
Capital Markets Strategy
Essential inCights for the C-Suite
MUFG
Bottlenecks to Scaling
AI Computational Power
JUN 2026


“Chip supply chains will shape geopolitics more than oil over the next 50 years.”
Pat Gelsinger,
Former CEO of Intel (January 2023)

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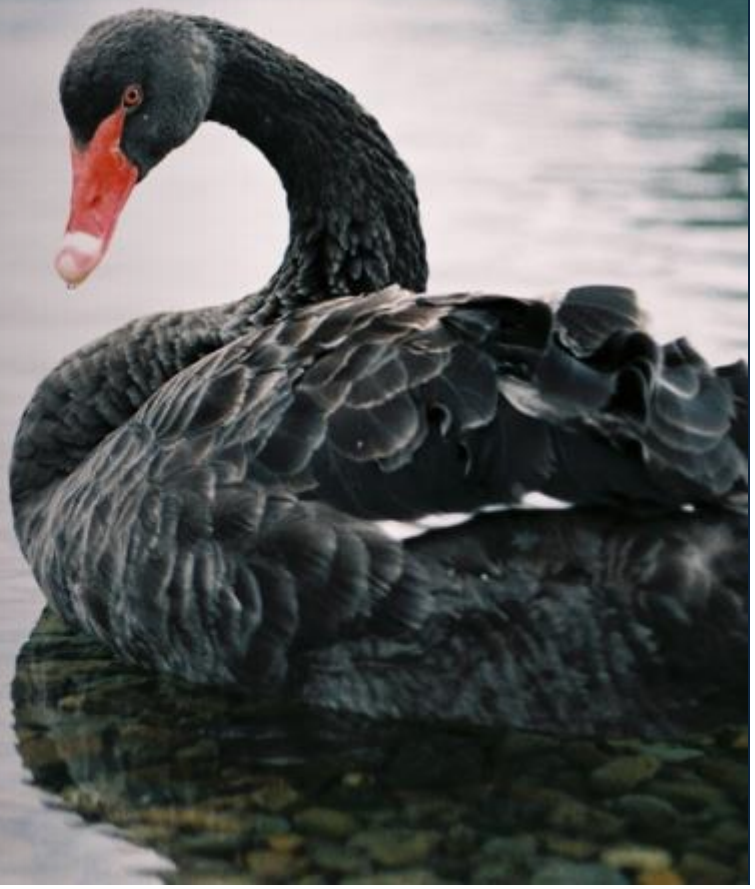
Contents

3 criteria of black swan events

1 ***Transformative in size and scope***

2 ***Outlier; not expected***

3 ***Predictable in hindsight***



1

AI Has Become a Pervasive Megatrend

Global Market Math

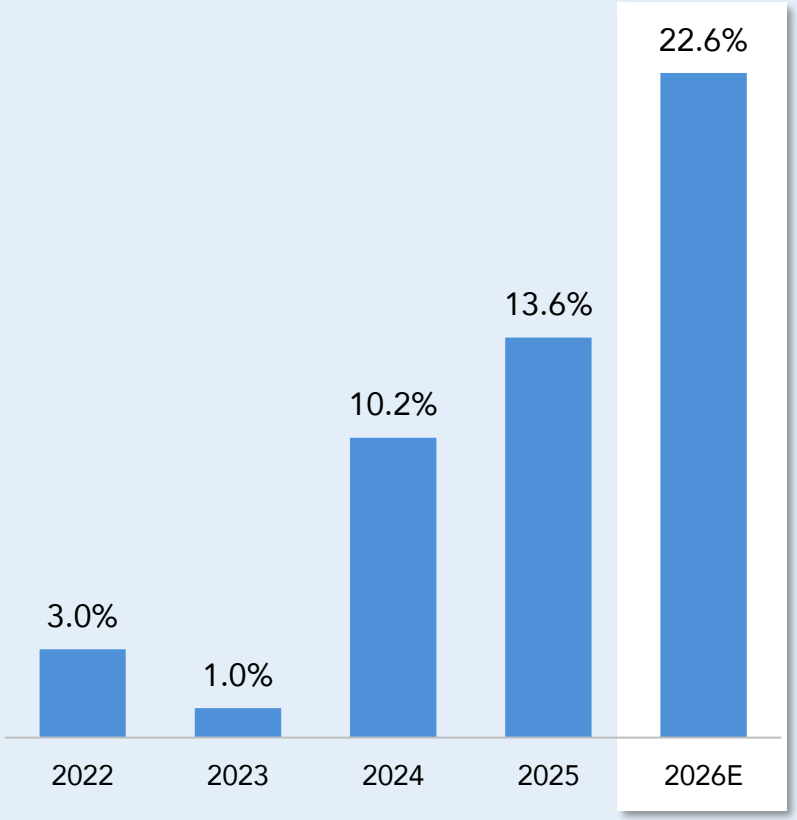
AI Tailwinds > **Iran War & Trade War Headwinds**

If oil < $120

AI is Greater Than Iran War + Trade War

Q1 2026 S&P 500 earnings growth is currently expected **to exceed 27%, more than double prior estimates of 13% just two months ago**. Q1 also represents the **sixth straight quarter of double-digit earnings growth** for the index, with AI and tech related companies driving the earnings expansion.

Post-COVID S&P 500 earnings growth, y/y



Notable observations (Q1 2026)

- Q1 earnings growth expectations have doubled since March
- 84% beat earnings expectations
- 80% beat revenue expectations
- Mag 7 (AI) dominating at +60% EPS growth
- Tech & communications leading all sectors
- 12% margins near post-COVID highs

Source: (1) FactSet, Earnings Insight Report (May 29, 2026).

AI Is Driving S&P 500 Earnings Growth

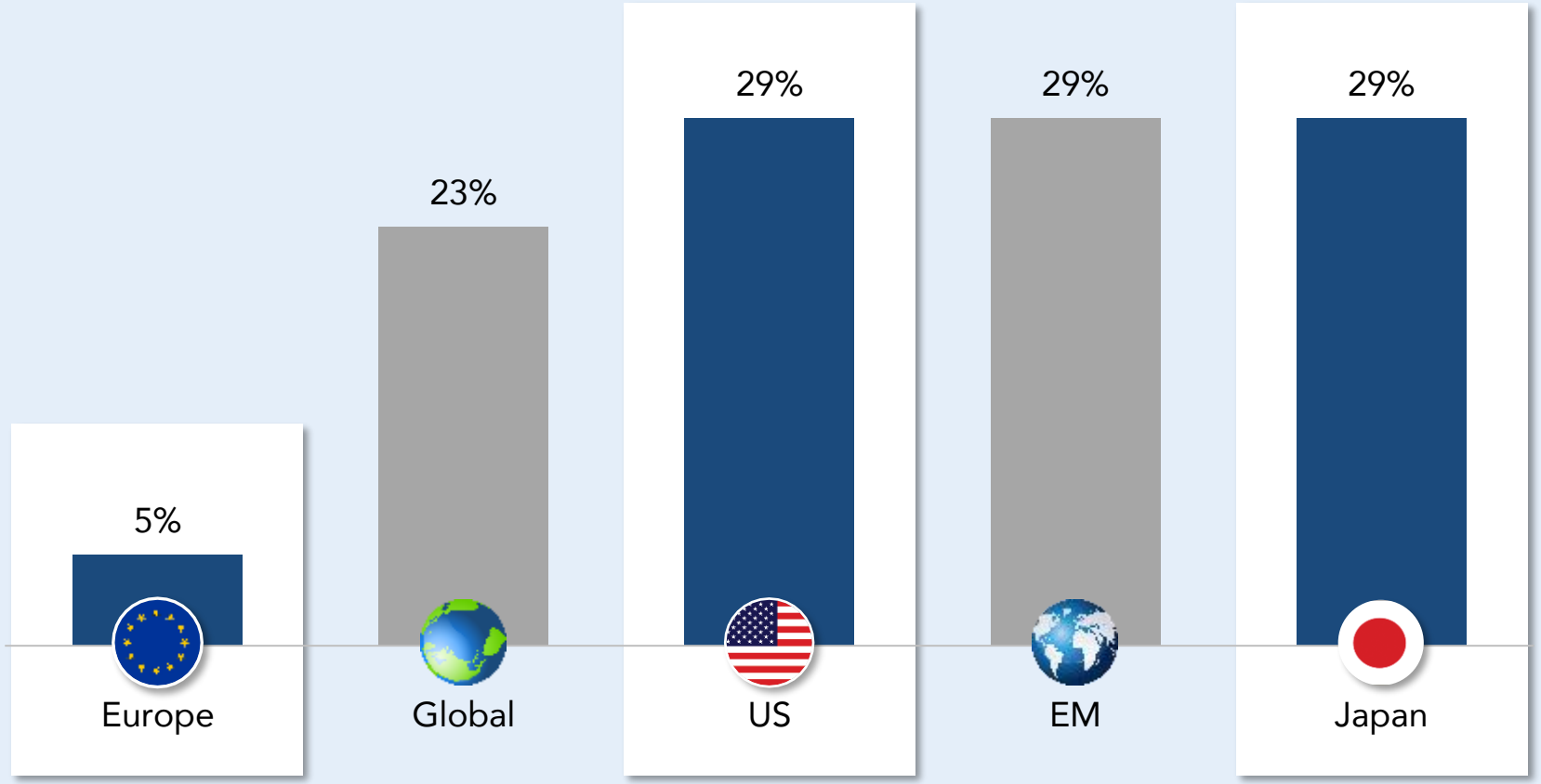
Q1 2026E earnings growth (S&P 500)

Source: (1) FactSet, "Earnings Insight" (May 29, 2026). Analyst estimates.

AI Also Evident in Global Earnings Growth

European corporate earnings, driven less by tech and AI, has lagged in the low-single digit range in the post-COVID period. Japanese earnings growth has risen to 4-year highs, while robust EM growth has been driven by AI-related demand.

Q1 2026 corporate earnings growth



Source: (1) FactSet. Bloomberg. Earnings for the US and EM are in USD terms, for Europe in EUR and for Japan in JPY.

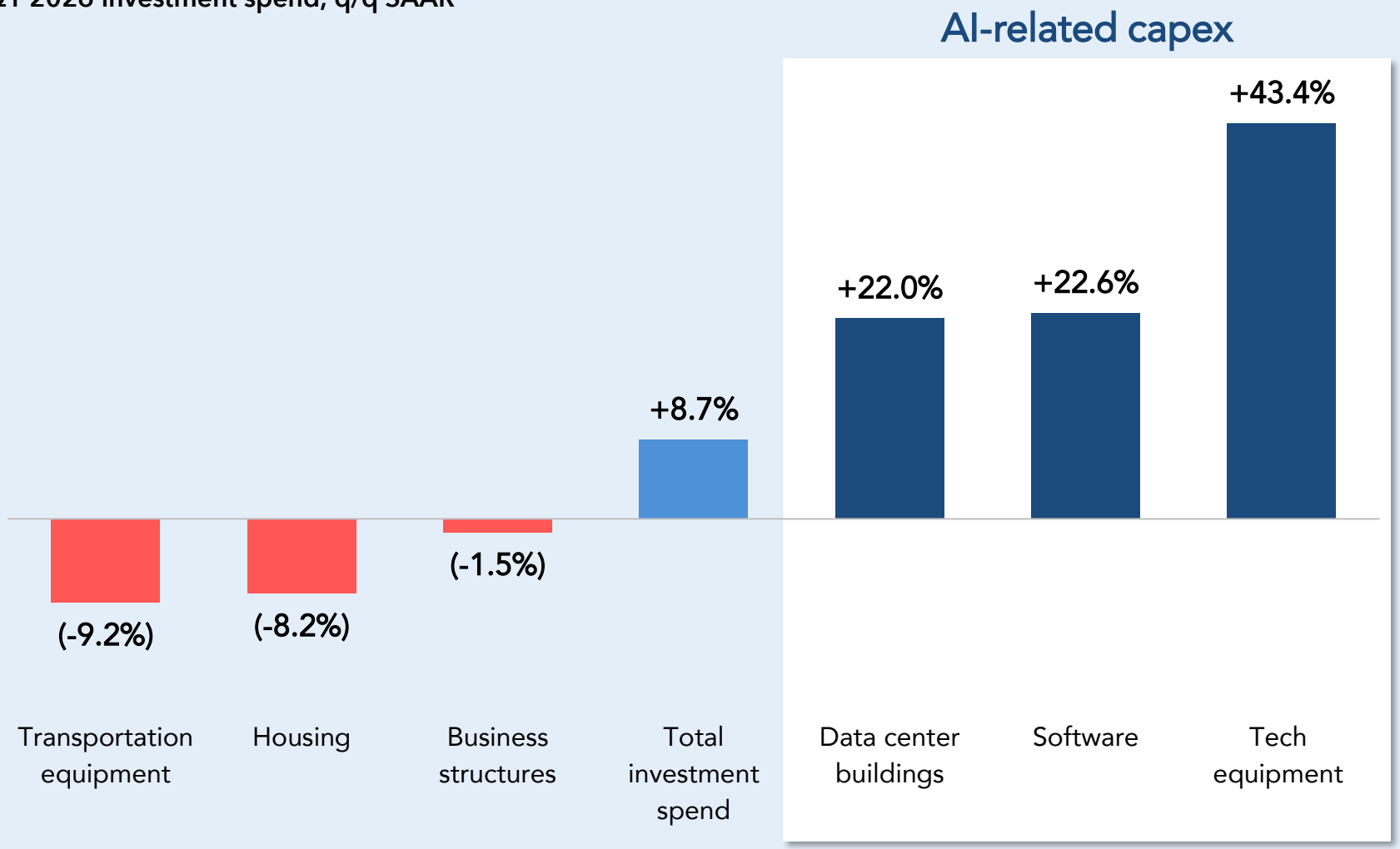
AI Is Driving the US Economy

Estimated growth of US economy in Q1 2026

Source: (1) WSJ, "AI Is Distorting Practically Everything About the Economy" (Greg Ip).

AI Driving Historic US Capex Supercycle

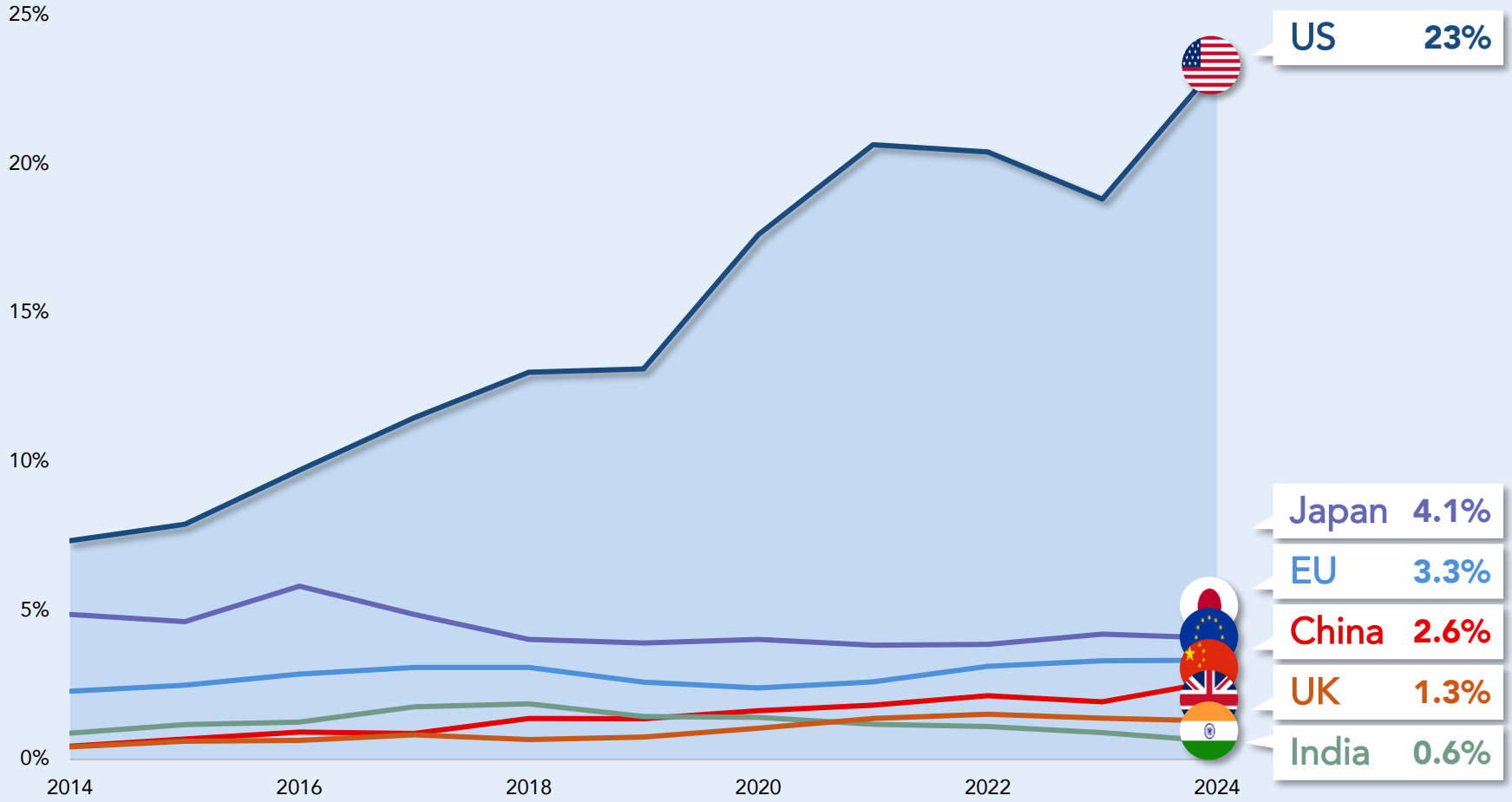
Q1 2026 investment spend, q/q SAAR



Source: (1) WSJ, "AI is Distorting Practically Everything About the Economy" (Greg Ip). BEA. Bloomberg. Data as of May 29, 2026.

AI Share of Total Capital Expenditure

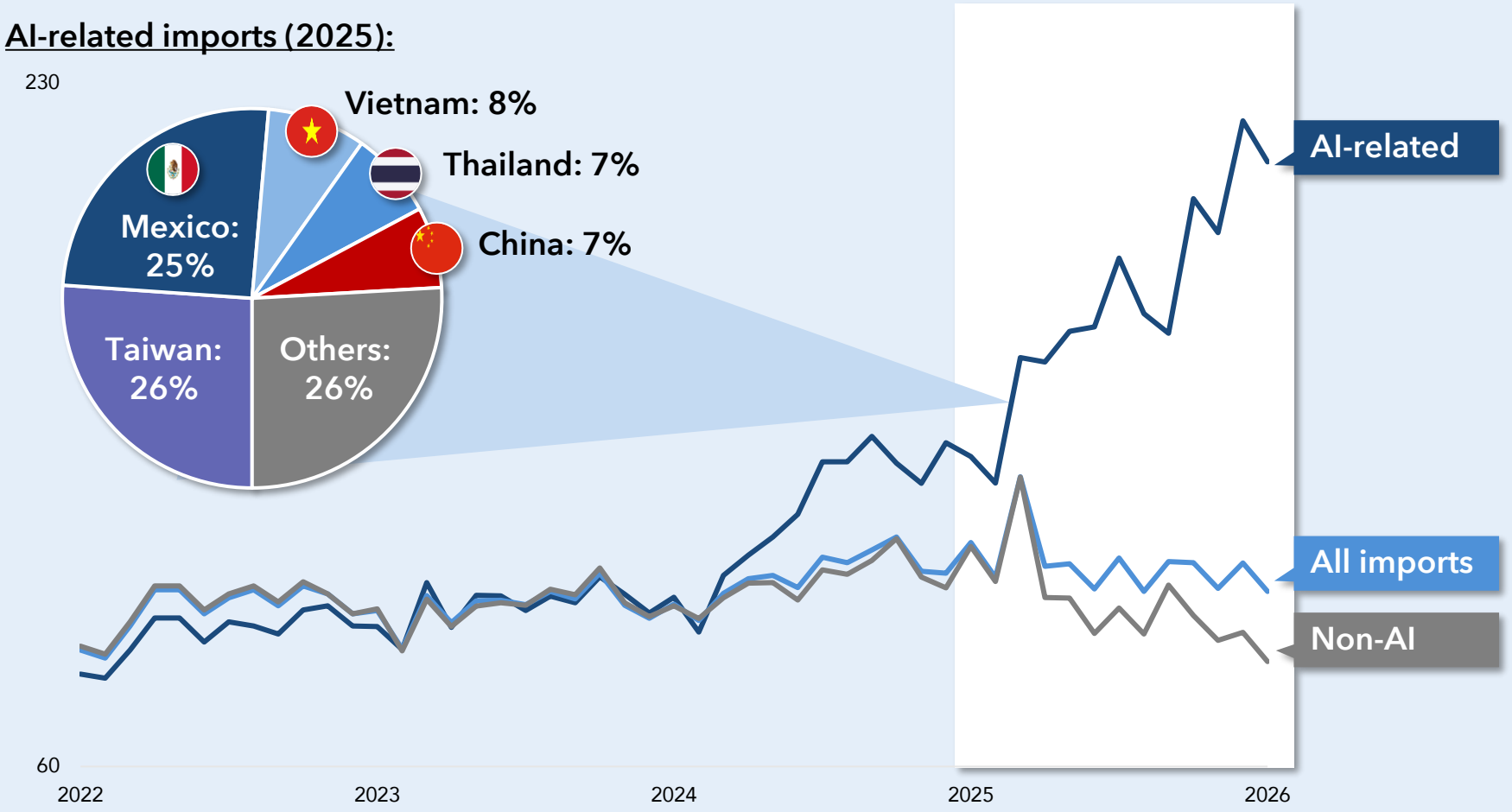
AI firms' share of total capital expenditure, by country



Source: (1) BIS, "The Geography of AI Firms" (April 2026). S&P Global. Share of capex is the sum of capex across AI firms divided by the sum across all public firms in each country.

Boom in AI-Related US Imports

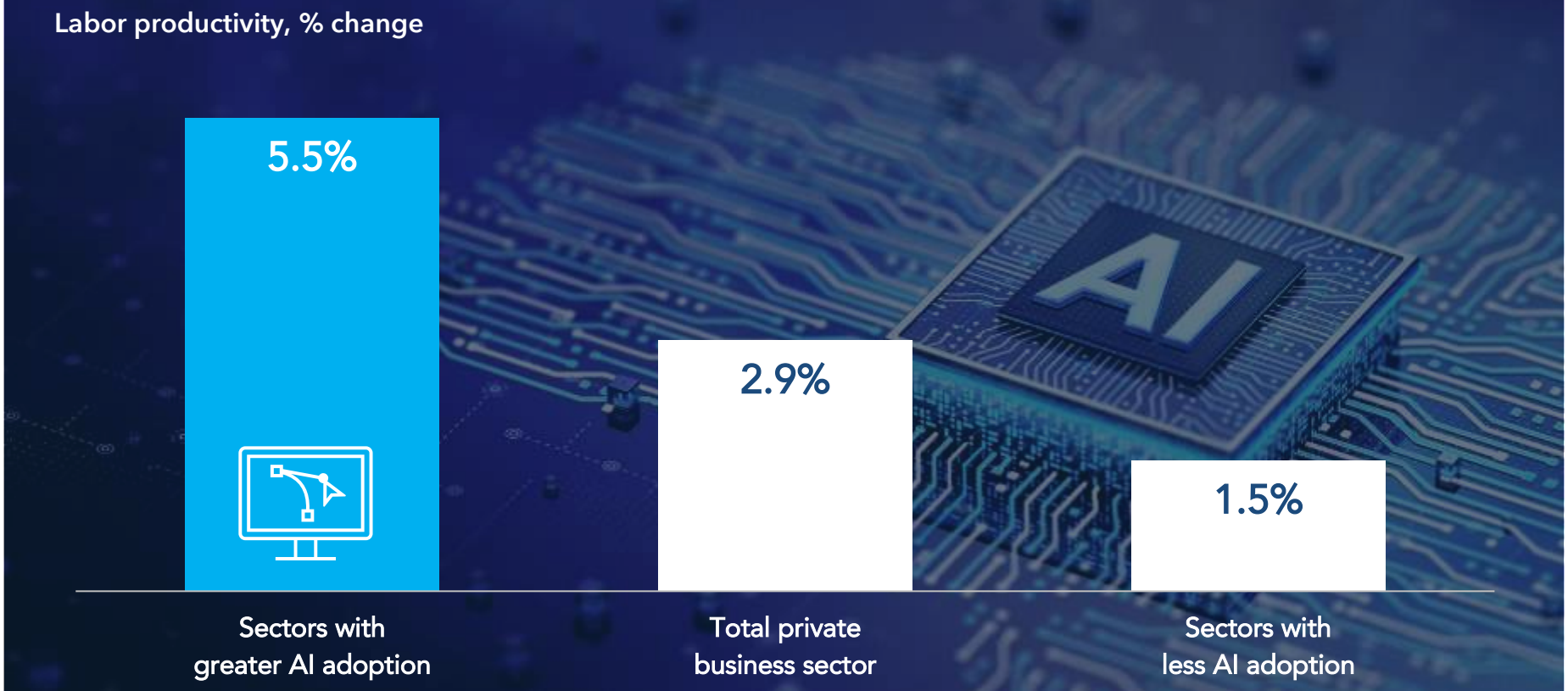
Breakdown of monthly US imports (2022-2026)



Source: (1-2) Federal Reserve of Minneapolis, "Trade in AI-Related Products" (April 2026). US Census Bureau. International Trade Commission. Data is indexed to 100 to the average monthly imports in 2023. Imports measured in nominal dollar volume and classified as high, medium, or low relevance to AI infrastructure using an LLM.

High AI Adoption Sectors Have Higher Productivity

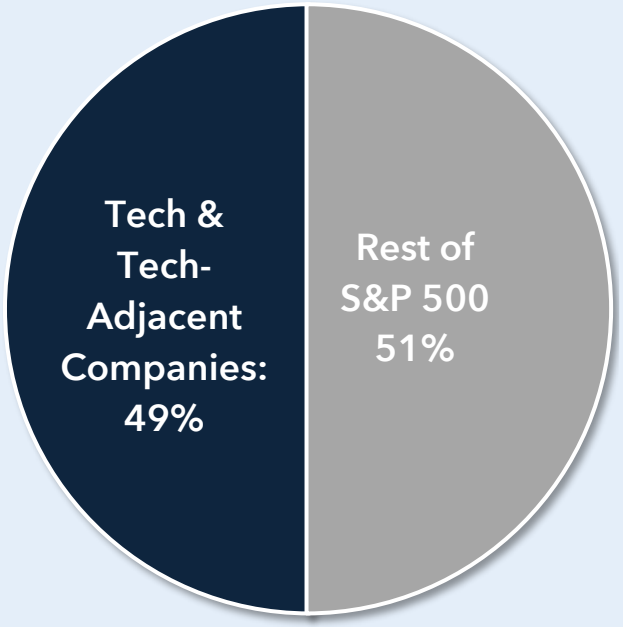
Research and data (industry, academic, Fed) increasingly show that sectors with higher AI adoption tend to exhibit faster productivity growth, frequently J-shaped over time.



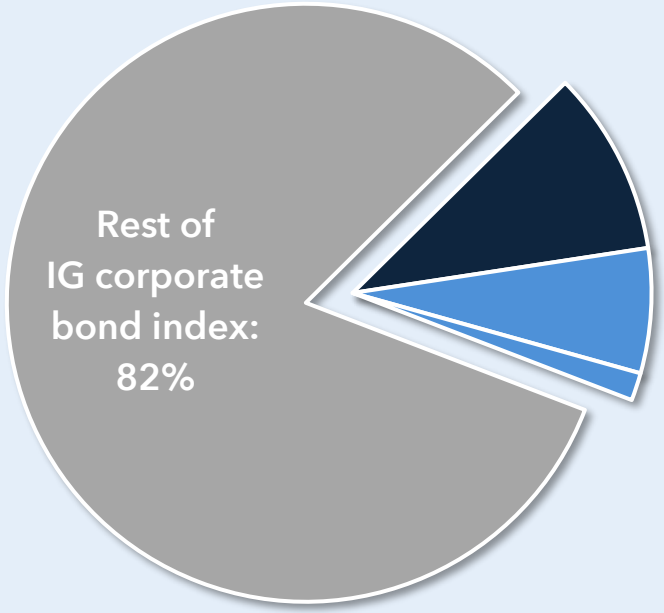
Source: (1) BLS. Data is latest available from 2024. Sectors with greater AI adoption include information, finance & insurance, educational services, and professional & technical services. Labor productivity is average of industry labor productivities.

Tech as Pervasive Megatrend in Markets

Breakdown of S&P 500 companies, % of total



IG corporate bond index, by sector



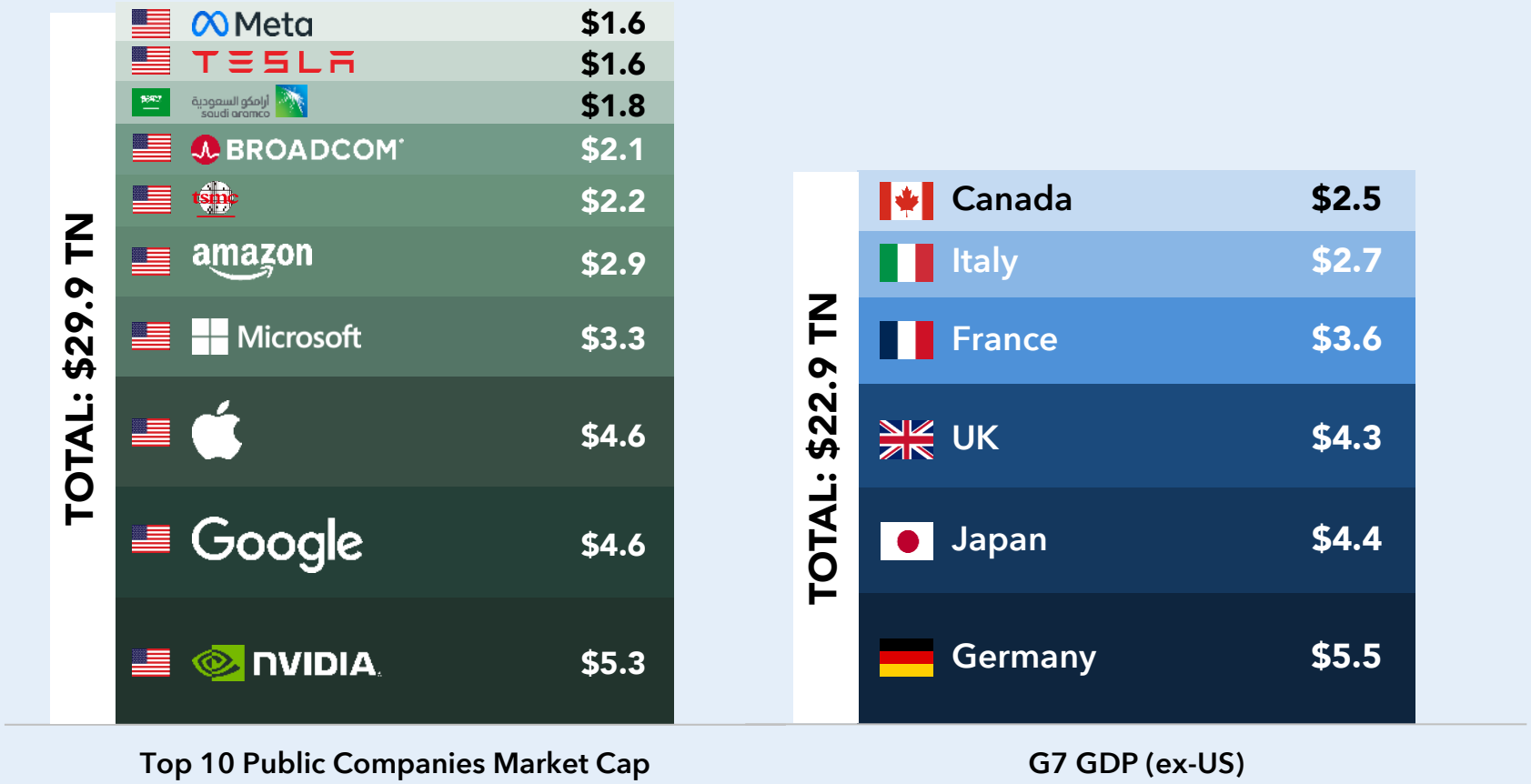
AI-related: 18%

- Utility: 10%
- Tech & electronics: 7%
- Data centers 2%

Source: (1) S&P 500. (2) Bloomberg. Data as of May 2026.

Top 10 Market Caps > G7 GDP (ex-US)

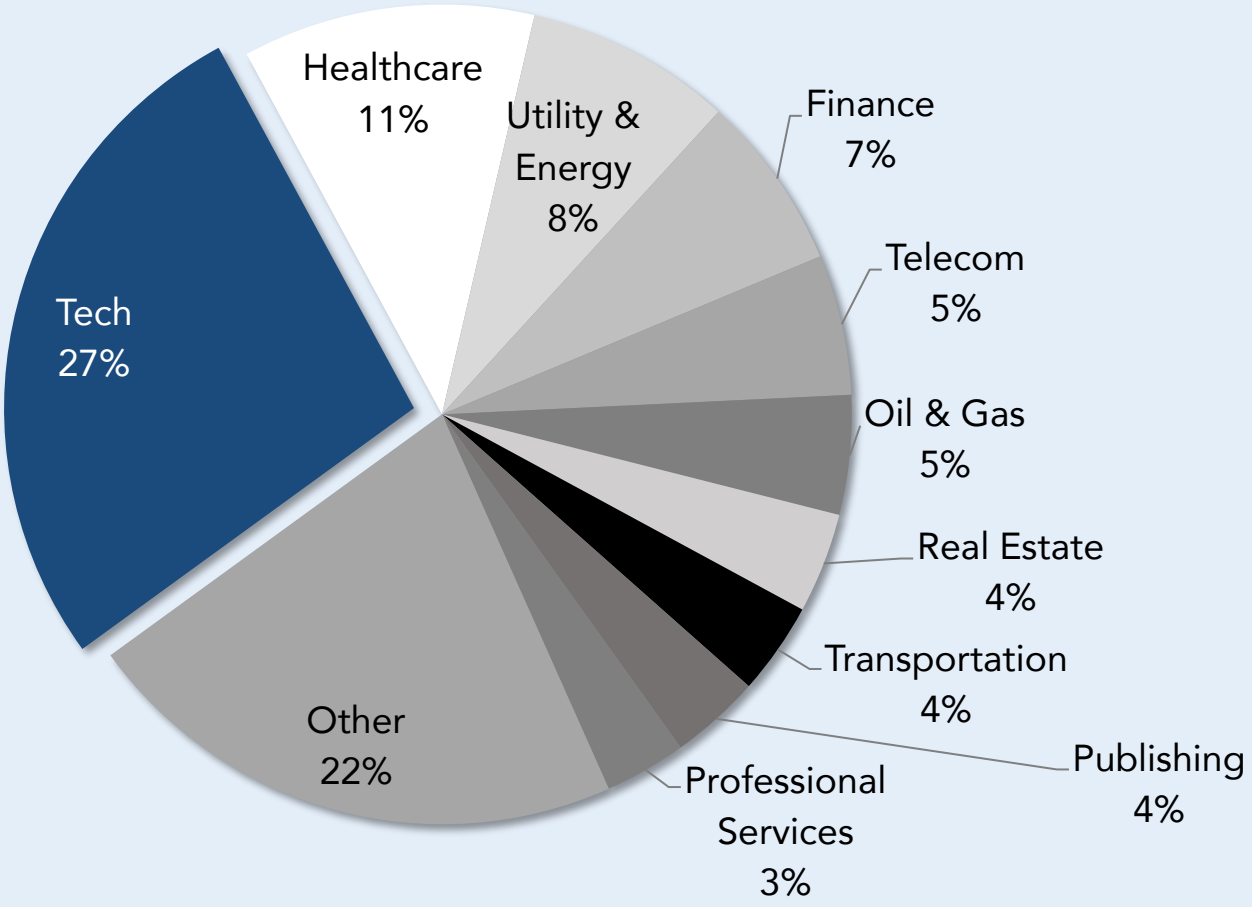
Top 10 public company market cap vs. G7 GDP (ex-US), USD tn



Source: (1) Bloomberg. IMF, "World Economic Outlook (April 2026)". A16z. Data as of May 29, 2026.

