

Capital Markets Strategy

Essential inCights for the C-Suite



Bottlenecks to Scaling AI Computational Power

JUL 2026

Global Corporate & Investment Bank

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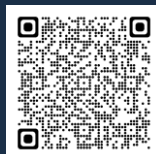


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***“Chip supply chains
will shape geopolitics
more than oil over
the next 50 years.”***

Pat Gelsinger,
Former CEO of Intel (January 2023)

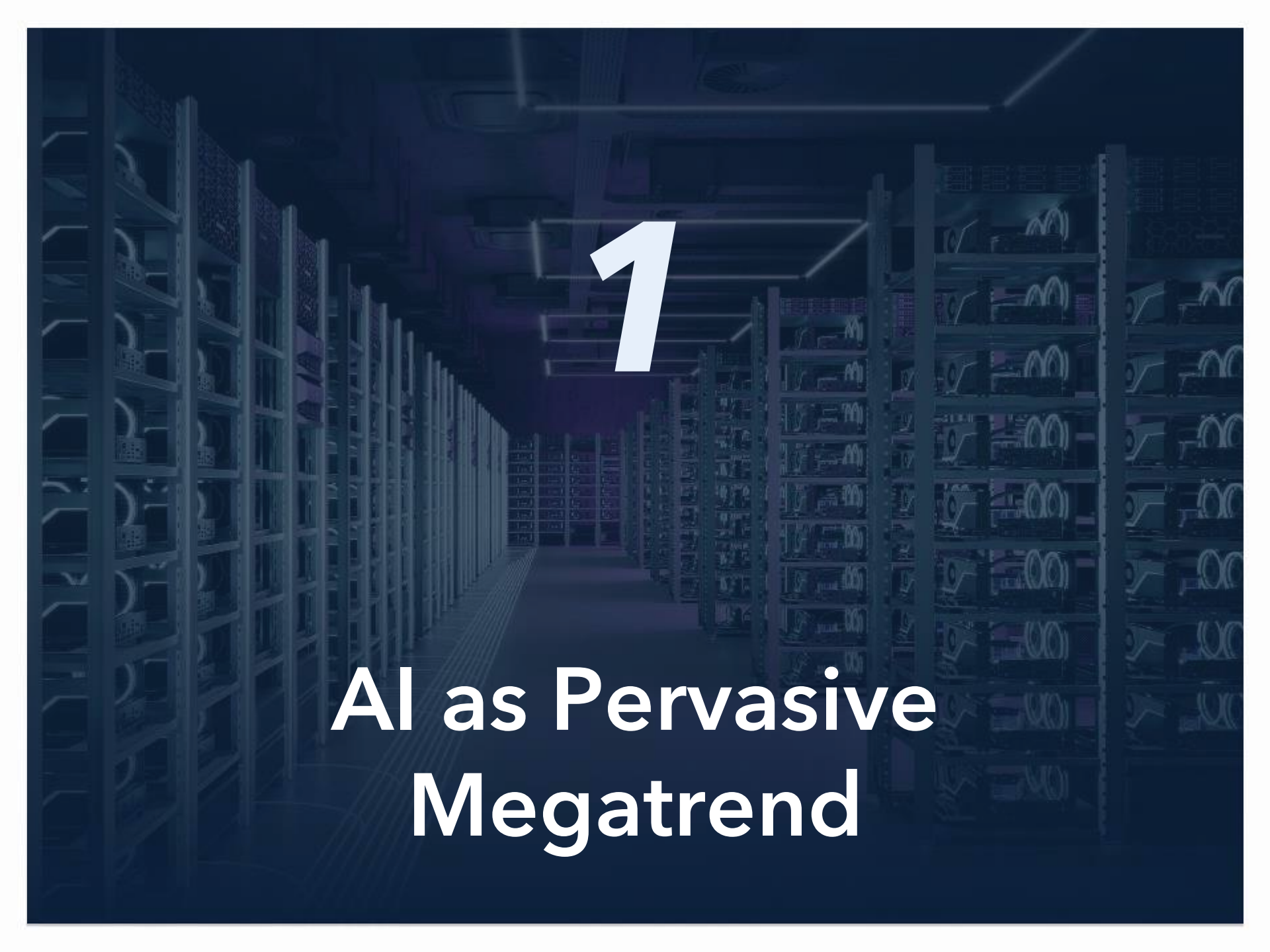


Evolving Bottlenecks to Scaling AI

2023 – 2024: GPUs (AI microchips)

2025 – 2026: Memory chips (DRAM, NAND)

2027 – 2028: Energy & power grid



1

AI as Pervasive Megatrend

Global Market Math

**AI
Tailwinds**



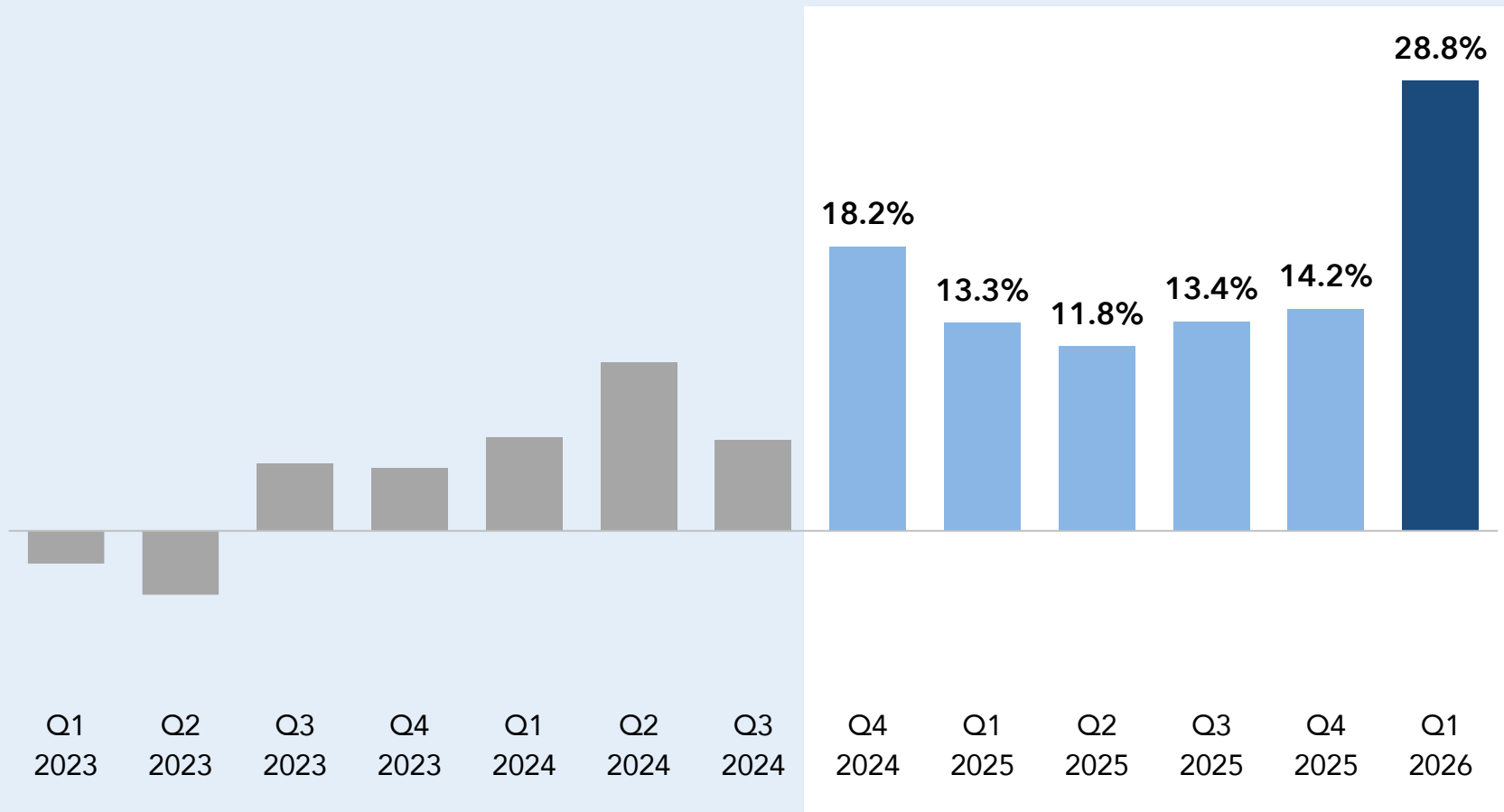
**Iran War
&
Trade War
Headwinds**

If oil < \$120

Corporate Earnings Engine Defies Iran & Trade War

S&P 500 quarterly earnings growth, y/y

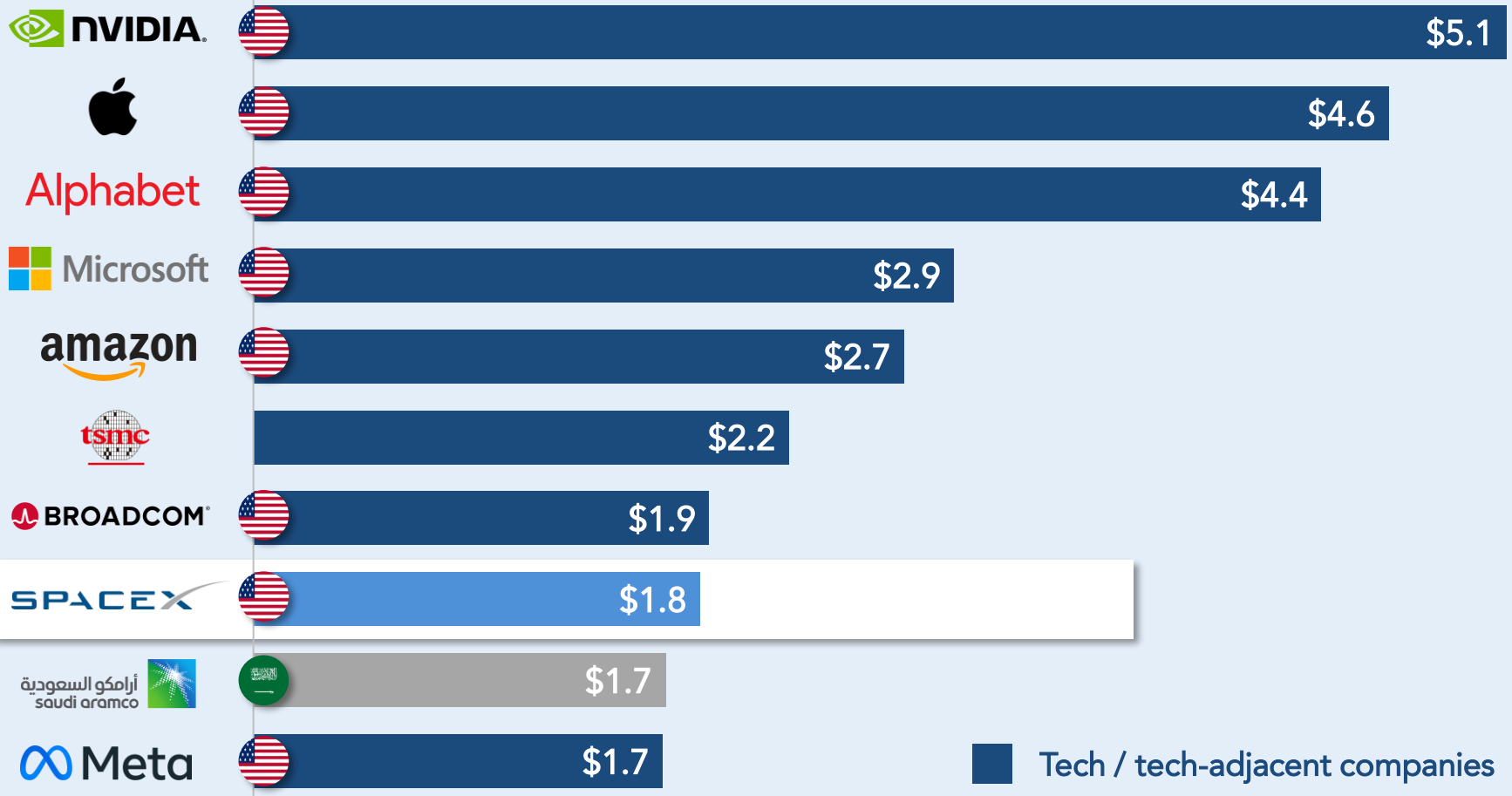
6 consecutive quarters of
double-digit earnings growth



Source: (1) FactSet, Earnings Insight Report (June 5, 2026). Q1 2026 earnings growth rate based on 97% of S&P 500 companies reporting actual earnings results.

AI Redefines Market Valuations

World's largest companies by market cap, USD tn

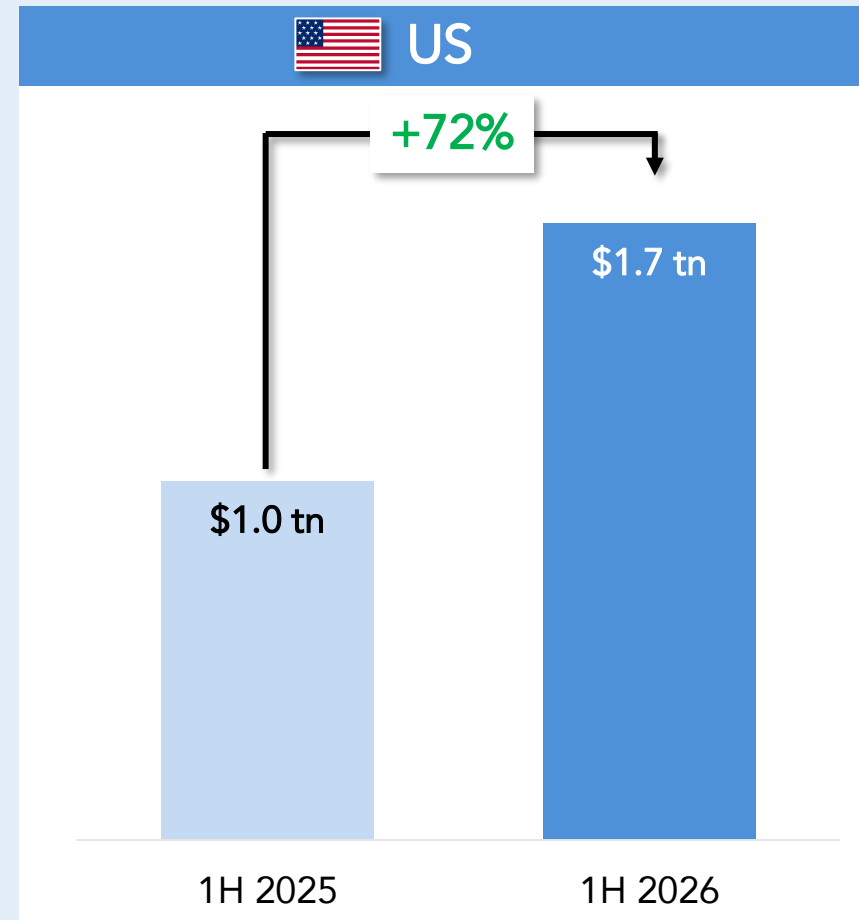
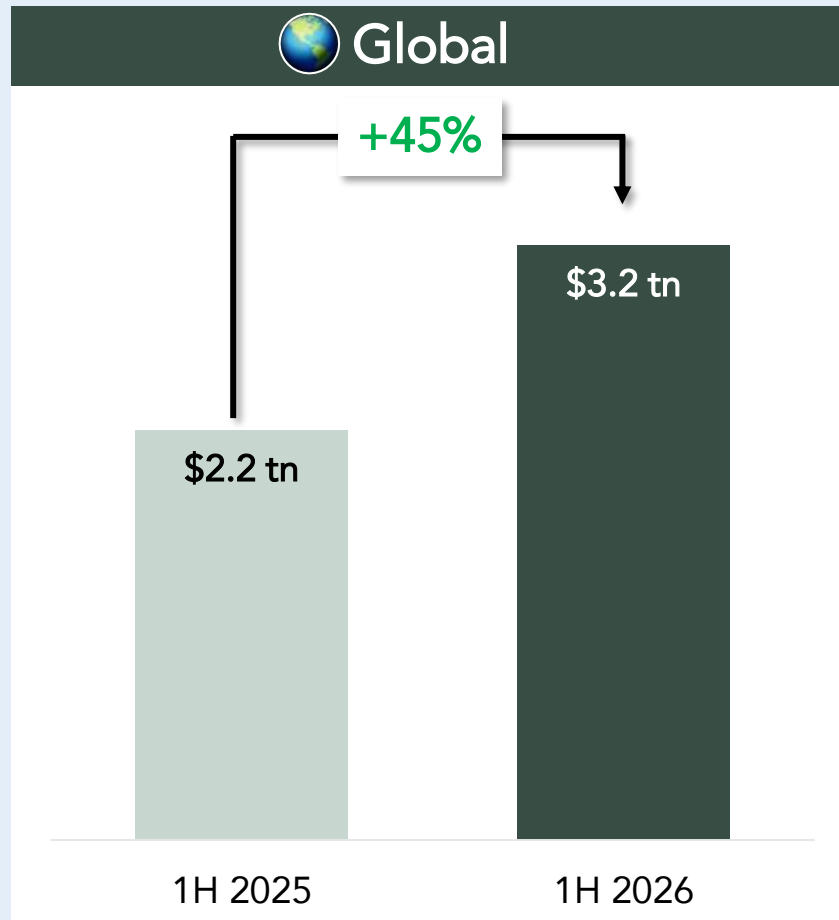


Source: (1) Bloomberg. Data as of July 14, 2026.

Largest 1H for Global M&A on Record



M&A volumes in 1H 2025 vs. 1H 2026 (USD)

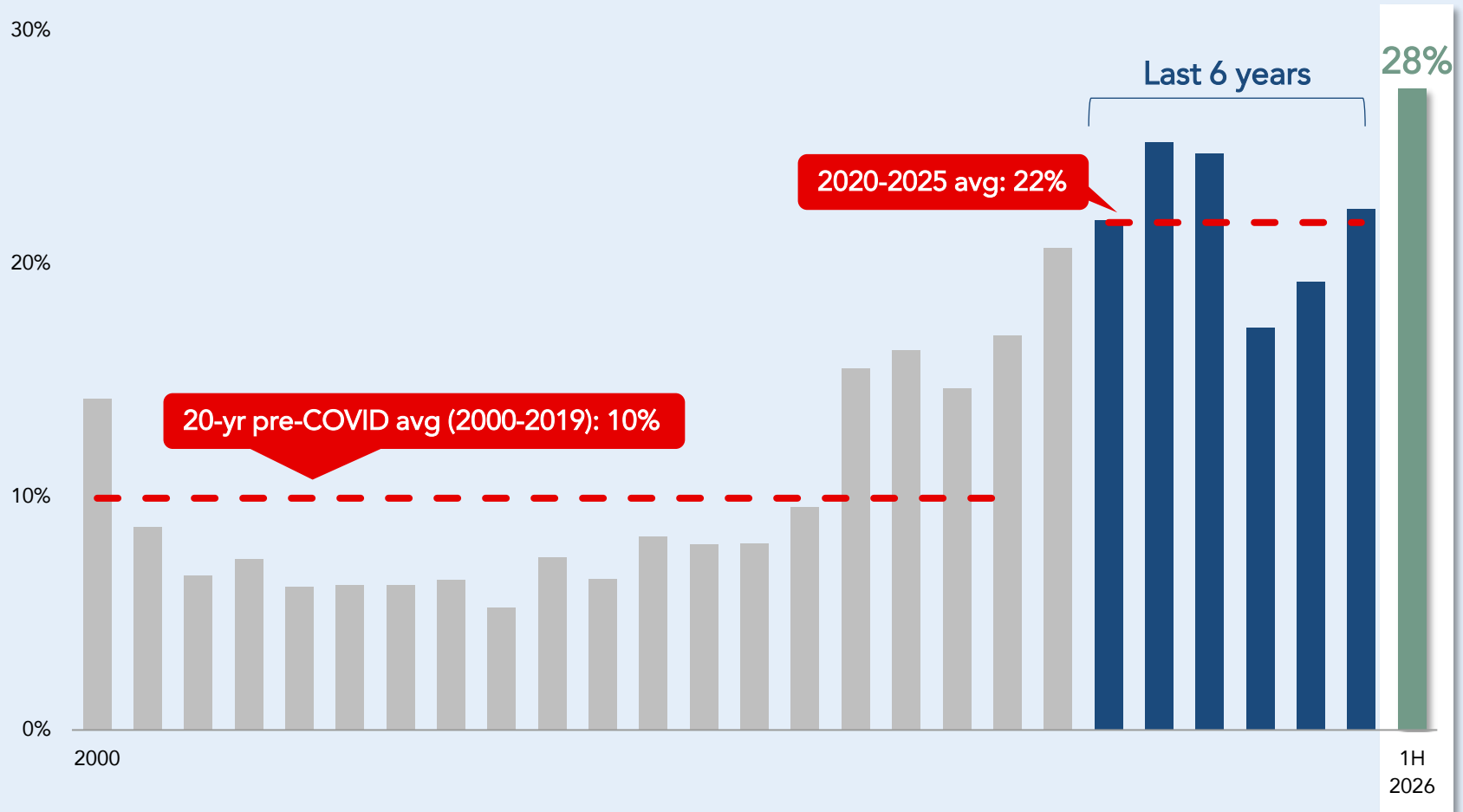


Source: Dealogic. Cortex. Data through June 30, 2026, accessed on July 7, 2026. Region is by target.

Technology Was a Pervasive M&A Driver



Tech as a % of global M&A

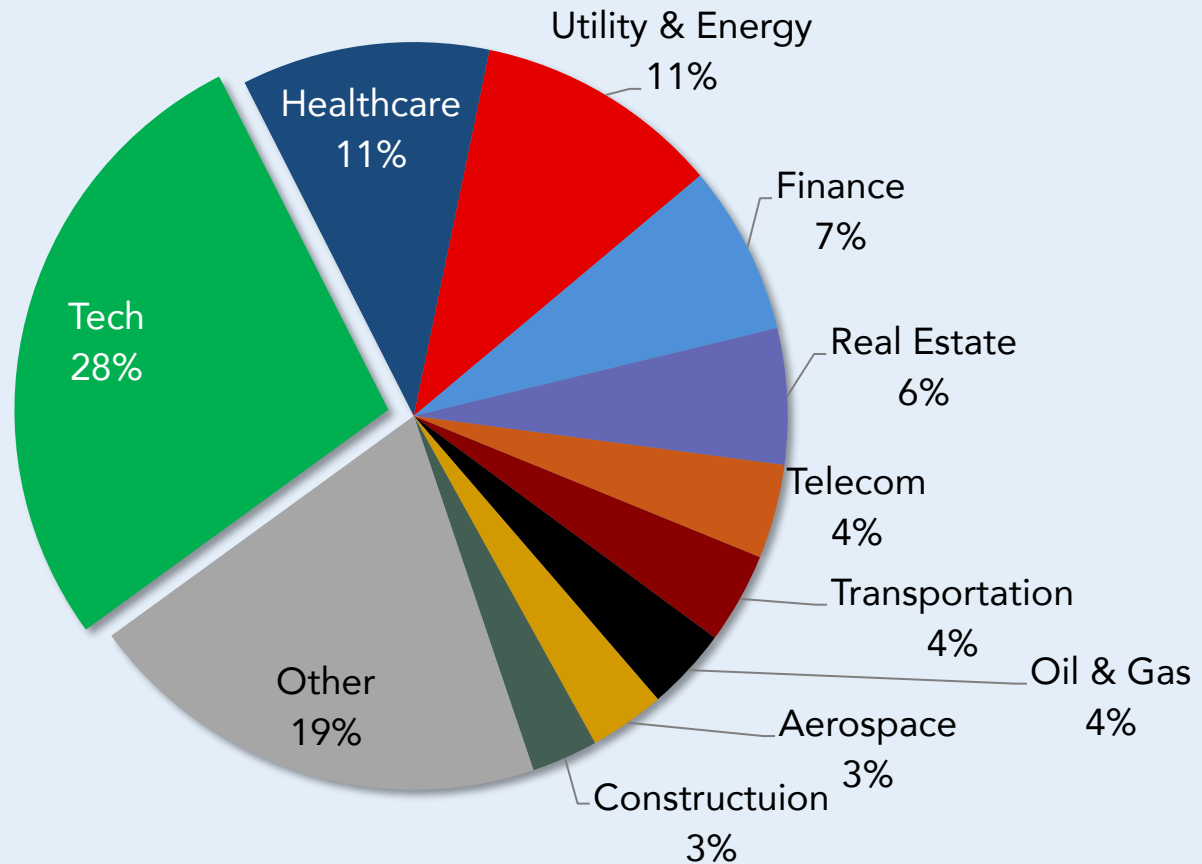


Source: (1) Cortex. Dealogic. Data is through June 30, 2026. Data accessed July 7, 2026. Includes rank eligible, M&A deals. Technology is computers and electronics as target sector.

Tech Sector Nearly 30% of M&A



Global M&A activity, by sector (1H 2026)

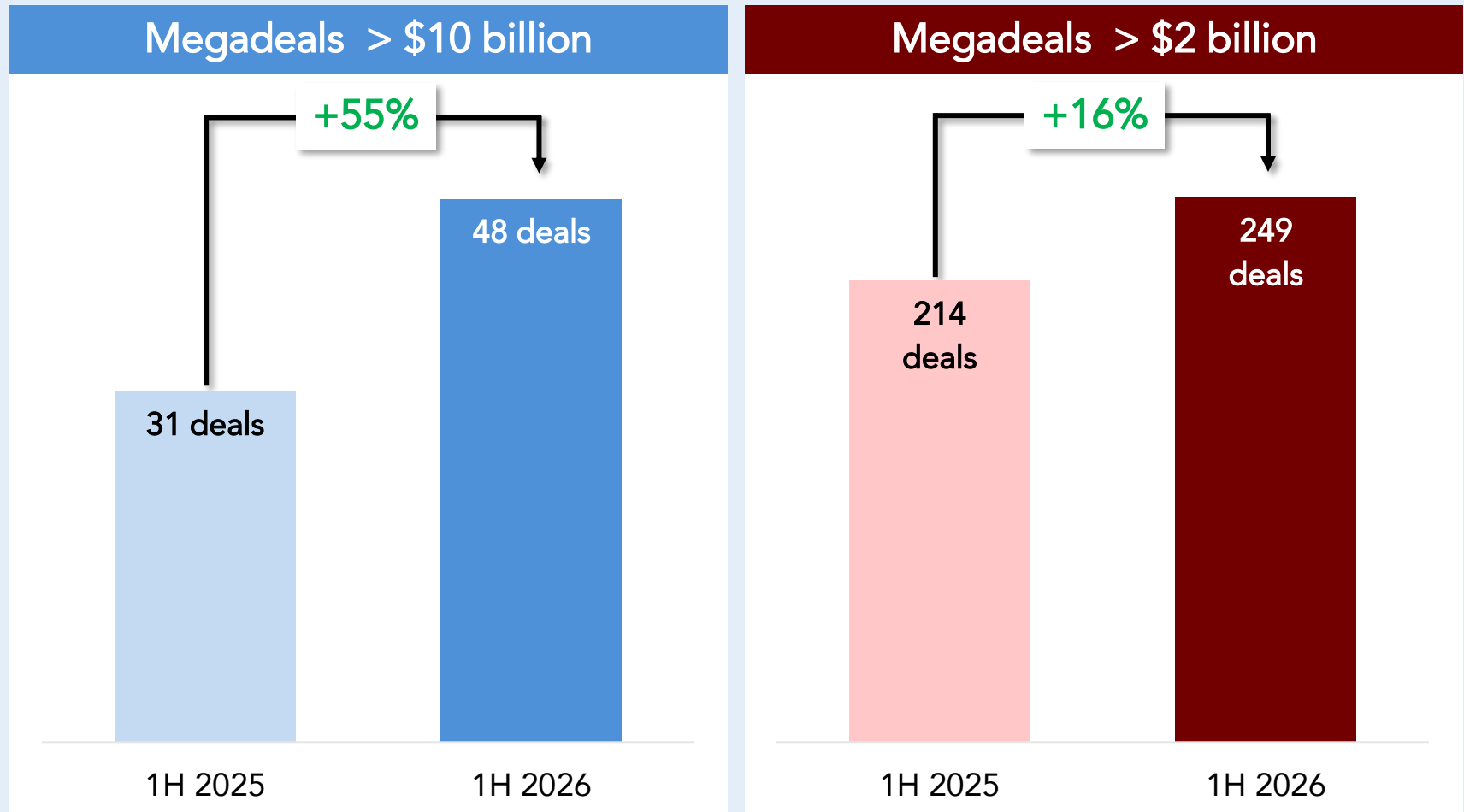


Source: (1) Dealogic. Cortex. Data through June 30, 2026, accessed on July 7, 2026.

Megadeals Drove Resurgent Deal Activity



Global M&A Megadeals 1H 2025 vs. 1H 2026 (# of deals)

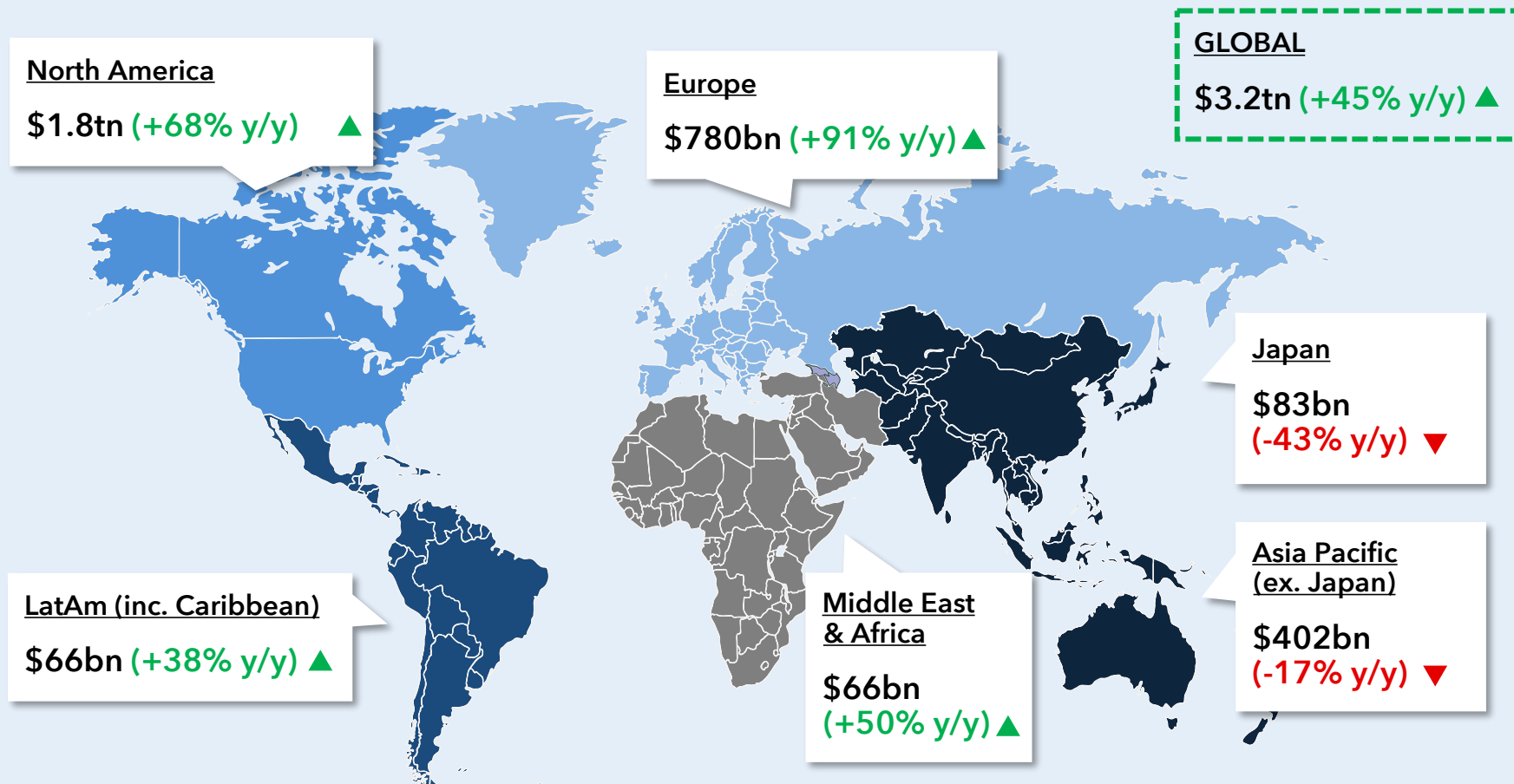


Source: Dealogic. Cortex. Data through June 30, 2026, accessed on July 7, 2026. Region is by target. Greater than or equal to \$2bn and \$10bn.

1H 2026 Global M&A Activity by Region



M&A volumes in 1H 2026 vs. 1H 2025 and y/y increase (based on target region)

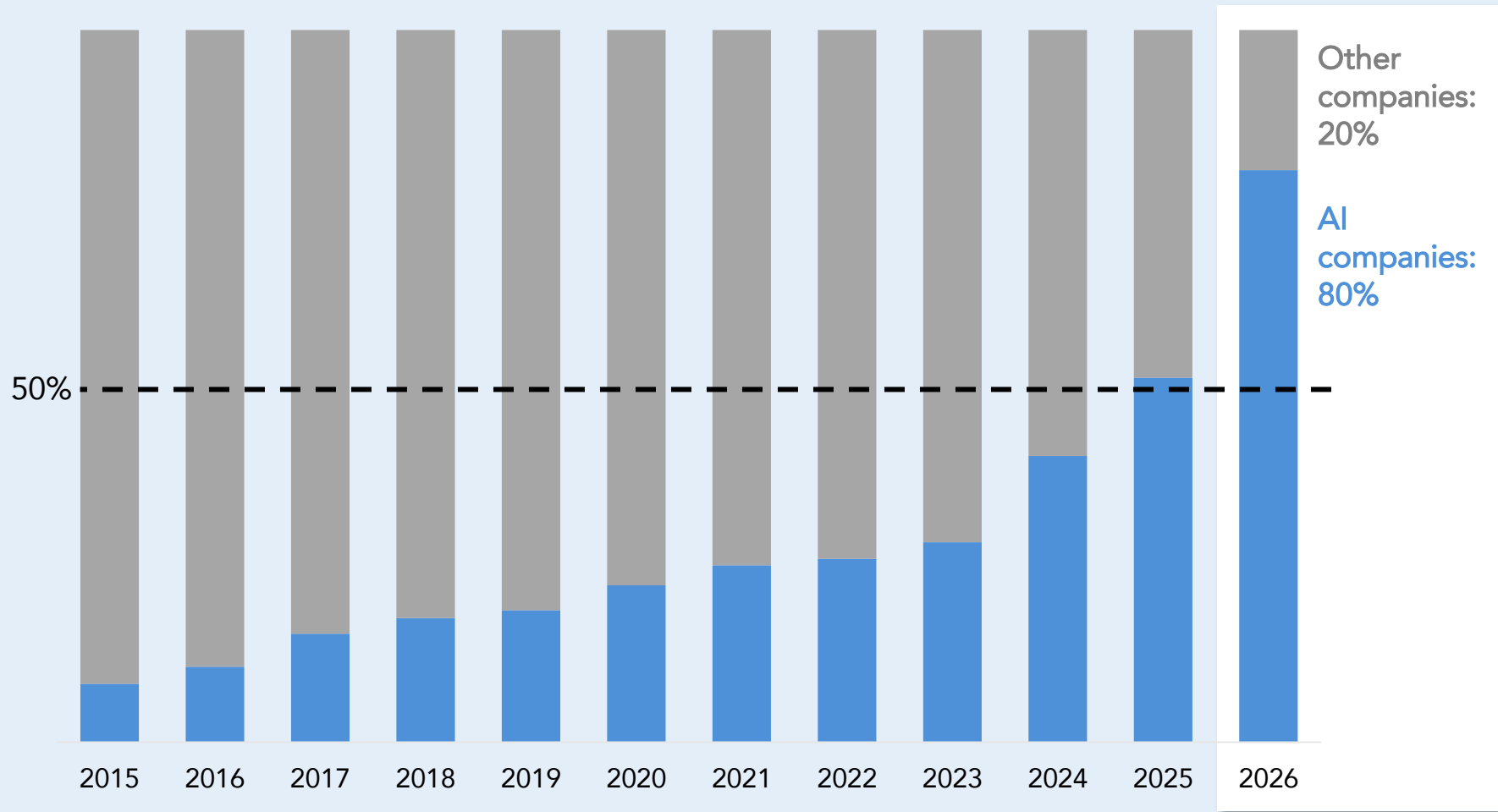


Source: (1) Dealogic. Cortex. Data through June 30, 2026, accessed on July 7, 2026. Region is by target.

