" The people who are crazy enough to think they can change the world are the ones who do. "

Steve Jobs

Agenda

- Key Themes to tease out over the next 48hours
  - AI: It's the end of the world as we know it!
  - The Health of the Digital Economy- does the gravy train have another year to run?
  - "From Eyeballs to Turbines" – Are we seeing a shift in the location of the largest digital investments to chase a new "holy grail" AI?
  - The Birds are Back
  - Here come the governments – are they here to help or to compete?
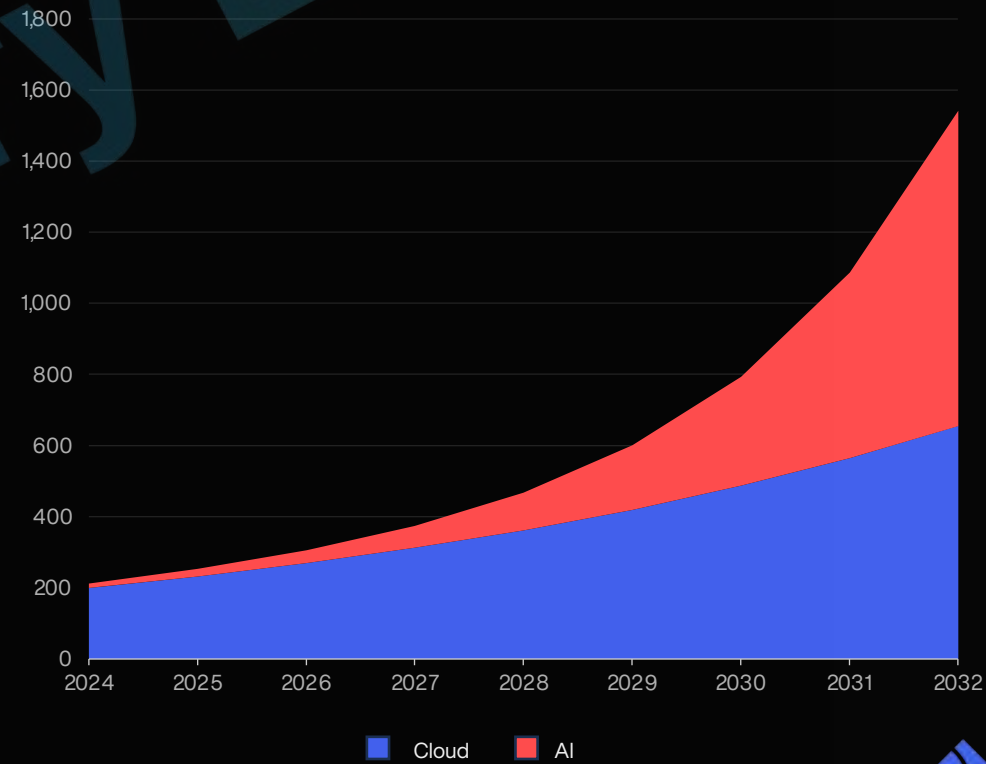
- The next 48 hours

- Goals for the PTC

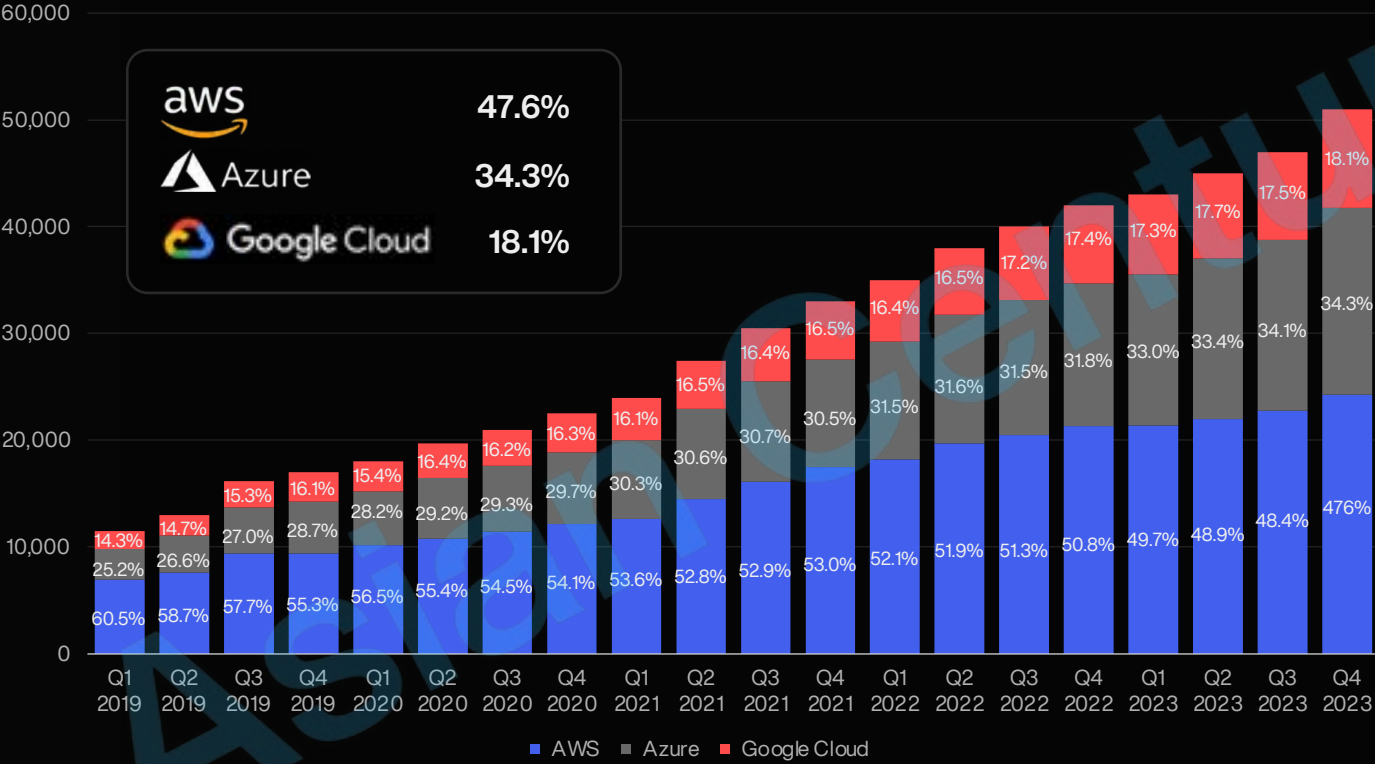# AI – it's the end of the world as we know it....
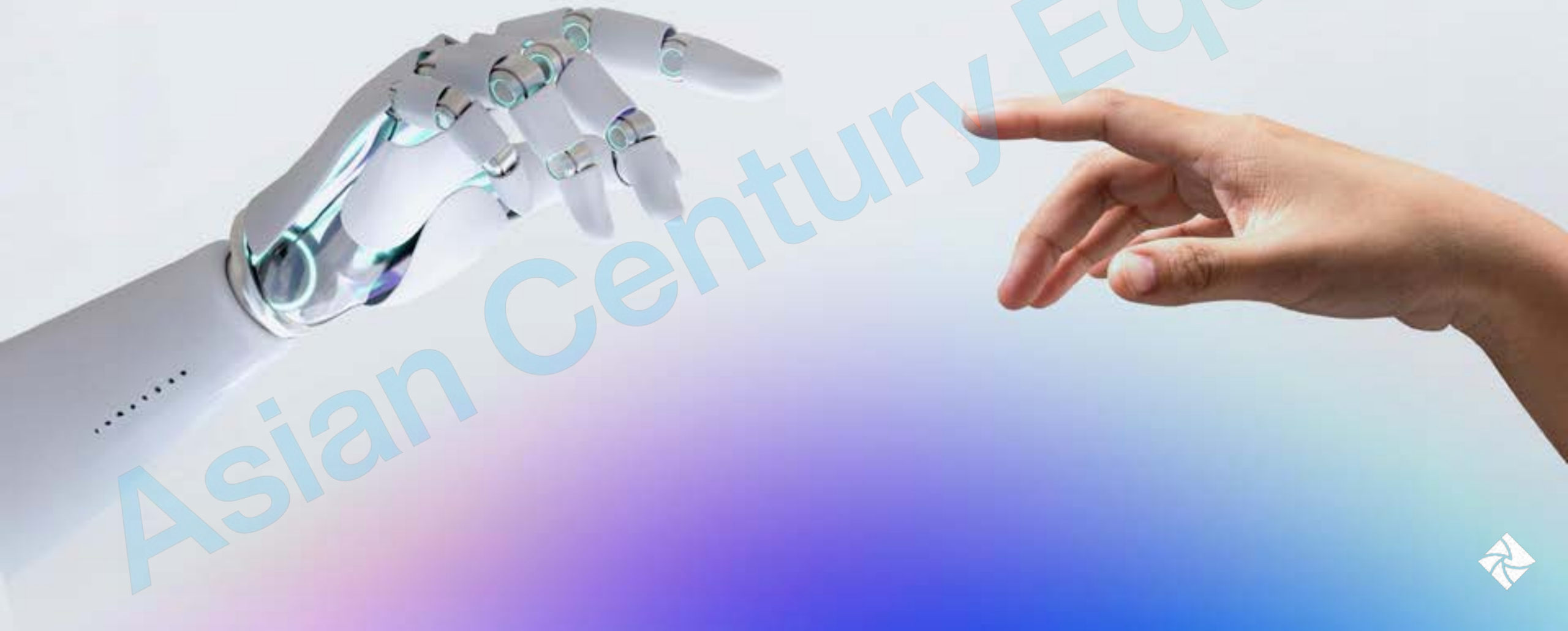
Cloud was the biggest driver of growth over half a decade – it will continue, yet AI will go even faster over the next five years