Tech Nearly 30% of Global M&A Activity

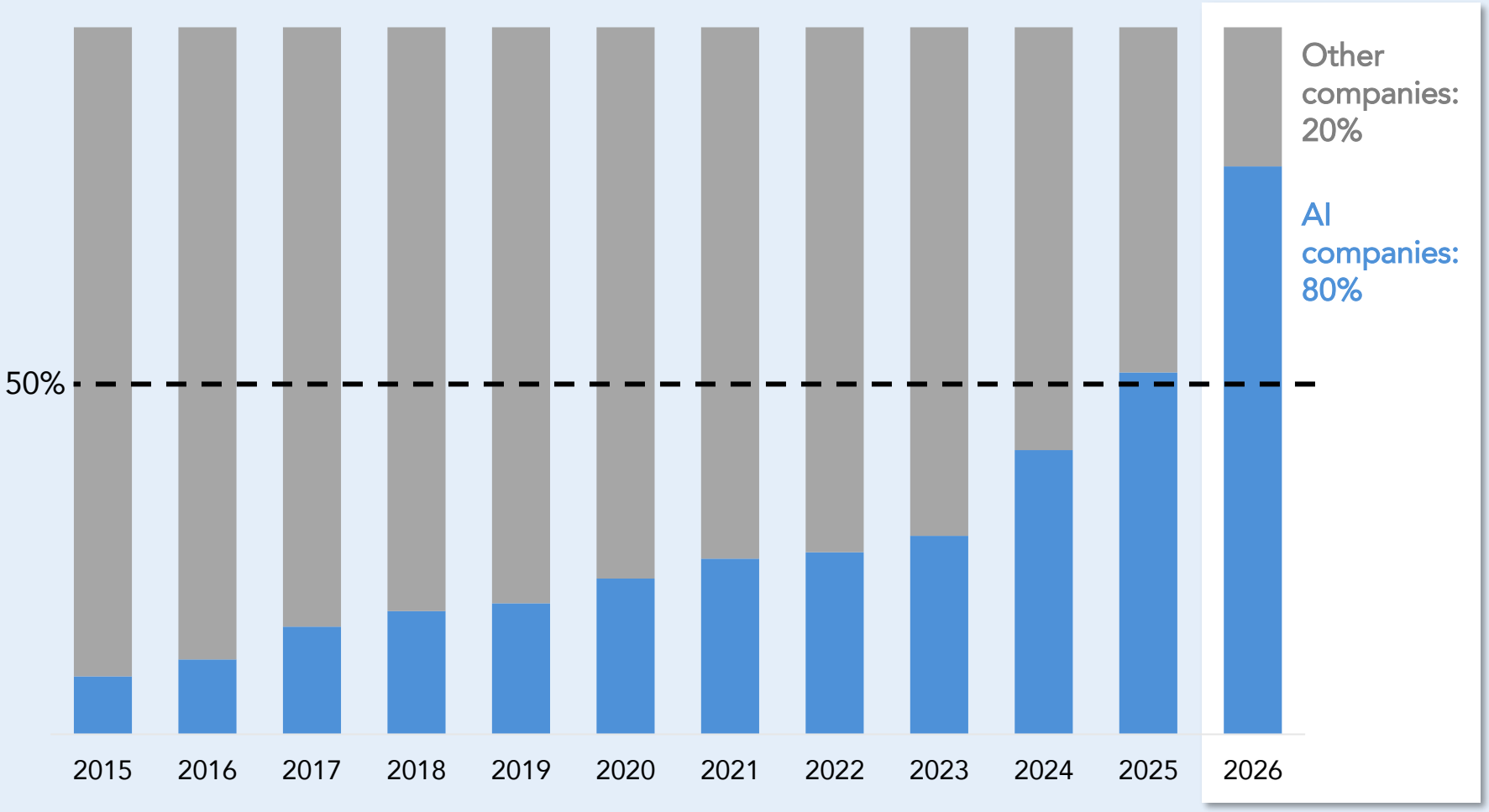
Global M&A activity, by sector (2026 YTD)



Source: (1) Dealogic. Cortex. Data through May 11, 2026, accessed on May 11, 2026.

80% of Global VC Activity is Now AI

Share of global VC deal value, by company type

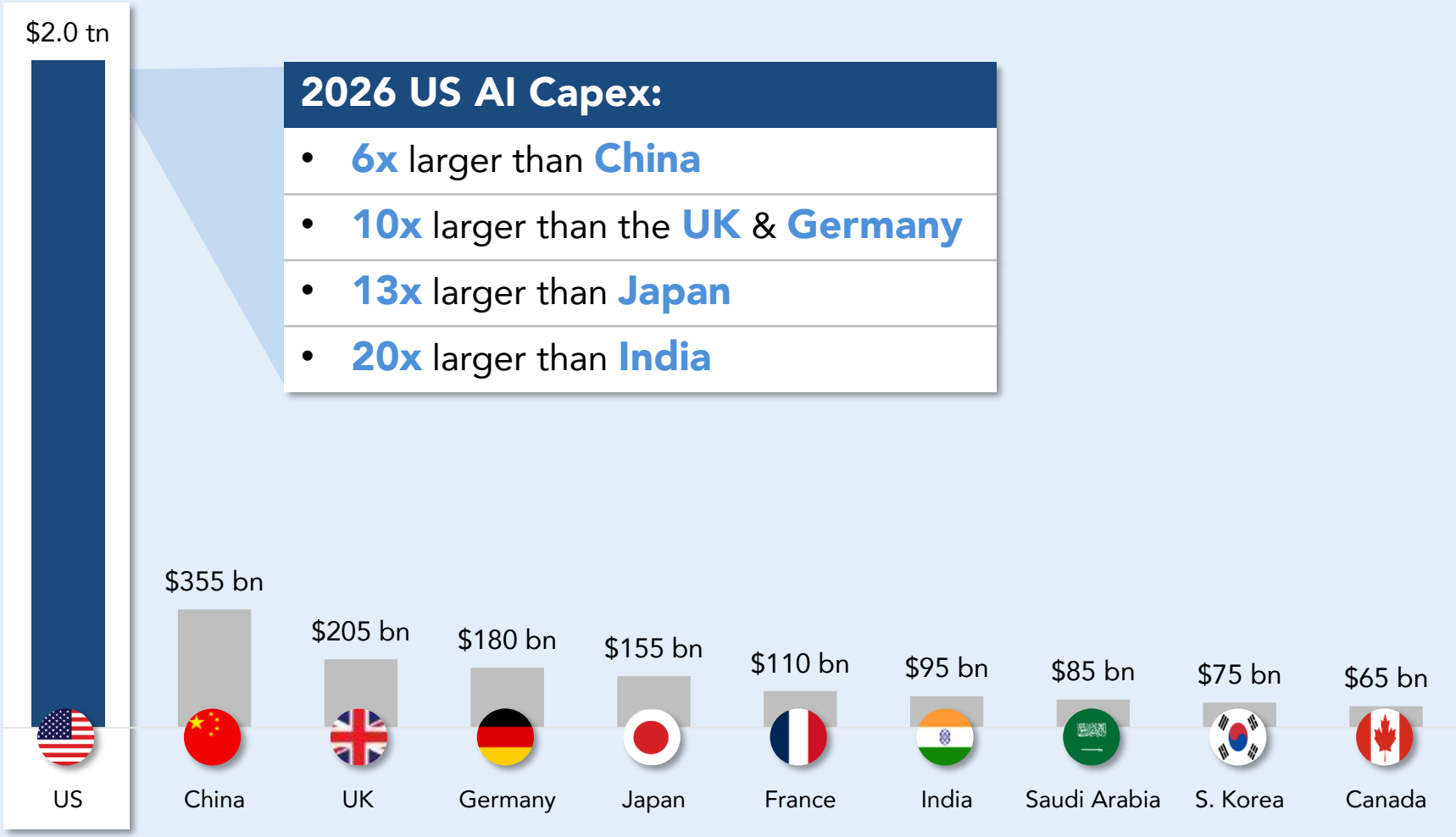


Source: (1) Pitchbook, "Q1 2026 Global VC First Look." Data through March 31, 2026.


2
Financing the Largest
Capex Supercycle in History

US Leadership in Global AI Capex Spend

2026 projected AI investment by region (infrastructure, software & services)

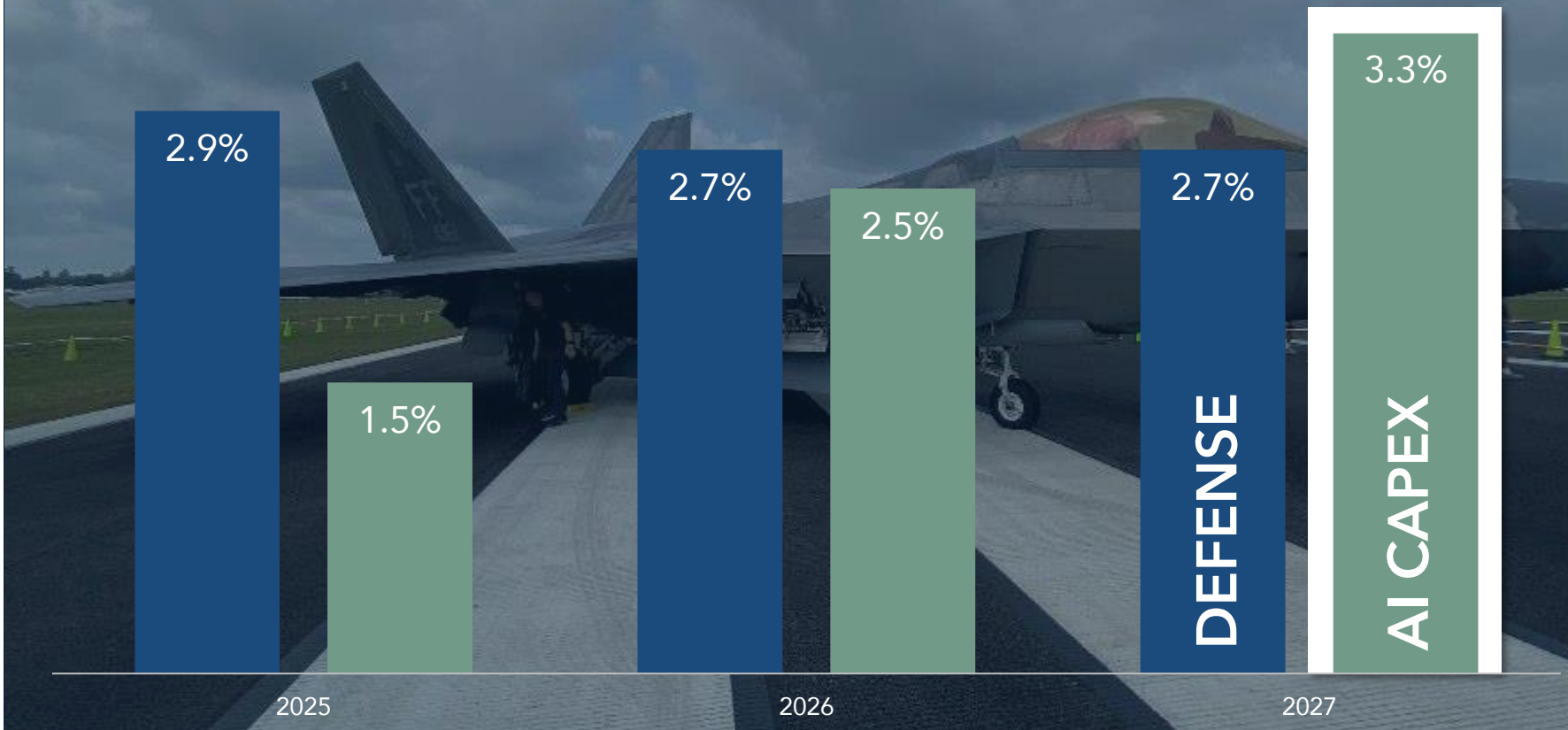


Source: (1) IDC. Gartner. Futurum Group. Wall Street tech sector research. US Dollars.

US AI Spend to Exceed National Defense

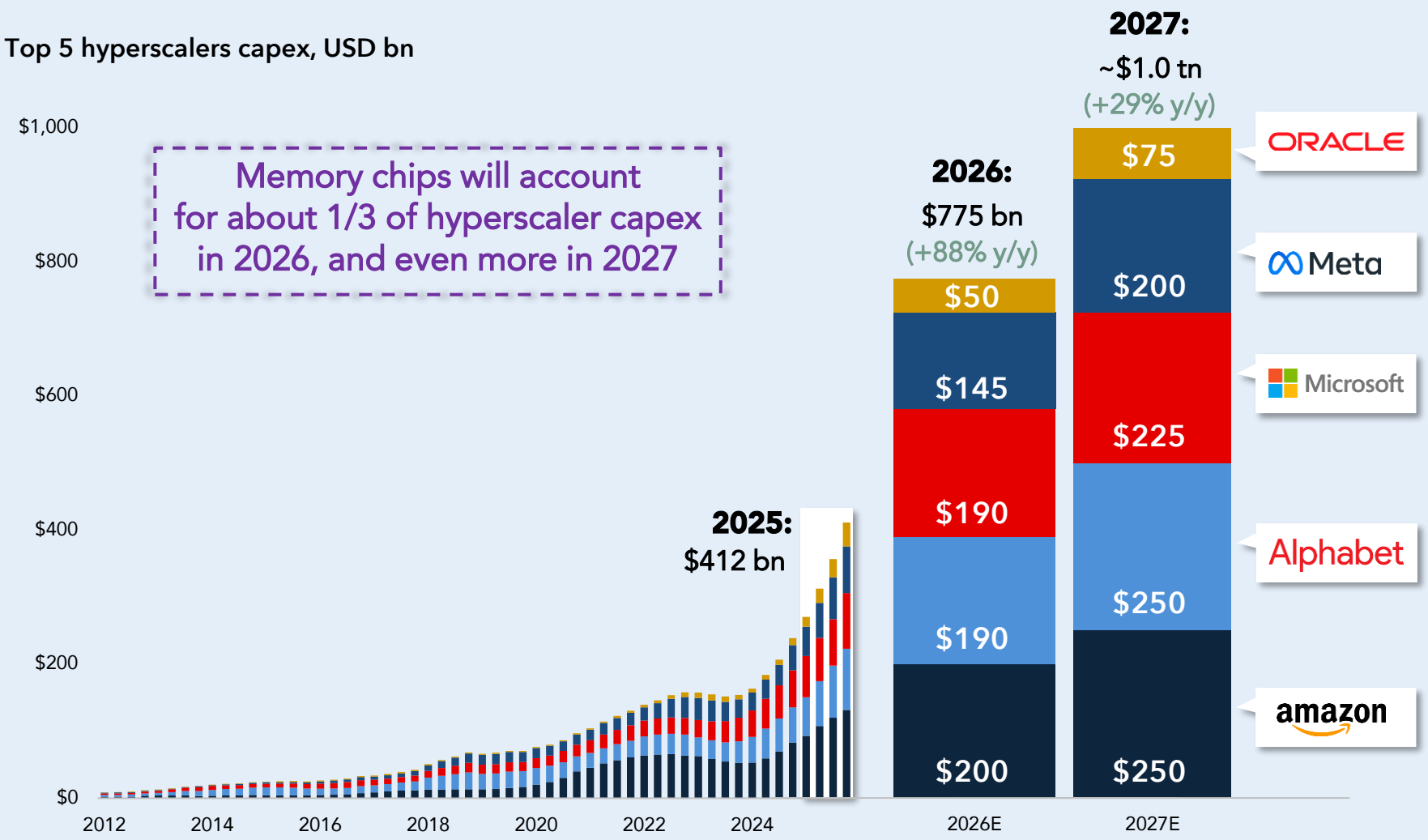
As noted by Greg Ip of the WSJ, US AI spend at 3.3% of GDP in 2027 would exceed projected US spending on national defense.

AI capital expenditure vs. national defense, % of GDP



Source: (1) WSJ, "AI Is Distorting Practically Everything About the Economy". Morgan Stanley. Congressional Budget Office. 2026 and 2027 are projections. AI capital expenditure is for Alphabet, Amazon, Meta, Microsoft and Oracle. CBO defense estimate does not include White House budget request.

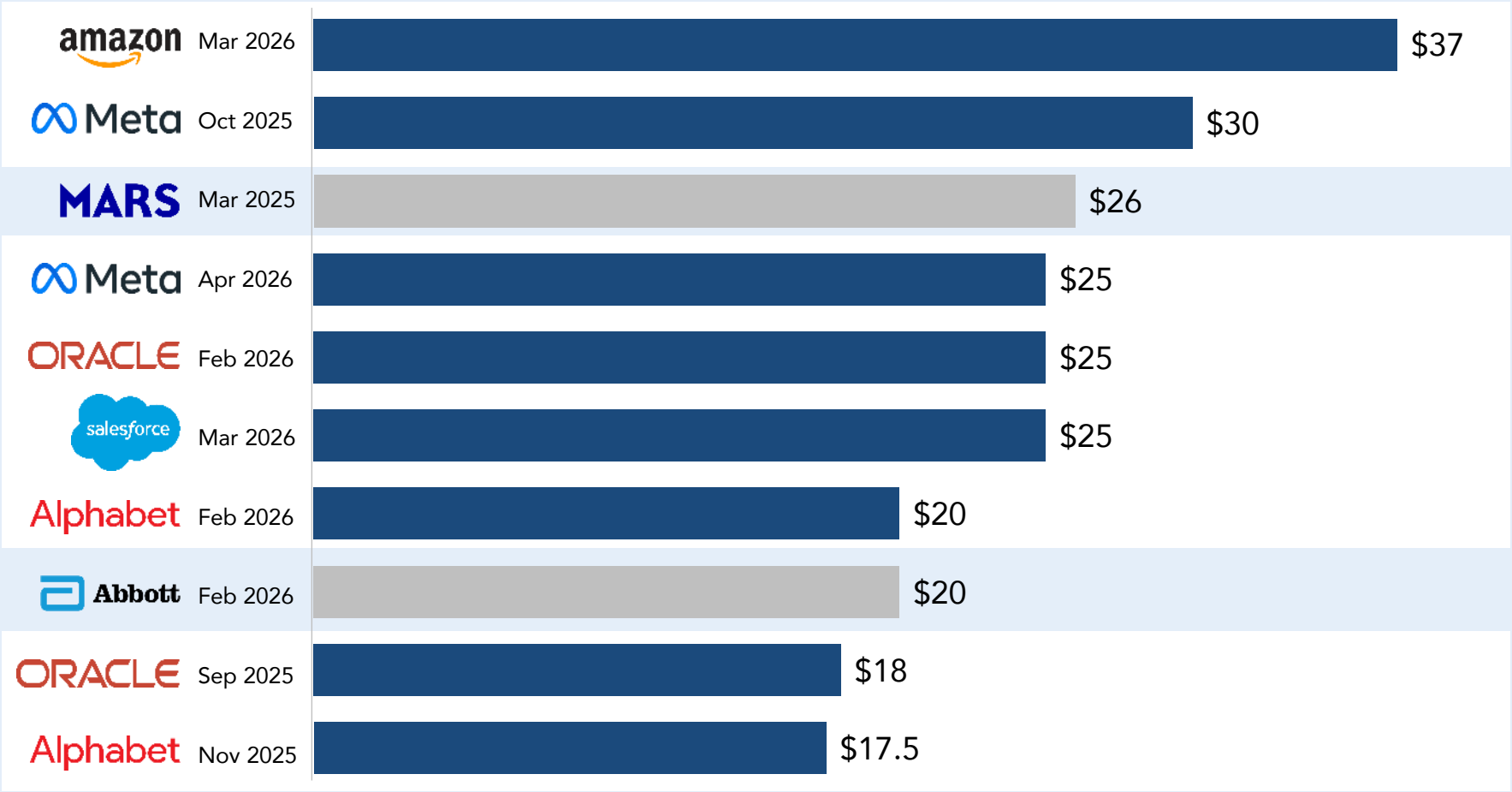
Hyperscalers' Capex > $1 Trillion in 2027



Source: (1) Bloomberg, "The AI Spending Boom Is Huge But Not Unprecedented". Data trailing 12 months. Oracle's quarters end a month earlier than the other companies. 2026E data is based on company announcements, including Q1. Oracle estimate for FY 2026. 2027 projections based on high-end of analyst estimates.

Tech Sector Driving USD Volumes Since Early 2025

Largest USD IG deals since Jan 2025, bn



Source: (1) CFR. Data as of May 29, 2026. Excludes bank and auto financing deals.

Tech / telecom

Tech & Telecom Driving Multi-Currency Financings

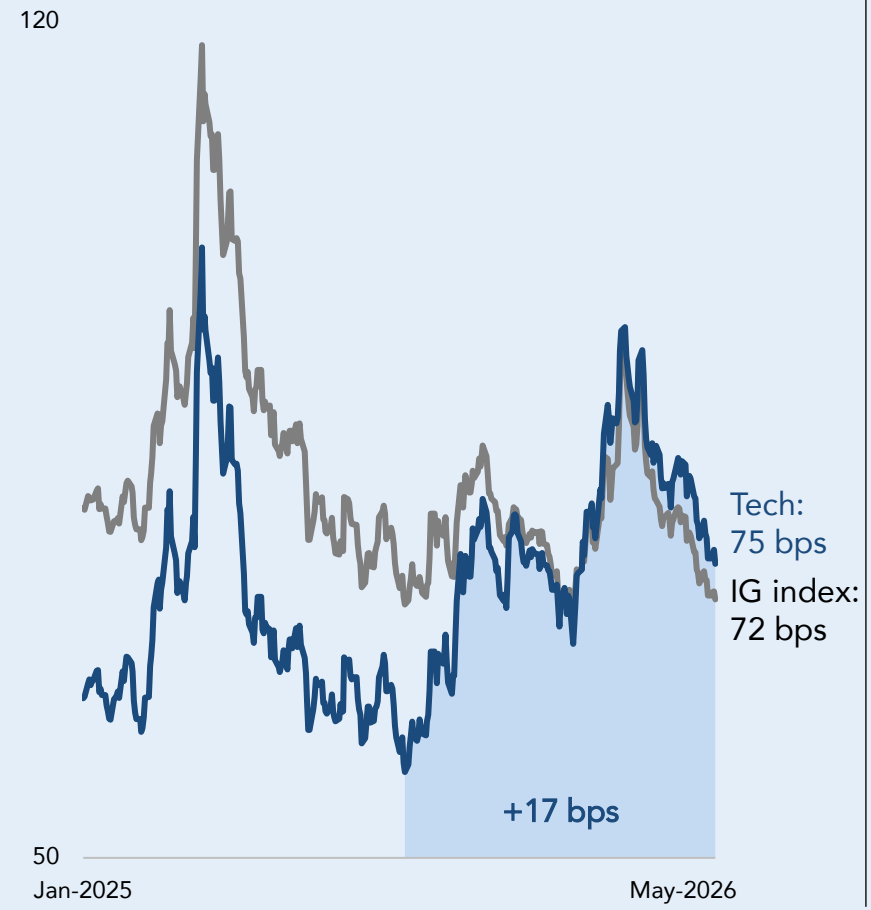
Selected Multi-Currency IG Deals since January 2025 *(excluding banks)*						
Company	USD	EUR	GBP	CHF	CAD	Total size (USD)
amazon *(Mar 10-11, 2026)*	37.0 bn	14.5 bn				$53.8 bn
Alphabet *(Feb 9-10, 2026)*	20.0 bn		5.5 bn	3.1 bn		$31.4 bn
Alphabet *(Nov 3-4, 2025)*	17.5 bn	6.5 bn				$25.2 bn
NTT FINANCE *(Jul 9, 2025)*	11.3 bn	5.5 bn				$17.7 bn
Alphabet *(May 5, 2026)*		9.0 bn			8.5 bn	$16.8 bn
verizon *(Nov 5-10, 2025)*	11.0 bn	2.3 bn	1.0 bn			$15.0 bn
Alphabet *(Apr 28, 2025)*	5.0 bn	6.8 bn				$13.0 bn
Baker Hughes *(Mar 5, 2026)*	6.5 bn	3.0 bn				$10.0 bn
EATON *(Mar 4-5, 2026)*	8.5 bn	1.2 bn				$9.9 bn
Johnson&Johnson *(Feb 18-19, 2025)*	5.0 bn	4.0 bn				$9.7 bn

Source: (1) CFR. Data as of May 29, 2026. Total size calculated used current USD exchange rates. Excludes bank and auto-financing deals.

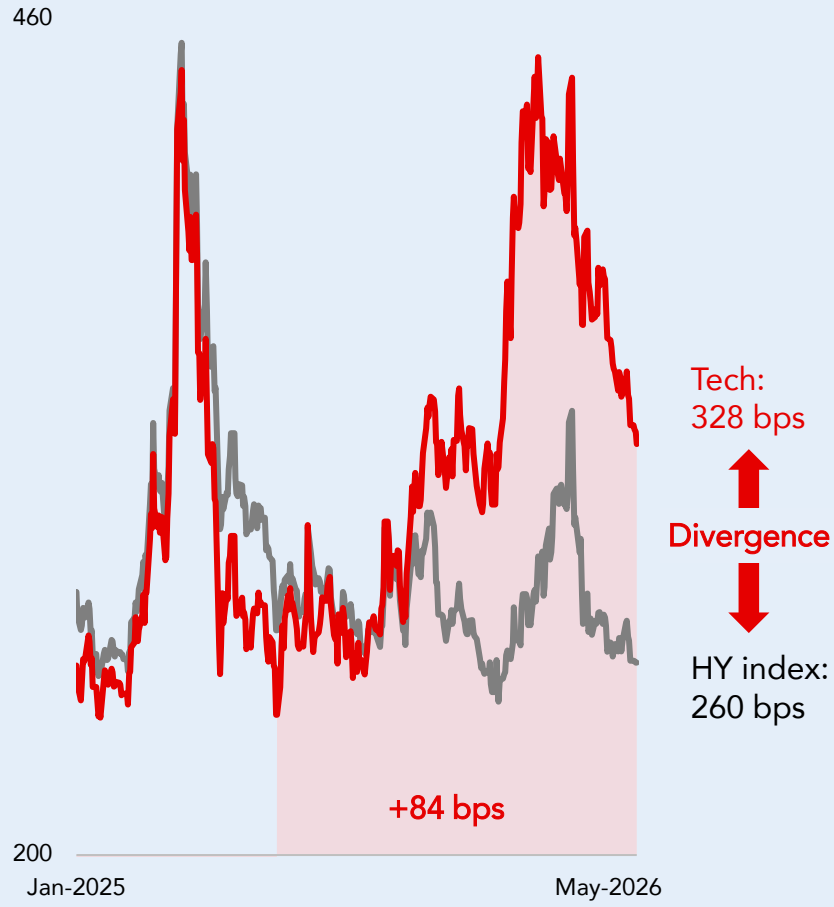
Tech / telecom

Tech Spreads Diverging Sharply on Credit Quality

IG index vs. IG tech spreads



HY index vs. HY tech spreads



Source: (1-2) Bloomberg. Data as of May 29, 2026. Index OAS to Treasury.

Notable Takeaways on IG Hyperscaler Financings

1. **Business model change:** From "asset light" to capex intensive, depreciation cycles

2. **Capex intensity:** Capex to OCF from 40% historically to 80% today; stock buybacks curtailed

3. **Financing model change:** Structural shift from CF-driven to multi-currency, mega-deals

4. **Forward guidance:** Investors demanding visibility on capex, future issuance and financing windows (i.e., quarterly)

5. **Size of financings:** Tech redefining the boundary of mega-deals from $10 bn to $30-40 bn with larger new issue premiums

Notable Takeaways on IG Hyperscaler Financings

6 **Longer tenor curves:** 30-40 year tranches now routine, rather than exception

7 **Structural demand:** Pension funds & life insurers seeking longer-dated, high quality yield

8 **Resilient IG Tech Spreads:** Investors assuming transient buildout cycle with large TAM & high ROI

9 **Credit cycle impact:** Tech now a core index pillar and structural driver of credit cycles

10 **Beyond corporate bonds:** Incremental financings via JVs, off-balance sheet, project finance and private-market structures


3
The Physical Footprint
of Computational Power

Evolving Bottlenecks to Scaling AI

2023 – 2024: GPUs (AI microchips)

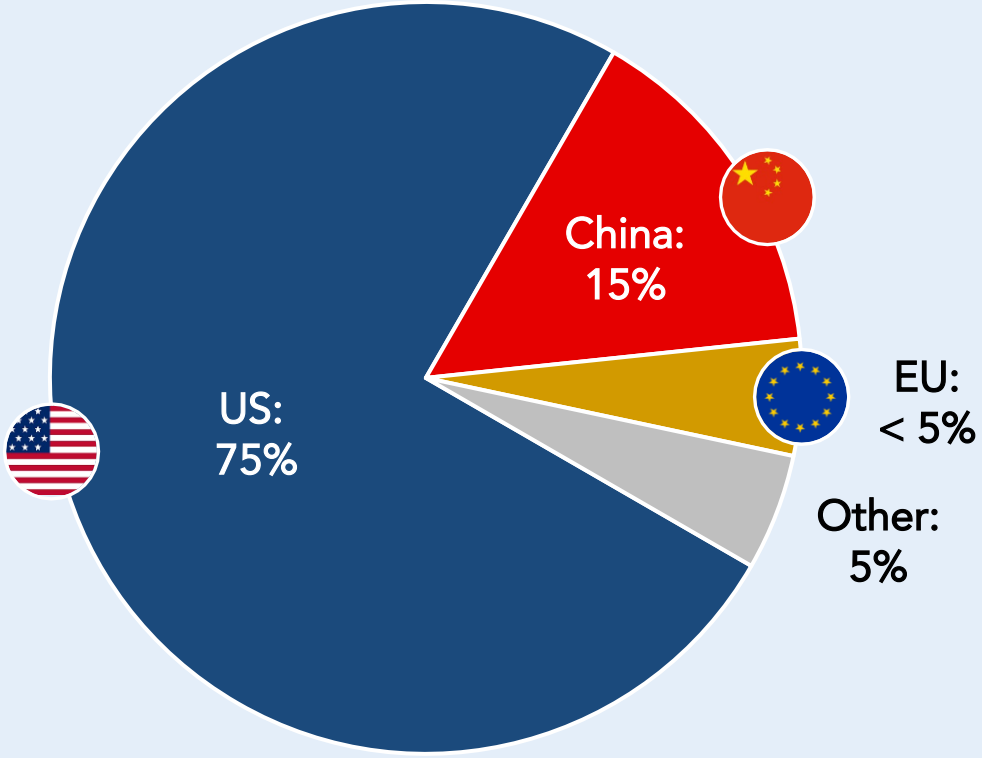
2025 – 2026: Memory chips (DRAM, NAND)

2027 – 2028: Energy & power grid

Relative AI Computational Power

The United States currently controls about 75% of global frontier AI compute, a core competitive advantage in the global AI arms race. US innovation, led by the integration of advanced software and microchip hardware, has given it control of large GPU clusters and high-end AI supercomputing capacity.

Estimated AI computing power, by country

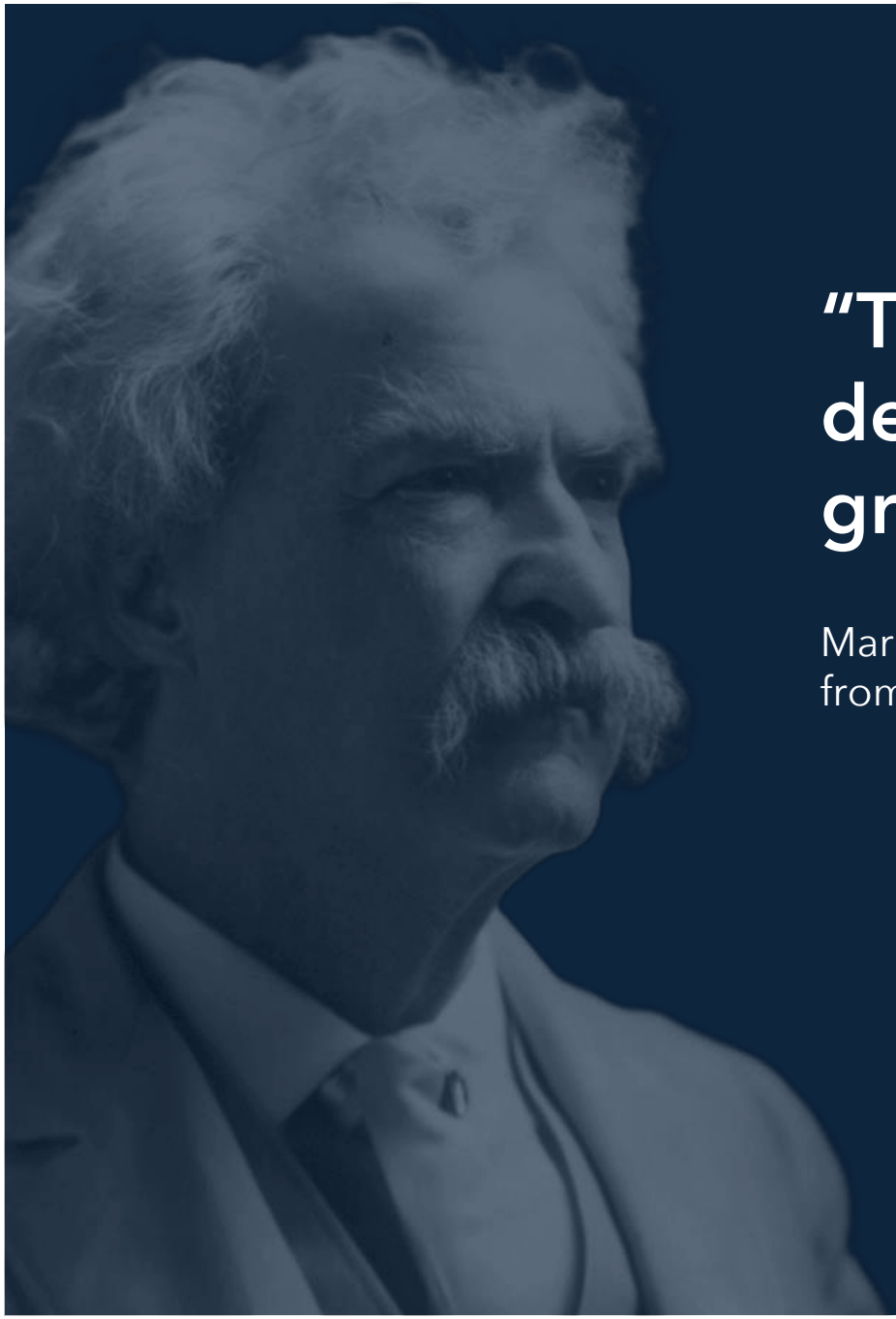


Source: (1) Epoch AI. Federal Reserve. Data shows 2025-26 estimates.

Leadership in Global Computational Capacity

Cumulative compute capacity (as measured by sale of H100-equivalent GPUs)

Source: (1) Epoch AI, "What you need to know about AI chips". Computing capacity is measured in number of H100-equivalent GPUs, based on dense 8-bit operations per second. Data as of Q4 2025. Nvidia cumulative total include sales from 2022 onward. TPU cumulative totals include sales from 2023 onward.