80% of Global VC Activity is Now AI



Share of global VC deal value, by company type

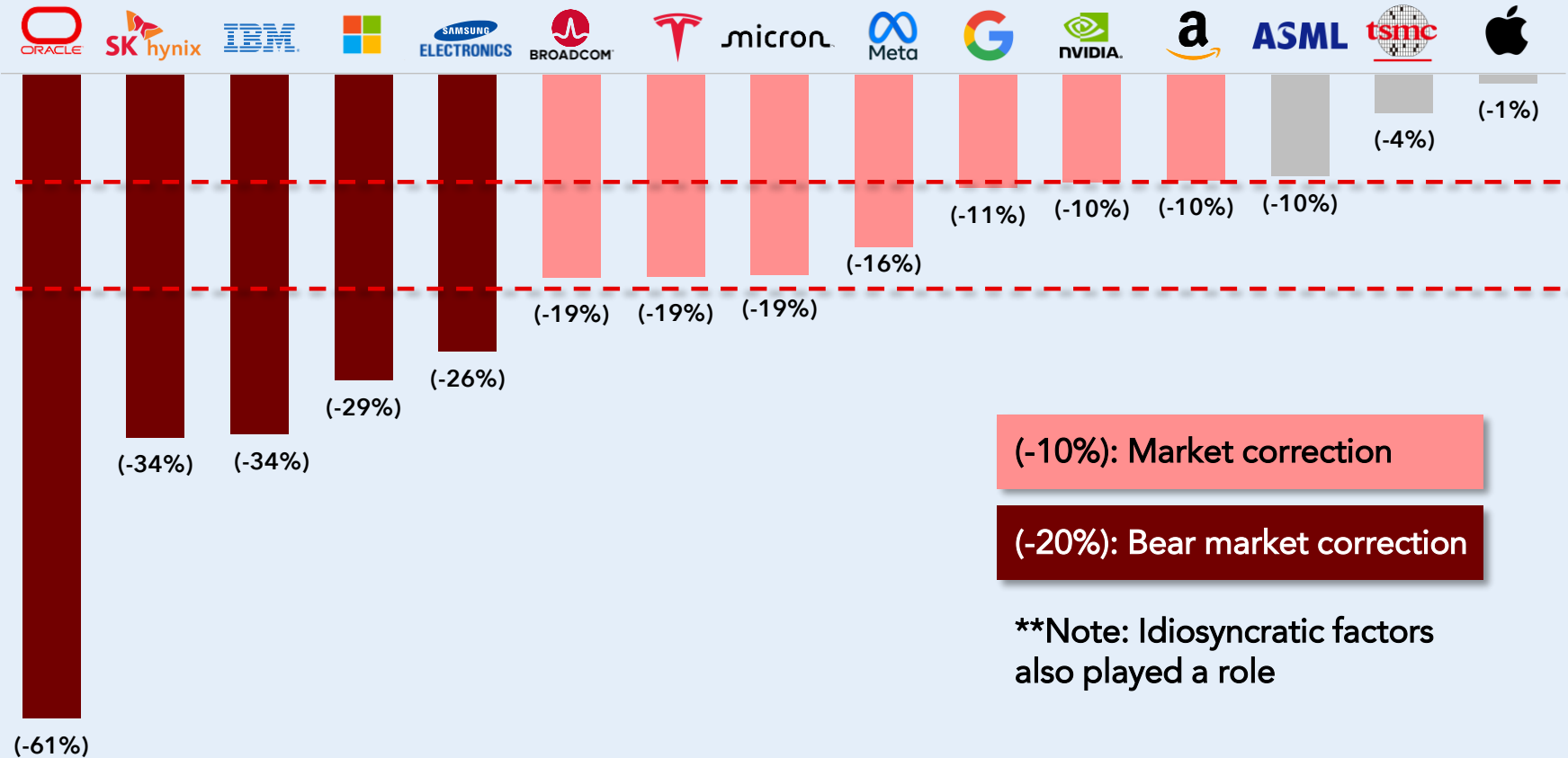


Source: (1) Pitchbook, "Q1 2026 Global VC First Look." Data through March 31, 2026.

Big Tech Stocks Enter Correction Territory

Big tech and AI hyperscalers have rolled into a textbook correction, one that looks **less like a macro scare and more like a position / valuation reset** after a parabolic AI run. By historical standards, a 10-20% selloff after a multi-year melt-up is **neither unusual nor, by itself, thesis-breaking**.

Tech stock performance since 52-week high

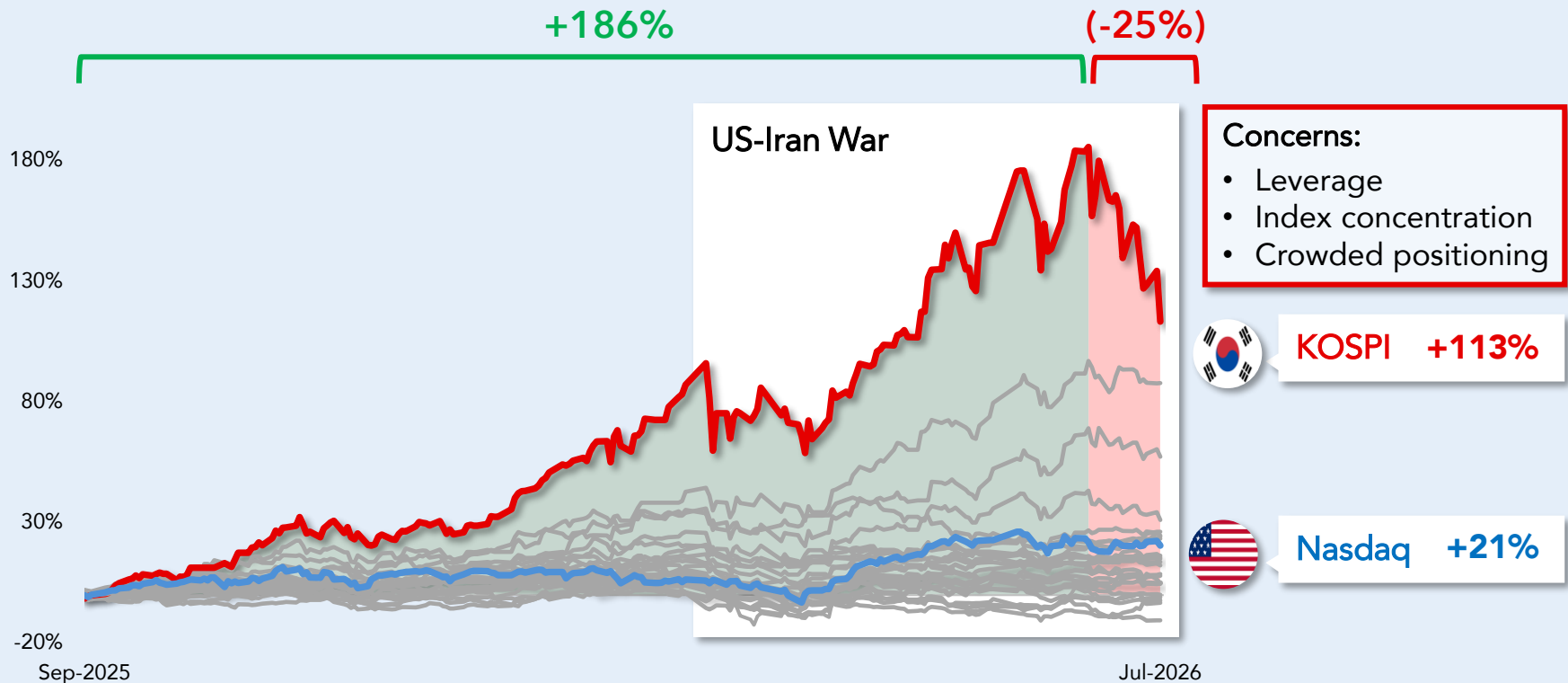


Source: (1) Bloomberg. Data as of July 14, 2026.

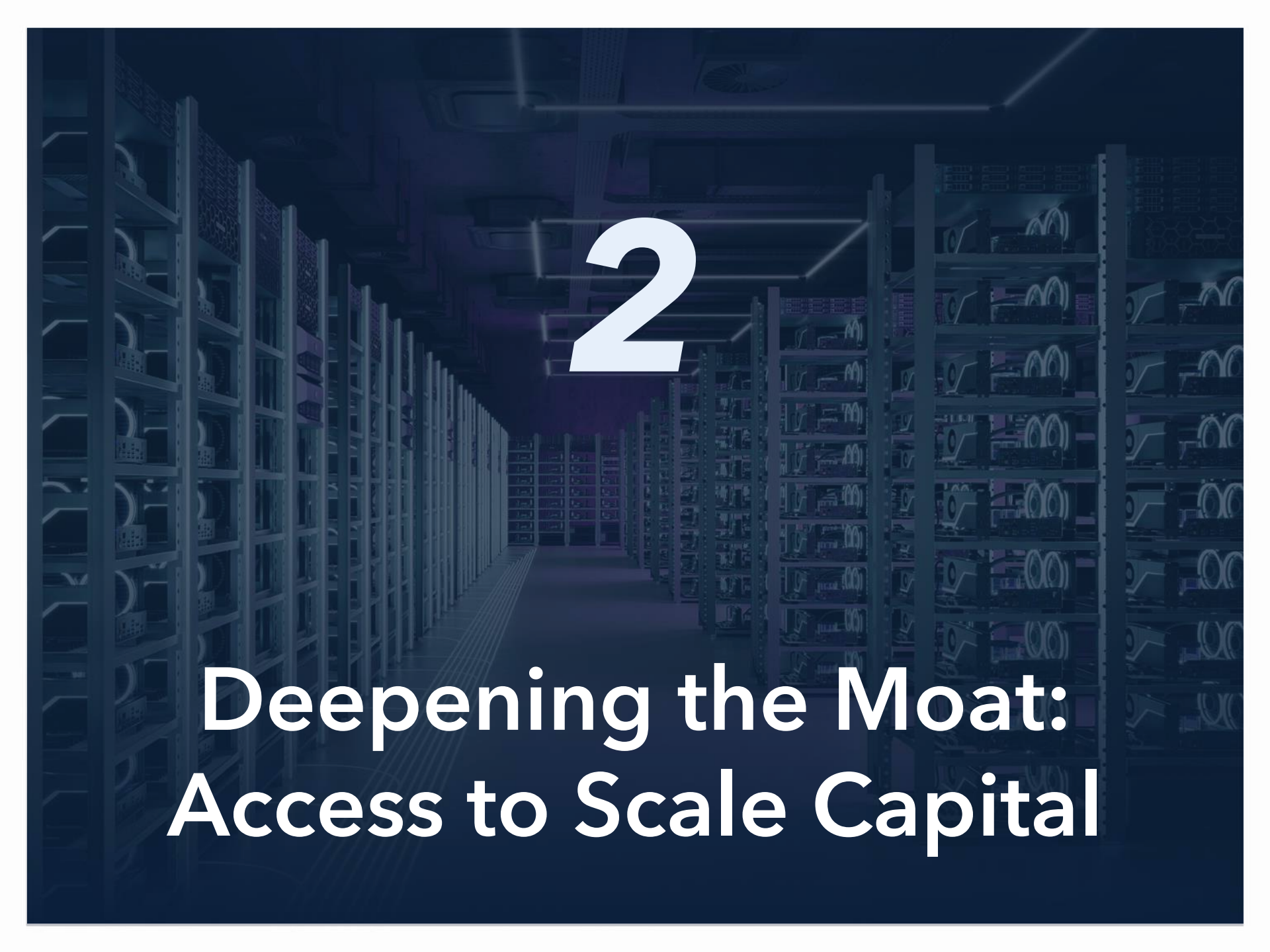
NASDAQ Importing KOSPI Volatility

Samsung Electronics and SK Hynix, global AI-memory chip leaders, account for nearly 60% of the KOSPI benchmark South Korean equity index, up from approximately 40% just two years ago. Recent KOSPI shocks have coincided with abrupt, outsized moves in Nasdaq 100 futures, suggesting real-time transmission of South Korean memory chip stock volatility into US tech sector risk pricing. The Nasdaq is effectively importing KOSPI volatility via share AI-sector exposures and cross-asset risk-off dynamics, rather than through a direct mechanical linkage.

Regional equity market performance since Sep 1, 2025

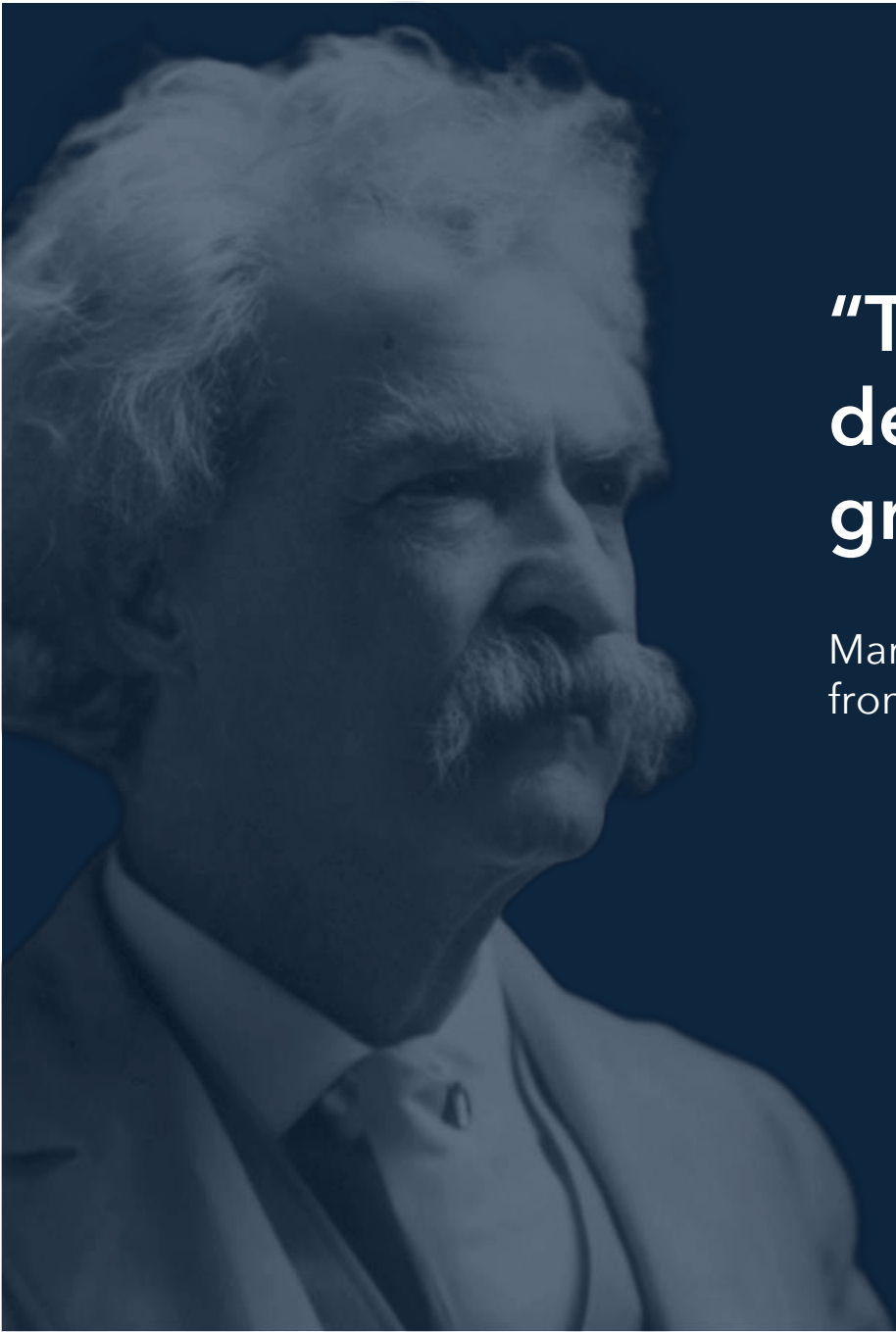


Source: (1) Bloomberg. Data as of July 14, 2026. Total returns. Grey lines show other regional equity markets, including: TWSE, Nikkei, MSCI EM, STI, Euro Stoxx 600, MSCI World, CSI 300, FTSE 100, Ibovespa, Bolsa, CAC 40, Saudi Tadawul, FTSE 250, DFM, DAX, Boursa Kuwait, FTSE ADX, QSE, Nifty 50, S&P 500, Dow Jones, Russell 2000 and Hang Seng.



2

Deepening the Moat: Access to Scale Capital

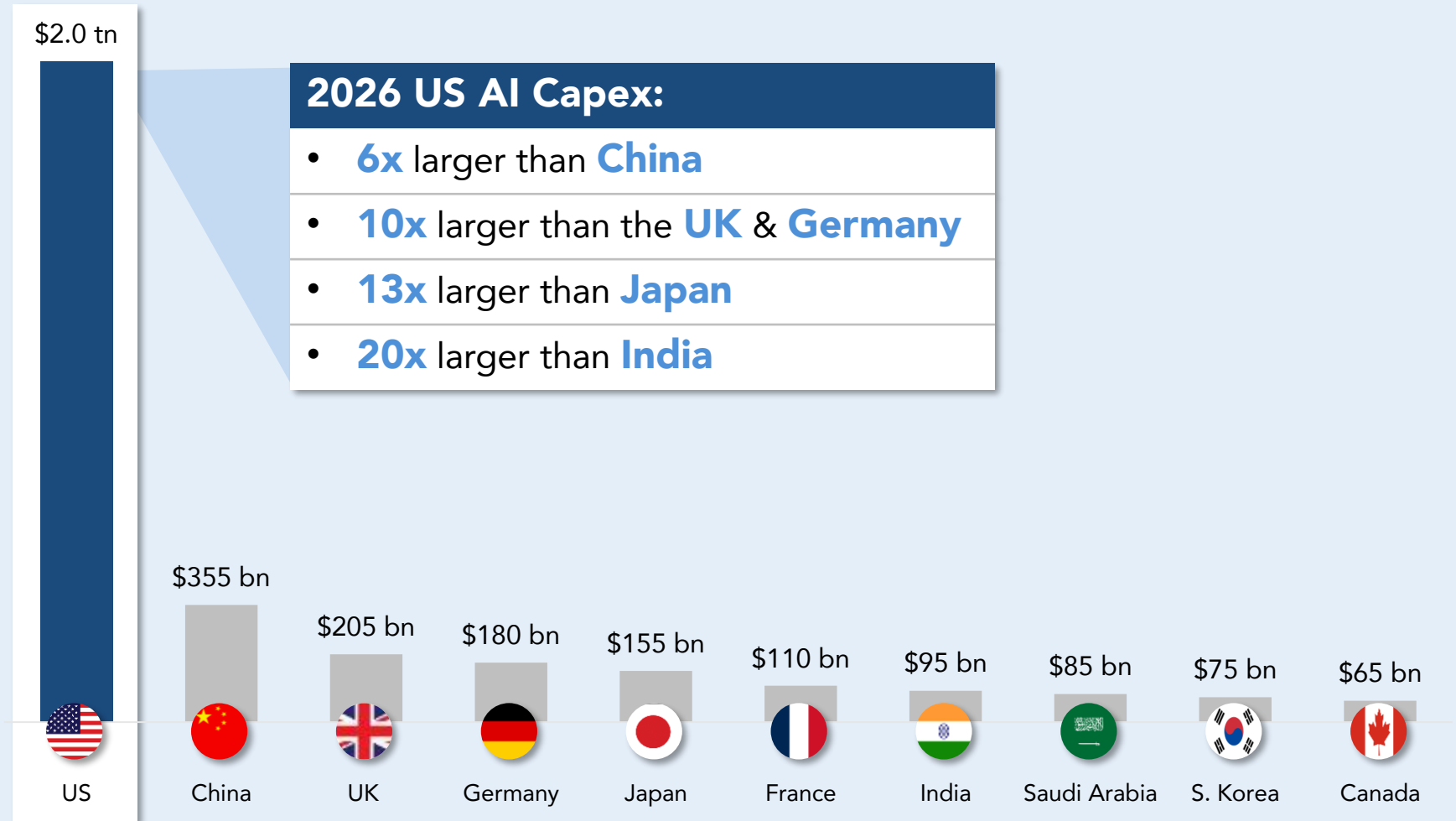


**"The rumors of my
death have been
greatly exaggerated."**

Mark Twain, acclaimed American novelist,
from London in 1897

US Leadership in Global AI Capex Spend

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

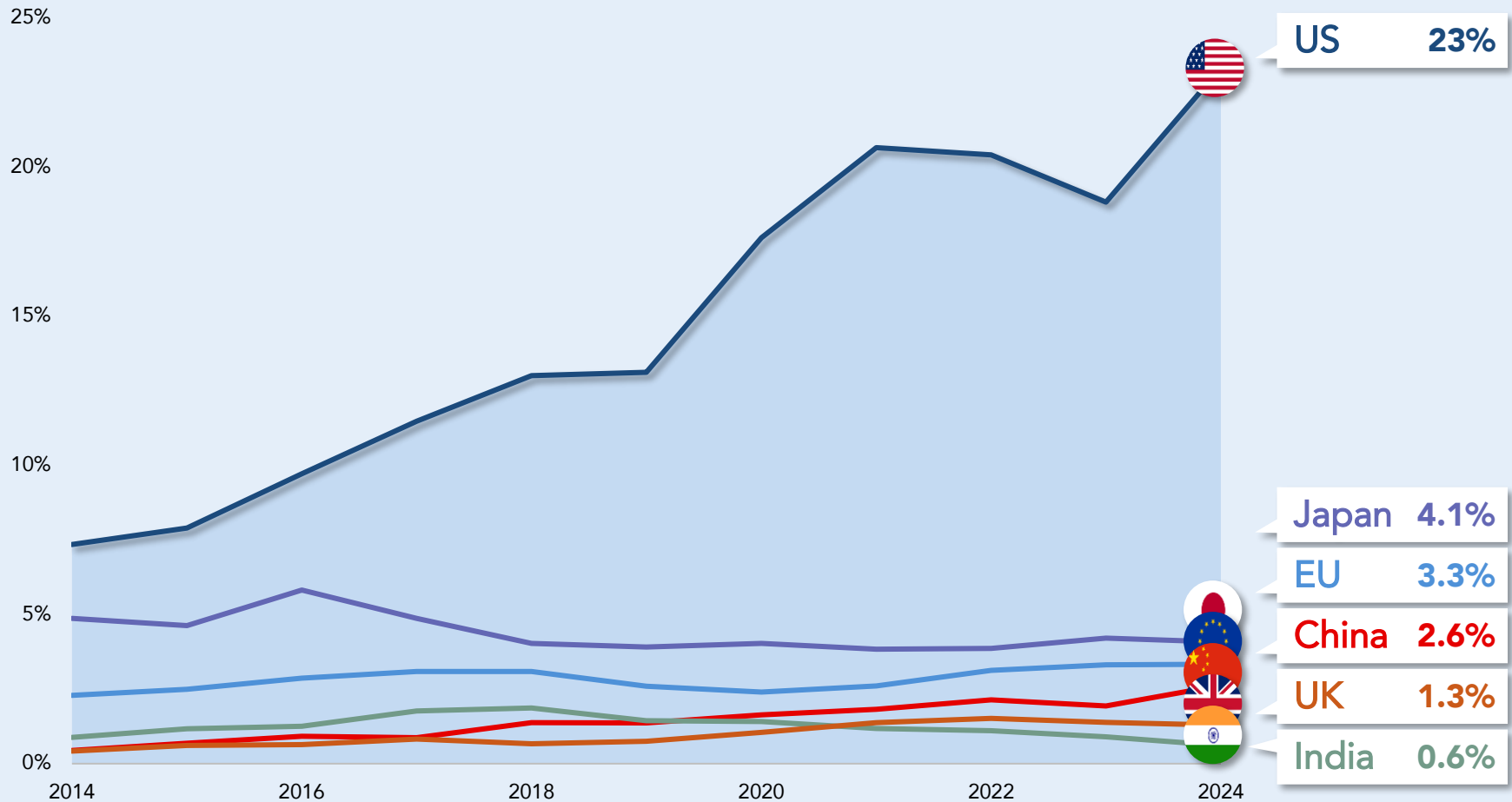


Source: (1) IDC. Gartner. Futurum Group. Wall Street tech sector research. US Dollars.

AI Share of Total Capital Expenditure



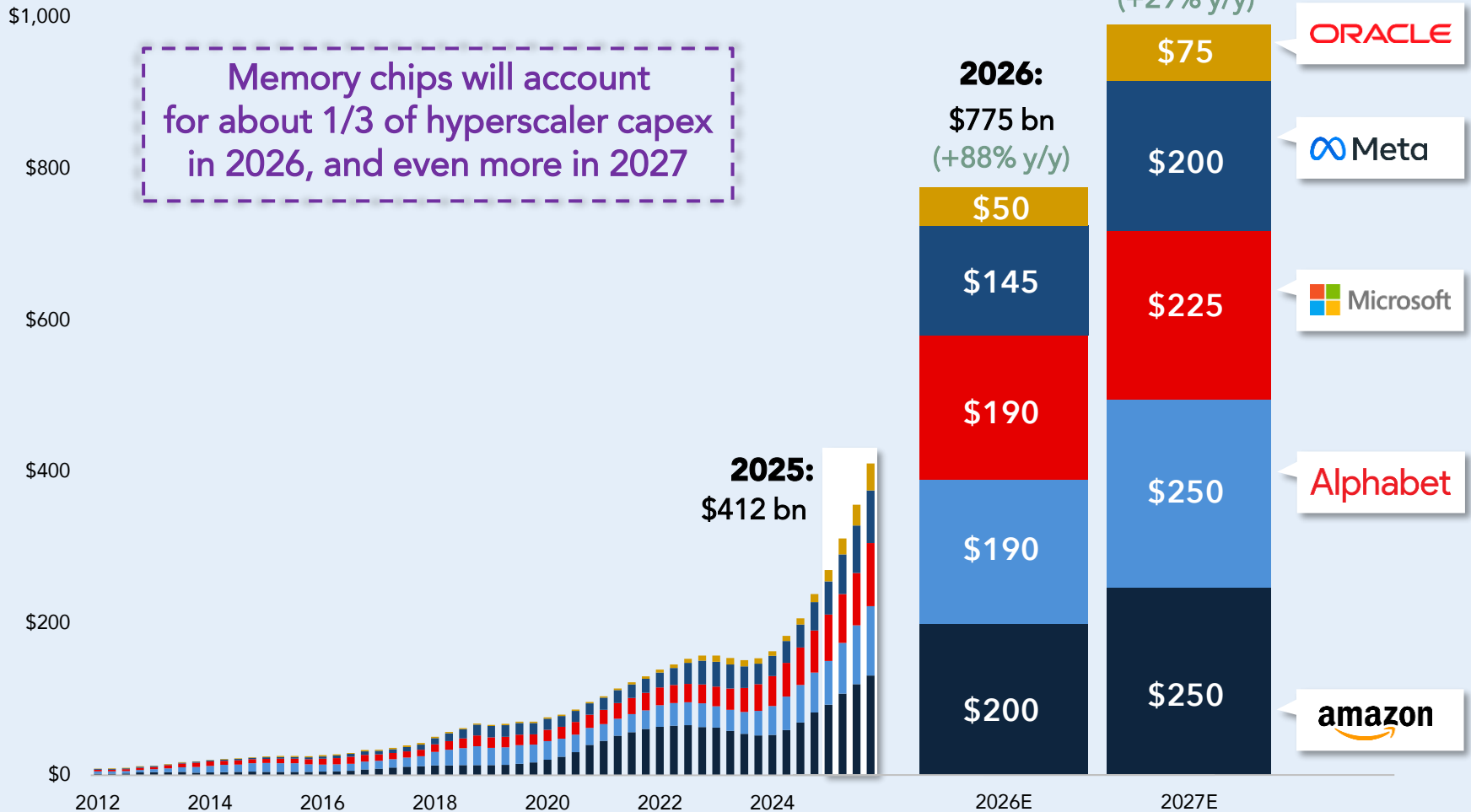
AI firms' share of total capital expenditure, by country



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.

Hyperscalers' Capex > \$1 Trillion in 2027

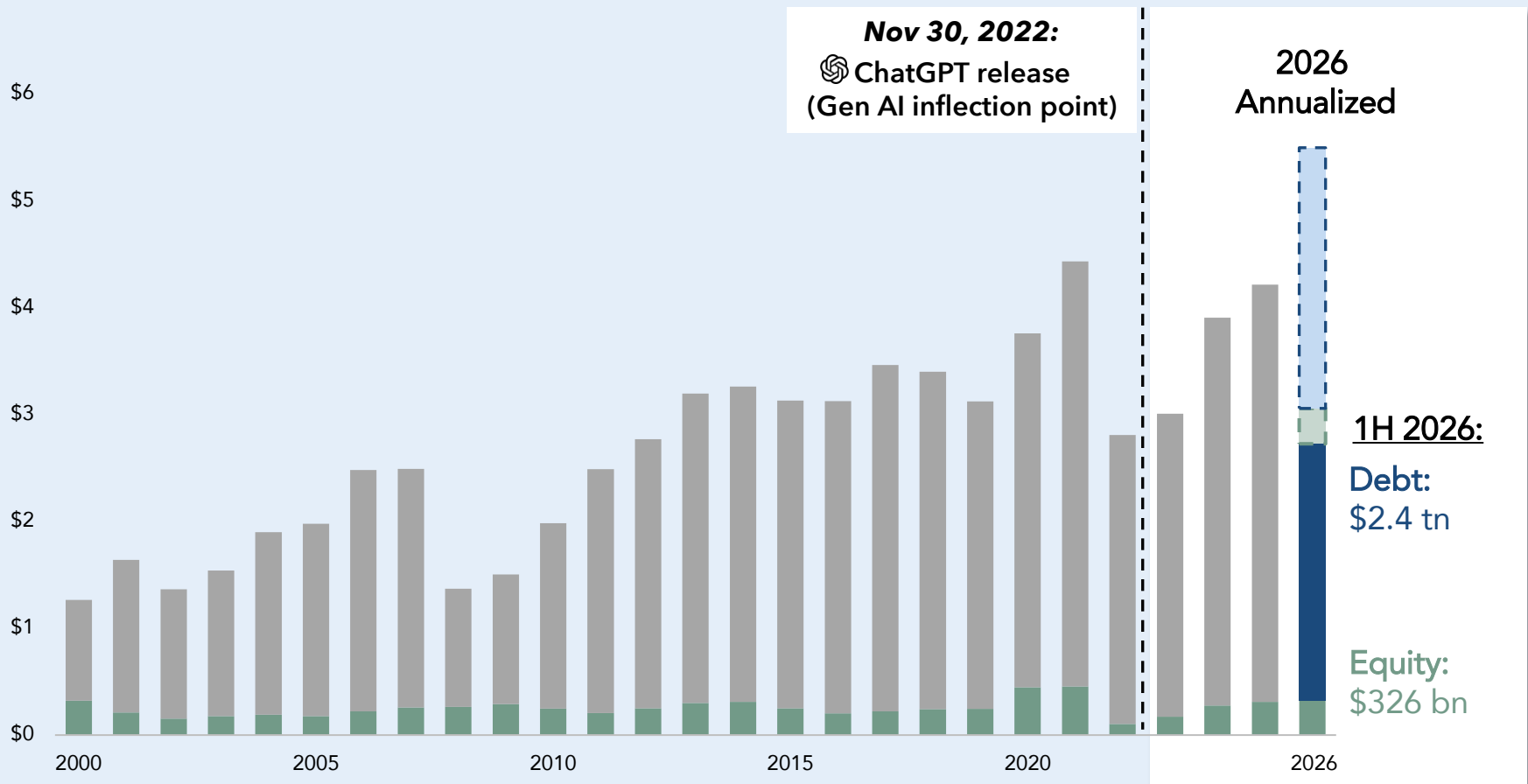
Top 5 hyperscalers capex, USD bn



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.

Inflection Point for Global Capital Markets

Total annual debt & equity issuance, USD tn



Source: (1) Equity issuance is Dealogic. Data as of June 30, 2026. Includes IPOs, follow-ons, and convertibles. Debt issuance is sum of IG & HY bonds, leveraged loans, and IG loans. IG & HY bond data are CFR. IG loan is LSEG. Data as of June 30, 2026. Leveraged loan is LCD. Data as of June 30, 2026.

