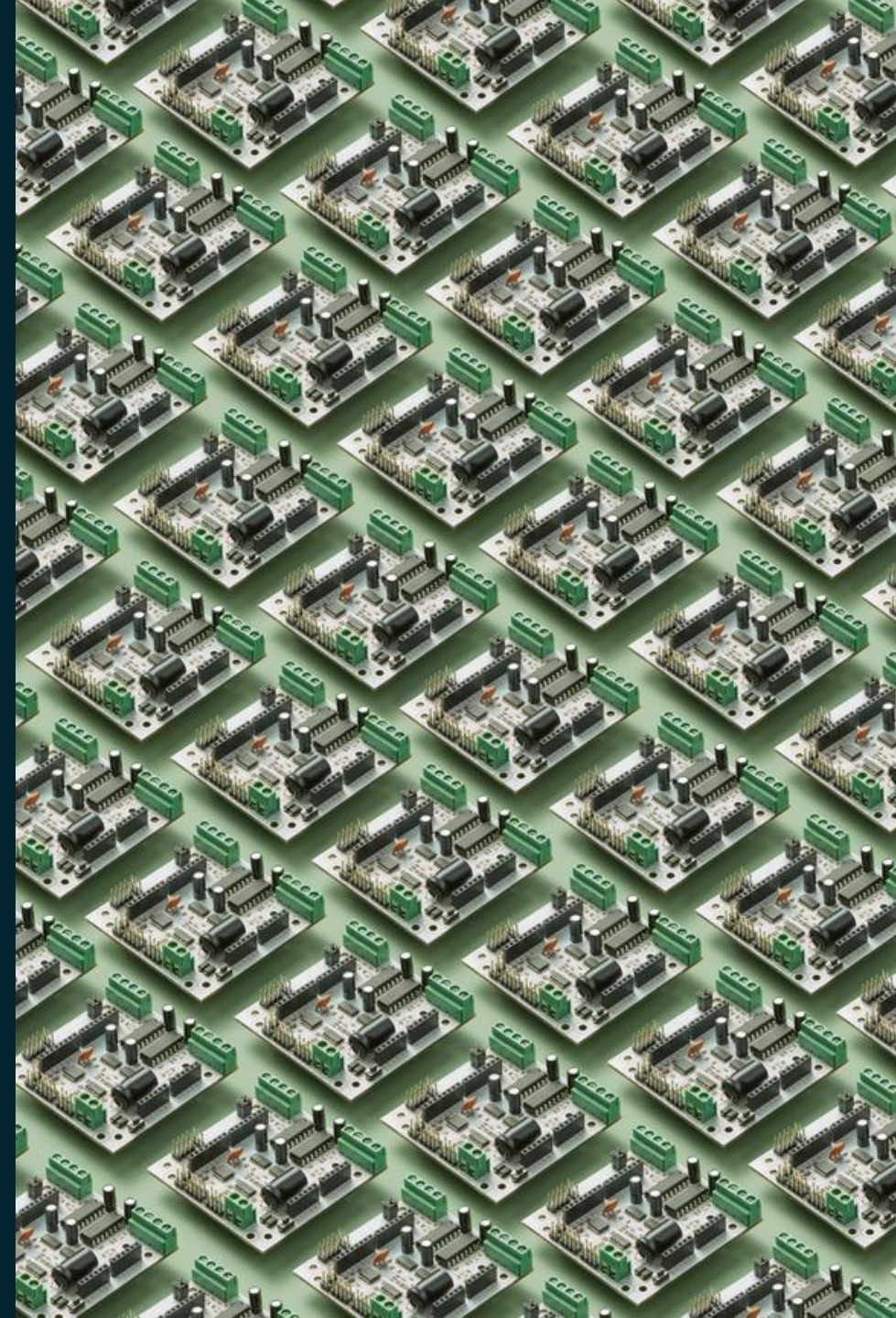


# AI Data Center Value Chain

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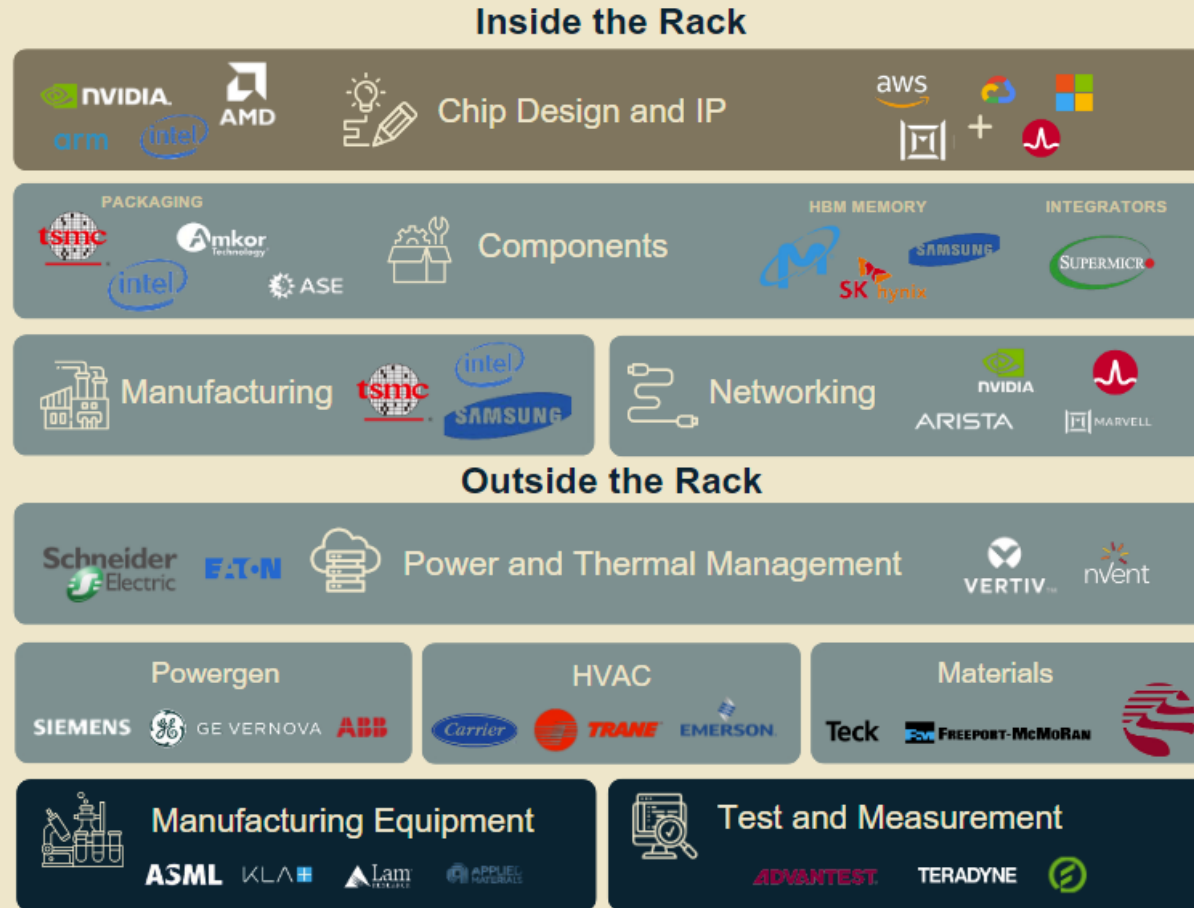
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# The AI Data Center Value Chain

