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Global Technology

AI Supply Chain – The Latest about NVDA GB200 Superchip

We note the supply chain has kicked off GB200 DGX/MGX server system project engagement with ongoing design fine-tuning and various testing. It might take a few more months to finalize the 2025 order book and supplier allocation, but we offer our latest thoughts here.

Asia semi supply chain color: Based on CoWoS capacity, we estimate around 420k of GB200 superchips to be shipped to downstream in 2H24. By assuming half is for rack and half is for AI severs, that implies 4k of NVL72 racks and 30k units of HGX baseboards. We think there could be a one-quarter lag from chip outs to downstream assembly. For 2025, our CoWoS capacity allocation suggests around 1.5mn-2mn units of GB200 chip output.

Asia hardware supply chain color: The GB200 computing tray comes with two designs – one GB200 superchip and two GB200 superchips per computing tray. As for GB200 server racks, each rack hosts 18 computing nodes and nine NVLink Switch Systems. That said, it comes in the GB200 NVL36 configuration with 36 GPUs in one rack and 18 single GB200 computing nodes. The GB200 NVL72 is configured with 72 GPUs in one rack and 18 dual GB200 computing nodes – or 72 GPUs in two racks with 18 single GB200 computing nodes. Each rack also accommodates nine NVLink switch systems (each tray with two NVLink Switch chips) to fully connect the 36/72 GPUs with the latest generation of NVLink in new liquid-cooled design capacity up to 1,300kW. (Exhibit 2 & Exhibit 3)

GB200 server rack estimates: Our current estimates are that GB200 DGX NVL72 rack systems will kick off with 400 rack shipments in 4Q24 for a pilot run at hyperscalers. In 2025, we note the development remains fluid but for now, we assume total 20K DGX NVL72 server rack shipments (starting in 1H25) and 10K MGX NVL36 server rack shipments (starting in mid-2025). This implies total GB200 superchip shipments of 0.9mn units in 2025.

Our preferred stock proxies for GB200 superchip related: Besides HBM/Hynix (link), we are OW TSMC (GB200 chip foundry), ASM Pacific (TCB tool for GB200 packaging), KYEC (GB200 chip testing), and ASpeed (BMC chip for GB200 board) as the key beneficiaries among the semi supply chain. For AI server hardware related, we rank Hon Hai/FII/Quanta (GB200 DGX/MGX server system ODM), Wistron (offering value increase per rack), Delta (power and cooling solution), Innolight (1.6T transceiver) and KingSlide (leading railkit vendor). For Japan SPE (semiconductor production equipment), we see Advantest as a key beneficiary for a high market share in GPU and HBM testers.

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GREATER CHINA TECHNOLOGY HARDWARE

Asia Pacific
Industry View **In-Line**

Order of Preference – Global AI supply chain

Exhibit 1: Order of preference – Global AI supply chain

	Wistron 3231.TW	King Slide 2059.TW	Hon Hai 2317.TW	HP Inc. HPQ.N	Lotes 3533.TW	TSMC 2330.TW	Delta 2308.TW	NVIDIA NVDA.O	DELL DELL.N	Intel INTC.O
Rating	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Equal-Weight
Trading Currency	TWD	TWD	TWD	USD	TWD	TWD	TWD	USD	USD	USD
Price Target	**158.0**	**1,650.0**	**210.0**	**36.0**	**1,750.0**	**928.0**	**355.0**	**1,000.0**	**128.0**	**36.0**
Current Price	111.0	1,250.0	169.5	29.7	1,500.0	819.0	316.5	898.8	132.8	29.9
Upside/(Downside) (%)	42%	32%	24%	21%	17%	13%	12%	11%	-4%	20%
Market Cap (in USD mm)	9,690.1	3,676.0	72,512.8	29,330.5	4,850.4	655,331.7	25,370.2	2,262,663.6	95,462.0	126,623.7
Avg Daily Traded Vol (in USD mm)	339.4	46.3	187.7	74.2	39.6	621.2	88.4	27,175.4	86.4	1,654.2
Street View: Ratings										
Buy/Overweight	79%	92%	83%	44%	88%	95%	86%	88%	78%	26%
Hold/Equal-weight	21%	8%	17%	44%	13%	5%	14%	12%	13%	63%
Sell/Underweight	0%	0%	0%	11%	0%	0%	0%	0%	9%	12%
Bull Case Value	220.0	1,950.0	294.0	49.0	2,535.0	1,180.0	434.0	1,200.0	163.0	53.0
Upside (%)	98%	56%	73%	65%	69%	44%	37%	34%	23%	77%
Bear Case Value	81.0	745.0	88.0	24.0	965.0	540.0	199.0	513.6	81.0	18.5
Downside (%)	-27%	-40%	-48%	-19%	-36%	-34%	-37%	-43%	-39%	-38%
Risk/Reward Skew	3.6	1.4	1.5	3.4	1.9	1.3	1.0	0.8	0.6	2.0
Valuation Multiples at Last Close										
FY24e										
P/E	17.5x	26.0x	15.0x	8.6x	20.7x	21.3x	27.5x	69.4x	18.6x	25.5x
EV/EBIT	8.9x	21.4x	9.9x	7.4x	15.1x	18.1x	18.4x	45.6x	10.2x	658.1x
EV/EBITDA	7.1x	20.2x	6.9x	6.4x	12.0x	11.3x	11.9x	39.6x	7.1x	10.8x
EV/Sales	0.3x	11.3x	0.3x	0.6x	4.9x	7.5x	1.8x	25.1x	0.9x	3.0x
FCF Yield	6.0%	3.5%	3.8%	10.8%	4.9%	2.9%	2.5%	1.7%	9.9%	-9.7%
FY25e										
P/E	11.3x	23.8x	12.6x	8.1x	16.2x	17.1x	24.1x	38.0x	16.8x	19.3x
EV/EBIT	6.2x	18.0x	7.9x	7.0x	10.6x	14.0x	16.0x	33.9x	13.2x	69.0x
EV/EBITDA	5.2x	17.1x	5.7x	6.1x	9.1x	8.8x	10.6x	30.5x	9.3x	8.7x
EV/Sales	0.3x	9.7x	0.3x	0.6x	3.9x	6.1x	1.6x	20.8x	1.1x	2.8x
FCF Yield	2.2%	3.8%	4.8%	10.4%	5.9%	4.3%	3.9%	3.5%	10.8%	-2.2%
Implied Multiples on MS Price Target										
FY24e										
P/E	47.2x	34.3x	18.6x	10.4x	24.2x	24.2x	30.9x	77.2x	18.0x	30.8x
EV/EBIT	28.22	29.11	12.84	9.60	17.88	20.57	20.88	74.42	14.43	759.40
EV/EBITDA	27.12	27.54	8.93	8.25	14.24	12.81	13.49	64.70	10.09	12.42
EV/Sales	5.45	15.43	0.38	0.82	5.81	8.51	2.03	41.04	1.25	3.49
FY25e										
P/E	41.9x	31.4x	15.6x	9.8x	18.9x	19.3x	27.0x	42.3x	16.2x	23.3x
EV/EBIT	28.86	28.19	13.07	14.17	14.79	17.25	20.36	74.47	22.58	111.13
EV/EBITDA	27.81	26.78	9.46	12.28	12.66	10.81	13.42	66.86	15.93	14.02
EV/Sales	5.46	15.12	0.44	1.14	5.36	7.51	2.06	45.57	1.96	4.50
Stock Price Performance										
1 Month	(9.4%)	(7.7%)	12.6%	2.7%	0.0%	0.1%	(0.2%)	3.3%	7.6%	(19.8%)
3 Month	(14.9%)	12.6%	67.8%	4.6%	49.3%	17.5%	11.2%	24.6%	54.0%	(31.1%)
1 Year	121.6%	209.8%	65.4%	(0.5%)	67.0%	65.1%	6.4%	211.2%	189.7%	(0.4%)
YTD	12.6%	36.8%	62.2%	(1.2%)	40.2%	38.1%	1.0%	81.5%	73.6%	(40.6%)

Source: Morgan Stanley Research, FactSet (consensus mean). e = Morgan Stanley Research estimates

Note: Past performance is no guarantee of future results. Results shown do not include transaction costs.

Source: Morgan Stanley Research, FactSet (consensus mean). e = Morgan Stanley Research estimates. Note: Past performance is no guarantee of future results. Results shown do not include transaction costs. Priced as of May 13, 2024.

AI Supply Chain Tracker – Key Data Points

AI downstream supply chain

- Hon Hai handles both board assembly (computing board, switch tray, SmartNIC, DPU driver board, etc) and server rack integration work for GB200 DGX/MGX systems.
- We think Quanta could be the major ODM partner for Meta, Amazon, and Google for GB200.
- Wistron is a GB200 content share gainer. Based on our analysis, we believe Wistron will be able to gain ~30% more content in GB200 vs B100. Wistron is one of two suppliers for the compute board for GB200, and we currently estimate it has around ~35% share with an ASP of ~US$2,300.
- Pegatron is currently working with cloud customers on GB200, but it has not confirmed any project wins yet.
- Giga-Byte will have GB200 solutions available to the market, but we think its share could be limited because we think hyperscalers are the target audience for GB200, but hyperscalers are not Giga-Byte's target market.
- Delta is able to offer integrated grid-to-chip power solution for AI server racks, including the GB200 system. It has also engaged with liquid cooling solution projects with various customers for a potential contribution to start showing in 2025.
- AVC is one of the two cold plate suppliers for NVDA GB200 superchip and schedules to kick off .shipments in 4Q24.
- Chroma is turning even more positive on the SLT tool (B200/GB200) order outlook this year, driving the overall semiconductor and photonics growth to surpass its previous target of 50-60% YoY.
- King Slide expects the rail kit dollar content should be similar for GB200 vs. HGX. Seeing demand for AI servers and traditional servers picking up from 2Q24.
- Zhen Ding's management said on its recent earnings call, that it will be a supplier of RPCB to Nvidia's GB200 racks, starting from peripheral boards. We believe these boards do not require direct qualification by Nvidia.
- Gold Circuit currently has not passed qualification with Nvidia yet, but it will be adding ~20% capacity in Taiwan (mostly HDI), and does not rule out the possibility of adding HDI capacity in Thailand, should there be demand for more HDI products.
- Chenbro (8210.TW, NC) believes 2U is the mainstream height of MGX server chassis, but it is capable of producing 1U and 4U chassis for MGX as well.
- Chenbro has won a GB200 chassis project with AWS, which should be NVL36 structure and could be equipped with either Grace CPU or x86 CPU. Chenbro is the reference design for this project, with chassis shipment likely kicking off in late 3Q24.
- Thanks to the launch of GB200 in 2H24, we expect Innolight's 1.6T transceiver to pass through the new product verification in 2H24 and kick off commercial production in 2025. Considering the positive stock price reaction during 800G's new order breakthrough, we believe 1.6T's breakthrough is also likely to become a positive catalyst. As one of the pioneers of 800G transceivers globally, we believe Innolight will continue to enjoy first-mover advantage in 1.6T new product

launches. With high market share in 1.6T new products, we believe Innolight's positive revenue and earnings growth will be sustained in 2025.

AI semi supply chain

AI GPU

- NVIDIA's AI GPU chip testing demand is growing at around 20% Q/Q in 2Q24.
- Based on CoWoS capacity (60k wafers from TSMC), we estimate around 420k of GB200 superchips to be shipped to downstream in 2H24. (see Exhibit 14) By assuming half is for rack and half is for AI severs, that implies 4k of NVL72 racks and 30k units of HGX baseboards. We think there could be a one-quarter lag from chip outs to downstream assembly.
- For 2025, our CoWoS capacity allocation (around 230k wafers from TSMC) would suggest around 1.5mn-2mn units of GB200 chip output.

