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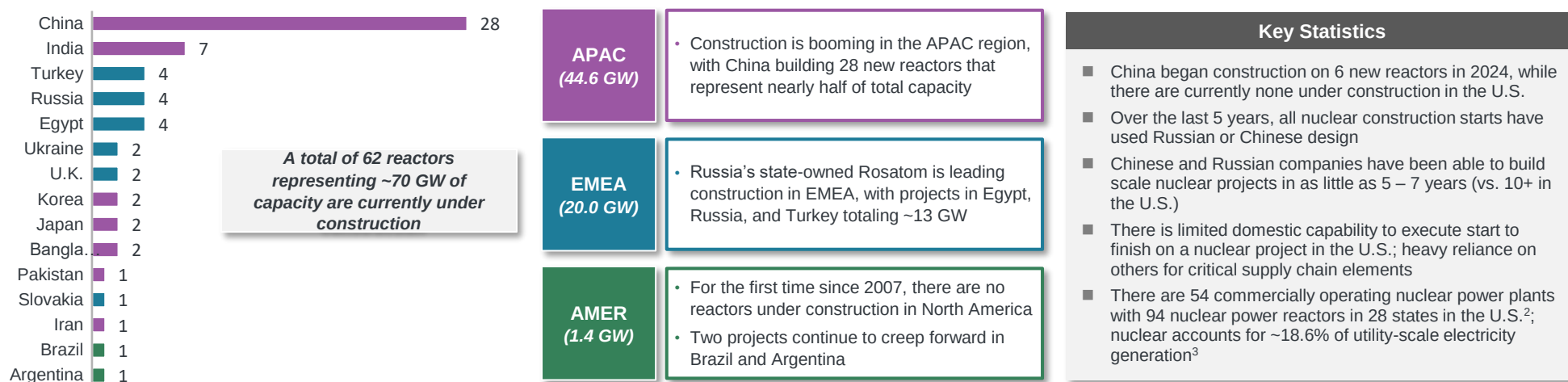
Hamm Institute for American Energy Roundtable Dialogue | Nuclear

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How the U.S. is positioned in the global nuclear sector

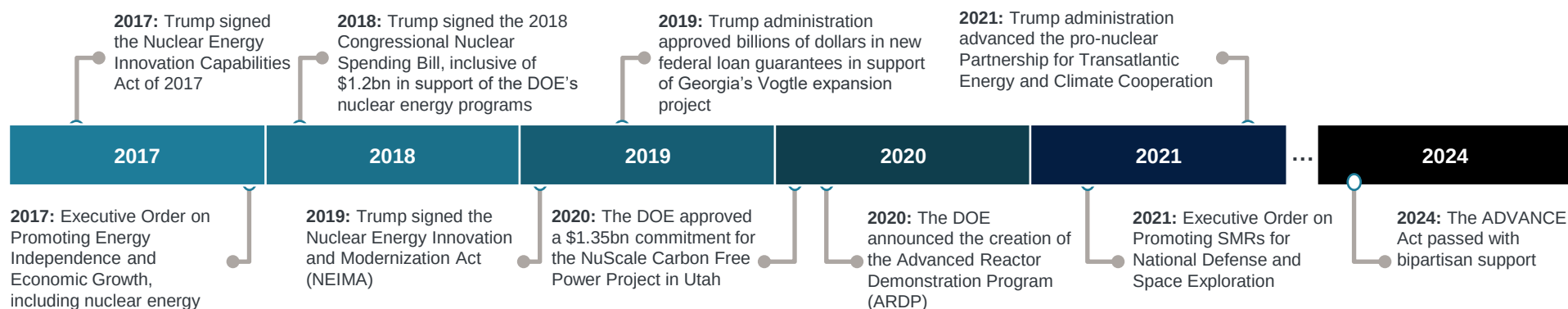
Rival nations currently outpace U.S. on nuclear buildout, underscoring urgency for action

NATIONAL DISTRIBUTION OF REACTORS UNDER CONSTRUCTION¹



U.S. SUPPORT FOR DOMESTIC NUCLEAR DEVELOPMENT

- During President Trump's first term, support for nuclear energy was part of a broader strategy to **boost domestic energy production**, **reduce regulatory burdens**, and maintain the **U.S.'s leadership in nuclear technology**
- Key areas of potential support in his second term may include further efforts to **streamline regulatory processes**, policies aimed at boosting **domestic uranium mining**, and measures to support the **economic viability of existing nuclear plants**
- Chris Wright, President Trump's pick for Secretary of Energy, has expressed support for nuclear power as part of expanding domestic energy production, indicating that the administration is **likely to provide financial and regulatory support for emerging nuclear technologies**



In response to the ongoing challenges with traditional nuclear fission, new advanced fission technologies have emerged...