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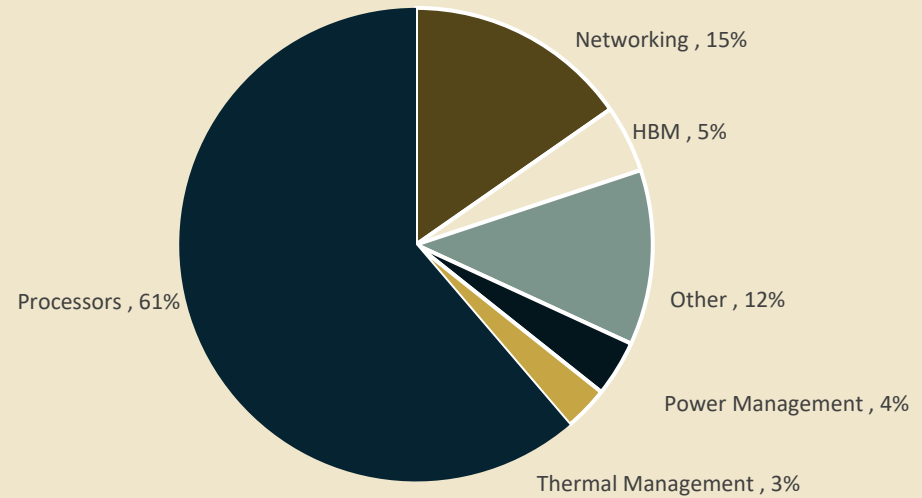
Source: Spear Invest

# Market overview

# What is the size of the market?

## Data Center TAM

	2023	2027	CAGR
<b>"Inside the Rack"</b>			
Processors	110	400	38%
Networking	25	100	41%
HBM	3	30	78%
Other	20	40	19%
<b>Total</b>	<b>158</b>	<b>570</b>	<b>38%</b>
<b>"Outside the Rack"</b>			
Power Management	12	25	20%
Thermal Management	5	20	40%
IT & Edge	11	19	15%
Services and Software	10	17	15%
	<b>38</b>	<b>81</b>	<b>21%</b>
<b>Total Data Center</b>	<b>196</b>	<b>651</b>	<b>35%</b>



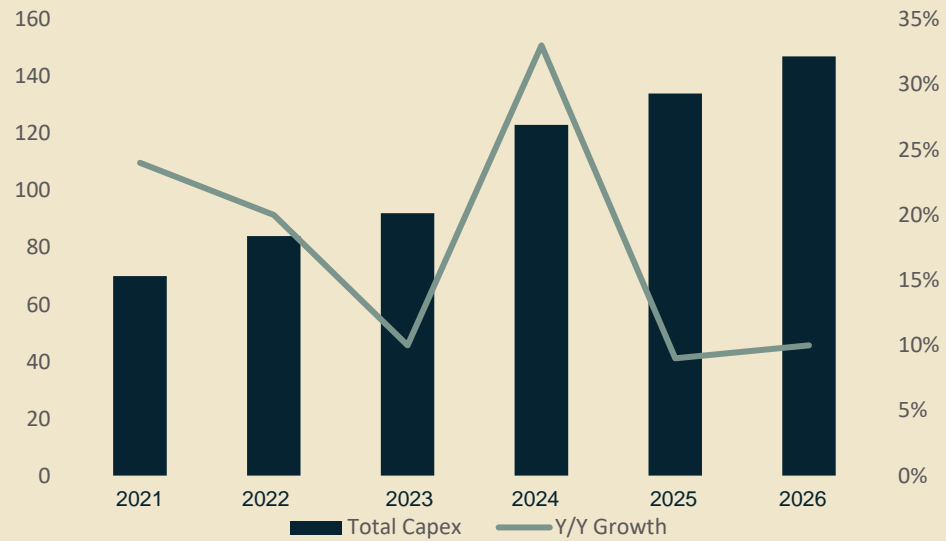
### Industry Data Points:

- *Processors:* AMD estimates \$400bn TAM by 2027
- *Total Data Center:* Nvidia estimates \$1T of data center installed base that needs upgrades (\$1T total, including new investments)
- *HBM Memory:* SK Hynix forecasts that the AI chip boom will allow the HBM market to grow at an annual compound growth rate of 82% by 2027.

Source: Spear Invest

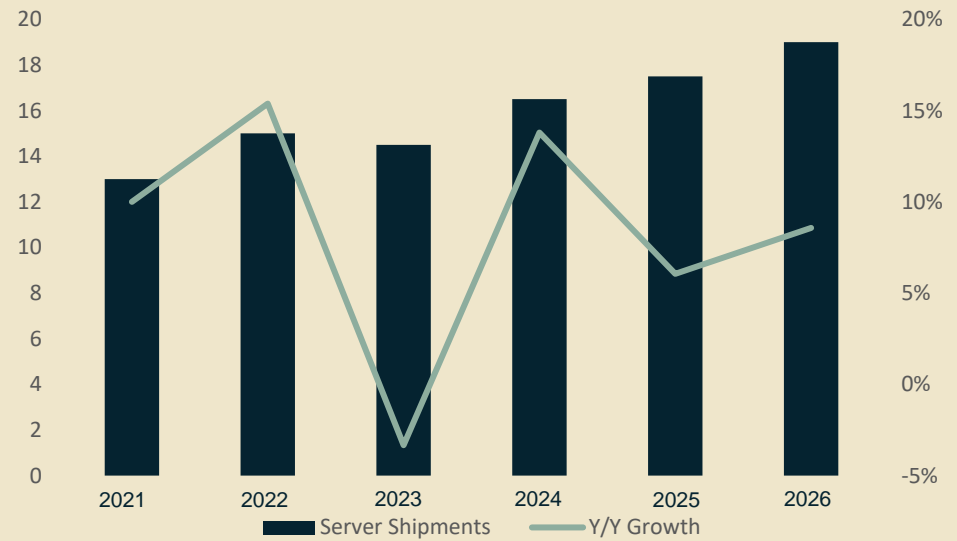
# Early innings...