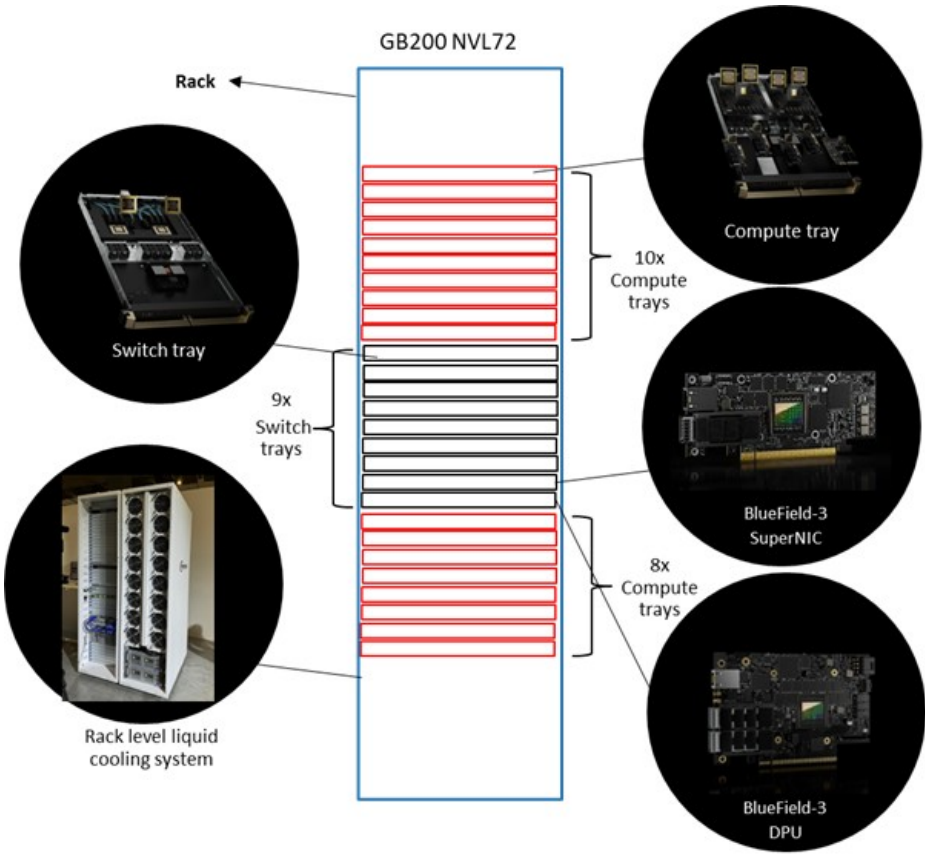
Traditional server and PC demand

- Other than CPU server recovery, there's also rush orders for AI Servers from China. We believe Aspeed's revenue will grow high teens Q/Q in 2Q (link).
- ASmedia's 2Q revenue guidance is flattish to up Q/Q, better than seasonality. We cite better AMD CPU performance on heat dissipation, especially for gaming PCs.

WoA AI PC trend

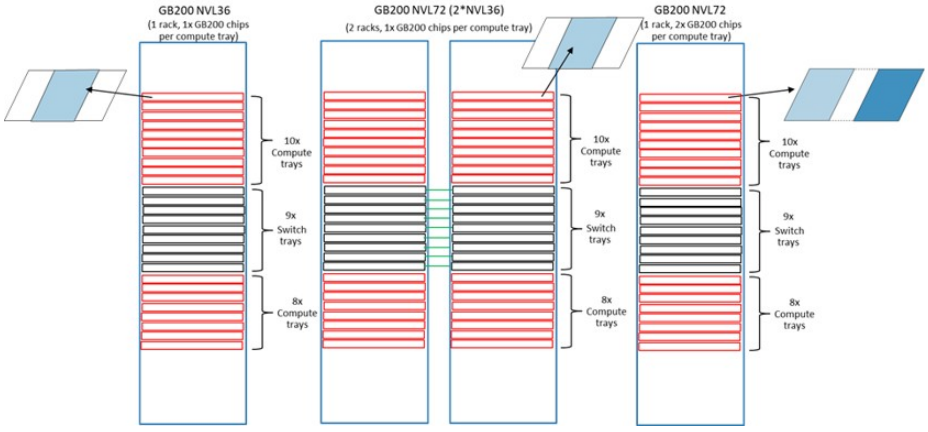
- Thanks to reduced power consumption, NVIDIA is introducing a highly-integrated PC chip by combining its gaming graphics with MediaTek's Arm-based SoC, likely at next year CES, enabling thinner gaming laptops with AI functions.
- TSMC's CoWoS technology and NVIDIA's NVLink interface are key technologies for combining NVIDIA's gaming graphics and MediaTek's Arm-based CPU in one chip.
- Our PC supply chain checks suggest Qualcomm will start WoA PC chip shipments with around 2mn units initially in 2024, joined after by NVIDIA and MediaTek's co-designed PC chip in 2025 and reach 12mn units.

Exhibit 2: GB200 related offerings + rack system assembly



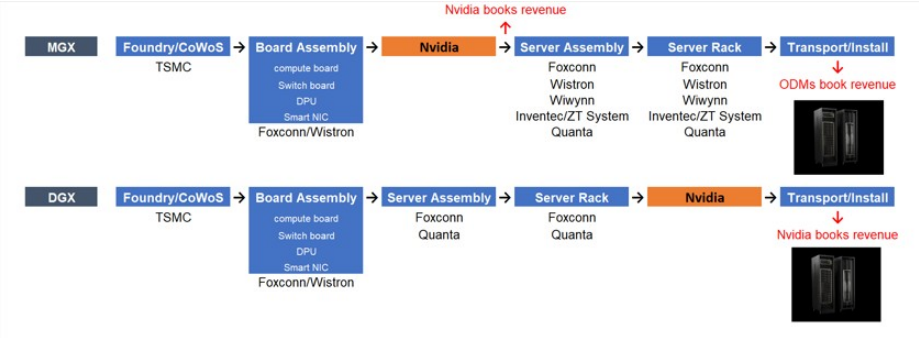
Source: NVIDIA, Morgan Stanley Research

Exhibit 3: GB200 NVL36 and NVL72 server rack



Source: Morgan Stanley Research

Exhibit 4: NVIDIA GB200 server supply chain flow chart



Source: : Morgan Stanley Research

Exhibit 5: GB200 supply chain

Grace CPU Substrate	Blackwell GPU Substrate	CCL	PCB	Compute Board	NVLink Switch Board	Sever	Rack
Unimicron Ibiden	Ibiden Unimicron	Doosan EMC	Unimicron WUS TTM ISU Gold Circuit Tripod	Foxconn Wistron	Foxconn	ODMs	Foxconn Wistron/Wiwynn Inventec/ZT System Quanta

Source: Morgan Stanley Research

Tailwinds from NVIDIA Blackwell to SPE market

Pushing the boundaries of compute speed: As we wrote in this report according to NVIDIA, the B200 DGX triples AI training speed compared with the previous iteration and accelerates inference performance by a multiple of 15. Both the GB200 and B100 comprise two N4P dies fabricated at the current limits of lithography and contain more than double the number of transistors as the H100. Blackwell has four HBM3e chips per die for a total of eight with a combined 192GB. NVIDIA will also offer the GB200 NVL72, which uses NVLink to connect 72 Blackwell GPUs to 36 Grace Blackwell CPUs, BlueField-3 DPUs and 13.5TB HBM3e in a liquid-cooled package.

Impact on SPE market: The announcement confirms NVIDIA is aiming to push the boundaries of compute speed using the current limits of lithography die sizes, instead of targeting yield improvement by reducing die size and employing chiplets. Devices with larger die sizes, lower yields and more cores will likely spur increased demand for testers. We also expect rising HBM speeds and capacity to drive demand for memory testers, probe cards and probers, and lead to wider adoption of die-level testing. System-level tests are also likely to become increasingly important due to advances in packaging and faster, more complex devices. Advantest has a high market share in GPU and HBM testers, while Teradyne has a large share of the system-level tester market.

NVIDIA uses proprietary architecture such as its NVLink interface to improve overall system performance. Looking ahead, we see a chance that glass substrates and optical-electrical devices may be adopted in GPUs in general. These kind of advances in packaging are likely to be positive for Disco and others.

Glass Substrates Poised to Take Off to enhance GPU performance

Pros and cons of glass substrates: We expect glass substrates to be adopted for advanced packages over the next two years or so, supporting growth in the SPE market. Glass is very rigid and its coefficient of thermal expansion can be adjusted by changing its composition. This means damage from warping should be limited, even when the glass is layered with silicon or organic materials. Glass substrates can also reduce power loss compared with organic substrates, offering major power-saving advantages for AI GPUs and other high-frequency devices. Glass has many other advantages – it is very flat and can be adapted to large, thin, narrow-pitch devices, while also being resistant to moisture and capable of operating at high temperatures. Negatives include immature fabrication technology, including processes for hole formation and metal coating. Poor shock-resistance presents problems for handling and glass is heavier than current substrate materials.

Outlook for GPU adoption: GPU makers are engaged in fierce competition to increase speed. In addition to improving GPU density and compute speed, they are working to accelerate CPU, DPU and memory speeds, as well as moving to wider memory buses. As glass substrate fabrication processes are established and prospects for adoption become clearer, we expect chipmakers to switch to glass for GPUs, CPUs, DPUs and HBM, despite higher costs. In other areas as well, companies are exploring the potential for glass substrates in mobile communication devices, automotive devices and medical equipment.

Compatible with optoelectronic devices: Optical components and optical wiring are likely to be increasingly integrated with silicon-based semiconductors. Rather than using glass fiber wiring to mount these optoelectronic devices on silicon or organic substrates, glass bridges – glass substrates with optical wave channels – will be more robust and easier to fabricate. Optoelectronic devices would require longer test times, which presents potential business opportunities for Advantest in the device development and market expansion phases.

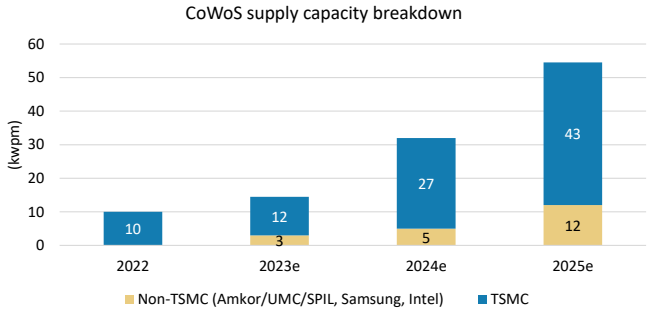
Implications for SPE makers – PLP: Glass microfabrication techniques and infrastructure developed for flat panel display (FPD) production could be adapted for glass core substrate processes. If the chip sector adopts glass, we anticipate increased demand for panel-level packaging (PLP) systems adapted from FPD. Ushio, SCREEN Holdings, Ulvac and others are stepping up efforts to develop PLP patterning systems and deposition systems, while Disco already supplies PLP assembly systems.

Implications for SPE makers – fabrication systems for glass substrates: Some existing types of SPE could be used in glass substrate fabrication. Ulvac, Ebara (not covered), Applied Materials (MS analyst: Joseph Moore) and Lam Research (MS analyst: Joseph Moore) supply sheet film formation and metal film formation systems; Applied Materials, Tokyo Electron, Toppan Holdings (not covered), SCREEN Holdings and Ushio supply lithography and developer systems; Viamechanics (not listed) supplies hole formation systems; and Ebara, Applied Materials and Tokyo Seimitsu (MS analyst: Yoshihito Hasegawa) sell chemical mechanical planarization (CMP) systems.

