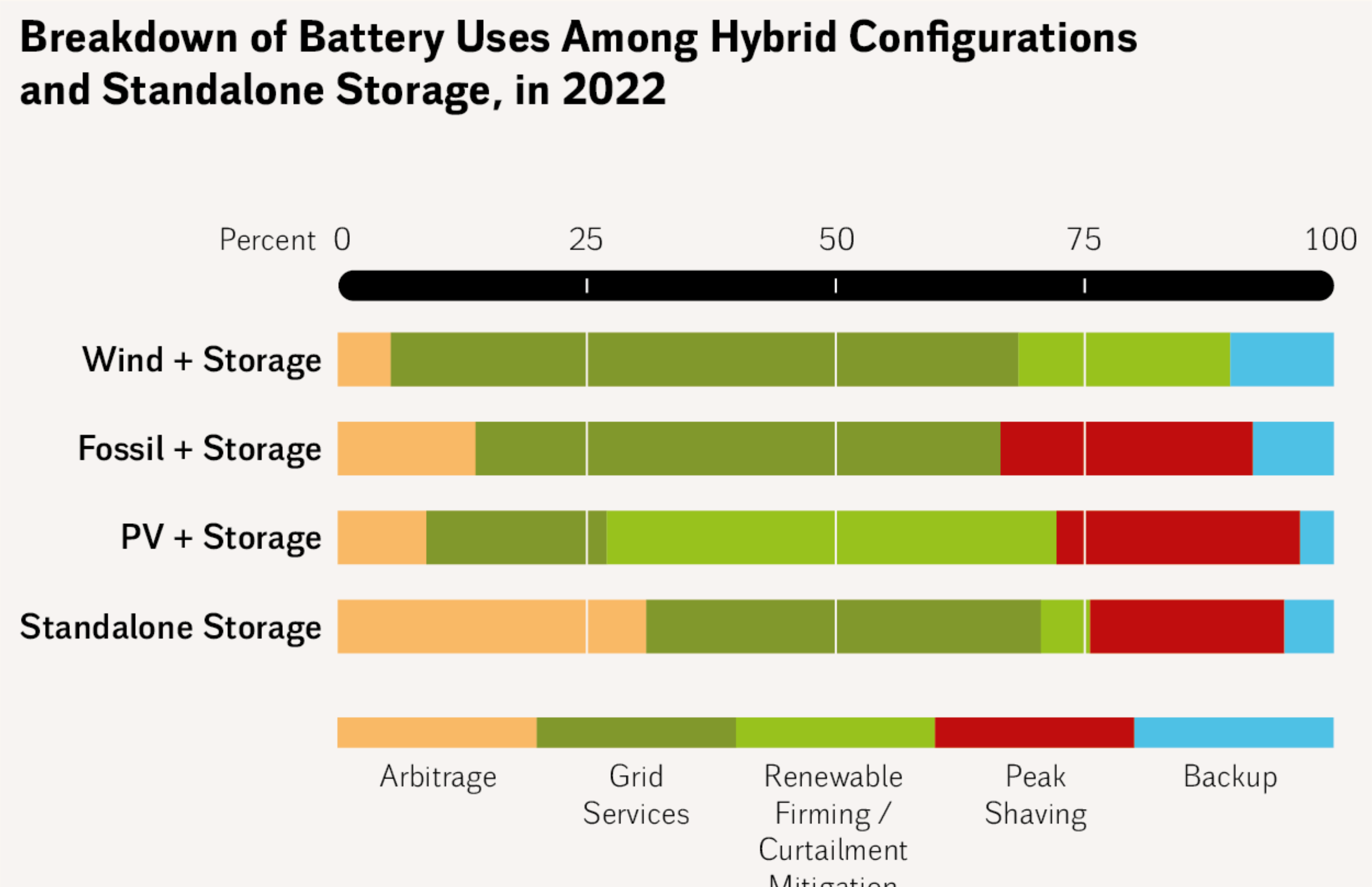
Sources: WNISR with IAEA-PRIS, IRENA, and Energy Institute, 2024