“The rumors of my death have been greatly exaggerated.”

Mark Twain, acclaimed American novelist, from London in 1897

Top 10 Countries by Data Centers

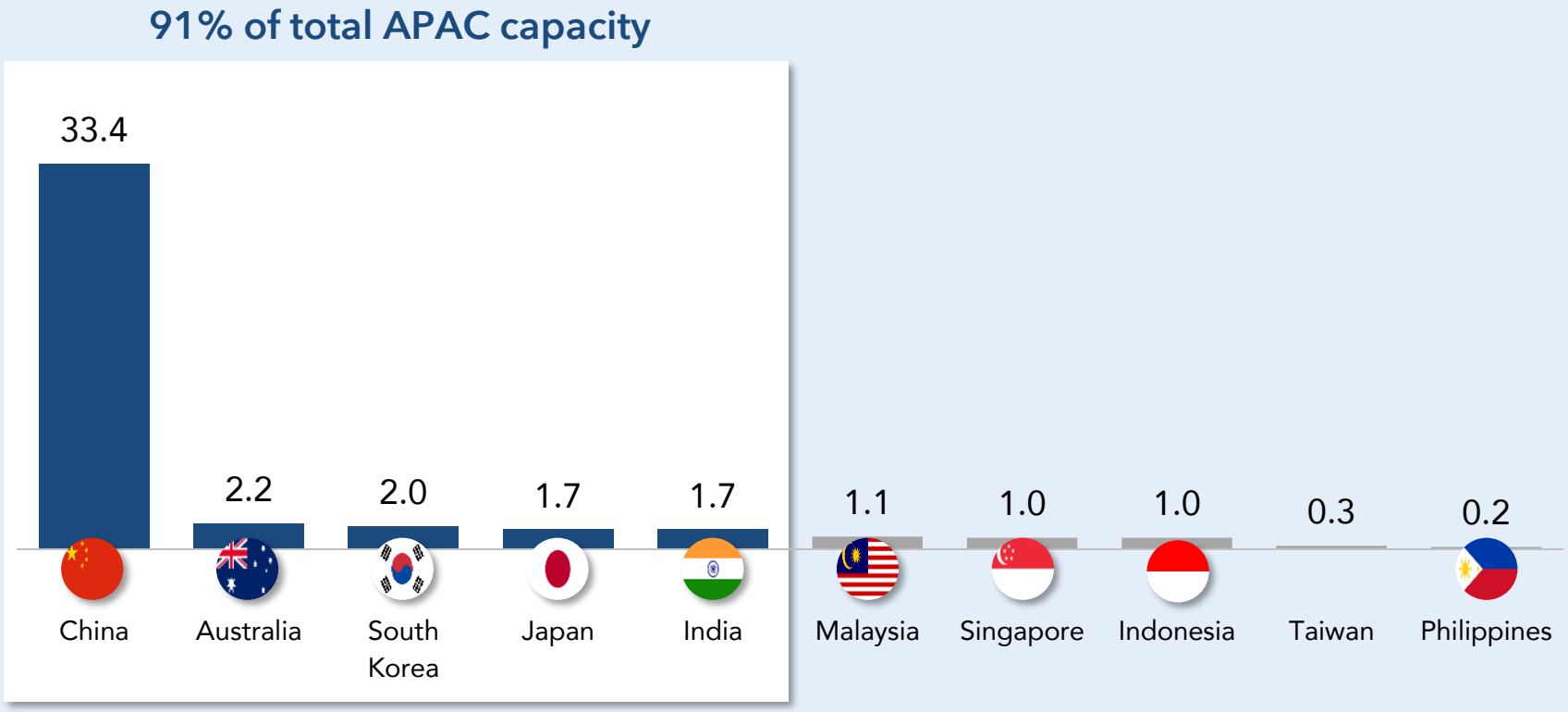
Global data centers

Source: Cloudscene. Data as of May 2026.

Largest Data Center Markets Across Asia Pacific

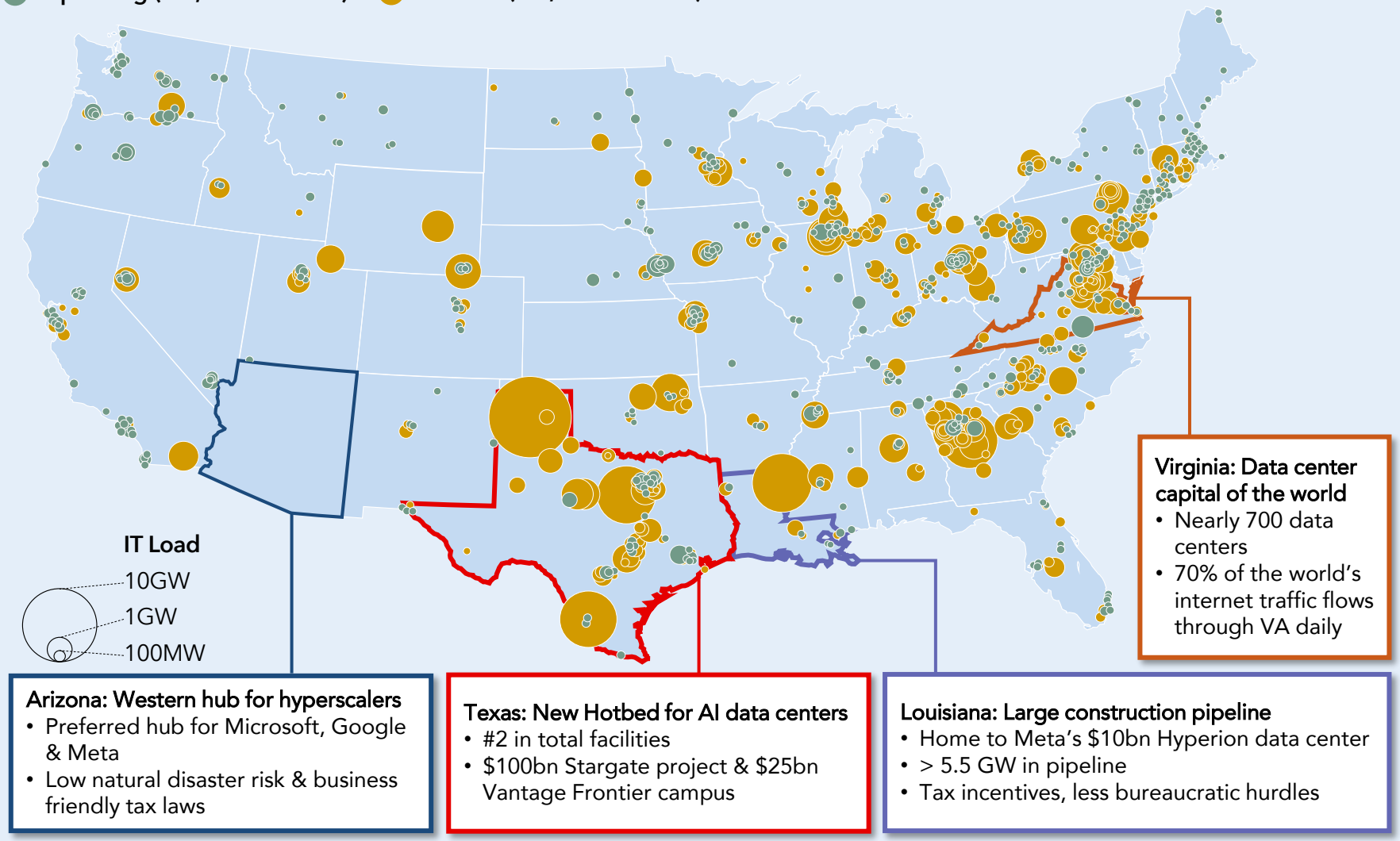
APAC is the world's second-largest data center region, behind North America, accounting for approximately 40% of total global capacity in GW. While North America has a massive installed base, the APAC region leads in terms of available capacity. The region is expected to account for 50% of all new GW added to the global grid between now and 2030 as fewer energy grid restrictions, government-led permitting and rapid adoption of AI and cloud technologies fuels growth.

Asia Pacific data center operational capacity by region, GW



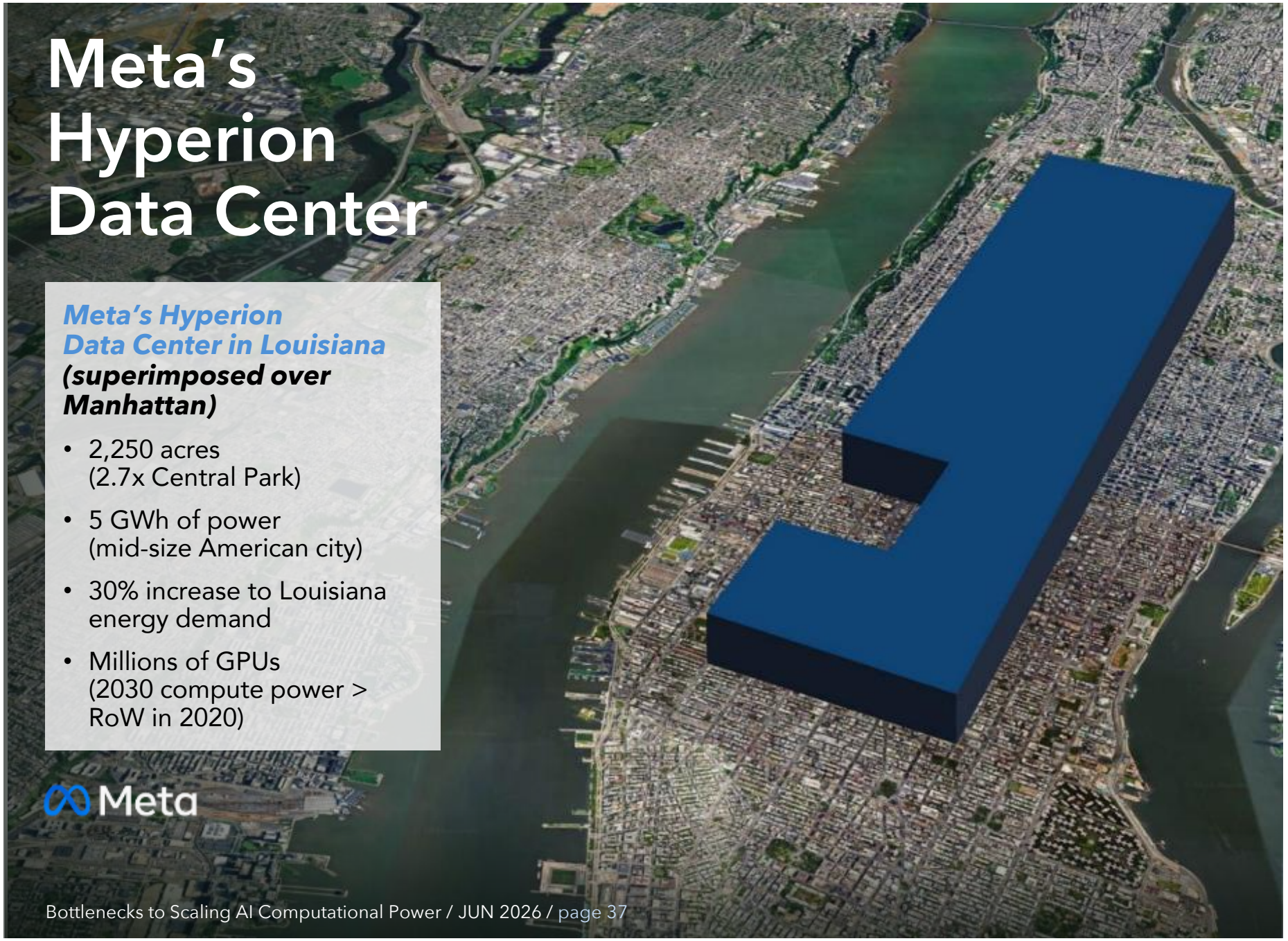
Source: (1) Mordor Intelligence. Rystad Energy. IEA. Cushman & Wakefield. ResearchAndMarkets. Arizton. CBRE. Ember Energy. Philstar. Data Center Knowledge. China capacity includes Hong Kong. Total operational capacity includes colocation and enterprise / self-build capacity. Numbers vary based on methodology.

Operating & Planned US Data Center Sites



Source: DC Byte. CMRA. FT, "The Power Crunch Threatening AI's Ambitions."

Meta's Hyperion Data Center



Meta's Hyperion Data Center in Louisiana (superimposed over Manhattan)

- 2,250 acres (2.7x Central Park)
- 5 GWh of power (mid-size American city)
- 30% increase to Louisiana energy demand
- Millions of GPUs (2030 compute power > RoW in 2020)

Meta

Texas: New Hotbed for AI Data Centers

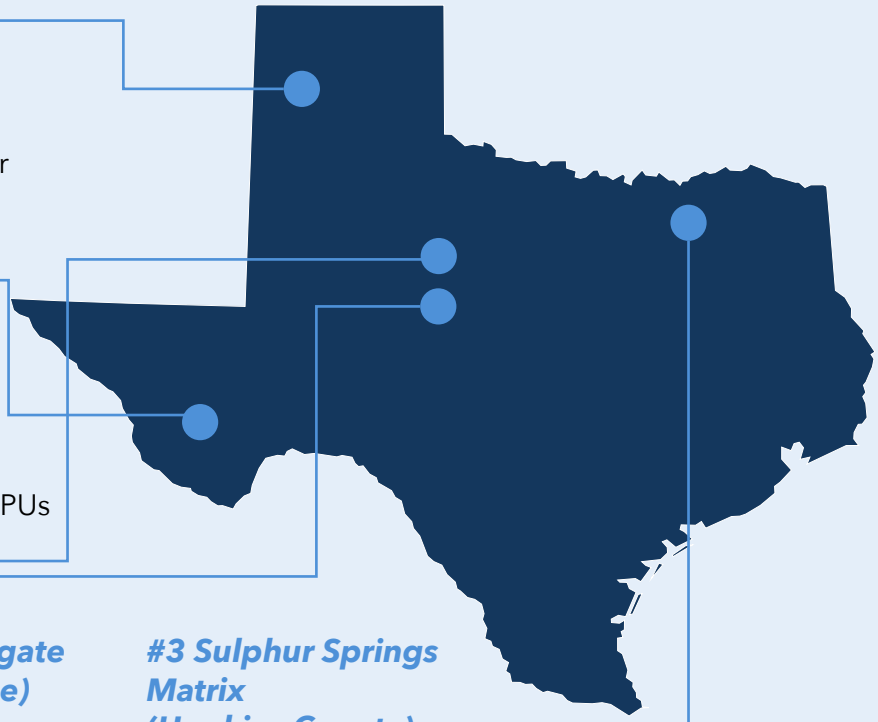
Largest data centers in Texas

#2 Advanced Energy Campus (Amarillo)

- 5,800 acres
- 11 GW of capacity
- Phased for multiple cluster GPUs

#1 GW Ranch (Pecos County)

- 8,000+ acres, largest permitted data center campus in the US
- 7.65 GW
- Designed for 1 million+ GPUs



#4 Vantage Frontier (Shackelford)

- 1,200 acres
- 1.4 GW
- High density Blackwell pods

#5 Stargate (Abilene)

- 1,100 acres
- 1.2 GW
- 150k+ NVIDIA GB200s

#3 Sulphur Springs Matrix (Hopkins County)

- 1,700 acres
- 3.0 GW
- ~450k GPUs

- Total number of data centers: ***> 400***
- Total number of planned data centers: ***>100***
- Active construction: ***35 facilities***
- Current power capacity: ***8.5 GW (grid)***
- Current power capacity: ***57.9 GW (off-grid)***
- Planned power capacity additional: ***~38.1 GW***
- Commercial construction spend: ***$90bn / year***

Data Centers in Space?

Space-based data centers have evolved from a long-term research goal to a potentially achievable milestone inside five years. In January 2026, SpaceX filed an application with the FCC to launch up to one million satellites to facilitate orbital data centers. While the challenges remain formidable (high launch costs, unstable GPU environment), the daunting concept also promises several compelling advantages (i.e., obviates excessive demands on land & water, accessible solar energy, carbon neutral, low temperatures for natural cooling).

Power & Energy

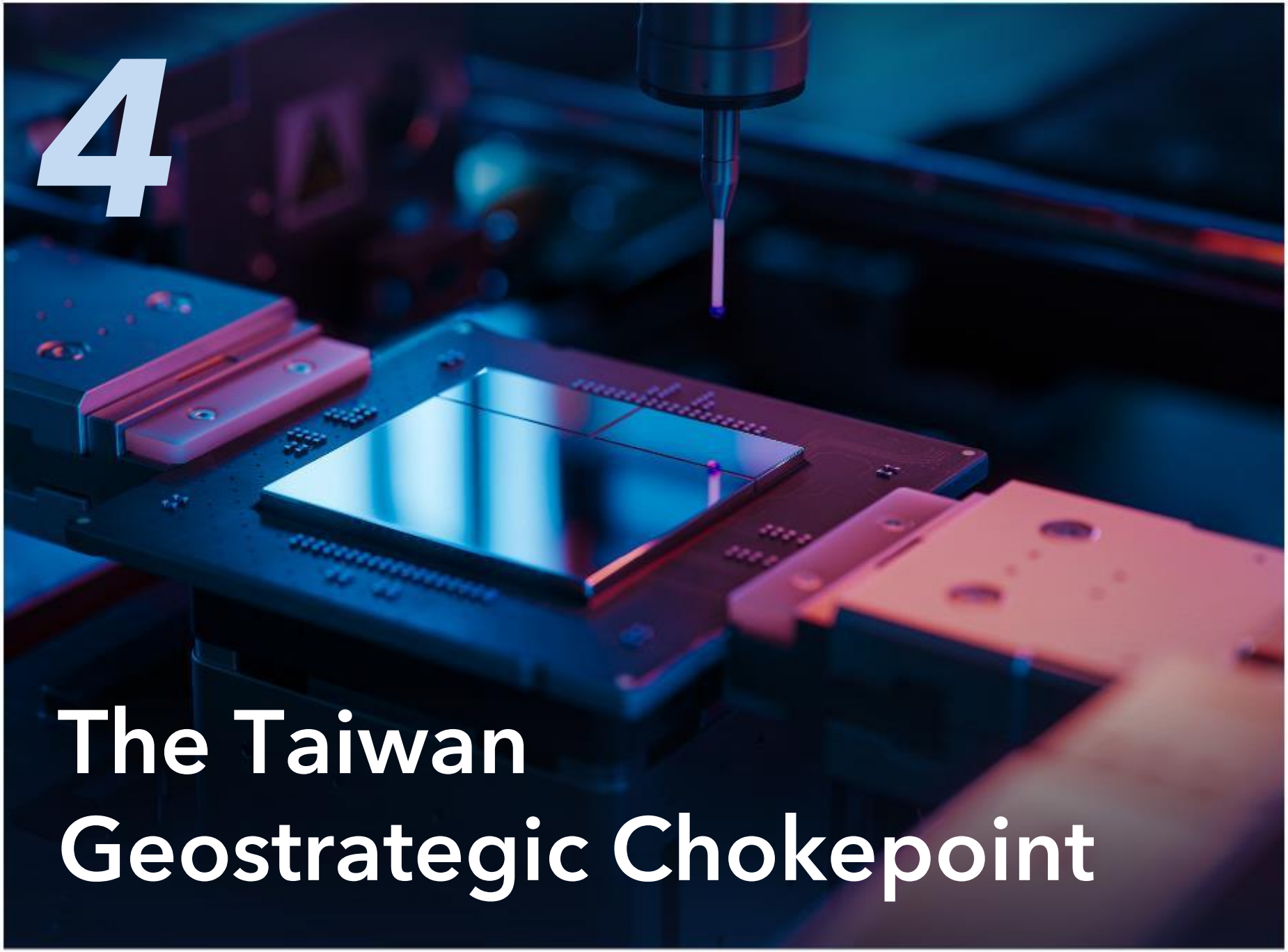
- ✓ Solar panels in space are 5x more efficient than on Earth
- ✓ Unlimited access to solar power (>95% capacity)
- ? Power-conversion challenge of delivering energy to high-density GPU racks in orbit
- ? Launch energy (rocket fuel)

Infrastructure & Security

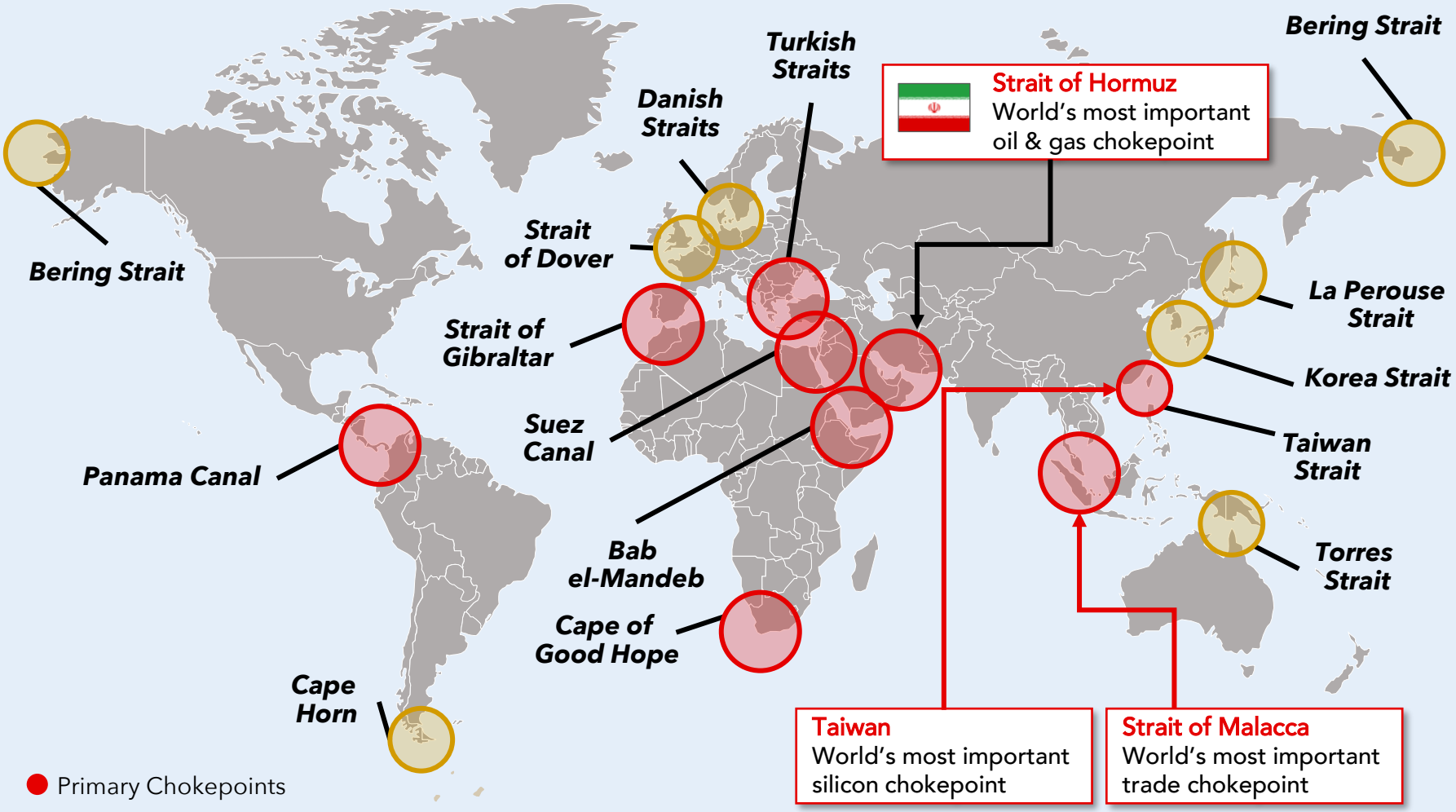
- ✓ Accelerated scalability (real estate, power, regulation)
- ✓ No local zoning / permitting
- ✓ Enhanced physical and digital security
- ? Limited maintenance capabilities
- ? Kessler effect (low orbit collisions)
- ? Potential radiation damage to GPUs

Environment & Cooling

- ✓ Naturally cold temperature (-270°C)
- ✓ Reduced impact on water, electricity, land
- ✓ Carbon-neutral long term
- ? "Thermos" effect (vacuum constraint, no air to "blow" away heat)
- ? Launch pollution


4
The Taiwan
Geostrategic Chokepoint

Important Global Geostrategic Chokepoints



May 2021


The Economist
Joe Biden and the 100-day obsession
The true cost of long covid
A history of post-pandemic booms
How to tax capital
MAY 1ST–7TH 2021
The most dangerous place on Earth
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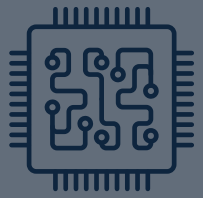
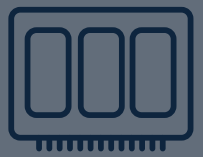
Highly Integrated Global Semiconductor Supply Chain

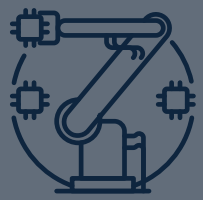
EDA software design tools



Fabless chip design

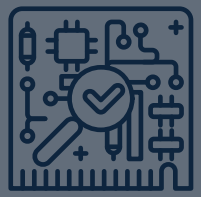


Memory chip IDMs



Capital equipment

Foundries (manufacturing)



Assembly, packaging & test

Morris Chang, 94-year-old Taiwanese-American businessman, and the founder of the largest, most advanced and most important semiconductor company in the world, TSMC.

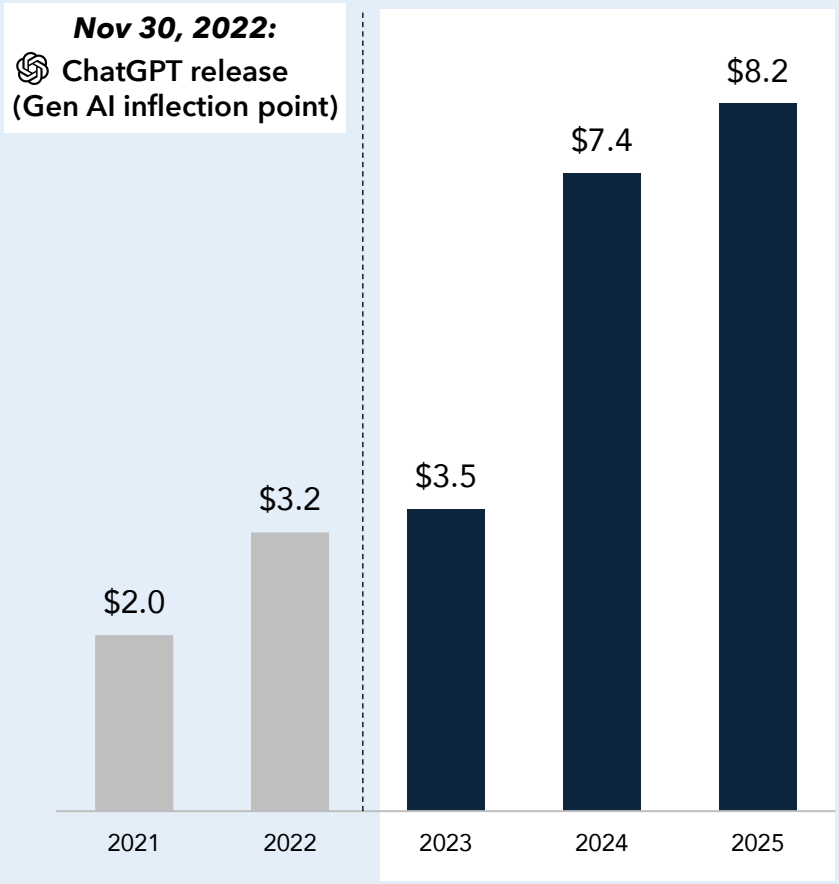
The Taiwan Silicon Chokepoint

TSMC stock price

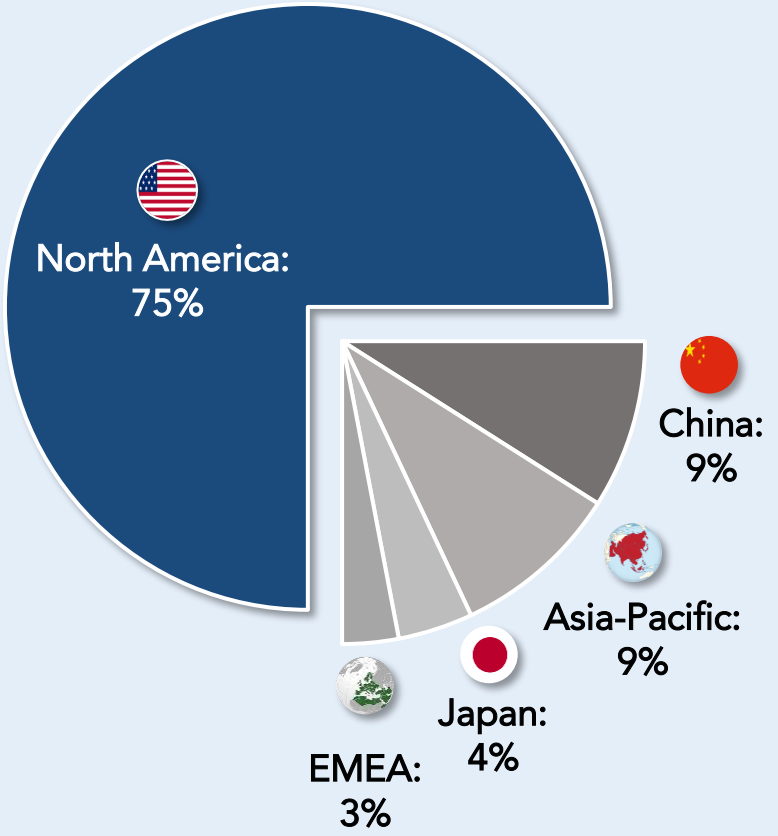
Source: (1) Bloomberg. Data as of May 29, 2026.

75% of TSMC's Revenue from North America

Taiwan's chip exports to US, USD bn



TSMC's net revenue (2025), by region



Source: (1) FT, "TSMC's US investment plans at heart of $250bn puzzle for chip sector". Taiwan's Customs Administration. Company reports.

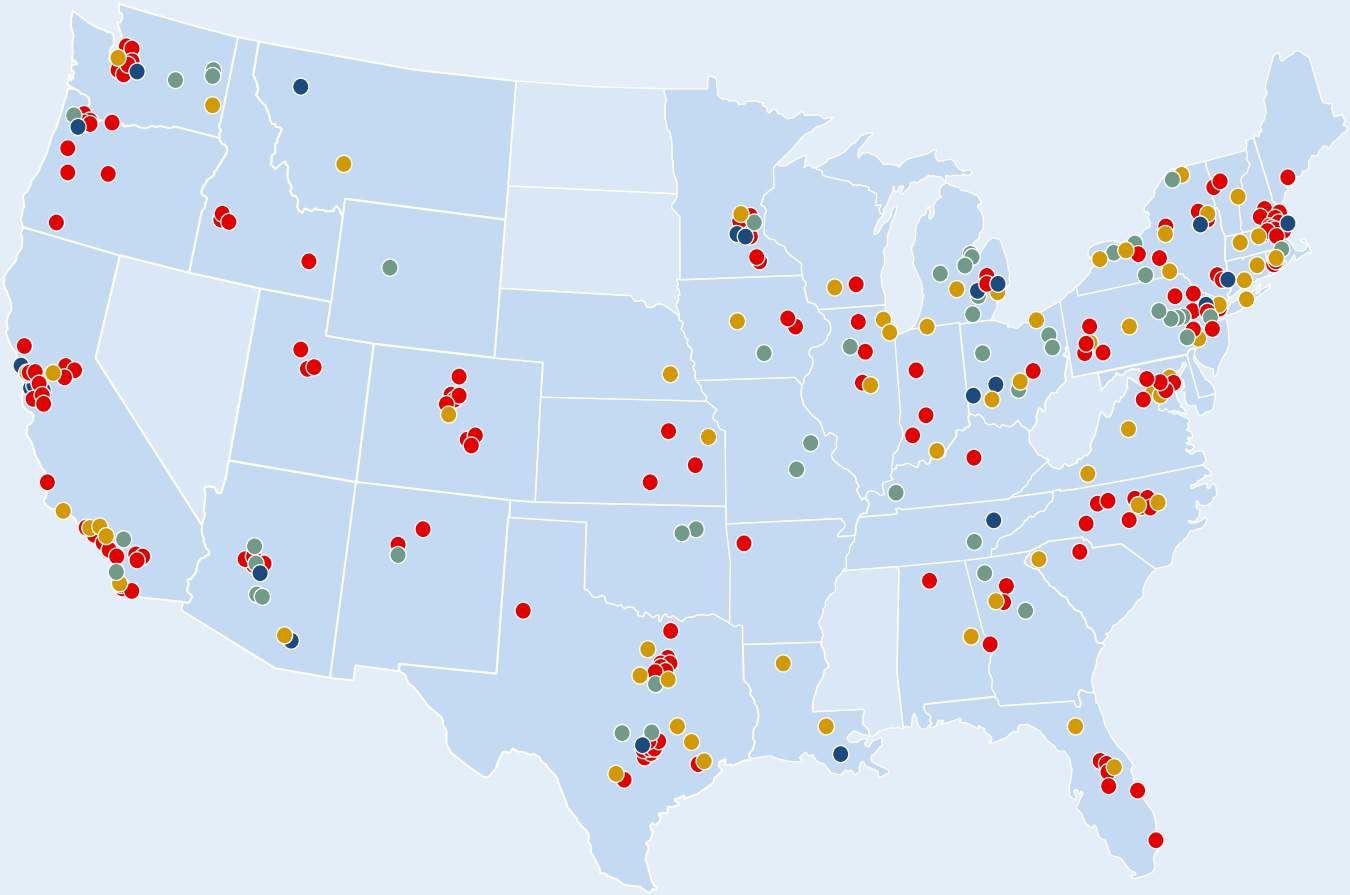
TSMC's Arizona Semi Fab

- Largest direct investment in US history ($165 - $465 bn)
- 1,100 acres (3.5 million square feet)
- 600k wafers (150-200mm chips) per year
- 4.7 mm gallons of water (per day)
- 2.8 GWh of electricity (per day)
- 6 fabs, 2 packaging plants & 1 R&D center

Diversification and "de-Taiwanization" of Chip Supply is Slower than the Risk Clock

Since Aug 2022 CHIPS Act:

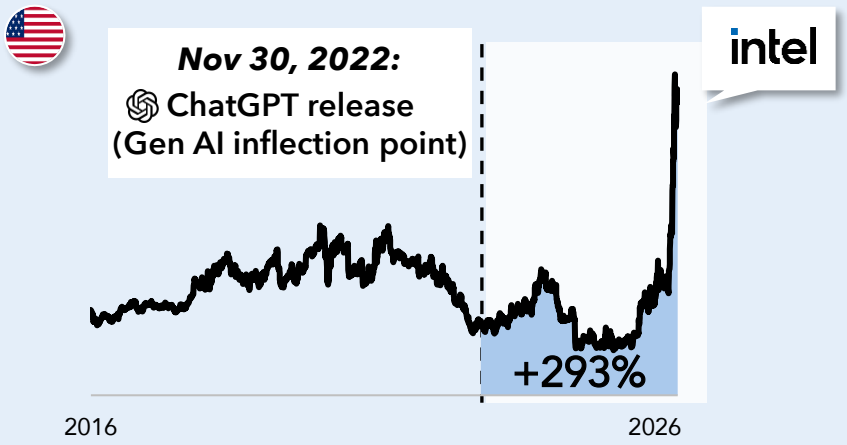
- > 80 investment projects
- > Nearly $500 bn private investment
- > 25 US states



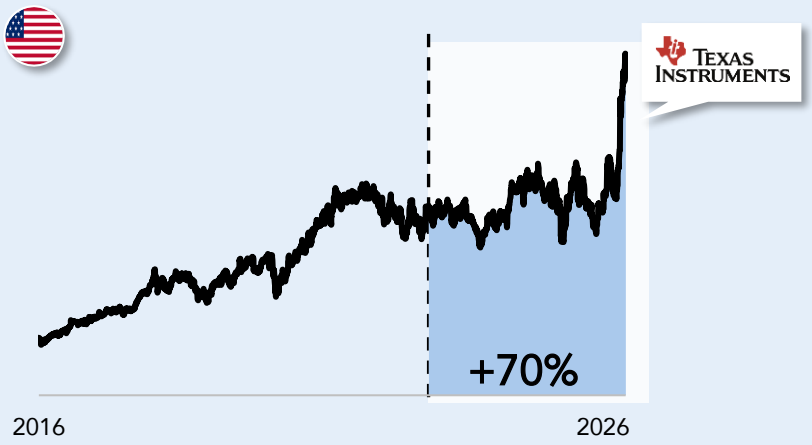
Source: Semiconductor Industry Association. Data as of December 1, 2025.