### Top Three Cloud Vendor Capex (\$bn)



Source: Bloomberg, Spear Invest

### Server Shipments (\$millions)

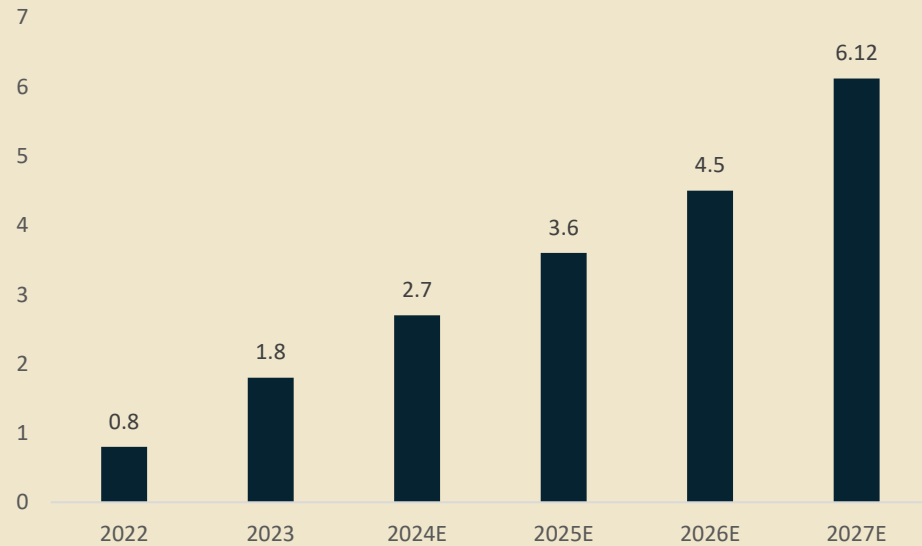


Source: Spear Invest

# AI Server Shipments to Reach 30% by '27

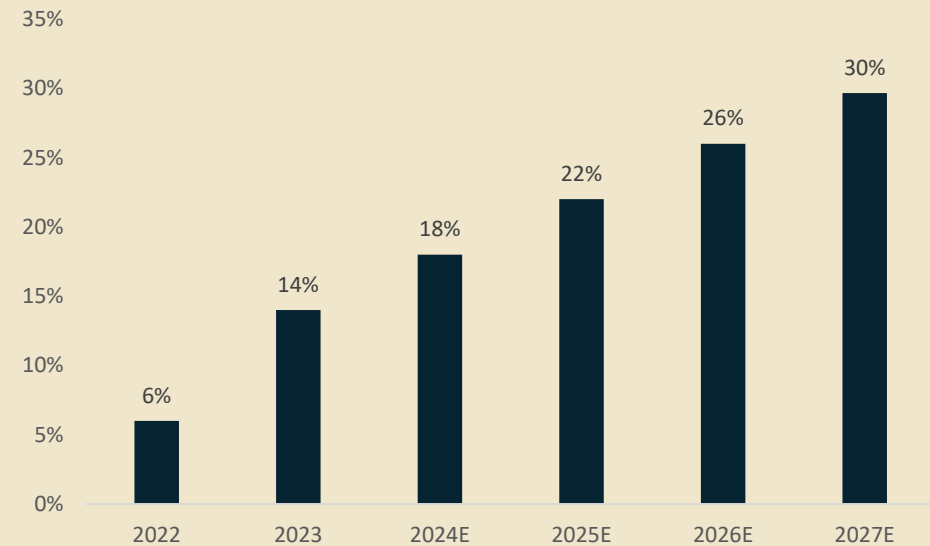
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AI Server Shipments (\$millions)