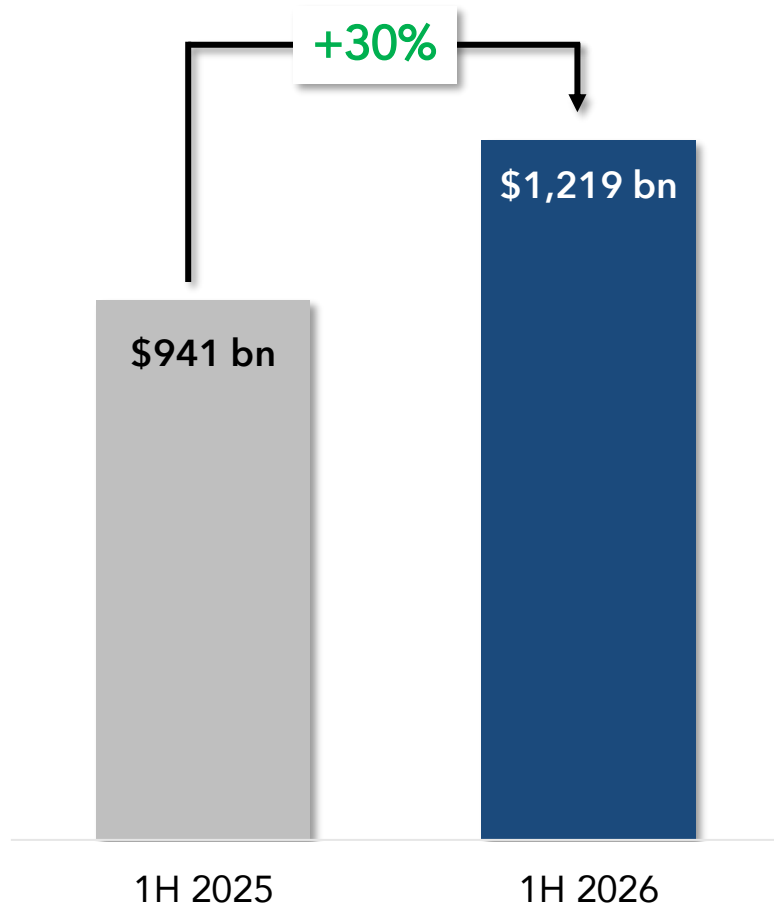
Observations on AI Debt Financed Scale Capital

- 1 **Megadeal sizes redefined** from \$10bn to \$30-40bn
- 2 **Longer tenor curves**, aligning long duration infrastructure economics
- 3 **Robust technical dynamics**, as evidenced by spreads, new issue premia and over-subscription levels
- 4 Tech as **core index pillar** and structural driver of credit cycles
- 5 **Blended execution strategies** across multiple markets & currencies, public & private
- 6 10 year UST yields becoming **the de facto discount rate** on future AI revenue

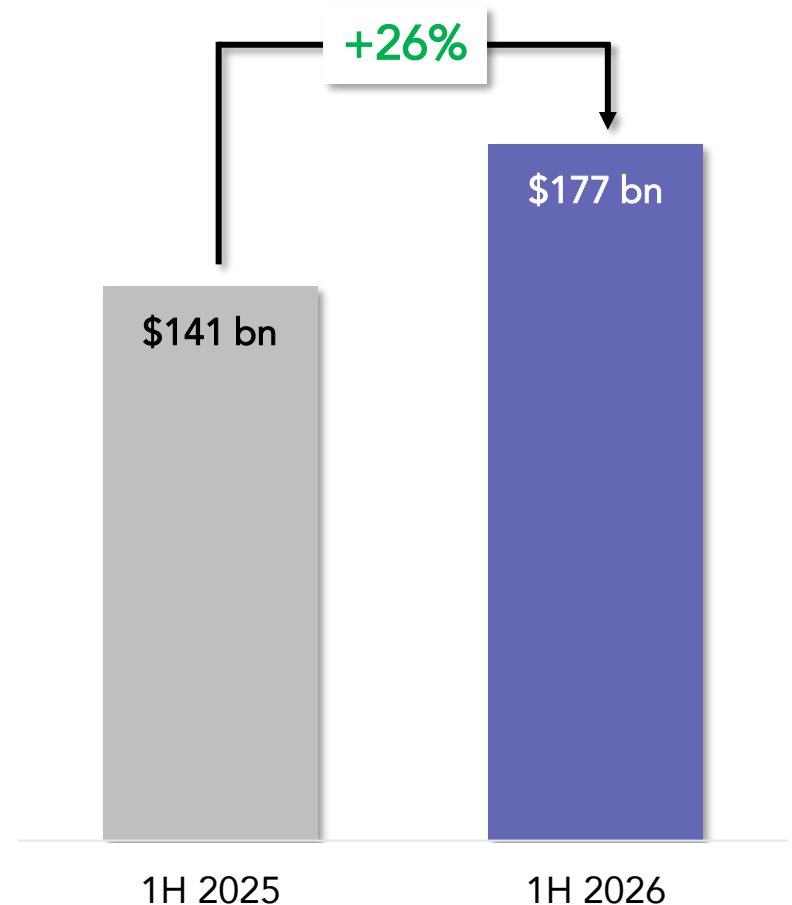
Largest 1H for USD Bond Issuance on Record



1H 2026 IG deal volume, USD bn



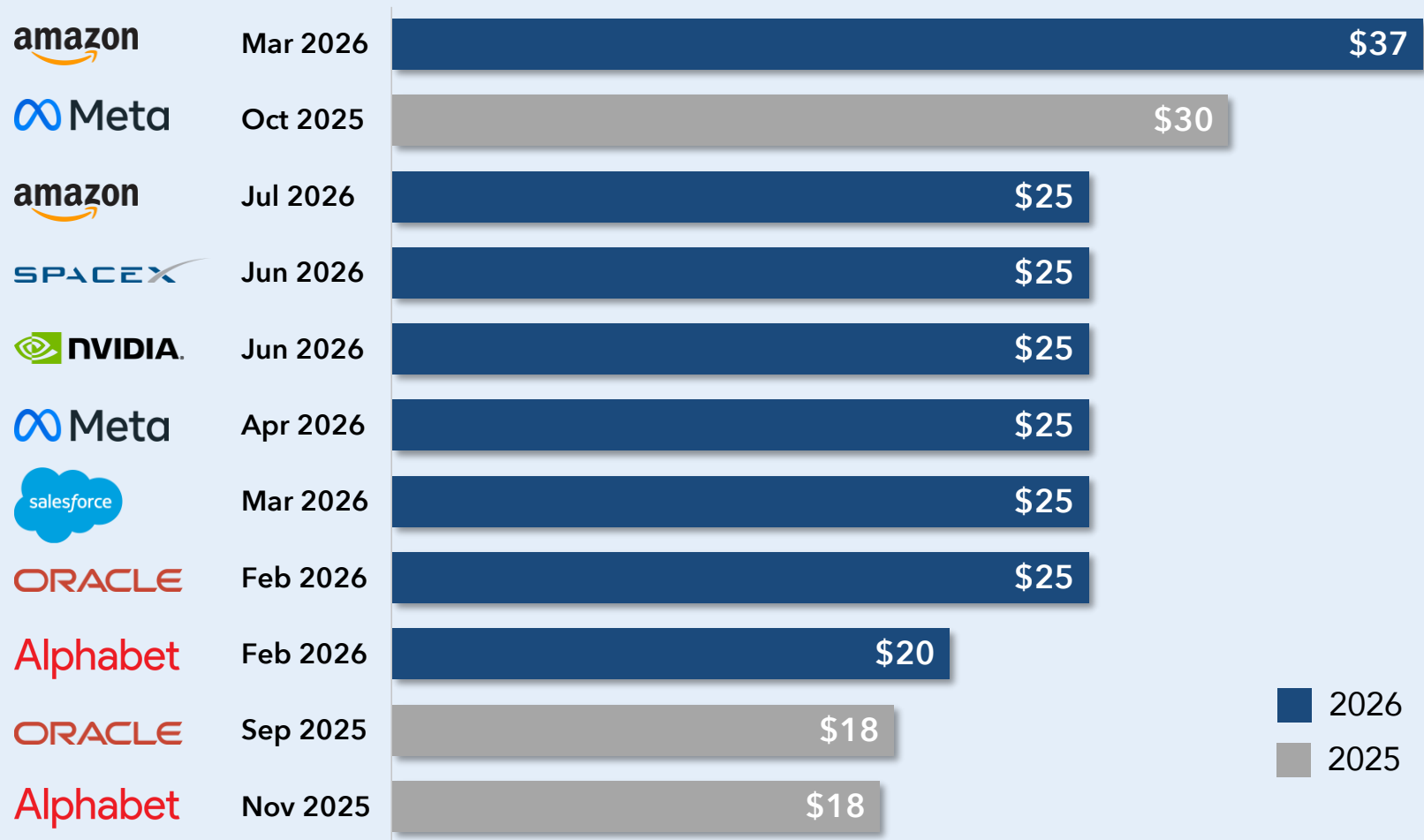
1H 2026 HY deal volume, USD bn



Source: (1-2) IG and HY bond data are CFR. Data as of June 30, 2026.

Big Tech Issued USD Bonds in Unprecedented Size

Largest USD IG tech deals since Jan 2025, bn



Source: (1) CFR. Data as of July 8, 2026.

Big Tech Leadership in EUR & GBP Issuance



EUR Market

amazon

Mar 2026

Largest on record

€ 14.5 billion

Alphabet

May 2026

4th largest on record

€ 9.0 billion



GBP Market

Alphabet

Feb 2026

Largest on record

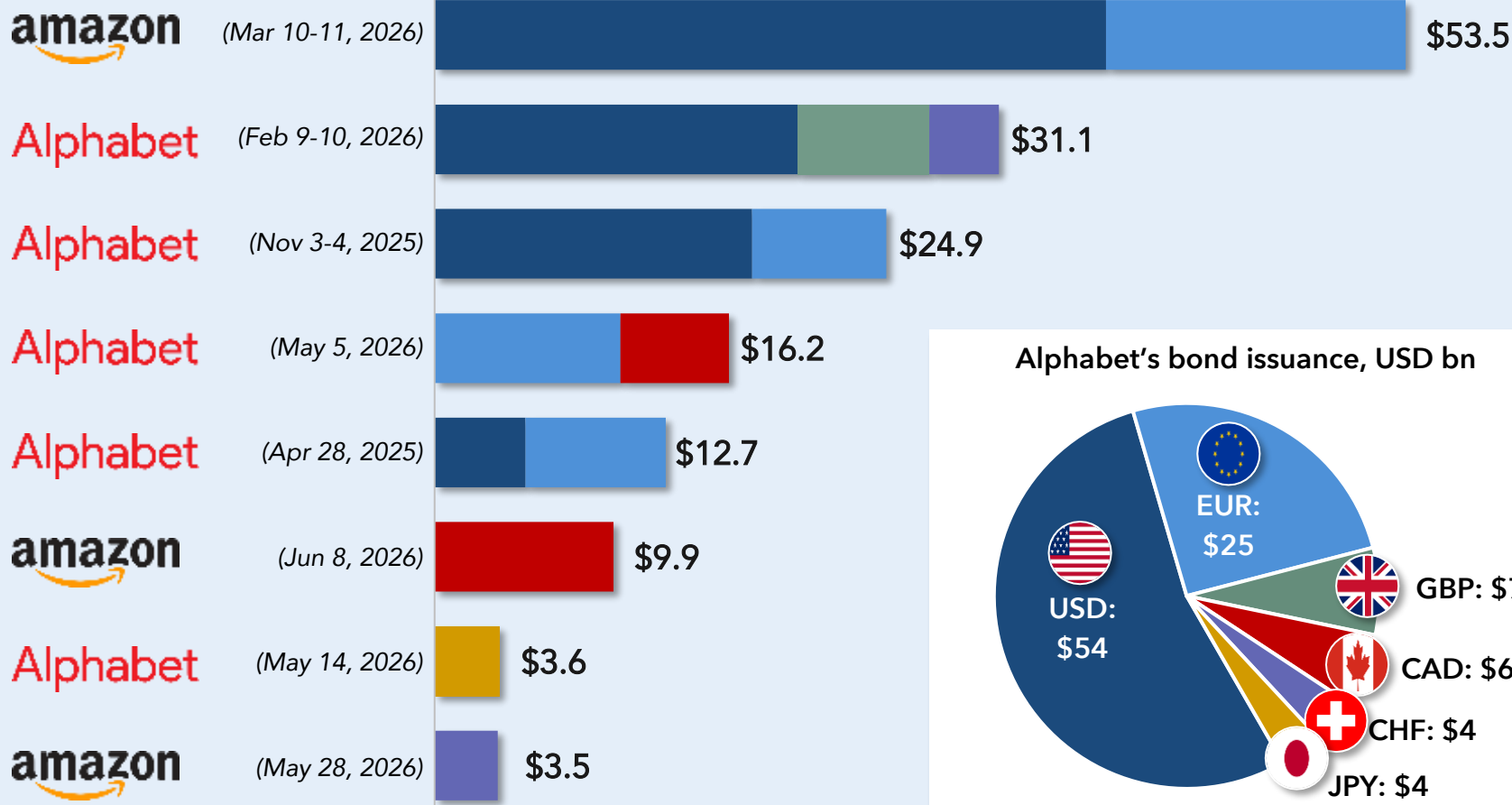
£5.5 billion

Source: (1-2) Bloomberg. Data as of July 14, 2026.

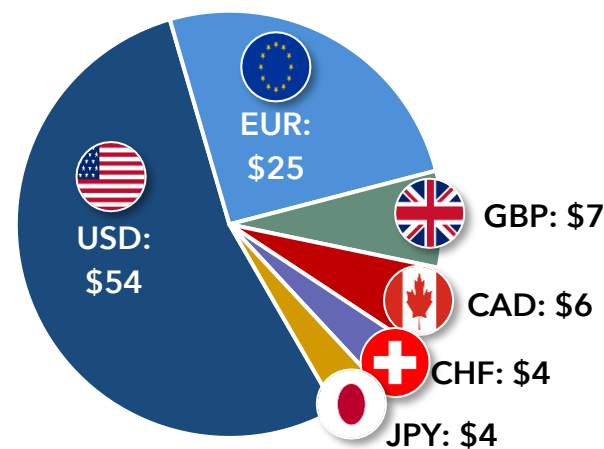
Big Tech Tapped Multiple Currencies to Achieve Scale



Selected multi-currency IG deals since January 2025, USD bn



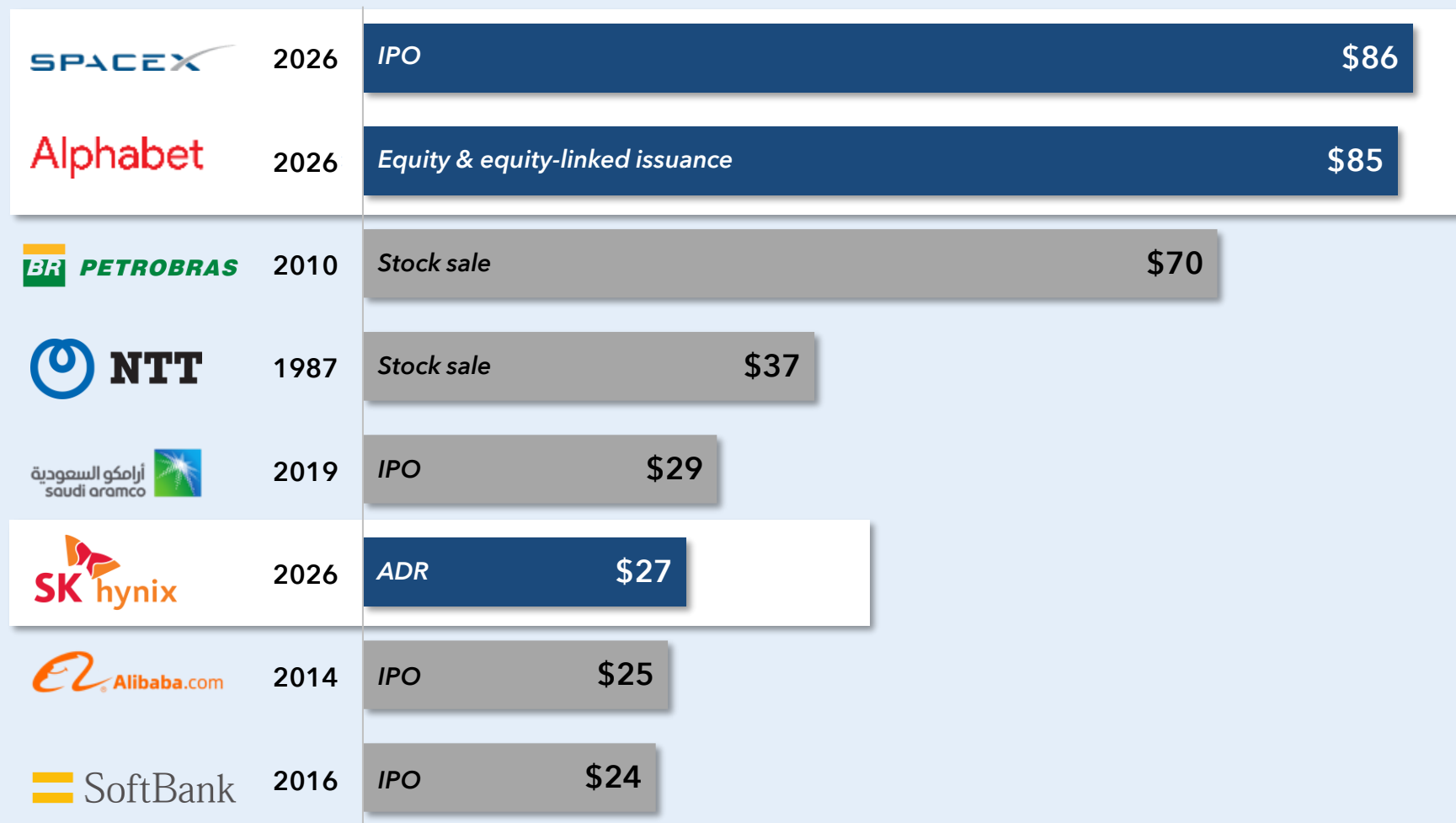
Alphabet's bond issuance, USD bn



Source: (1) CFR. Data as of June 30, 2026. Total size calculated using current USD exchange rates.

Big Tech Redefined Scale of Equity Financing

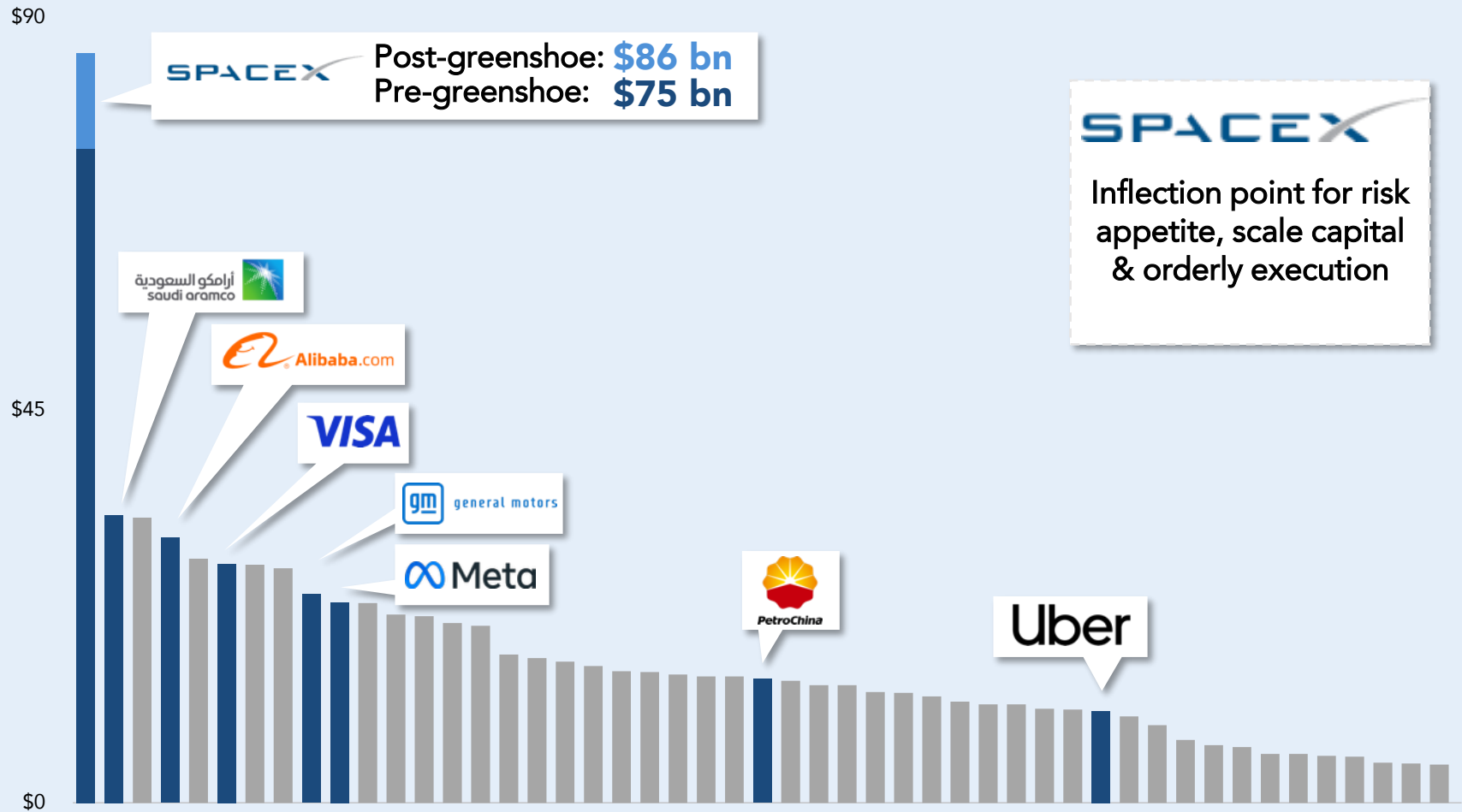
All-time largest equity financings, USD bn



Source: (1) Company filings. All IPO offerings include greenshoe option.

SpaceX Reset the Upper Bound for IPOs

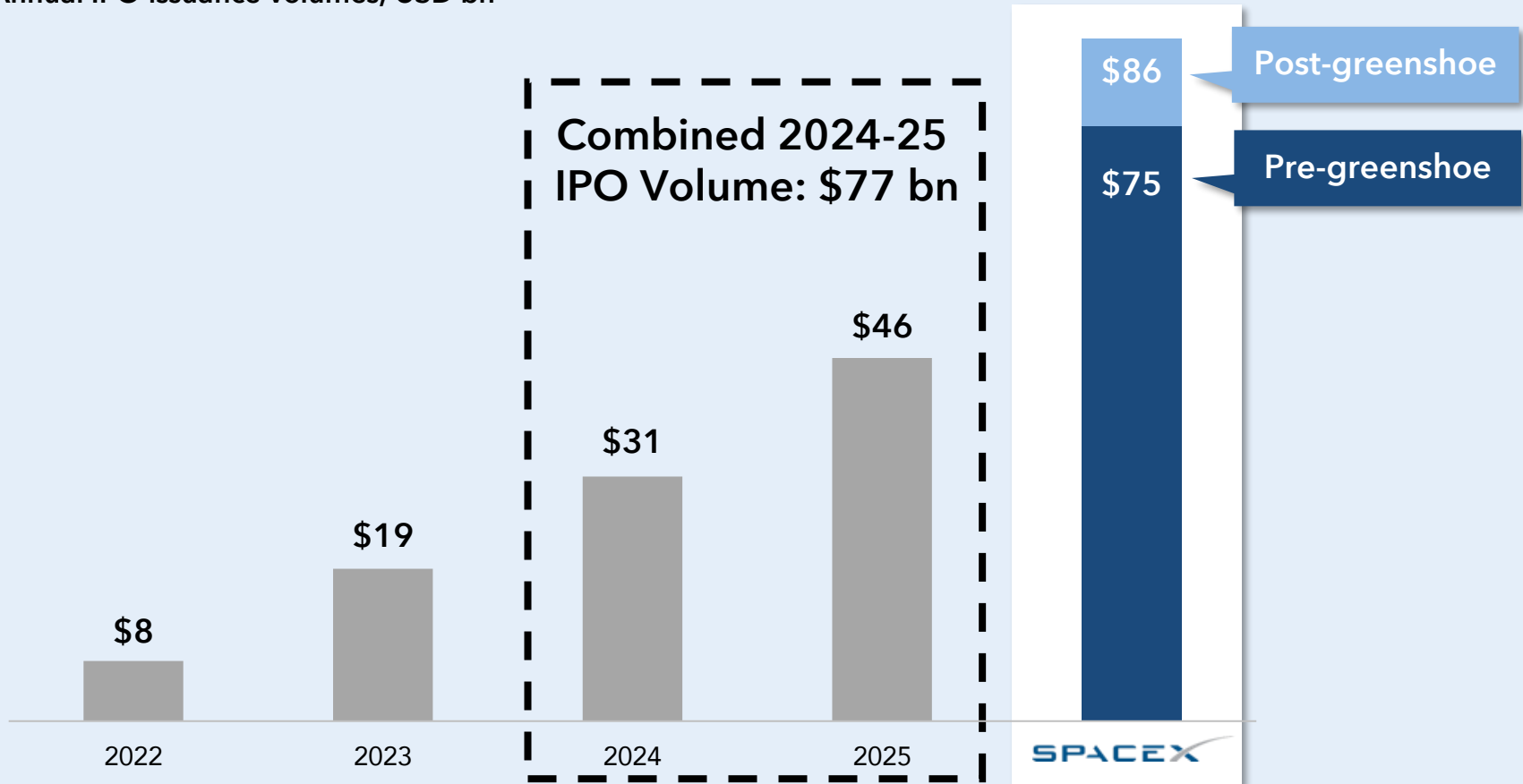
50 largest IPOs in history by offer size, USD bn



Source: (1) Company filings. Offer size is 2026 US dollars. Data as of June 2026.

SpaceX IPO Eclipsed Prior Full Year IPO Volumes

Annual IPO issuance volumes, USD bn

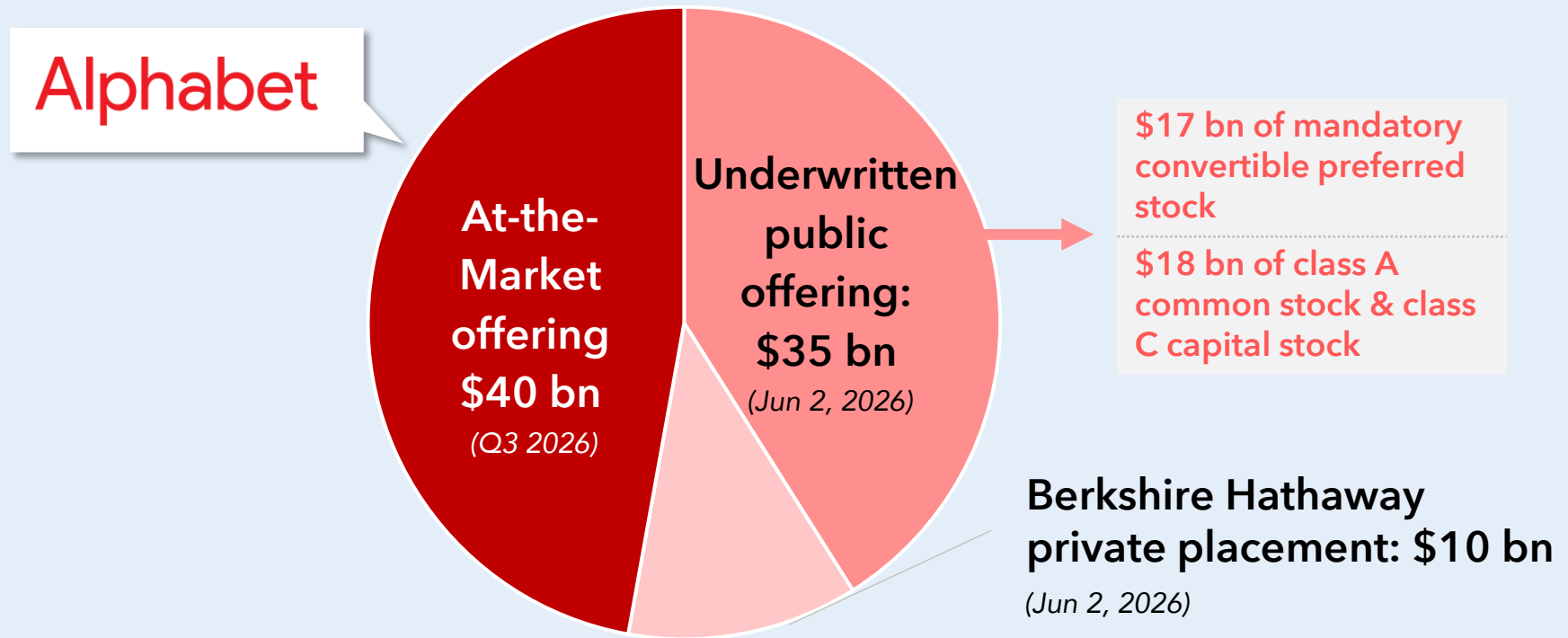


By virtue of its unprecedented size and pioneering execution strategy, SpaceX's IPO demonstrated how AI-linked platforms can dominate capital formation cycles.

Source: (1) Dealogic. Data as of June 2026.

Alphabet's Historic \$85 Bn Equity Capital Raise

Breakdown of Alphabet's equity capital raise



Source: (1) Company announcements. News sources. Alphabet initially announced \$80 bn in equity raise but exercised a greenshoe option. Allocations to investors in the common & capital stock portion were split 50/50.



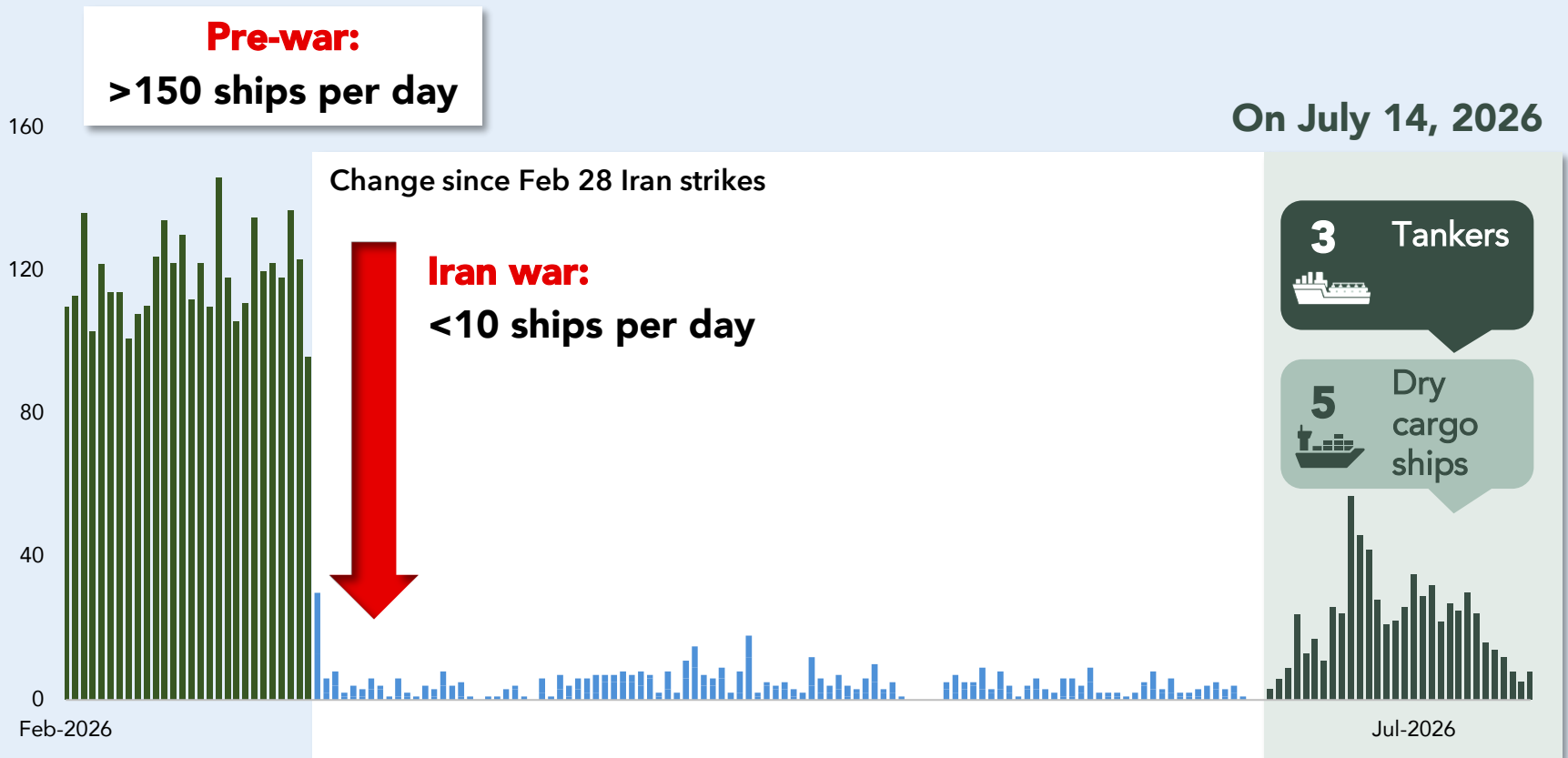
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Supply Side Inflation Shock & Bond Market Tightening

Global Supply-Side Inflation Shock

With approximately 20-25% of seaborne oil and natural gas emanating from the Persian Gulf, the protracted period of disruption in the critically important Strait of Hormuz geostrategic chokepoint has created a supply-side inflation shock for the global economy. Notably, control of Hormuz has become an undeniable source of power and deterrence for Iran that they are unlikely to give up easily.

2026 YTD Strait of Hormuz bidirectional intraday ship crossings (over last 24 hrs)



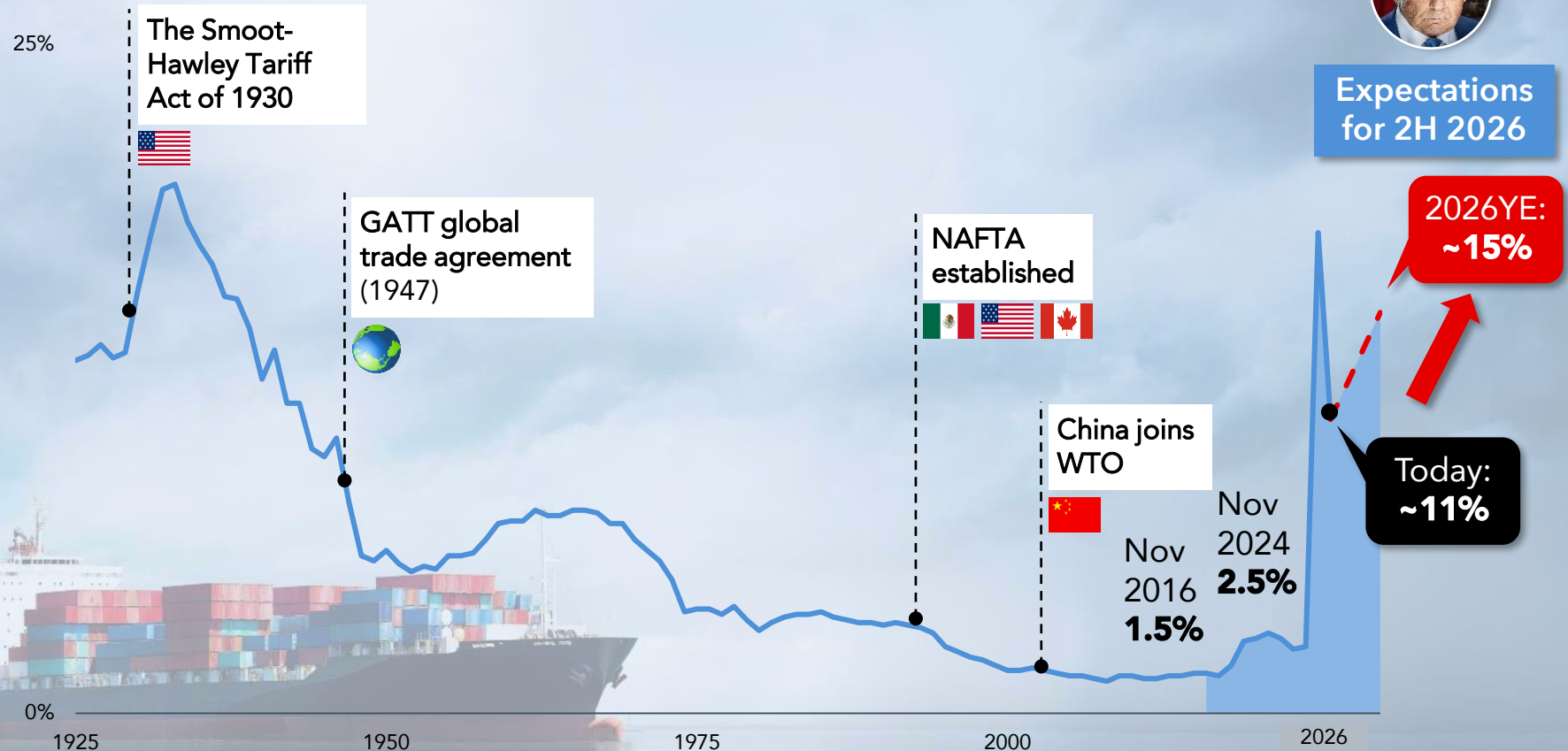
Source: (1) Bloomberg. Data as of July 14, 2026.

Structurally Higher US Tariffs, Fragmented Supply Chains

US tariff policy has shifted structurally higher, reinforcing a broader move from integrated global value chains toward more regionalized, politically screened supply networks. Following the SCOTUS decision narrowing the scope of Executive branch IEEPA authority, Sections 232 and 301 of US trade law have become the core legal architecture of a more durable period of higher US tariffs.