Other Leading Chip Manufacturers

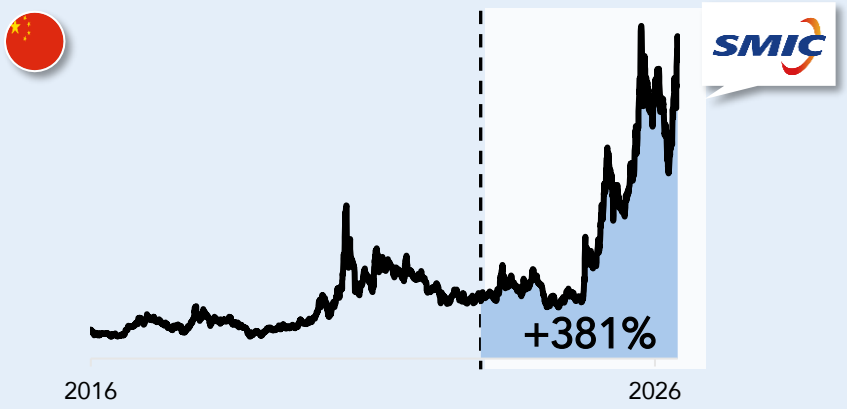
Intel stock price



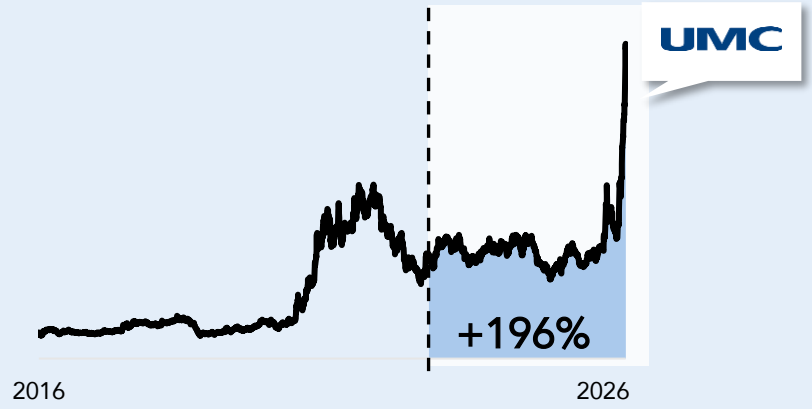
Texas Instruments stock price



SMIC stock price



UMC stock price



Source: (1-4) Bloomberg. Data as of May 29, 2026.

The Risk-Clock for Potential China-Taiwan Conflict

President Xi's political lifetime (legacy)
(age 72, health considerations)

Resolution of China's key strategic vulnerabilities
(oil, semiconductors, military)

Preparedness of China's military
(corruption, technology, relative strength)

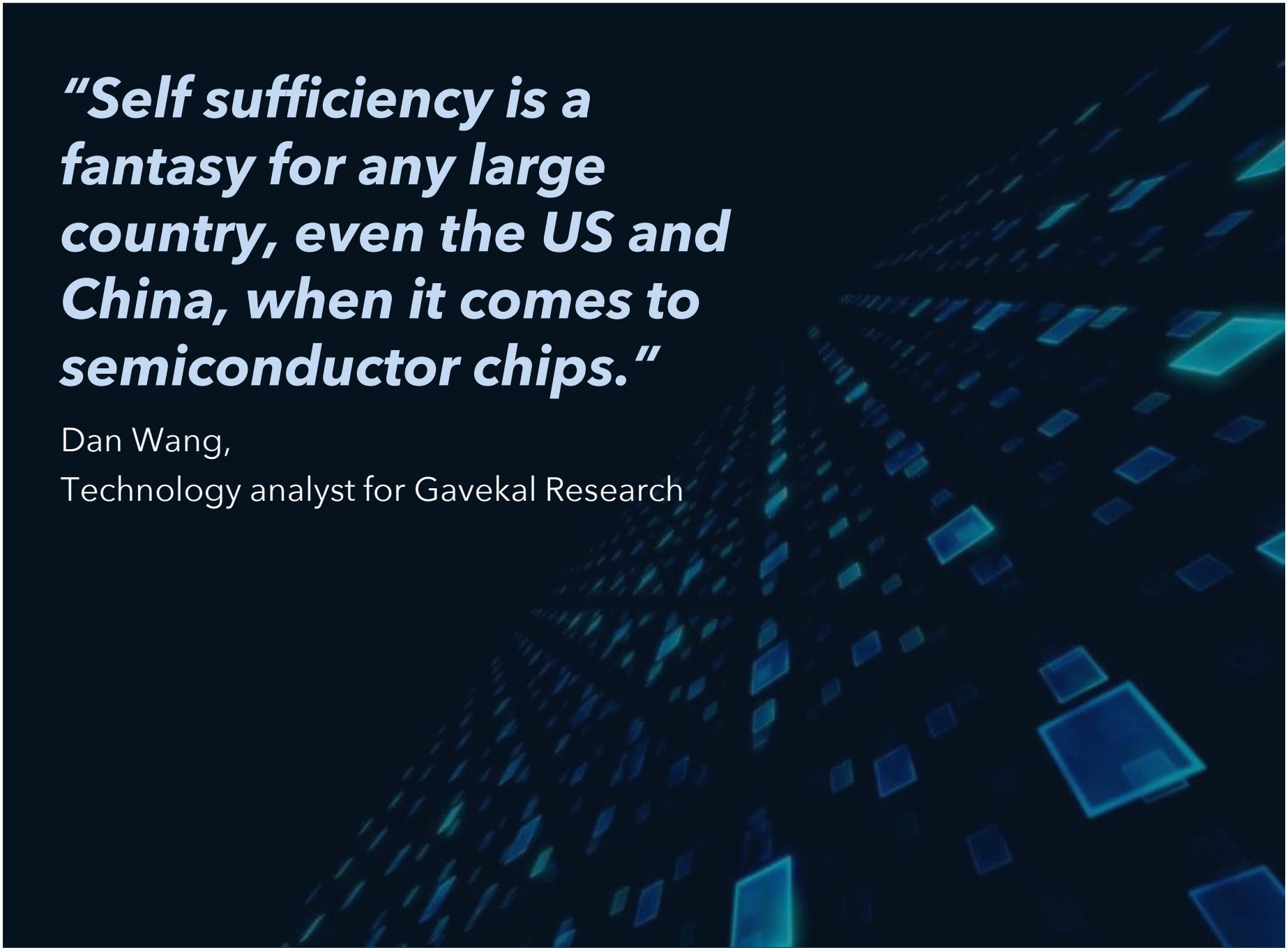
Complexity of a Taiwan invasion creates spectrum of possibilities
(cyber, ballistic missiles, critical infrastructure, amphibious, special ops, response assessment, propaganda narrative)

Political leadership in the West
(US President, strength of regional alliances)

Horizontal globalization of a crisis
(Hormuz precedent, economic warfare, sanctions, SWIFT, supply chains)

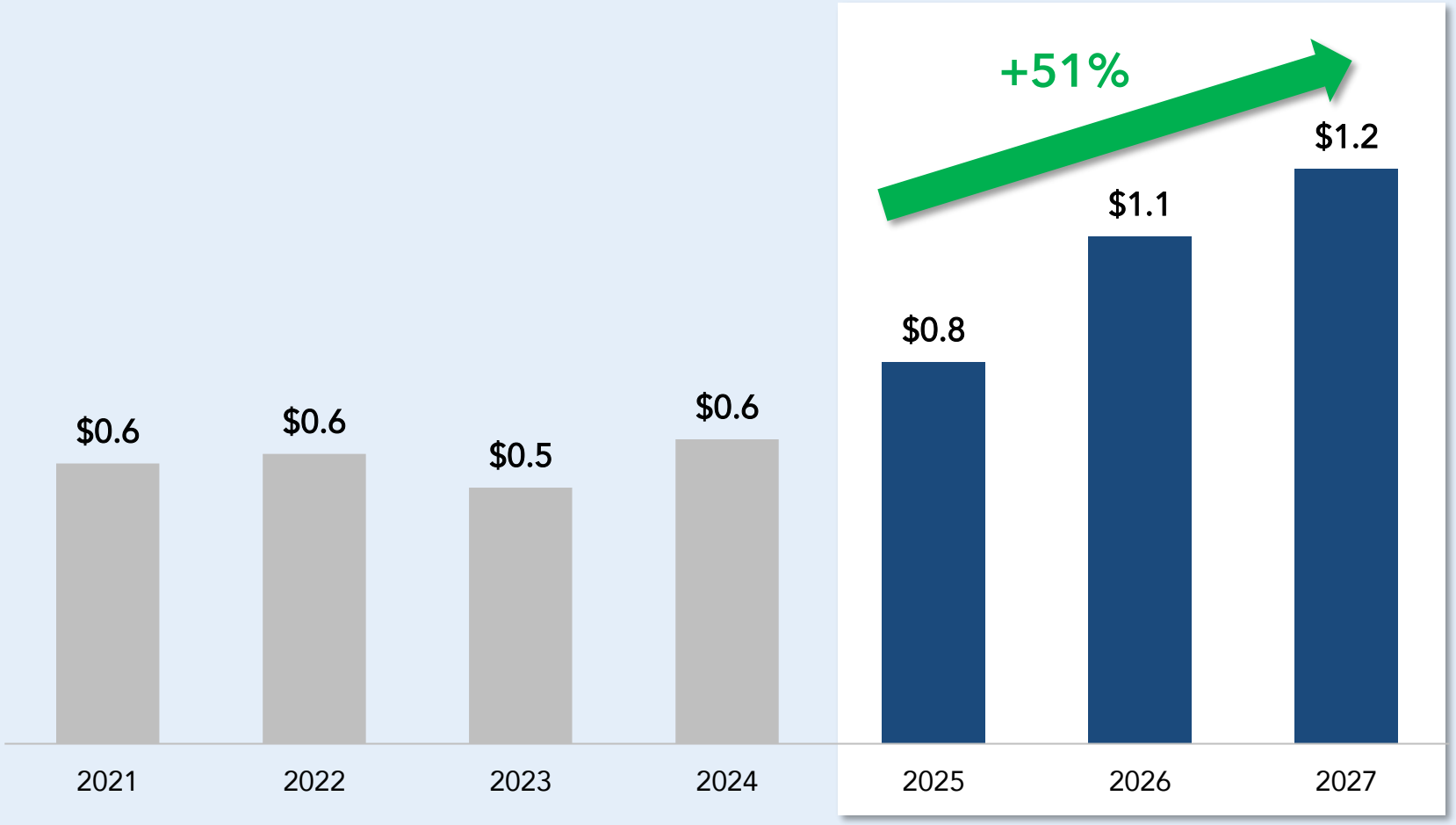
Lessons of Ukraine & Hormuz
(asymmetric power, land vs. aerial vs. amphibious invasions, economic implications - chips > energy)


5
The Silicon Squeeze


“Self sufficiency is a fantasy for any large country, even the US and China, when it comes to semiconductor chips.”
Dan Wang,
Technology analyst for Gavekal Research

Global Semiconductor Revenue Expected to Double by 2027

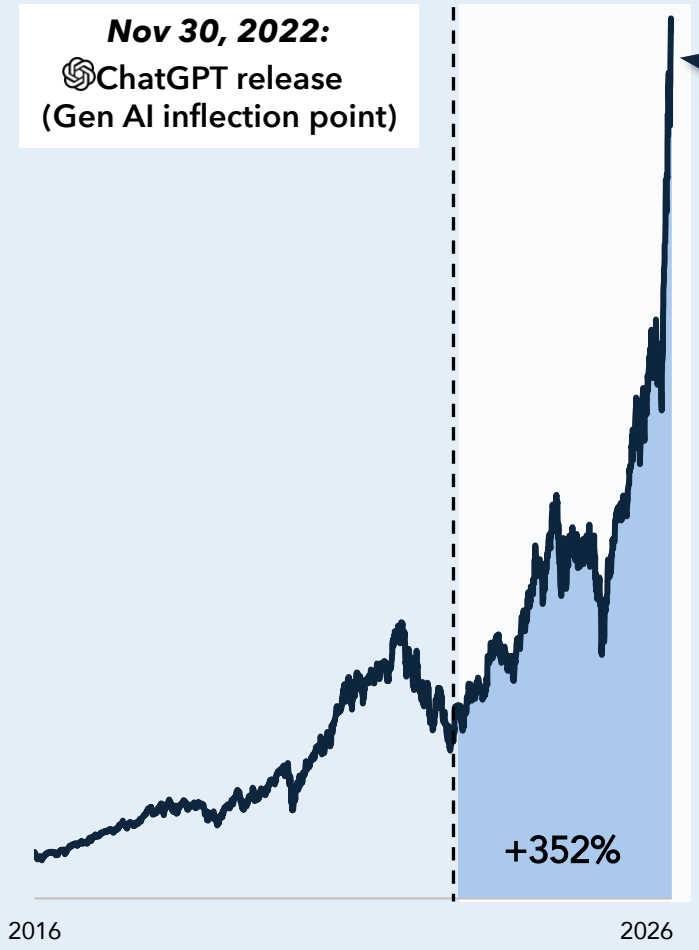
Global semiconductor revenue, USD tn



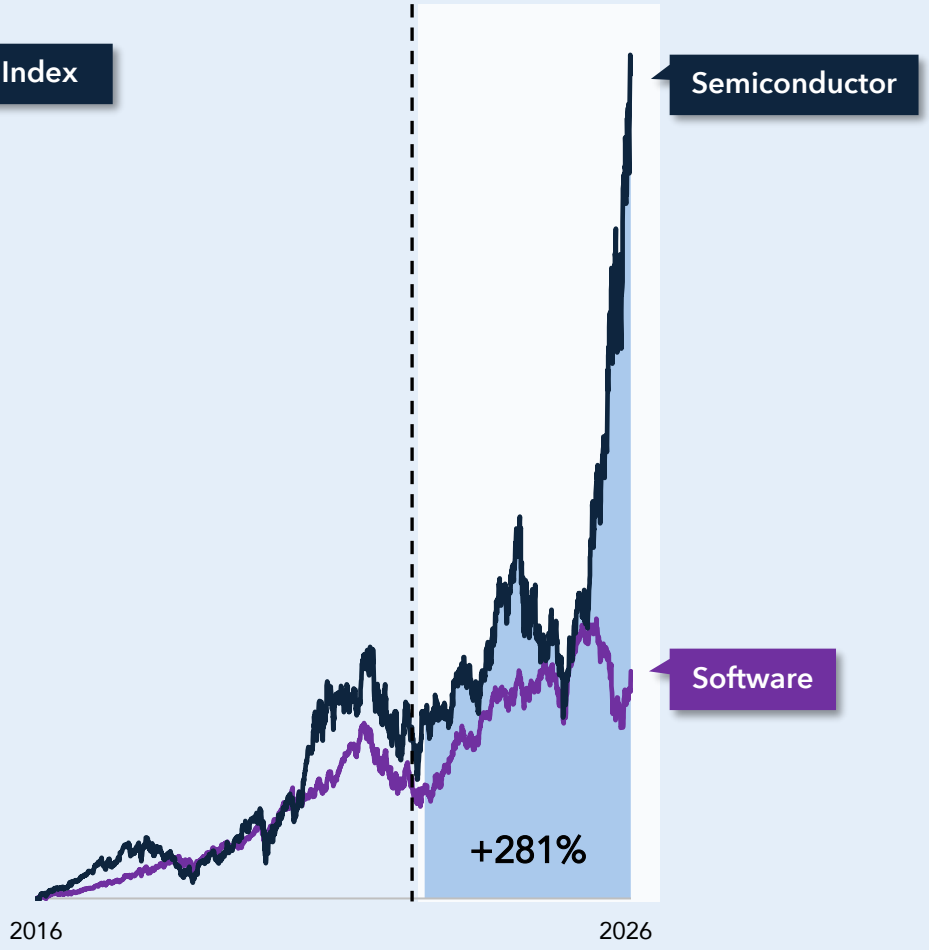
Source: (1) WSJ, "How the AI Boom Has Transformed the Chip Industry Into a Market Monster." Gartner. 2026 and 2027 data are forecasts.

Semiconductor Valuations Soaring

PHLX semiconductor index (SOX)



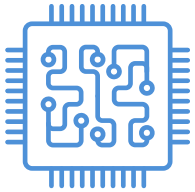
S&P 1500 software vs. semiconductor performance



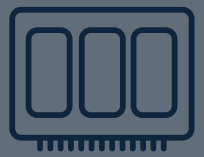
Source: (1-2) Bloomberg. Data as of May 29, 2026. S&P 1500 data is normalized as of April 29, 2016.

Highly Integrated Global Semiconductor Supply Chain

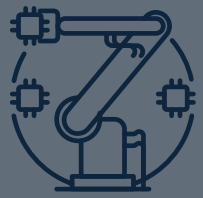
EDA software design tools



Fabless chip design

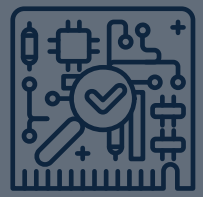


Memory chip IDMs



Capital equipment

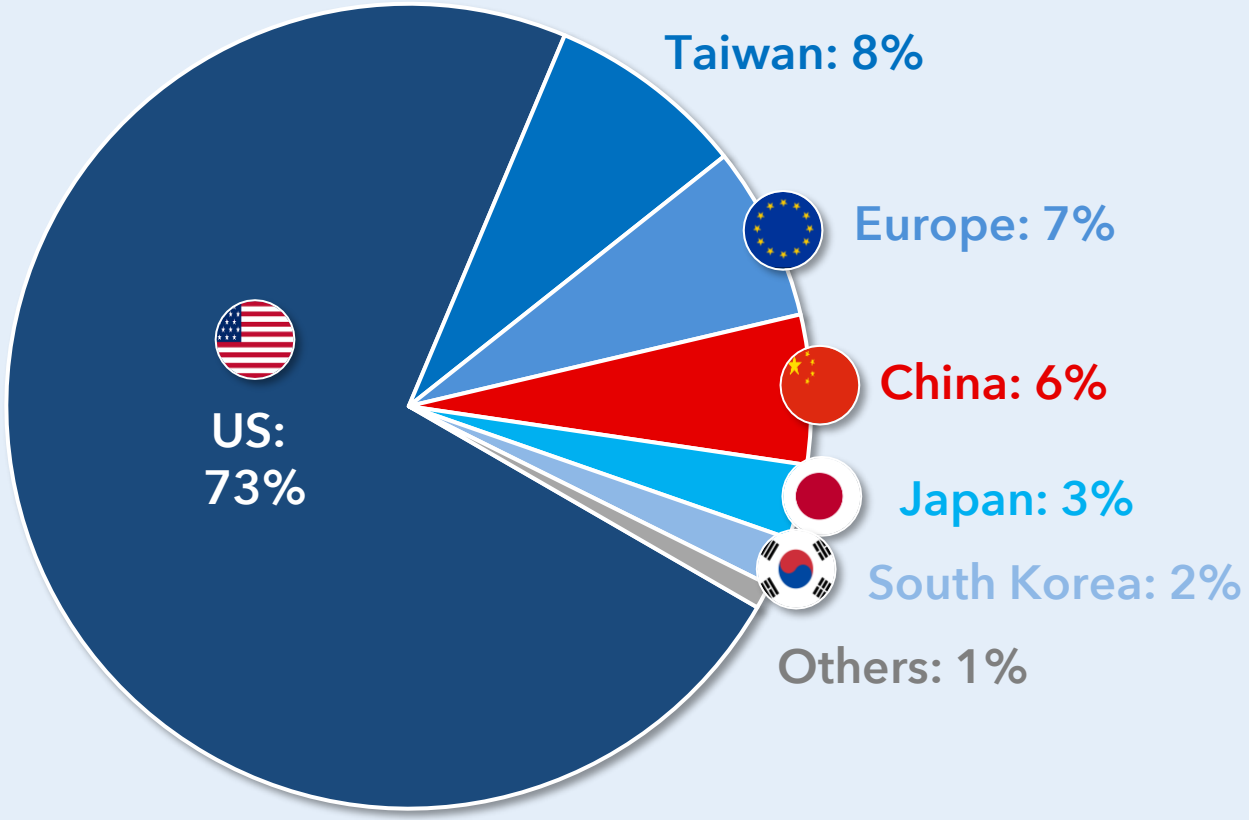
Foundries (manufacturing)



Assembly, packaging & test

Global Leadership in Semi Chip Design

Logic design value added, by region (2024)

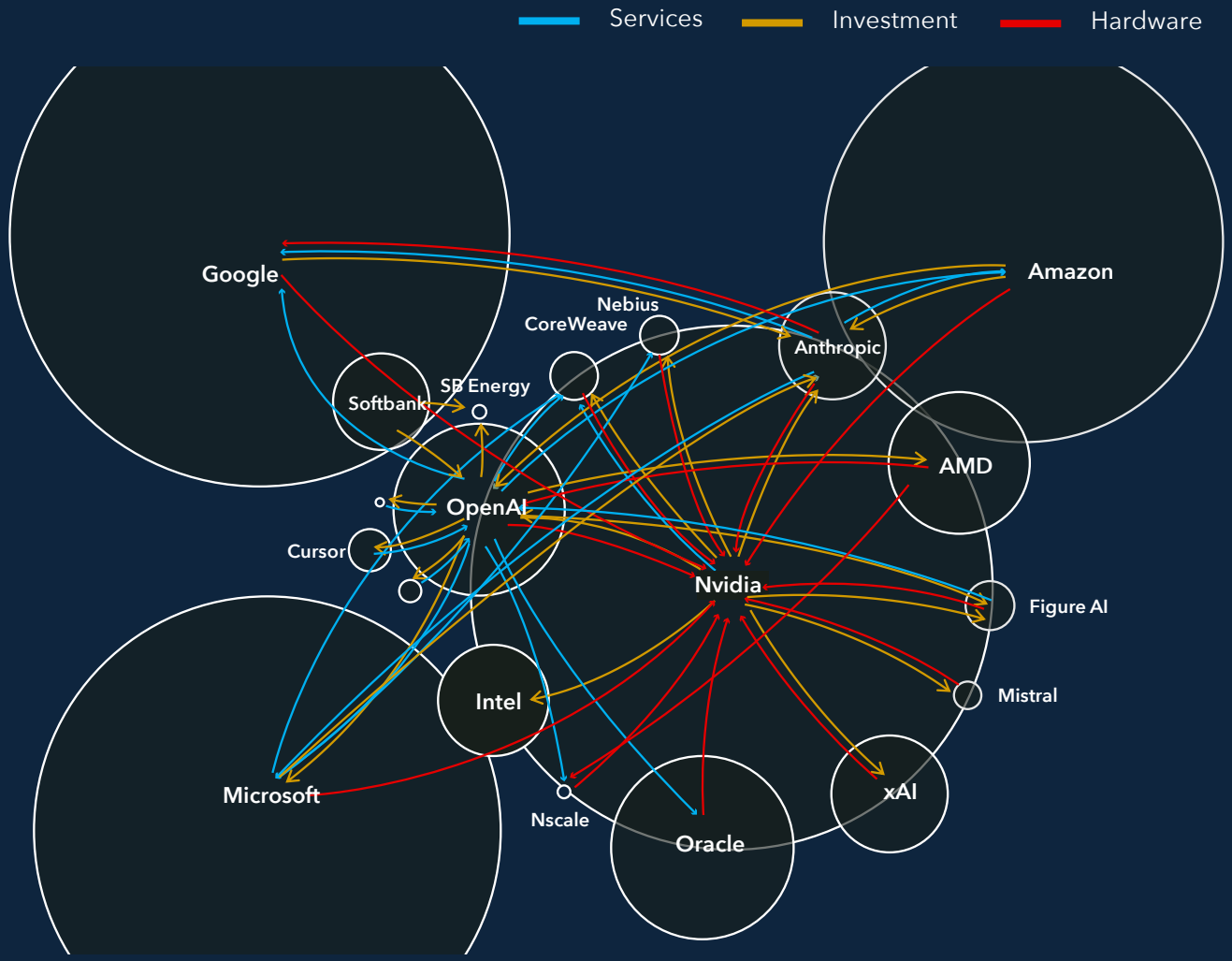


Source: (1) Semiconductor Industry Association, "2025: State of the U.S. Semiconductor Industry". Data as of 2024.

Access to Chips Driving Growth & Deal Activity

NVIDIA is at the center of circular AI deals

Over the last few years, NVIDIA has sat at the epicenter of an extraordinary and complex web of AI investment and cross-holdings in a multi-trillion capex buildout powered substantially by NVIDIA hardware and software. Notably, NVIDIA has become the indispensable supplier, customer, partner, and in some cases competitor, of every major AI hyperscaler, as well as numerous other critically important players in the AI ecosystem.

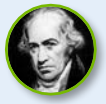


Source: Bloomberg, "Nvidia CEO Says New OpenAI Investment May Be Largest Yet." (February 2026). Size of circle denotes company market cap.

"Huang's Law" Replacing "Moore's Law"

NVIDIA's remarkable chip product evolution each derive their names from acclaimed scientists. Over the last decade, NVIDIA has scaled the **number of transistors per Blackwell chip to over 300 billion, increasing performance more than 1,000x** (vs. the 30x Moore's Law would predict). More importantly, however, chip performance today relies less on scaling transistors and more on an **innovative system-level architecture**, which includes transistor hardware, tensor cores, scaling systems, algorithms, accelerators, complex software overlay (i.e., CUDA, CUDA-X libraries, domain tools) and **parallel GPU architectures via stack co-design and clustering.**

The evolution of Nvidia's GPU architecture

Fahrenheit	Celsius	Kelvin	Rankine	Curie	Tesla	Fermi	Kepler	Maxwell
1998	1999	2001	2003	2004	2006	2010	2012	2014
								
Daniel Gabriel Fahrenheit *Physicist, inventor*	**Anders Celsius** *Astronomer, physicist, mathematician*	**Lord Kelvin** *Physicist, mathematician engineer*	**William Rankine** *Mathematician, physicist*	**Marie Curie** *Physicist, chemist*	**Nikola Tesla** *Engineer, inventor*	**Enrico Fermi** *Physicist*	**Johannes Kepler** *Astronomer, mathematician*	**James Clerk Maxwell** *Physicist, mathematician*

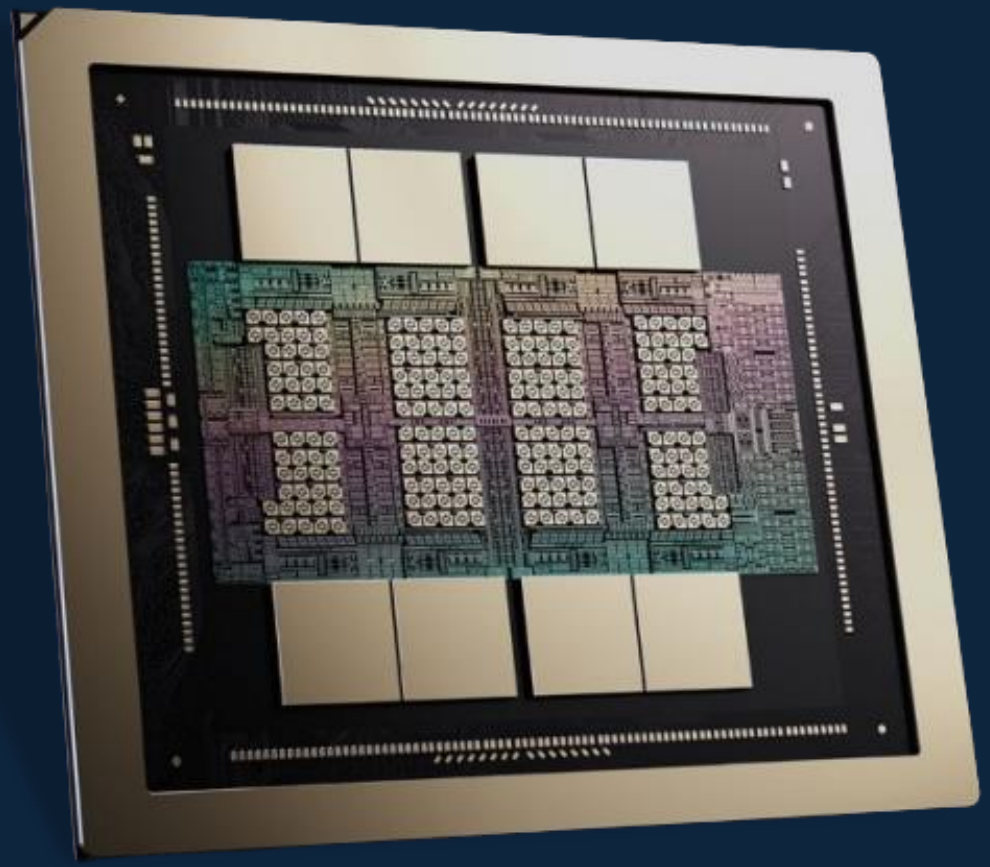
The Future

Pascal	Volta	Turing	Ampere	Hopper	Lovelace	Blackwell	Rubin	Feynman
2016	2017	2018	2020	2022	2022	2024	2026	2028
								
Blaise Pascal *Mathematician, physicist, philosopher*	**Alessandro Volta** *Chemist, physicist*	**Alan Turing** *Mathematician, computer scientist, logician*	**André-Marie Ampère** *Physicist, mathematician*	**Grace Hopper** *Computer scientist, mathematician, Navy admiral*	**Ada Lovelace** *Writer, mathematician*	**David Blackwell** *Statistician, mathematician*	**Vera Rubin** *Astronomer*	**Richard Feynman** *Theoretical physicist*

World's Most Complex Piece of Hardware

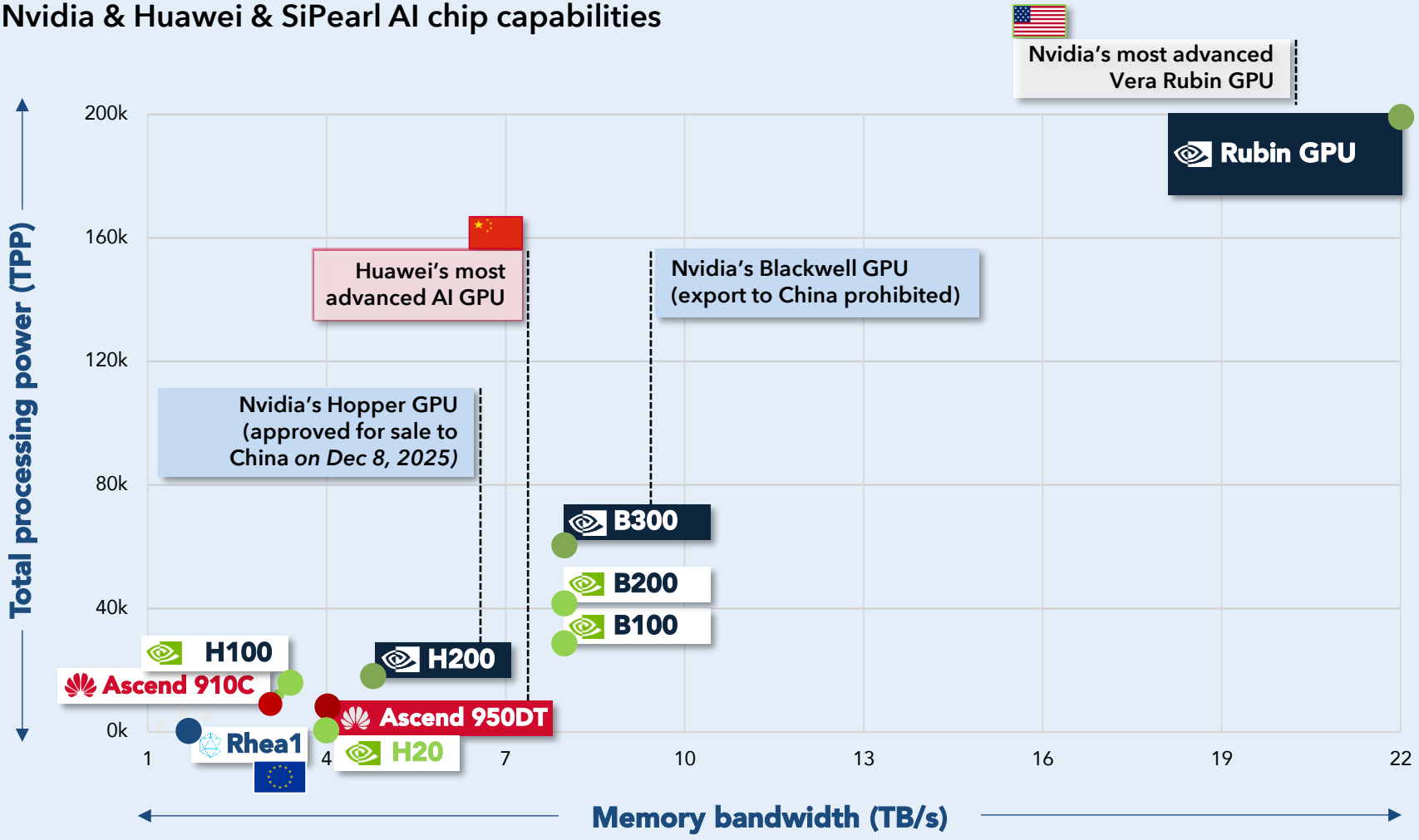
NVIDIA's Rubin GPU

- 336 billion transistors per GPU
- 5x the AI performance of the previous Blackwell generation at 10x lower cost per token
- Nearly triple memory bandwidth compared to Blackwell (22 TB/s)
- NVL72 rack scale system - full rack of 72 Rubin GPUs delivers 3.6 EFLOPS of AI compute (5x more than Blackwell generation)
- 2,300 watts of power consumption
- Expected release date: Q4 2026 / Q1 2027



GPU Design Leadership & Export Controls

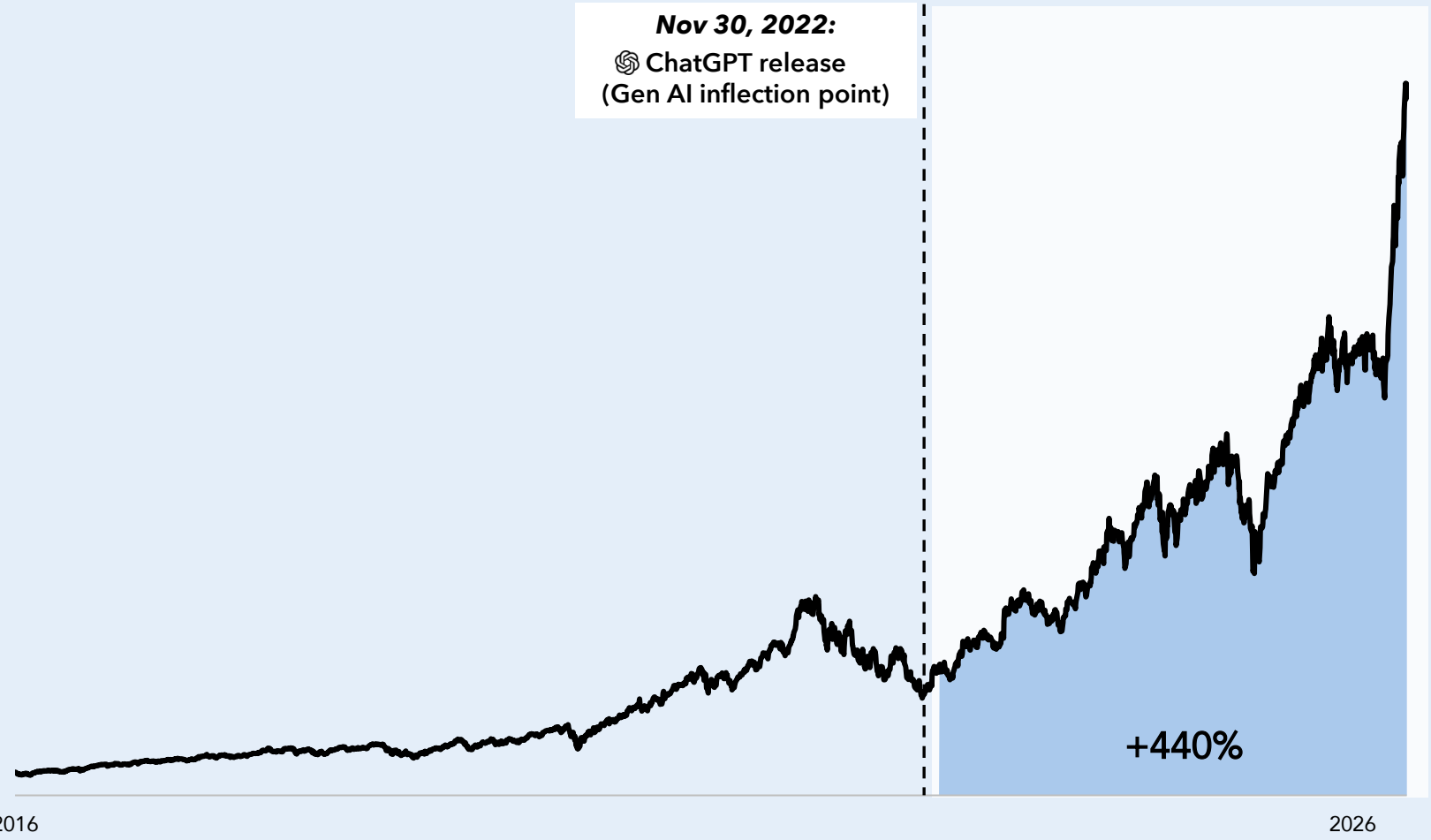
Nvidia & Huawei & SiPearl AI chip capabilities



Source: (1) Bloomberg, "Nvidia's H200 Could Turbocharge China's AI Clout". IFP. Tom's Hardware. Nvidia. Actual names and specifications may be different than those listed above.