Source: Spear Invest

AI Server Shipments as % of Total



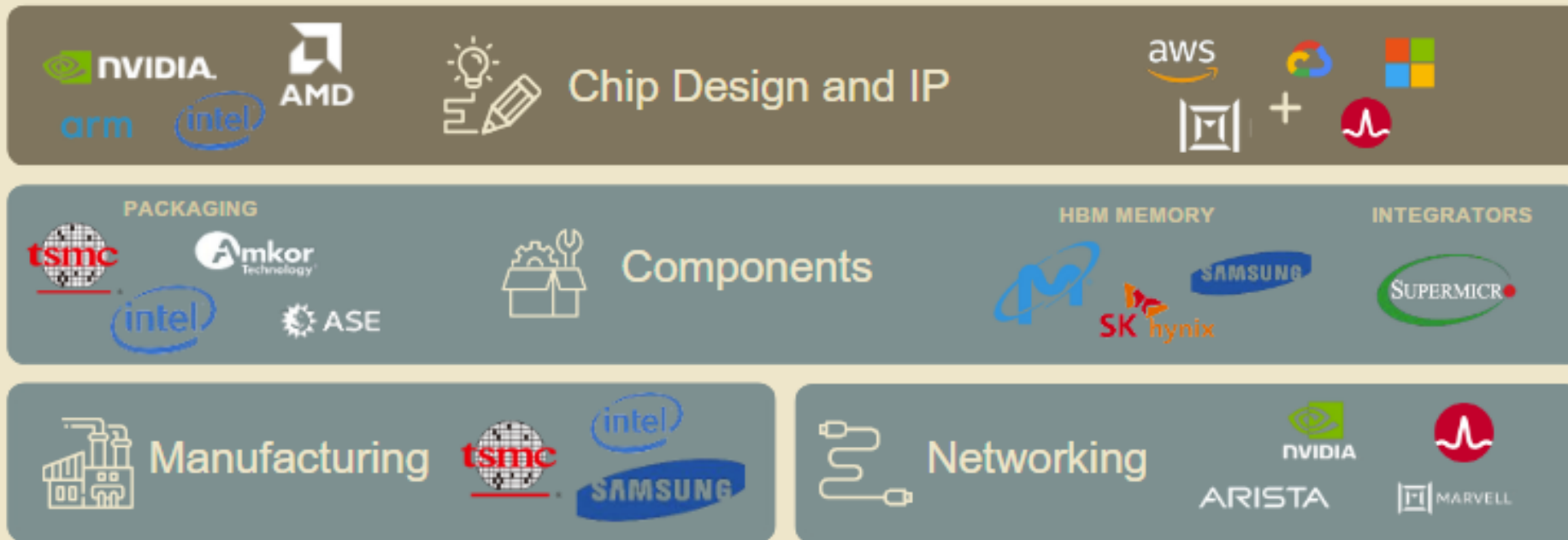
Source: Spear Invest

# Inside the Rack



# Chip design is a resilient business model

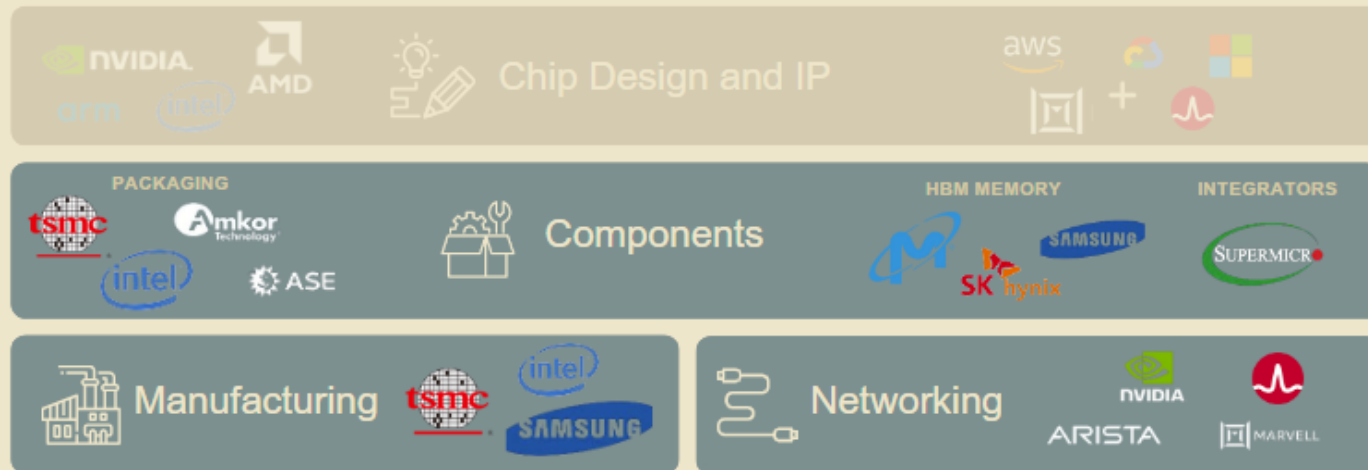
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Source: Spear Invest

# Components can be very cyclical...

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Source: Spear Invest

...but can generate great returns when supply is tight

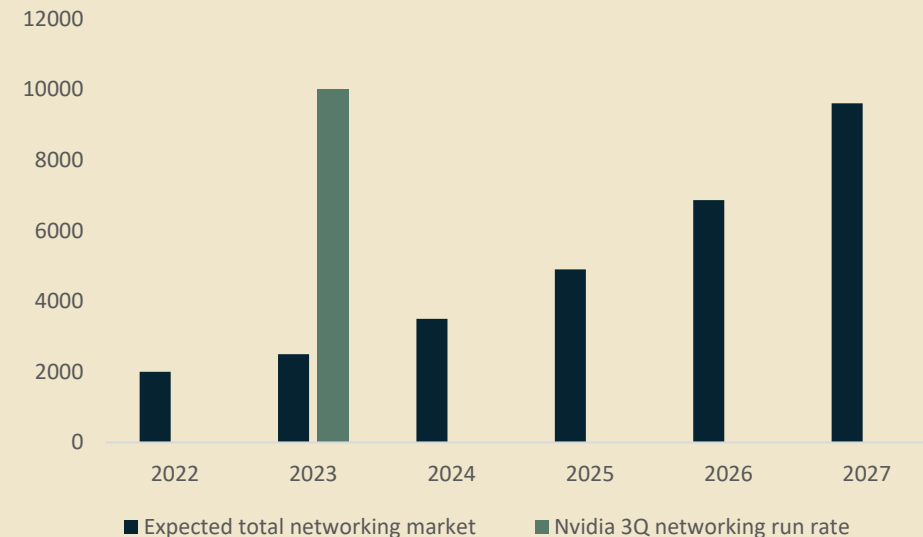
# Networking to become a \$100bn market by '27

- Networking refers to equipment that interconnects different hardware components e.g., cables, switches, etc.
- If networking equipment is not optimized, server operators will be left with unused GPUs.
- AI servers have very high data bandwidth and low latency requirements, multiples compared to traditional servers
- Nvidia's highly popular InfiniBand grew 5X just in 3Q23. Networking for Nvidia is a \$13bn run rate business **today!**



Azure uses over 29,000 miles of InfiniBand cabling, enough to circle the globe.

Previously Expected Networking market vs. Nvidia's C3Q23 Networking run-rate



Source: Bloomberg, Company Reports, Spear Invest

# Networking: Switches and Interconnects

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## Switches

## Interconnects

### Ethernet

Leader in inference



- Nvidia Spectrum Ethernet Switch – connects to 128 GPUs

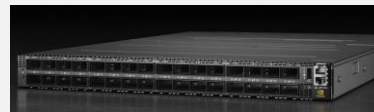


### InfiniBand

Optimized for model training



- InfiniBand is the incumbent high-speed, low-latency connectivity standard
- Nvidia Quantum (Mellanox) Switch – supports 64GPUs



### Dedicated Digital Signal Processing (DSP)



- Electro-optic pluggable
- DSP, a ~\$500mn+ market led by MRVL with 75%+ share. Potential to grow 3x to \$1.4bn by CY27E.

LLM Servers drive 10-100x higher data/bandwidth compared to traditional servers

# Memory and Packaging are Bottlenecks

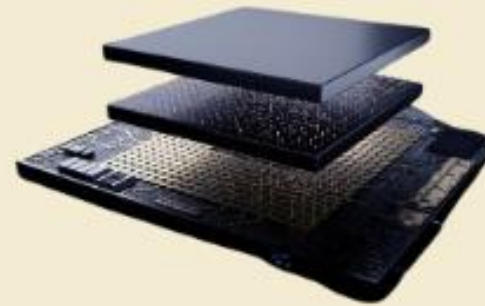
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HBM Memory on a Chip