Average tariff rate on all imports

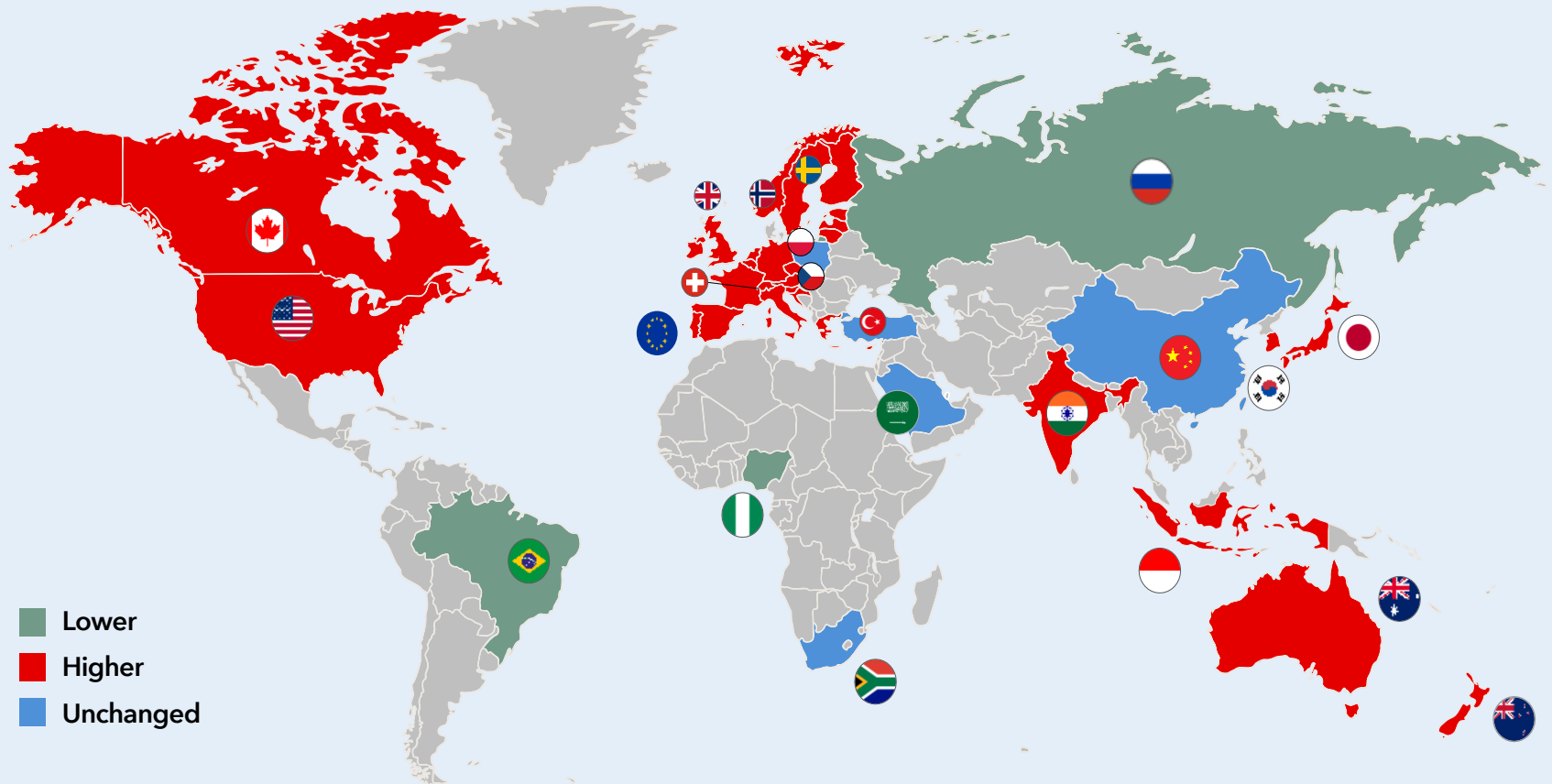


Source: (1) US International Trade Commission, "US Imports for Consumption, Duties Collected, and Ratio of Duties to Value." Table 1. US Census Bureau. The Tax Foundation, "Trump Tariffs: Tracking the Economic Impact of the Trump Trade War." 2026 rate is an estimate from Yale Budget Lab, Capital Econ & Oxford as of May 2026.

Asynchronous Defensive Pivot Toward Policy Tightening

Just six months ago, more than 70 central banks had been actively engaged in synchronized global policy easing, with only Australia and Japan expected to modestly increase rates in 2026.

Expectations for YE 2026 central bank policy rates

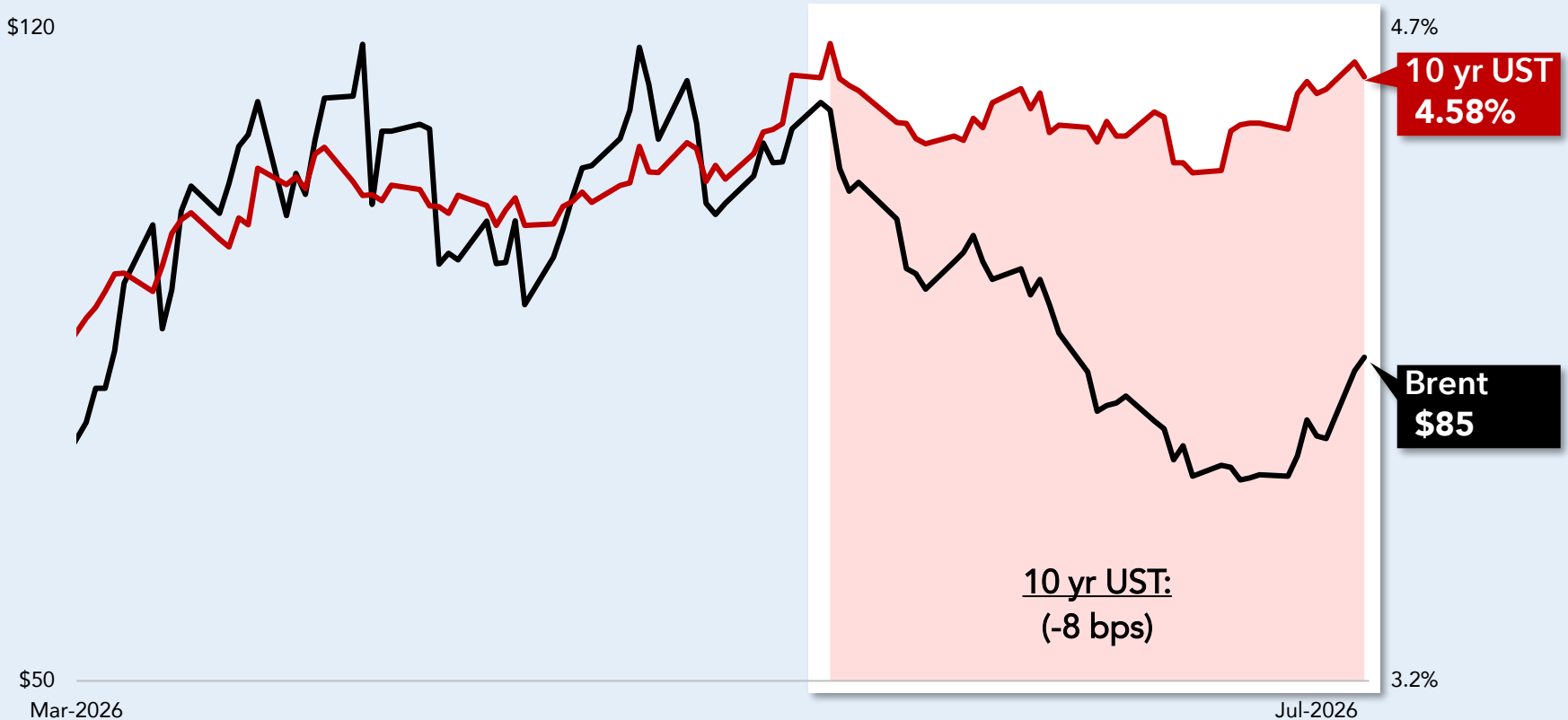


Source: (1) Bloomberg. Data is based on economic forecasts, market-implied rates, and global central banks. Data as of June 30, 2026.

Rates Decouple from Oil

Historically, rising oil prices have pushed nominal US Treasury yields and breakevens higher by augmenting both realized and expected inflation. As the US-Iran ceasefire has driven oil prices lower, UST yields have not declined in tandem. Rather, the rates curve is now taking its cue from the Fed's reaction function, term premium, fiscal concerns and election-related policy risk.

Brent (LHS) vs. 10 yr UST (RHS)

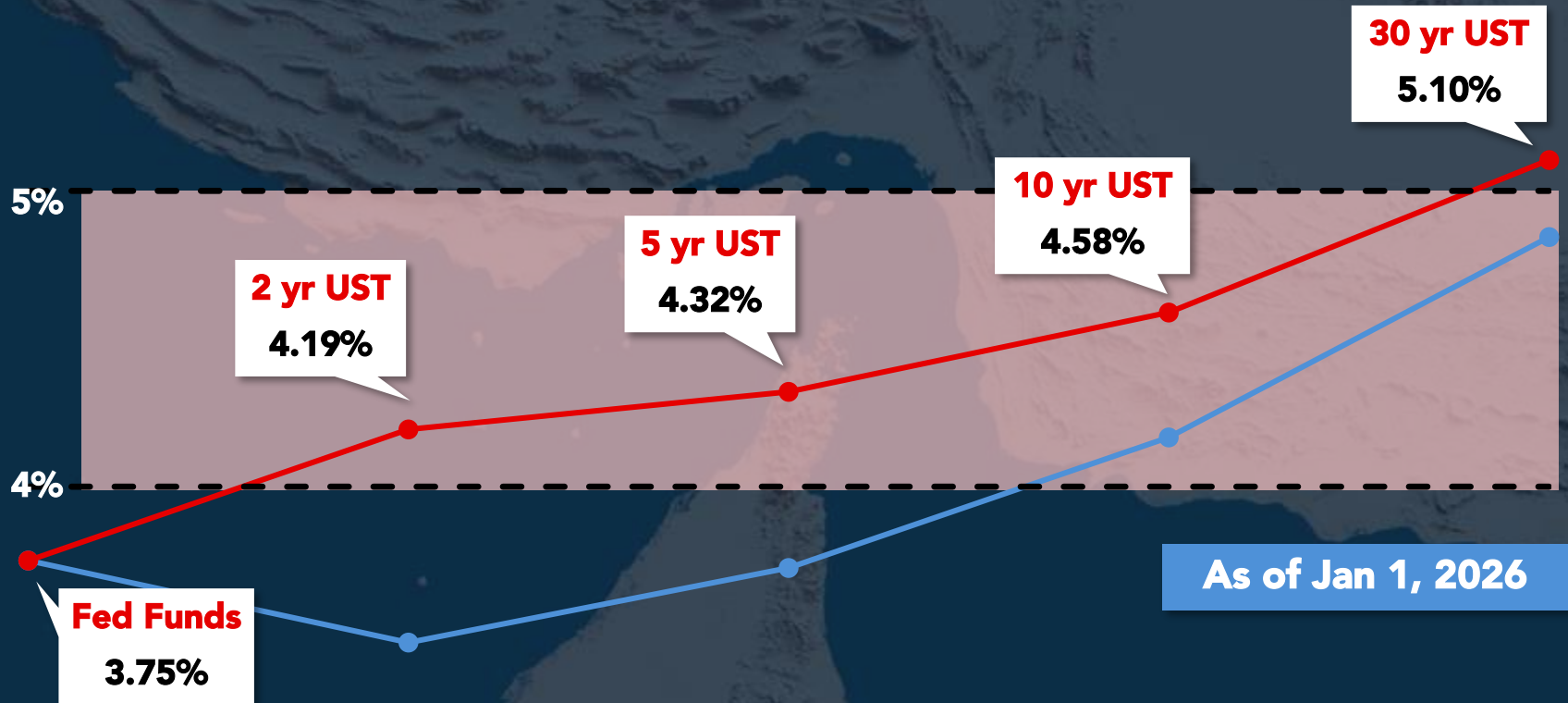


Source: (1) Bloomberg. Data as of July 14, 2026.

UST Curve Repriced Higher

UST curve

As of Jul 14, 2026



Source: (1) Bloomberg. Data as of July 14, 2026. Fed funds is upper bound.

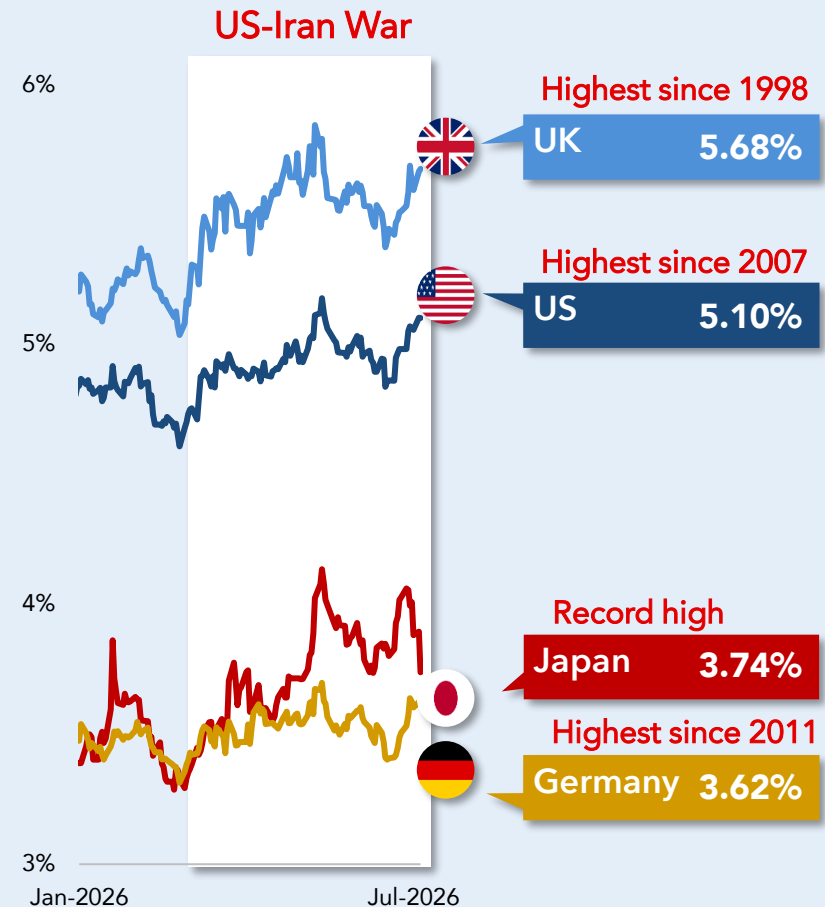
Global Markets Repriced Duration Risk



10 yr global government bond yields



30 yr global government bond yields



Source: (1) Bloomberg. Data as of July 14, 2026.

Key Drivers of the Widening in Big Tech USD Credit

1

Big tech business model transition from self-funded expansion to **heavy debt-market reliance** as projected AI capex needs outpace free cash flow (FCF)

2

Primary supply indigestion with record-breaking new issue volumes and jumbo transactions saturating the market

3

Liquidity overhang as market braces for an estimated **multi-year barrage of future AI-related debt issuance**

4

Growing investor fatigue and scrutiny regarding the **monetization timeline** of multi-trillion-dollar AI capex

5

Portfolio concentration constraints as institutional buyers hit strict single-issuer and sector-level investment policy limits

Key Drivers of the Widening in Big Tech USD Credit

6

Market-wide repricing of traditional software credit on **rapid AI-agent adoption disruption fears**

7

Rating profile migration as **lower-rated, negative-cash-flow mega-borrowers scale up issuance**

8

Steepening of tech credit curve driven by **heavy long-duration supply** (10-30-year bonds)

9

Utility and energy capex drag as big tech investments in power infrastructure shift the sector to more capital-intensive and low-margin profiles

10

Technical selling pressure on existing secondary bonds as managers free up cash and limit capacity to participate in new, discounted primary offerings

EUR & GBP Tech Spreads Moving More with Market

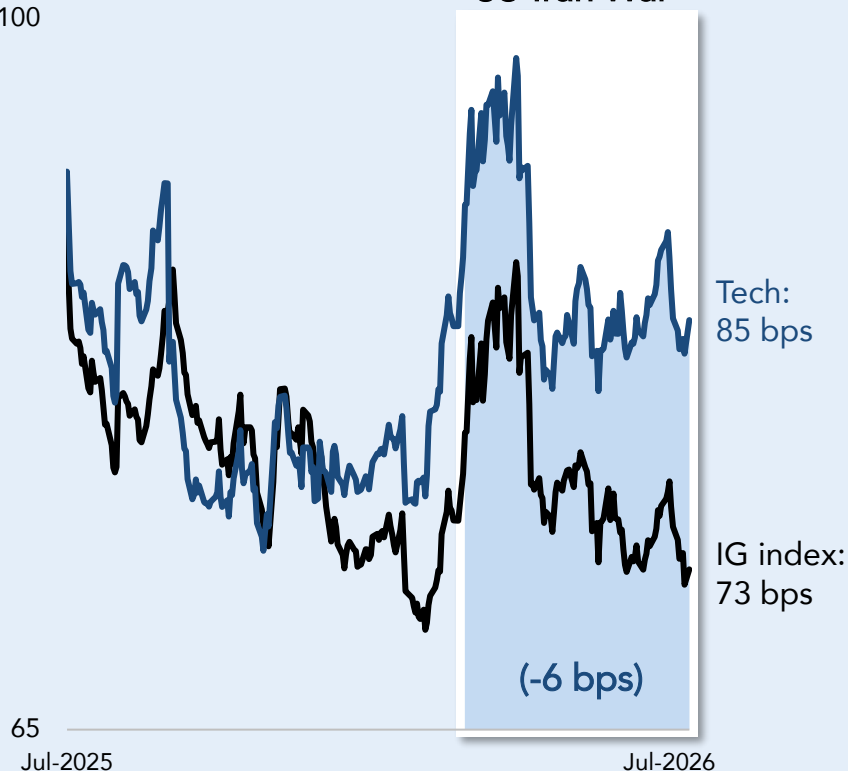
EUR & GBP tech spreads tend to move broadly in line with their respective broader IG indices over the cycle, though with higher beta and more pronounced pro-cyclical tightening / widening given the sector's growth equity-like profile.

IG EUR index vs. IG EUR tech spreads



100

US-Iran War

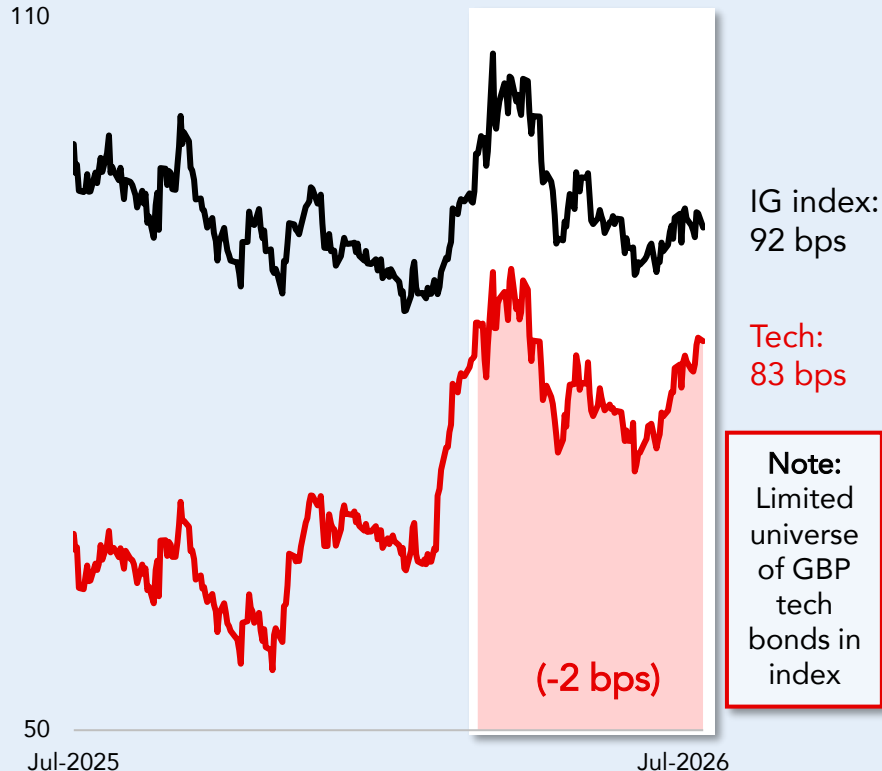


IG GBP index vs. IG GBP tech spreads



110

US-Iran War



Note:
Limited universe of GBP tech bonds in index

Source: (1-2) Bloomberg. Data as of July 13, 2026. EUR & GBP IG indices are iBoxx non-financials. EUR spreads are I-spread. GBP spreads are UKT spreads.

USD Tech Credit Spreads Diverging from Broader Indices

USD tech spreads have diverged notably wider from broader indices, trading at a meaningful premium due to concerns around: (1) the scale of capex spending; (2) the volume of bond issuance and increased leverage; (3) duration and project risk; (4) technology disruption risk; and (5) ROI uncertainty. The divergence has also been reinforced by heavy hedging.

IG index vs. IG tech spreads



HY index vs. HY tech spreads

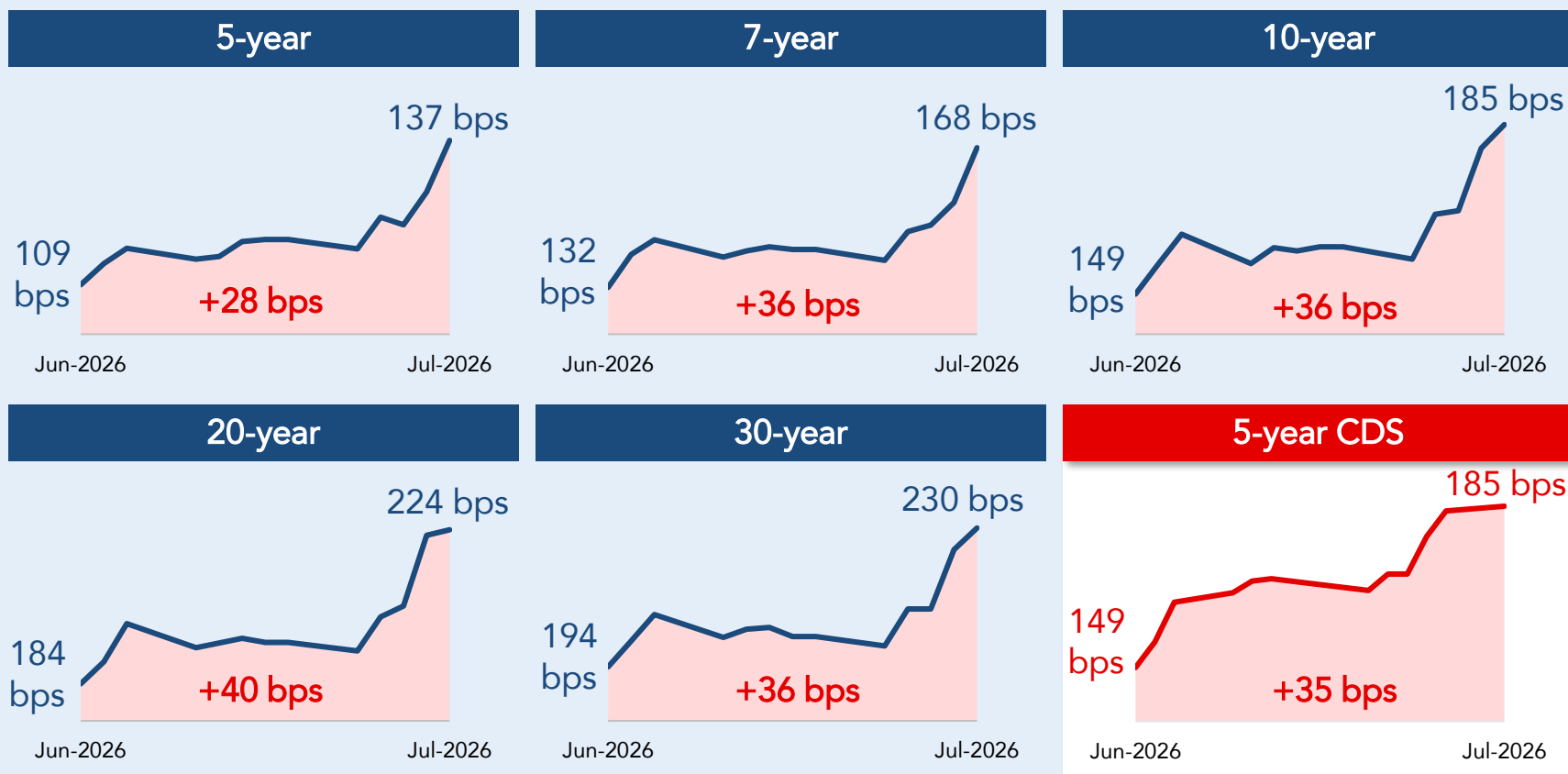


Source: (1-2) Bloomberg. Data as of July 13, 2026. Index OAS to Treasury.

Blockbuster SpaceX Bond Debut Notably Wider

Just 11 days after its historic IPO, SpaceX's inaugural and blockbuster bond deal raised an additional \$25 billion. Since then, secondary trading has been notably weak, with **longer-dated tranches bearing the brunt of investor skepticism** given the combination of **execution risk, negative free cash flow and the sheer scale of leverage and capex required** for simultaneous space, satellite and AI infrastructure build-outs.

SpaceX credit spreads by maturity & 5-year CDS



Source: (1-6) Bloomberg. Data as of July 13, 2026.



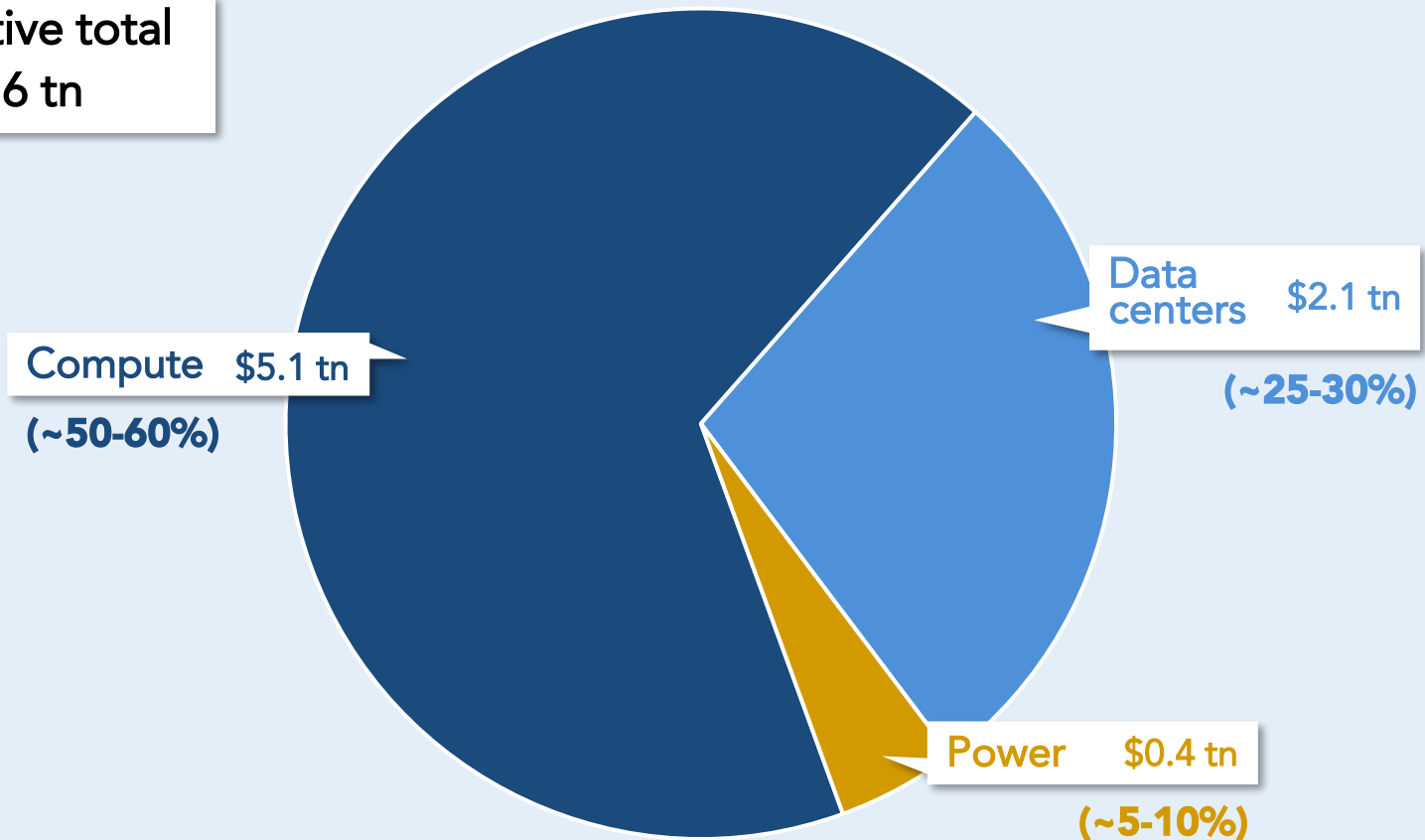
4

Data Centers & Computational Power

Breaking Down \$8 Trillion of Global AI Capex

Baseline aggregate AI capex estimates, USD tn (2026-2031)

Cumulative total
\$7.6 tn

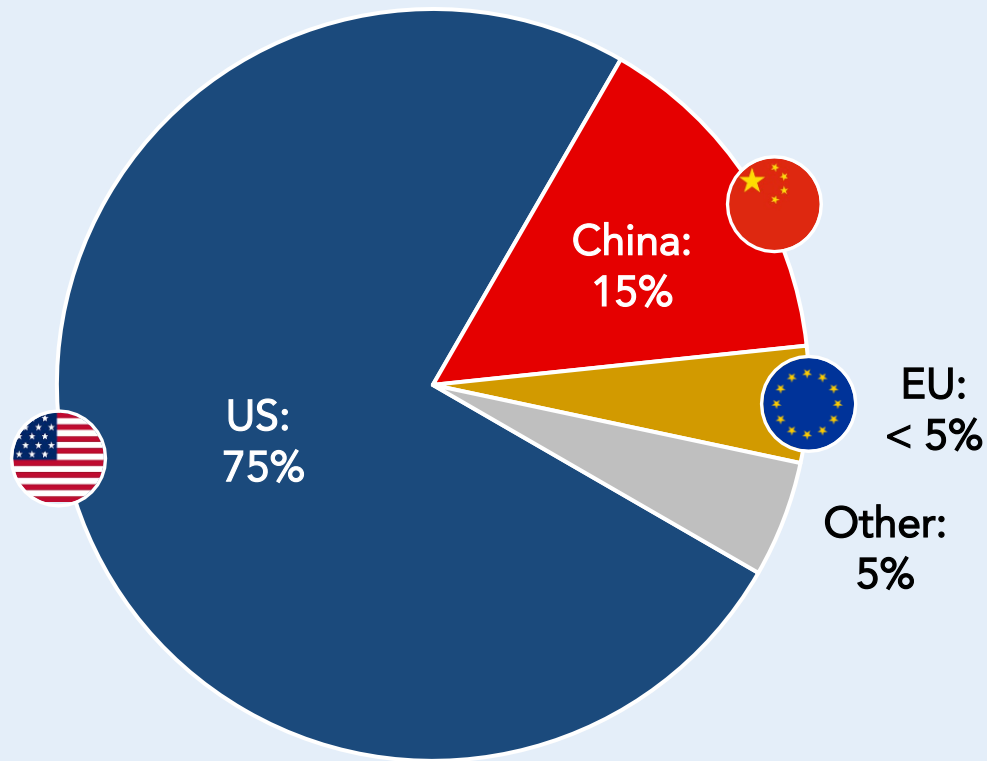


Source: (1) Goldman Sachs, "Tracking Trillions: The Assumptions Shaping the Scale of AI Build-Out" (April 2026). Forecasts and expectations based on GS assumptions. Assumptions: Nvidia accounts for 75% of total compute spend in each period. 5% y/y compute growth past 2031. Vera Rubin chip as the baseline spec (\$80.5k per GPU (including node costs), 3,000 W per package). 1.2 PUE, \$15mn per MW for data centers, and \$2,500 per kW for new power. 15% of required data center space is brownfield (i.e. excluded from calculation) in 2026, growing to 30% in 2031. Totals may not sum due to rounding.

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.

Top 10 Countries by Data Centers

Global data centers

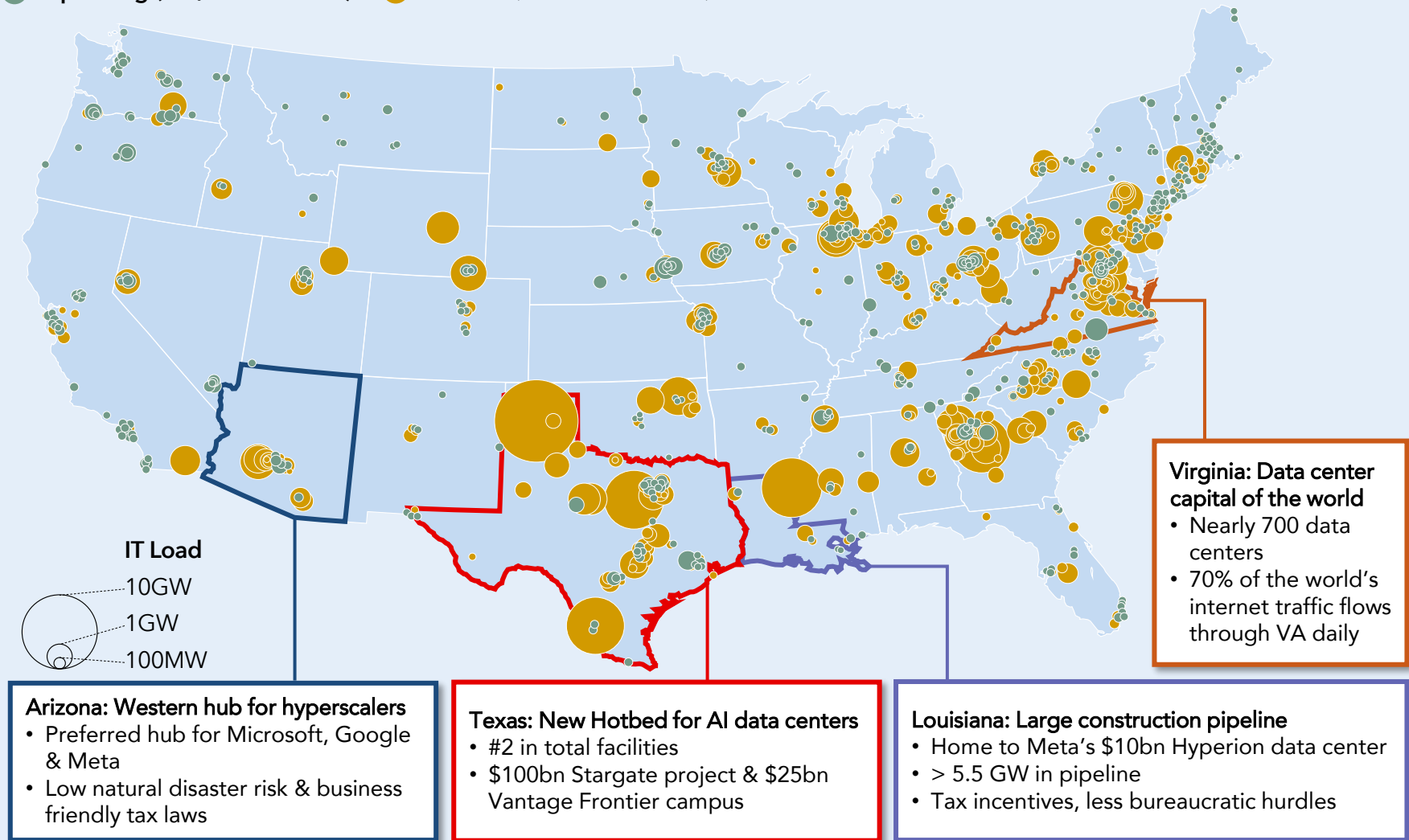


Source: Cloudscene. Data as of July 2026.