Quarterly Cloud Revenue
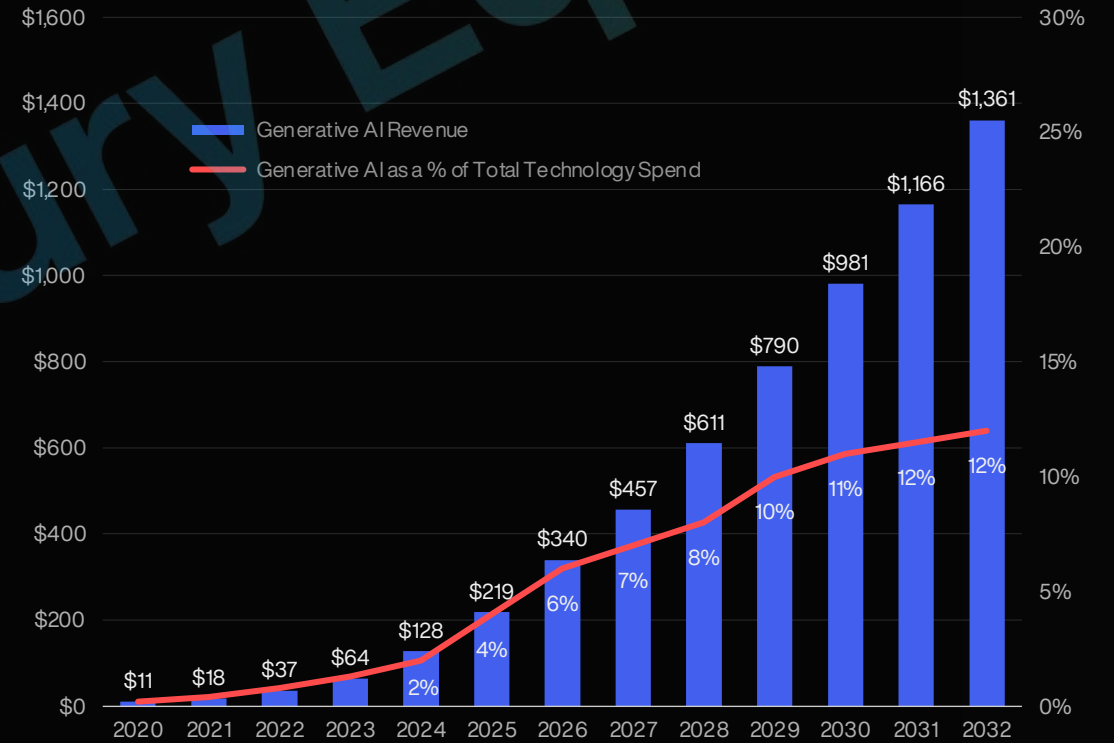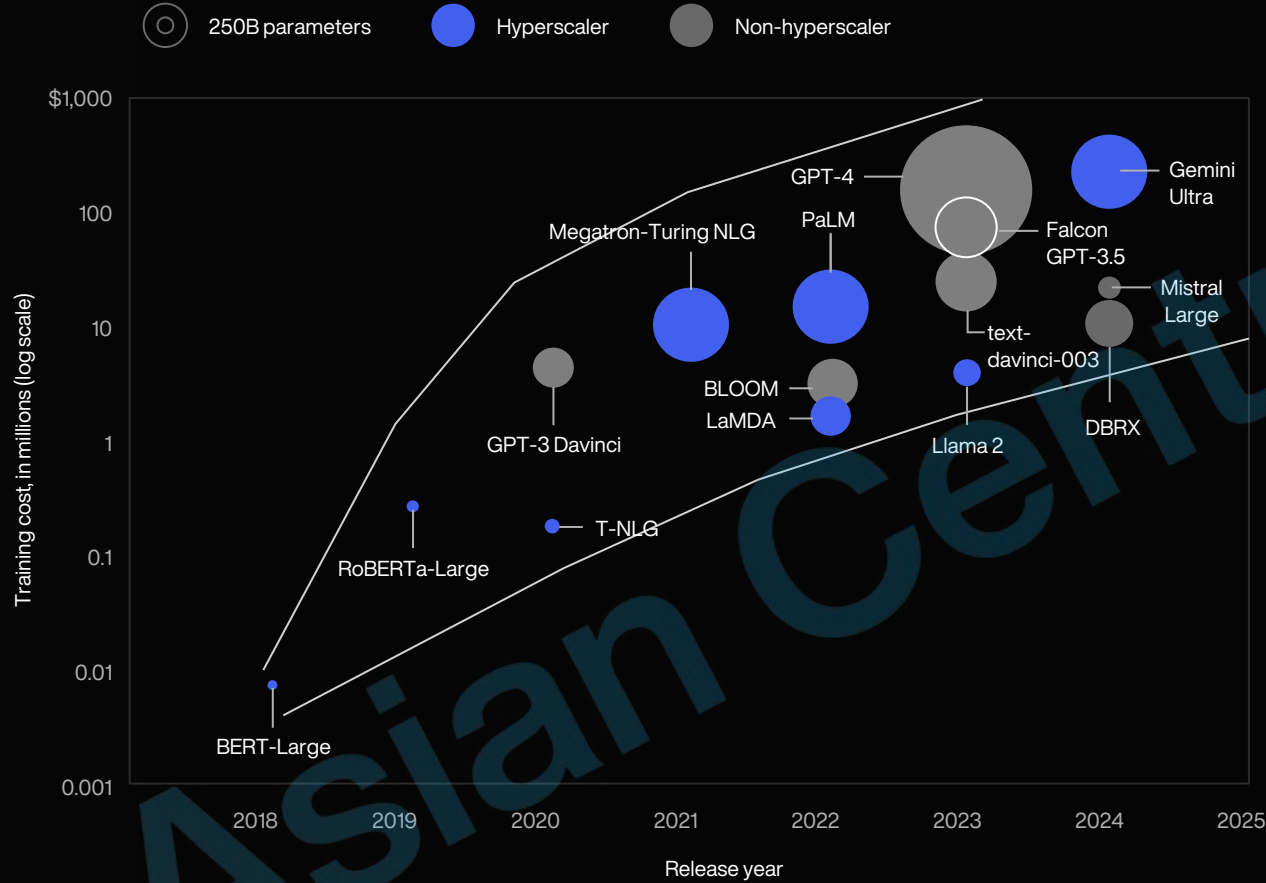Big 3 Cloud Providers (in millions) & % of revenue

aws	47.6%
Azure	34.3%
Google Cloud	18.1%

Legend (left chart): AWS, Azure, Google Cloud

Legend (right chart): Cloud, AI

The arrival of extremely fast new servers has been the game changer

Legend:
- ○ 250B parameters
- ● Hyperscaler
- ● Non-hyperscaler

Left chart — Training cost, in millions (log scale) vs Release year

Data points labeled:
- BERT-Large
- RoBERTa-Large
- GPT-3 Davinci
- T-NLG
- Megatron-Turing NLG
- PaLM
- BLOOM
- LaMDA
- GPT-4
- Falcon
- GPT-3.5
- text-davinci-003
- Llama 2
- DBRX
- Mistral Large
- Gemini Ultra

Y-axis: $1,000 / 100 / 10 / 1 / 0.1 / 0.01 / 0.001
X-axis: 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025

Right chart — Generative AI Revenue (bars) and Generative AI as a % of Total Technology Spend (line)

Year	Generative AI Revenue	% of Total Technology Spend
2020	$11	
2021	$18	
2022	$37	
2023	$64	
2024	$128	2%
2025	$219	4%
2026	$340	6%
2027	$457	7%
2028	$611	8%
2029	$790	10%
2030	$981	11%
2031	$1,166	12%
2032	$1,361	12%

Y-axis left: $0 / $200 / $400 / $600 / $800 / $1,000 / $1,200 / $1,400 / $1,600
Y-axis right: 0% / 5% / 10% / 15% / 20% / 25% / 30%

By 2032, just the hardware and software revenue from AI will equal the total revenue of the Big 3 this year at 1.3T USD

#	Name	Revenue
1	amazon Amazon 1AMZN	$620.12 B
2	Apple 2AAPL	$391.03 B
3	Alphabet Alphabet (Google) 3GOOG	$339.85 B

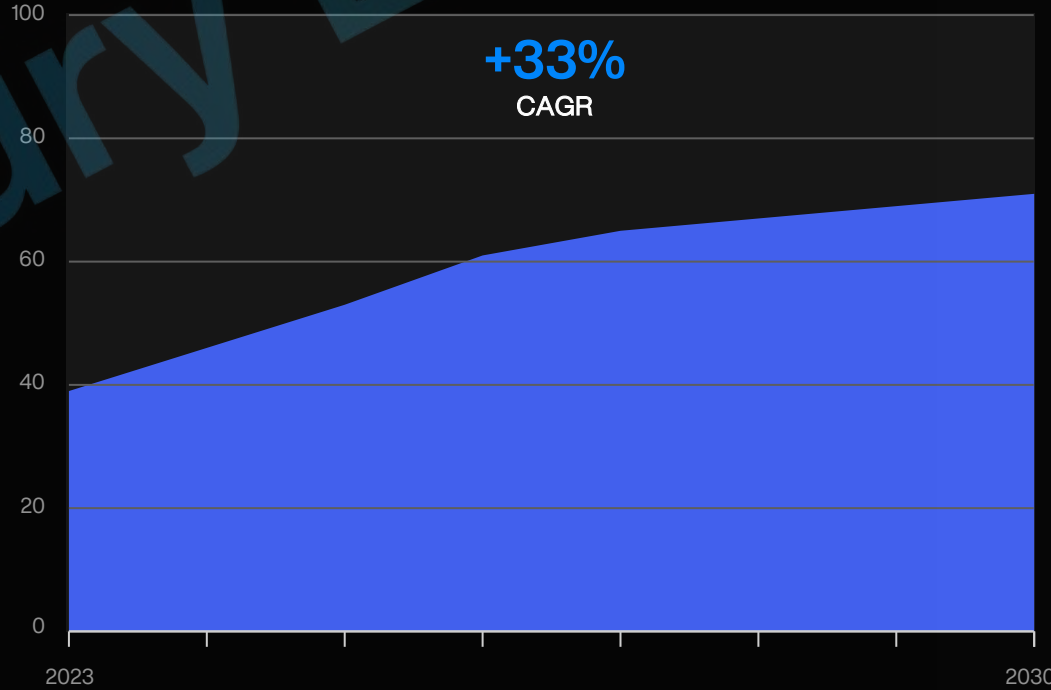| (in millions of $)	2023	2027E	2032E	Implied 9 Year CAGR (%)
Hardware	$53,105	$286,903	$639,399	32%
Devices (Inference)	$6,415	$72,703	$168,641	44%
Computer Vision AI Products	$2,749	$19,387	$58,376	40%
Conversational AI Products	$3,666	$53,315	$110,265	46%
Infrastructure (Training)	$46,690	$214,200	$470,758	29%
AI Server	$26,060	$73,984	$105,197	17%
AI Storage	$10,858	$31,707	$56,982	20%
Generative AI Infrastructure as a Service	$9,772	$100,509	$308,579	47%
Compute	$4,343	$69,756	$173,575	51%
Internal Consumption	$1,303	$20,434	$33,312	43%
Hyperscale Consumption	$3,040	$49,322	$140,263	53%
Networking	$3,257	$16,911	$43,832	33%
Inference / Fine-Tuning Cloud	$2,172	$21,843	$91,171	51%
Software	$5,028	$61,680	$317,961	59%
Specialized Generative AI Assistants	$2,489	$22,029	$95,259	50%
Enterprise Applications	$1,493	$13,217	$50,011	48%
Consumer/E-Commerce Applications	$995	$8,812	$45,248	53%
Coding, DevOps and Generative AI Workflows	$473	$13,436	$68,763	74%
Generative AI Workload Infrastructure Software	$1,195	$13,885	$80,788	60%
Generative AI Drug Discovery Software	$32	$4,561	$35,091	117%
Generative AI Based Cybersecurity Spending	$11	$3,419	$15,063	124%
Generative AI Education Spending	$829	$4,349	$22,996	45%
Generative AI Based Gaming Spending	$533	$24,890	$83,591	75%
Virtual Goods	$133	$8,889	$31,347	83%
Game Design Software	$399	$16,000	$52,244	72%
Generative AI Driven Ad Spending	$4,624	$53,154	$206,693	53%
Search	$2,458	$21,006	$67,661	45%
Videos	$1,666	$2,4729	$100,941	58%
Messaging	$500	$7,419	$38,091	62%
Generative AI Focused IT Services	$165	$20,451	$80,904	99%
Generative AI Based Business Services	$78	$9,705	$32,443	95%
Total	**$63,533**	**$456,782**	**$1,360,990**	**41%**