Source: Micron

CoWoS Packaging



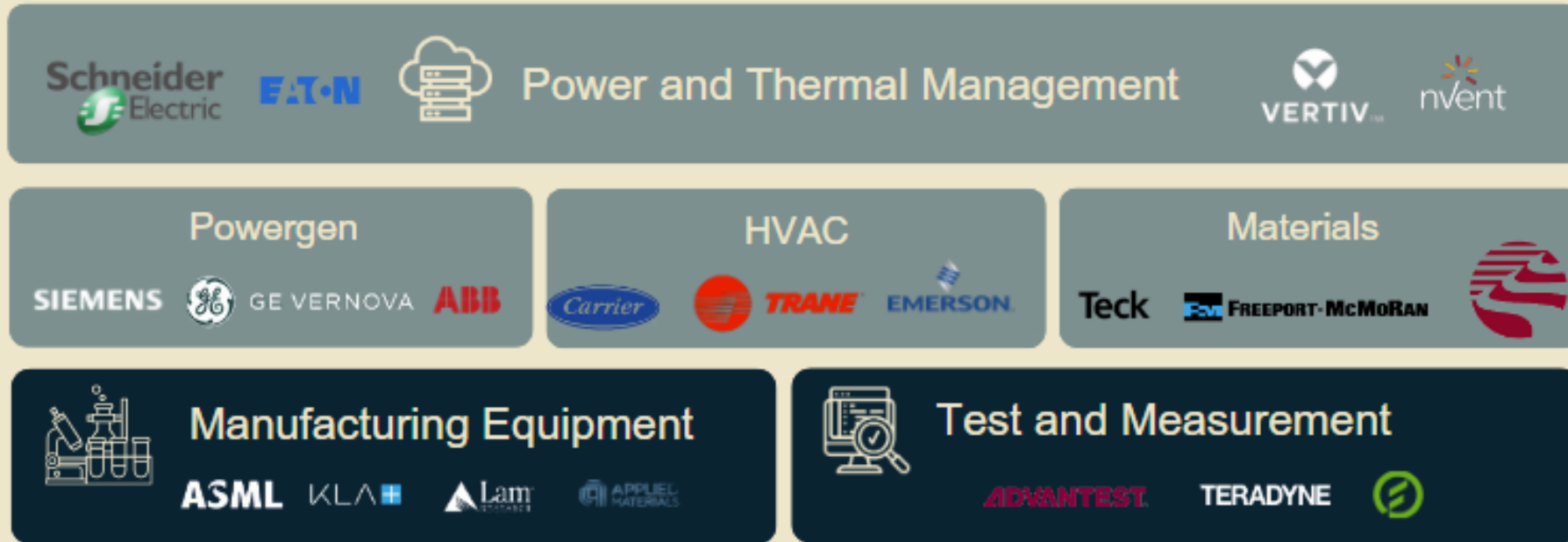
Source: SMYG Ltd

**HBM to grow to a \$30bn market from <\$3bn today**

Outside the Rack

# The upside is broadening across the value chain

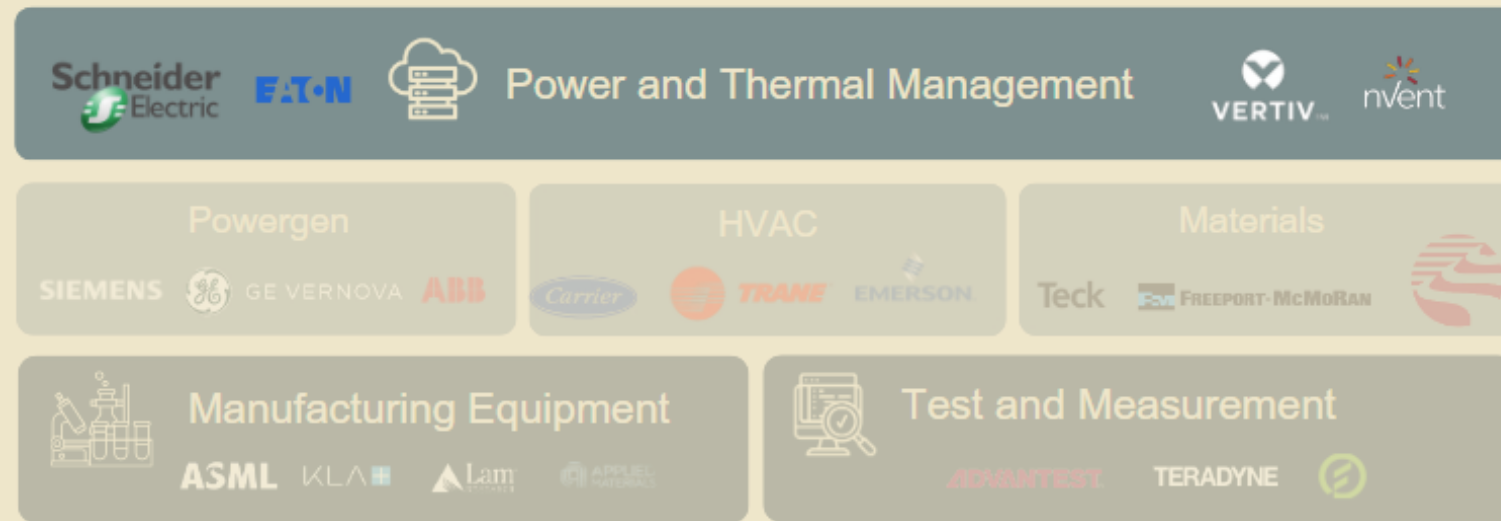
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Source: Spear Invest

# Power & Thermal management to realize significant benefits

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Source: Spear Invest



# Thermal Management expected to grow at 40% CAGR

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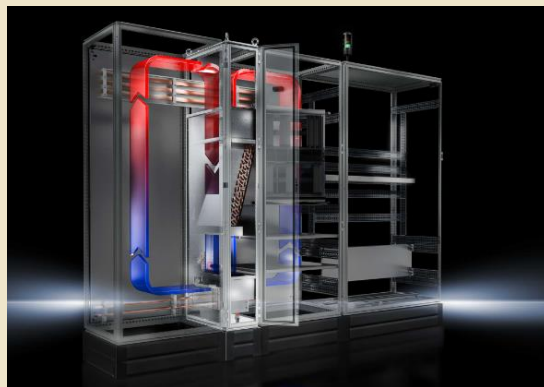
## Data Center TAM

### "Outside the Rack"

	2023	2027	CAGR
Power Management	12	25	20%
Thermal Management	5	20	40%
IT & Edge	11	19	15%
Services and Software	10	17	15%
Total	<u>38</u>	<u>81</u>	21%
<b>Incremental contribution</b>		<b>\$43</b>	