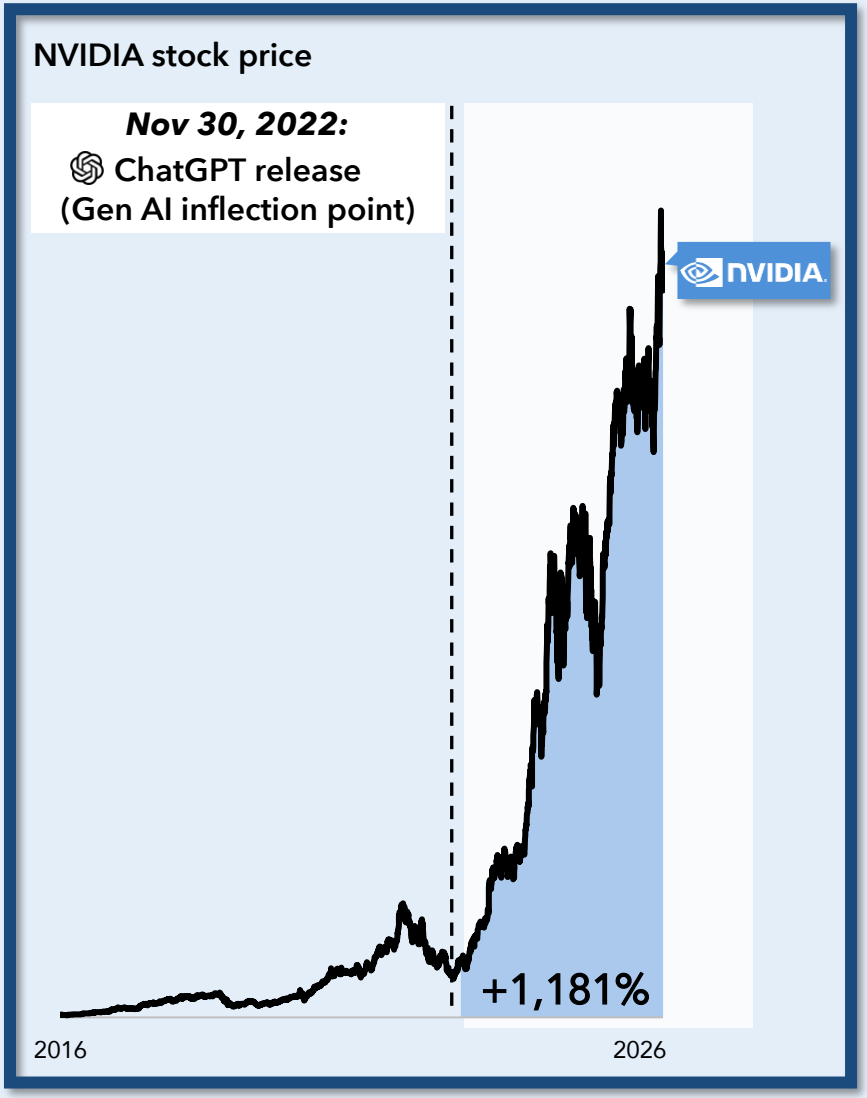
Fabless Semiconductor Design Index

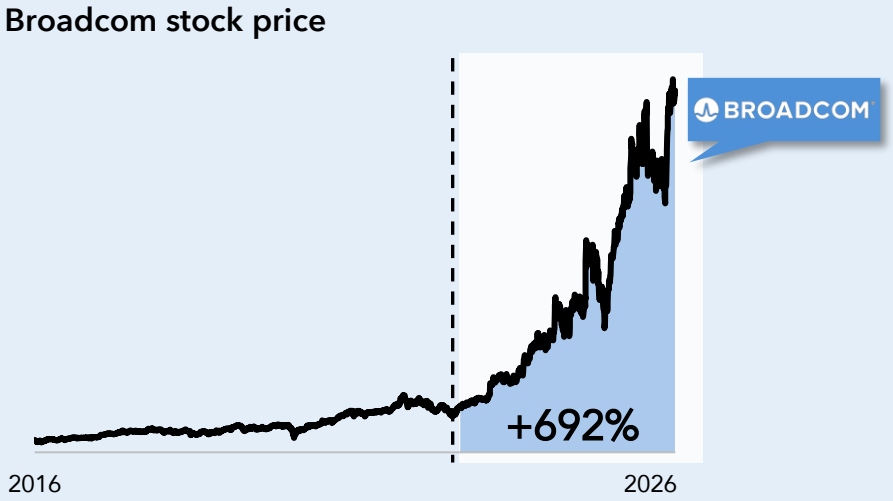
MarketVector US-listed fabless semiconductor index



Source: (1) Bloomberg. Data as of May 29, 2026.

Leading Fabless Semi Design Companies



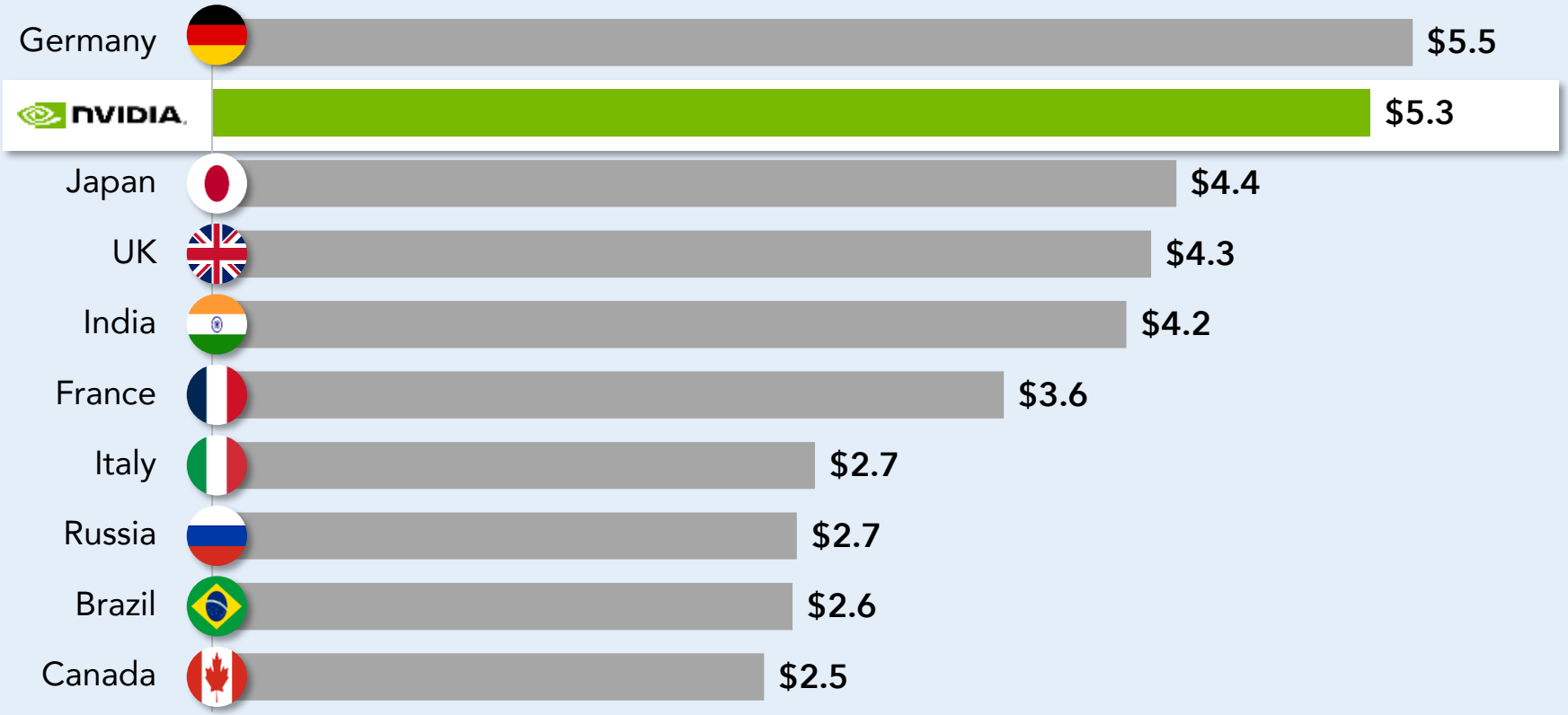


Source: (1-3) Bloomberg. Data as of May 29, 2026.

NVIDIA Larger Than Most Global Economies

NVIDIA, the world's most valuable company, has a valuation of approximately $5 trillion, larger than the GDP of every global economy except the US, China and Germany. NVIDIA's valuation reflects not just cyclical chip demand but the company's position as **a critical infrastructure layer in AI's seismic buildout.** Notably, the world's most valuable company has a **5-year revenue CAGR in the high-60s** percent, with **gross, operating and FCF margins above 70%, 60% and 45%, respectively.**

World's largest economies (ex-US & China) vs. NVIDIA, USD tn

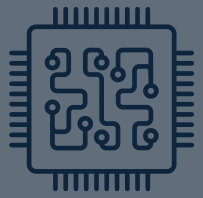


Source: (1) IMF, "World Economic Outlook (April 2026)". Bloomberg. NVIDIA data as of May 29, 2026.

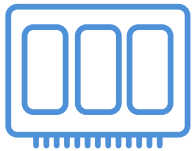

6
Losing
My Memory

Highly Integrated Global Semiconductor Supply Chain

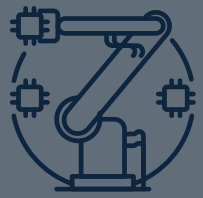
EDA software design tools



Fabless chip design

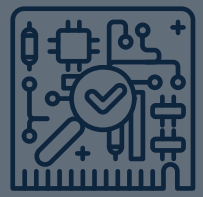


Memory chip IDMs



Capital equipment

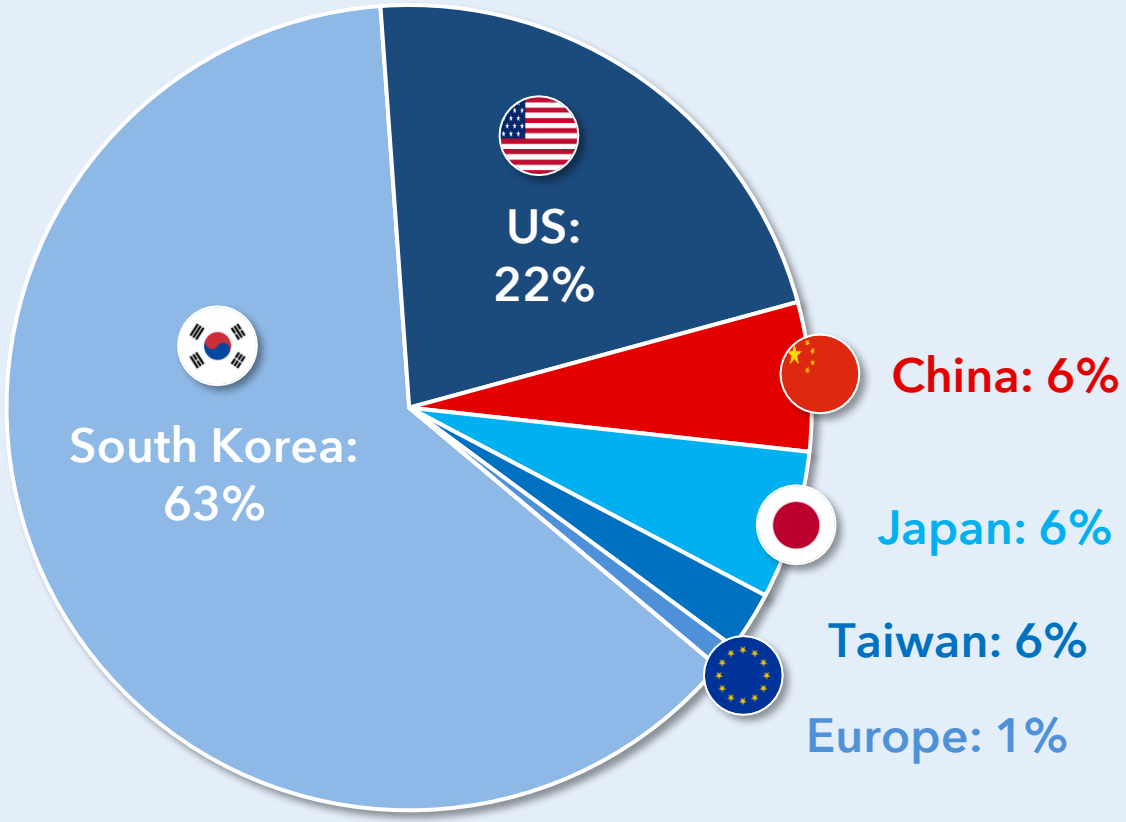
Foundries (manufacturing)



Assembly, packaging & test

Global Leadership in Memory Chip Design

Memory chip design value added, by region (2024)

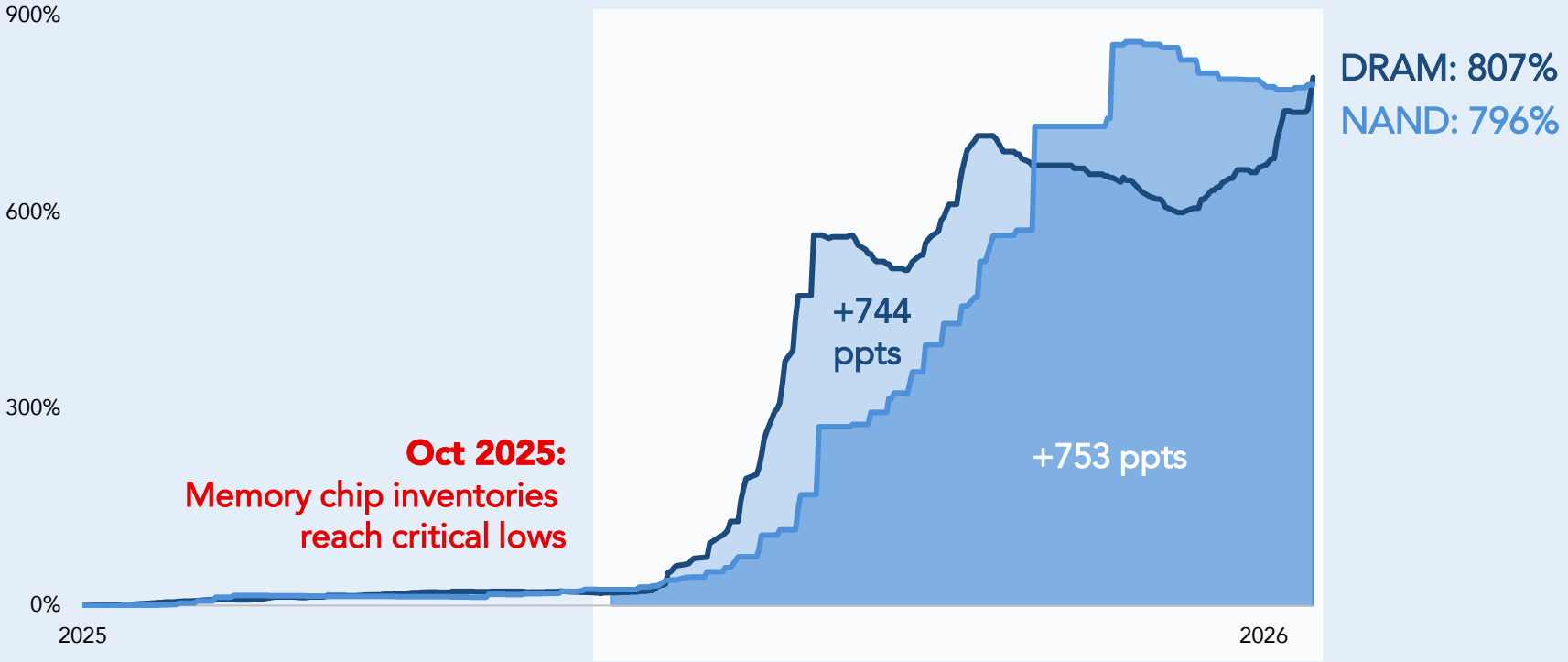


Source: (1) Semiconductor Industry Association, "2025: State of the U.S. Semiconductor Industry". Data as of 2024.

Memory Chip Shortages Ripple Through Markets

A sharp global shortage in memory chips has driven DRAM and NAND prices up more than 700% in recent months as hyperscaler AI data centers lock-in multi-year supply, crowding out other applications. While DRAM is much more important to AI's expansion, NAND (flash storage) memory chip prices have risen more rapidly over the last 18 months because: (1) deeper NAND under-supply prior to this cycle; **(2) the cannibalization impact of DRAM stealing NAND fab capacity;** (3) NAND also important to AI; and (4) varying price elasticity with NAND coming off a lower price base.

DRAM & NAND price performance since Feb 10, 2025



Source: (1) Bloomberg, "Memory Chip Squeeze Widens Gap Between Market Winners and Losers". Data as of May 29, 2026.

Confluence of Forces Driving Memory Crunch

AI infrastructure demand

Data centers, servers, accelerators.
Represents about 70% of memory demand in 2026.

Big 3 memory IDM supply discipline

Extreme supplier concentration from rational, experienced oligopoly.
95% of DRAM market share. Majority of NAND supply.

Long lead times on new fab construction

Now 3-5 years vs 18-24 months previously.
Constraints on power, equipment and labor.
Reallocations to high-bandwidth memory (HBM) also take time.

Multi-year underinvestment from 2022-23 downcycle

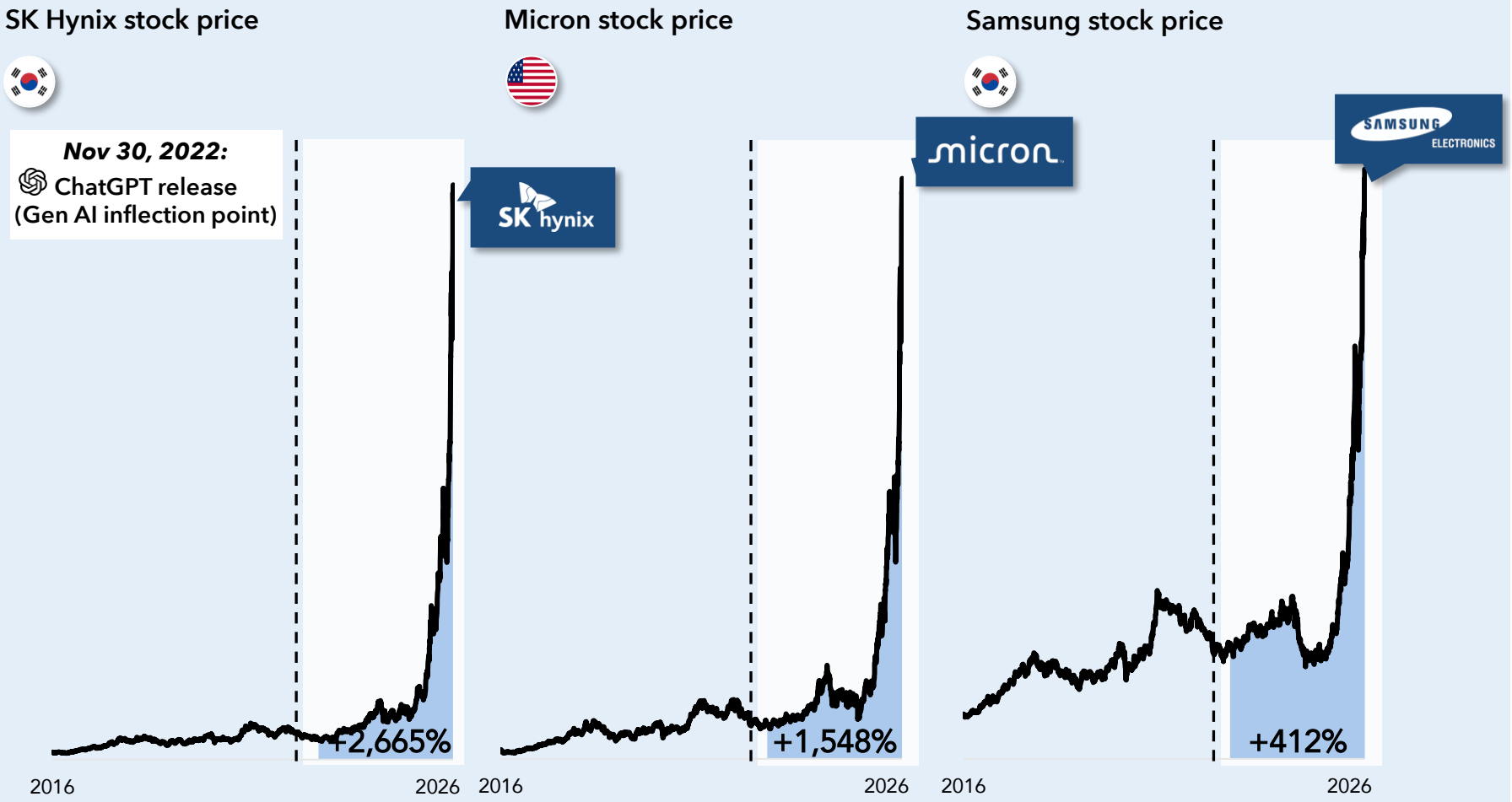
Meaningful new capacity expected in 2027-28.

Long-term hyperscaler supply agreements

Approximately 1/3 of hyperscaler capex going to memory.
Increased visibility raises pricing power.

The Big 3 Memory Chip IDMs

The big 3 vertically integrated memory chip integrated device manufacturers (IDMs) **control 95% of the DRAM market**, and a majority of NAND, critical for AI's expansion.



Source: (1-3) Bloomberg. Data as of May 29, 2026.

Impact of US Export Controls on HBM

US export controls on high bandwidth memory (HBM) have achieved global extra-territorial reach through a two-layer framework. BIS export controls apply directly to Micron (US), while the Foreign Direct Product Rule (FDPR) extends that jurisdiction to Samsung and SK Hynix (South Korea). Those three producers collectively supply over 95% of global HBM.

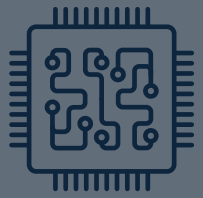
Notable provisions:

- BIS Dec 2024 rule imposed a **ban on advanced HBM exports to China**
- Export controls on **advanced packaging SME and DRAM** more broadly
- **Foreign Direct Product Rule** (FDPR) extends the ban globally
- South Korea has no **FDPR exemption**
- **Technical memory bandwidth threshold** effectively blocks all commercially relevant modern HBM generations
- All three major producers covered (**Micron, Samsung, SK Hynix**)
- China's domestic alternative is year away

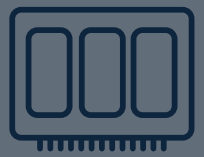

7
EDA, Cap Equipment,
Packaging & Test

Highly Integrated Global Semiconductor Supply Chain

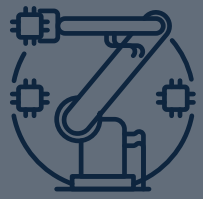
EDA software design tools



Fabless chip design

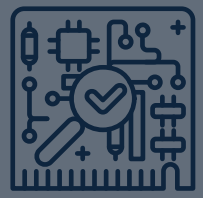


Memory chip IDMs



Capital equipment

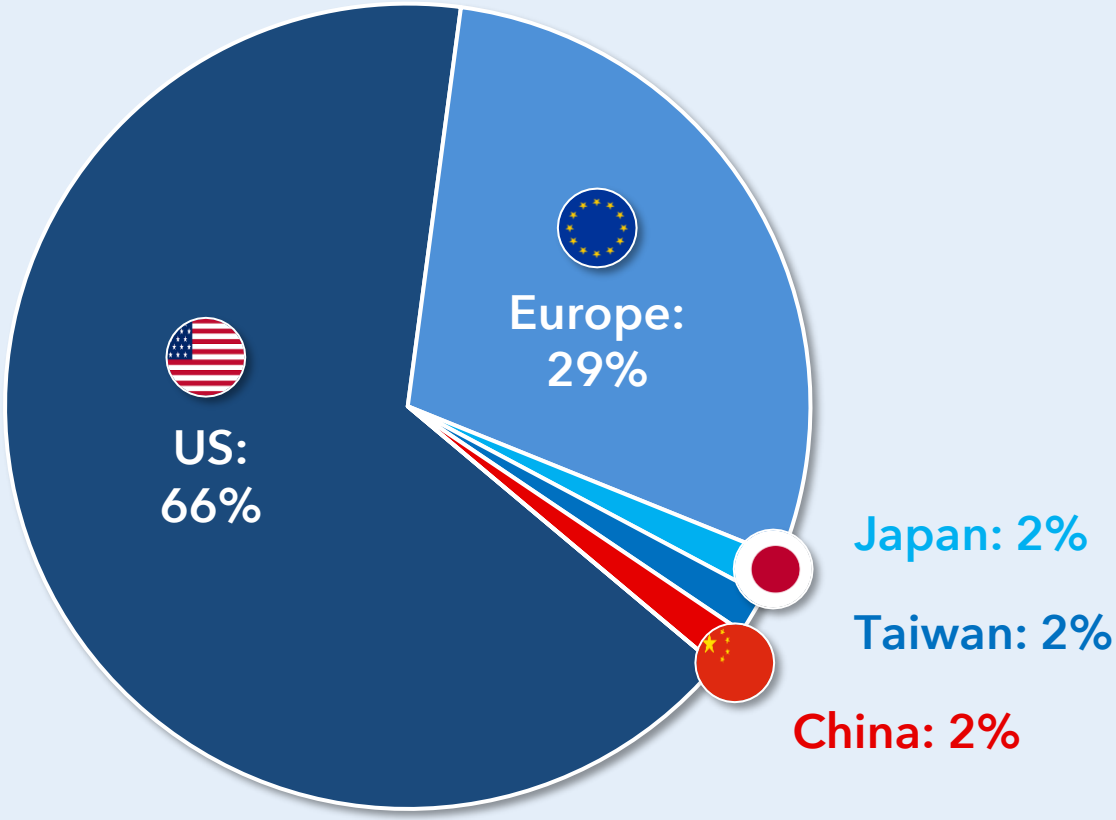
Foundries (manufacturing)



Assembly, packaging & test

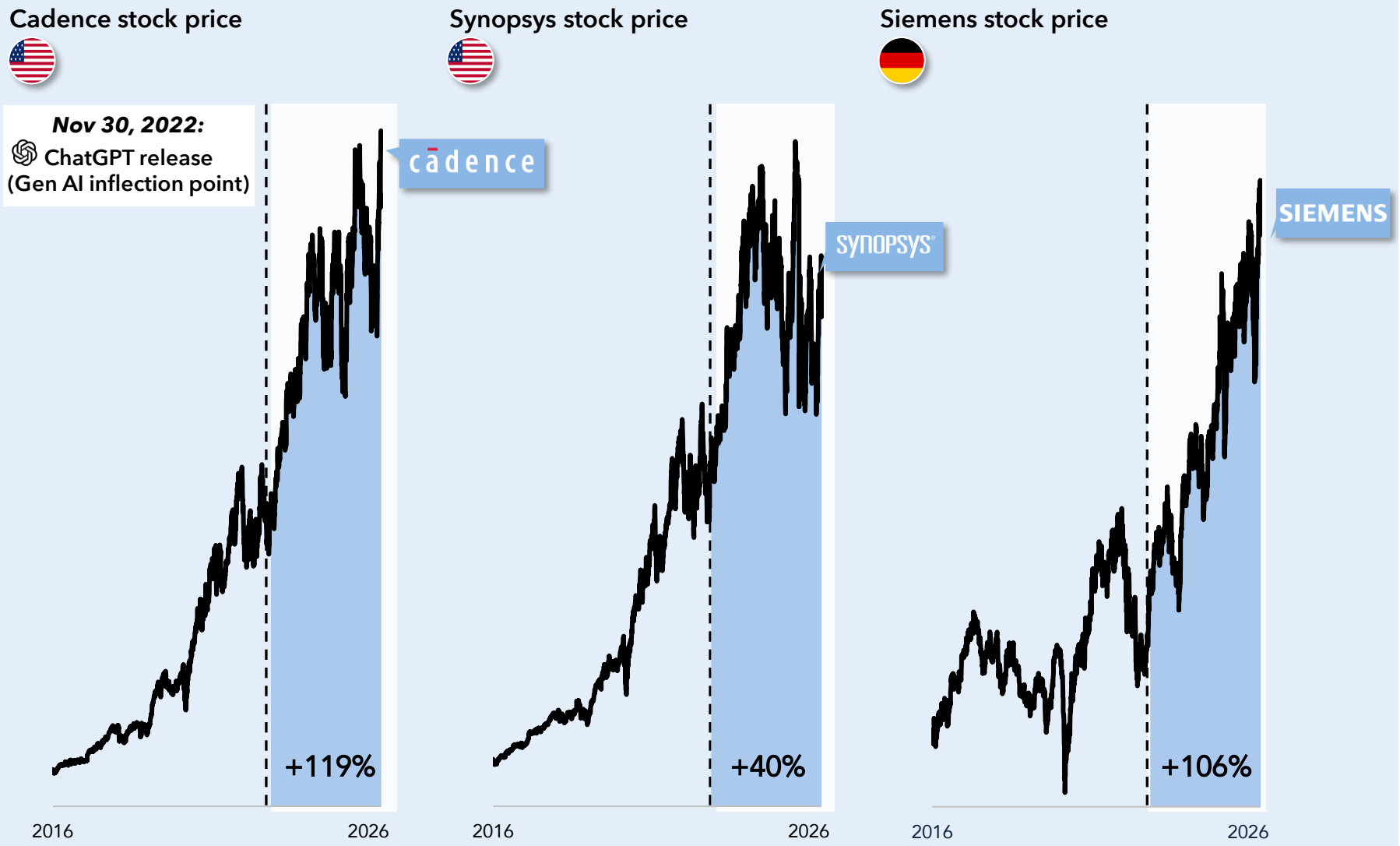
Global Leadership in EDA Design Tools

IP / EDA software design value added, by region (2024)



Source: (1) Semiconductor Industry Association, "2025: State of the U.S. Semiconductor Industry". Data as of 2024.

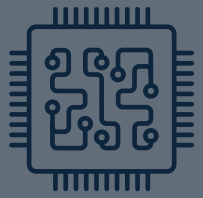
Leading EDA Software Design Companies



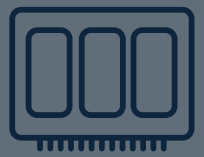
Source: (1-3) Bloomberg. Data as of May 29, 2026.