This has created absolutely enormous demand for data centers, power and fiber

Estimated global data center capacity demand,[1] gigawatts

+22% CAGR

+39% CAGR

Generative AI workload

+16% CAGR

Other workload

2023 — 2030
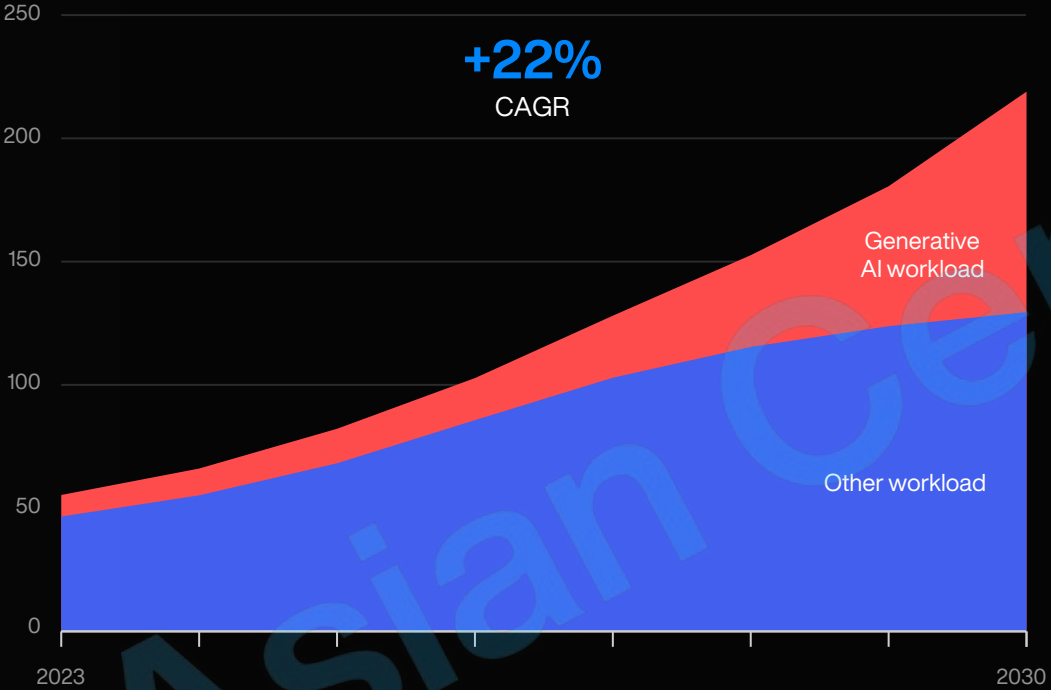
Demand for advanced-AI capacity,[1] % of total data center capacity demand

+33% CAGR

2023 — 2030

[1] Midrange scenario is based on analysis of AI adoption trends; growth in shipments of different types of chips (application-specific integrated circuits, graphics processing units, etc.) and associated power consumption; and the typical compute, storage, and network needs of AI workloads. Demand is measured by power consumption to relect the number of servers a facility can house.

Source: McKinsey Data Center Demand model

Are Clouds evaporating? According to the stats, it's not likely! These profitable streams show no signs of slowing...

— Alibaba, Amazon, Meta, and Microsoft currently should show the largest ramp in 2024E capex

— Amongst the hyperscalers we track below, total capex should grow from $184B in 2023 to $213B in 2024 (16% increase)

Hyper scaler capex

(in $M)	CY2020	CY2021	CY2022	CY2023E	CY2024E	2023E-2024E
Amazon	$57,976	$72,325	$60,836	$51,762	$59,984	16%
Microsoft	$21,557	$23,216	$24,768	$34,880	$43,365	24%
Google	$22,281	$24,640	$31,485	$32,146	$34,956	9%
Meta/Facebook	$15,163	$18,690	$31,431	$29,735	$33,937	14%
Apple	$8,702	$10,388	$11,692	$11,501	$11,715	2%
Alibaba Group	$4,986	$6,525	$7,729	$3,489	$8,451	142%
Oracle	$1,833	$3,118	$6,678	$8,617	$8,172	-5%
Tencent	$5,219	$4,613	$3,288	$4,040	$4,452	10%
Hewlett Packard	$2,328	$2,613	$3,292	$2,751	$2,900	5%
IBM	$2,618	$2,062	$1,346	$1,960	$2,051	5%
Baidu Inc	$779	$1,715	$1,201	$1,158	$1,223	6%
SAP SE	$816	$800	$874	$1,004	$1,117	11%
salesforce.com	$710	$717	$798	$866	$913	5%
Total Capex	**$144,967**	**$171,422**	**$185,419**	**$183,908**	**$213,236**	**16%**

With these demand drivers how could we lose? Or could we?

Before the arrival of AI, many analysts had us on the brink of a massive reset...

We can argue the similarities and the difference with the tech sector turn at the turn of the century, yet we have defied gravity for two+ years and counting ....

The Tech Bubble Then
Top 5 US Market Cap Stocks at 2000 Peak: Enterprise Value as % of GDP
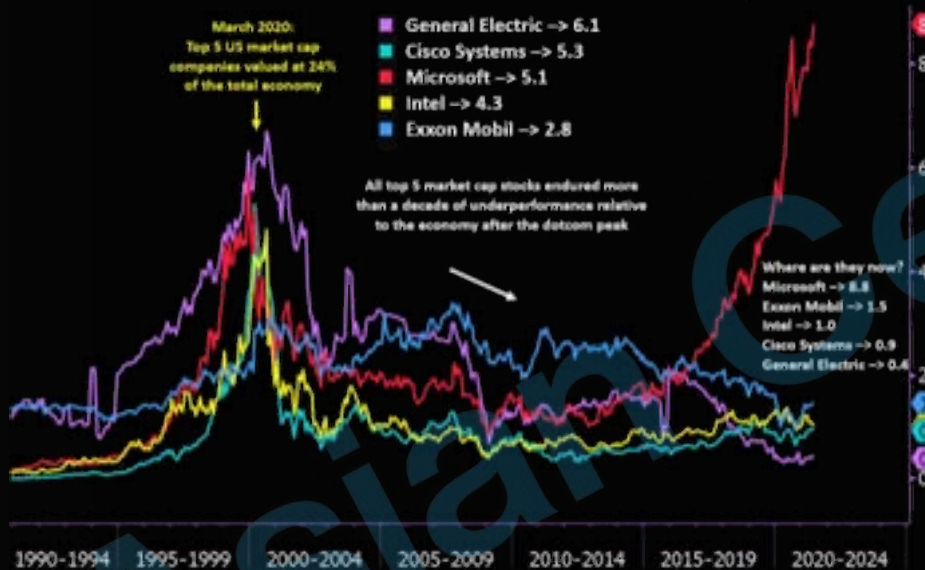
The Tech Bubble Now
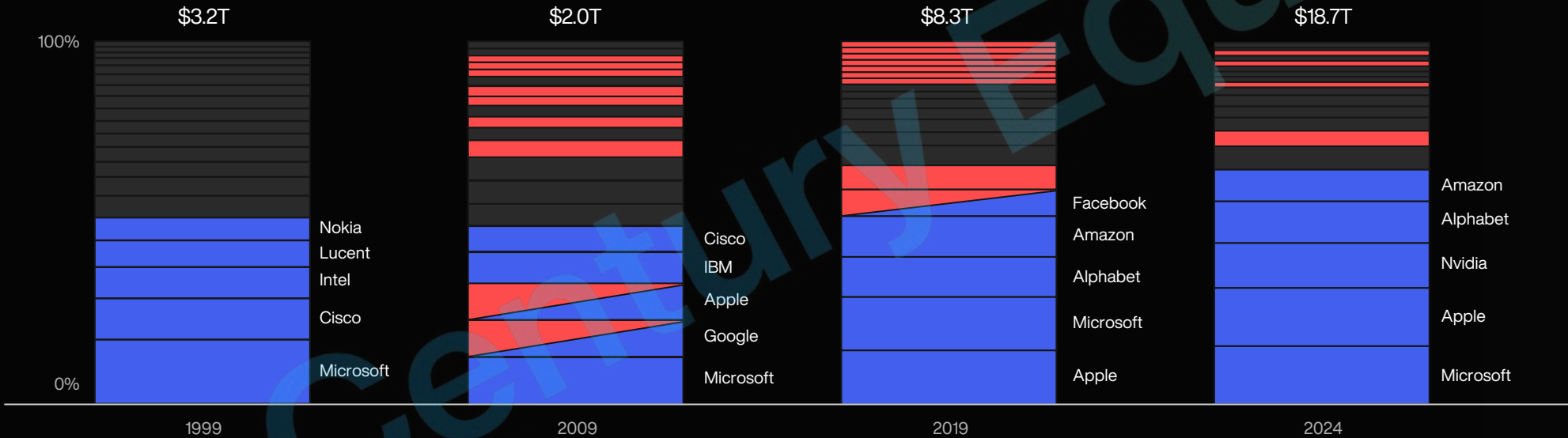Top 5 US Market Cap Stocks at 2021: Enterprise Value as % of GDP

On the Buffet Index our US market Cap is 200% of GDP - the last time we saw such a high index was 1999!