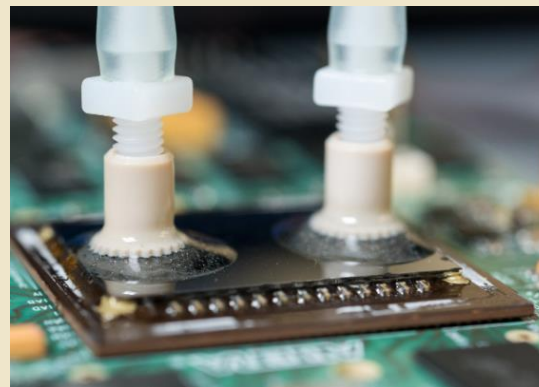
Source: Spear Invest

## Liquid Cooled Rack



Source: The Engineer

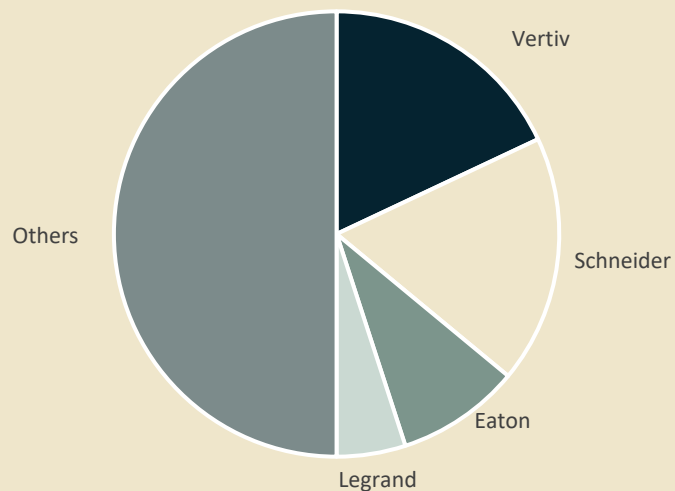
## Direct-to-chip-liquid cooling



Source: GeorgiaTech

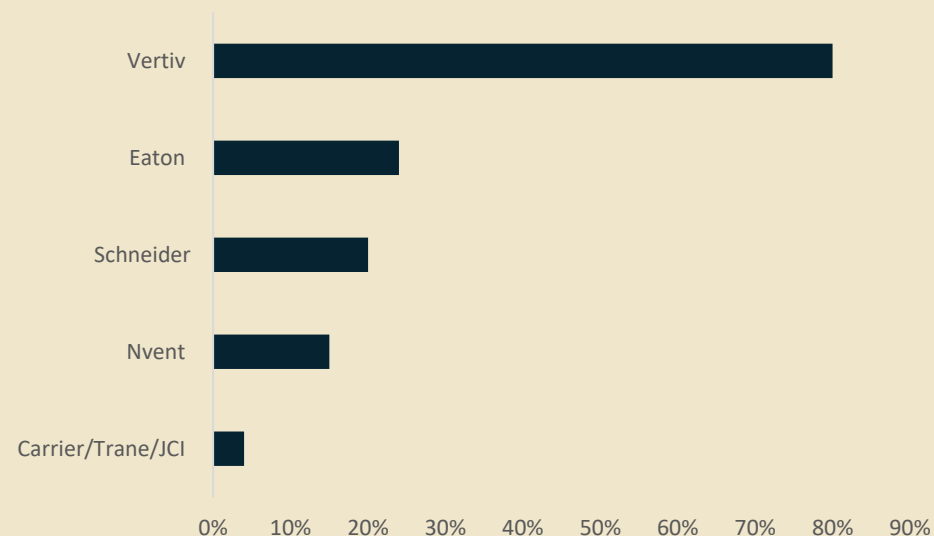
# Top 3 players dominate the market

The top 3 players control 45% of the market



Source: Spear Invest

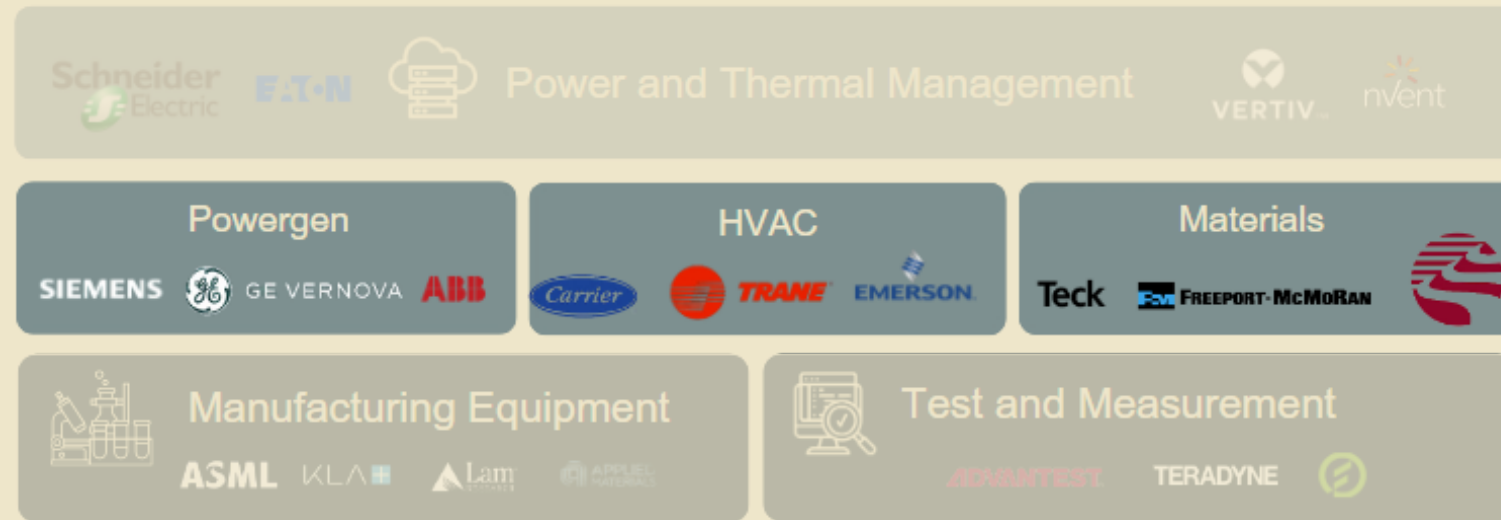
DC represents > 20% of revenue for several large players



Source: Spear Invest

# Upside will extend beyond the DC

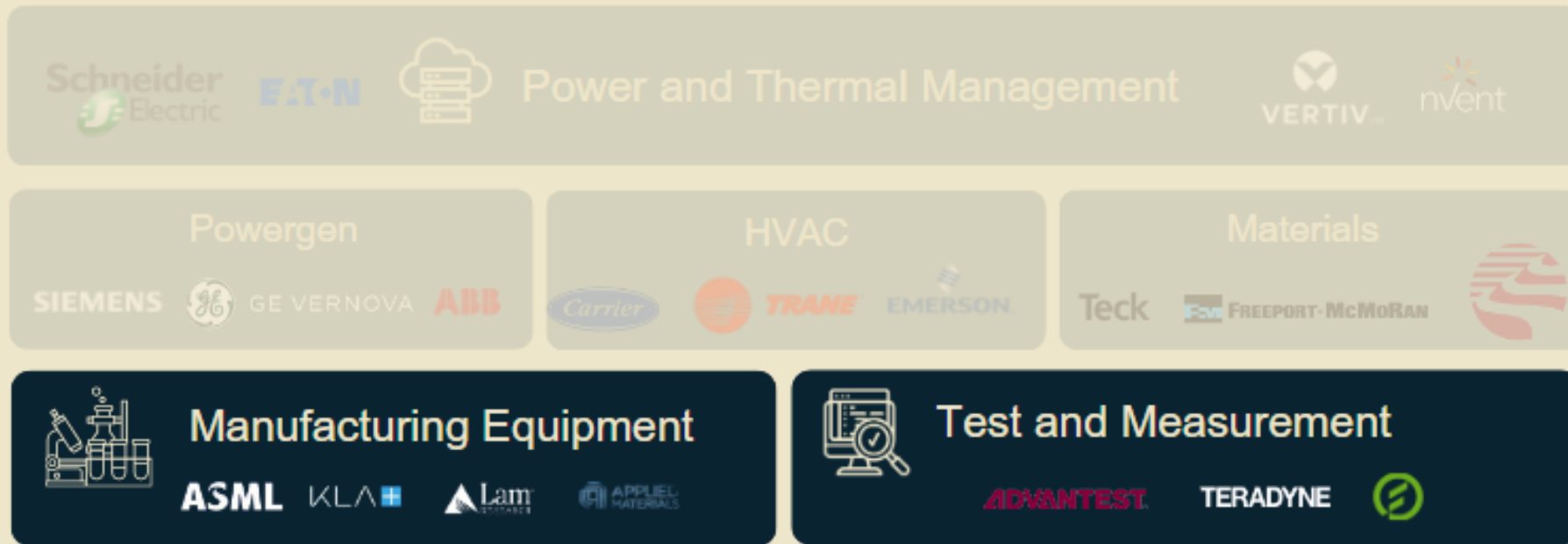
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DC share of US electricity usage to grow to 7.5% from 2.5% by 2030 per BCG