Supply-chain Tracker – AI Semis

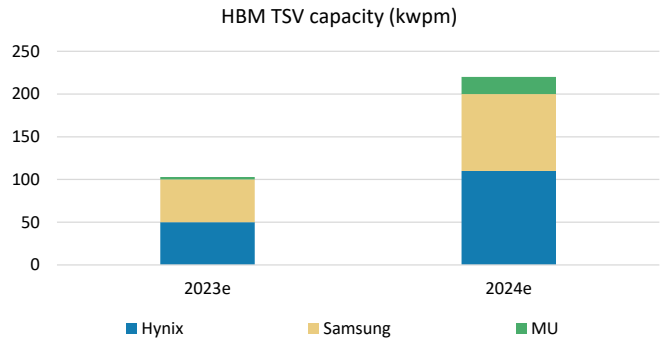
Major supply bottleneck – CoWoS capacity trend

Exhibit 6: Global CoWoS capacity expansion, by vendor



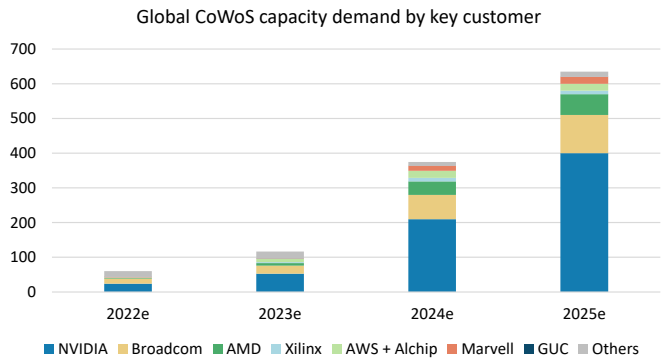
Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 7: HBM TSV capacity also set to double in 2024



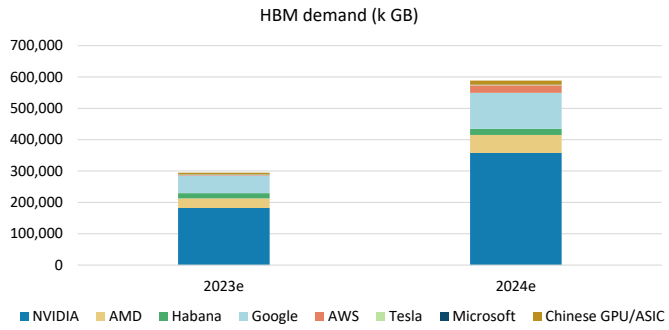
Source: TrendForce, Morgan Stanley Research (e) estimates

Exhibit 8: Global CoWoS consumption, by customer



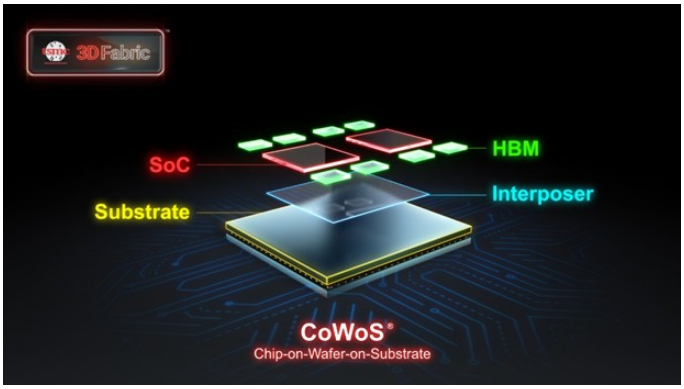
Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 9: HBM demand is nearly twice the 2023 level



Source: TrendForce, Morgan Stanley Research

Exhibit 10: What is CoWoS? Chip on Wafer (interposer) on Substrate



Source: TSMC

Exhibit 11:

NVIDIA AI GPU revenue implied CoWoS demand – Double booking at foundries?

	CY23e	CY24e	CY25e	CY26e
NVIDIA revenue forecast implied GPU volume				
NVIDIA AI GPU revenue (US$ mn)	37,842	72,270	76,037	90,360
Y/Y %	*180%*	*91%*	*5%*	*19%*
AI GPU ASP (US$)	29,139	30,395	30,711	35,313
AI GPU volume (k units)	1,299	2,378	2,476	2,559
Y/Y %	*14%*	*83%*	*4%*	*3%*
CoWoS bookings implied AI GPU volume	1,600	4,000		
GPU chip cost calculation				
Wafer frontend cost				
# of gross die per wafer	65	64	59	44
Production yield	60%	65%	70%	70%
# of good die per wafer	39	42	41	31
TSMC blended wafer price for NVIDIA AI GPU	16,000	18,000	18,000	20,000
Wafer die revenue to TSMC per chip	410	434	435	645
Advanced backend cost				
# of chip per CoWoS wafer	29	28	24	18
CoWoS wafer price for NVIDIA AI GPU	6,000	8,000	8,500	9,000
CoWoS revenue to TSMC per chip	209	288	347	502
Chip probe (wafer test) revenue to TSMC per chip	199	317	382	552
Total revenue to TSMC per chip	**818**	**1,038**	**1,165**	**1,699**
NVIDIA AI GPU implications to TSMC				
Demand for TSMC CoWoS capacity				
k wafer per annum	45	86	101	143
k wafer per month	4	7	8	12
Demand for TSMC 4nm/7nm capacity				
k wafer per annum	33	57	60	83
k wafer per month	3	5	5	7
Revenue contribution to TSMC (US$ mn)	**1,062**	**2,468**	**2,883**	**4,349**
Y/Y %	*46%*	*132%*	*17%*	*51%*
Revenue contribution % of TSMC	**1.5%**	**2.9%**	**2.8%**	**3.7%**

Source: Company data, Morgan Stanley Research (e) estimates

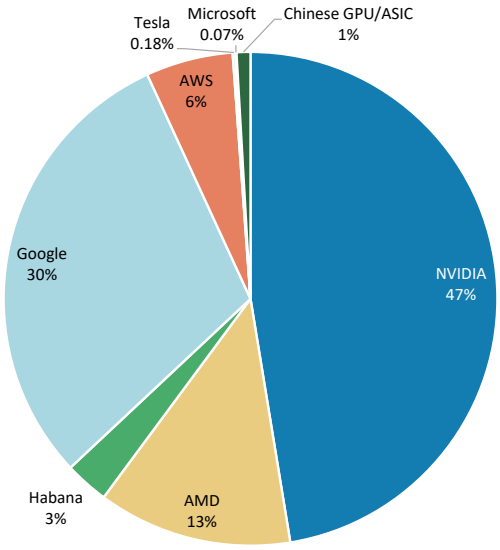
2024 AI semi wafer revenue and HBM demand calculation

Exhibit 12: HBM consumption in 2024 – Up to 8.2bn Gb

AI chip vendor	Product name	CoWoS capacity allocation (k wafers)	Chips per CoWoS wafer	Implied shipments (k)	HBM chip density (GB)	HBM chip units	Total HBM size (GB)	HBM generation	HBM vendor	Total HBM demand (k GB)
AI GPU (2024e)										
NVIDIA	H100	72	29	2,088	16	5	80	HBM3	Hynix	167,040
	B100	60	14	840	25	8	200	HBM3e	Hynix/Micron/Samsung	168,000
	H200	78	29	2,262	24	6	141	HBM3e	MU	318,942
AMD	MI300	39	12	468	24	8	192	HBM3	Samsung	89,856
Habana	Gaudi2	4	30	105	16	6	96	HBM2e	Samsung	10,080
	Gaudi3	4	20	80	16	8	128	HBM2e	Samsung	10,240
AI ASIC (2024e)										
Google	TPU v5 training	35	30	1,050	16	6	96	HBM2e	Samsung	100,800
	TPU v5 inference	35	50	1,750	16	4	64	HBM2e	Samsung	112,000
AWS	Inferentia 2	16	35	560	24	2	48	HBM2e	Samsung	26,880
	Trainium 2	7	20	140	24	4	96	HBM3	Samsung	13,440
Tesla	Dojo 1	NA	NA	200	32	5	160	HBM2e/HMB3	Samsung	1,280
	FSD	NA	NA	1,600	NA	NA	NA	NA	NA	-
Microsoft	Maia 100	0.3	29	8	16	4	64	HBM2e	Samsung	520
Chinese GPU/ASIC	Chinese GPU/ASIC	5	20	100	16	4	64	na	Samsung	6,400
Total		**355**								**1,025,478**
								Total HBM demand (mn Gb)		**8,204**

Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 13: HBM consumption in 2024 – NVIDIA to be the largest customer



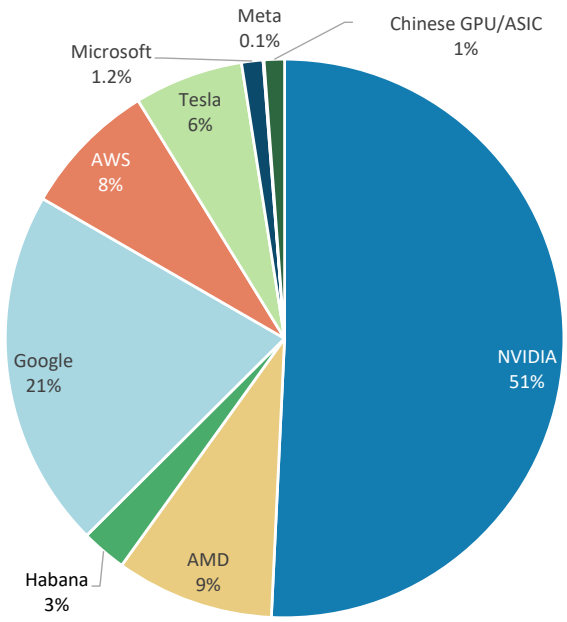
Source: Company data, Morgan Stanley Research estimates

Exhibit 14: AI computing wafer consumption in 2024 – Up to US$4bn revenue

AI chip vendor	Product name	CoWoS capacity allocation (k wafers)	Chips per CoWoS wafer	Implied shipments (k)	Compute die size	Geometry	Compute die units	Wafer consumption (k wafers)	Wafer price (US$)	Wafer revenue TAM (US$ mn)
AI GPU (2024e)										
NVIDIA	H100	72	29	2,088	814	4nm	1	49	18,000	890
	B100	60	14	840	700	4nm	2	34	18,000	620
	H200	78	29	2,262	814	4nm	1	54	18,000	964
AMD	MI300	39	12	468	110	5nm	8	14	20,000	272
Habana	Gaudi2	4	30	105	768	7nm	1	2	14,000	27
	Gaudi3	4	20	80	650	5nm	2	4	20,000	78
AI ASIC (2024e)										
Google	TPU v5 training	35	30	1,050	325	5nm	1	12	20,000	232
	TPU v5 inference	35	50	1,750	325	5nm	1	19	20,000	387
AWS	Inferentia 2	16	35	560	700	7nm	1	9	14,000	131
	Trainium 2	7	20	140	600	5nm	2	5	20,000	104
Tesla	Dojo 1	NA	NA	200	645	7nm	1	3	14,000	43
	FSD	NA	NA	1,600	300	7nm	1	10	14,000	145
Microsoft	Maia 100	0.3	29	8	700	5nm	1	0.2	20,000	4
Chinese GPU/ASIC	Chinese GPU/ASIC	5	20	100	1,000	7nm	1	3	14,000	35
Total		**355**						**220**		**3,965**

Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 15: Leading-edge wafer consumption, by customer, 2024



Source: Company data, Morgan Stanley Research estimates

How is Gaudi 3's cost-performance?

We update the cost-performance comparison of Gaudi 3 vs. NVIDIA's H100 and B100, and believe that if Gaudi 3 were to sell at US$10,000, its cost-performance would be comparable to H100 (we use a US$10,000 assumption based on our estimates and channel checks).

Here is how we calculate the cost-performance:

Total Processing Performance (TPP) *is 2x "MacTOPS" x "bit length of the operation", aggregated over all processing units on the integrated circuit.* For example, NVIDIA's A100 TPP = 2*312*16 = 9,984. Below is a detailed explanation of TPP:

- **2x:** It is based on an industry convention of counting one multiply-accumulate computation as two operations for the purpose of datasheets.
- **MacTOPS:** The theoretical peak number of TOPS (tera operations per second) for multiply-accumulate computation.
- **Bit length of the operation:** It is the largest bit-length of the inputs to multiply-accumulate.
- Aggregate the TPPs for each processing unit on the integrated circuit to arrive at a total (mainly for chiplet designs).

Performance Density (PD) *is TPP divided by "applicable die area", which is measured in millimeters squared and includes all die area of logic dies manufactured with a process node that uses a non-planar transistor architecture.* For example, NVIDIA's A100 PD = 9,984/826 = 12.09.