The top five companies in the tech sector have increased their share of the entire market value to 65%

$3.2T $2.0T $8.3T $18.7T

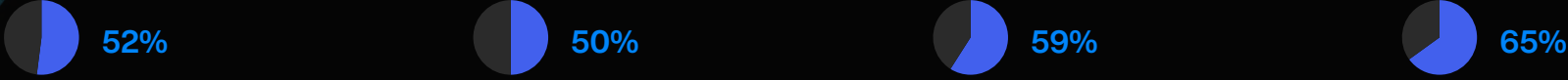**Technology market caps by calendar year**

100%

🟥 New to list

🟦 5 largest

0%

1999
- Nokia
- Lucent
- Intel
- Cisco
- Microsoft

2009
- Cisco
- IBM
- Apple
- Google
- Microsoft

2019
- Facebook
- Amazon
- Alphabet
- Microsoft
- Apple

2024
- Amazon
- Alphabet
- Nvidia
- Apple
- Microsoft

New-to-list companies' percentage of overall value

39% Includes Amazon, Apple, and Google

26% Includes Paypal, Netflix, and Alibaba

9% Includes Tesla and Qualcomm

Top 5 companies' percentage of overall value

52%

50%

59%

65%

Like the submarine cable industry, the largest operators have begun to build their own capabilities

Global forecasted new data center capacity through 2027, by provider (MW)
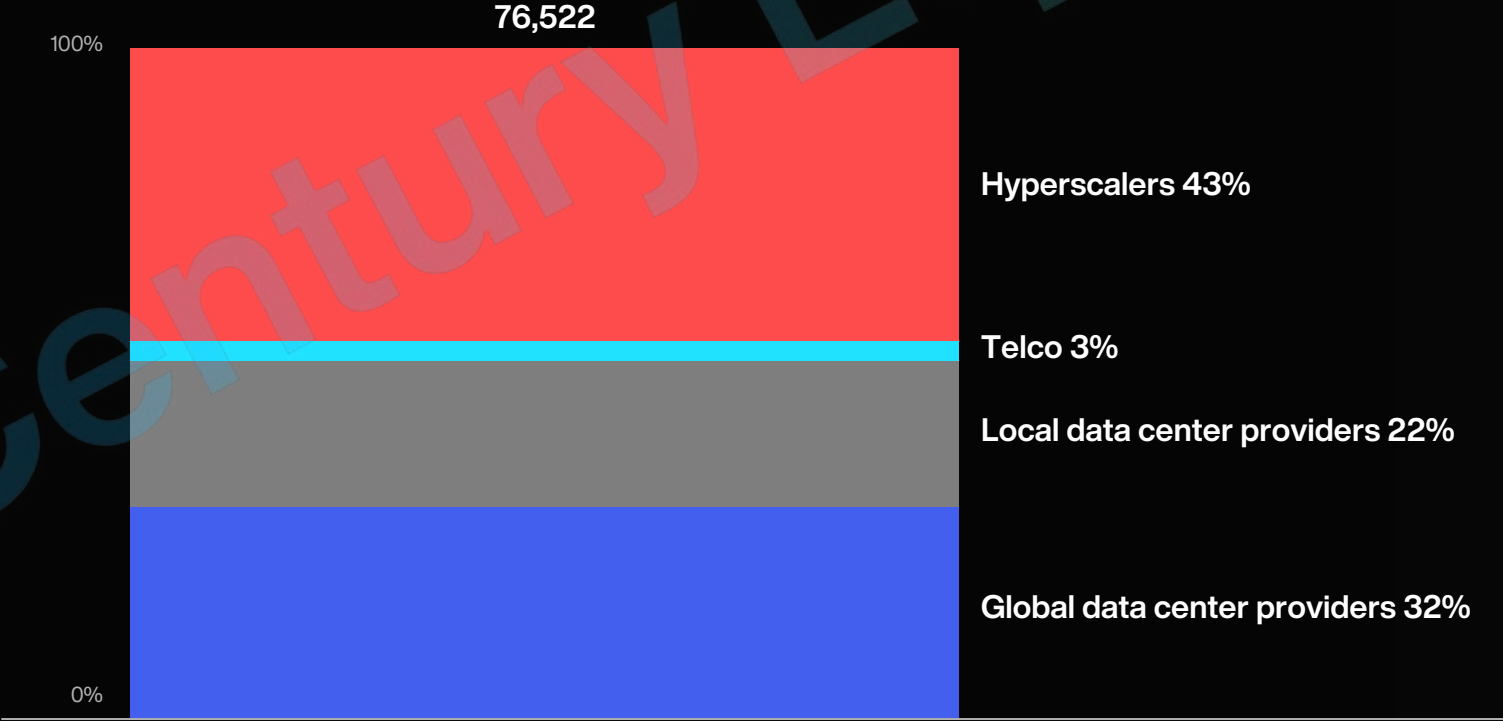
76,522

100%

- Hyperscalers 43%
- Telco 3%
- Local data center providers 22%
- Global data center providers 32%

0%

There is a changing dynamic in the developed markets in the digital infrastructure space, and it is frighteningly similar to the trends in 2000...

Revenue Generating Capex is actually declining
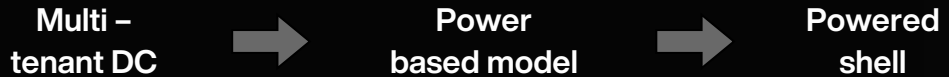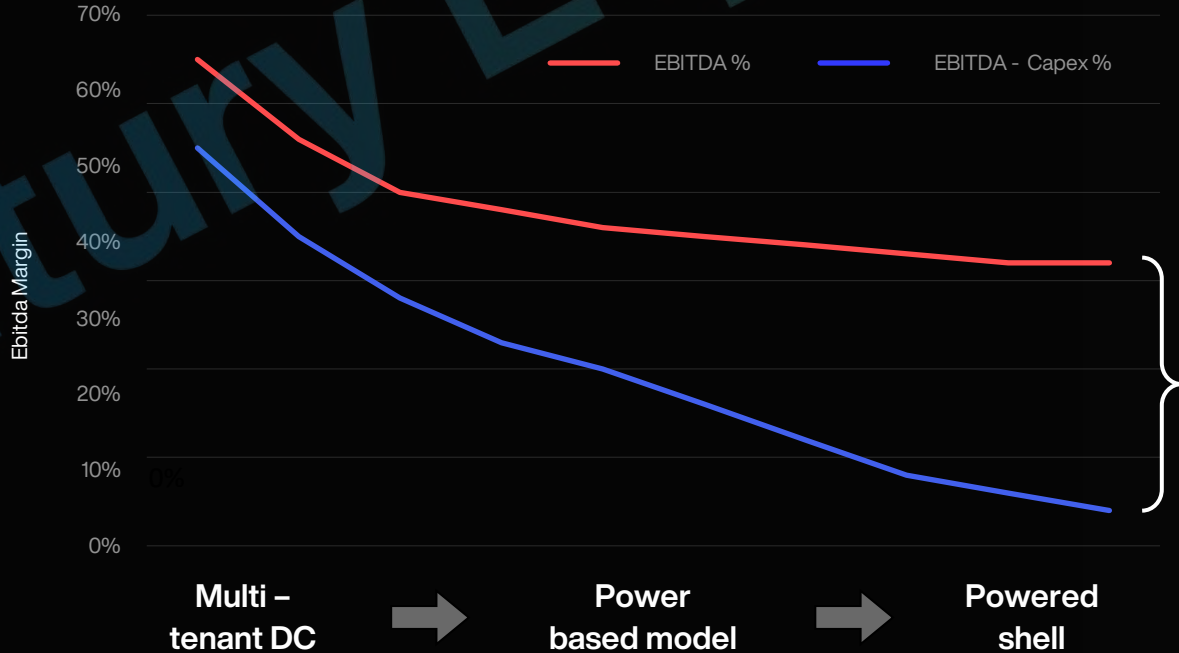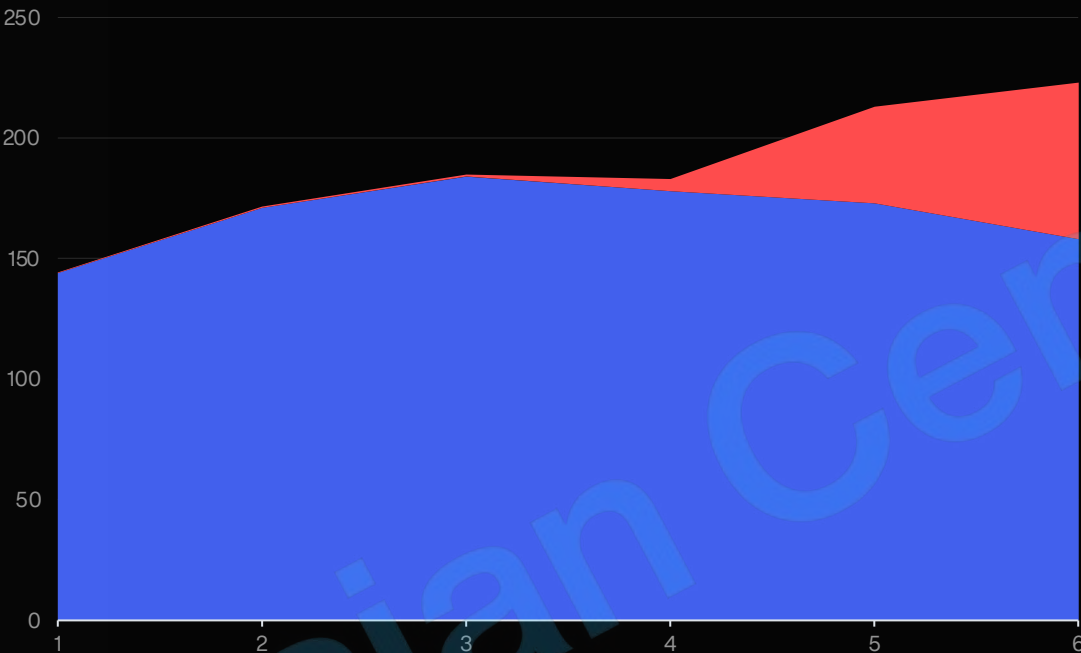
Digital infrastructure operators and investors are going to need to chase new emerging markets with a more integrated approach with fiber power and compute

The Digital Infrastructure players surrounding the Hyper-scalers are declining...

Despite making huge capital investments to enable 3G and 4G technology, operators have created less and less value in the last decade

Index – 100, December 2010–Dec 2020, (Local currency)

Avg. TSR trend for telcos and other industry players

Legend:
- OTT / Hyperscalers
- InfraCo
- ICT
- Telco US
- Telco LATAM
- Telco EU
- Telco ME