Highly Integrated Global Semiconductor Supply Chain

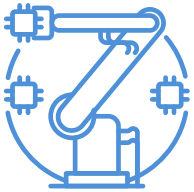
EDA software design tools



Fabless chip design

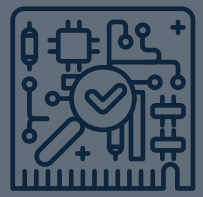


Memory chip IDMs



Capital equipment

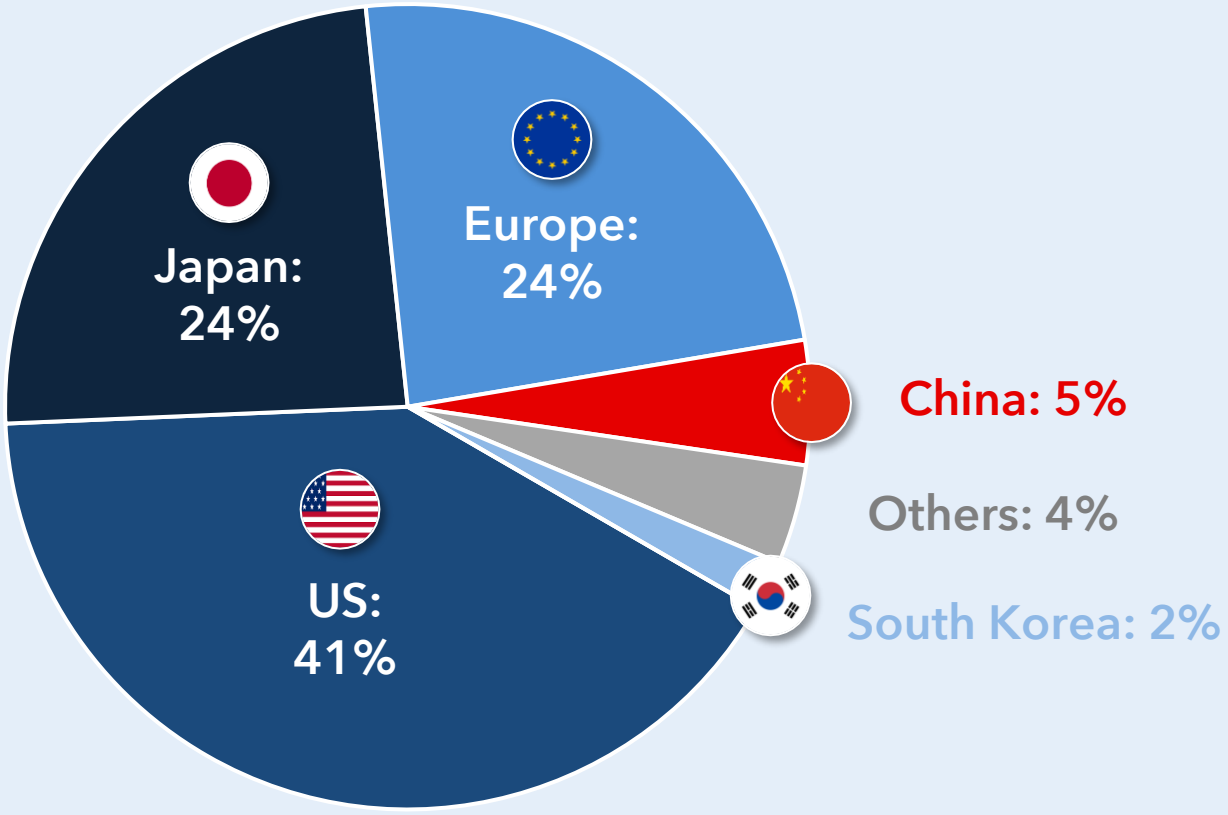
Foundries (manufacturing)



Assembly, packaging & test

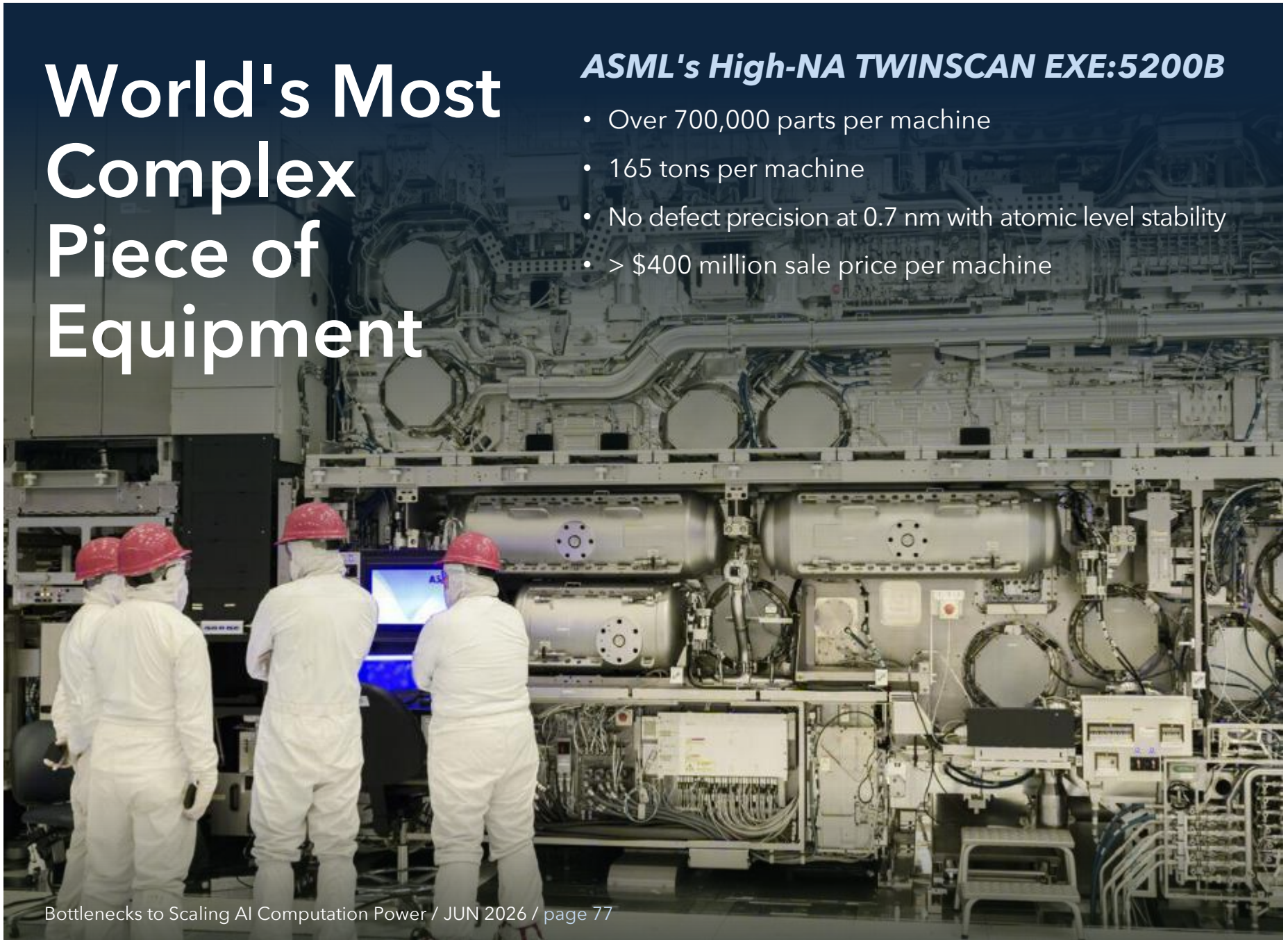
Global Leadership in Capital Equipment

Semiconductor capital equipment value added, by region (2024)



Source: (1) Semiconductor Industry Association, "2025: State of the U.S. Semiconductor Industry". Data as of 2024.

World's Most Complex Piece of Equipment

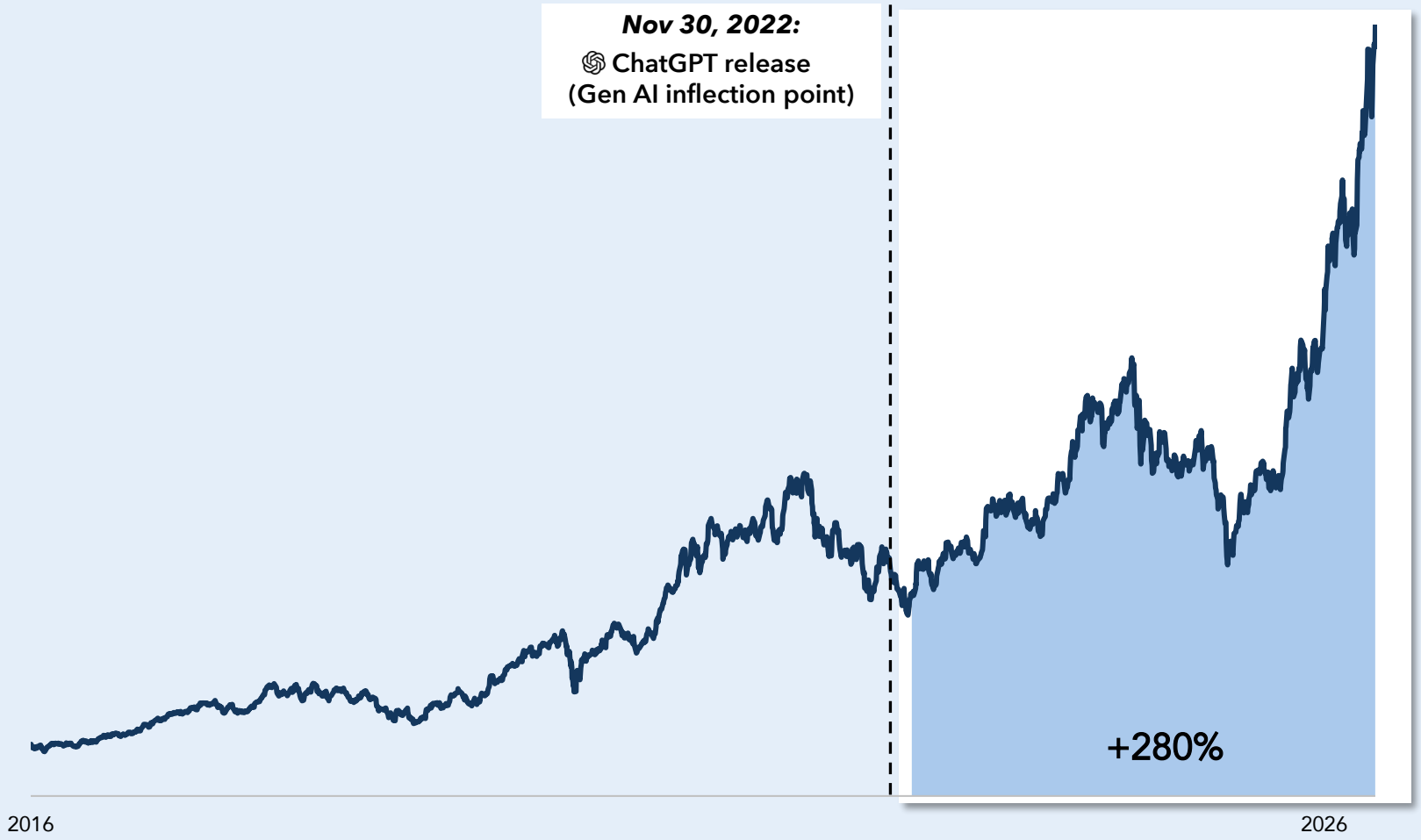


ASML's High-NA TWINSCAN EXE:5200B

- Over 700,000 parts per machine
- 165 tons per machine
- No defect precision at 0.7 nm with atomic level stability
- > $400 million sale price per machine

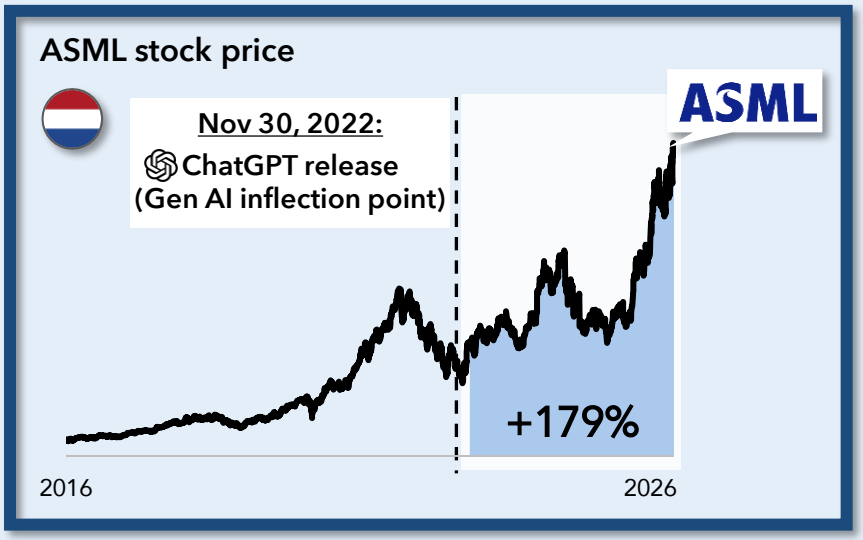
Semiconductor Capital Equipment Index

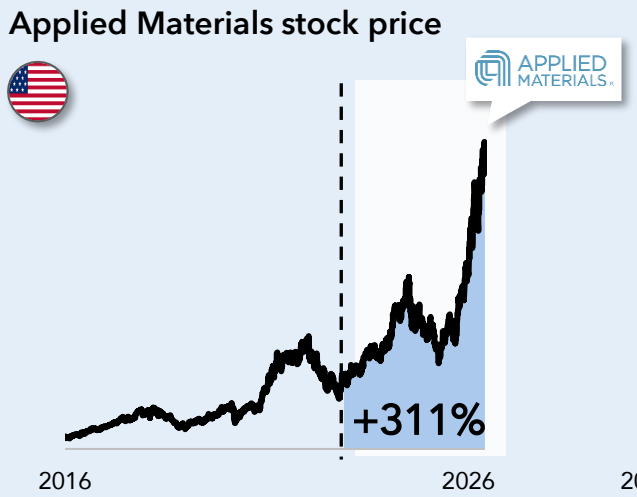
Solactive semiconductor equipment index

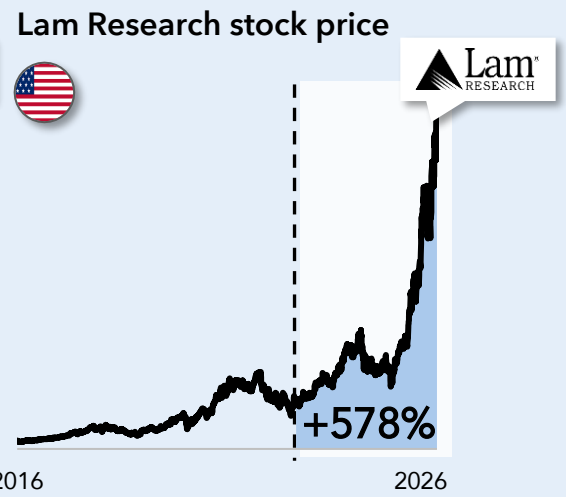


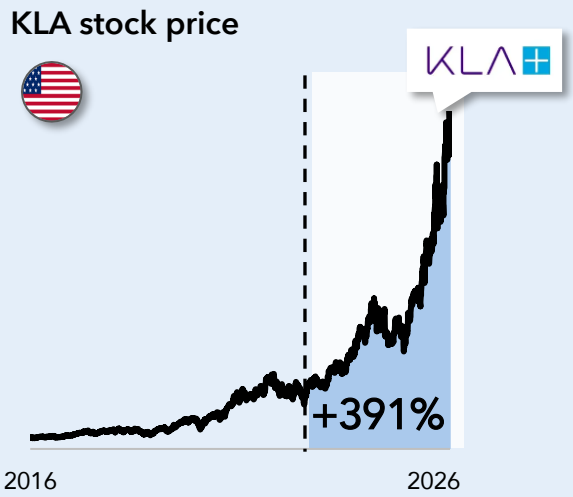
Source: (1) Bloomberg. Data as of May 29, 2026.

Leading Semi Equipment Manufacturers









Source: (1-4) Bloomberg. Data as of May 29, 2026.

Trilateral Agreement Restricting Capital Equipment

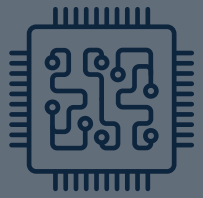
In January 2023, the US, Netherlands and Japan, **controlling roughly 90% of advanced semiconductor manufacturing equipment**, agreed to jointly restrict China's access to frontier chip-making tools.

Notable provisions:

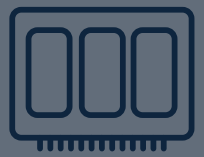
- Export controls on **EUV and DUV lithography equipment**
- Export controls on 23 types of **Japanese advanced equipment**
- **No allied backfilling of US-restricted** chipmaking equipment to China
- **Technology thresholds** aligned with Oct 2022 US controls
- De minimis and **Foreign Direct Product Rule (FDPR)** alignment
- Restrictions on US persons and service support
- Licensing system tiered by "friendly" and "restricted" countries

Highly Integrated Global Semiconductor Supply Chain

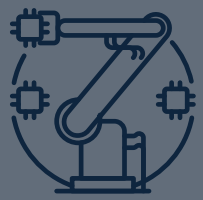
EDA software design tools



Fabless chip design

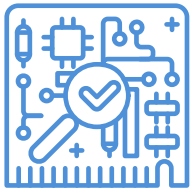


Memory chip IDMs



Capital equipment

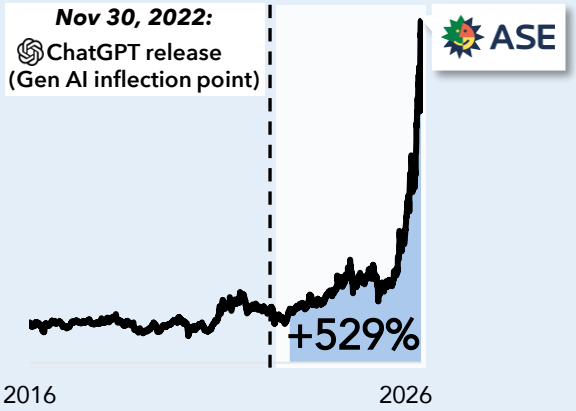
Foundries (manufacturing)



Assembly, packaging & test

Leading Assembly, Packaging & Test Companies

ASE Technology stock price
(Taiwan)

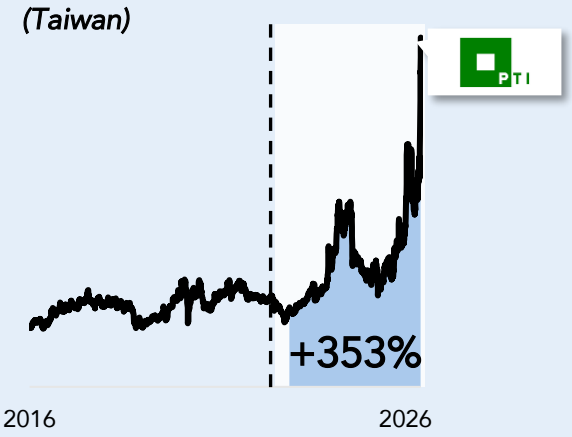


Amkor Technology stock price

JCET stock price

TongFu Microelectronics stock price

Powertech Technology stock price
(Taiwan)



Tianshui Huatian Tech stock price

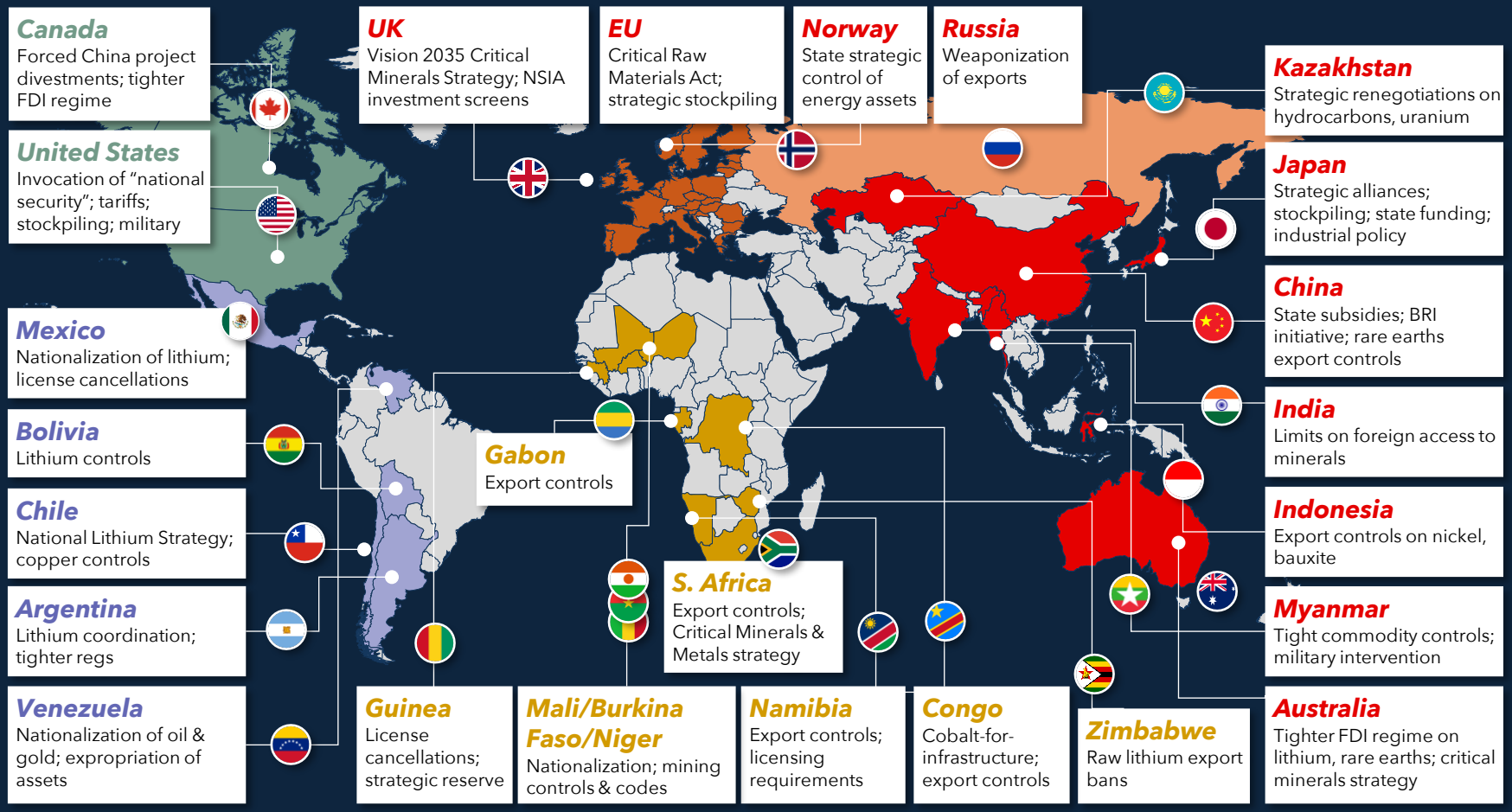
Source: (1-6) Bloomberg. Data as of May 29, 2026.

8

Strategic Minerals & Electrons

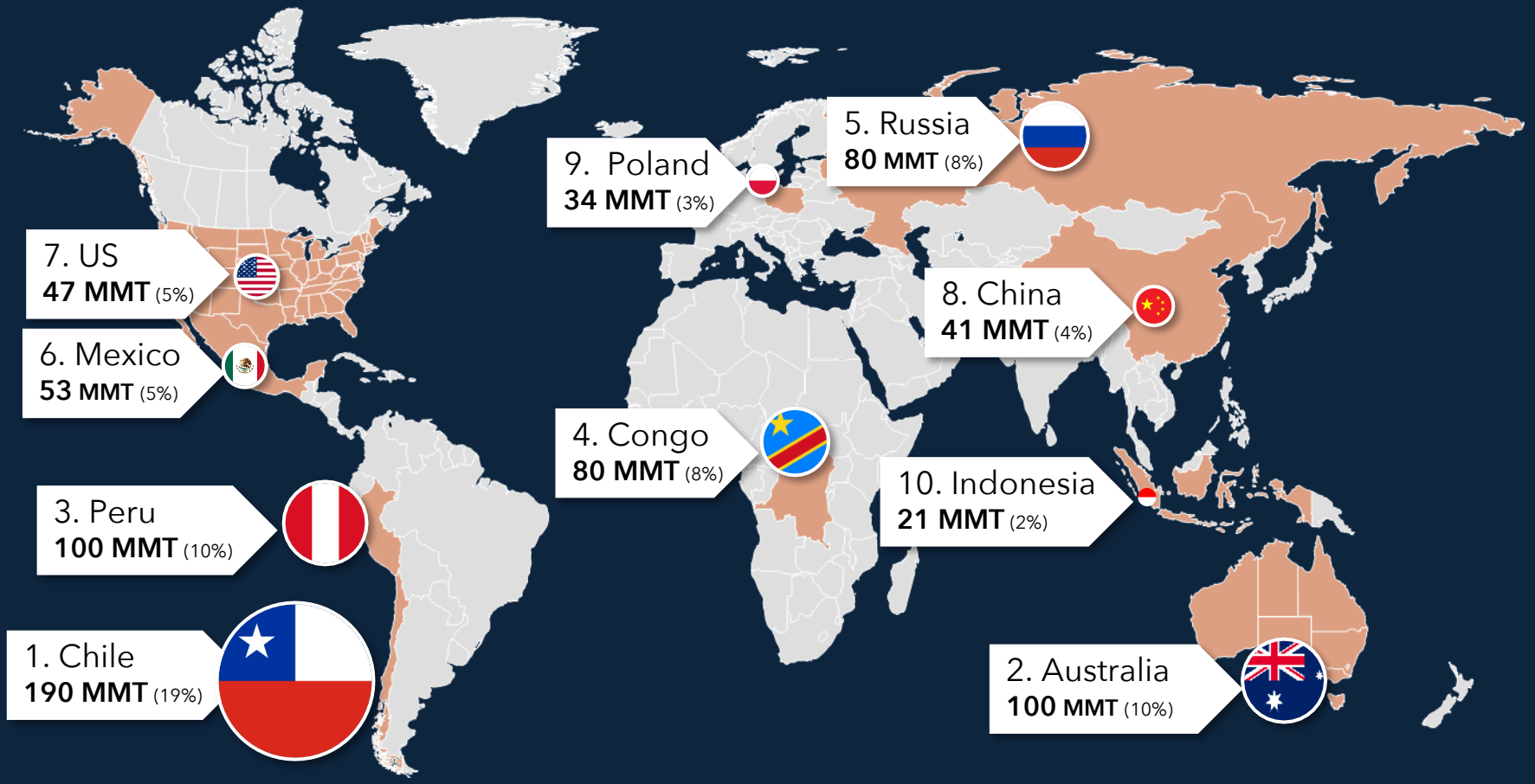
New Era of Resource Nationalism

Countries are layering a broad range of traditional resource nationalism tools with newer geoeconomic and industrial policy instruments that target entire supply chains and the most strategically significant minerals for high-end manufacturing (EVs, defense, semis, AI).



Top 10 Sources of Global Copper Reserves

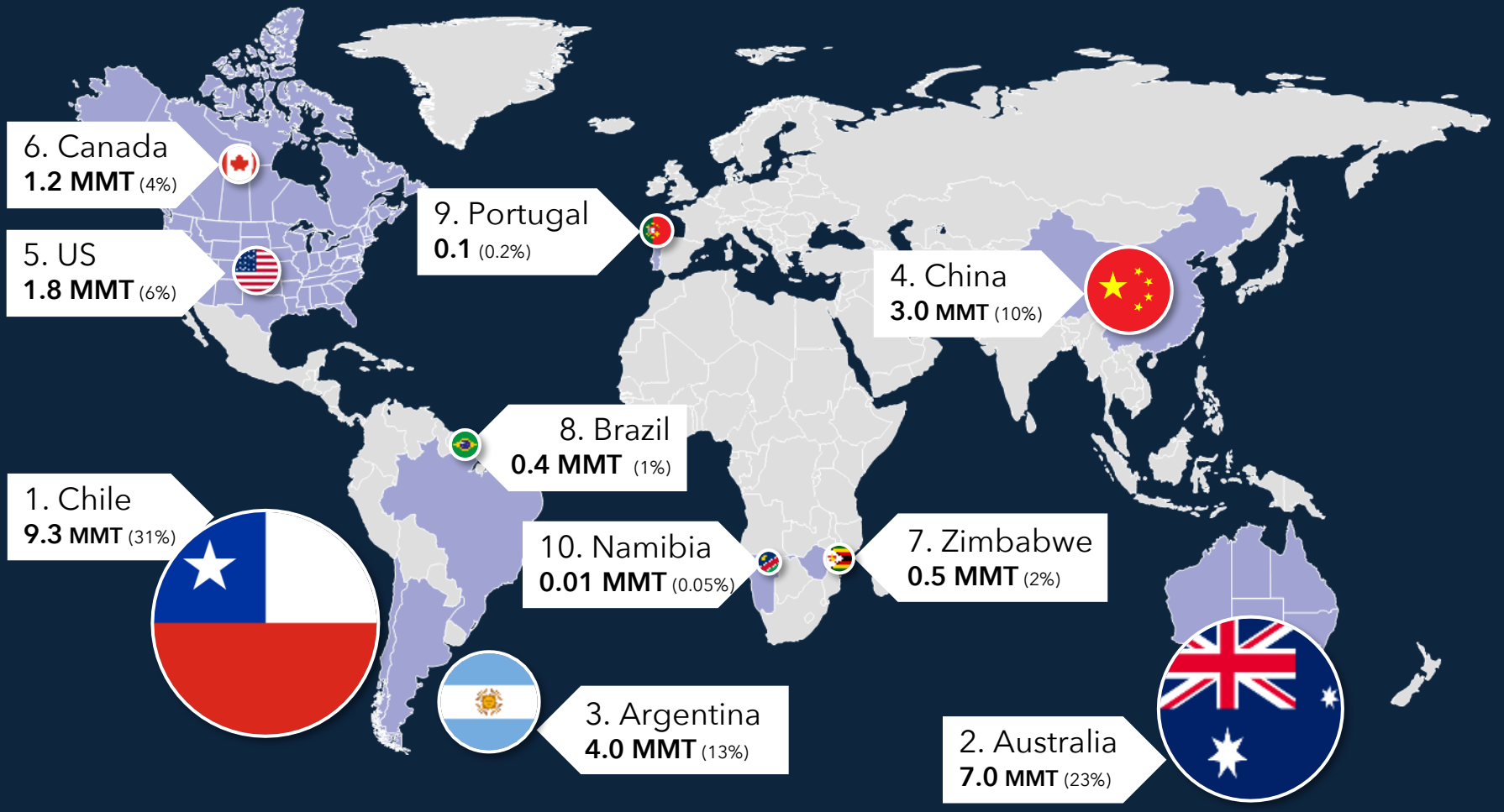
Global copper reserves, million tons (2024)



Source: US Geological Survey. Mineral Commodity Summaries 2025.

Top 10 Sources of Global Lithium Reserves

Global lithium reserves, million tons (2024)

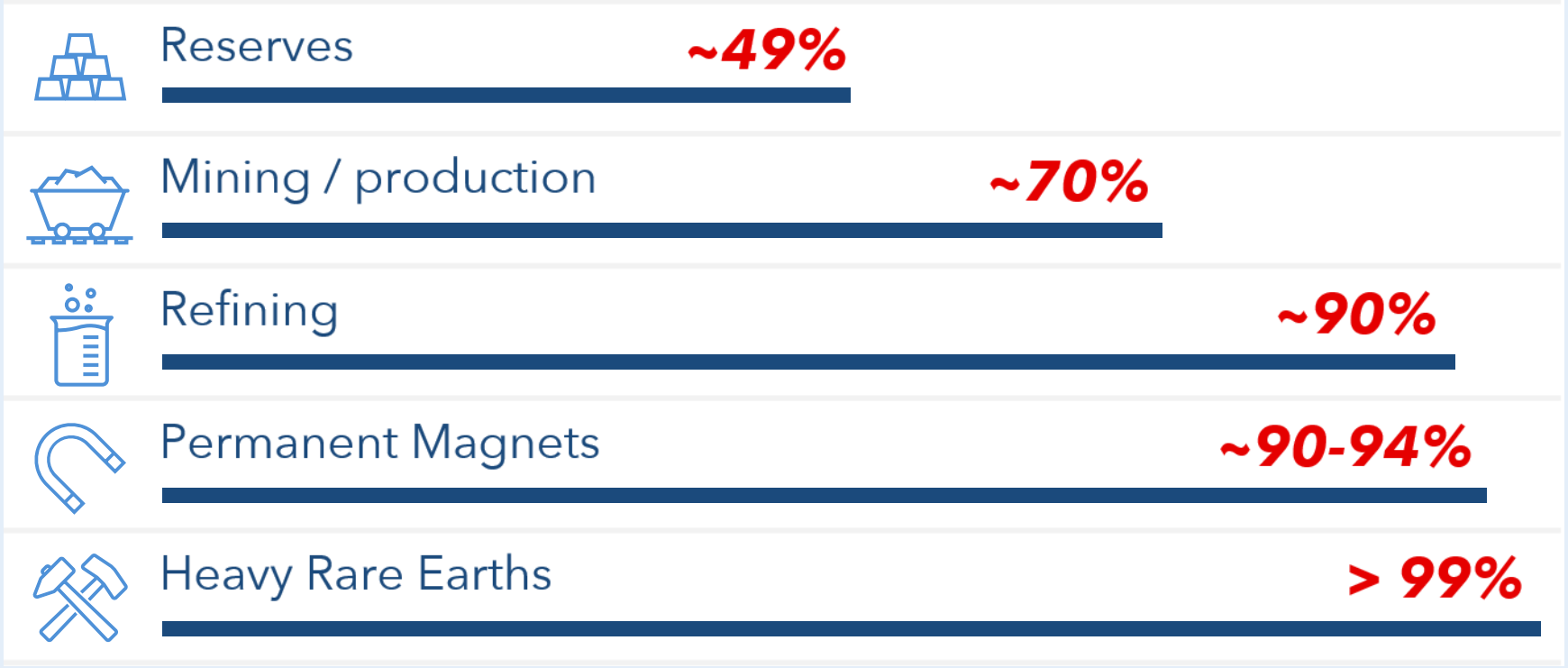


Source: US Geological Survey. Mineral Commodity Summaries 2025.

China's Dominance of the Rare Earth Value Chain

China's dominance of the complete rare earths value chain – from reserves to refining – and the 10+ year lead to the West in this regard, is one of the most consequential and underappreciated structural stories in the global economy and geopolitics. Further, as evidenced by policy decisions in 2025, China has demonstrated a willingness to use this leverage.

China's global share in the rare earth value chain

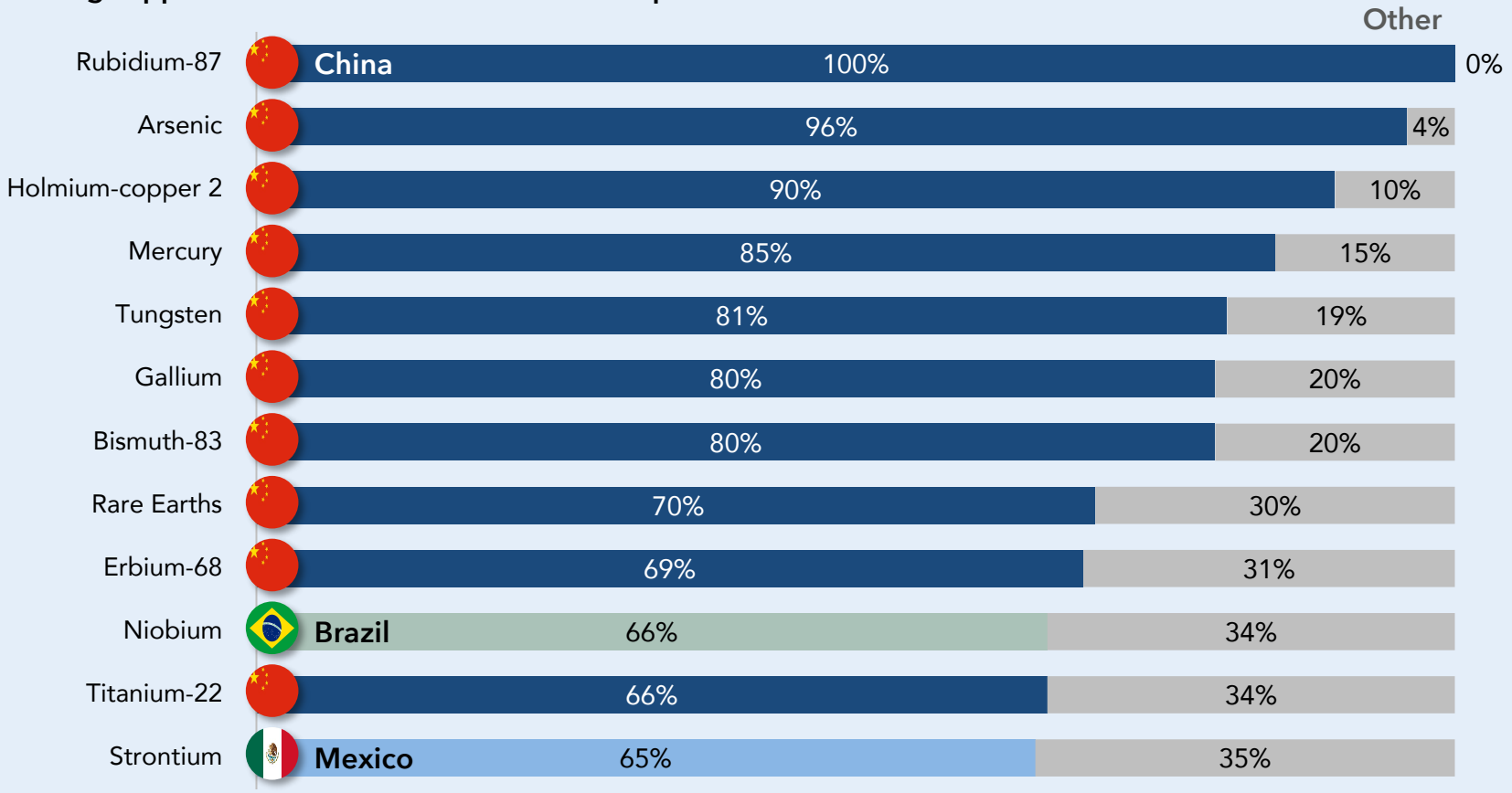


Source: Reserves is US Geological Survey data as of 2025. Mining / production is IEA 2025 data. Refining is CSIS 2025. Permanent magnets is IEA / CFR 2026. Heavy rare earths is IEA data.