Operating & Planned US Data Center Sites



● Operating (< 5,000 locations) ● Planned (< 3,000 locations)



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)

- 3,650 acres (> 4x Central Park)
- 5 GWh of compute power (mid-size American city)
- 30% increase to Louisiana energy demand
- Millions of GPUs (2030 compute power > RoW in 2020)





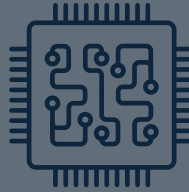
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EDA Software Design Tools

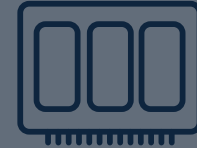
Highly Integrated Global Semiconductor Supply Chain



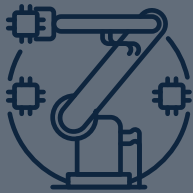
**EDA software
design tools**



**Fabless
chip design**



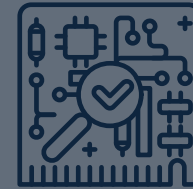
**Memory chip
IDMs**



**Capital
equipment**



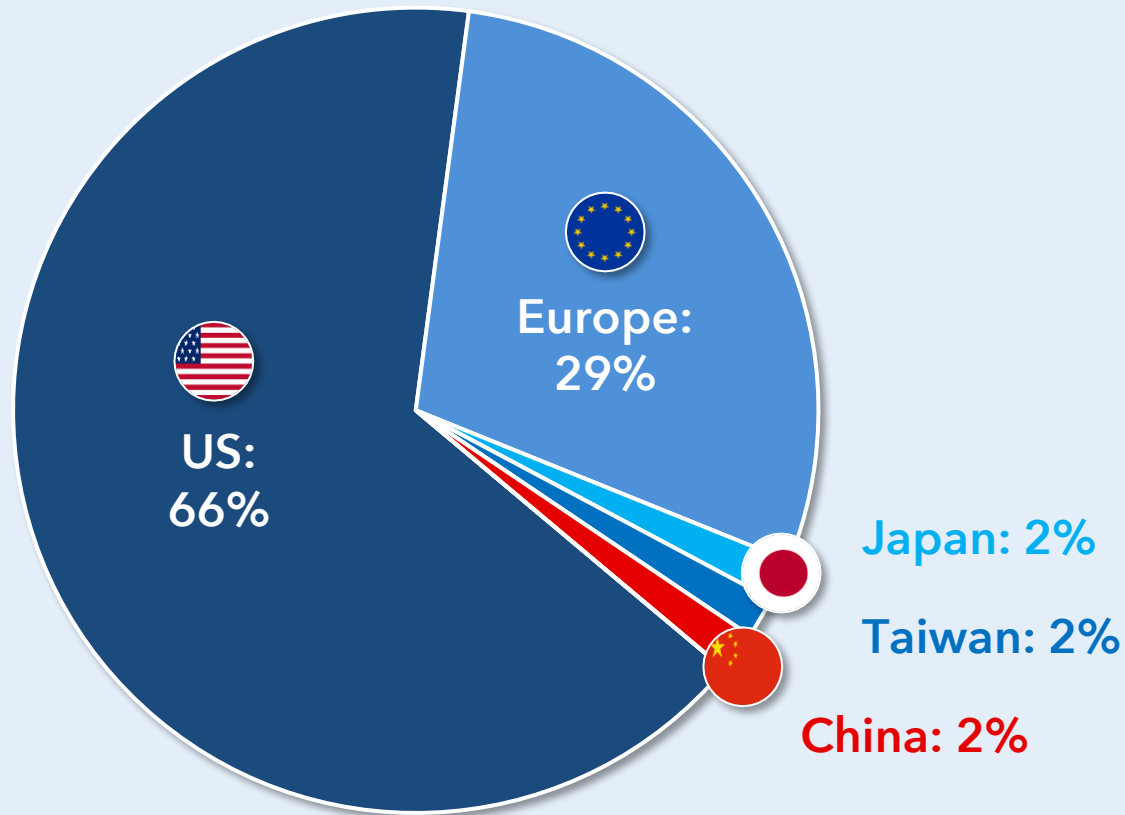
**Foundries
(manufacturing)**



**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.

Semi EDA Software Design Tools

Cadence stock price



Nov 30, 2022:
ChatGPT release
(Gen AI inflection point)

cādence

+119%

2016 2026

Synopsys stock price



SYNOPSYS®

+25%

2016 2026

Siemens stock price

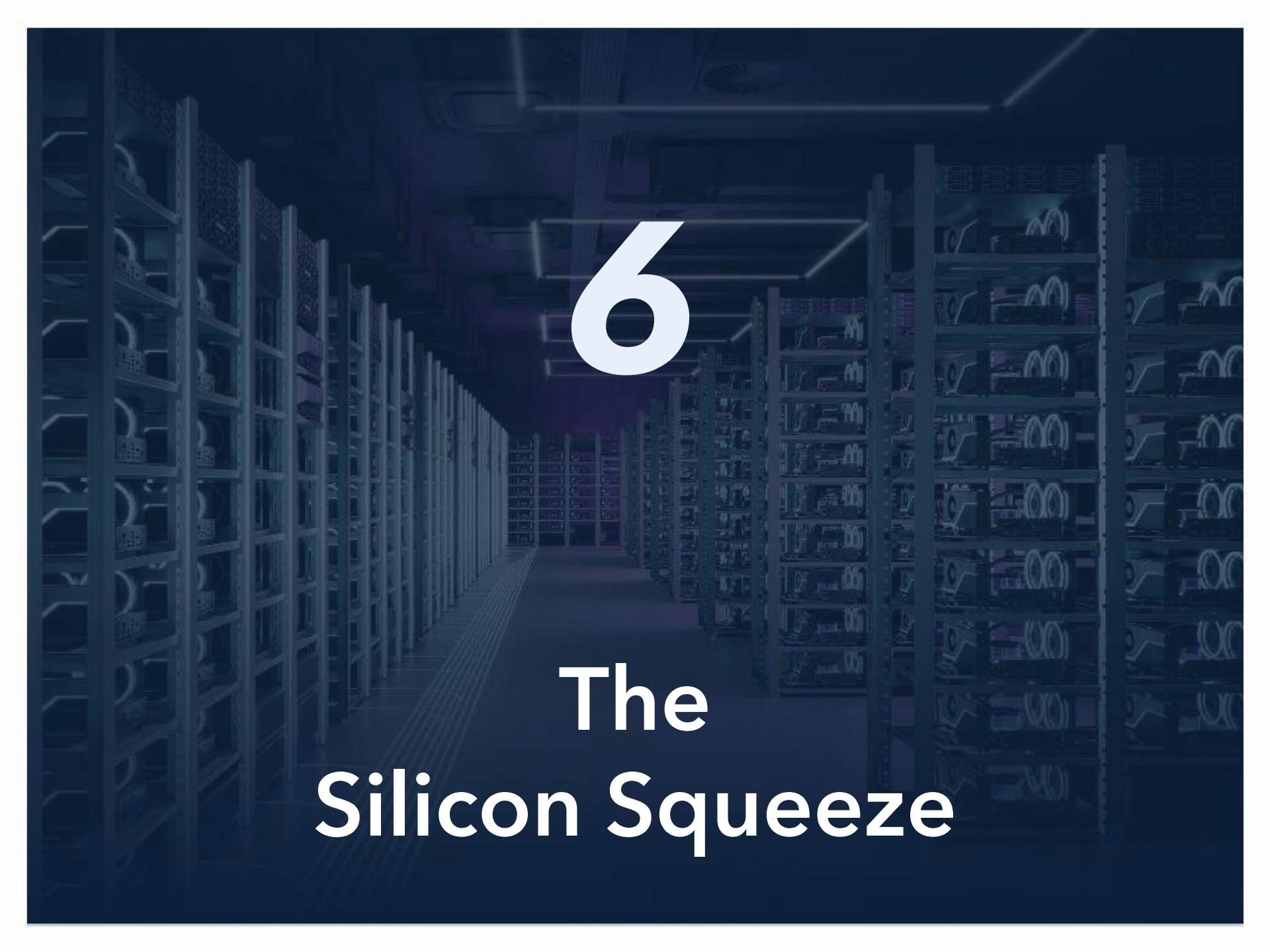


SIEMENS

+108%

2016 2026

Source: (1-3) Bloomberg. Data as of July 14, 2026.



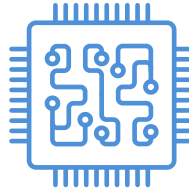
6

The Silicon Squeeze

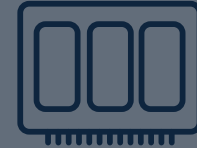
Highly Integrated Global Semiconductor Supply Chain



**EDA software
design tools**



**Fabless
chip design**



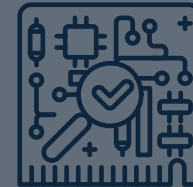
**Memory chip
IDMs**



**Capital
equipment**



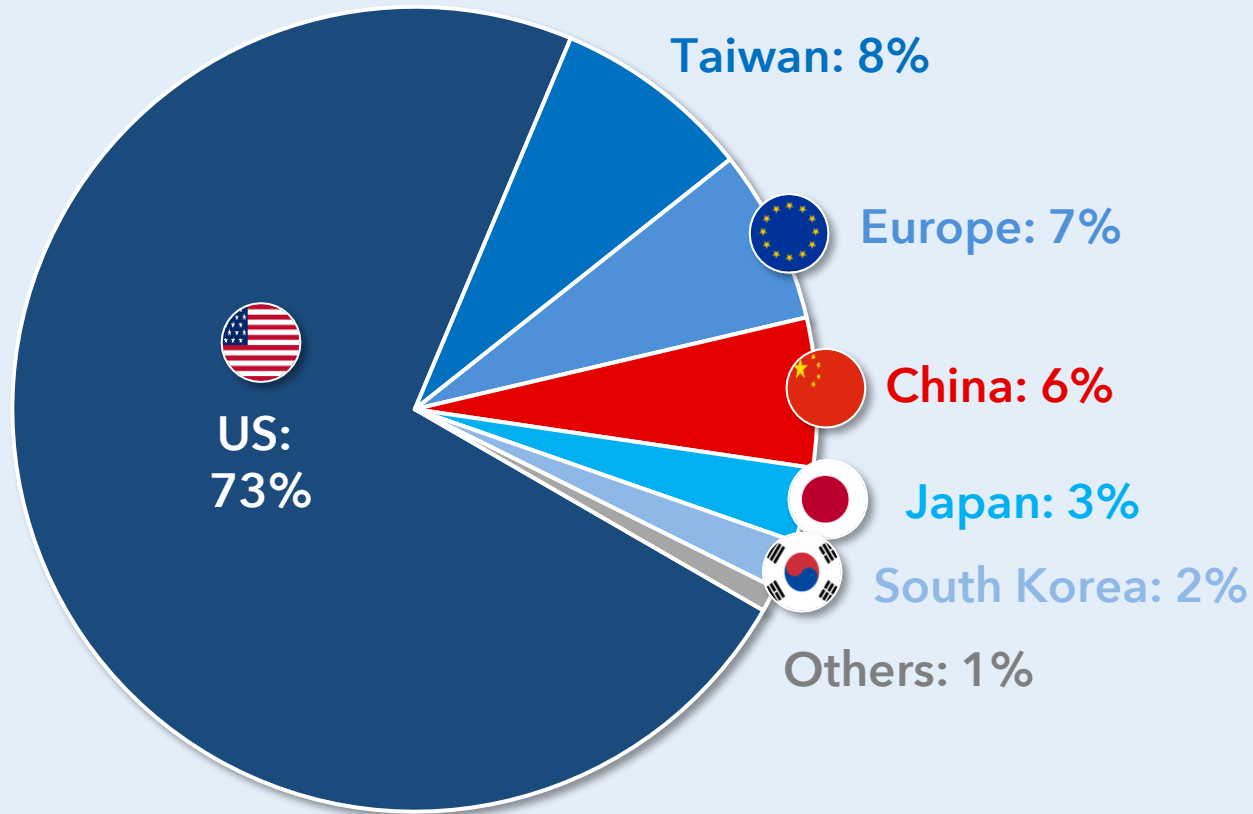
**Foundries
(manufacturing)**



**Assembly,
packaging & test**

Global Leadership in Semi Chip Design

Logic design value added, by region (2024)

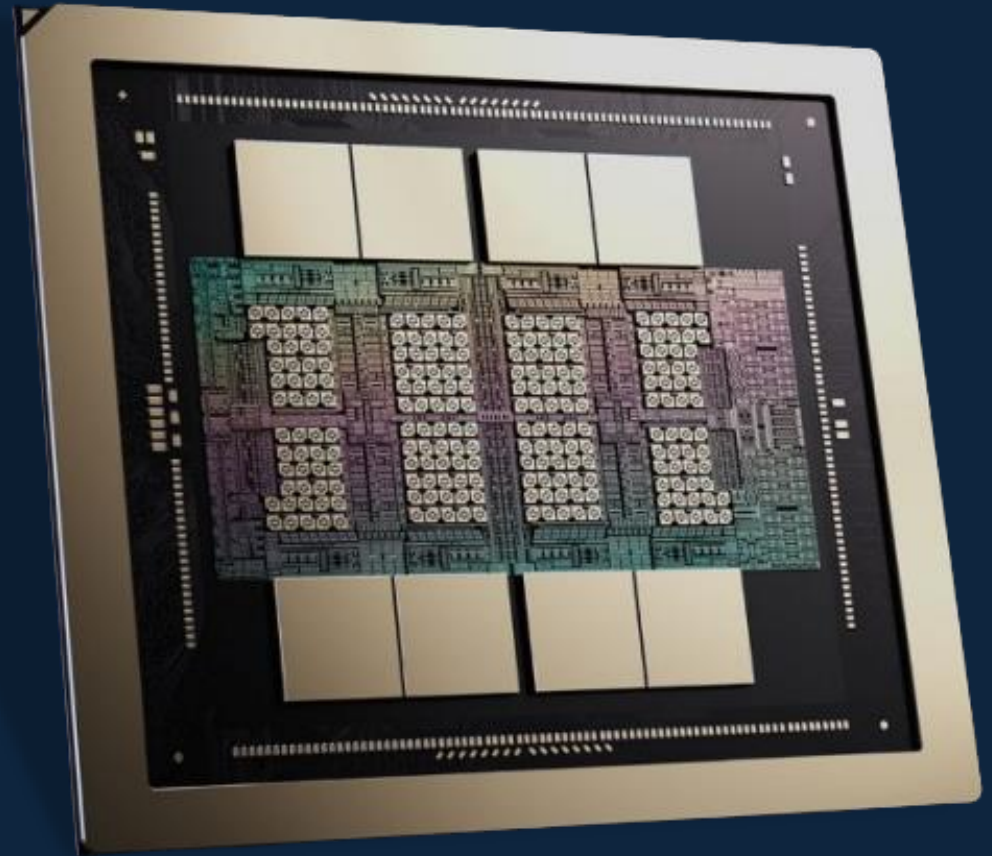


Source: (1) Semiconductor Industry Association, "2025: State of the U.S. Semiconductor Industry". Data as of 2024.

World's Most Complex Piece of Hardware

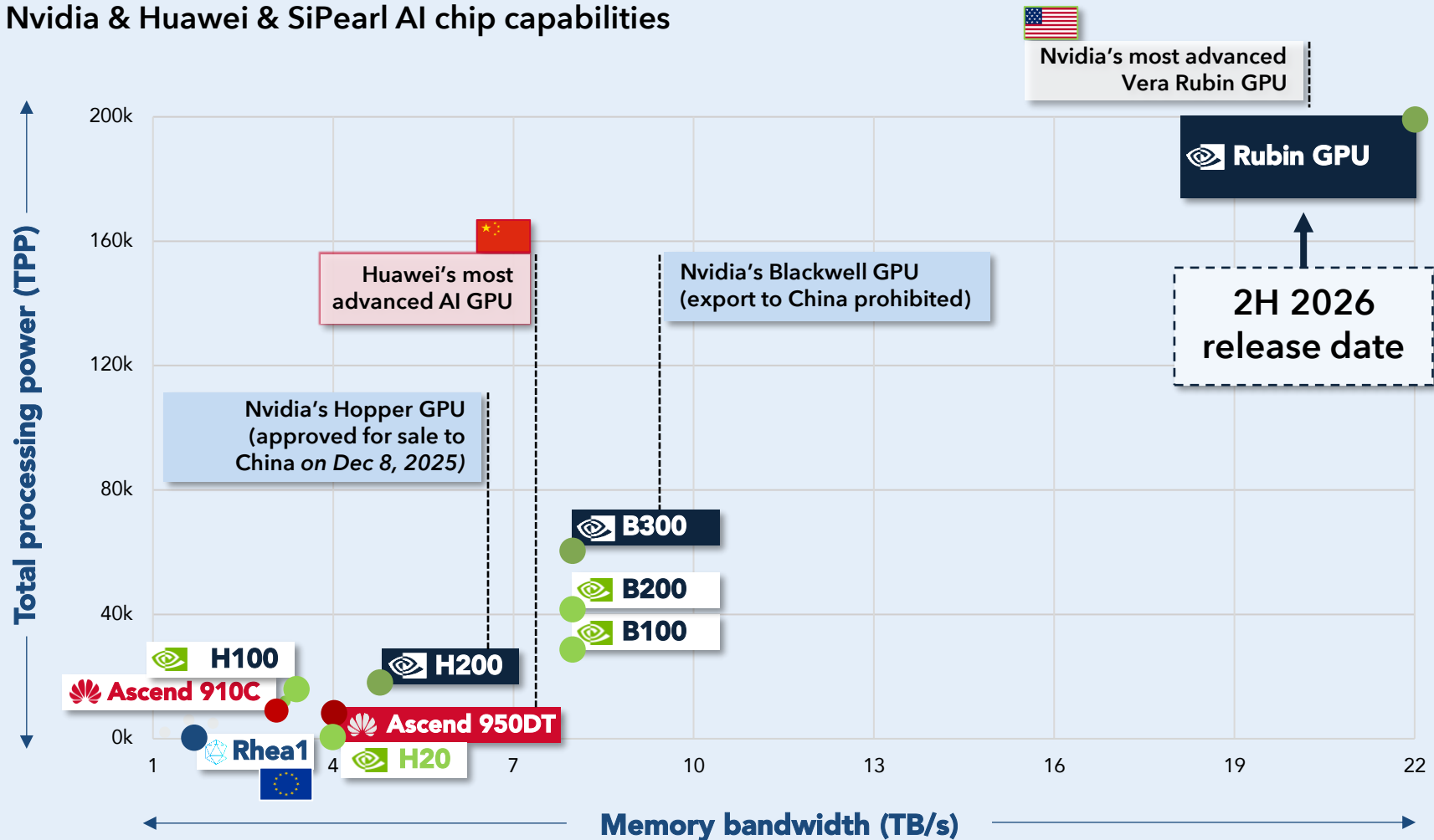
NVIDIA's Rubin GPU

- 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
- Key dates:
 - Announced: Jan 2026
 - Shipments: 2H 2026



GPU Design Leadership & Export Controls

Nvidia & Huawei & SiPearl AI chip capabilities

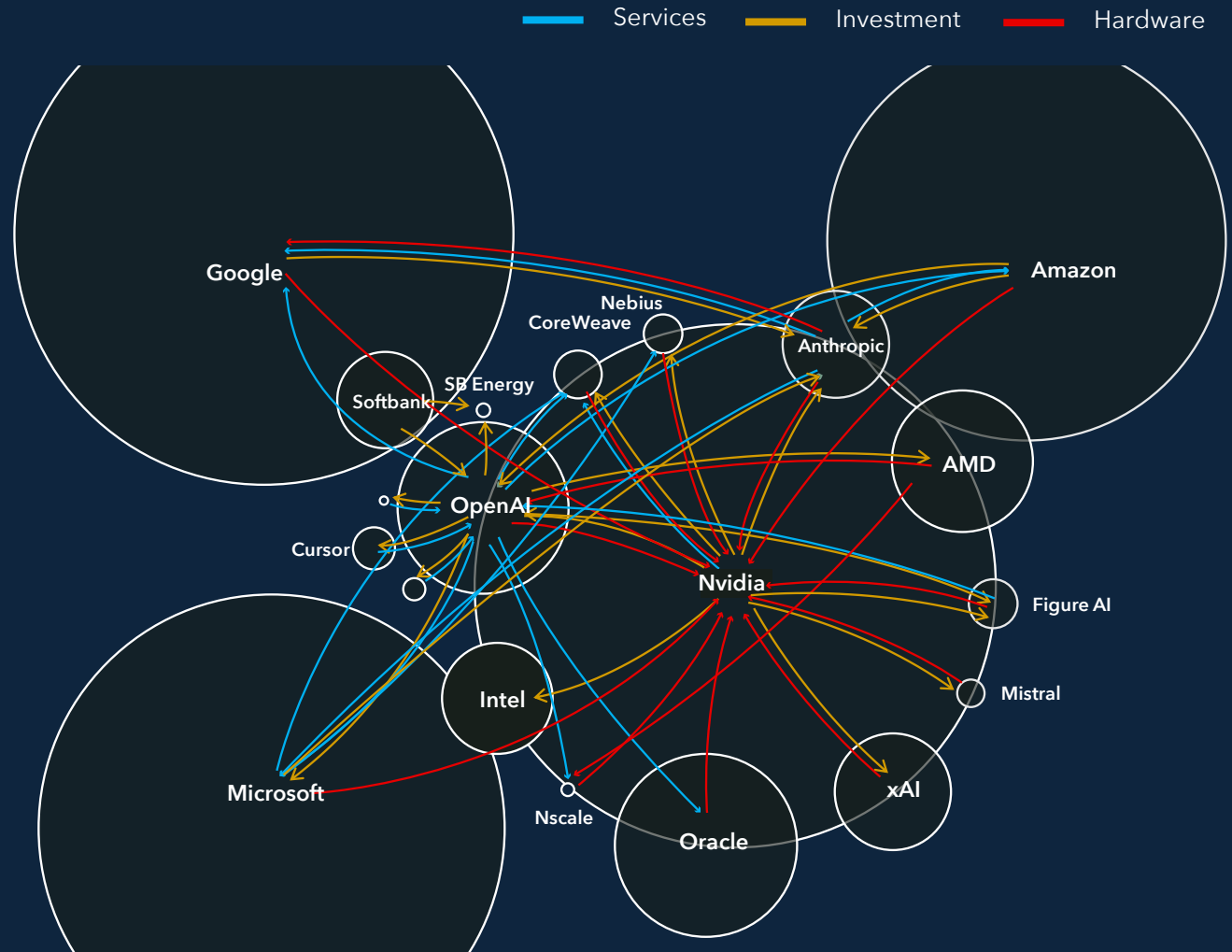


Source: (1) Bloomberg, "Nvidia's H200 Could Turbocharge China's AI Cloud". IFP. Tom's Hardware. Nvidia. Actual names and specifications may be different than those listed above.

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.

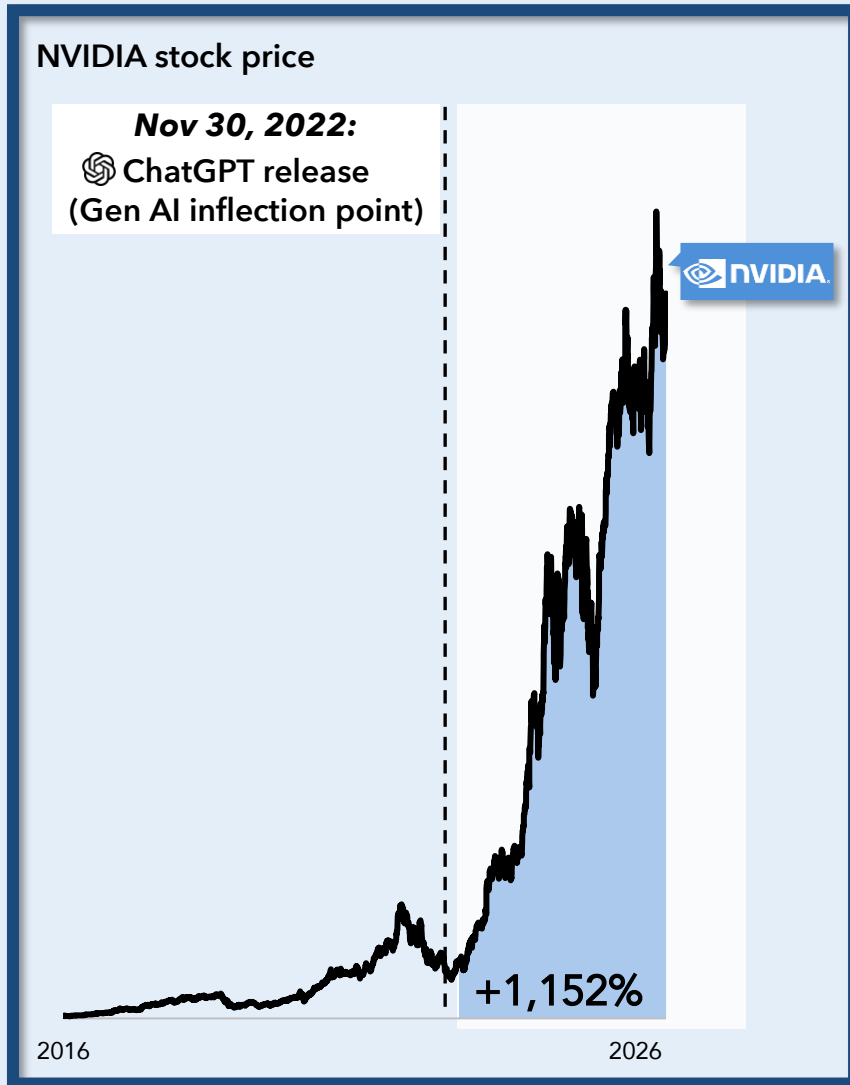


Source: Bloomberg, "Nvidia CEO Says New OpenAI Investment May Be Largest Yet." (February 2026). Size of circle denotes company market cap.

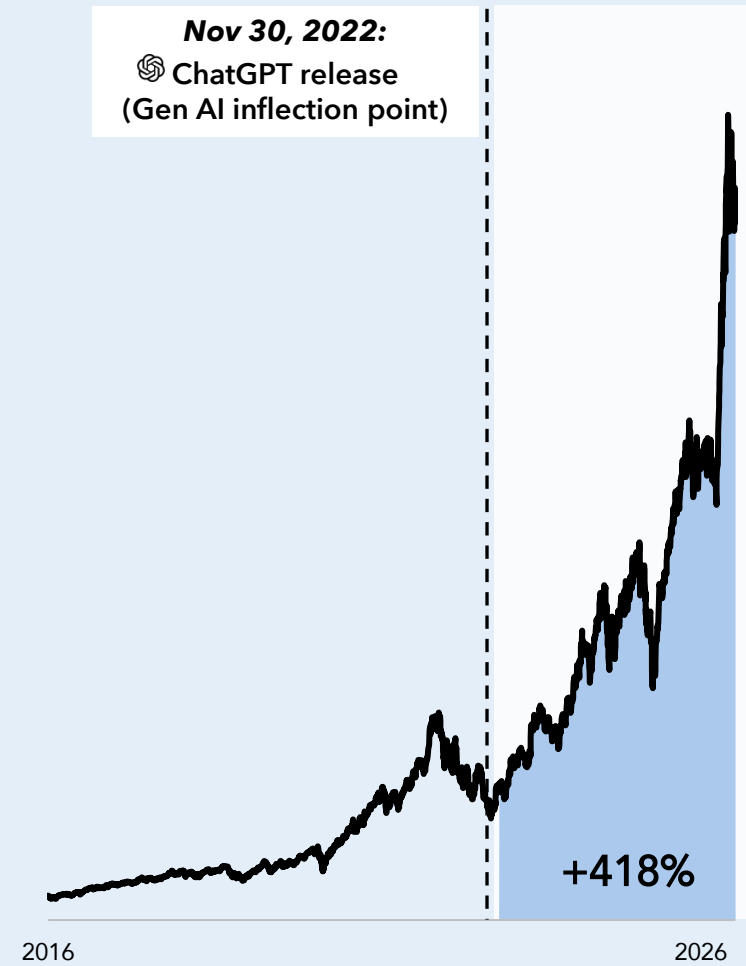
The World's Most Valuable Company



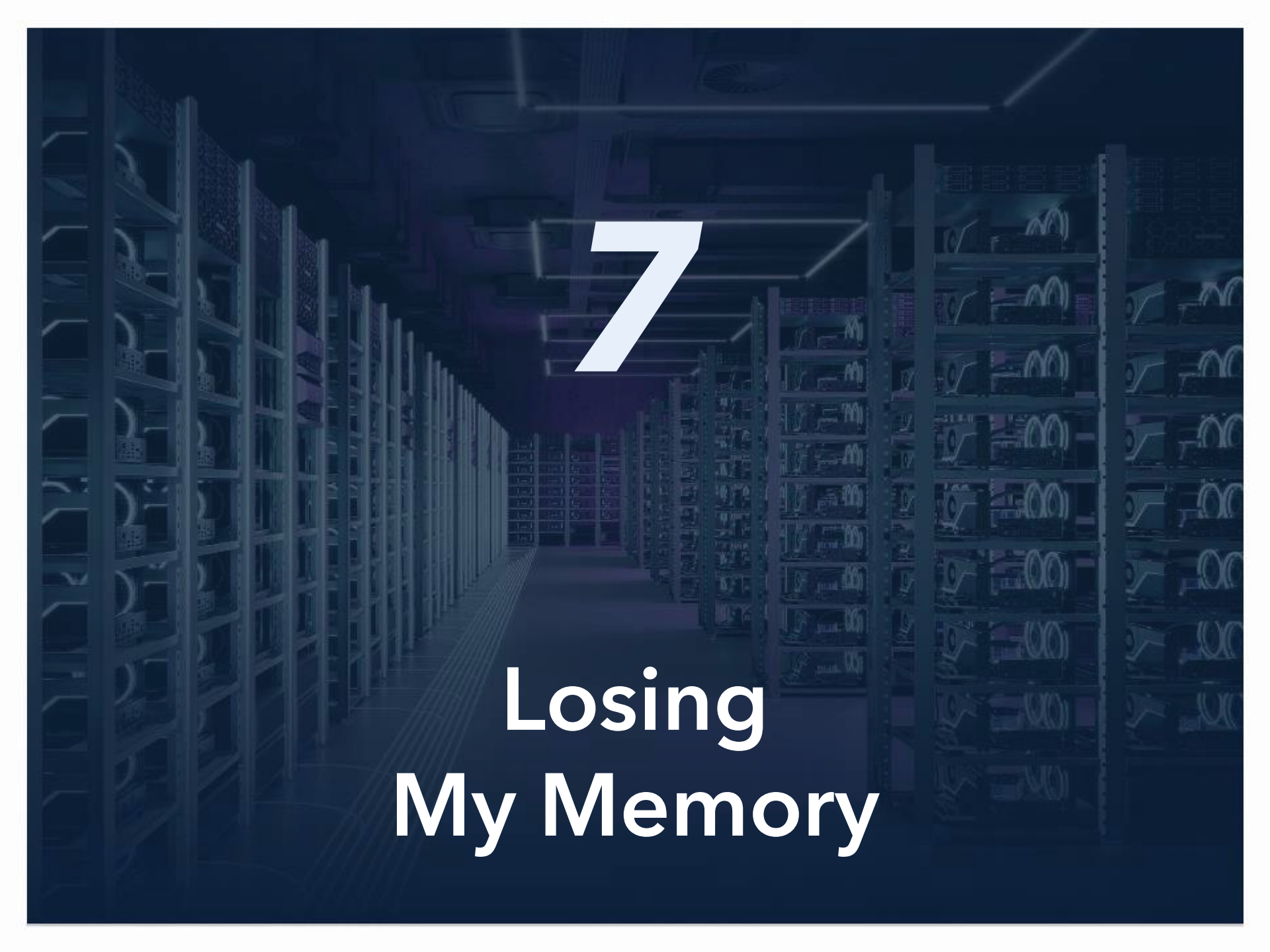
NVIDIA stock price



MarketVector US-listed fabless semiconductor index



Source: (1-2) Bloomberg. Data as of July 14, 2026.