Median TSR CAGR %

	Last 10 years	Last 5 years	Last 3 years
OTT / Hyperscalers	30%	34%	39%
InfraCo	17%	21%	20%
ICT	16%	10%	10%
Telco US	10%	10%	8%
Telco LATAM	5%	10%	5%
Telco EU	2%	-5%	-11%
Telco ME	5%	0%	1%
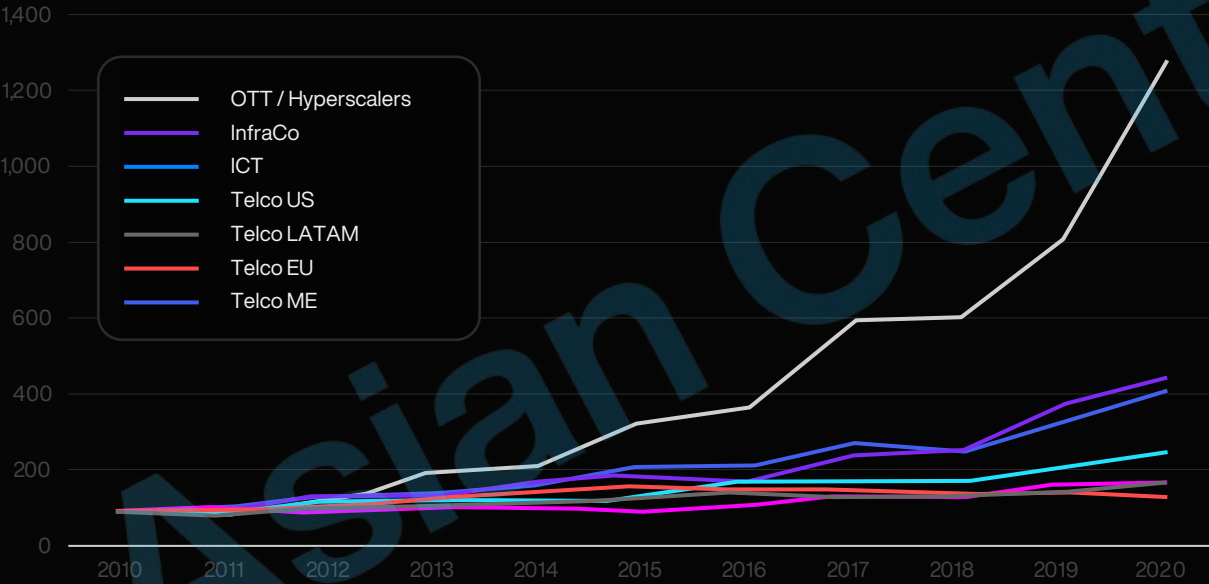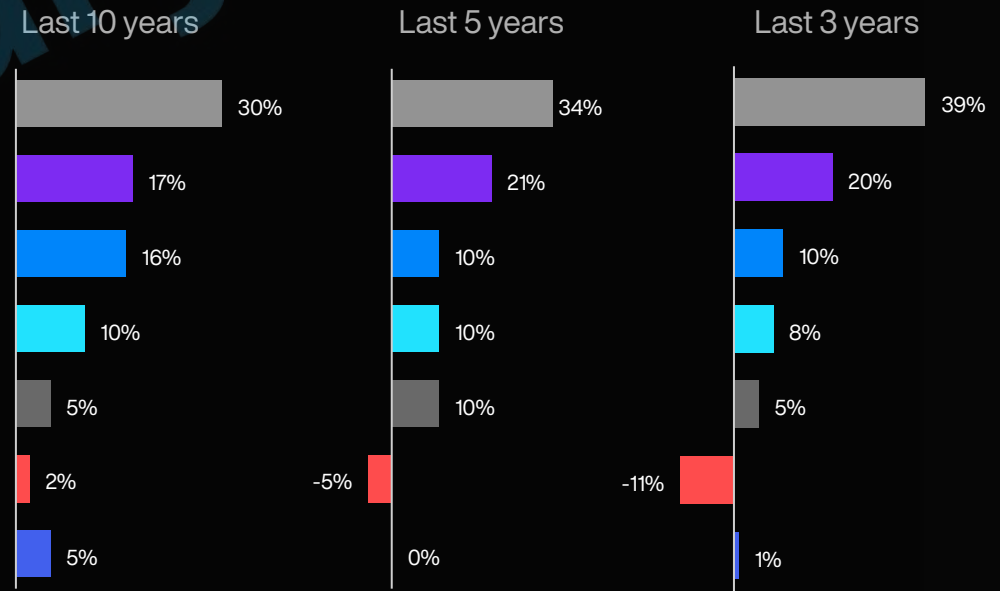
From Eyeballs to Turbines

Welcome Power Generation Companies to
the digital infrastructure ecosystem

Total US data center electricity use from 2014 through 2028

- US data center energy use remained stable at ~60 TWh from 2014–2016, with minimal growth since 2010.

- By 2017, the rise of GPU-accelerated servers for AI drove energy use up, reaching 76 TWh (1.9% of U.S. electricity) by 2018. Energy use has continued to grow, hitting 176 TWh (4.4% of U.S. electricity) in 2023.
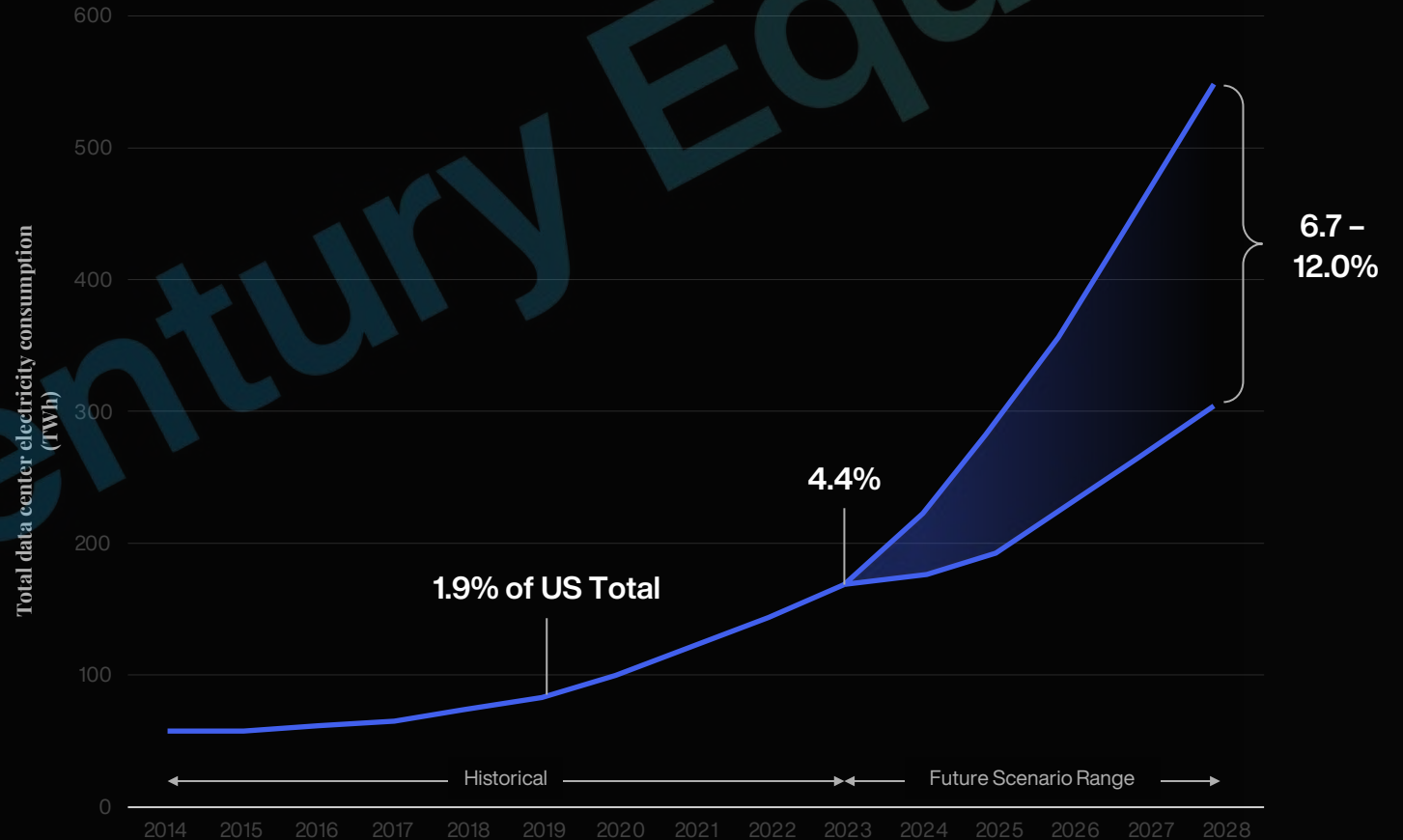
The Global Data Center industry could be the largest emitter of carbon in the next quarter century
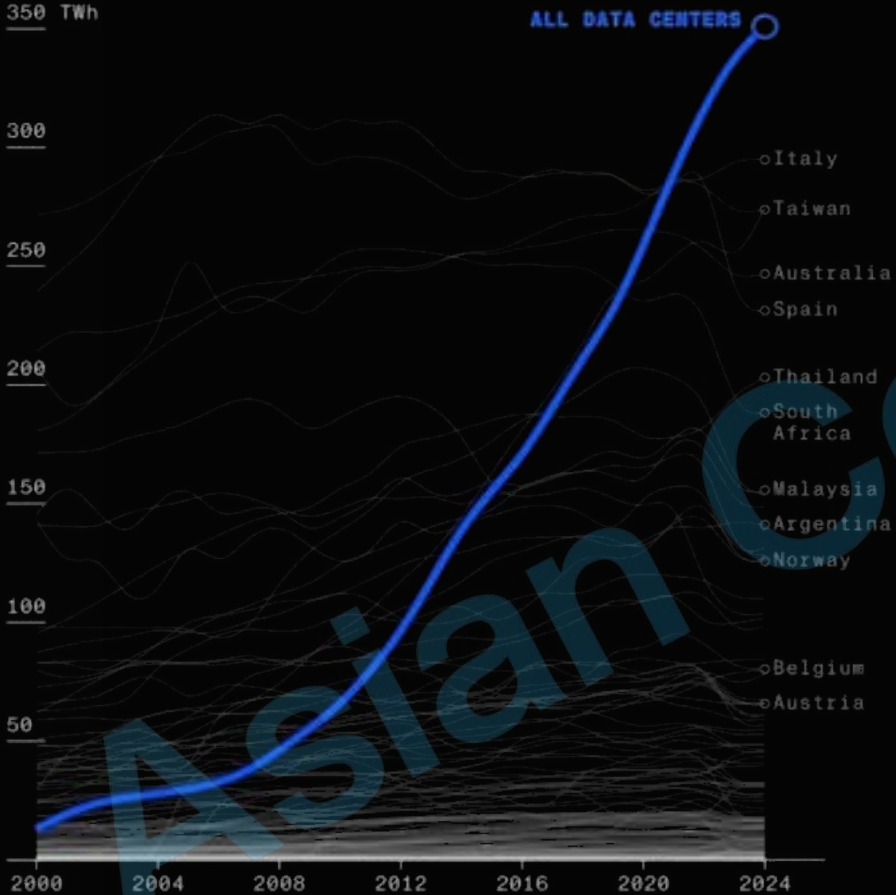
Data centers are responsible for **1%** of the total electricity demand worldwide and it will clear **10%** in the next decade at current rates of growth

422,000,000,000
Pounds of CO2 emissions yearly

61%
Increase in data traffic per year

350 TWh
Consumed by data centers annually

Traditionally, data centers were concentrated in the USA & Europe.
Now, global OTTs are heading towards emerging markets for their next stage of expansion...