# Manufacturing equipment follows a different cycle...

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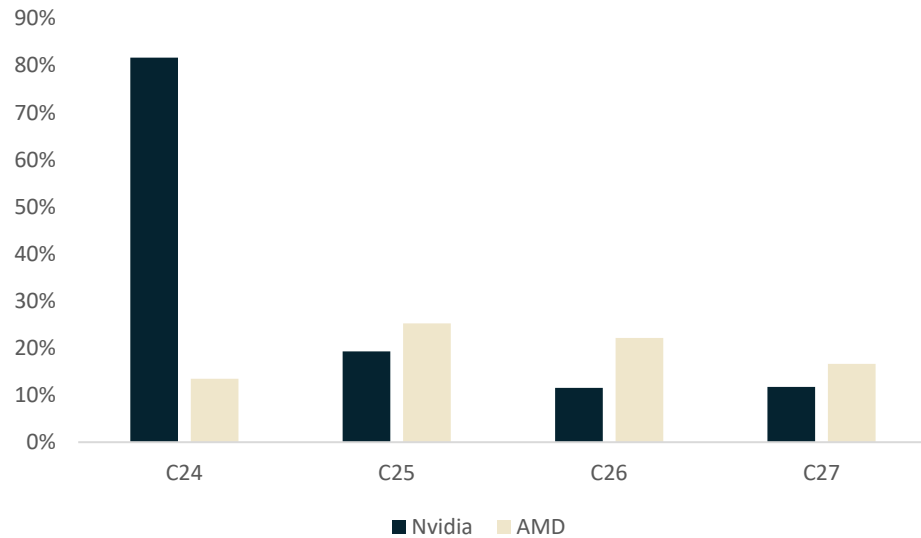


...usually bottoms 6months to 1 year post the semi cycle bottom

# Nvidia vs. AMD

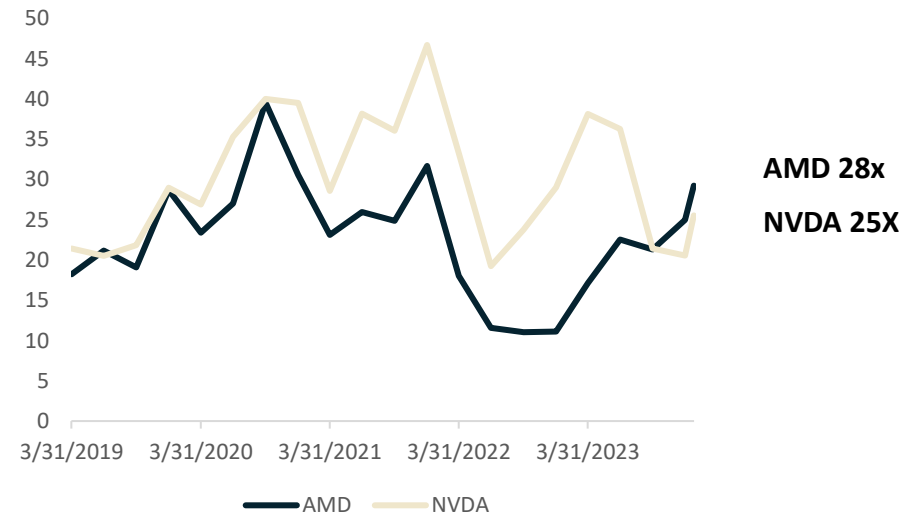
# Nvidia vs. AMD

Nvidia and AMD revenue growth estimates



Source: Bloomberg, Spear Invest

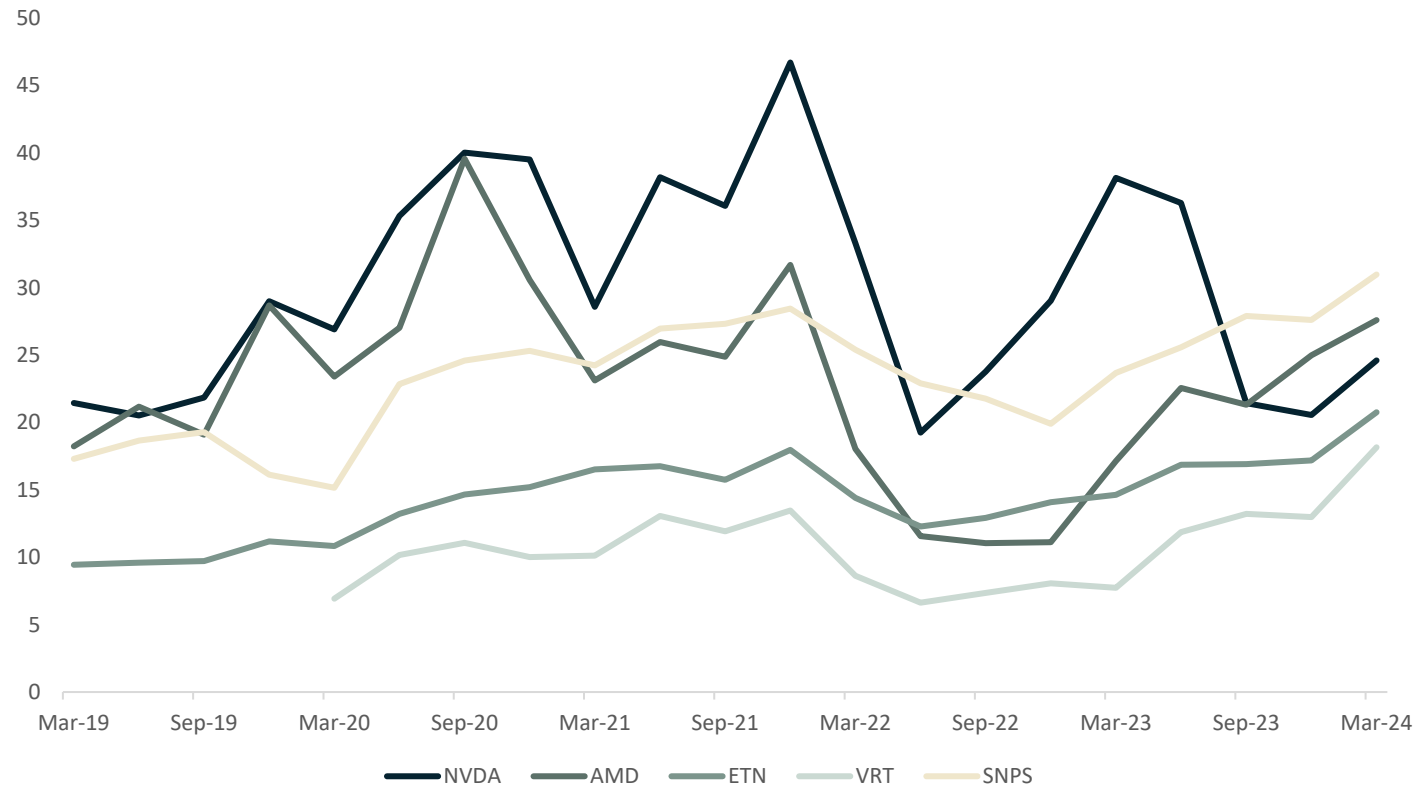
EV/EBITDA Multiples for Nvidia and AMD (1-year forward)