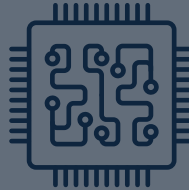
7

Losing My Memory

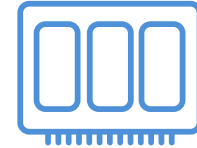
Highly Integrated Global Semiconductor Supply Chain



**EDA software
design tools**



**Fabless
chip design**



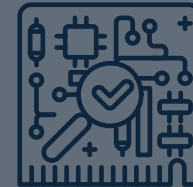
**Memory chip
IDMs**



**Capital
equipment**



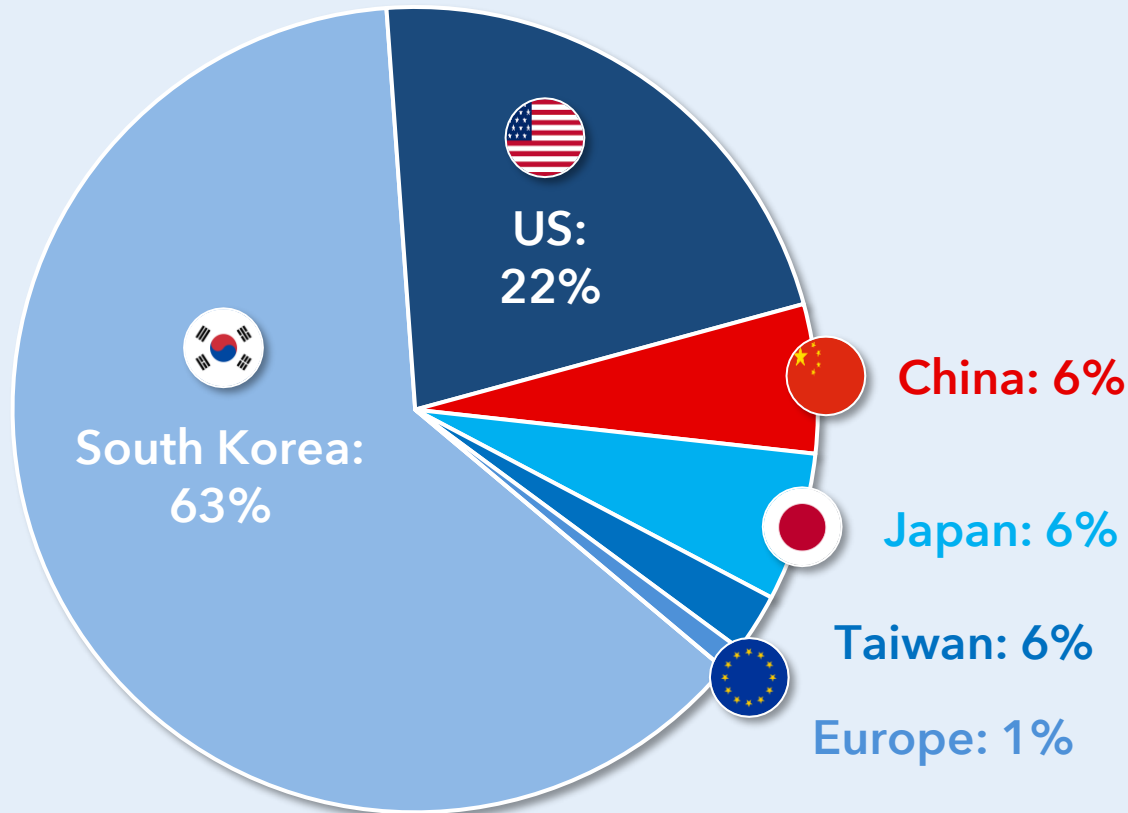
**Foundries
(manufacturing)**



**Assembly,
packaging & test**

Global Leadership in Memory Chip Design

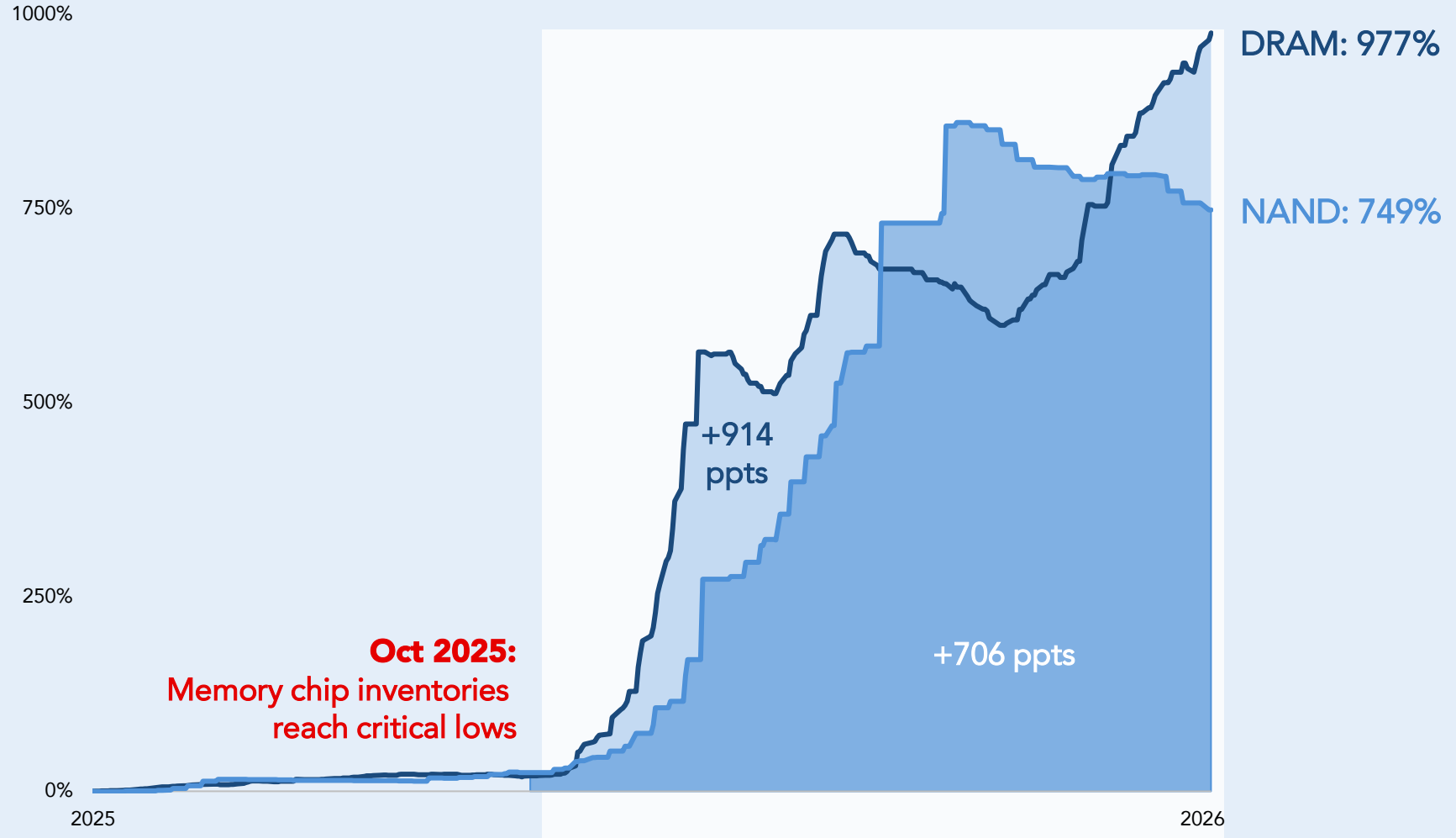
Memory chip design value added, by region (2024)



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

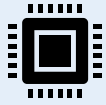
Memory Chip Shortages Ripple Through Markets

DRAM & NAND price performance since Feb 10, 2025



Source: (1) Bloomberg, "Memory Chip Squeeze Widens Gap Between Market Winners and Losers". Data as of July 14, 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.

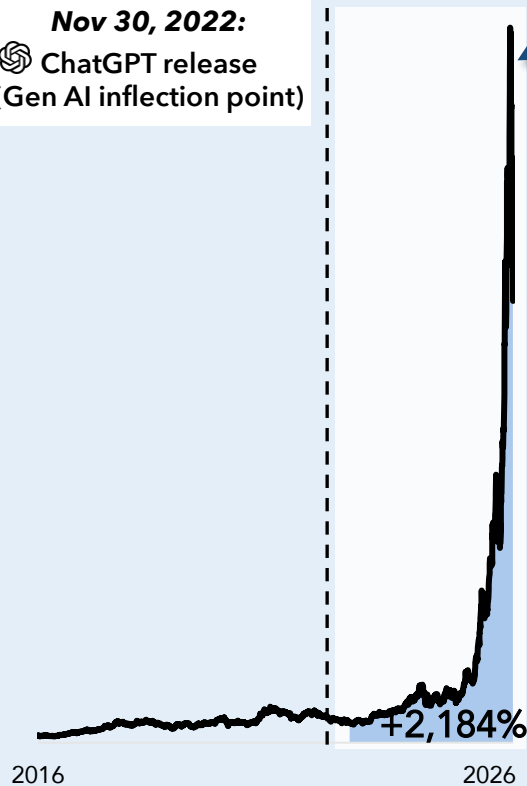
Experienced, Disciplined Oligopoly

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.

SK Hynix stock price



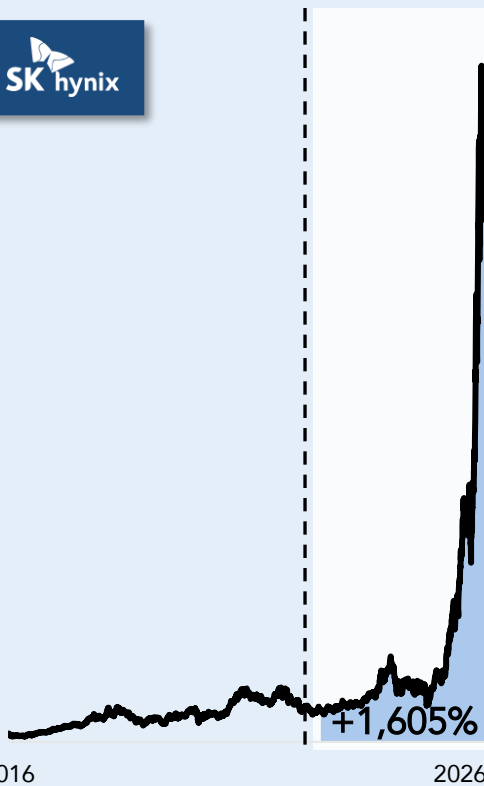
Nov 30, 2022:
ChatGPT release
(Gen AI inflection point)



Micron stock price



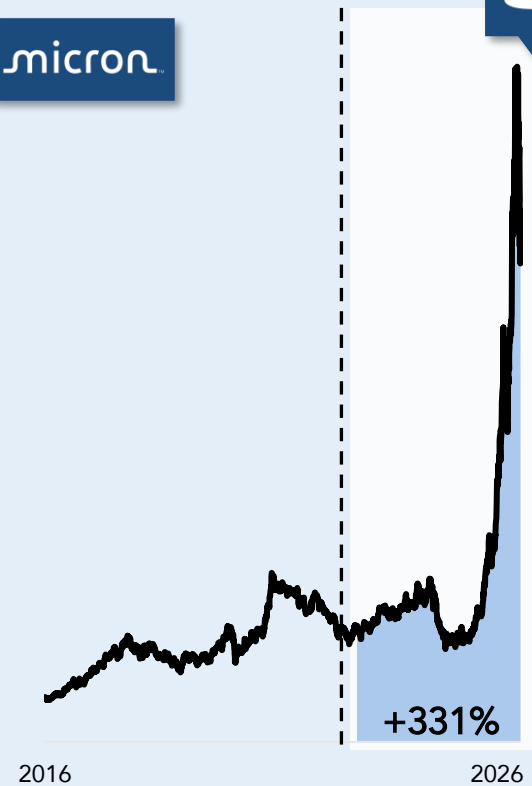
SK hynix



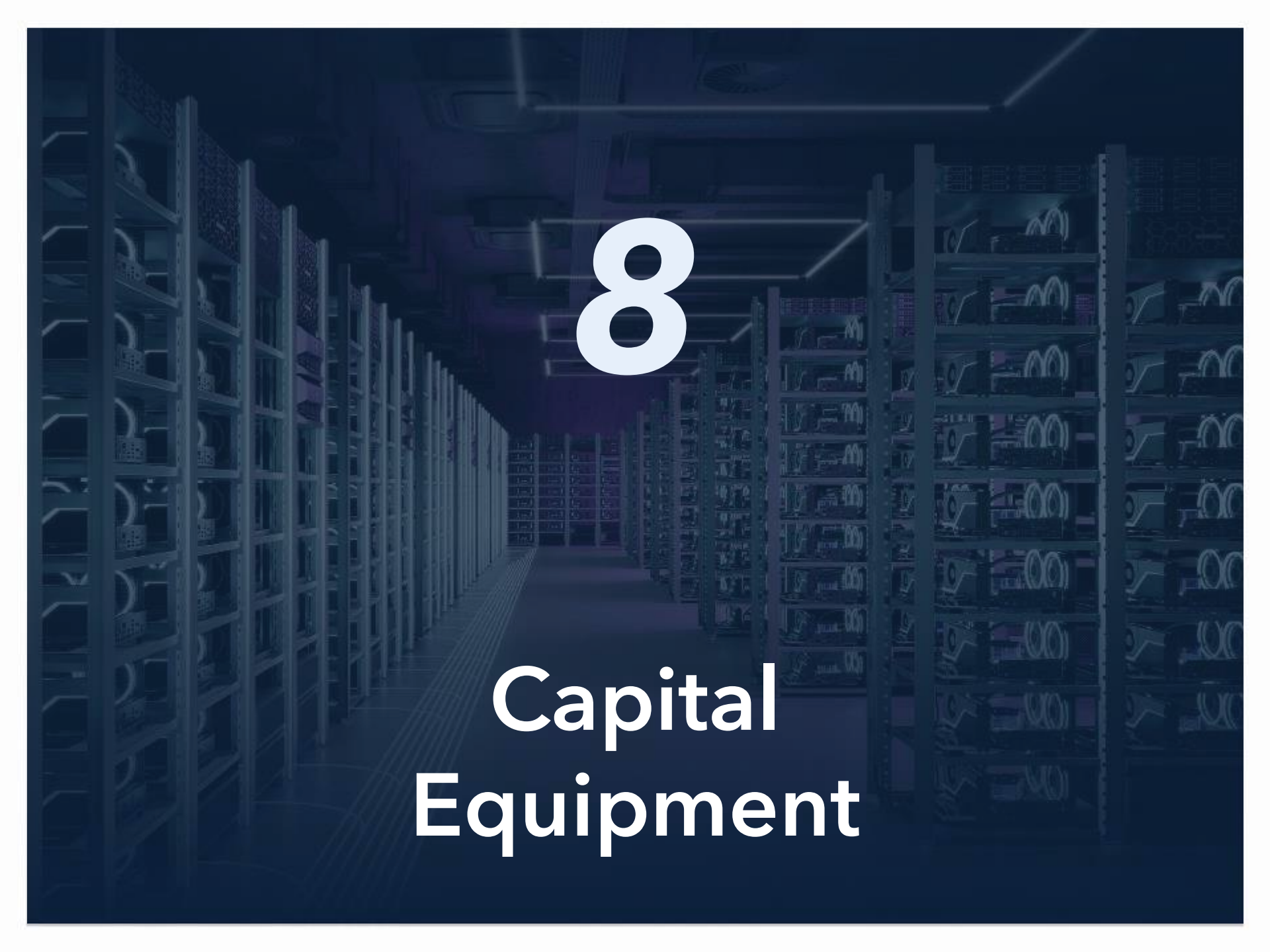
Samsung stock price



micron



Source: (1-3) Bloomberg. Data as of July 14, 2026.



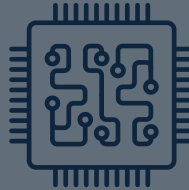
8

Capital Equipment

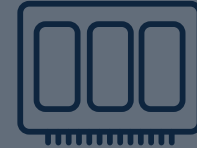
Highly Integrated Global Semiconductor Supply Chain



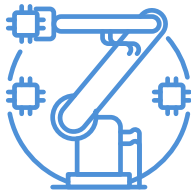
**EDA software
design tools**



**Fabless
chip design**



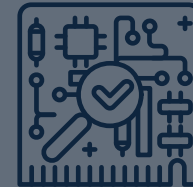
**Memory chip
IDMs**



**Capital
equipment**



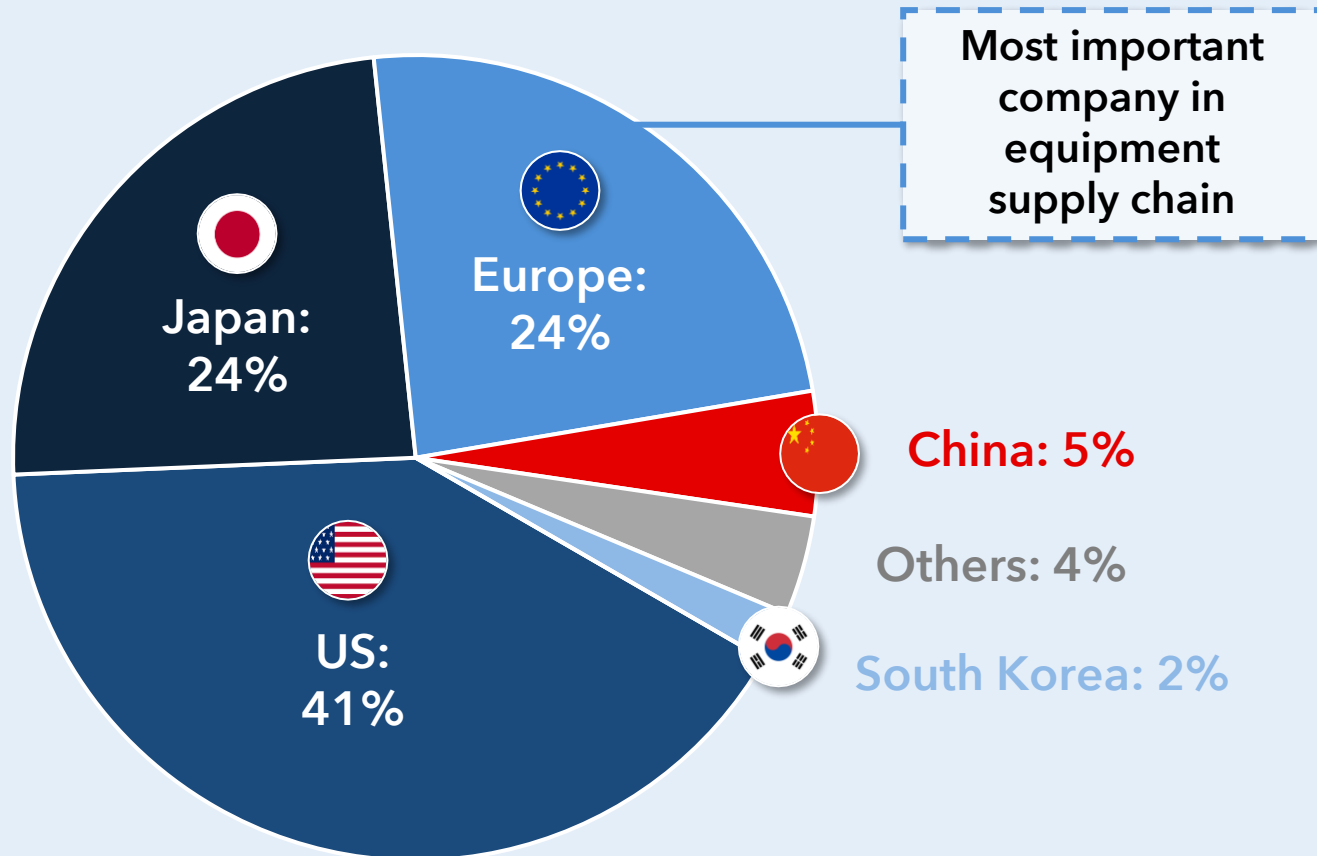
**Foundries
(manufacturing)**



**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.

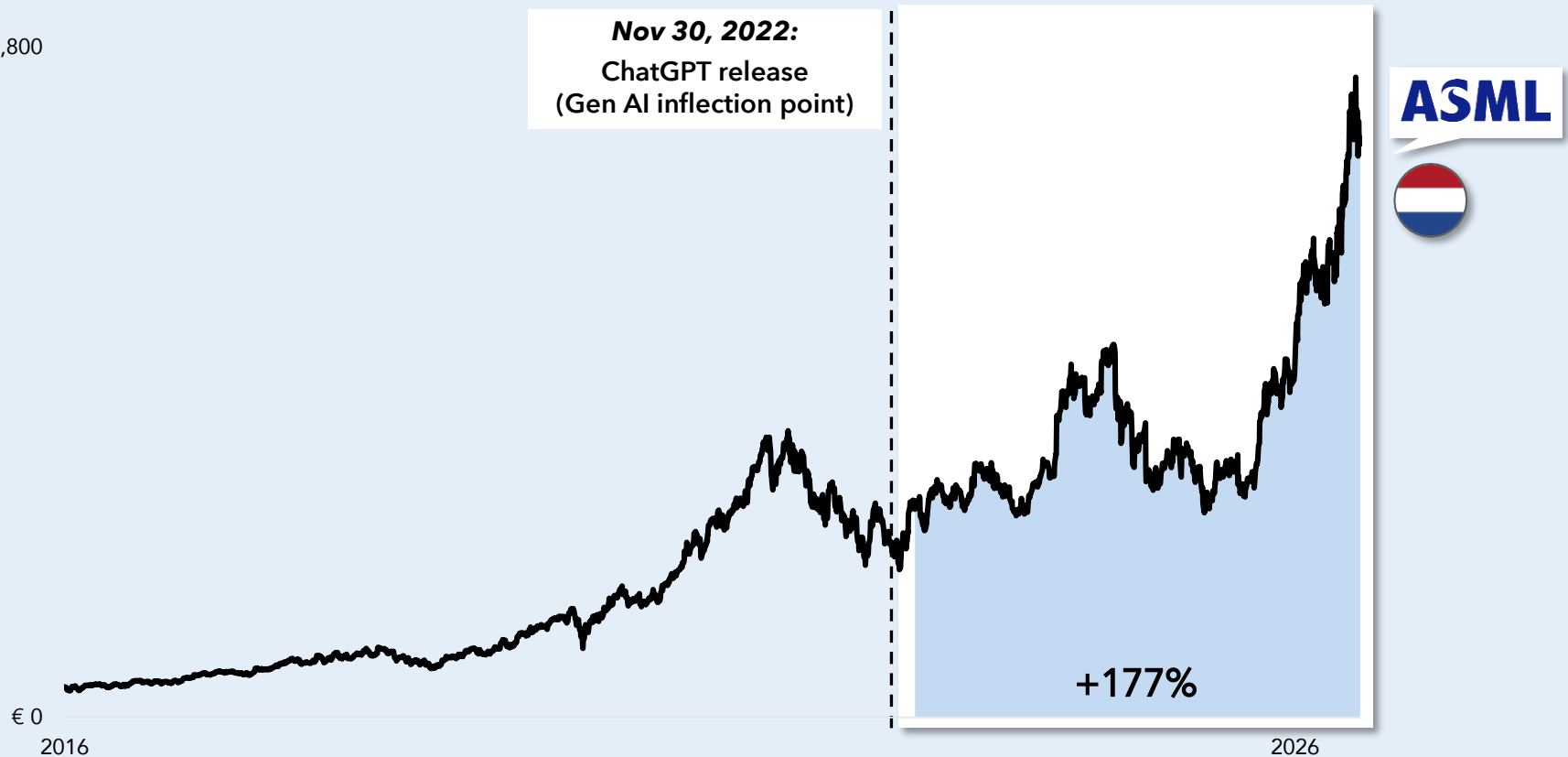
Europe's Most Valuable Company



ASML has become Europe's most valuable listed company on the back of surging AI capex and its unique position in advanced chipmaking equipment, which includes a near-monopoly on EUV lithography (one of the most complex and expensive machines in the world). Supplanting market leaders in both European luxury and pharmaceutical markets, ASML's rise is a testament to the transformative expansion of the AI capex supercycle.

ASML stock price

€ 1,800

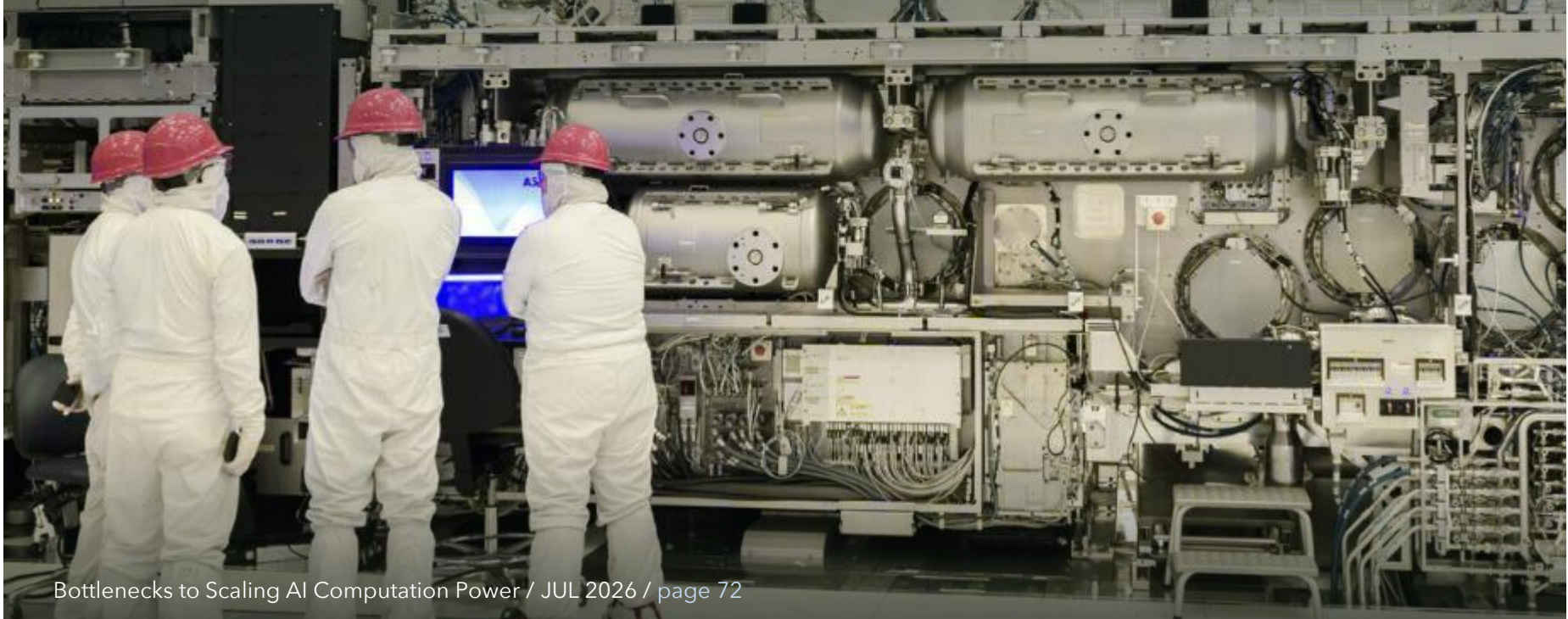


Source: (1) Bloomberg. Data as of July 14, 2026.

World's Most Complex Piece of Equipment

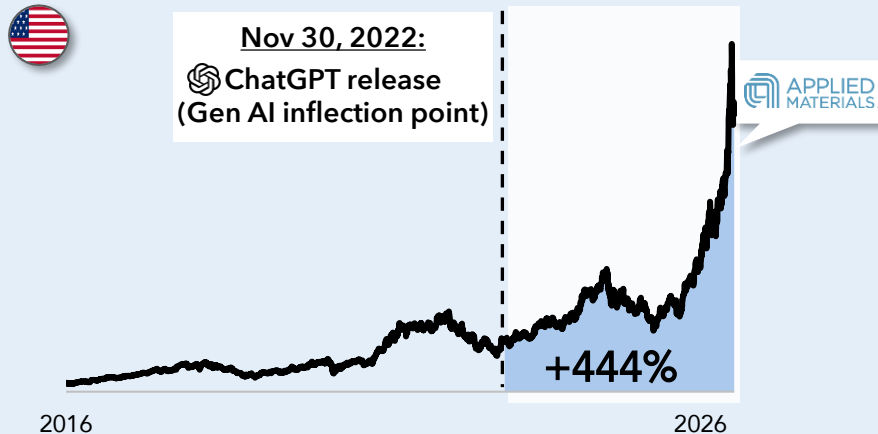
ASML's High-NA TWINSCAN EXE:5200B

- 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



Other Leading Semi Equipment Manufacturers

Applied Materials stock price



Tokyo Electron stock price



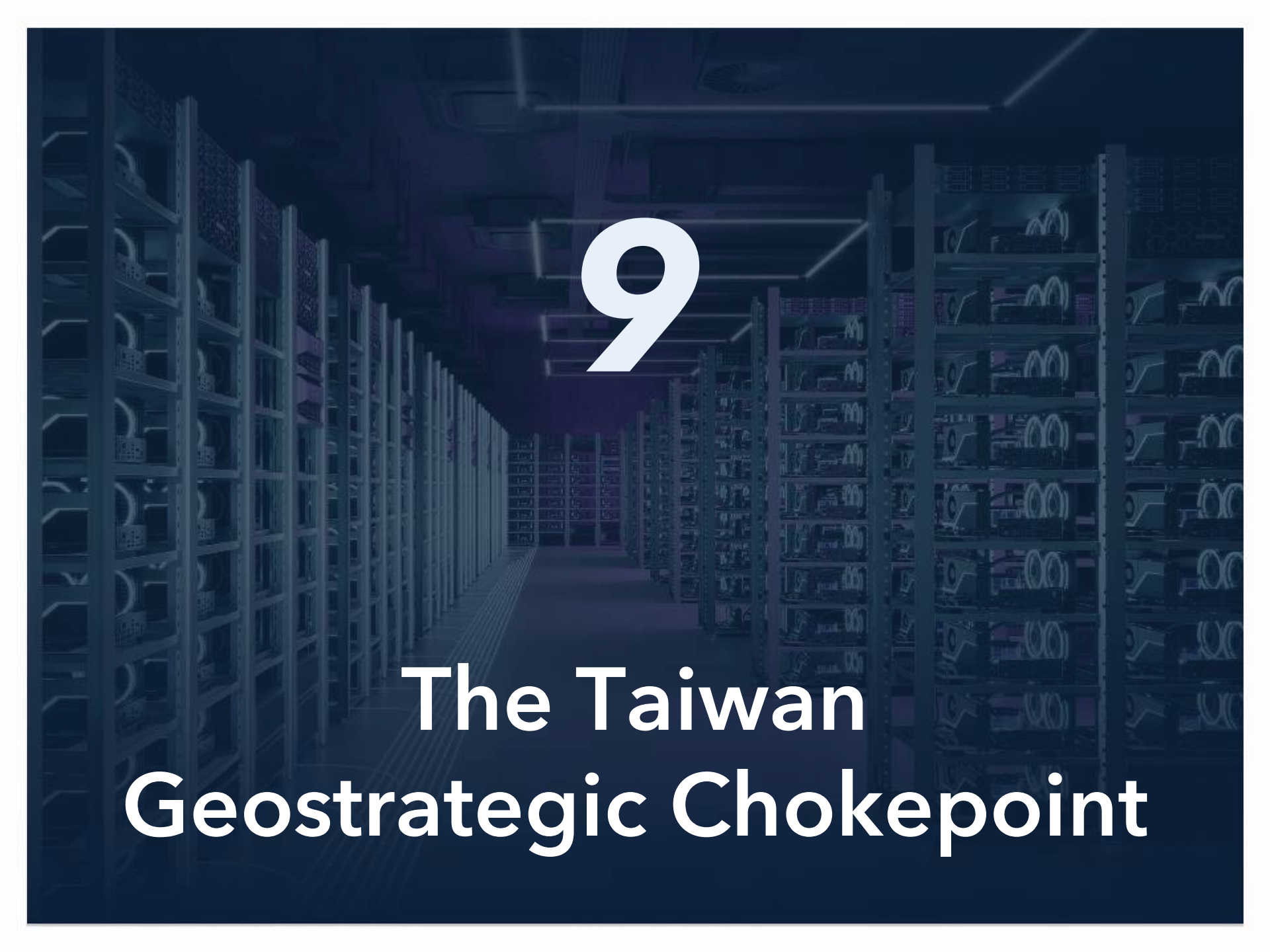
Lam Research stock price



KLA stock price



Source: (1-4) Bloomberg. Data as of July 14, 2026.



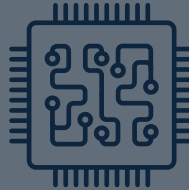
9

The Taiwan Geostrategic Chokepoint

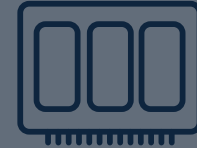
Highly Integrated Global Semiconductor Supply Chain



**EDA software
design tools**



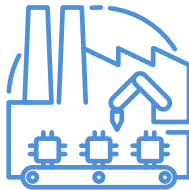
**Fabless
chip design**



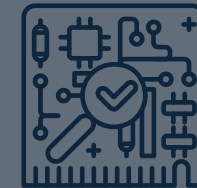
**Memory chip
IDMs**



**Capital
equipment**



**Foundries
(manufacturing)**



**Assembly,
packaging & test**



Morris Chang, 95-year-old Taiwanese-American businessman, and the founder of the largest, most advanced and most important semiconductor company in the world, TSMC.

Asia's Most Valuable Company

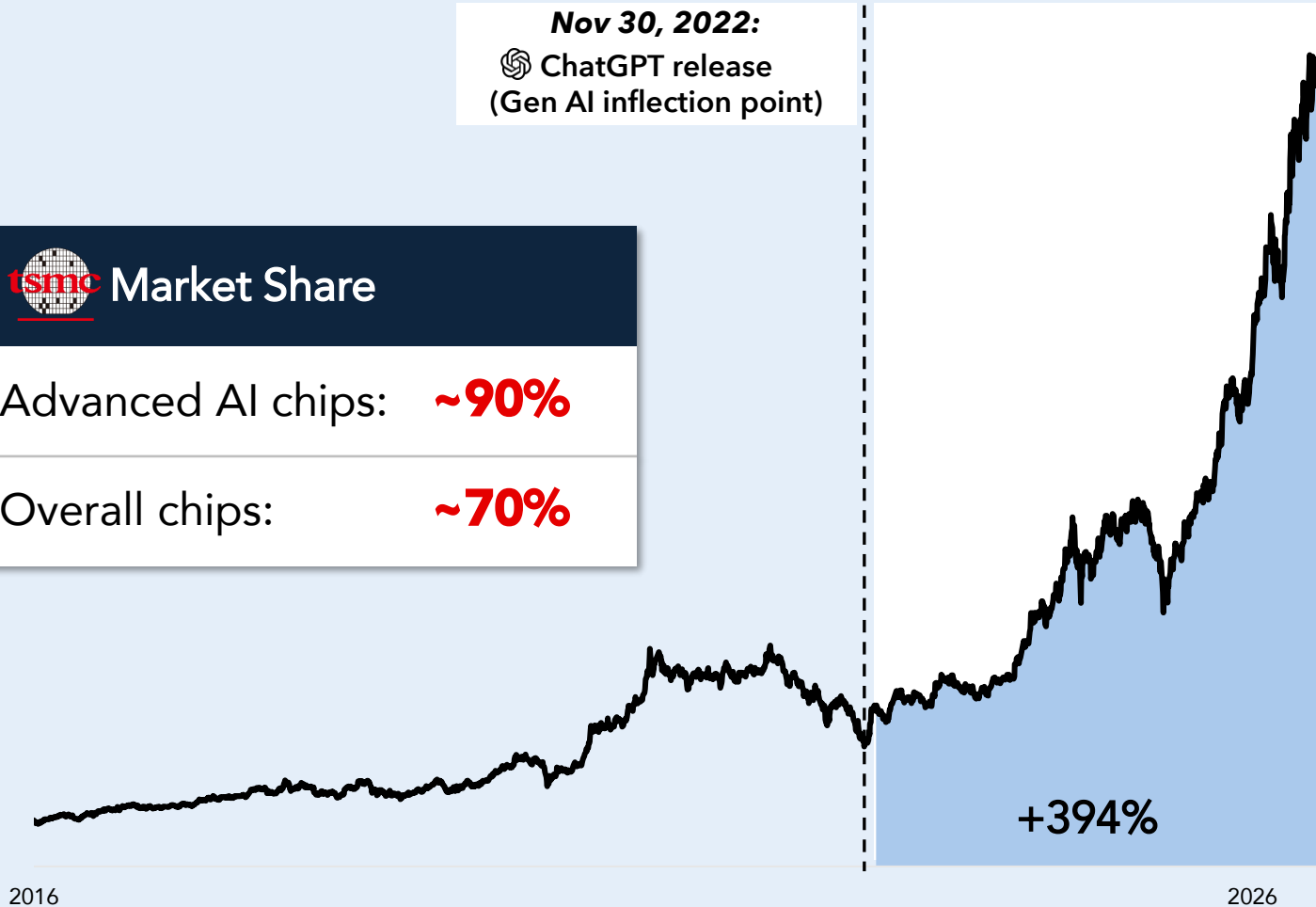
TSMC stock price

Nov 30, 2022:
ChatGPT release
(Gen AI inflection point)

 **Market Share**

Advanced AI chips: **~90%**

Overall chips: **~70%**



The world's
most
important
chip
manufacturer

Source: (1) Bloomberg. Data as of July 14, 2026.