Chip price/cost *means the procurement cost from of hyperscalers. If it is internal ASIC design, we would use design service shipment price.*

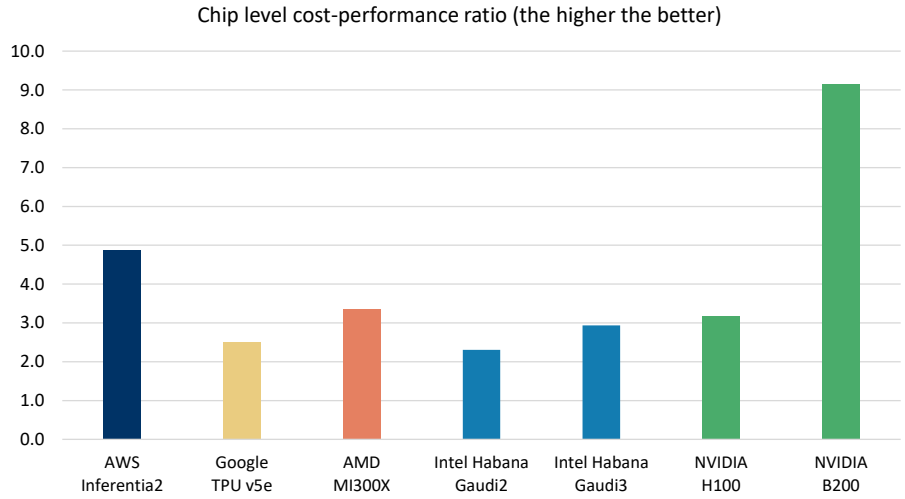
Cost-performance ratio *is TPP divided by chip cost; the higher the better.*

Exhibit 16: Spec comparison of major AI GPUs and ASICs

	AWS Inferentia2	Google TPU v5e	AMD MI300X	Intel Habana Gaudi2	Intel Habana Gaudi3	NVIDIA H100	NVIDIA B200
Compute die process node	TSMC 7nm	TSMC 5nm	TSMC 5nm	TSMC 7nm	TSMC 5nm	TSMC 4nm	TSMC 4nm
INT8 Tensor Core/FP8 (TOPS/TFLOPS)	380	393	2,615	865	1,835	3,958	20,000
TPP ("Total Processing Performance")	**6,080**	**6,288**	**41,835**	**13,840**	**29,360**	**63,328**	**320,000**
Compute die size (mm^2)	700	325	1,017	768	1,300	814	1,700
PD ("Performance Density")	**8.69**	**19.35**	**41.14**	**18.02**	**22.58**	**77.80**	**188.24**
Assumed chip price/cost (US$)	1,250	2,500	12,500	6,000	10,000	20,000	35,000
Cost-performance ratio *(the higher the better)*	**4.9**	**2.5**	**3.3**	**2.3**	**2.9**	**3.2**	**9.1**

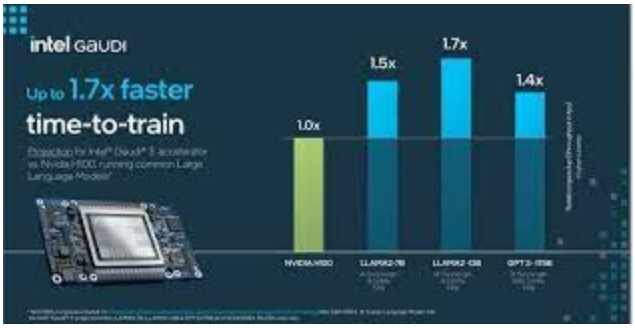
Source: Company data, Morgan Stanley Research estimates. Note: TPP and PD calculations are based on BIS's rulings in Oct. 2023.

Exhibit 17: To hyperscaler customers, the cost-performance ratio for Gaudi 3 should be similar to H100



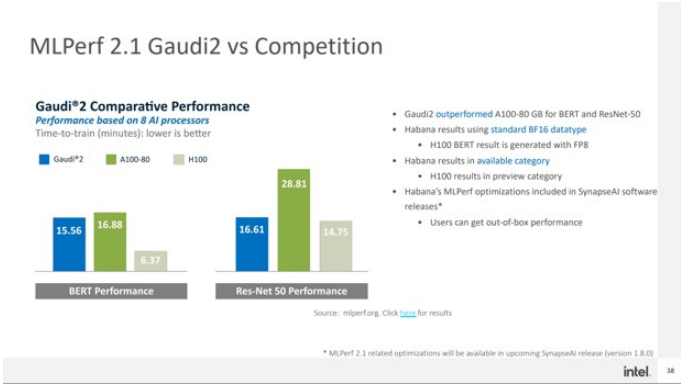
Source: Company data, Morgan Stanley Research estimates

Exhibit 18: Habana's Gaudi 3 could be 1.7x faster in training than NVIDIA's H100 GPU



Source: GPUlist.ai, Morgan Stanley Research

Exhibit 19: Habana's Gaudi 2 has comparable AI capability with NVIDIA's A100 (80GB) GPU



Source: Intel

Exhibit 20:

Both Gaudi 2 and Gaudi 3 are made at TSMC's foundry. It remains to be seen whether Gaudi 4 will continue or move to an Intel foundry

Source: Intel.

Exhibit 21: Who (design service vendor) will win which ASIC projects? Alchip provides design services for Intel Habana Gaudi

	Alchip	Global Unichip	Broadcomm	Marvell	TSMC direct	Samsung direct	MediaTek	Socionext
AWS – Annapurna	Inferentia2/Tranium1 (7nm) Inferentia3 (3nm)			Inferentia2.5/Trainium2 (5nm)	Graviton 1 (16nm) Graviton 2 (7nm) Graviton 3 Nitro Security Chip			
Amazon – Lab 126	Kindle processor Echo processor (12nm)	Echo processor (5nm)						
Google		Security Chip	TPU 1/TPU 2 TPU 3/TPU 4 TPU 5/TPU 6 *TPU 7 Training*	Maple CPU (5nm)	Axion CPU (5nm) Tensor (3nm)	Tensor (7nm) Tensor (5nm)	TPU 3 *TPU 7 Inference*	
Microsoft		Maia 100 (5nm) Cobalt 100 (5nm) *Maia 200 (3nm)?*		AI accelerator *(3nm)?*			Azure IoT XBox Bluray	
Meta	Oculus ASIC		MTIA				Oculus ASIC	*CPU (3nm)?*
Sony	TV ASIC Smartphone ISP	DSC ASIC					PS5 South Bridge	
Tesla	D1/Dojo (7nm)				D1/Dojo (7nm) D2/Dojo (5nm)	Autopilot 3.0/FSD 1 (14nm) Autopilot 4.0/FSD 2 (7nm)		
Li Auto	ADAS (5nm)							
GM – Cruise								5nm
Intel – Habana	Gaudi 1 (16nm) Gaudi 2/Goya 2 (7nm) Gaudi 3/Goya 3 (5nm)	Goya 1 (16nm)						
Baidu					Kunlun 2 (5nm)	Kunlun 1 (7nm)		
Alibaba – T-head		Generation 1			Hanguan Xuantie			
Tencent					Zixiao (12nm)			
ByteDance			AI accelerator (7nm) *5nm?*					

Source: Company data, Morgan Stanley Research

AI compute outsourcing – AI GPU rentals

The biggest concern from the GPU arms race is how hyperscalers or cloud providers could monetize this substantial computing power. We found different AI startups, such as CoreWeave, starting GPU rental businesses to help customers that would like to have GPU-accelerated workloads at enterprise scale. Customers could choose different GPUs to conduct compute-intensive use cases, such as machine learning, VFX rendering, pixel streaming and batch processing. We see NVIDIA H100 now being the mainstream rental solution at different vendors, with H200, MI300X, Intel Gaudi 2, A100 and RTX being different options.

Exhibit 22: NVIDIA H100 is still the mainstream solution

	NVIDIA H100						NVIDIA H200	
Cloud provider	CoreWeave	Massed Compute	Hydra Host	Nebius AI	Hydra Host	Hydra Host	Hydra Host	Green AI Cloud
Minimum bookable GPUs		8	64	128	512	1024	64	128
Interconnect	Ethernet	Ethernet	Infiniband 3.2 Tb	Infiniband 3.2 Tb	Infiniband 3.2 Tb	Infiniband 3.2 Tb	Infiniband 3.2 Tb	Infiniband 3.2 Tb
INT8 Tensor Core (TOPS)	3,958	3,958	3,958	3,958	3,958	3,958	3,958	3,958
FP16 Tensor Core (TFLOPS)	1,979	1,979	1,979	1,979	1,979	1,979	1,979	1,979
Cores per node		104	128	160	128	64	128	112
Location	US	Midwest	Europe	Europe	US	US	Europe	Europe
Minimium bookable duration		24 weeks	12 weeks	12 weeks	12 weeeks	52 weeks	24 weeks	104 weeks
Rental Fee (US$; Per GPU Per Day)	**114**	**62**	**54**	**53**	**52**	**50**	**76**	**90**
Rental fee Per TFLOPS Per Day (US$)	**0.05773**	**0.03141**	**0.02729**	**0.02668**	**0.02644**	**0.02547**	**0.03820**	**0.04548**

Source: CoreWeave, GPUlist.ai, Morgan Stanley Research

Exhibit 23: AMD MI300X GPU rent cost

AMD MI300X		
Cloud provider	TensorWave	Lamini
Minimum bookable GPUs	8	8
Interconnect	RoCE	Ethernet
INT8 Tensor Core (TOPS)	2,615	2,615
FP16 Tensor Core (TFLOPS)	1,307	1,307
Cores per node	192	8
Location	US	US
Minimium bookable duration	52 weeks	13 weeks
Rental Fee (US$; Per GPU Per Day)	**79**	**72**
Rental fee Per TFLOPS Per Day (US$)	**0.06058**	**0.05507**

Source: GPUlist.ai, Morgan Stanley Research

Exhibit 24: Intel Gaudi 2, NVIDIA A100 and RTX 4090 are also solutions provided

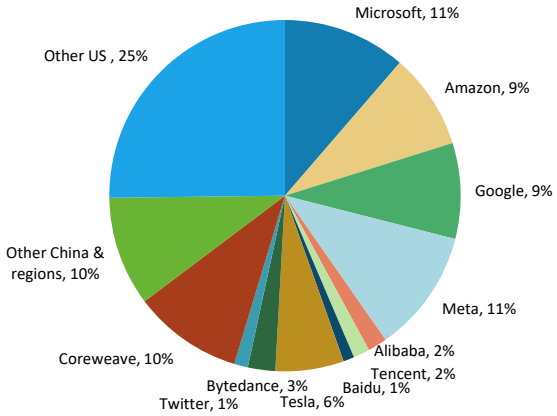
	Other Solutions				
GPU Type	Intel Gaudi 2	NVIDIA A100 80GB	NVIDIA A100 80GB	NVIDIA A100 80GB	NVIDIA RTX 4090
Cloud provider	Green AI Cloud	Hyperbolic Labs	Hydra Host	Hydra Host	Hydra Host
Minimum bookable GPUs	8	8	40	128	8
Interconnect	Ethernet	Ethernet	Ethernet	Infiniband 3.2 Tb	Ethernet
INT8 Tensor Core (TOPS)		1,248	1,248	1,248	661
FP16 Tensor Core (TFLOPS)		624	624	624	330
Cores per node	112	96	128	128	48
Location	Sweden	US	Europe	Europe	US
Minimium bookable duration	12 weeks	1 week	12 weeks	4 weeks	4 weeks
Rental Fee (US$; Per GPU Per Day)	**36**	**48**	**37**	**43**	**13**
Rental fee Per TFLOPS Per Day (US$)		**0.07692**	**0.05962**	**0.06923**	**0.03996**

Source: GPUlist.ai, Morgan Stanley Research

Key AI server spending among hyperscalers in 2024

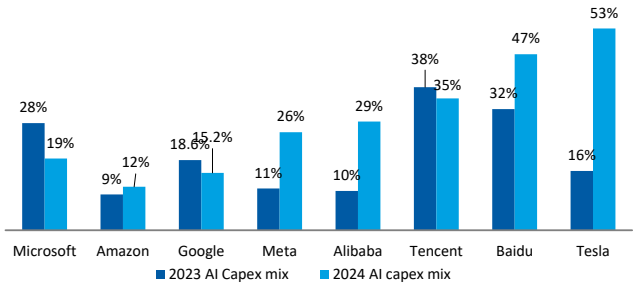
We update our 2024 AI server procurement numbers. We see overall hyperscalers being more aggressive in AI server procurement, while we see Microsoft lowering AI allocation in its capex. This is in line with Aspeed's observation that it is seeing some US CSP customers buying more baseboard management controllers (BMC) for traditional servers in 1H24.