Source: Bloomberg, Spear Invest

# Semis vs. Industrials vs. Software

EV/EBITDA Multiples for Semis vs. Industrials vs. Software (1-year forward)

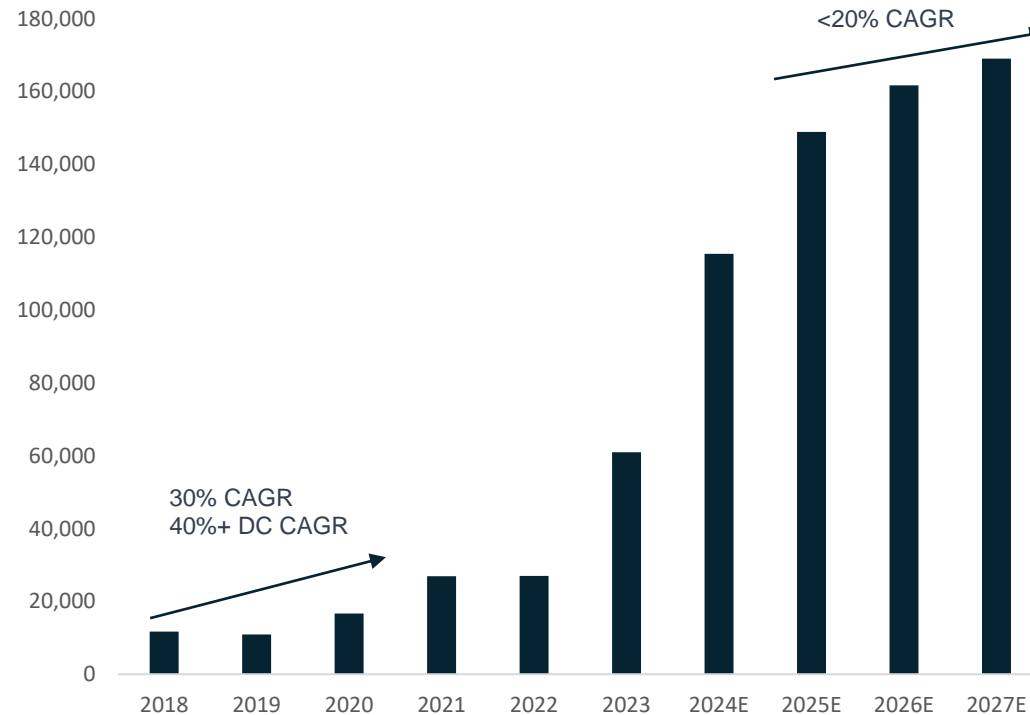


Source: Bloomberg, Spear Invest

# Nvidia: earnings estimates upside

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Nvidia Total Revenues



Source: Bloomberg, Spear Invest

**The Street is assuming <20% CAGR vs. 40%+ in the prior cycle**



# Accelerated product innovation cycle 2Y=>1Y

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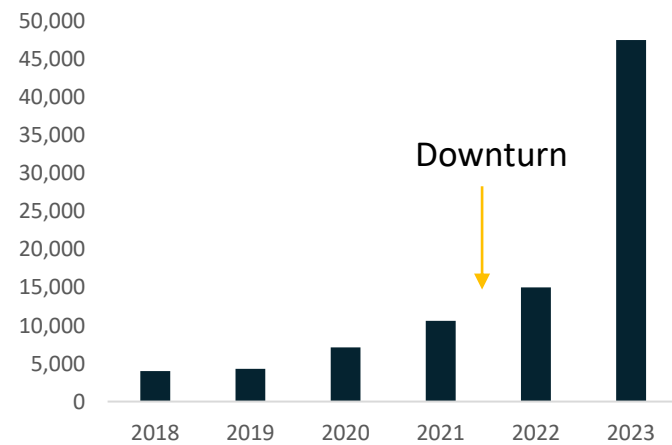


Source: Nvidia, Spear Invest

# Data Center is less cyclical

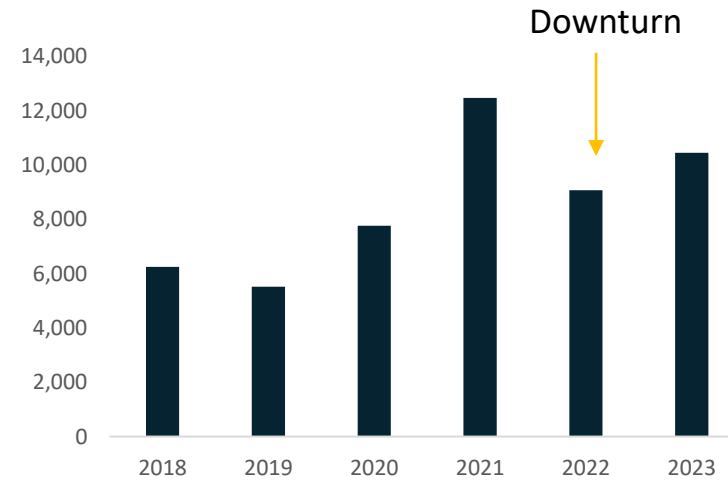
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### Nvidia Data Center Revenues



Source: Bloomberg, Spear Invest

### Nvidia Gaming Revenues



Source: Bloomberg, Spear Invest

THE END