China Dominates US Imports of AI Critical Minerals

China dominates more than a dozen major categories of critical mineral groups that the United States has become dependent on for AI's expansion. Notably, the US is more than 80% reliant on China specifically for numerous critical minerals.

Leading supplier's share of US critical mineral imports for AI

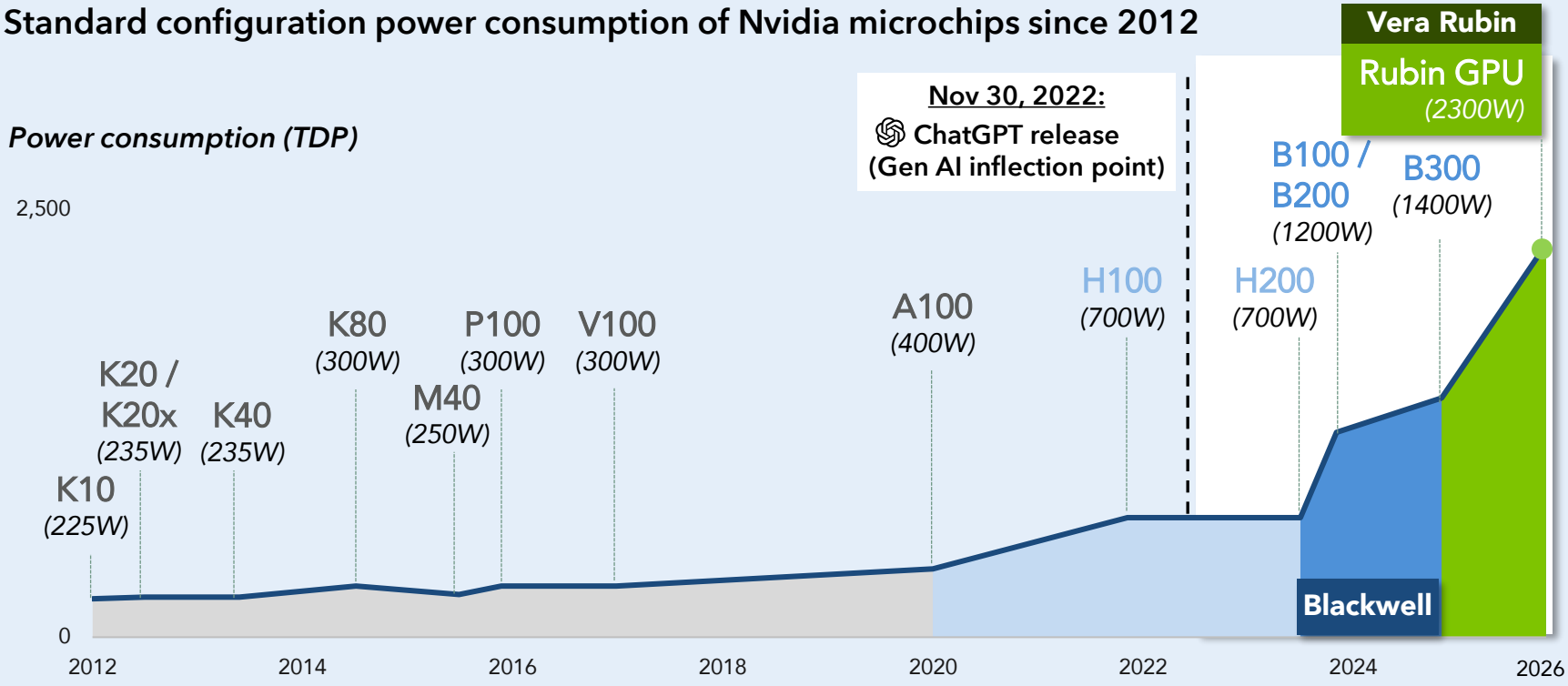


Source: (1) CFR, "US Economic Security – Winning the Race for Tomorrow's Technologies". US Geological Survey. Values for mercury, holmium-copper 2, and gallium are approximated due to lack of data on global production and US imports. Data shows critical minerals where the US is at least 65% dependent on a single country

Inflection Point for AI Expansion Has Shifted to Data Center Infrastructure

For the first time in history, **the limiting factor for AI's progress** is no longer GPU architecture or software, but rather **the physical limitations of power grid and cooling systems**. The computational performance of the latest Nvidia Rubin GPU is so powerful that it requires **a complete rethinking of data center power delivery, cooling systems and physical infrastructure** that now require 24-month construction lead times. The Rubin has also transcended the thermal limit of air, with 100% liquid cooling required. Energy has now replaced silicon as the more binding constraint for AI's expansion.

Standard configuration power consumption of Nvidia microchips since 2012

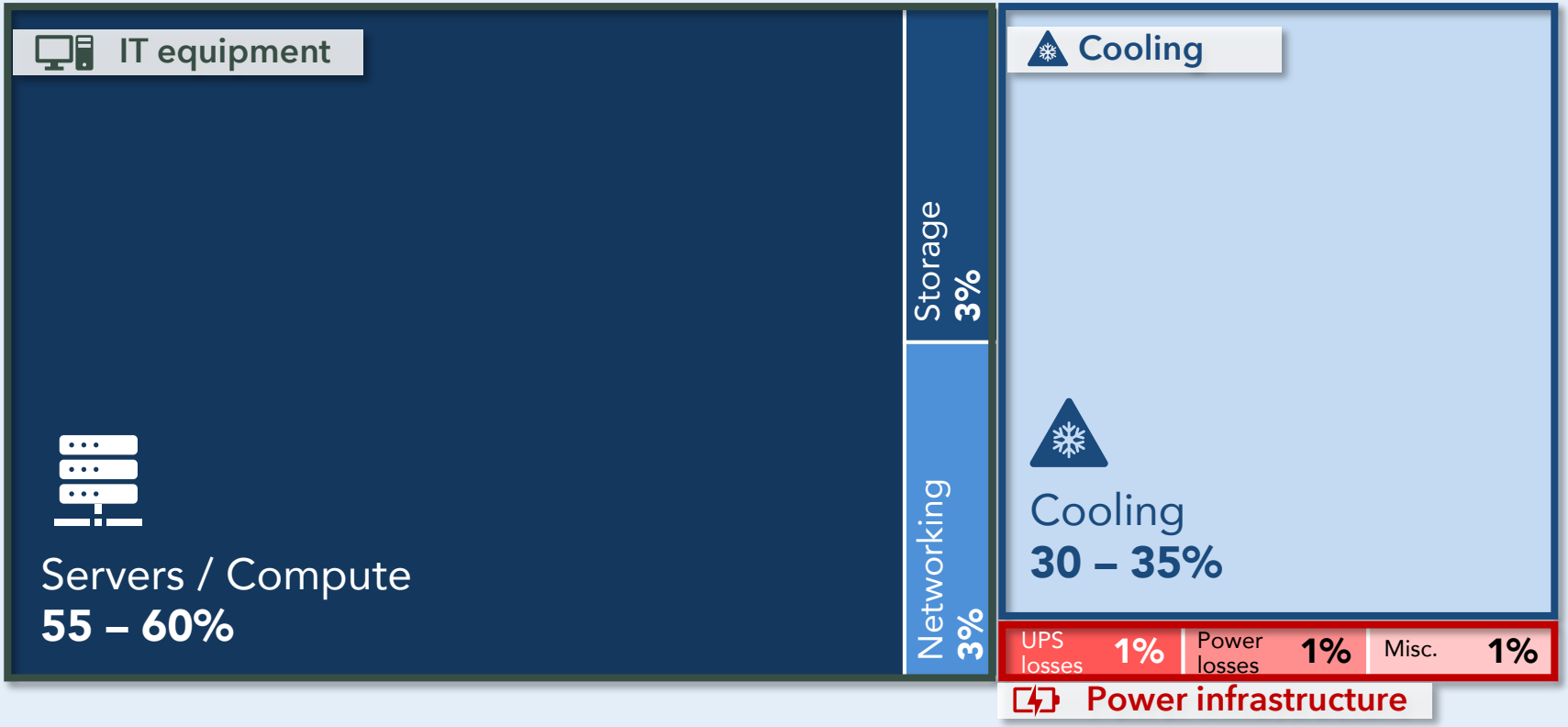


Source: (1) Nvidia. Various news sources.

The Evolving Ratio of Data Center Power Requirements

Historically, the ratio of data center power demand has been split at roughly **60% for compute and 40% for non-compute requirements** (i.e., cooling, power conversion, lighting, etc). The new horizon of data centers, purpose-built for advanced Nvidia Rubin-class GPUs, pushes that balance toward a world where **more than 90% of used power is for computational and IT demands.** The move to the more thermally efficient, direct-to-chip liquid cooling requirements of Nvidia's Blackwell and Rubin generation chips contribute to this shift.

Breakdown of energy consumption of a data center

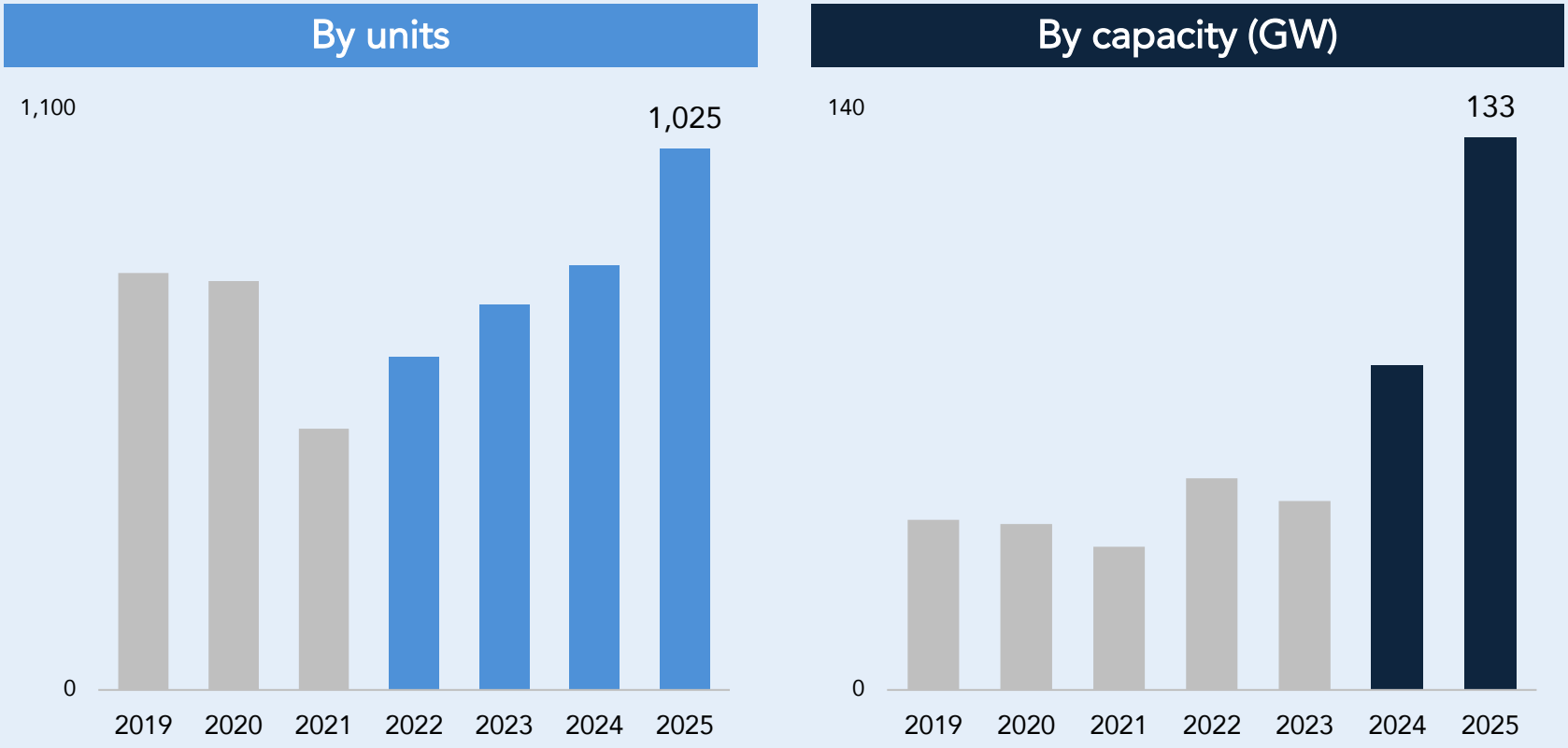


Source: (1) IEA, "Energy and AI (2025)". Uptime Institute Global Data Center Survey (2025). Lawrence Berkeley National Laboratory US Data Center Energy Usage Report (2024).

Global Shortages of Gas Turbines

Global gas turbine orders of 133 GW in 2025 against manufacturing capacity of just 60-70 GW represents **a 50% supply shortage**. Companies in the US, Japan and Germany account for 2/3 of global supply and are struggling to increase production fast enough to keep up with demand. China, by contrast, has not deeply penetrated this market, as natural gas accounts for only 3% of China's domestic electricity production.

Gas turbine new orders

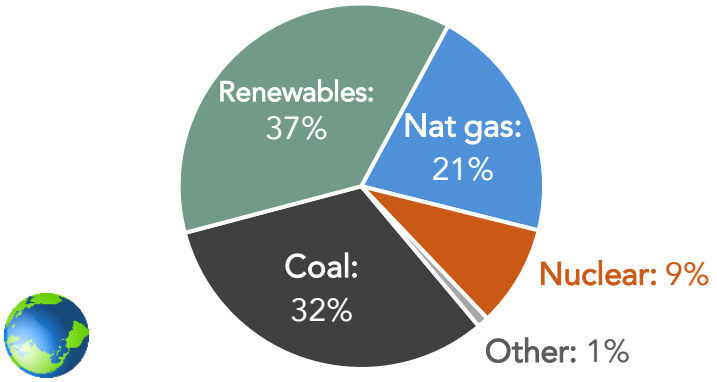


Source: (1-2) Financial Times, "The fallout from the AI-fueled dash for gas". Dora Partners. 2024 and 2025 data is IEA as of April 16, 2026.

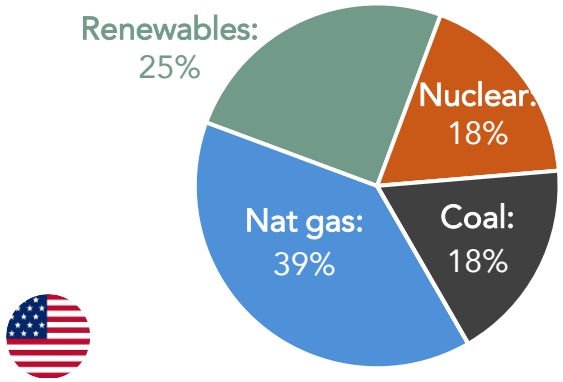
Hormuz Closure Will Trigger Significant Growth in Nuclear & Renewables

Data center power supply mix (2025)

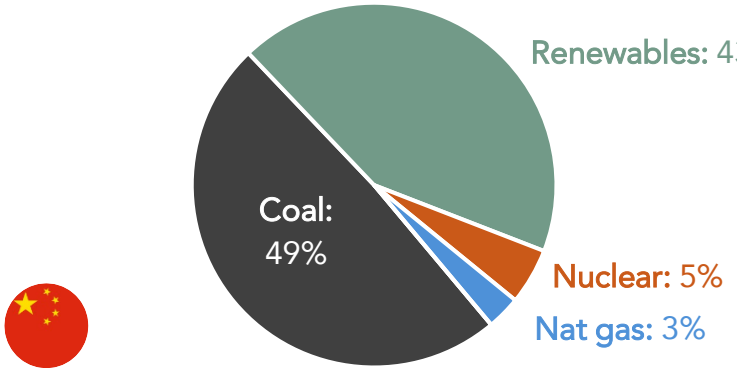
Global



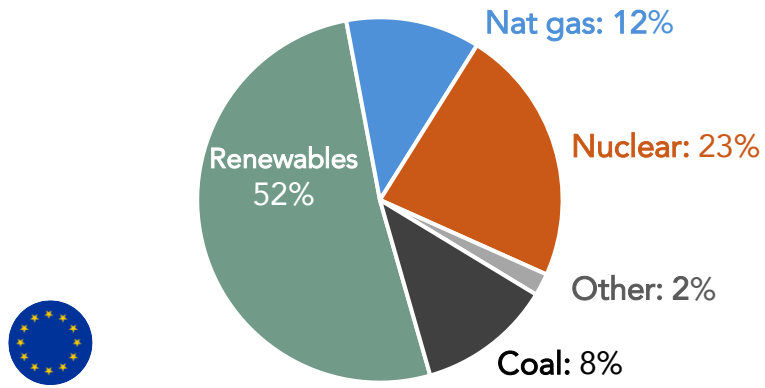
US



China



EU



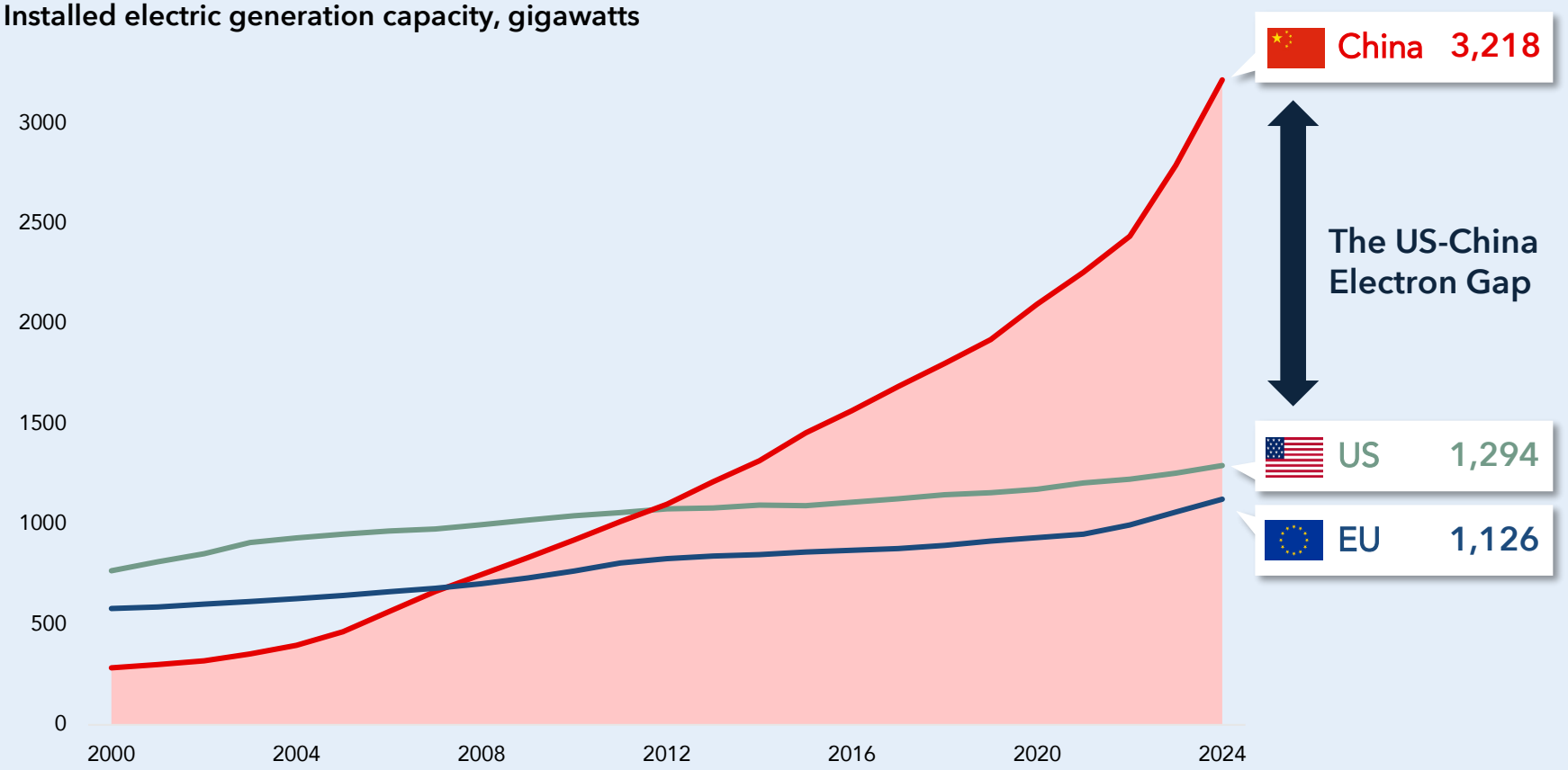
Source: (1-4) Wood Mackenzie. Data as of February 2026.

Wood Mackenzie

The World's Largest Power Grid

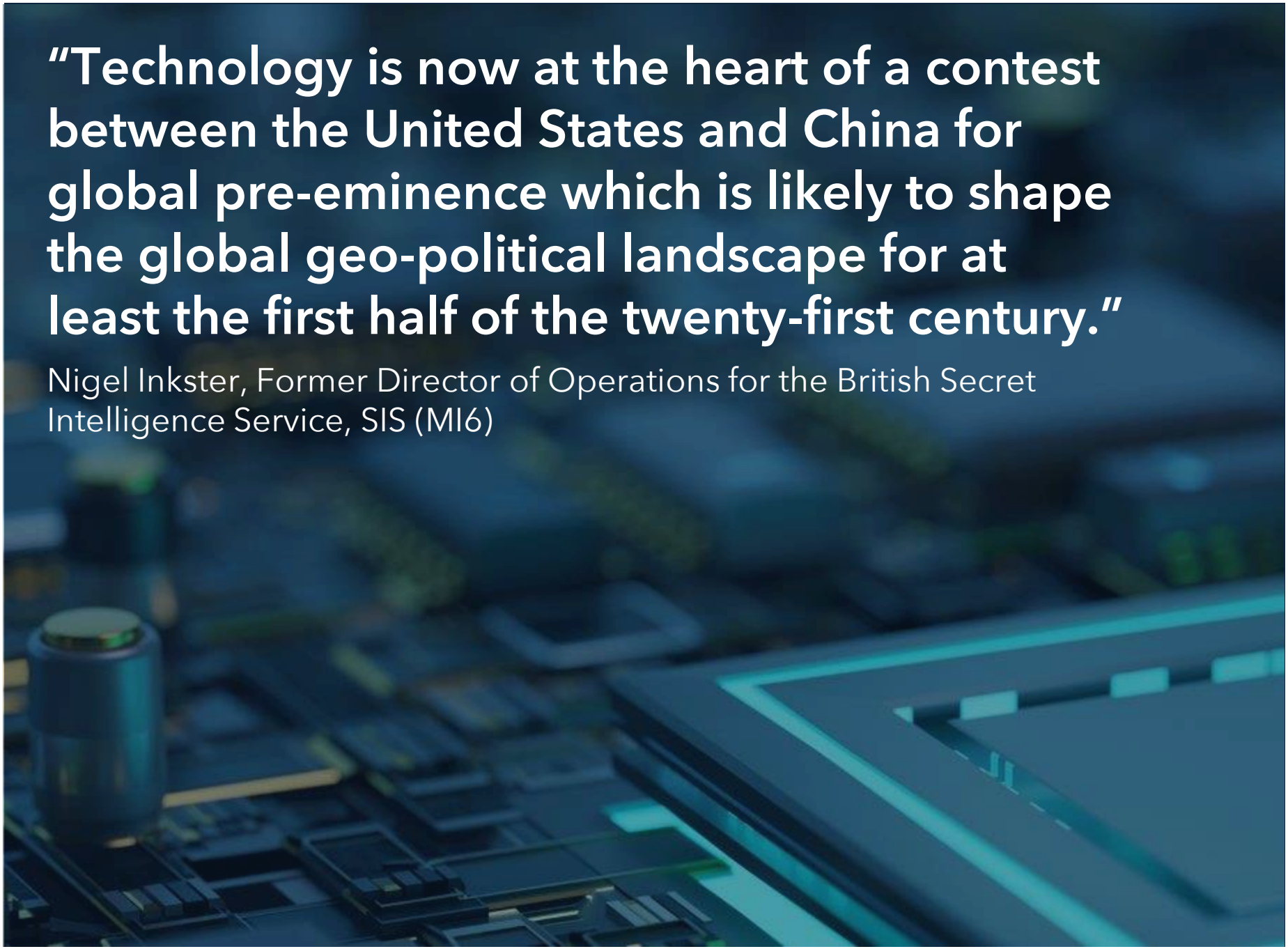
Power and electricity has become a **core competitive advantage** for China in the AI arms race. Over the last 15 years, **China increased its power production more than the rest of the world combined**, and currently boasts **the world's largest power grid**. Last year, China generated **more than twice as much electricity as the US.** Looking ahead, China is expected to invest **more than $500 billion on power grid projects through 2030.**

Installed electric generation capacity, gigawatts



Source: (1) WSJ, "China's AI Power Play: Cheap Electricity from World's Biggest Grid." EIA (US), National Bureau of Statistics (China). IEA. Federal Reserve.

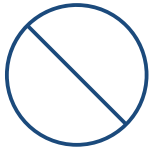

9
Tech Sector
Export Controls


“Technology is now at the heart of a contest between the United States and China for global pre-eminence which is likely to shape the global geo-political landscape for at least the first half of the twenty-first century.”
Nigel Inkster, Former Director of Operations for the British Secret Intelligence Service, SIS (MI6)

US Government Semiconductor Policy Restrictions

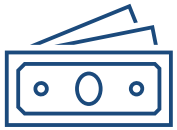
Export Restrictions

Commerce Dept. Entity List



Foreign Direct Product Rule (FDPR)

Follows the "technology lineage" of goods, including all advanced chip production in China



Outbound Investment Restrictions

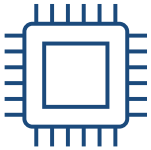
Restricts US capital inside China

Multilateral Coordination

Netherlands, Japan, S. Korea

Sanctions & Financial Restrictions

OFAC / Treasury



Tariffs & Trade Remedies

25% advanced semiconductors

Source: (1) Center for Strategic and International Studies. Congress.Gov. Various News Sources.

US Semiconductor Policy Restrictions

Selected US government technology sector policy restrictions on China

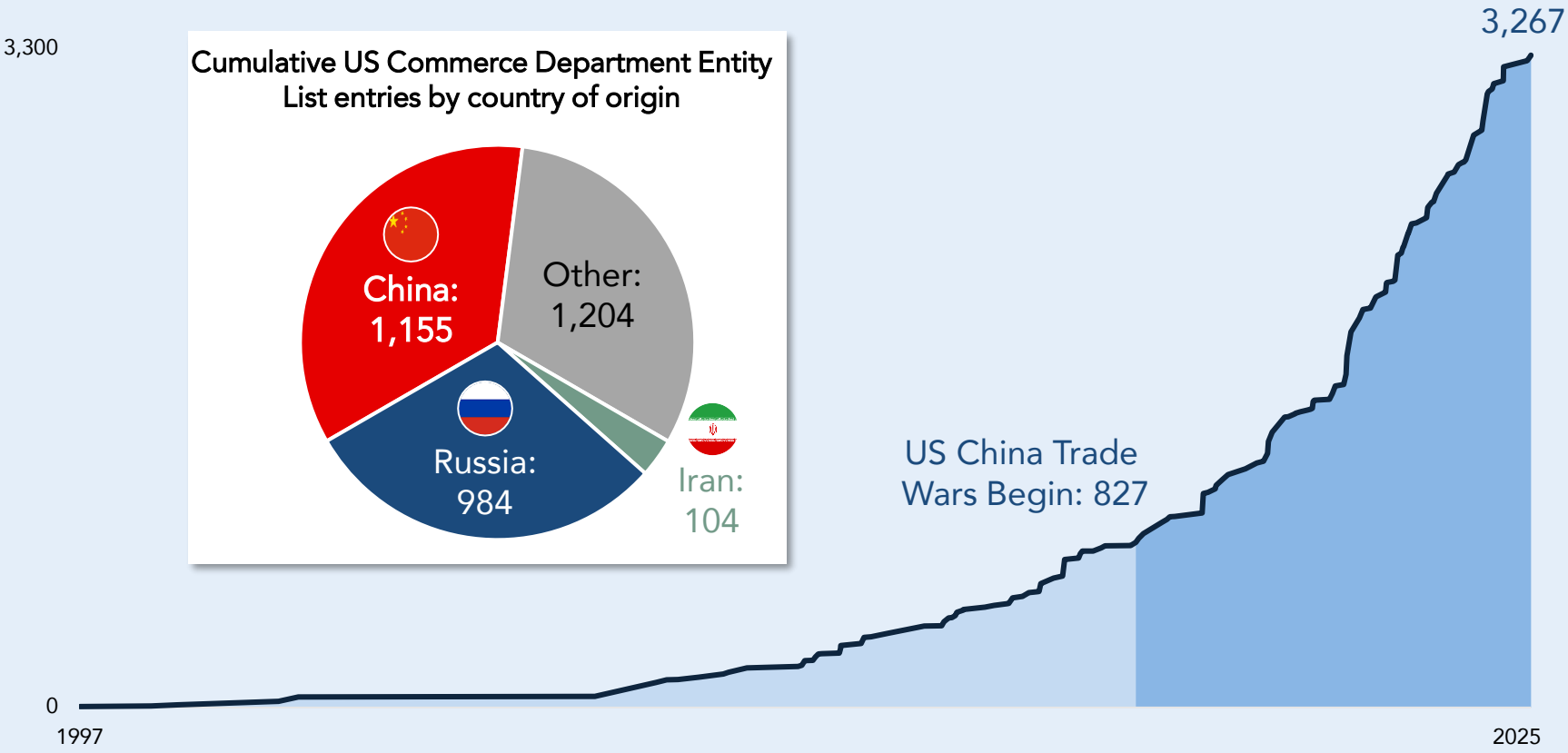
May 2019	**Huawei** subject to US FDPR and added to US Entity List
Dec 2020	**SMIC** to US Entity List
Oct 2022	Export controls on **advanced semiconductor technology**
Jan 2023	US / Netherlands / Japan export controls on **semiconductor capital equipment**
Aug 2023	Executive order **restricting outbound US investments** in Chinese tech
Jan 2025	AI Diffusion Rule for **export of advanced tech**
Apr 2025	US imposes new **Nvidia H20 license requirement**
May 2025	Pres. Trump **rescinds AI Diffusion rule**
Jul 2025	US approves **Nvidia's H20** and **AMD's MI308** for sale to China
Jan 2026	**25% tariff on semiconductors**, case-by-case review for **H200 chips** to China
2026	**AI OVERWATCH Act** advancing in Congress

Source: (1) Center for Strategic and International Studies. Congress.Gov. Various News Sources.

More Expansive Use of Entity-Specific Restrictions

Since inception in 1997, the US Commerce Department's Entity List has grown to over 3,000 entities and sub-entities. Members of the Entity List are subject to specific licensing requirements which may limit their ability to transact with US entities.

Cumulative additions to the US Commerce Department Entity List (1997 – 2025)



Source: (1-2) Commerce Department. Includes entities and sub-entities. Latest data available through October 2025. China figures include Hong Kong. Undated entries excluded.

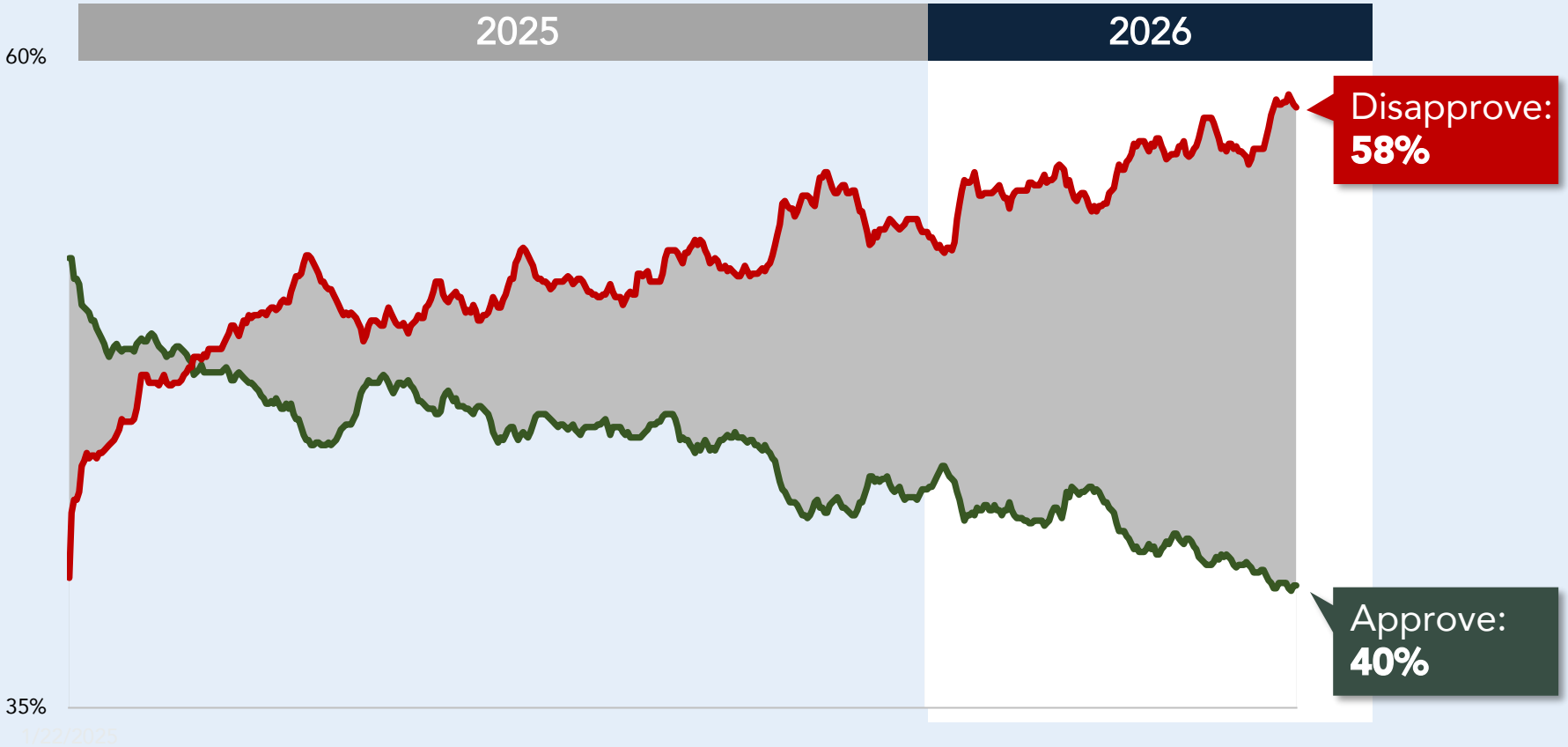
10

The Messy Politics of AI

President Trump Job Approval Ratings

Presidential approval ratings have **historically been the single most reliable leading indicator of US midterm election outcomes**, which have typically been unkind to incumbents. The correlation is strong though **not always deterministic** (1998, 2002).