Excess Earth Friendly Power

In the Pacific region Indonesia, the Philippines and Hawaii will be huge sources of green power

The race for power is on in America

Data center presence in the US

Map legend (left):
- Primary markets Existing demand of more than 800 MW[1]
- Secondary markets Lower but fast-growing demand
- Emerging markets Emerging demand in markets where power is still abundant

Map labels (left): Northwest, Minnesota, Wisconsin, Chicago, Wyoming, Iowa, Omaha, Northern California, Salt Lake City, Indiana, Ohio, Pennsylvania, Boston, New York, New Jersey, Denver, Kansas, Northern Virginia, Las Vegas, Los Angeles, North Carolina, Tennessee, South Carolina, Phoenix, Albuquerque, Oklahoma, Alabama, Mississippi, Atlanta, Dallas, Austin/San Antonio, Houston, Florida

Map labels (right): Northwest, MISO, ISO-NE, NYISO, SPP, PJM, CIASO, South West, MISO, PJM, ERCOT, South East

Data values (right map):
- 20% / 500 (ISO-NE)
- 20% / 800 (NYISO)
- 1,900
- 1,100 / 120%
- 2,200 / 130%
- 2,300 / 70% (PJM)
- 120% (CIASO)
- 900 / 200
- 130%
- 120% / 1,400 (ERCOT)
- 1,400 / 120% (South East)

Legend (right):
- Current MW
- Growth by 2027

[1] Megawatt

Largest source of electricity generation as a percentage of total generation, by country

Ranking	Country	Avg Electric Price (in U.S. cents per kWh)
1	Sudan	0
2	Venezuela	0
3	Iran	0
4	Ethiopia	1
5	Kyrgyzstan	1
6	Cuba	1
7	Libya	1
8	Zimbabwe	1
9	Bhutan	2
10	Angola	2
11	Suriname	2
12	Uzbekistan	3
13	Zambia	3
14	Iraq	3
15	Kuwait	3
16	Qatar	3
17	Oman	3
18	Algeria	4
19	Egypt	4
20	Kazakhstan	4

Legend:
- Coal
- Gas
- Geothermal
- Hydro
- Nuclear
- Oil
- Solar
- Wind
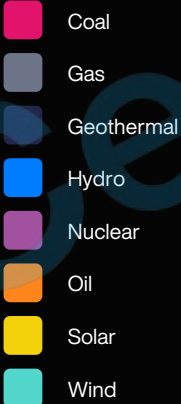
The places where low cost and green power is available is a very different set of locations from where digital infrastructure has previously been deployed
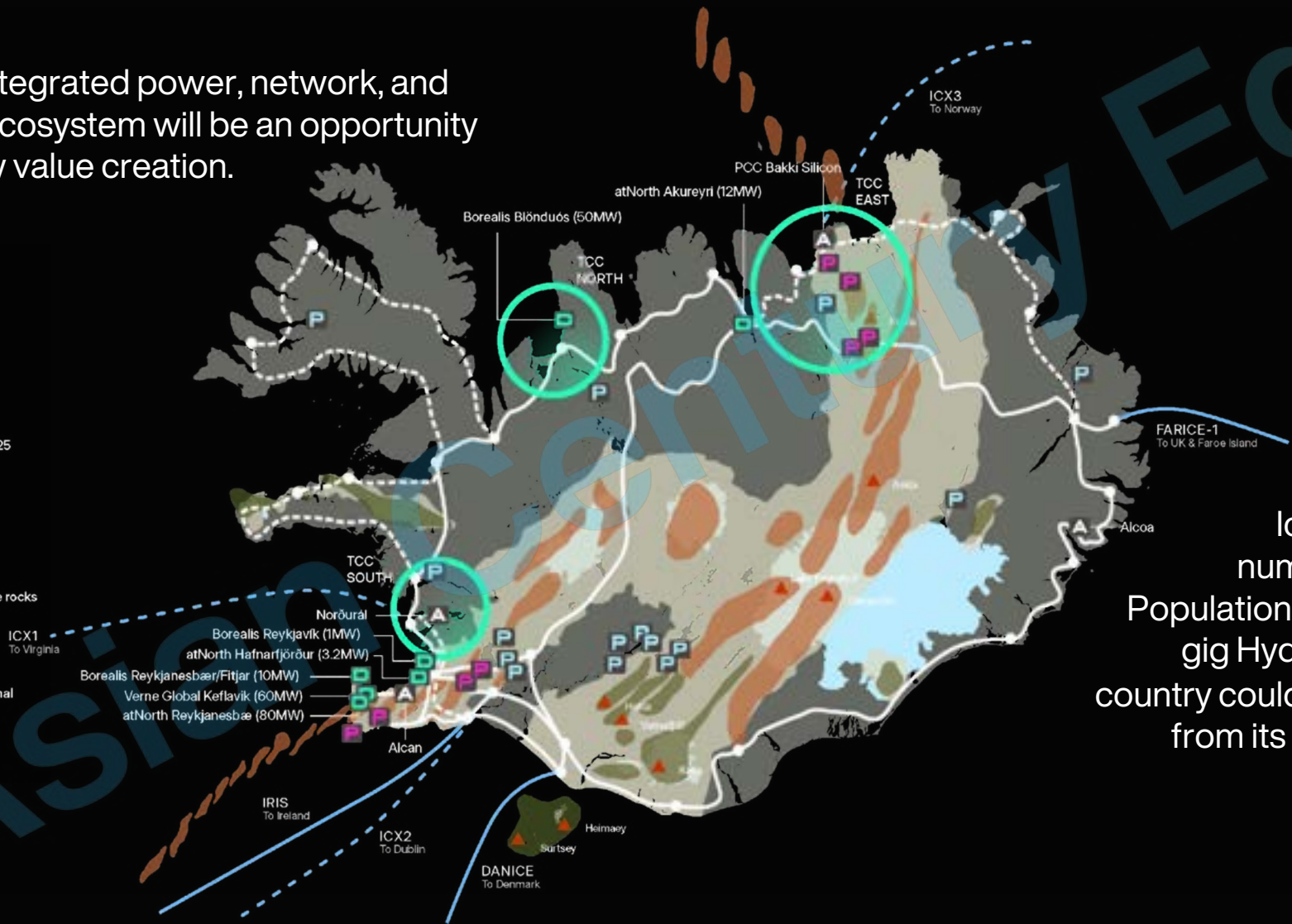
Places like Indonesia, the Philippines and Iceland, Norway, Canada, Kenya, Costa Rica and Uruguay have an over abundance of Green Power

Building an integrated power, network, and data center ecosystem will be an opportunity to create new value creation.

Legend:
- ○ Sites for Data Centers
- □ Data Centers
- A Aluminum Smelters
- — Subsea Cables
- - - Proposed Subsea Cables
- — Terrestrial Cables
- ···· Planning Terrestrial 2024-25
- ▲ Main volcanoes
- Tholeiitic basalt
- Alkalic basalt
- Transitional alkalic basalt
- Late Pleistocene/ Holocene rocks
- Other rocks
- Glaciers
- P Power Stations – Geothermal
- P Power Stations – Hydro

Map labels:
ICX3 To Norway
PCC Bakki Silicon
atNorth Akureyri (12MW)
Borealis Blönduós (50MW)
TCC NORTH
TCC EAST
FARICE-1 To UK & Faroe Island
Alcoa
Alcan
Norðurál
Borealis Reykjavík (1MW)
atNorth Hafnarfjörður (3.2MW)
Borealis Reykjanesbær/Fitjar (10MW)
Verne Global Keflavík (60MW)
atNorth Reykjanesbæ (80MW)
TCC SOUTH
ICX1 To Virginia
IRIS To Ireland
ICX2 To Dublin
DANICE To Denmark
Heimaey
Surtsey

Iceland is a case study where the numbers are extremely compelling. Population uses 1 gig of power, industry 1.6 gig Hydro, thermal and wind across the country could create between 10 and 45 GW from its thermal wells and hydro damns.

Look out fiber –
The Birds are Back!

Starlink has launched in the Pacific Islands

– Deep GEO coverage

– Price for 40M of IP service is $200 USD a month

– Modem sharing allows up to four user to share

– Static price point will be around $12USD a month

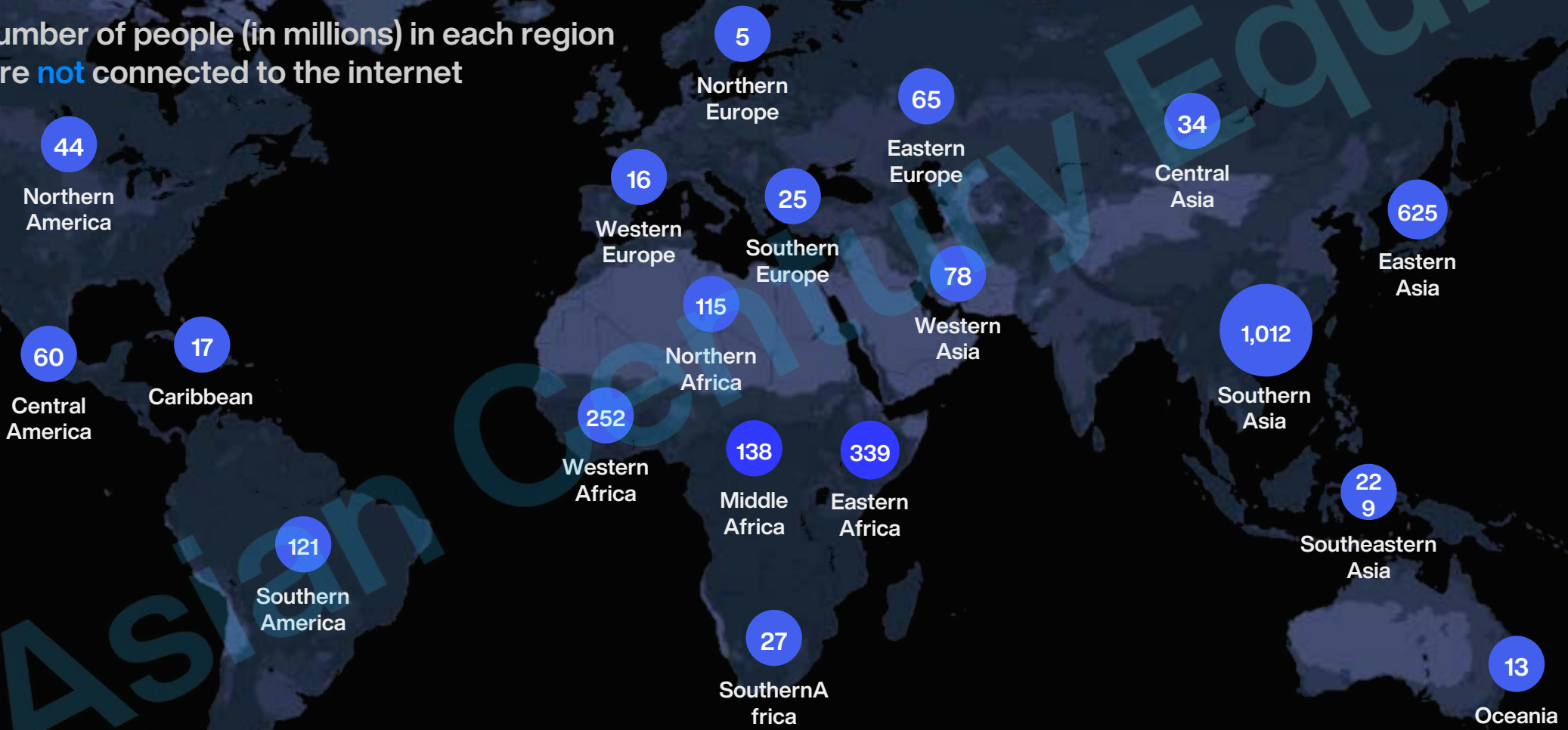# "Thousand Sails" is launched by Chinese government

– Key attributes:

   – 15,000 – 2600 GEO satellites

   – New telecom network for emerging markets

   – Average cost per user will be $20 USD for 100meg connection at full load

   – Cost per 10 Meg will be around $2US

The 'next billion' : unconnected audiences – will they all be satellite users?