NUCLEAR POWER VS. RENEWABLES – European Union



Source: EMBER, 2024

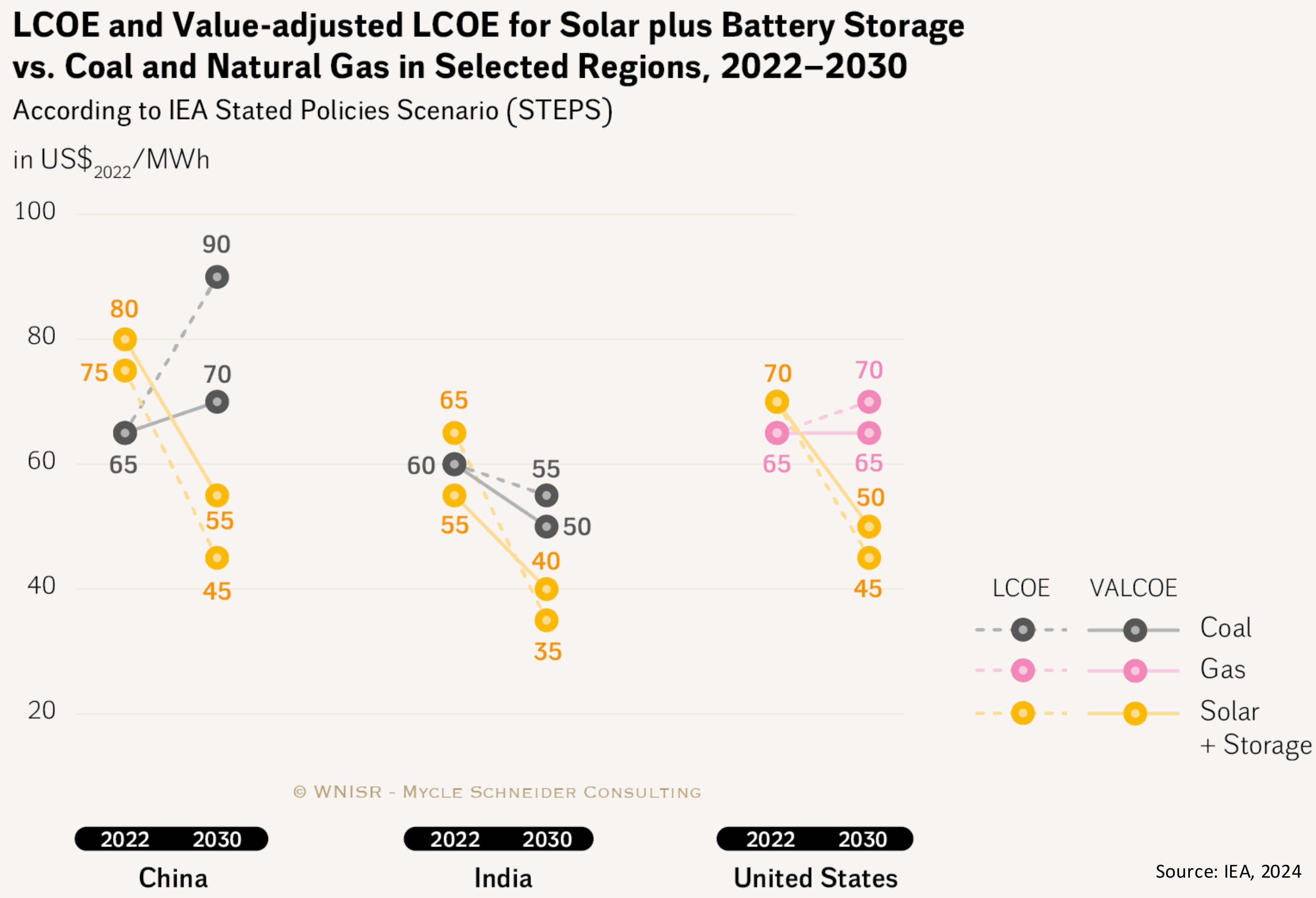
FIRMING – Utility-scale Storage Scaling Rapidly Due to Multiple Drivers



Source: Lawrence Berkeley National Laboratory, 2023

- Variable plus firming increasingly competitive.
- Utility scale batteries:
  - >80% cost decline in Li-ion battery costs (all types) from 2013-23.
  - More capacity to grid than nuclear starting in 2022.
  - As of 2023, 52 GW total, of which 35 GW added 2022-23.
- Installations supported by:
  - Declining costs.
  - Increased installation opportunities, location-neutral subsidies in US.
  - Multiple sources of value-added.

FIRMING – Solar + Storage Lowest Cost in Key Countries by 2030



International projections for PV + storage (IEA)

- IEA analysis, existing policies and renewable adjustments for grid integration (VALCOE)
- China: costs drop below coal and nuclear plants around 2025.
- India: already more competitive than coal; advantage expected to continue.
- EU: already more competitive that natural gas, due to price on carbon via ETS.
- New nuclear unlikely to be competitive with PV + storage anywhere.

CONCLUSIONS

Few major developments on the ground – despite numerous political announcements and funding allocations, and significant increase in media attention. Major trends in nuclear sector are unchanged, including:

- Growth rates in nuclear production are insignificant and remain insufficient to reverse the long-term decline of nuclear's share in total power generation.
- Nuclear capacity shrank while renewables—primarily wind and solar—added hundreds of gigawatts and storage options tens of gigawatts.
- The only countries building reactors at any significant level are China (at home) and Russia (abroad).
- The competitive advantage of solar and wind, now often with storage, expand across global markets, challenging nuclear newbuild and, increasingly, the operation of existing reactors. Especially solar plus storage might rapidly turn into a global changemaker in the energy equation.