Real Clear Politics President Trump job approval ratings

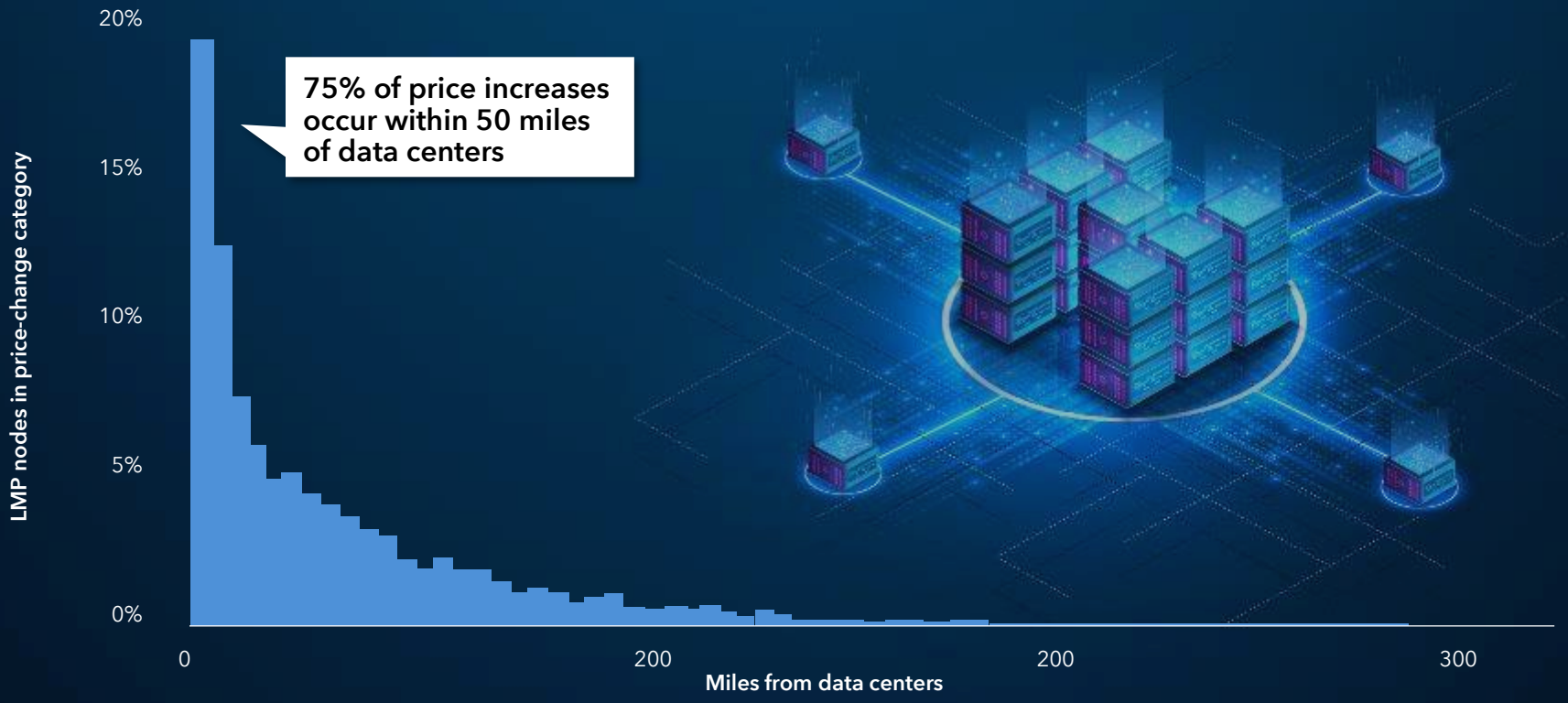


Source: (1) RealClearPolitics. Bloomberg. Data as of May 29, 2026.

Data Center Proximity Impacts Electricity Prices

Data centers are a major driver of the surge in energy costs and are the largest source of new power consumption in certain US regions. According to data analyzed by Bloomberg, electricity costs have risen over 200% over the last five years in areas located near significant data center activity.

Distance from significant data center activity for LMP nodes and change in the median wholesale electricity prices (2020-2025)



Source: (1) Bloomberg, "AI Data Centers Are Sending Power Bills Soaring". GridStatus. DC Byte. Analysis includes a small number of nodes in Canada used by US RTOs. To determine significant data center activity, a dynamic threshold was used that took into account the total data center capacity in the area around any given LMP node.

Americans View Data Centers Negatively

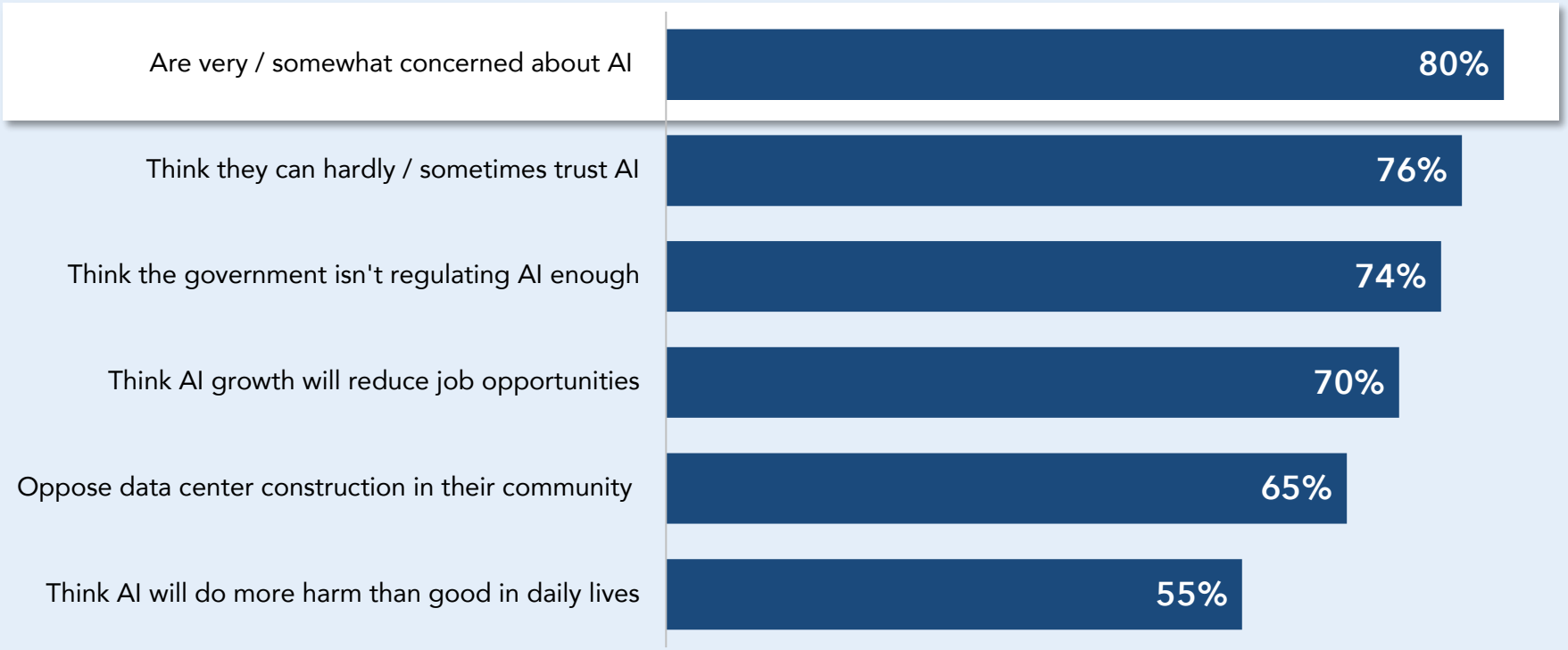
% of US adult respondents view on data centers, by impacted area

Source: (1) Pew Research Center. Survey of 8,512 respondents, conducted from January 20-26, 2026. Excludes responses who did not answer or had not heard about data centers, percentages may not sum to 100.

AI Emerging as More Prominent Issue Ahead of US Midterm Elections

As we approach the US midterm elections in November, **artificial intelligence has become a more prominent issue with voters given: (1)** data center energy costs; **(2)** physical footprint and land use; **(3)** labor market displacement concerns; and **(4)** limited regulatory frameworks. According to a recent Quinnipiac University poll, more than 75% of Americans have expressed significant concerns with AI and believe the government is not doing enough on regulation.

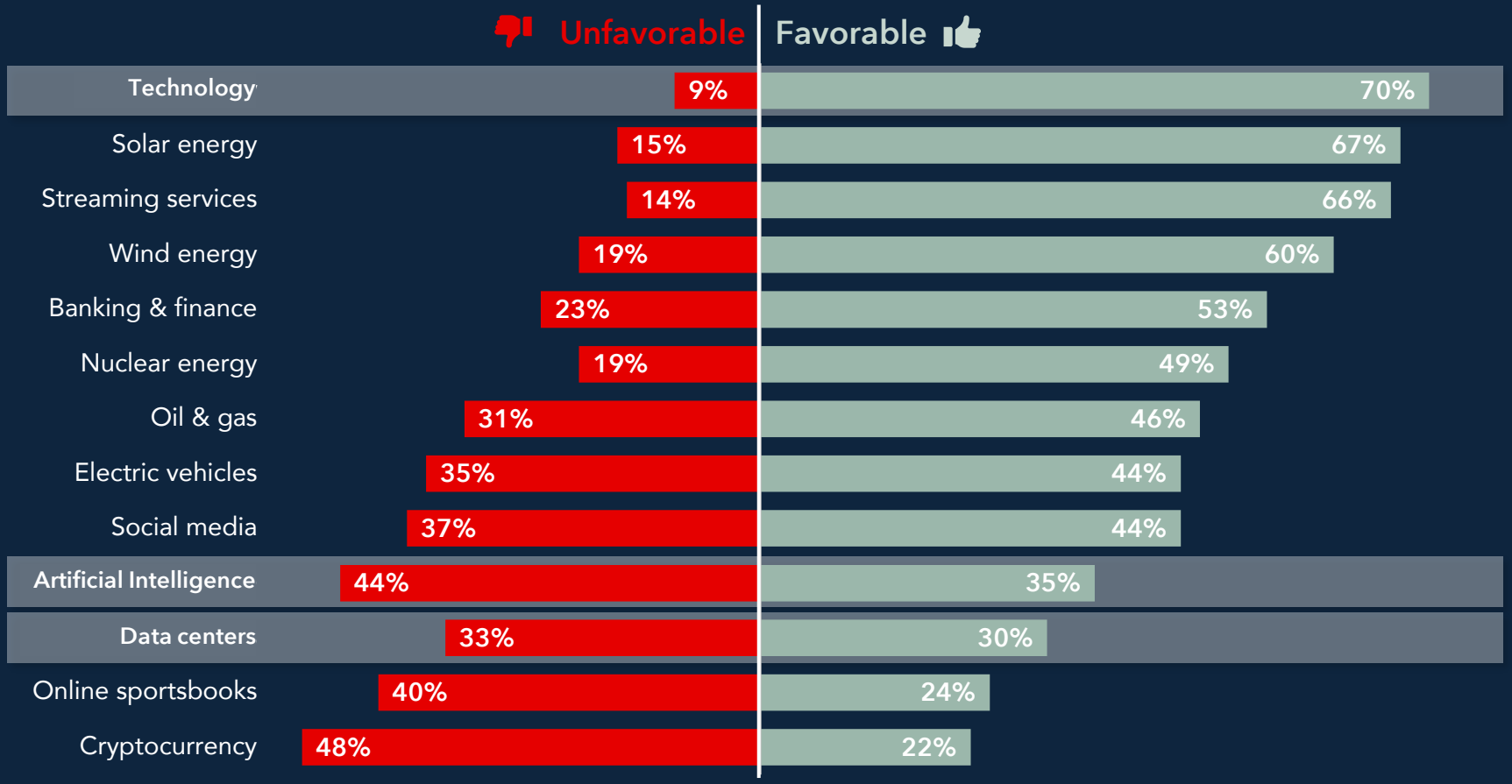
Percentage of respondents who agree with each statement:



Source: (1) WSJ. Quinnipiac University. Poll of 1,397 adults conducted from March 19-23.

Voters Prefer Tech Companies to AI

Do you generally have a favorable or unfavorable view of companies in the following industries?



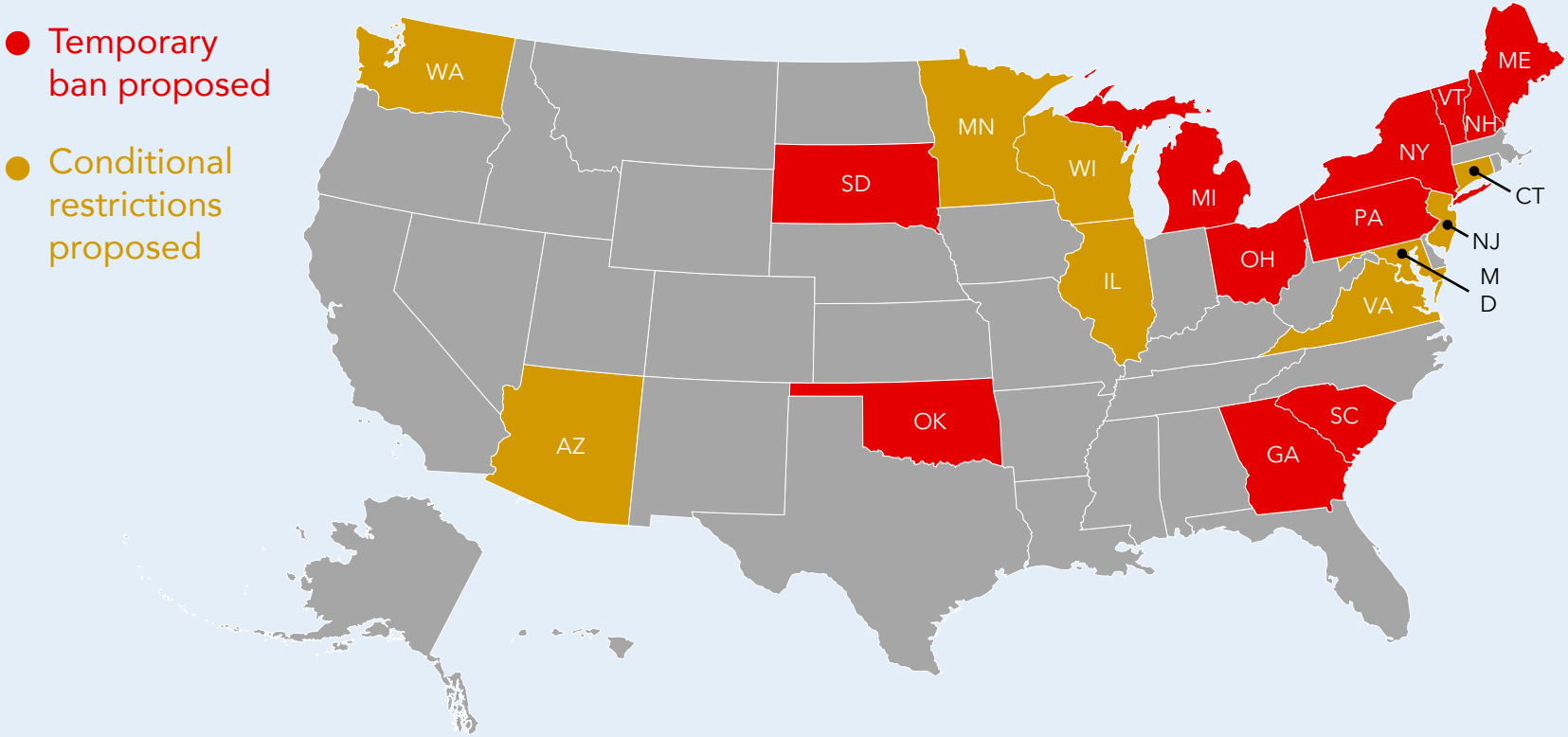
Source: (1) Bruce Mehlman, "Six-Chart Sunday – Why AI Regulations Are Likely". Echelon Insights.
Survey of 1,029 registered voters in the likely electorate nationwide conducted in January 2026. Data excludes "no opinion" responses.

ECHELON INSIGHTS

US States Considering Data Center Bans

20 US states have introduced bills to restrict data center construction and associated energy use, though none have been enacted yet. While statewide bills face resistance, dozens of municipalities across over 30 states have successfully enacted **local moratoriums** on data center construction. **Communities are pushing back** against rising electricity costs, high water consumption and the job vs. cost mismatch (few permanent jobs, generous tax breaks). Stricter restrictions on data center construction could lead to increased investment uncertainty, geographic concentration risk, offshoring of AI infrastructure and geopolitical implications in the AI arms race.

Status of US states considering statewide data center bans



Source: (1-2) Visual Capitalist. National Conference of State Legislatures. DataCenterBans. Aterio. Stateline. Data as of May 29, 2026.

US States Considering Data Center Bans

Outright / temporary ban proposed

Georgia

350 announced DCs

Status: Failed

Maine

7 announced DCs

Vetoed

Michigan

20 announced DCs

Under review

New Hampshire

0 announced DCs

Failed

New York

73 announced DCs

Under review

Ohio

143 announced DCs

Under review

Oklahoma

37 announced DCs

Under review

Pennsylvania

201 announced DCs

Under review

South Carolina

13 announced DCs

Under review

South Dakota

6 announced DCs

Postponed

Vermont

0 announced DCs

Under review

Source: (1-2) Visual Capitalist. National Conference of State Legislatures. DataCenterBans. Aterio. Stateline. Data as of May 29, 2026.

US States Considering Data Center Bans

Conditional restrictions proposed

Arizona

139 announced DCs

Under review

Connecticut

33 announced DCs

Under review

Illinois

153 announced DCs

Under review

Maryland

18 announced DCs

Under review

Minnesota

40 announced DCs

Under review

New Jersey

7 announced DCs

Under review

Virginia

508 announced DCs

Postponed

Washington

26 announced DCs

Failed

Wisconsin

26 announced DCs

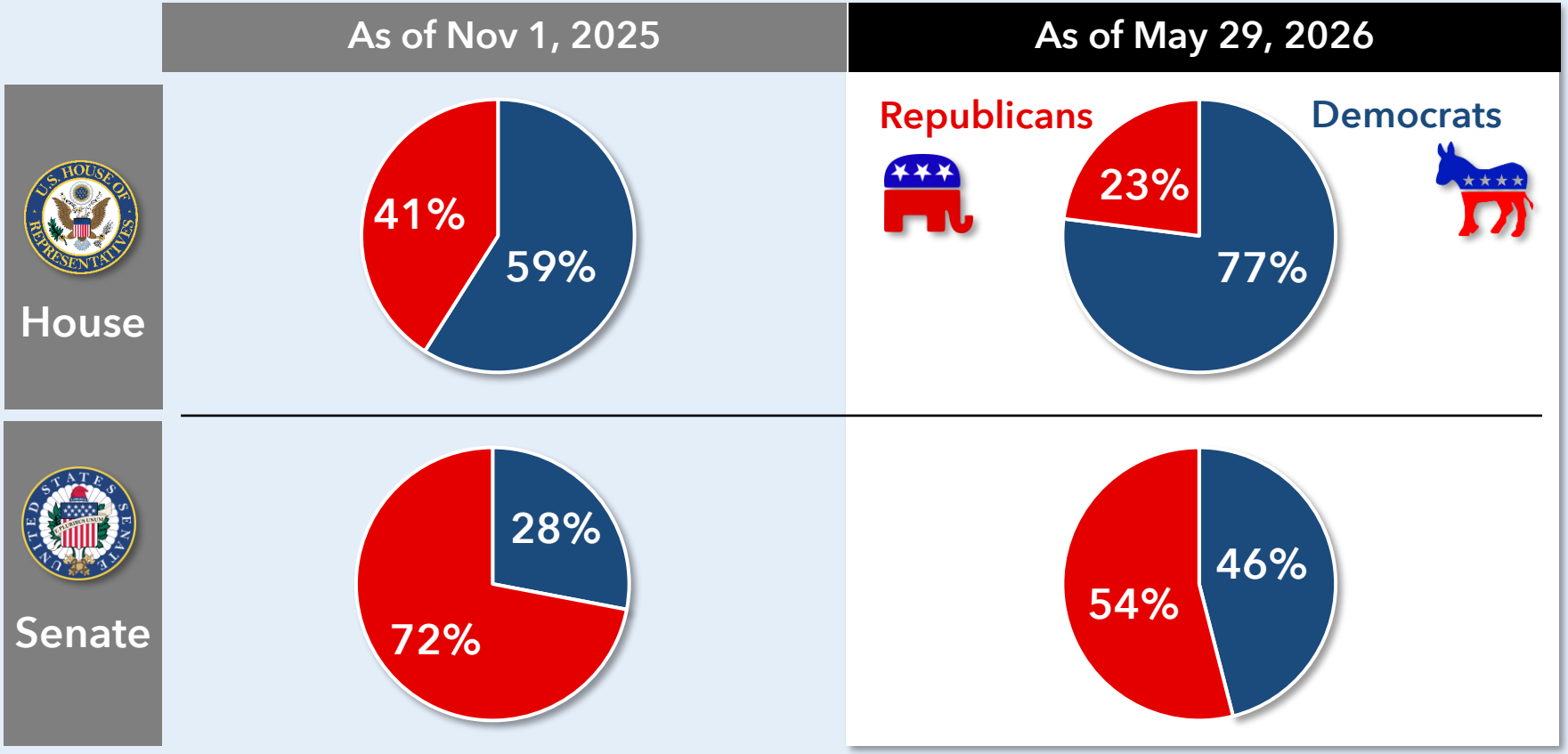
Failed

Source: (1-2) Visual Capitalist. National Conference of State Legislatures. DataCenterBans. Aterio. Stateline. Data as of May 29, 2026.

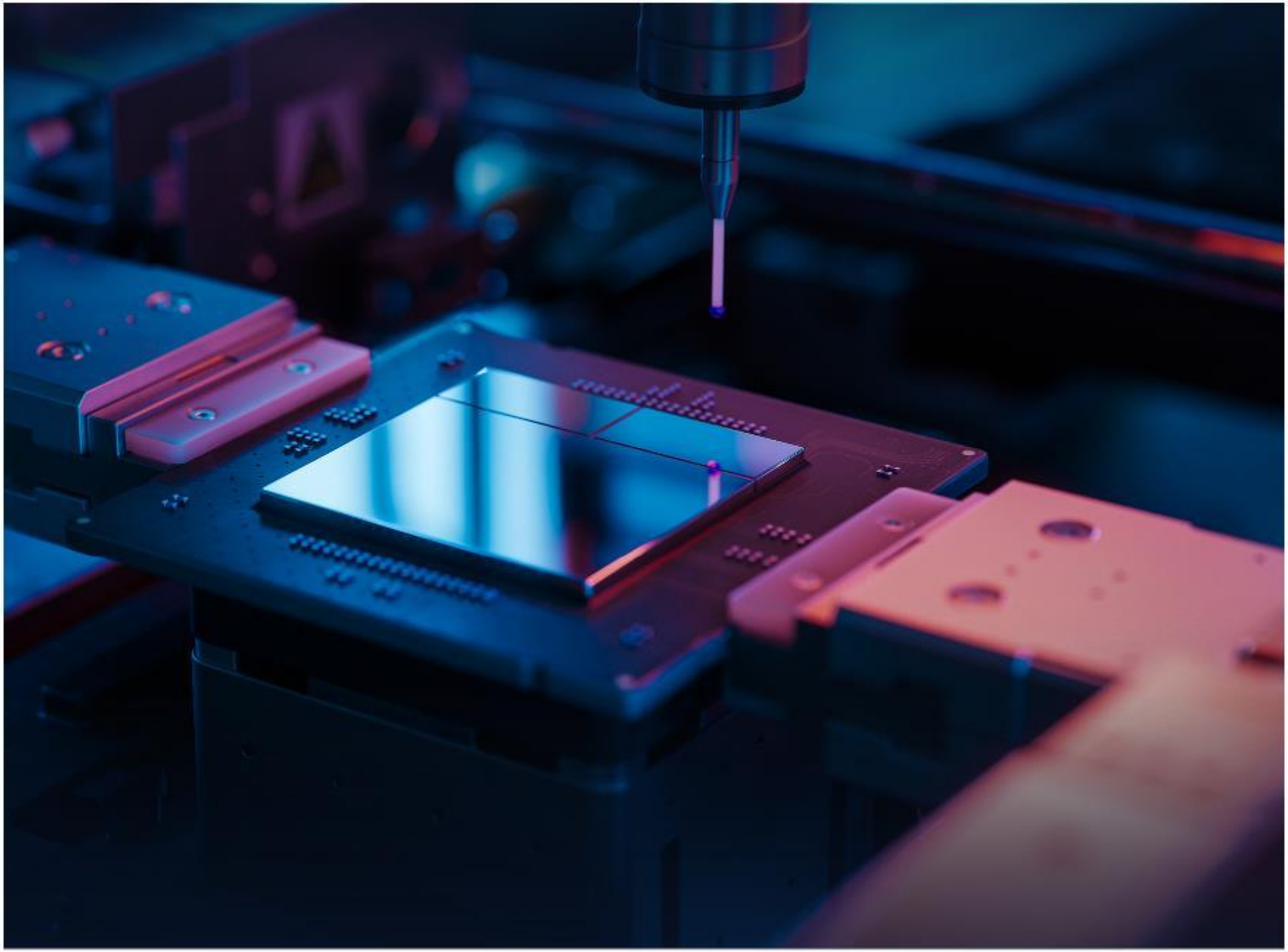
Shift in Prediction Markets Over Last 6 Months

Though fluid and subject to rapid change, Kalshi prediction markets for the US midterms have repriced dramatically in recent months. Betting markets are currently assigning nearly an 80% chance of the US House flipping to Democrats. Notably, the US Senate is also very much back in play, a sharp departure from expectations just a few months ago.

Kalshi prediction market odds of 2026 midterm election congressional control



Source: (1) Bloomberg. Kalshi. Data as of May 29, 2026.



2026 Global Growth Revised Lower

GDP growth forecasts, y/y (January 2026 vs. May 2026)

Region	Jan 2026	May 2026	
North America			
US	2.5%	**2.2%**	↓
Canada	0.9%	**1.2%**	↑
Mexico	1.4%	**1.1%**	↓
Eurozone	0.9%	**0.7%**	↓
Spain	2.4%	**2.4%**	–
France	0.8%	**0.6%**	↓
Italy	0.6%	**0.4%**	↓
Germany	0.7%	**0.4%**	↓
Other Europe			
Poland	3.8%	**3.6%**	↓
Sweden	2.4%	**2.0%**	↓
Norway	2.2%	**1.2%**	↓
Switzerland	0.9%	**0.8%**	↓
UK	1.0%	**0.7%**	↓
Russia	(-0.1%)	**0.4%**	↑
LatAm			
Colombia	3.0%	**2.9%**	↓
Argentina	2.3%	**2.4%**	↑
Brazil	1.6%	**1.5%**	↓
Chile	2.2%	**1.5%**	↓

Region	Jan 2026	May 2026	
MENA			
Iran	2.1%	**?**	↓
Israel	4.2%	**3.1%**	↓
Saudi Arabia	4.3%	**1.8%**	↓
UAE	4.5%	**0.1%**	↓
Qatar	6.4%	**(-17.4%)**	↓
Kuwait	3.4%	**(-6.9%)**	↓
Oman	2.3%	**1.9%**	↓
Bahrain	3.0%	**(-4.6%)**	↓
Egypt	4.9%	**4.5%**	↓
Türkiye	3.0%	**2.4%**	↓
APAC			
India	6.5%	**6.2%**	↓
Indonesia	5.1%	**5.0%**	↓
China	4.5%	**4.7%**	↑
Philippines	5.4%	**3.5%**	↓
South Korea	2.1%	**2.5%**	↑
Singapore	3.1%	**2.3%**	↓
Australia	2.5%	**2.1%**	↓
Thailand	1.5%	**1.8%**	↑
Japan	0.7%	**0.3%**	↓

Source: (1) Oxford Economics. Data as of May 29, 2026. Bahrain, Iran, Israel Jan 2026 forecast is Bloomberg consensus.

2026 Global Currency Forecasts

Currency pair	Spot (May 29)	Q2 2026	Q3 2026	Q4 2026	Q1 2027
EUR / USD	**1.17**	1.15	1.18	1.20	1.20
GBP / USD	**1.35**	1.31	1.34	1.36	1.35
USD / JPY	**159**	158	156	154	152
USD / CNY	**6.77**	6.85	6.83	6.80	6.78
AUD / USD	**0.72**	0.71	0.72	0.72	0.73
NZD / USD	**0.60**	0.58	0.59	0.60	0.61
USD / CAD	**1.38**	1.37	1.36	1.35	1.34
USD / NOK	**9.24**	9.48	9.32	9.25	9.33
USD / SEK	**9.24**	9.48	9.15	8.92	8.92
USD / CHF	**0.78**	0.79	0.77	0.76	0.77
USD / MXN	**17.34**	17.75	17.75	17.50	17.50
USD / BRL	**5.06**	5.00	5.10	4.90	4.80
USD / CLP	**889**	920	900	880	860

Source: (1) MUFG Foreign Exchange Monthly – May 2026. (Derek Halpenny). Bloomberg.

2026 MUFG Global Rates Forecasts

		Q2 2026		Q3 2026		Q4 2026		Q1 2027	
	Spot (May 29)	MUFG	Consensus	MUFG	Consensus	MUFG	Consensus	MUFG	Consensus
Fed Funds	3.75%	3.75%	3.75%	3.50%	3.72%	3.25%	3.59%	3.25%	3.48%
2 yr UST	4.01%	3.63%	3.88%	3.38%	3.78%	3.13%	3.68%	3.13%	3.61%
5 yr UST	4.15%	3.88%	4.03%	3.63%	3.94%	3.38%	3.87%	3.38%	3.83%
10 yr UST	4.45%	**4.25%**	**4.41%**	**4.00%**	**4.34%**	**3.88%**	**4.31%**	**3.88%**	**4.27%**
30 yr UST	4.99%	4.75%	4.95%	4.50%	4.88%	4.25%	4.83%	4.25%	4.79%

Source: (1) MUFG Global Macro Research (George Goncalves). Bloomberg. Data as of May 29, 2026. Fed funds is upper bound.

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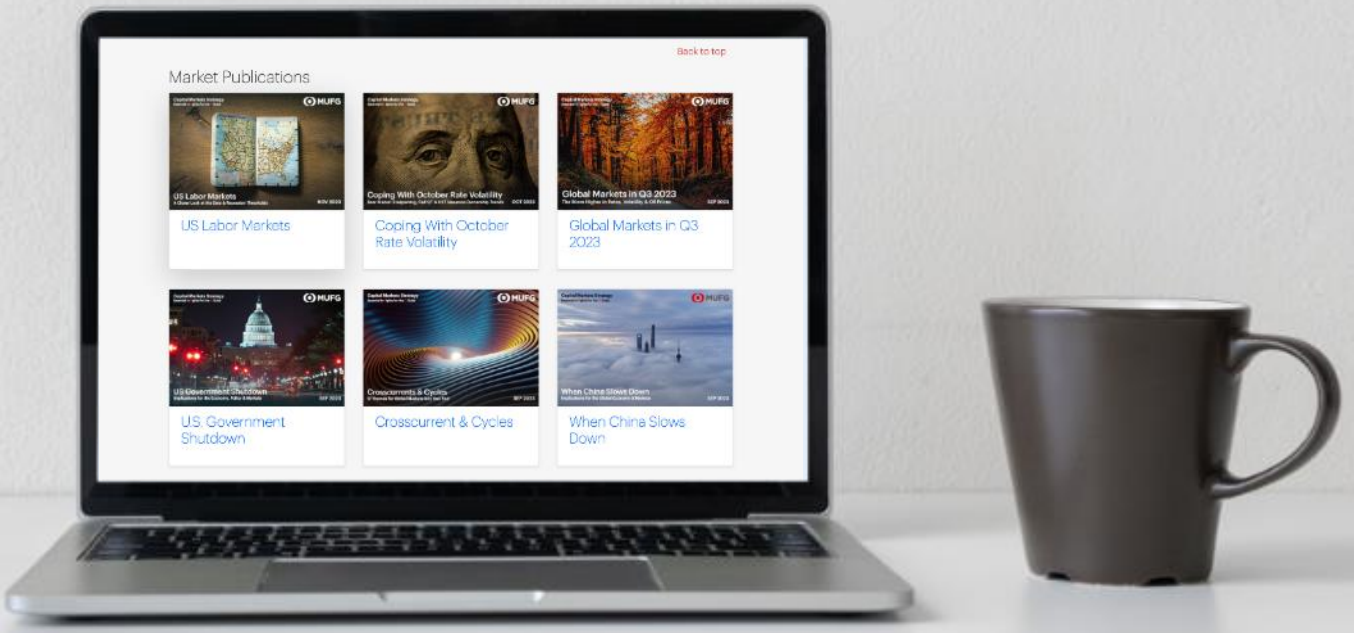

About the Authors

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Role

Tom Joyce is a Managing Director and Capital Markets Strategist within MUFG's global capital markets and investment banking business. Based in New York, Tom heads a team that creates customized analytical content for multi-national S&P 500 companies. His team provides in depth analysis on the impact of economic, political, public policy and regulatory dynamics on the US credit, foreign exchange, rates and commodities markets.

Experience

Tom has over 30 years of Investment Banking experience in New York, London, Hong Kong, and San Francisco. Tom created and built the Capital Markets Strategy role, advising corporate C-Suite executives (Boards, CEOs, CFOs, and Treasurers) on the pervasive macro forces driving markets. Tom also presents at dozens of corporate events each year including Board meetings, CEO ExCo sessions, CFO and Treasury off-sites, corporate leadership events and conferences.

Education

Tom's educational background includes a year of study at Oxford University from 1991 - 1992, a Bachelor of Arts in Political Science from Holy Cross College in 1993, and a MBA from Kellogg Business School, Northwestern University in 2000.

Personal

Tom resides in New Canaan, CT with his wife and four sons, where he previously served on the Board of Trustees of the New Canaan Library. Tom also serves on the President's Council of Holy Cross College.

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Experience

Stephanie has spent nearly eight years as a Capital Markets Strategist. She is an active member of the University of Michigan recruiting team and is focused on the diversity recruiting effort at MUFG. Stephanie is also a part of MUFG's DEI, Culture & Philanthropy (DCP) Council.

Education

Stephanie graduated with honors from the University of Michigan's Ross School of Business with a BBA .

Personal

Stephanie is involved in NYC's iMentor program, mentoring high school students with their journey to college graduation. She also volunteers at Experience Camps, a free summer camp program for grieving children, as the associate program director.

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Experience

Angela previously interned at MUFG working in Capital Markets within the Equity Capital Markets and Leveraged Finance divisions. She is also an active member of the Carnegie Mellon University recruiting team.

Education

Angela graduated with honors from Carnegie Mellon University's Tepper School of Business with a BS in Business Administration with an additional major in Statistics and a minor in Media Design. She was a member of Alpha Kappa Psi business fraternity and the Undergraduate Entrepreneurship Association.

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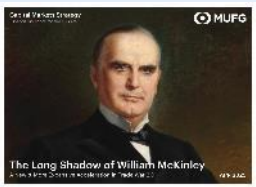

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