Exhibit 25: 2024 AI server procurement share



Source: Company data, Morgan Stanley Research estimates

Exhibit 26: AI capex mix changes for key hyperscalers in 2023-24



Source: Company data, Morgan Stanley Research estimates

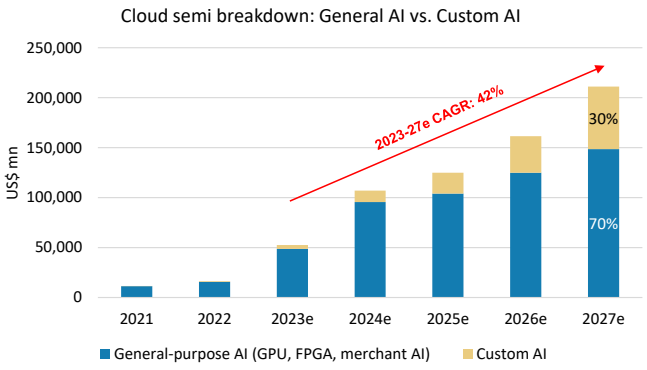
AI semi alternatives – Custom chips (ASIC)

Exhibit 27: Data center companies' custom AI chip strategy

	First official announcement for AI ASIC	AI ASIC project	ASIC partners	ASIC's benefits vs. merchant solutions	Chip sourcing strategies
Google	2016	TPU	Broadcom	2-3x greater energy efficiency	Google started to increase in-house custom chip (TPU) adoption since 2017. Currently, most of the internal training and inference workloads are now completed by TPUs, while NVIDIA's solutions are also available for Google's cloud customers.
AWS	2018	Inferentia Trainium	Alchip, Marvell	50% greater performance per watt	AWS uses multiple sources of chips to support customers' different workloads. For example, custom ASICs (Trainium/Inferentia AI chips, Gravaton CPU) and GP CPU/ GPUs (Intel, NVIDIA and AMD).
Tesla	2018	D1 (Dojo supercomputer) FSD (on-car AD/ADAS)	Alchip, Samsung	33% of cost savings	Tesla started to incorporate its in-house custom chips (D1 and FSD) since 2019 to replace NVIDIA's general-purpose solutions.
Microsoft	2023	Maia 100 AI Accelerator Cobalt 100 CPU	GUC	40% performance improvement	Microsoft's Athena project adopts AI solutions from multiple sources, such as in-house ASIC (Maia 100 AI Accelerator & Cobalt 100 CPU), AMD's/NVIDIA's GPUs, d-Matrix's AI chip, etc. We expect its own custom chips to enter volume production in 2024.
Meta	2023	MTIA MSVP	N/A	2x performance	Meta uses in-house ASIC for AI inference workload, but sticks with NVIDIA's A100 for its training supercomputer. Its custom accelerator (MTIA) adopts RISC-V cores.

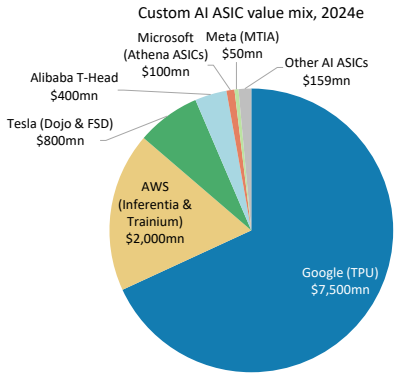
Source: Company data, Morgan Stanley Research estimates

Exhibit 28: We expect custom AI chips (ASICs) to outgrow GPUs and potentially take up to 30% of the cloud AI semi market in four to five years



Source: Company data, Gartner, Morgan Stanley Research (e) estimates

Exhibit 29: We estimate custom AI ASICs will represent ~US $11bn in market value in 2024



Source: Company data, Morgan Stanley Research (e) estimates

Along with higher NVIDIA estimates (see Joe's report), we have updated our assumptions for cloud AI semi capex. Key highlights below:

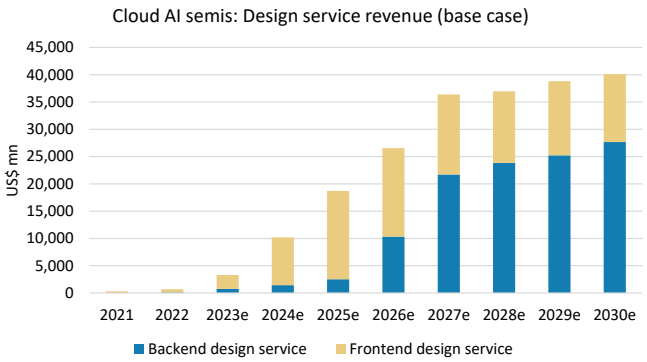
- 2030 global cloud AI capex to reach US$300bn:
  - AI semi capex to be US$230bn.
  - AI hardware to be US$70bn.
- 2030 ASIC value to reach US$80bn:
  - Design service TAM to be US$40bn.
  - We maintain Alchip's 2030 base-case revenue at US$6bn, but that implies its market share declines to 15% (vs. 20% market share previously), assuming some competition from Arm Total Design.

Exhibit 30: We now expect global cloud AI capex to reach US$300bn by 2030, with cloud AI semi capex reaching US$230bn

Base Case (US$ mn)	2021	2022	2023e	2024e	2025e	2026e	2027e	2028e	2029e	2030e	2024-30 CAGR
Global cloud AI capex											
Cloud AI semis	11,629	16,435	52,556	106,969	124,991	161,469	211,132	217,397	224,395	230,000	14%
Cloud AI server system & infrastructure	18,371	23,565	27,444	43,031	55,009	45,531	53,828	58,161	62,185	70,000	8%
Total	**30,000**	**40,000**	**80,000**	**150,000**	**180,000**	**207,000**	**264,960**	**275,558**	**286,581**	**300,000**	**12%**
Cloud AI semi capex											
Custom AI (ASIC)	357	769	3,883	11,364	20,864	36,645	62,651	68,916	74,430	80,000	38%
General AI (e.g., GPU, FPGA)	11,271	15,666	48,672	95,604	104,128	124,825	148,481	148,481	149,966	150,000	8%
Total	**11,629**	**16,435**	**52,556**	**106,969**	**124,991**	**161,469**	**211,132**	**217,397**	**224,395**	**230,000**	**14%**
Design service TAM											
In-house market share in custom AI chips	1%	1%	2%	2%	3%	6%	10%	13%	15%	15%	
Design service revenue	**313**	**674**	**3,297**	**10,202**	**18,694**	**26,553**	**35,015**	**36,951**	**38,803**	**40,082**	**26%**
Backend design service	*63*	*128*	*758*	*1,428*	*2,524*	*10,321*	*22,319*	*23,848*	*25,238*	*27,657*	*64%*
Frontend design service	*250*	*546*	*2,539*	*8,773*	*16,171*	*16,232*	*12,697*	*13,103*	*13,566*	*12,424*	*6%*
Design service gross margin	50%	50%	49%	53%	50%	39%	29%	27%	27%	25%	
Design service costs	157	336	1,685	4,838	9,276	16,189	24,894	26,793	28,421	29,890	35%
HBM % of custom semi project cost	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	
Foundry revenue from design service projects	**118**	**252**	**1,264**	**3,629**	**6,957**	**12,142**	**18,671**	**20,095**	**21,316**	**22,418**	**35%**

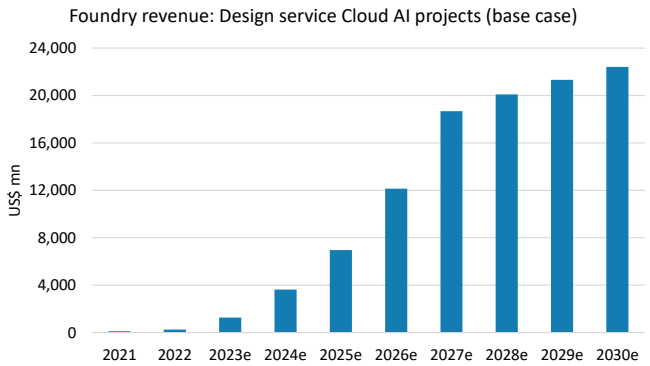
Source: Company data, Gartner, Morgan Stanley Research (e) estimates

Exhibit 31: We expect back-end design services to become more important as system houses build up their own chip front-end design teams



Source: Company data, Gartner, Morgan Stanley Research (e) estimates

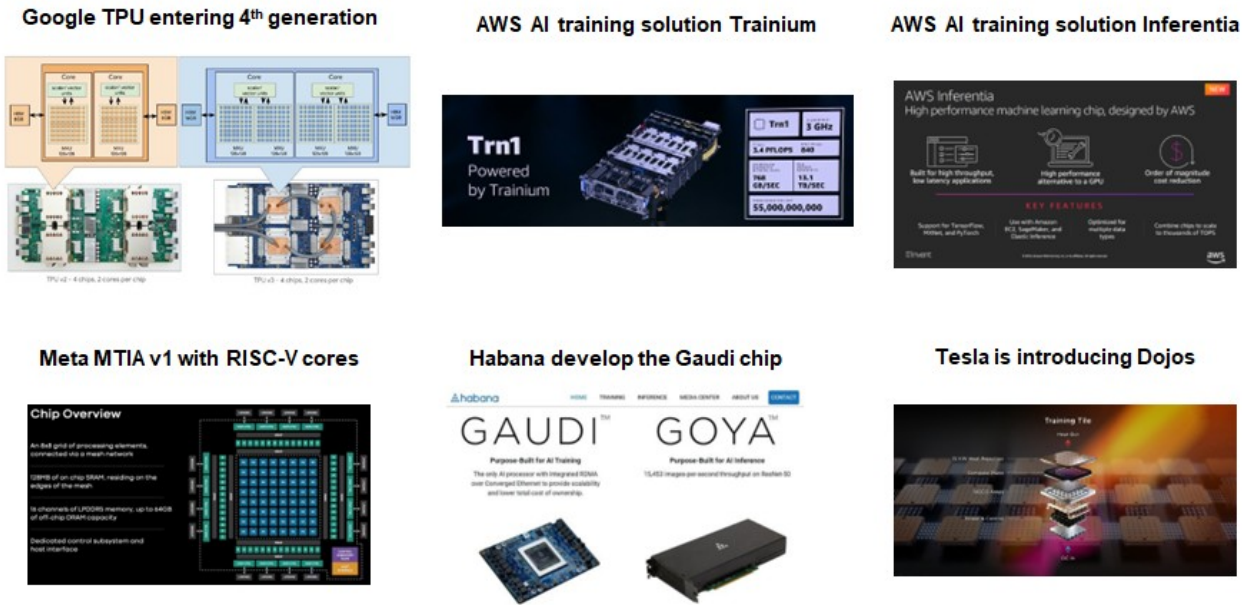
Exhibit 32: AI projects by design service companies could be an important driver for the foundry industry



Source: Company data, Gartner, Morgan Stanley Research (e) estimates

Exhibit 33:

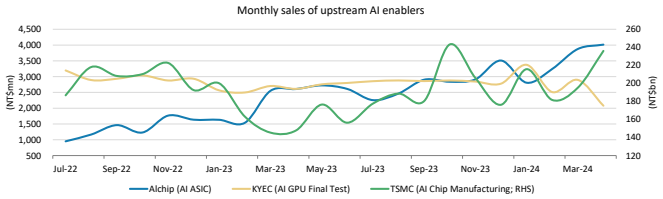
Major custom AI chip projects



Source: Google, AWS, Meta, Intel, Tesla

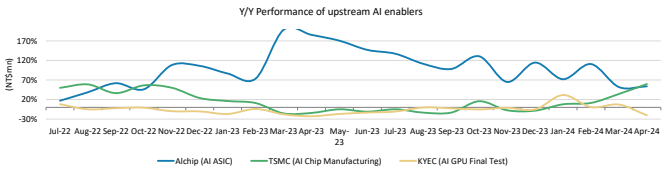
Monthly sales of Taiwan's AI semi supply chain

Exhibit 34: Key AI upstream enablers: Alchip, KYEC and TSMC – Monthly sales



Source: Company data, TEJ, Morgan Stanley Research

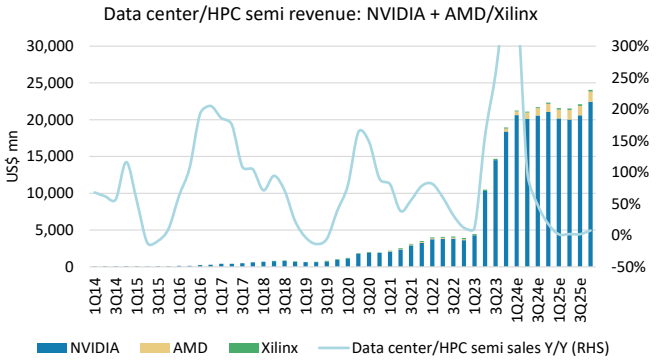
Exhibit 35: Key AI upstream enablers Y/Y performance



Source: Company data, TEJ, Morgan Stanley Research

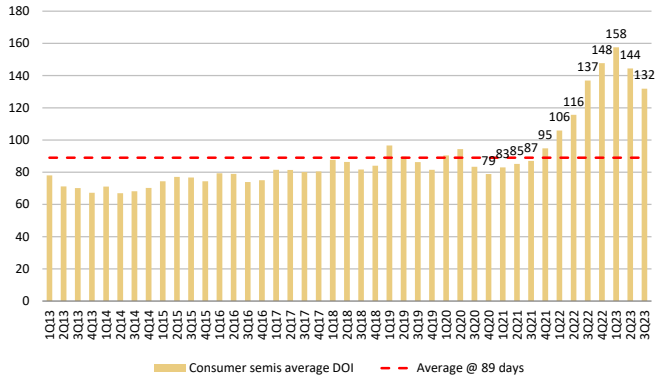
Major AI GPU vendors – NVIDIA sales and inventory trend