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



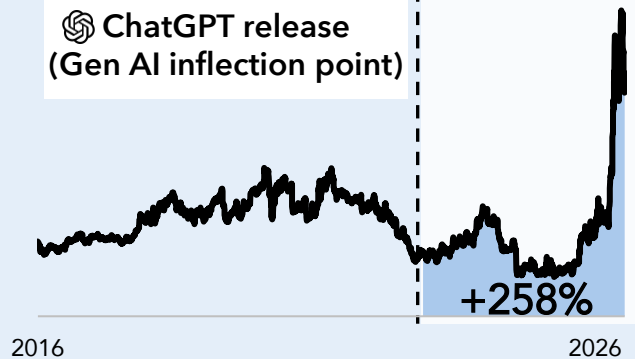
Other Leading Chip Manufacturers

Intel stock price



Nov 30, 2022:
ChatGPT release
(Gen AI inflection point)

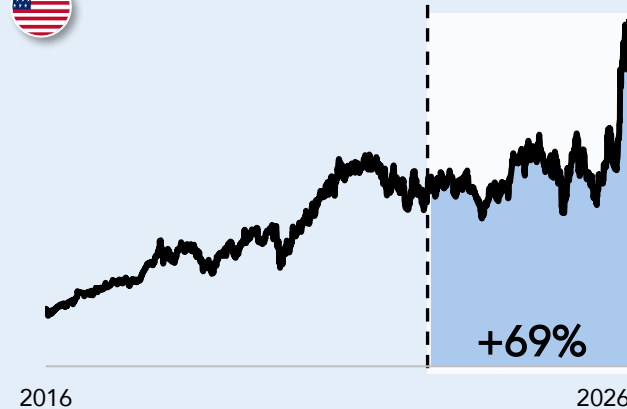
intel



Texas Instruments stock price



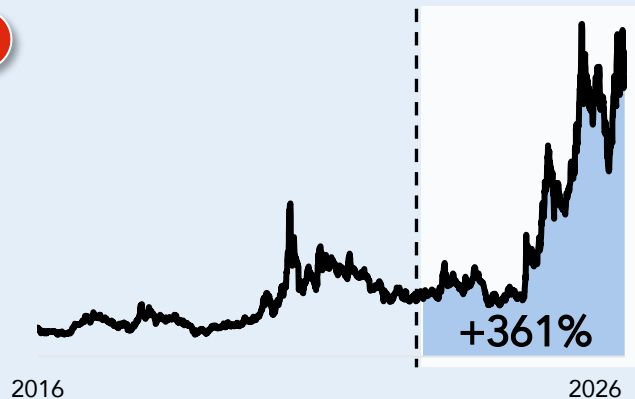
TEXAS
INSTRUMENTS



SMIC stock price

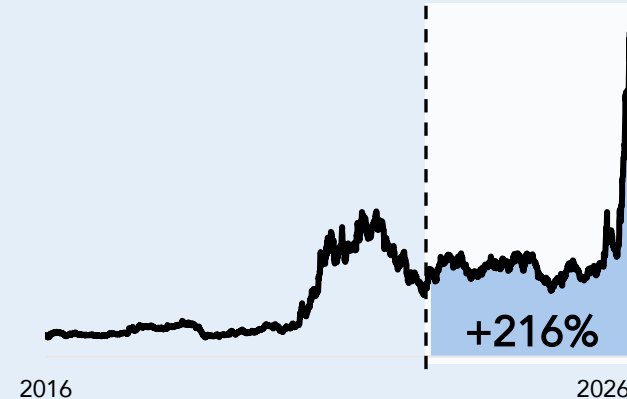


SMIC



UMC stock price

UMC



Source: (1-4) Bloomberg. Data as of July 14, 2026.

The Risk-Clock for Taiwan's Silicon Chokepoint



President Xi's political lifetime (legacy)

(age 73, 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)



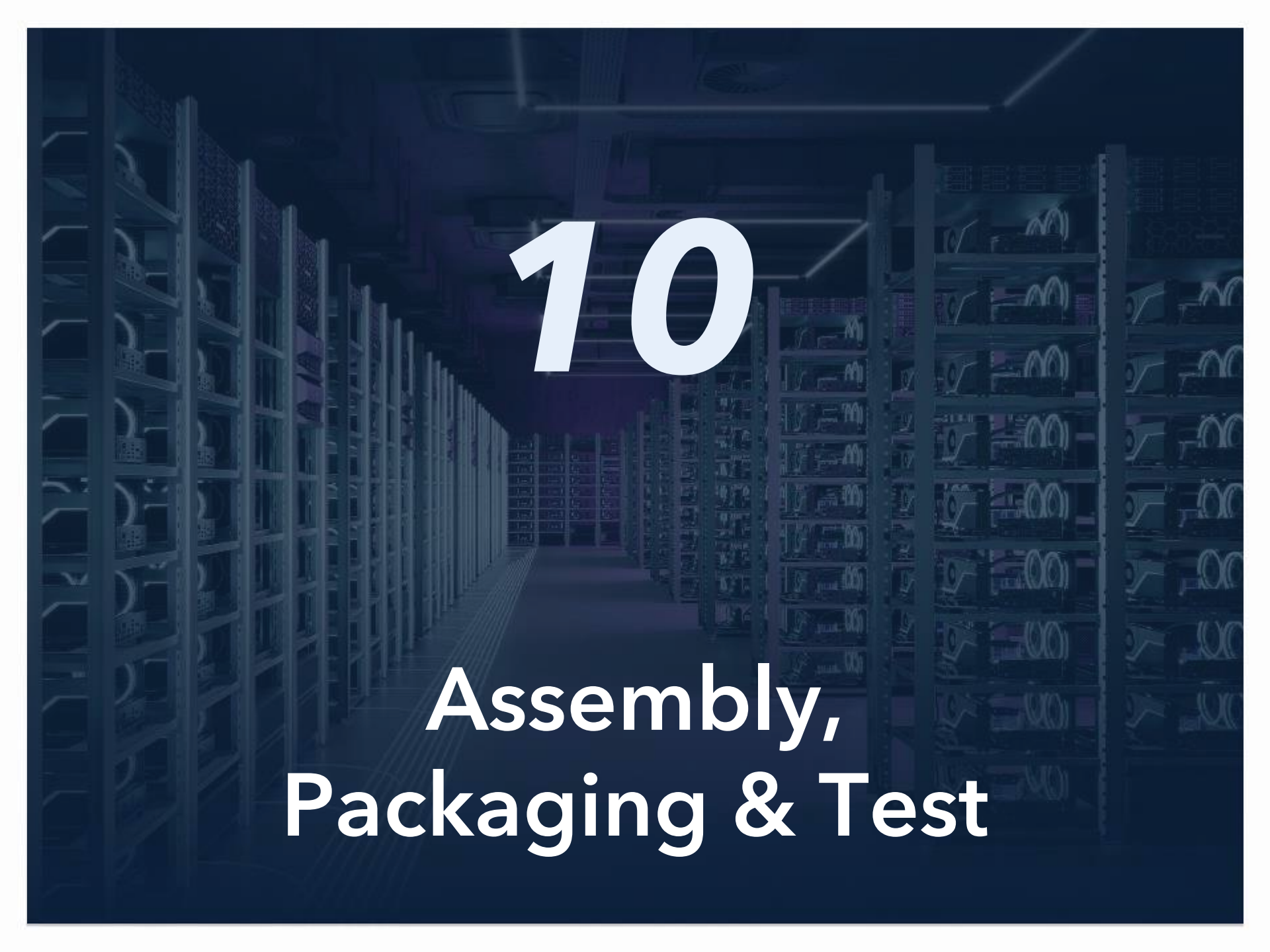
Horizontal globalization of a crisis

(Hormuz precedent, economic warfare, sanctions, SWIFT, supply chains)



Lessons of Ukraine & Hormuz

(asymmetric power, land vs. aerial vs. amphibious invasions, economic implications - chips > energy)



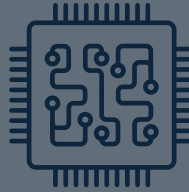
10

**Assembly,
Packaging & Test**

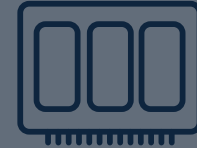
Highly Integrated Global Semiconductor Supply Chain



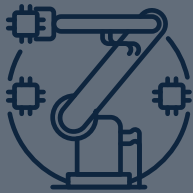
**EDA software
design tools**



**Fabless
chip design**



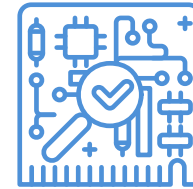
**Memory chip
IDMs**



**Capital
equipment**



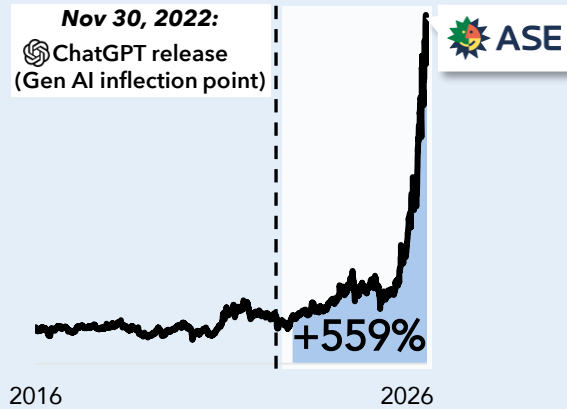
**Foundries
(manufacturing)**



**Assembly,
packaging & test**

Leading Assembly, Packaging & Test Companies

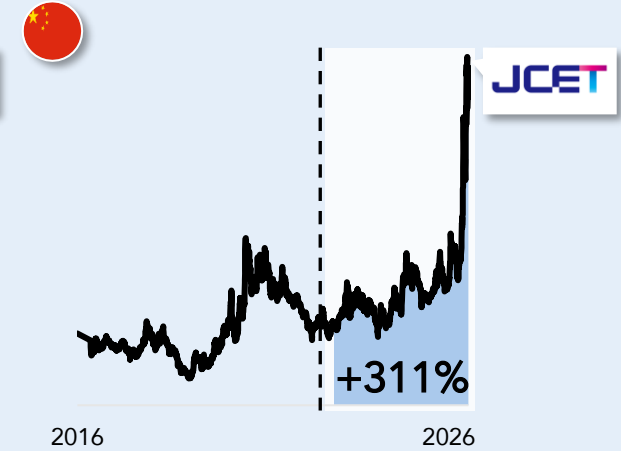
ASE Technology stock price
(Taiwan)



Amkor Technology stock price



JCET stock price



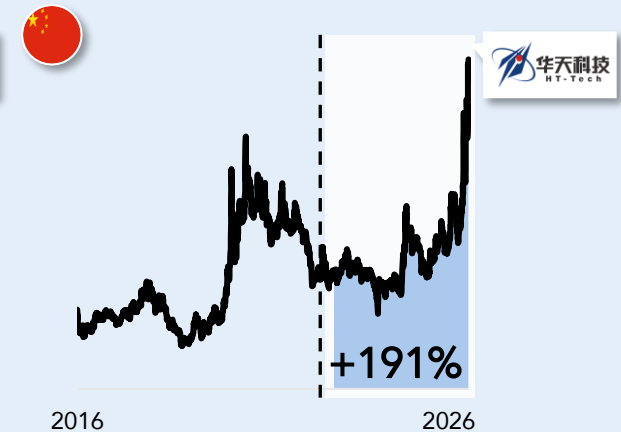
TongFu Microelectronics stock price



Powertech Technology stock price
(Taiwan)



Tianshui Huatian Tech stock price



Source: (1-6) Bloomberg. Data as of July 14, 2026.

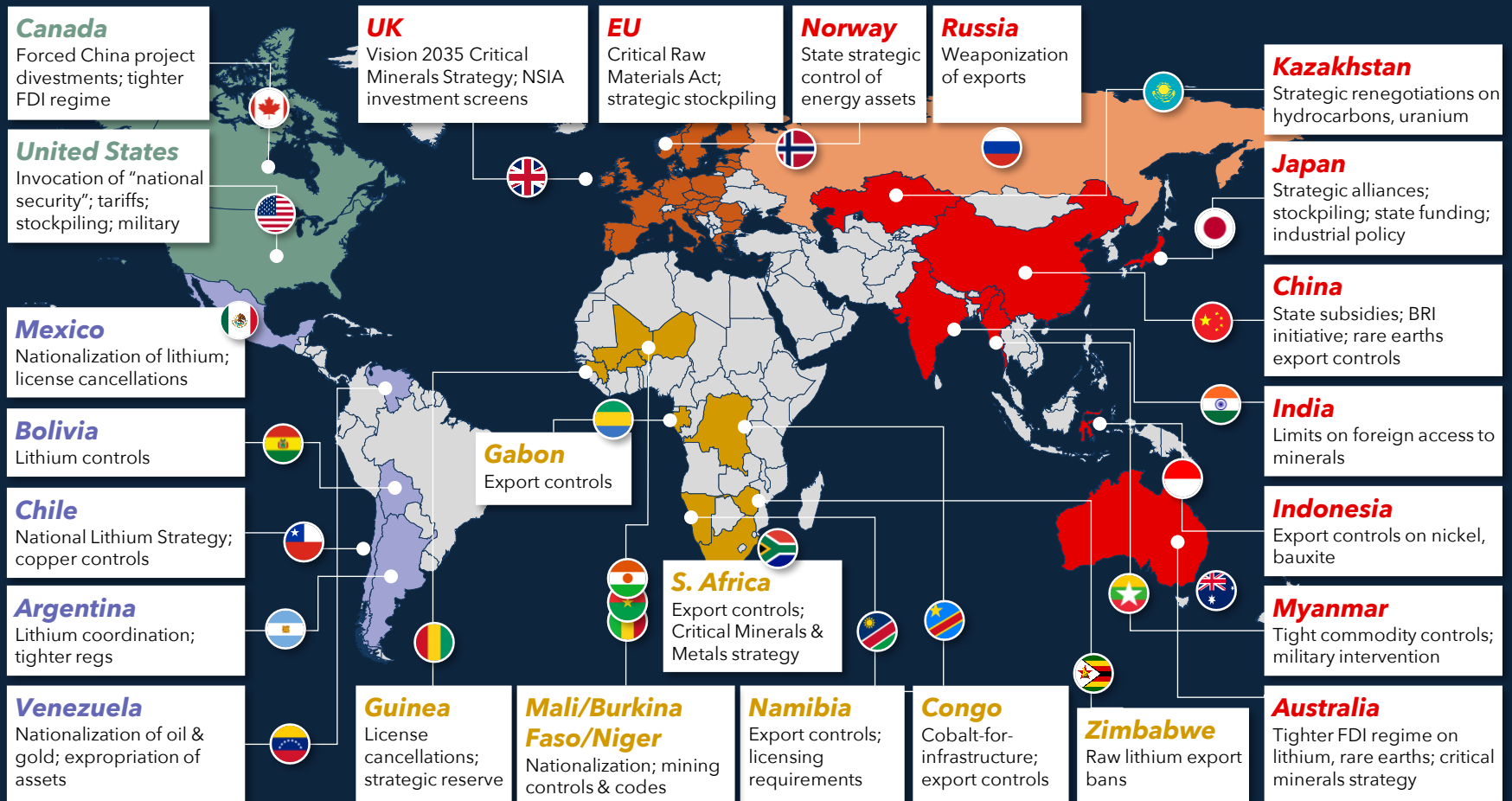


11

Strategic Minerals & Electronics

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).



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



Reserves

~49%



Mining / production

~70%



Refining

~90%



Permanent Magnets

~90-94%



Heavy Rare Earths

> 99%

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.

Inflection Point for AI Expansion Has Shifted to Energy & Infrastructure

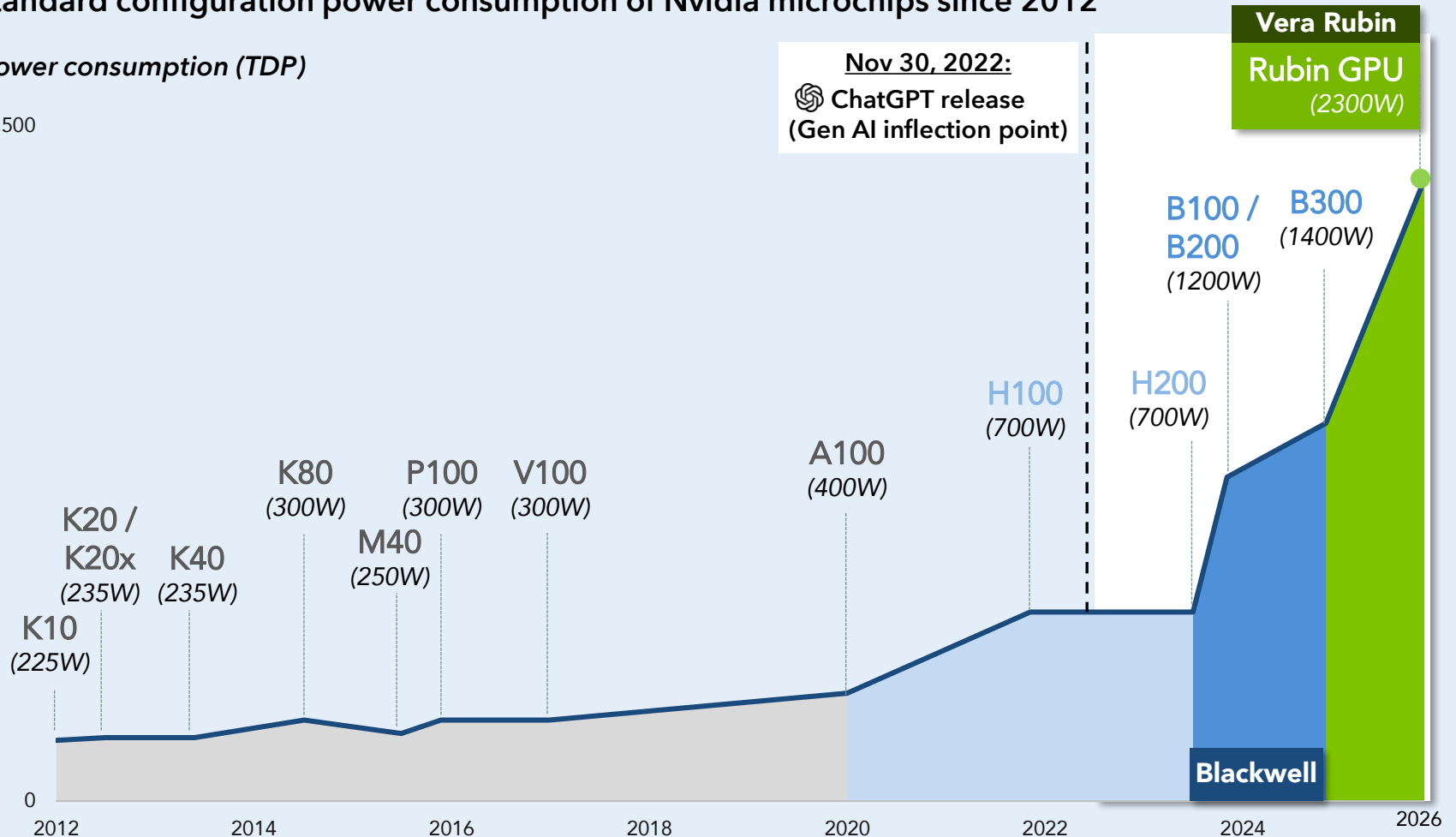


Standard configuration power consumption of Nvidia microchips since 2012

Power consumption (TDP)

2,500

Nov 30, 2022:
 ChatGPT release
(Gen AI inflection point)

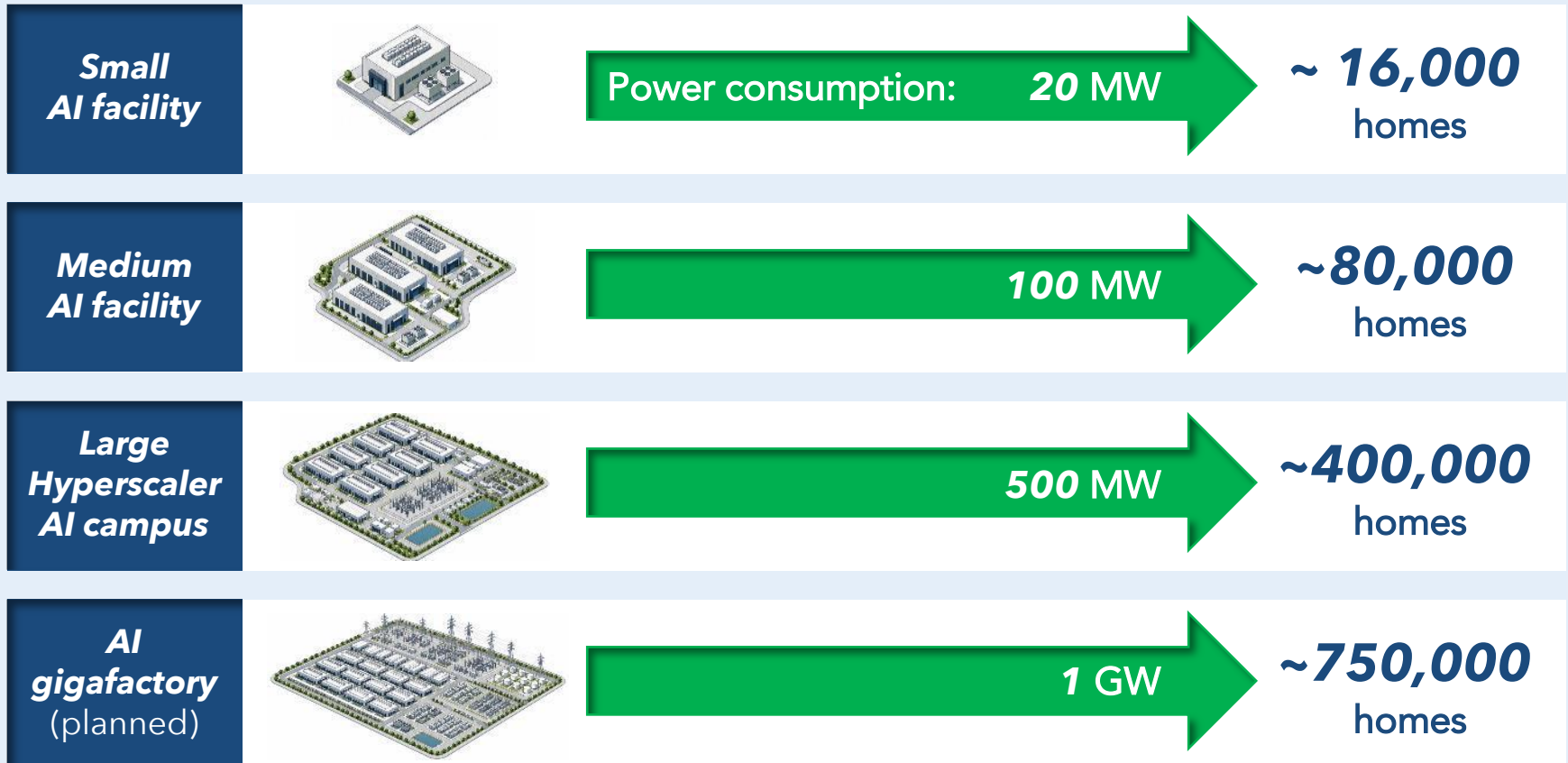


Source: (1) Nvidia. Various news sources.

Energy Demands of New AI Data Centers

According to data from the US Energy Information Agency, a new gigawatt-sized data center at 85% peak capacity will consume as much energy in a year as approximately 750,000 households or nearly 2 million people.

How much power does an AI data center use?



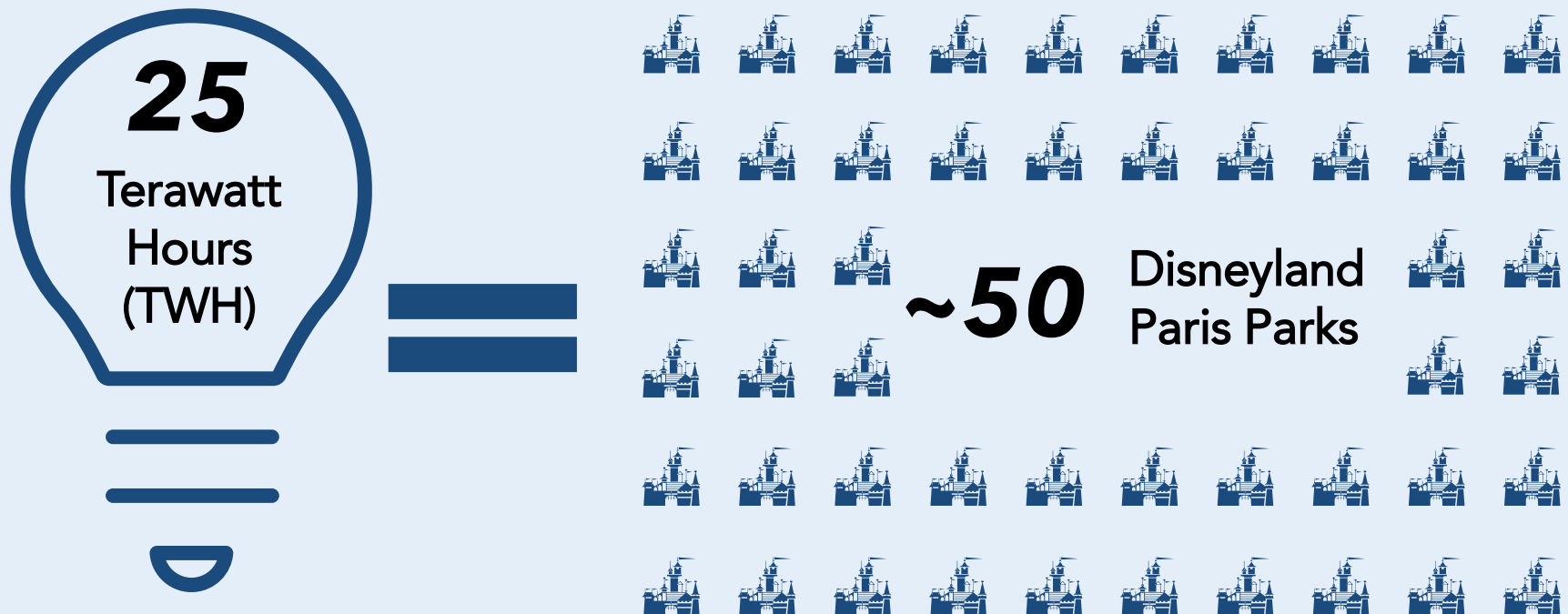
Source: (1) IEA, "Energy and AI" (April 2025). Federal Energy Regulatory Commission, "Interconnection of Large Loads to the Interstate Transmission System". Introl, "Nuclear Power for AI: Inside the Data Center Energy Deals".

Alphabet's Annual Energy Use

Alphabet

Alphabet's annual energy use alone is equivalent to ~2.5 million households, or nearly 50 Disneyland Paris parks for an entire year.

Alphabet's annual energy consumption



Source: IMD, "Big AI's dirty secret: The environmental cost of generative AI" (March 2025). Alphabet, "2023 Environmental Report".

Alphabet's Annual Water Consumption

Alphabet

Data centers rely heavily on water for cooling systems to prevent over-heating. Nvidia's most advanced GPUs, which utilize direct liquid cooling vs. legacy air-cooled data centers, are explicitly designed to reduce on-site cooling and water requirements.

Alphabet's annual water consumption

24 Million Cubic Meters

=

9,618 Olympic-sized swimming pools

or 120 million bathtubs

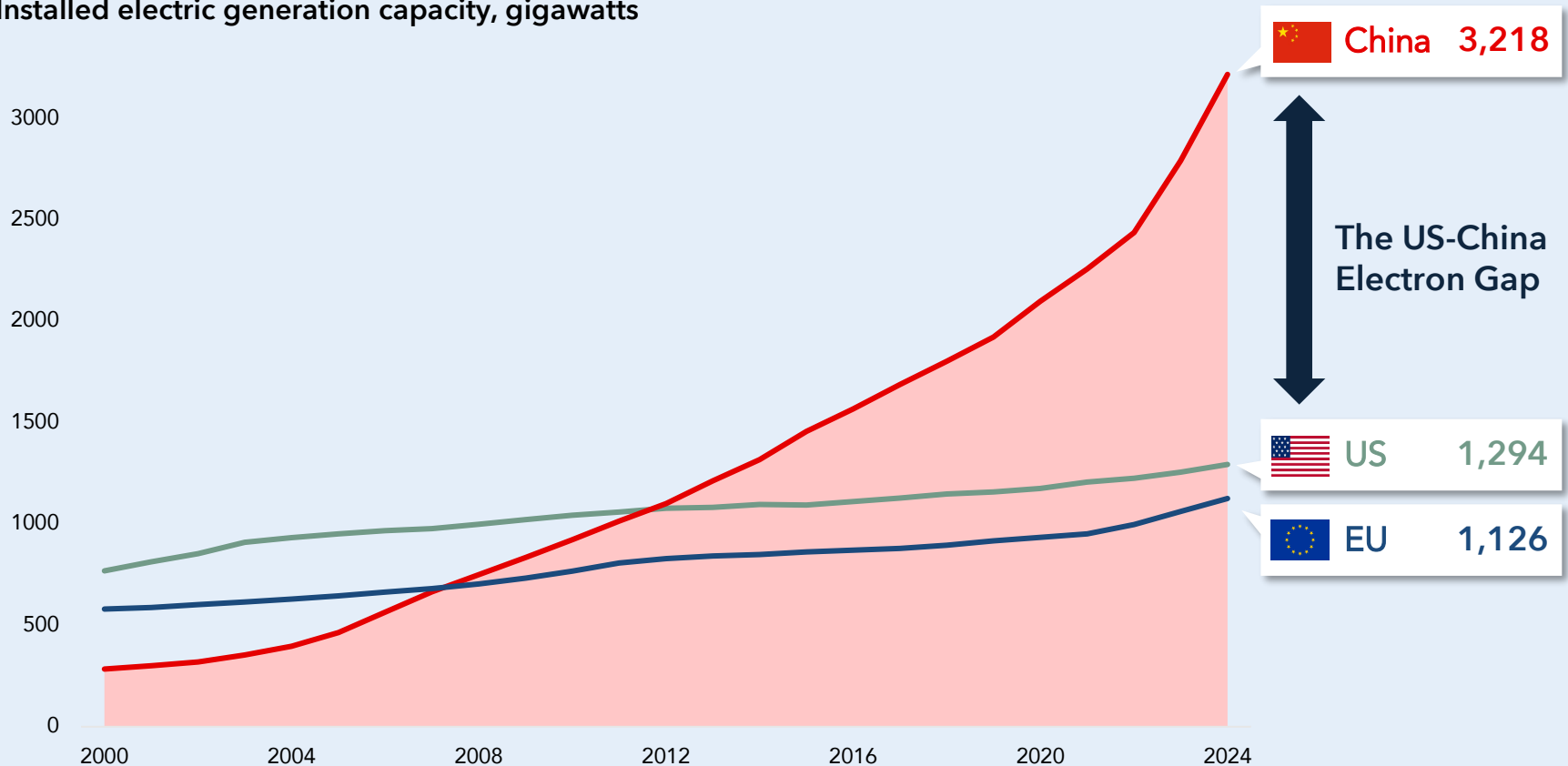
Source: IMD, "Big AI's dirty secret: The environmental cost of generative AI" (March 2025). Alphabet, "2023 Environmental Report".

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**.

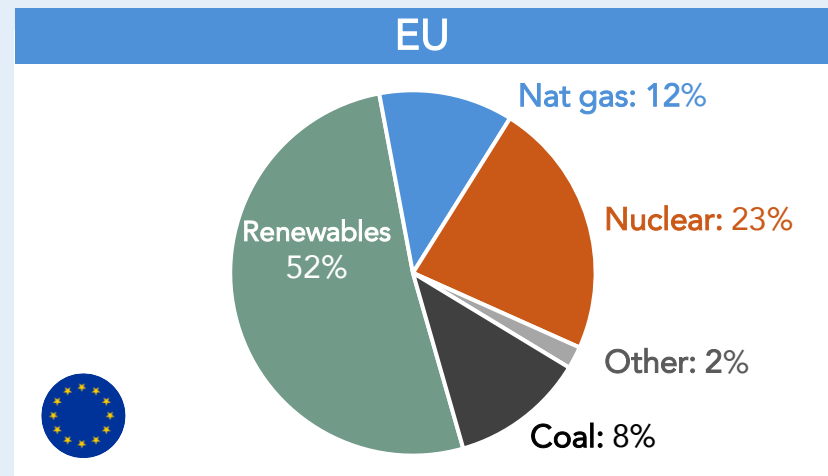
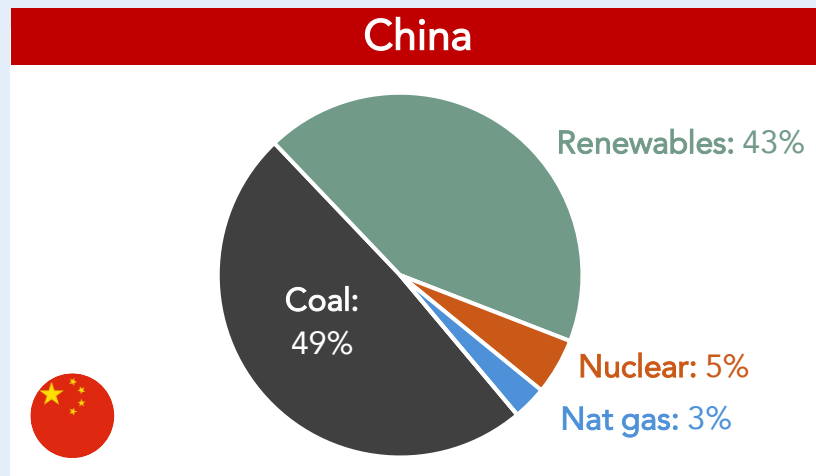
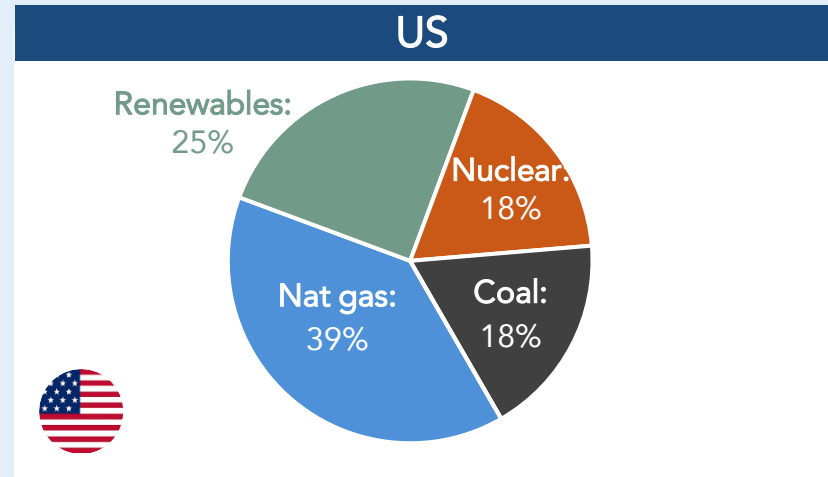
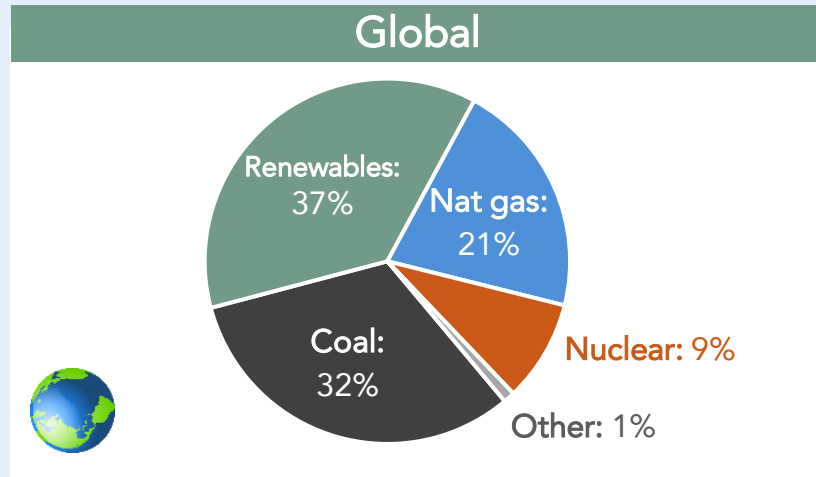
Installed electric generation capacity, gigawatts



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.