The number of people (in millions) in each region who are not connected to the internet

44 Northern America

60 Central America

17 Caribbean

121 Southern America

5 Northern Europe

16 Western Europe

25 Southern Europe

65 Eastern Europe

115 Northern Africa

252 Western Africa

138 Middle Africa

339 Eastern Africa

27 SouthernAfrica

78 Western Asia

34 Central Asia

625 Eastern Asia

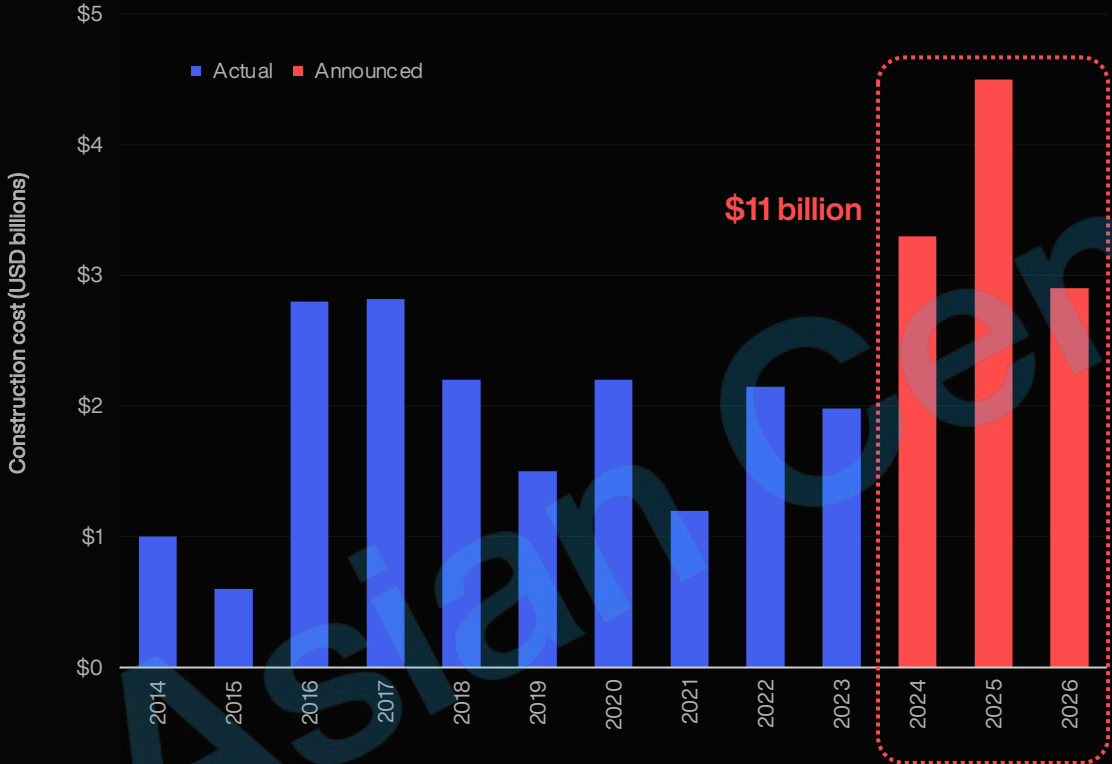**1,012** Southern Asia

229 Southeastern Asia

13 Oceania

Cables are getting bigger and more concentrated

Cable building has slowed over the last four years

Is there overinvestment in cables?
Construction cost of new submarine cables by RFS

$11 billion

(Chart: Construction cost (USD billions), 2014–2026, Actual in blue, Announced in red)

Not partying like it's 1999
Construction cost of new submarine cables by RFS

$25 billion (or $43 billion in current dollars)

(Chart: Construction cost (USD billions), 1999–2026, Actual in blue, Announced in red)
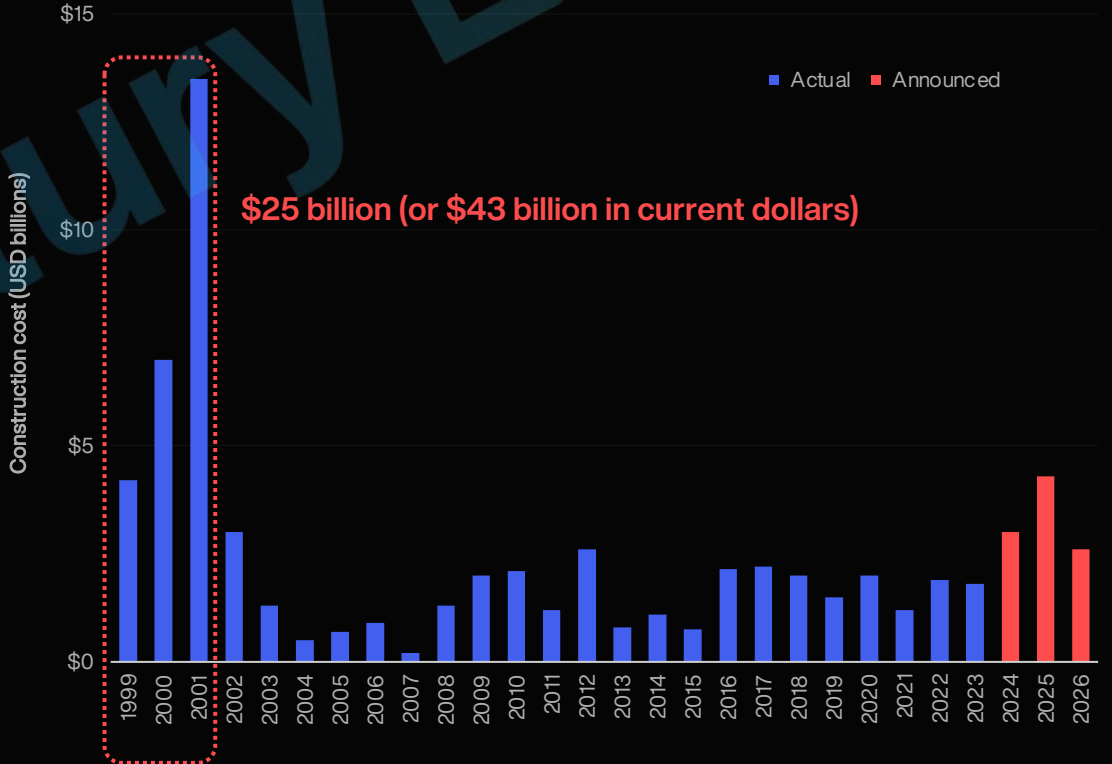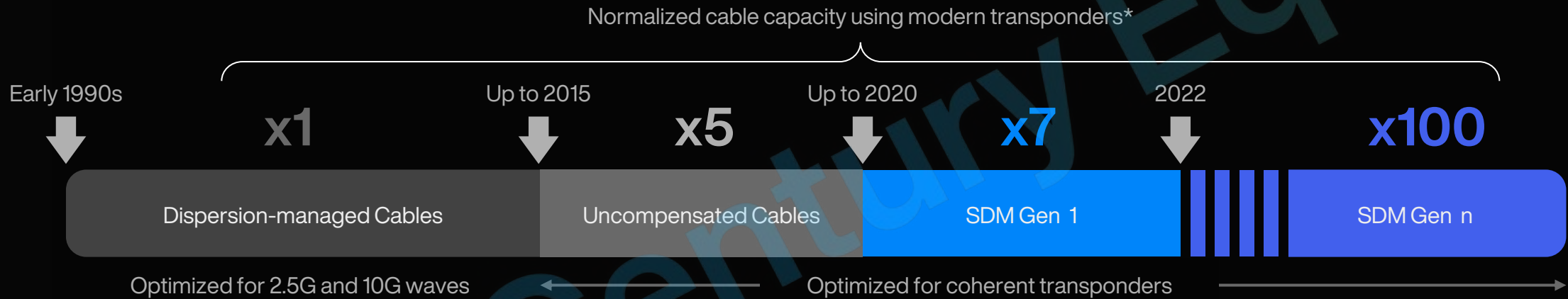
The main reason for limited cable builds is the cables are more efficient ....

Evolution of submarine cables

Normalized cable capacity using modern transponders*

Early 1990s	Up to 2015	Up to 2020	2022
x1	x5	x7	x100

| Dispersion-managed Cables | Uncompensated Cables | SDM Gen 1 | SDM Gen n |

Optimized for 2.5G and 10G waves   Optimized for coherent transponders

* Compares total cable capacity of trans-Atlantic distance using fifth-generation coherent transponders

There are only a few SDM cables today, but SDM is the accepted architecture for new long-distance submarine cables
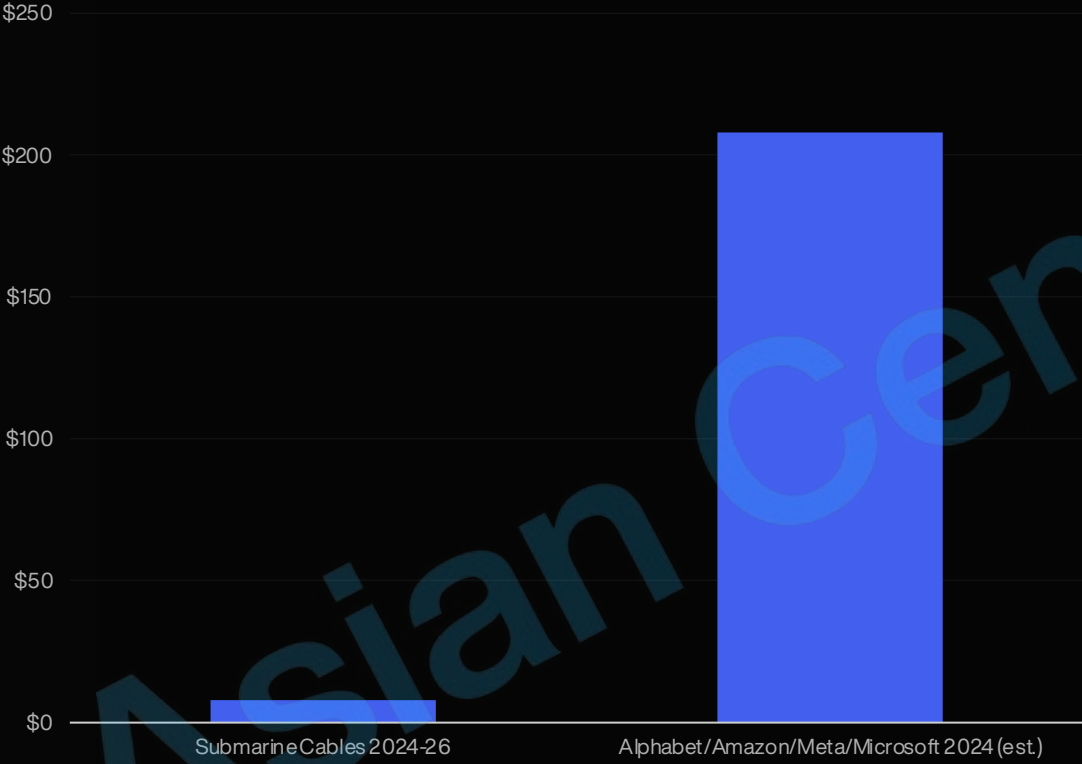
SDM

Pre-DSM cables

Uncompensated cable

500
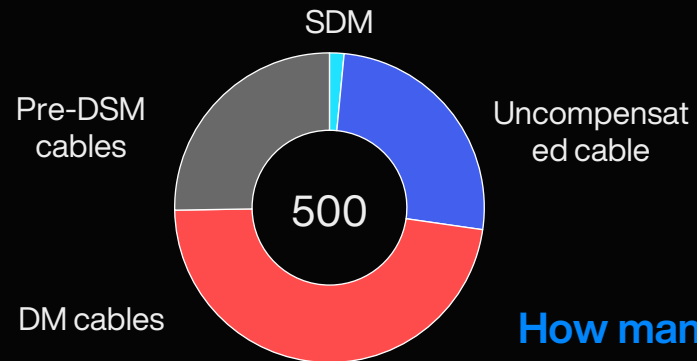
DM cables

How many of each cable type?