There are ~80 SMR concepts currently under development and they all utilize the core physics of splitting atoms in order to generate heat, and are therefore best defined by their cooling/moderation mechanisms

What is an SMR?

Small	Typically less than 300Mwe, some as small as 1-10MWe
Modular	Designed for modular manufacturing, factory production, portability and scalable deployment
Reactor	Use nuclear fission reactions to create heat

	DESCRIPTION	PROS/CONS
WATER COOLED REACTORS	- Most mature technology - The water boils at or near the reactor core (in the case of pressurized water reactors) producing steam that turn turbines to generate electricity - Reflects today's nuclear technology but at smaller unit scales	↑ Long history given same core technology as today's reactors ↑ Ease of visual inspection ↑ Current designs are all SMRs, with off-site manufacturing and intact shipping ↓ Water is not the most efficient heat transfer mechanism limiting industrial applications
SALT AND SODIUM COOLED REACTORS	- Instead of water, uses molten salt or liquid metals - These materials do not expand nearly as much as water when heated, so reactors can run at higher temperatures and lower pressures	↑ Lower cost design due to reduced expansion of heat transfer medium (salt vs. water) ↑ Higher heat results in higher electricity generation efficiency ↑ Lower chance of coolant loss accidents ↓ High-Assay Low-Enriched Uranium (HALEU) fuel currently difficult to attain domestically
HIGH TEMPERATURE GAS COOLED REACTORS	- Produces high temperatures while operating at varying pressure levels - The moderator for thermal gas-cooled reactors is typically pure graphite - No water is involved with an inert gas (usually helium) used as the coolant and heat-transfer medium	↑ High thermal efficiency for electricity generation or process heat applications ↑ High degree of inherent safety due to single phase coolant use ↓ Very limited experience with the technology in North America
FAST REACTORS	- The reactor is cooled with helium (for gas cooled), which is routed directly to a turbine, so there is no steam generator and an overall high efficiency of 45% - Also, can utilize lead which provides additional passive safety benefits - Operates at lower temperatures than other gas reactors	↑ Direct use of helium to cool the core and spin the turbines enables fast power-level changes, with up to a 20% per minute power ramping ↑ Automatic control of the reactor power and turbo machinery keeps the reactor at a constant temperature reducing wear on metal components ↓ Very limited experience with the technology in North America

... and there are a few key players that have dominated each sector of advanced fission technology development

Part of a
Conglomerate

EMERGING LEADERS IN ADVANCED FISSION TECHNOLOGY DEVELOPMENT

WATER COOLED REACTORS	  HITACHI   
SALT AND SODIUM COOLED REACTORS	      
HIGH TEMPERATURE GAS COOLED REACTORS	   
FAST REACTORS	   

A few names have shown strong progress in terms of depth of regulatory engagement and project development