Exhibit 36: We continue to see AI chip quarterly revenue increase



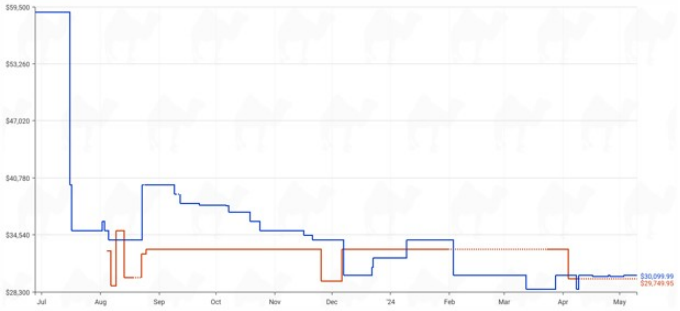
Source: Company data, Refinitiv, Morgan Stanley Research (e) estimates

Exhibit 37: NVIDIA's inventory days/level



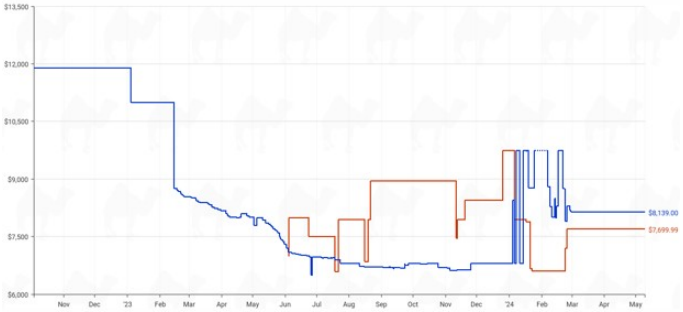
Source: Company data, Refinitiv, Morgan Stanley Research

Exhibit 38: NVIDIA H100 GPU pricing



Source: Camelcamelcamel, Morgan Stanley Research

Exhibit 39: NVIDIA A100 GPU pricing

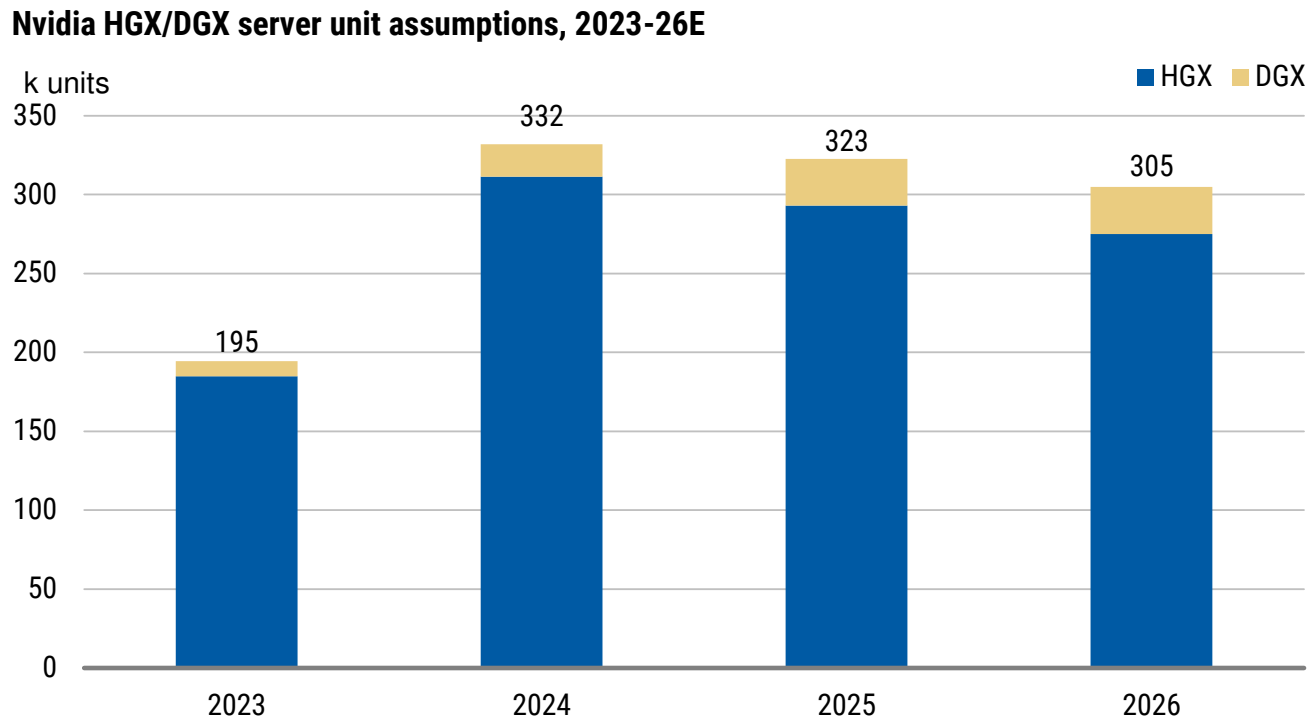


Source: Camelcamelcamel, Morgan Stanley Research

Supply-chain tracker – AI tech hardware

AI server and baseboard shipments

Exhibit 40: NVIDIA HGX/DGX unit assumptions, 2023-26E



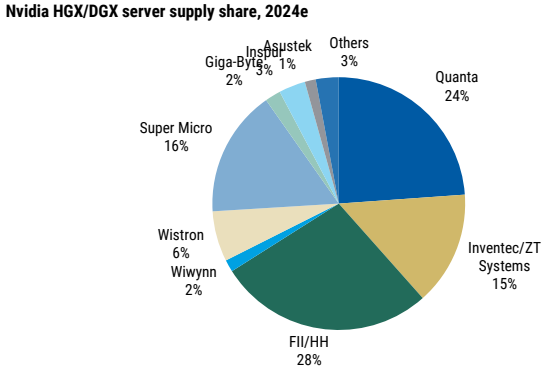
Source: Morgan Stanley Research estimates.

Exhibit 41: Nvidia AI server unit assumptions

Nvidia AI server unit assumption k units	2023	2024	2025	2026
HGX+DGX+L40S	**293**	**505**	**503**	**538**
HGX+DGX	**195**	**332**	**323**	**305**
HGX	185	311	293	275
A100	70	37	0	0
H100	115	265	232	77
B100	0	10	61	198
DGX	10	21	29	30
A100	6	3	0	0
H100	4	18	27	15
B100	0	0	2	15
Others (L40S, etc)	98	173	180	233
y/y				
HGX+DGX+L40S	**143%**	**73%**	**0%**	**7%**
HGX+DGX		**71%**	**-3%**	**-5%**
HGX	**--**	**68%**	**-6%**	**-6%**
A100	-3%	NM	-100%	--
H100	522%	131%	-12%	-67%
B100	--	--	542%	225%
DGX	92%	117%	41%	2%
A100	32%	NM	-100%	--
H100	461%	354%	52%	-44%
B100	--	--	--	525%
Others (L40S, etc)		77%	4%	29%

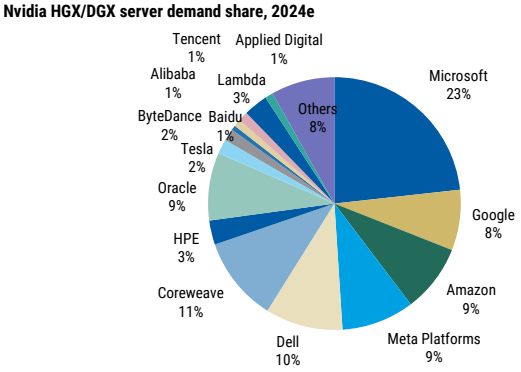
Source: Morgan Stanley Research estimates.

Exhibit 42: NVIDIA AI server unit share, 2024



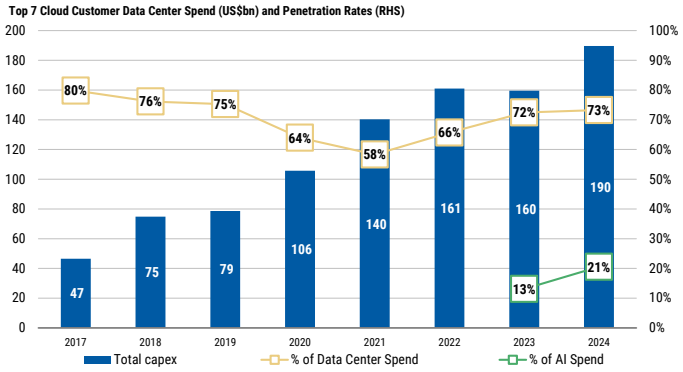
Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 43: Nvidia HGX/DGX server demand analysis, 2024



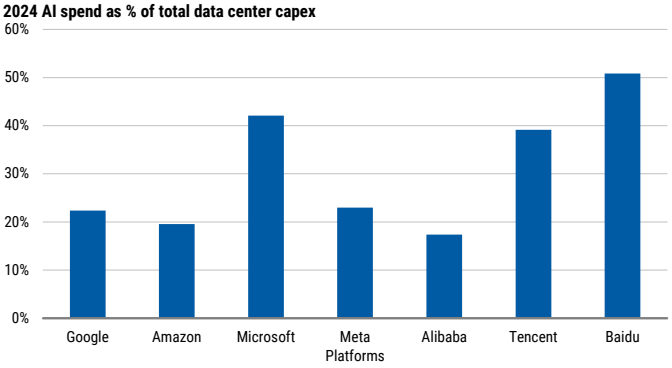
Source: Morgan Stanley Research (e) estimates

Exhibit 44: Top 7 cloud customer data center spend and penetration rates, 2017-24



Source: Dell'Oro, company data, Morgan Stanley Research estimates. Note: Companies included are Google, Amazon, Microsoft, Meta Platforms, Alibaba, Tencent, Baidu.

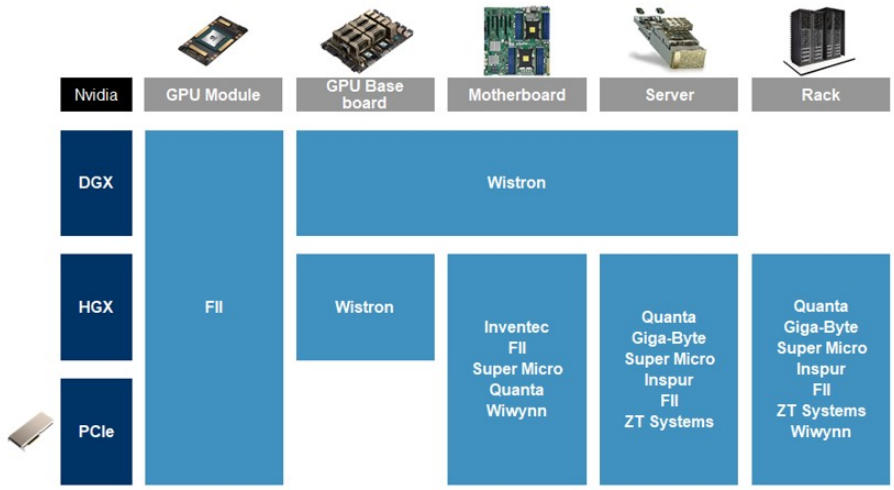
Exhibit 45: AI spend as % of total data center capex (2024)