Hormuz Closure Will Trigger Significant Growth in Nuclear & Renewables

Data center power supply mix (2025)

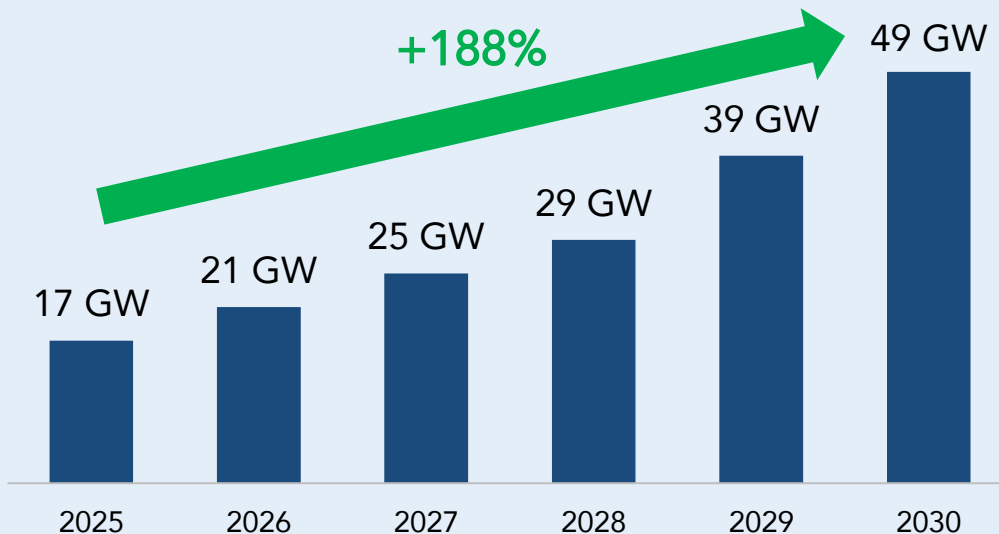


Source: (1-4) Wood Mackenzie. Data as of February 2026.

Moving Off-The-Grid: "Behind-the-Meter" (BTM) Power Capacity

Large AI operators are increasingly viewing power as a **strategic input rather than a pass-through utility cost** with added transmission constraints, connection delays and regulatory friction. Many hyperscalers are instead moving off-the-grid, building **dedicated on-site or adjacent power generation that is physically and commercially tied to a specific data center**, with the grid used only as a backup or off-peak balancing source. To be sure, access to reliable and efficient energy has quickly become as important to AI's buildout as the availability of low cost, scale capital and high-performing semiconductors.

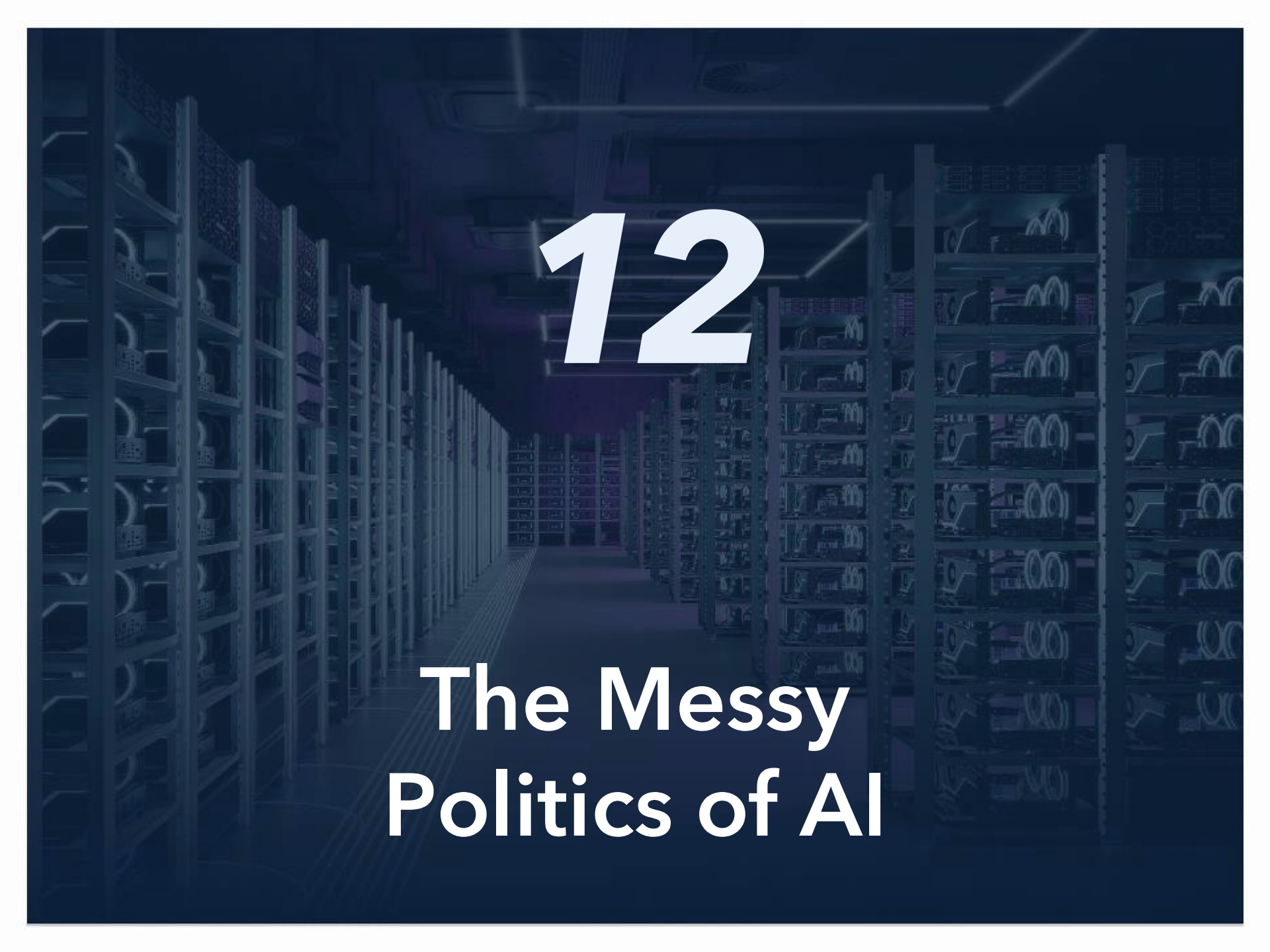
Cumulative "behind-the-meter" US power capacity growth estimates



Sources of BTM
• Nat gas engines & turbines
• Hydrogen & nat gas fuel cells
• Small modular reactors (SMR)
• Battery energy storage systems (BESS)
• Solar photovoltaic (PV)
• On-site wind
• Geothermal energy
• Coal-mine methane

By 2030, about 50% of incremental power capacity in the US will be BTM

Source: (1) RAND, "How Much More Power Can the U.S. Grid Provide for AI?"



12

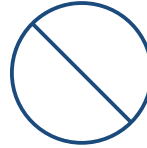
The Messy Politics of AI

US Government Semiconductor Policy Restrictions



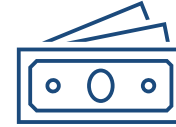
Export Restrictions

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



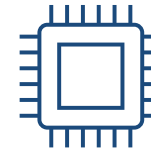
Multilateral Coordination

Netherlands, Japan, S. Korea



Sanctions & Financial Restrictions

OFAC / Treasury



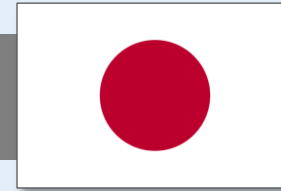
Tariffs & Trade Remedies

25% advanced semiconductors

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

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:

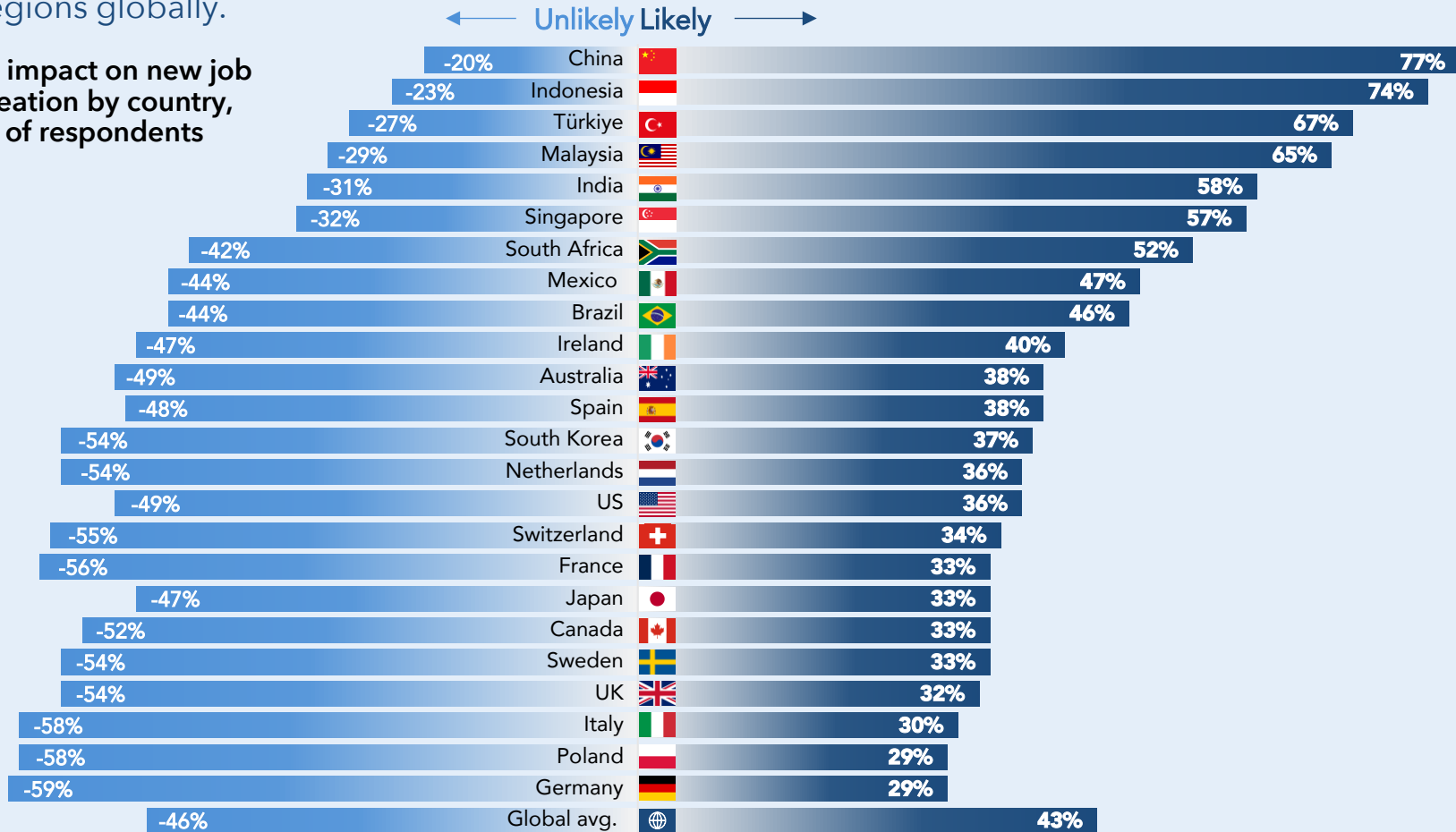
- Export controls on **EUV and DUV lithography equipment**
- Export controls on 23 types of **Japanese advanced equipment**
- **No allied backfilling of US-restricted** chipmaking equipment to China
- **Technology thresholds** aligned with Oct 2022 US controls
- De minimis and **Foreign Direct Product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

Global Sentiment Varies Sharply on AI Job Creation



As evident in a global survey of nearly 25,000 people across 34 countries, global sentiment varies significantly around AI's expected impact on labor markets. Generally speaking, survey respondents across Asia were much more optimistic about AI's positive impact on new job creation than other regions globally.

AI impact on new job creation by country, % of respondents

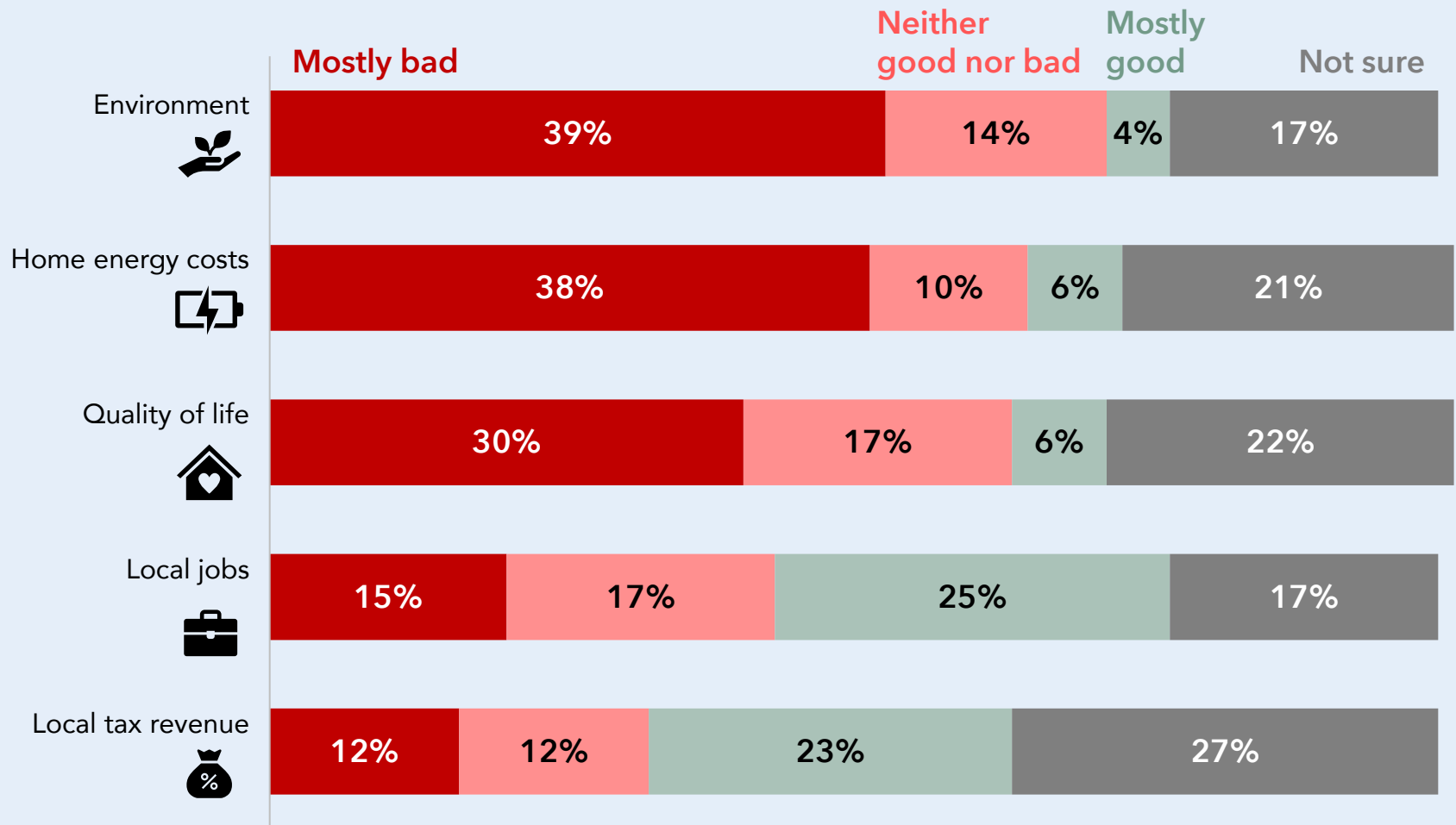


Source: (1) Visual Capitalist. Ipsos, "Predictions for 2025". Survey of 23,721 people from 34 countries conducted October 25 - November 8, 2024. Percentages may not add up to 100 due to rounding, multiple responses, or the exclusion of "don't know" or unstated responses.

Americans View Data Centers Negatively



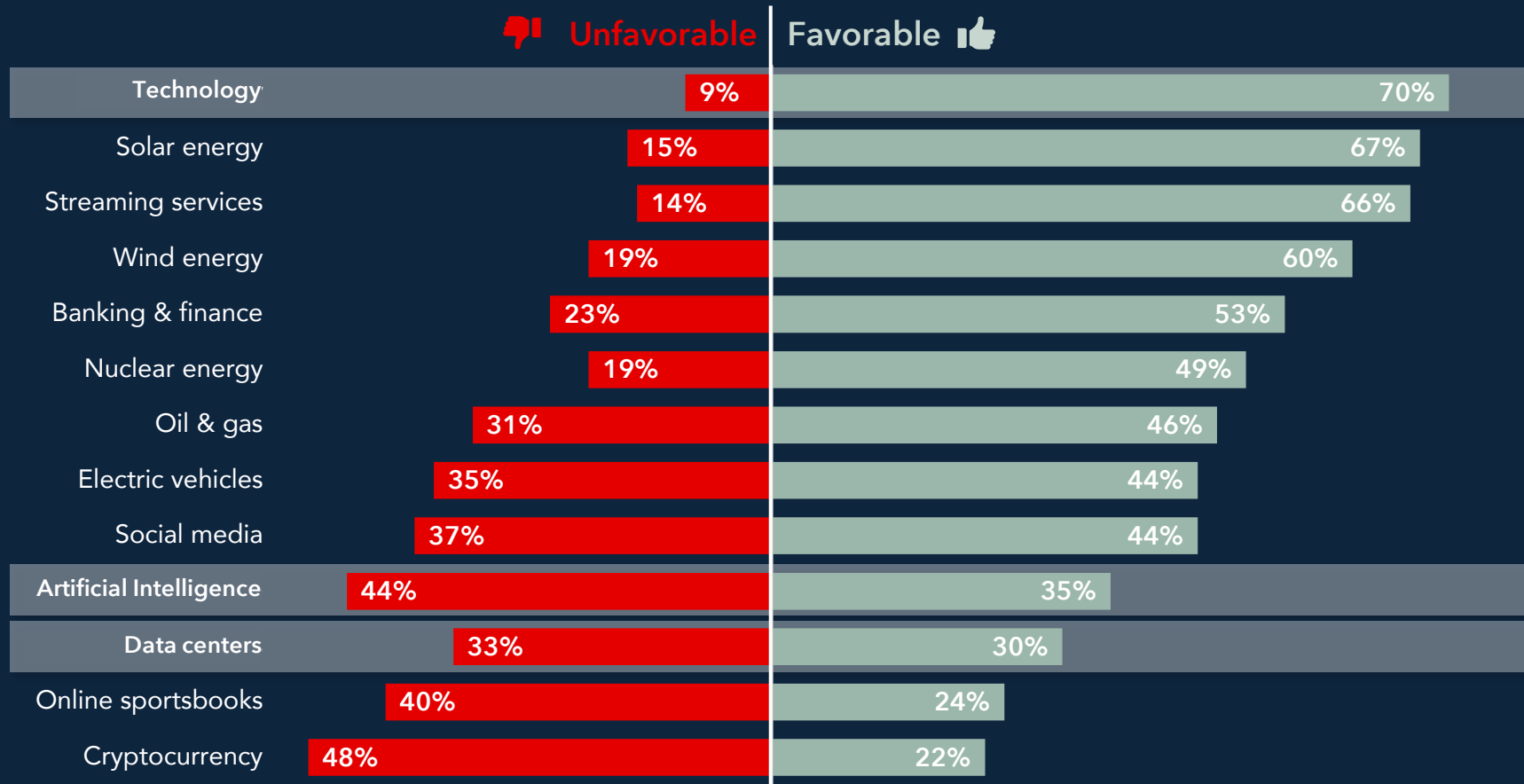
% of US adult respondents view on data centers, by impacted area



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.

Voters Prefer Tech Companies to AI

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

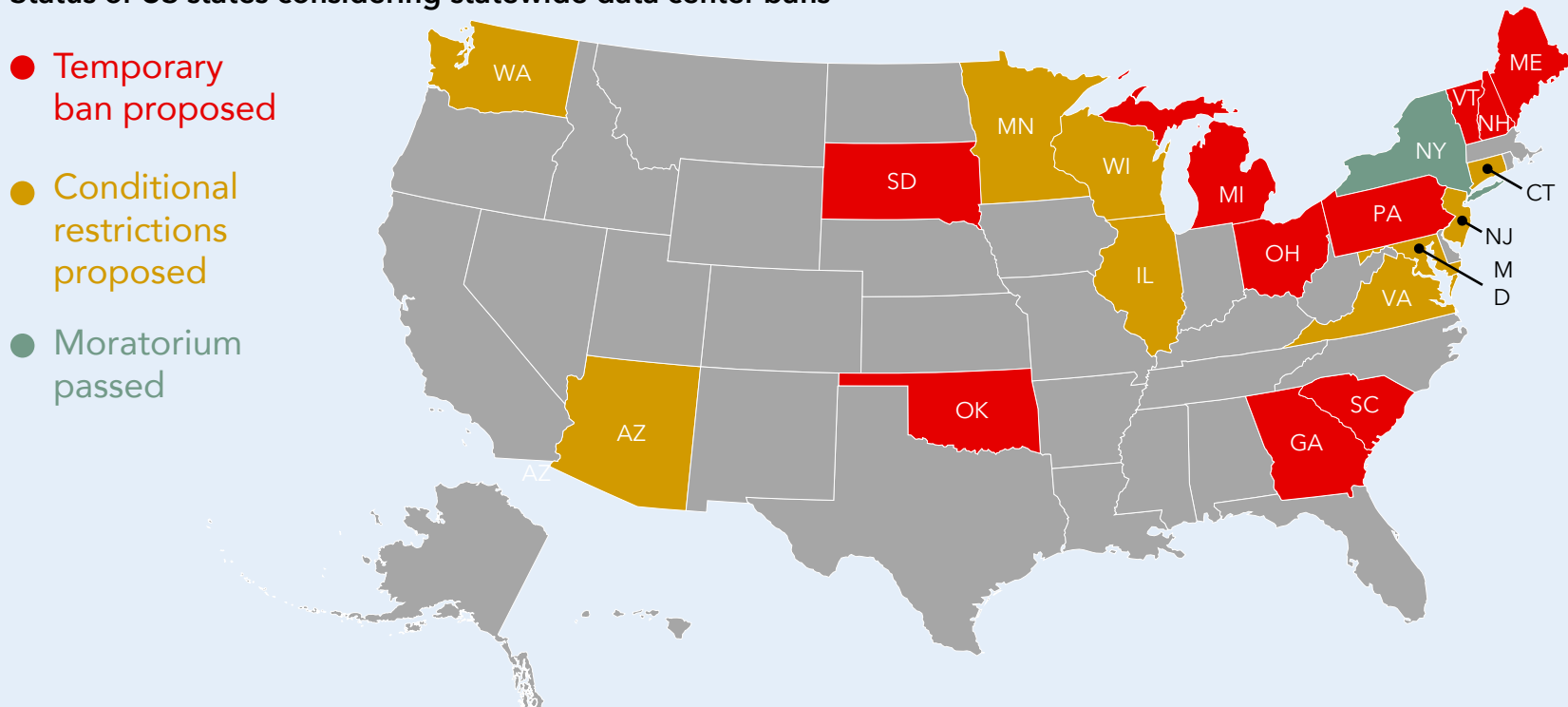


Source: (1) Bruce Mehlmán, "Six-Chart Sunday - Why AI Regulations Are Likely". Echelon Insights.
Survey of 1,029 registered voters in the likely electorate nationwide conducted in January 2026. Data excludes "no opinion" responses.

US States Considering Data Center Bans

20 US states have introduced bills to restrict data center construction and associated energy use, with New York becoming the first state to successfully pass a temporary moratorium. 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



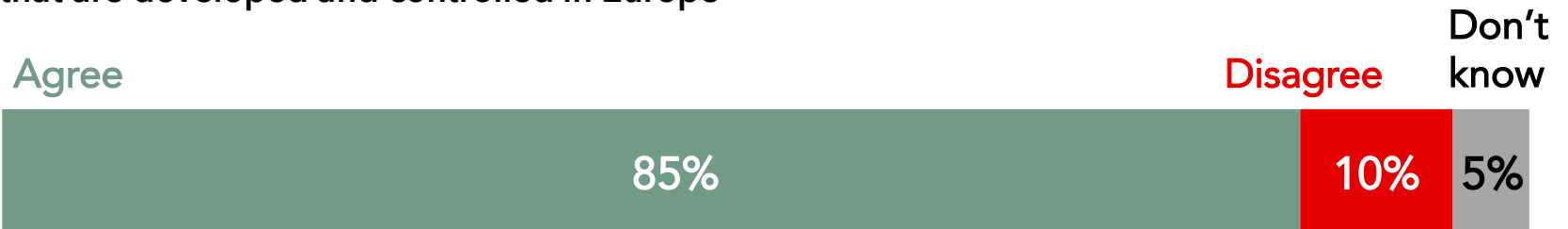
Source: (1-2) Visual Capitalist. National Conference of State Legislatures. DataCenterBans. Aterio. Stateline. Data as of July 14, 2026.

AI Nationalism & National Security



To what extent do you agree or disagree with the following statements:

The EU should prioritize investments in digital infrastructure and services that are developed and controlled in Europe



The EU should reduce its dependencies on digital from third countries



Personally, you would be willing to switch to an EU-based digital service provider even if it means slightly higher costs

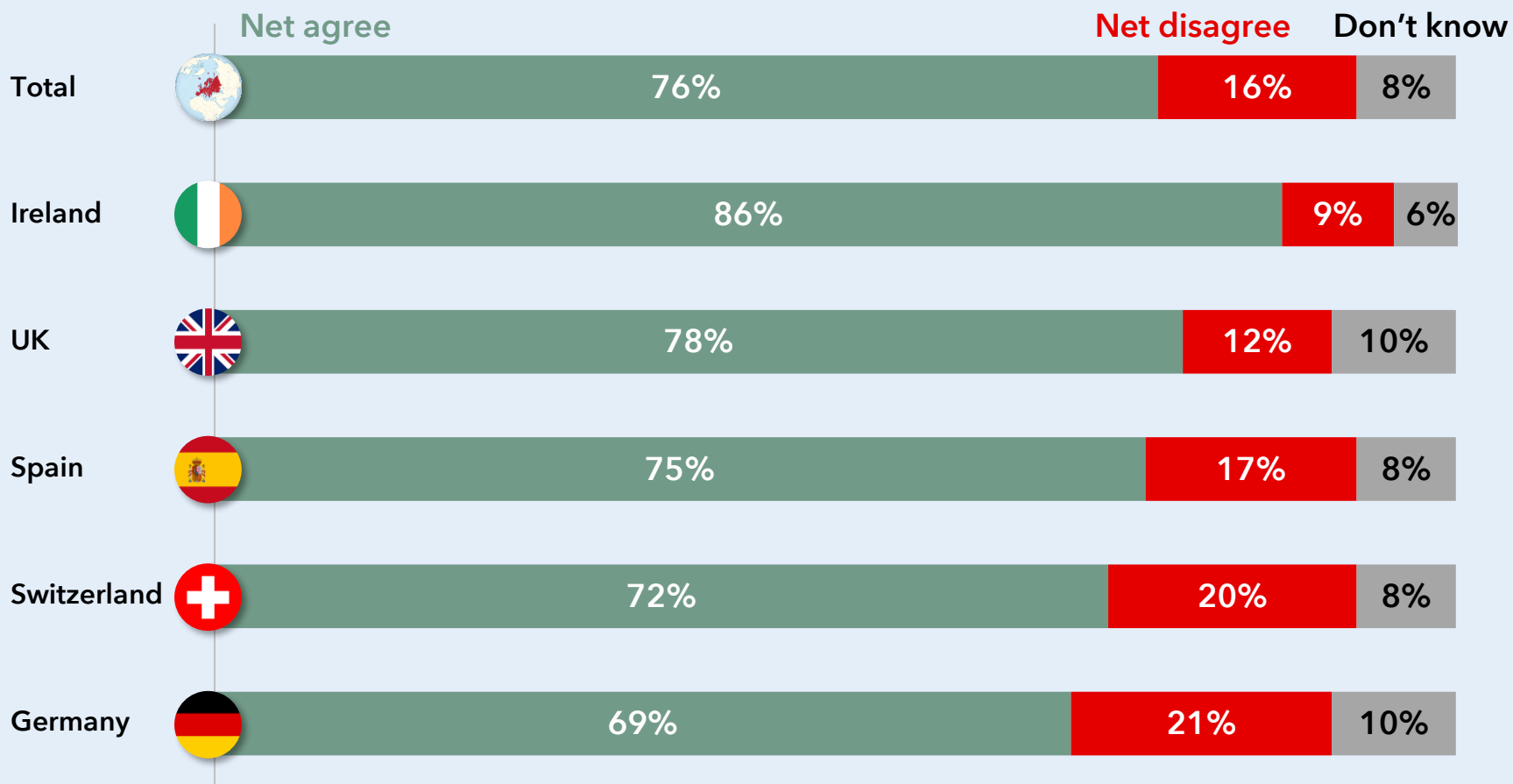


Source: (1) European Commission, "Special Eurobarometer: Digital Decade" (February - March 2026). Survey of 26,494 respondents from the European Union (EU27) from different social and demographic groups in their respective languages. Responses for total EU are weighted average.

Protecting the Environment



New data centers should only be constructed if they will be powered by renewable energy sources:



Source: (1) Savanta, "Majority of Europeans Polled Want Rules to Limit New Data Centre Impacts on Energy, Water and Economy" (October 2025). Survey of 5,032 adults from Germany, Ireland, Spain, Switzerland, and UK conducted from September 11-30, 2025. Total bar includes all listed countries.



2026 Global Growth Revised Lower



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

Region	Jan 2026	Jul 2026	
North America			
US	2.5%	2.3%	↓
Mexico	1.4%	0.9%	↓
Canada	0.9%	0.7%	↓
Eurozone	0.9%	0.6%	↓
Spain	2.4%	2.8%	↑
Italy	0.6%	0.8%	↑
France	0.8%	0.5%	↓
Germany	0.7%	0.5%	↓
Other Europe			
Poland	3.8%	3.5%	↓
Sweden	2.4%	2.0%	↓
Norway	2.2%	1.3%	↓
Switzerland	0.9%	1.2%	↑
UK	1.0%	0.9%	↓
Russia	(-0.1%)	0.5%	↑
LatAm			
Colombia	3.0%	2.9%	↓
Argentina	2.3%	2.8%	↑
Brazil	1.6%	1.8%	↑
Chile	2.2%	0.9%	↓

Region	Jan 2026	Jul 2026	
MENA			
Iran	2.1%	?	↓
Israel	4.2%	3.3%	↓
Saudi Arabia	4.3%	0.5%	↓
UAE	4.5%	(-0.04%)	↓
Qatar	6.4%	(-24.5%)	↓
Kuwait	3.4%	(-19.3%)	↓
Oman	2.3%	2.1%	↓
Bahrain	3.0%	(-16.0%)	↓
Egypt	4.9%	4.5%	↓
Türkiye	3.0%	2.3%	↓
APAC			
India	6.5%	6.7%	↑
Indonesia	5.1%	5.0%	↓
China	4.5%	4.8%	↑
Philippines	5.4%	3.5%	↓
Singapore	3.1%	3.4%	↑
South Korea	2.1%	2.5%	↑
Australia	2.5%	2.0%	↓
Thailand	1.5%	2.0%	↑
Japan	0.7%	0.5%	↓

Source: (1) Oxford Economics. Data as of July 14, 2026. Bahrain, Iran, Israel Jan 2026 forecast is Bloomberg consensus.

Global Currency Forecasts

Currency pair	Spot (Jul 14)	Q3 2026	Q4 2026	Q1 2027	Q2 2027
EUR / USD	1.14	1.16	1.18	1.20	1.20
GBP / USD	1.34	1.33	1.34	1.36	1.35
USD / JPY	162	160	158	156	154
USD / CNY	6.77	6.70	6.65	6.60	6.60
AUD / USD	0.70	0.70	0.71	0.72	0.73
NZD / USD	0.58	0.57	0.58	0.59	0.60
USD / CAD	1.41	1.40	1.38	1.36	1.35
USD / NOK	9.67	9.74	9.49	9.33	9.25
USD / SEK	9.63	9.48	9.24	9.00	8.92
USD / CHF	0.81	0.79	0.78	0.76	0.76
USD / MXN	17.41	17.50	17.50	17.25	17.25
USD / BRL	5.07	5.20	5.10	5.00	4.90
USD / CLP	926	900	890	880	870

Source: (1) Bloomberg. MUFG Foreign Exchange Outlook - July 2026 (Derek Halpenny). Data as of July 14, 2026.

MUFG Global Rates Forecasts

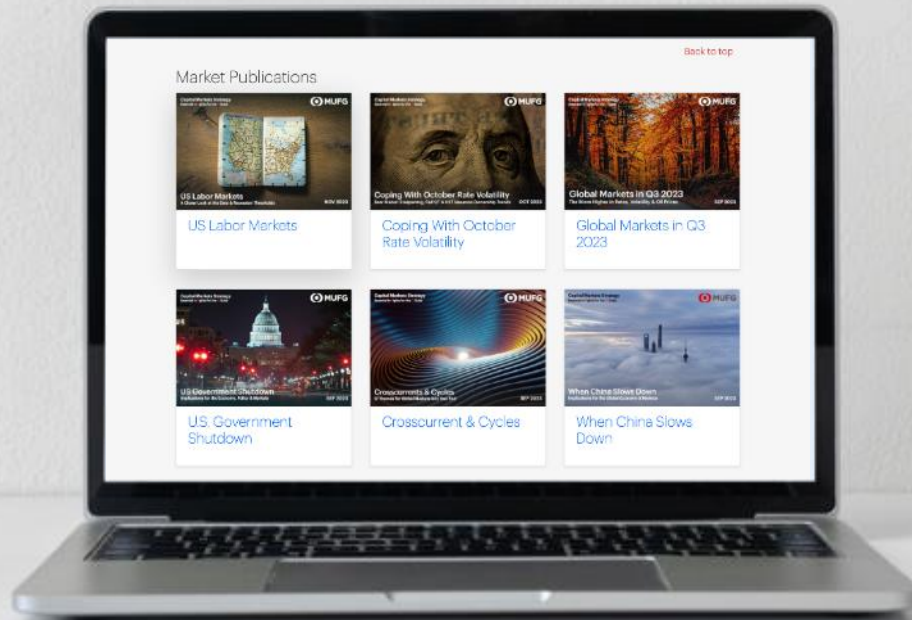
		Q3 2026		Q4 2026		Q1 2027		Q2 2027	
	Spot (Jul 14)	MUFG	Consensus	MUFG	Consensus	MUFG	Consensus	MUFG	Consensus
Fed Funds	3.75%	3.75%	3.76%	3.50%	3.76%	3.25%	3.72%	3.25%	3.62%
2 yr UST	4.20%	4.00%	3.99%	3.63%	3.89%	3.25%	3.81%	3.13%	3.76%
5 yr UST	4.32%	4.13%	4.10%	3.88%	4.03%	3.63%	3.98%	3.50%	3.93%
10 yr UST	4.59%	4.25%	4.44%	4.13%	4.40%	4.00%	4.36%	3.88%	4.35%
30 yr UST	5.11%	4.50%	4.94%	4.50%	4.89%	4.38%	4.87%	4.25%	4.88%

Source: (1) MUFG Global Macro Research (George Goncalves). Bloomberg. Data as of July 14, 2026. Fed funds is upper bound.



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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 10 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

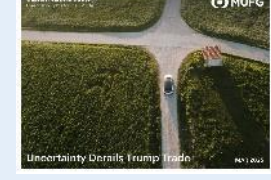
Angela previously interned at MUFG working in Capital Markets within the Equity Capital Markets and Leveraged Finance divisions. She is also an active member of the Carnegie Mellon University recruiting team.

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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