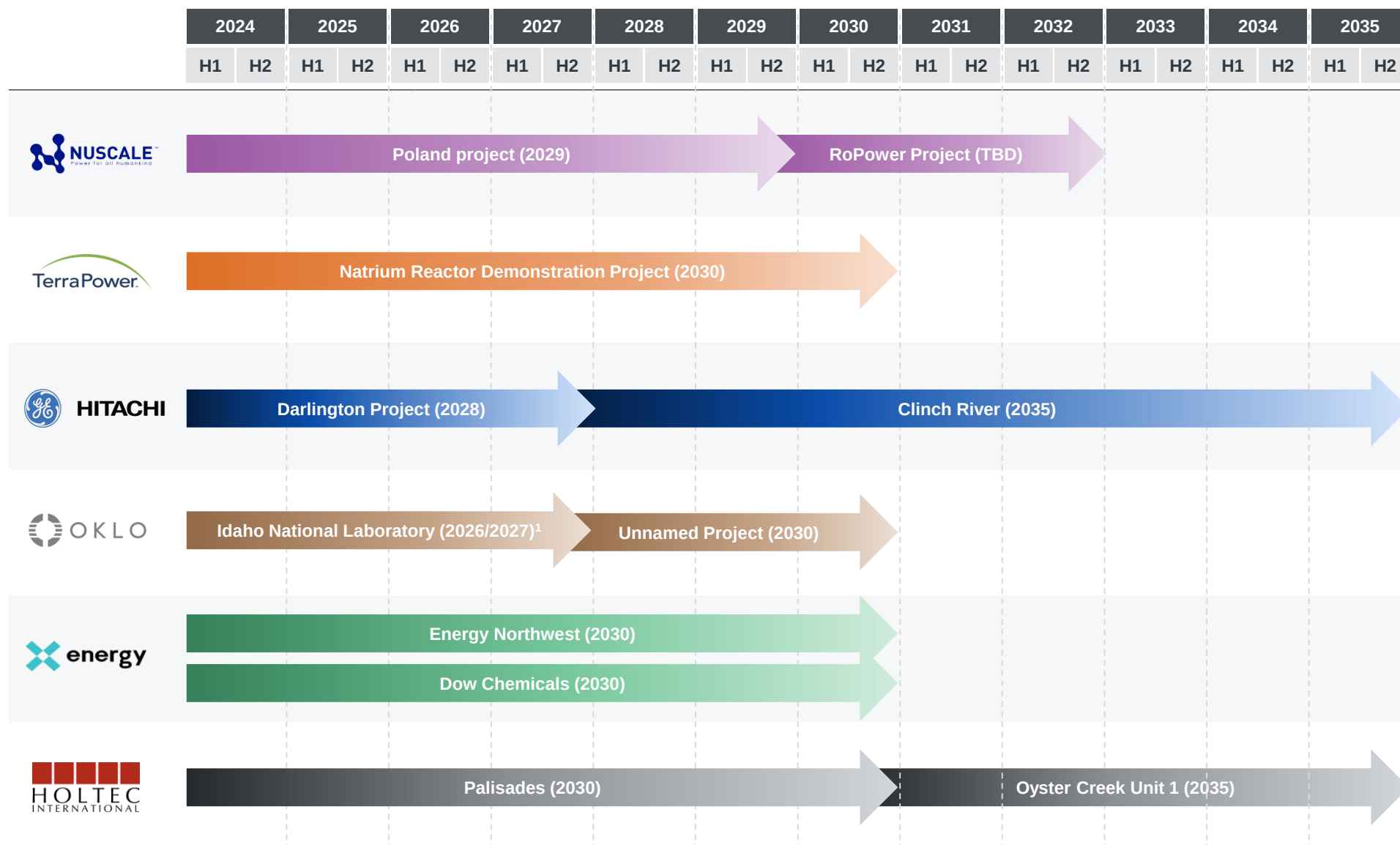
						
HQ	Corvallis, OR	Bellevue, WA	Wilmington, NC	Santa Clara, CA	Rockville, MD	Jupiter, FL
Founded	2007	2006	2007	2013	2009	1986
Name	VOYGR SMR	Sodium reactor	BWRX-300	Aurora	Xe-100	SMR-300
MW	6 module / 462 MW	345 MW	300 MW	15 MW ¹	4 module / 320 MW	300 MW
Type	PWR	SFR	BWR	LMFR	HTGR	PWR
Regulatory status	Construction permit approved in 2023	Awaiting construction permit approval	Awaiting construction approval submittance	Awaiting construction permit approval submittance	Awaiting construction approval submittance	Awaiting construction permit approval submittance
Expected approval	Approved	2028	2029	2027	2028	2029
Ownership	Public	Bill Gates and SK Group	General Electric and Hitachi	Public	Kamal Ghaffarian, Ares ²	Private (founder)
Expected first reactor COD	2029	2030	2029	2027	2030	2030

Recent announcements in the nuclear SMR space have been driven by Big Tech, as they continue to seek a carbon free solution for data center demand