Source: Morgan Stanley Research estimates

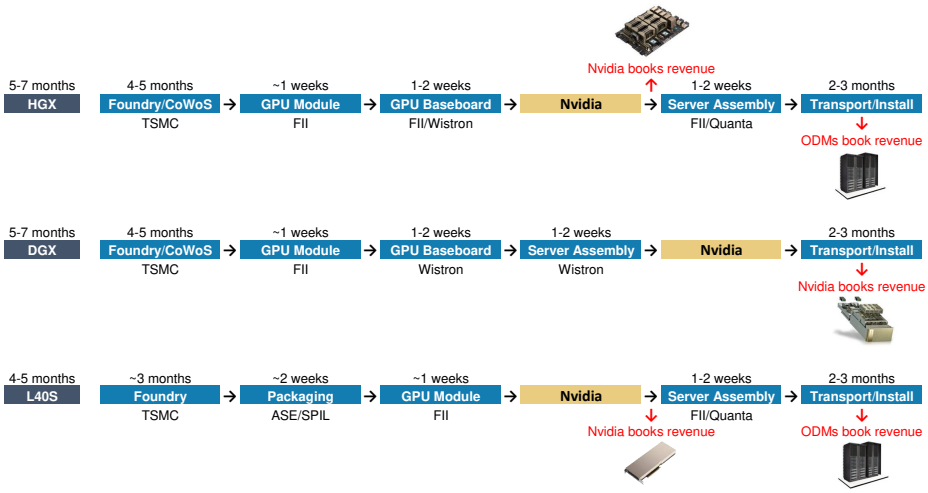
AI hardware supply chain

Exhibit 46: NVIDIA AI server supply chain



Source: Company data, Morgan Stanley Research

Exhibit 47: Nvidia HGX/DGX/L40S lead-time flow chart



Source: Morgan Stanley Research

Exhibit 48: AI tech hardware revenue and profit contribution

Company	Ticker	AI revenue mix		AI profit mix		P/E		PEG
		2024e	2025e	2024e	2025e	2024e	2025e	2025e
Wistron	3231.TW	8%	10%	26%	26%	18.4x	11.3x	0.18x
Gold Circuit	2368.TW	23%	18%	29%	21%	14.3x	10.6x	0.30x
Giga-Byte	2376.TW	47%	57%	40%	49%	21.2x	15.2x	0.39x
Yageo	2327.TW	0-5%	0-5%	0-5%	0-5%	13.3x	10.5x	0.41x
Quanta	2382.TW	34%	35%	24%	22%	20.2x	15.5x	0.50x
Wiwynn	6669.TW	26%	46%	13%	24%	22.5x	16.9x	0.50x
Asustek	2357.TW	8%	12%	-1%	3%	18.1x	14.6x	0.61x
Hon Hai	2317.TW	10%	12%	6%	12%	15.0x	12.6x	0.64x
FII	601138.SS	29%	27%	14%	13%	17.0x	13.9x	0.64x
Eoptolink	300502.SZ	30%	40%	40%	45%	56.0x	37.9x	0.80x
AVC	3017.TW	5%	5%	8%	7%	33.0x	27.7x	1.46x
TFC Optical	300394.SZ	50%	55%	30%	35%	56.7x	43.9x	1.50x
Chroma	2360.TW	19%	23%	20-30%	25-35%	22.3x	19.7x	1.50x
Delta	2308.TW	4%	4%	4%	4%	27.5x	24.1x	1.68x
Accelink	002281.SZ	0-5%	0-5%	0-5%	0-5%	34.3x	29.8x	2.01x
King Slide	2059.TW	18%	27%	20-25%	30-35%	26.0x	23.8x	2.54x
Auras	3324.TWO	2-3%	5%	2-3%	5%	44.5x	39.5x	3.09x
Sunon	2421.TW	5%	4%	6%	5%	16.5x	15.7x	3.17x
Lite-on Tech	2301.TW	5%	6%	5%	5%	18.6x	17.8x	3.76x
Innolight	300308.SZ	65%	67%	75%	78%	31.6x	31.3x	30.02x

Source: Morgan Stanley Research (e) estimates

Exhibit 49: Server revenue contribution comparison of major power supply companies

Company name	Delta Electronics	Lite-on Tech
Ticker	2308.TW	2301.TW
2024e total revenue (NT$ mn)	427,905	152,093
Server power supply as % of total revenue	17-18%	~20%
2024e server power supply revenue (NT$ mn)	77,023	30,419
AI server power supply as % of total revenue	4%	4%
2024e AI power supply revenue (NT$ mn)	17,660	6,197

Source: Company data, Reuters Eikon, Morgan Stanley Research (e) estimates. Data as of 13 May, 2024.

Exhibit 50: Server revenue contribution comparison of major thermal companies

Company name	AVC	Sunonwealth	Auras
Ticker	3017.TW	2421.TW	3324.TWO
2024e total revenue (NT$ mn)	70,536	15,247	15,140
Server revenue as % of total revenue	33%	29%	24%
2024e server related revenue (NT$ mn)	23,543	4,471	3,672
AI server thermal solution as % of total revenue	5%	5%	2%
2024e AI server thermal solution revenue (NT$ mn)	3,767	774	367

Source: Company data, Reuters Eikon, Morgan Stanley Research (e) estimates. Data as of 13 May, 2024.

Exhibit 51: How much does one Nvidia 8x GPU H100 server cost?

Bill of materials (US$)	
CPU + CPU motherboard	**$4,950**
CPU	$4,000
CPU motherboard	$950
8x GPU + NVSwitch baseboard	**$169,000**
GPU	$164,400
GPU baseboard	$4,600
Memory (includes HBM)	**$11,300**
Storage	**$3,200**
Network Interface Card	**$11,340**
Chassis	**$563**
Cooling	**$550**
Power supply	**$2,400**
Assembly and Test	**$1,545**
Markup	**$8,955**
Total	**$213,803**

Bill of materials breakdown	
CPU + CPU motherboard	**2%**
CPU	2%
CPU motherboard	0%
8x GPU + NVSwitch baseboard	**79%**
GPU	77%
GPU baseboard	2%
Memory (includes HBM)	**5%**
Storage	**1%**
Network Interface Card	**5%**
Chassis	**0%**
Cooling	**0%**
Power supply	**1%**
Assembly and Test	**1%**
Markup	**4%**
Total	**100%**

CPU motherboard	$950
PCB	$350
Passive cooling (VC, heat sink/fin)	$43
Ethernet/BMC/DPU	$150
Others (includes markup)	$407

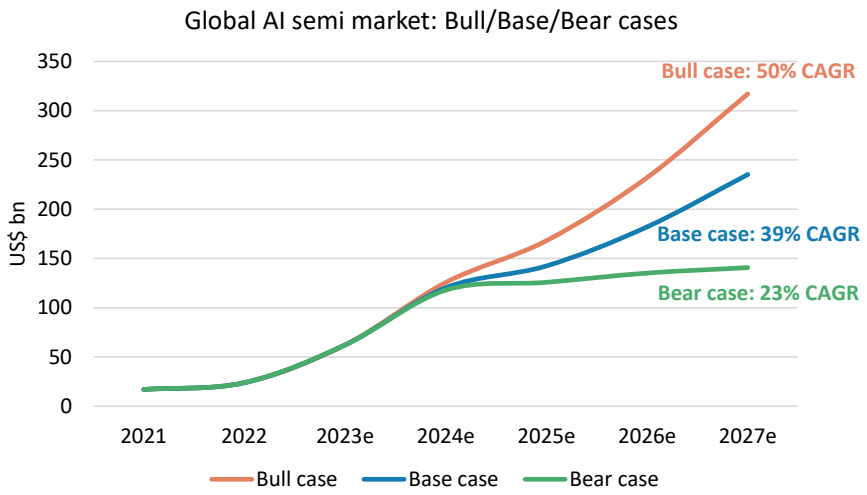
GPU baseboard	$4,600
GPU Module (8x)	$1,200
PCB (OAM)	$400
Others (includes thermal, markup)	$800
PCB (UBB)	$800
3D VC / liquid cooling	$800
NVSwitch	$240
Ethernet/BMC/DPU	$150
Others (includes markup)	$1,410

Memory	$11,300
HBM 80GB	$8,000
1.92TB Server DRAM (64GB modules)	$3,300

Source: Morgan Stanley Research estimates

Demand tracker – AI capex

Exhibit 52: In our base case, we assume 39% AI semi industry growth during 2023-27, based on current AI capex trends



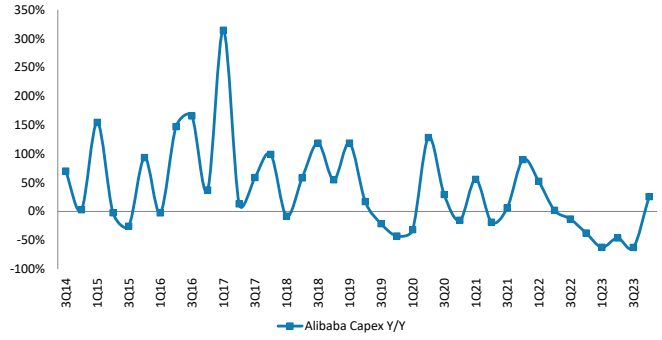
Source: Morgan Stanley Research (e) estimates. Note: CAGRs refer to growth during 2023-27e.

Chinese hyperscalers BAT in 4Q23

Cloud/AI capex update

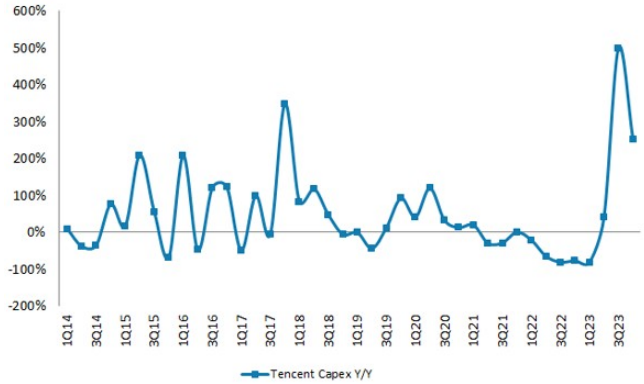
- We see Chinese hyperscalers continuing to invest heavily in AI related deployment, with more adoption being combined with their daily operations.

Exhibit 53: Alibaba – capex was +26% Y/Y in calendar 4Q23 after -62% Y/Y in 3Q23



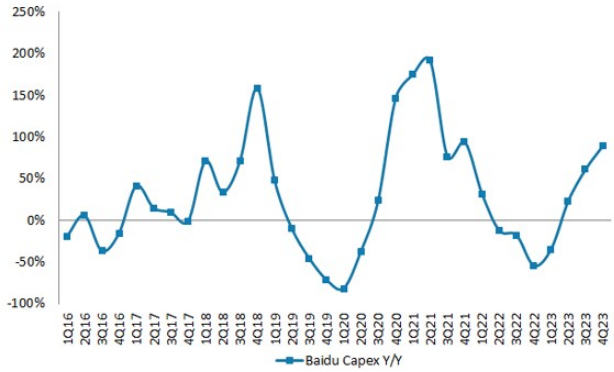
Source: Company data, Morgan Stanley Research

Exhibit 54: Tencent – capex was +253% Y/Y in calendar 4Q23 from +500% Y/Y in calendar 3Q23



Source: Company data, Morgan Stanley Research

Exhibit 55: Baidu – capex was +90% Y/Y in 4Q23, from +61% Y/Y in 3Q23



Source: Company data, Morgan Stanley Research

Exhibit 56:

Chinese Hyperscalers: 4Q23 commentary

Company	Date	4Q23 Cloud Capex Quote
Alibaba	2/7/2024	*" In cloud computing, we're committed to our strategy of **prioritizing public cloud** . We have proactively optimized our business structure, reduced revenue from project-based contracts and **increased investment in public cloud products** ."* *"We're also actively deploying AI to enhance operating efficiency and lower barriers for merchants. Our suite of AI-based digital foreign trade products have been officially launched, enabling real-time language translation, AI logistics services, rapid generation of images and videos for marketing, et cetera."* *"...see very strong potential for greater synergy between Alibaba Cloud and the Taobao Tmall Group, especially driven by AI. As you know, we've been developing our own large language model called **Tongyi Qianwen** and we're currently testing ways to leverage this model, ... to enhance search and to enhance advertising as well. This initiative is still in the early testing phase, but we **see very strong potential to leverage AI to significantly enhance search conversion and add monetization** . So, as I say, that's still in early testing, but we see excellent potential there."*
Tencent	3/20/2024	*"Our Tencent Hunyuan foundation model is now the top tier of large language model in China with a notable strength in advanced logical reasoning…."* *"We're increasingly integrating Hunyuan to provide co-pilot services from enterprise SaaS products, including Tencent Meeting and Tencent Docs....This is most obvious in our advertising business, where our AI-powered ad tech platform is contributing to more accurate ad targeting, higher ad click-through rates and thus, faster advertising revenue growth rates. We're also seeing earlier stage business opportunities in providing AI services to Tencent Cloud customers. "* *"we are **increasingly going to be deploying AI** , including generative AI in areas such as accelerating the creation of animated content..."*
Baidu	2/28/2024	*"Looking into 2024, we believe this incremental revenue will multiply to several billion RMB, primarily from advertising and **AI Cloud** businesses. While we are beginning to commercialize Gen-AI and foundation models, we see enormous monetization potential in this groundbreaking technology. We envisioned ERNIE as the future foundation system serving as the foundation for millions of AI-native applications developed by third party and Baidu. This paradigm will enable us to create an ecosystem around ERNIE, which opens up various revenue sources."* *"Gen-AI enabled search complements traditional search, expanding the TAM of Baidu Search by serving a wider range of information needs, and answering content creation-related questions."* *" Gen-AI and LLMs have become pivotal considerations for many enterprises, driving a shift in the cloud industry from general-purpose computing to AI computing. This evolution is reshaping the competitive dynamics within the cloud industry, strengthening our lead in AI, and expanding our total addressable market."*