Cables have declined as a percentage of Hyper scalers capital yet still are being invested in and will be for the foreseeable future!

New submarine cables 2024-26 vs 4 hyperscalers' CAPEX 2024

"Even in scenarios where if it turns our we are overinvesting, these are infrastructure which are widely useful lives, and we can apply it across products. For us the risk of underinvestment far outweighs the risk of overinvestment."
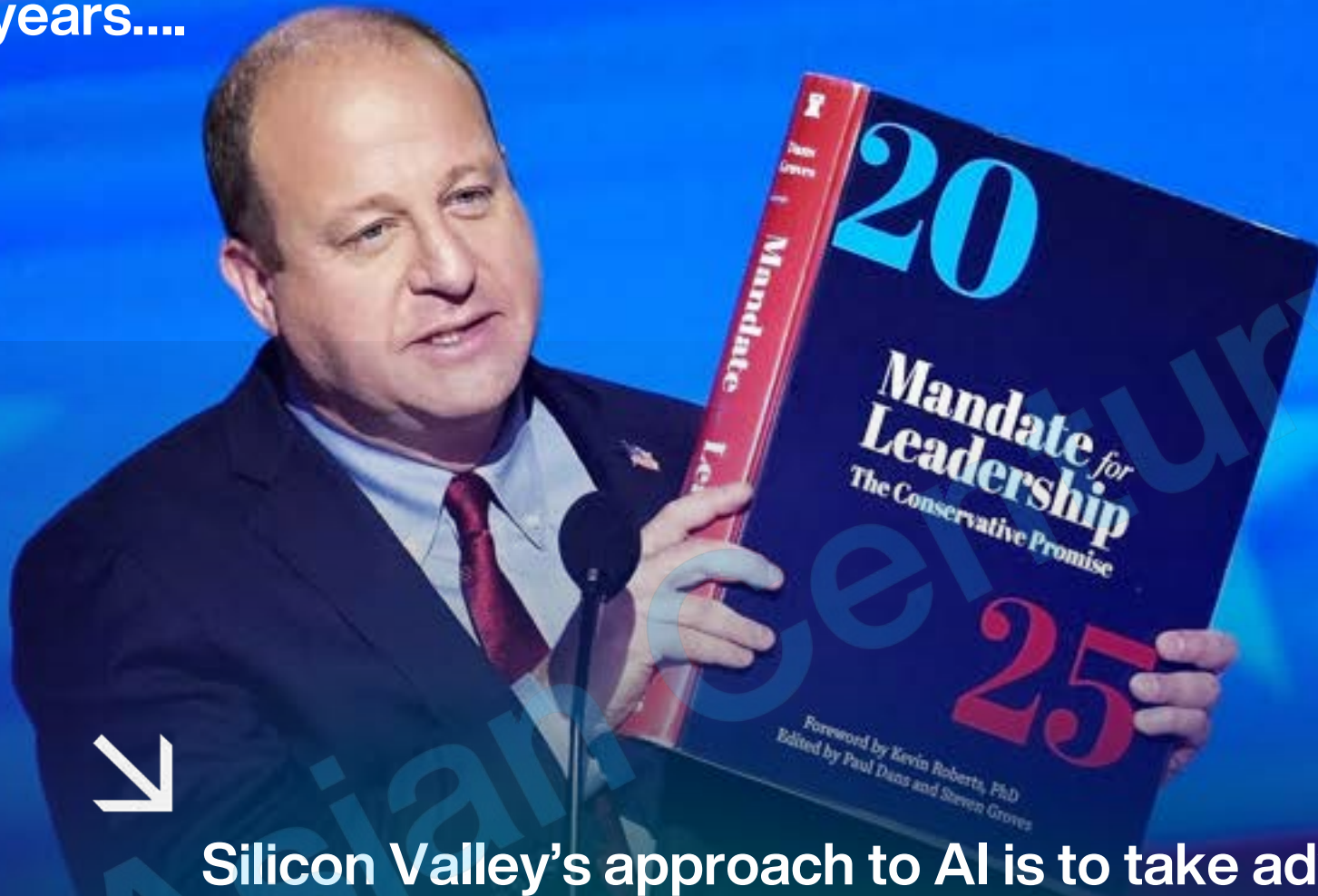
Sundar Pichai, CEO Alphabet

Source: TeleGeography

Here comes the Governments

Some new faces may have an influence on how and where our infrastructure is built in the next four years....

Silicon Valley's approach to AI is to take advantage of our leadership position in technology to lead the world in AI by being one step ahead of our competitors around the globe.....
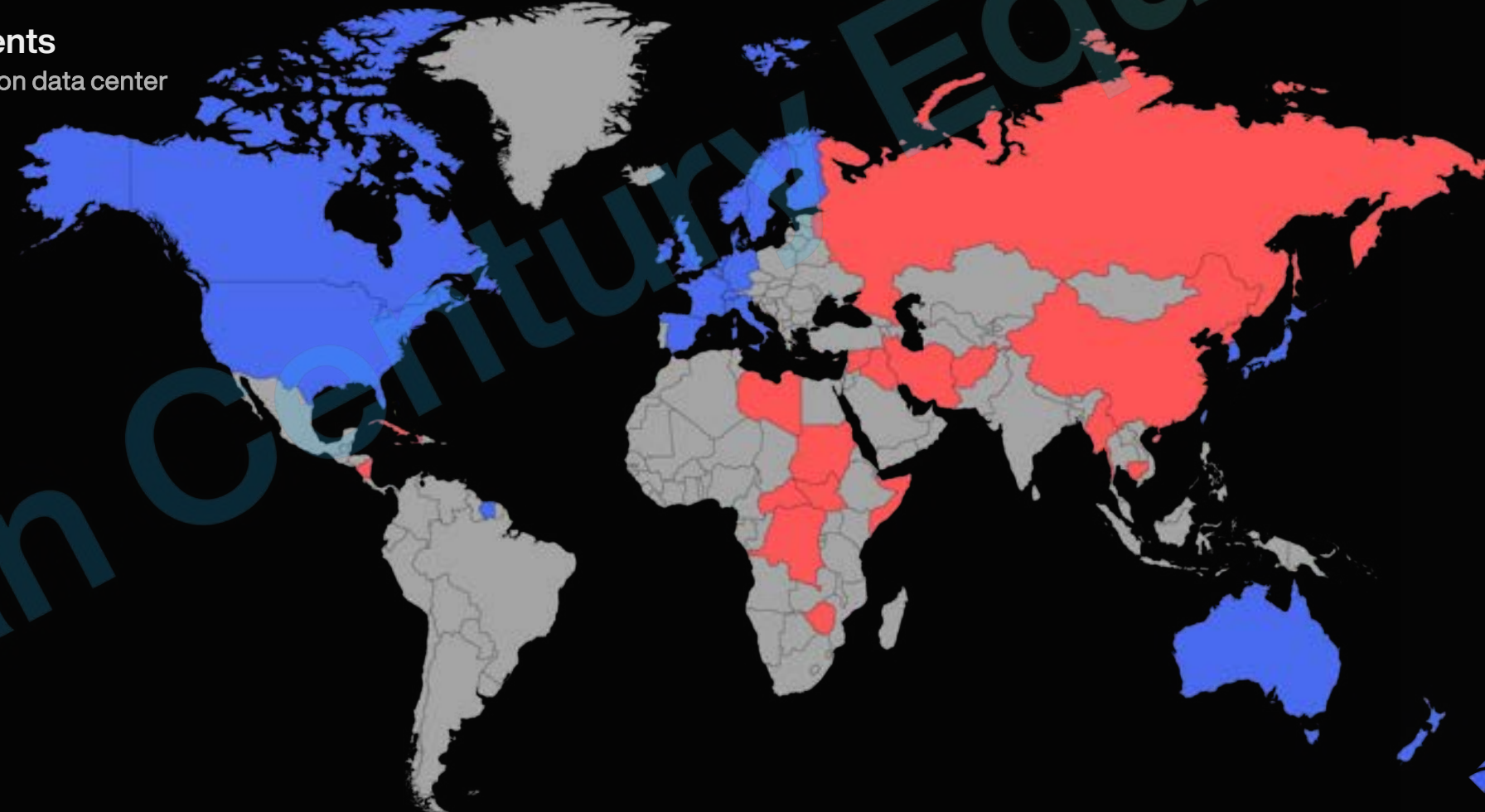
Collaboration and creation of AI training models has now become a government issue

US to curb global chip shipments
Most markets will face new restrictions on data center development

- 🟦 Tier 1 (Most permissive)
- ⬜ Tier 2
- 🟥 Tier 3 (Most restrictive)

The China US relationship has also become a front and center issue

The Greater East Asia Prosperity Spere

- From 1870 to 1945 Japan embarked on a program to free the Asian economies from Western exploitation

- The guise was to give the new colonies a new life based on the Japanese model of the East Asia Prosperity Sphere

- Pundits believed the purpose was to feed the isolated Japanese surging population and provide resources for industrialization ....

China will spend over 1 trillion on the BRI by 2027

Experts have different views on the path forward yet one fact that is clear there will be accelerated government participation in digital infrastructure policy going forward

" There is no greater opportunity – or challenge – for U.S. foreign policy than to encourage China's integration as a fully responsible member of the international system. Maintaining normal trade relations reflects our commitment to this goal. "

Madeline Albright 1995

" In 2017 Xi gave a speech in which he declared that China would surpass the United States in these frontier technologies (AI, Quantam Computing, Synthetic biology, robotics) by 2035........ The US was forced to confront the possibility it could lose a technological race to its main adversary "

Condolezza Rice

" We seek a relationship grounded in fairness, reciprocity, and respect for sovereignty, and we have taken strong and swift action to achieve that goal. "

Mike Pence 2018

Final Thoughts

We share a planet; global digital infrastructure only works effectively in an open collaborative way with players collaborating across sectors and geographies across the globe.

Some players' failure to adhere to agreed principals in WTO documents should not mean that globalization is a failure.

AI already has and will continue to improve the lives of all humans collectively.

The Big Seven approach of "out running" the foreigners and driving global market domination is far better than protectionism and inward focused trade and tech policies.

Final Remarks

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We must adjust to changing times and still hold to unchanging principles.

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Jimmy Carter