NUCLEAR COMPANY	PARTNER	PROJECT DESCRIPTION	# REACTORS	TARGET COD
	 	TRI-Energy Partnership – Energy Northwest First commercial Xe-100 nuclear plant (320 MW) and TRISO-X facility to install four SMRs with an expandable capacity from 320 MW to 960 MW	1 reactor	2030
		Dow Chemicals Developing an advanced SMR nuclear plant at UCC Seadrift Operations, cutting emissions by 440,000 MT CO2/year and generating 320 MW from four reactors	4 reactors	2030
		Sodium Reactor Demonstration Project 345MW nuclear plant based on Sodium technology - Construction started in June 2024 in Kemmerer¹, Wyoming and includes storage technology which boosts output to 500MW (400,000 homes) if needed	1 reactor	2030
 HITACHI		Darlington New Nuclear Project - Partnering with Ontario Power Generation to deploy a BWRX-300 SMR at Darlington site (potential to power 300,000 homes) - Expecting nuclear construction on first out of four SMRs to begin in 2025	1 reactor	2029
		Google AI SMR construction Agreement will support first commercial deployment of Kairos' Power's reactors by 2030 for a total fleet of 500 MW by 2035	5 reactors through 2035	2030
<i>To be determined</i>		SMR-powered gigawatt data center In Sep-24, Oracle announced that its planning to build a >1 GW data center, powered by three small modular nuclear reactors	3 reactors	-
		Oklo and Switch form landmark strategic relationship Signed a non-binding Master Power Agreement to deploy 12 GW of Oklo Aurora powerhouse projects through 2044	-	-
		Equinix secures nuclear power with Oklo Equinix signed a pre-agreement with Oklo to procure up to 500 MW of nuclear energy, marking the first SMR deal by a colocation data center company	-	-

In addition to discrete projects, dozens of MOUs have been signed globally for the development of SMRs technology across the top players

Although public estimates vary, we don't expect to see meaningful SMR deployments until the 2030s



Spent nuclear fuel, often called “nuclear waste,” is produced during the nuclear fission process in reactors

COMMON CONCERNS ON NUCLEAR WASTE

Absence of a permanent disposal solution

- Communities are concerned about the indefinite storage of radioactive materials near their residences, fearing potential environmental and health risks
- The U.S. still has **no permanent geological repository** for high-level waste

Transportation challenges

- Despite the industry's assurances regarding safety, transporting radioactive materials through populated areas continues to raise public anxiety
- The primary concerns revolve around the **risk of potential accidents** and **whether emergency response plans are adequate**.

Evolving waste profiles from advanced reactors

- Some early critiques claimed advanced reactors would produce more waste, which has **largely been debunked**, though managing long-lived isotopes still requires **sustained technical and regulatory focus**.

QUICK FACTS ON SPENT NUCLEAR FUEL

1



What is spent nuclear fuel?

- Spent fuel refers to the **nuclear fuel that has been used in a reactor**.
- The fuel is a **solid when it goes into the reactor and a solid when it comes out**, and is typically made up of ceramic pellets in metal rods

2



How much spent nuclear fuel has been generated?

- The U.S. has produced roughly **90,000 metric tons of spent fuel** since 1950s. This could all fit on a football field at a **depth of less than 10 yards** if it could be stacked together
- On a yearly basis, the US generates about **2,000 metric tons of spent fuel**. The clean energy generated from this fuel would be enough to power more than **70 million homes**

3



How to safely store spent nuclear fuel?

- Spent fuel from power reactors is safely and securely stored at more than **70 sites in 35 states**. Roughly a quarter of these sites no longer have a reactor in operation.
- For the foreseeable future, the spent fuel will stay at the reactor sites or a future consolidated interim storage facility until a permanent disposal solution is determined by the federal government

4



How to safely transport spent nuclear fuel?

- Spent fuel is safely transported across the US with **>2,500 cask shipments over the last 55 years**
- The fuel is shipped in transportation casks that are designed to **withstand more than 99 percent of vehicle accidents**, including water immersion, impact, punctures and fires

5



Can spent nuclear fuel be recycled?

- Spent nuclear fuel **can be recycled** to make new fuel and byproducts. **More than 90% of its potential energy still remains in the fuel**
- The U.S. does not currently recycle spent nuclear fuel, but some countries do (e.g., France)
- Some advanced reactor designs in development can consume/run on spent nuclear fuel in the future

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