Source: Company data, FactSet, Morgan Stanley Research

Key featured reports on AI supply chain

AI supply chain trackers

Global Technology: AI Supply Chain – Capex Still Growing (29 Apr 2024)

Global Technology: AI Supply Chain – Intel Habana implications (23 Apr 2024)

Asia Technology: AI Supply Chain Tracker – Keep the Ball Rolling (15 Apr 2024)

Asia Technology: AI Supply Chain Tracker – AI ASIC Demand Remains Strong (8 Apr 2024)

Asia Technology: AI Supply Chain Tracker – Developments in NVDA GB200 NVL72 Liquid-cooled Rack Solution (1 Apr 2024)

Asia Technology: AI Supply Chain Tracker – AI GPU rental; GTC demo (25 Mar 2024)

Asia Technology: AI Supply Chain Tracker – AI Server ODMs Catching Up (18 Mar 2024)

Asia Technology: AI Supply Chain Tracker – TMT conference takeaways (11 March 2024)

Asia Technology: AI Supply Chain Tracker – AI Party Keeps Growing (4 Mar 2024)

Asia Technology: AI Supply Chain Tracker – All eyes on MWC (26 Feb 2024)

Asia Technology: AI Supply Chain Tracker – Dynamic Developments (19 Feb 2024)

Asia Technology: AI Supply Chain Tracker – AI GPU Supply/Demand Growing (29 Jan 2024)

Asia Technology: AI Supply Chain Tracker – AI Demand Keeps Growing (22 Jan 2024)

AI Supply Chain Tracker – AI PC under the spotlight (15 January, 2024)

AI Supply Chain Tracker – Making Progress (8 January, 2024)

Foundation

Global Semiconductors: Windows on Arm AI PC – This Time is for Real (7 May 2024)

Global Technology: US export controls impact (19 Oct 2023)

Asia Technology: AI Hardware Supply Chain – The Value of STEAM Power (16 Oct 2023)

Global Technology: Correction: AI – A New Era for Advanced Packaging (20 Sep 2023)

Global Technology: Correction: More aggressive AI custom chip designs from hyperscalers (12 Sep 2023)

Global Technology: AI – Golden Age of Technology (6 Jul 2023)

Asia Semiconductors: Tech Diffusion – Fulfilling the surge in AI demand with custom chips (11 Jun 2023)

Greater China Technology Hardware: AI - Assessing Downstream Hardware AI Enablers (11 Jul 2023)

Key AI capex updates

Greater China Semiconductors: Cloud Semis: Turning More Constructive; up to OW (7 Nov

2023)

Key Upstream AI supply chain companies

MediaTek: Investor feedback – Is the WoA PC chip for real? (12 May 2024)

Phison Electronics Corp: Time to take profits; down to EW (12 May 2024)

Greater China Semiconductors: Cloud and PC Semis – China may remain tough (12 May 2024)

Aspeed Technology: Recovery continues; raise PT (6 May 2024)

MediaTek: Marching into the AI PC market; reiterate OW (7 May 2024)

TSMC: Arm-based chips lead to higher CPU foundry market share; OW (7 May 2024)

King Yuan Electronics Co Ltd: Higher capex driven by robust AI testing demand; OW (5 May 2024)

Alchip Technologies Ltd: Patience will be rewarded by major project wins; OW (3 May 2024)

Greater China Technology Semiconductors: Cloud semis: Readacross from Meta capex rise – positive for AI and non AI cloud semis (25 Apr 2024)

ASMPT Ltd: High confidence in unlocking 3D packaging markets; keep OW (24 Apr 2024)

Key Downstream AI supply chain companies

Greater China Technology Hardware: Downstream Tech Spotlight Remains on AI (16 Oct, 2023)

Greater China Technology Hardware: AI Server Components – Our Stock Preference (16 Oct, 2023)

Hon Hai Precision: One of a Kind AI Server ODM (9 May, 2024)

Lotes Co. Ltd.: 1Q GM strong beat; Stay OW (12 May 2024)

Asia Vital Components Co. Ltd.: Liquid Cooling Offerings Underway (10 May 2024)

Wistron Corporation: AI ramp on track; stay OW (10 May 2024)

Sunonwealth Electric Machine Industry Co: 1Q24 Margin Miss; Business Strength Recovering (3 May 2024)

Delta Electronics Inc.: 2024 Growth Led by AI Server Power Supply and Mobility (2 May 2024)

Greater China Technology Hardware: Power and Thermal Solutions – Implications from Vertiv 1Q24 Results (24 Apr, 2024)

Greater China Technology Hardware: Thermal Solutions – PUE Requirement Driving Upgrades to Liquid Cooling Solutions (23 Apr, 2024)

Greater China Technology Hardware: Thermal Solutions – Implications from Nidec's CDU Capacity Addition (16 Apr, 2024)

AI Upstream Semis – Order of Preference

Exhibit 57: Preference Table

	Alchip 3661.TW	Andes 6533.TW	KYEC 2449.TW	ASMPT 0522.HK	MediaTek 2454.TW	Aspeed 5274.TWO	GUC 3443.TW	TSMC 2330.TW	Silergy 6415.TW
Rating	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Underweight
Trading Currency	TWD	TWD	TWD	HKD	TWD	TWD	TWD	TWD	TWD
Price Target (as of 2024/5/13)	**4,880.0**	**608.0**	**110.0**	**123.0**	**1,388.0**	**3,800.0**	**1,600.0**	**928.0**	**280.0**
Current Price	2,520.0	383.5	85.4	98.0	1,115.0	3,125.0	1,335.0	819.0	412.5
Upside/(Downside) (%)	94%	59%	29%	26%	24%	22%	20%	13%	-32%
Market Cap (in USD mm)	6,081.1	599.4	3,243.9	4,988.9	53,855.3	3,621.5	5,554.5	655,331.7	5,004.9
Avg Daily Traded Vol (in USD mm)	238.4	22.7	43.3	13.5	195.3	40.0	183.8	616.5	40.3
Street View: Ratings									
Buy/Overweight	94%	33%	23%	90%	70%	77%	35%	95%	59%
Hold/Equal-weight	6%	67%	54%	10%	30%	23%	59%	5%	18%
Sell/Underweight	0%	0%	23%	0%	0%	0%	6%	0%	24%
Bull Case Value	5,680.0	780.0	140.0	155.0	1,888.0	5,000.0	2,180.0	1,180.0	460.0
Upside (%)	125%	103%	64%	58%	69%	60%	63%	44%	12%
Bear Case Value	2,880.0	280.0	72.0	68.0	708.0	1,800.0	1,000.0	540.0	155.0
Downside (%)	14%	-27%	-16%	-31%	-37%	-42%	-25%	-34%	-62%
Risk/Reward Skew	(8.8)	3.8	4.1	1.9	1.9	1.4	2.5	1.3	0.2
Morgan Stanley Estimates									
FY24e	TWD	TWD	TWD	HKD	TWD	TWD	TWD	TWD	TWD
Sales	48,662	1,378	37,586	14,031	523,534	5,002	28,659	2,740,197	18,968
EBITDA	8,725	65	18,638	1,925	115,143	2,126	4,438	1,820,925	2,294
EBIT	7,369	33	9,267	1,244	96,109	2,126	4,171	1,133,753	1,824
EPS	77.70	3.96	5.64	2.25	59.03	48.85	27.82	38.42	6.51
FY25e									
Sales	63,430	1,925	43,500	17,572	648,836	7,724	35,732	3,292,076	25,539
EBITDA	12,297	560	22,235	3,571	164,660	3,977	5,975	2,287,425	6,212
EBIT	10,941	528	11,913	2,719	144,793	3,977	5,708	1,432,873	5,695
EPS	110.01	13.61	7.29	4.94	85.17	86.35	37.29	48.03	15.31
FY24 MSe vs. Consensus Mean									
Sales	2.4%	3.7%	10.3%	-9.2%	1.2%	4.2%	0.9%	0.4%	-1.0%
EBITDA	-12.0%	-60.6%	8.3%	-19.3%	1.5%	-3.3%	-1.0%	-0.1%	-18.8%
EBIT	4.8%	-249.1%	11.2%	-30.8%	-4.4%	0.3%	3.7%	-0.4%	0.1%
EPS	0.3%	102.3%	-13.7%	-29.2%	-3.8%	2.8%	3.7%	-1.6%	2.4%
FY25 MSe vs. Consensus Mean									
Sales	10.2%	8.8%	16.1%	-7.6%	9.8%	12.2%	-3.3%	0.3%	3.8%
EBITDA	-1.3%	-1.5%	14.9%	-4.0%	28.1%	14.4%	-2.8%	3.0%	9.9%
EBIT	42.2%	57.1%	16.0%	-12.4%	24.3%	20.4%	-0.7%	0.5%	19.8%
EPS	15.0%	88.7%	8.7%	-13.3%	21.9%	16.3%	-1.1%	-1.5%	18.7%
Valuation Multiples at Last Close									
FY24e									
P/E	32.4x	97.0x	15.1x	43.6x	18.9x	64.0x	48.0x	21.3x	63.4x
EV/EBIT	25.4x	467.8x	12.8x	28.2x	16.9x	54.1x	40.9x	18.1x	78.6x
EV/EBITDA	21.4x	239.3x	6.4x	18.2x	14.1x	54.1x	38.5x	11.3x	62.5x
EV/Sales	3.8x	11.3x	3.2x	2.5x	3.1x	23.0x	6.0x	7.5x	7.6x
FCF Yield	1.0%	0.8%	2.7%	4.5%	2.0%	1.0%	0.8%	2.9%	1.1%
FY25e									
P/E	22.9x	28.2x	11.7x	19.8x	13.1x	36.2x	35.8x	17.1x	26.9x
EV/EBIT	17.1x	28.7x	9.7x	13.2x	11.1x	28.7x	29.5x	14.0x	24.5x
EV/EBITDA	15.2x	27.1x	5.2x	10.1x	9.7x	28.7x	28.2x	8.8x	22.4x
EV/Sales	3.0x	7.9x	2.7x	2.0x	2.5x	14.8x	4.7x	6.1x	5.5x
FCF Yield	2.1%	3.1%	7.3%	2.7%	5.6%	2.1%	2.3%	4.3%	2.9%
Implied Multiples on MS Price Target									
FY24e									
P/E	62.8x	47.2x	47.2x	47.2x	23.5x	47.2x	57.5x	47.2x	43.0x
EV/EBIT	50.43	28.22	28.22	28.22	21.36	28.22	49.51	28.22	50.04
EV/EBITDA	42.60	27.12	27.12	27.12	17.83	27.12	46.53	27.12	39.78
EV/Sales	7.64	5.45	5.45	5.45	3.92	5.45	7.21	5.45	4.81
FY25e									
P/E	44.4x	41.9x	41.9x	41.9x	16.3x	41.9x	42.9x	41.9x	18.3x
EV/EBIT	35.46	28.86	28.86	28.86	15.38	28.86	38.80	28.86	20.22
EV/EBITDA	31.55	27.81	27.81	27.81	13.52	27.81	37.06	27.81	18.53
EV/Sales	6.12	5.46	5.46	5.46	3.43	5.46	6.20	5.46	4.51
Stock Price Performance									
1 Month	(16.6%)	(10.2%)	(19.4%)	(10.3%)	(6.7%)	(1.9%)	1.1%	0.5%	16.0%
3 Month	(43.1%)	(31.0%)	0.0%	14.4%	14.7%	0.8%	(8.6%)	17.5%	5.8%
1 Year	87.4%	(11.8%)	88.3%	58.7%	66.9%	15.1%	18.1%	62.8%	(8.5%)
YTD	(23.1%)	(20.1%)	0.6%	31.5%	9.9%	0.2%	(23.3%)	38.1%	(17.5%)

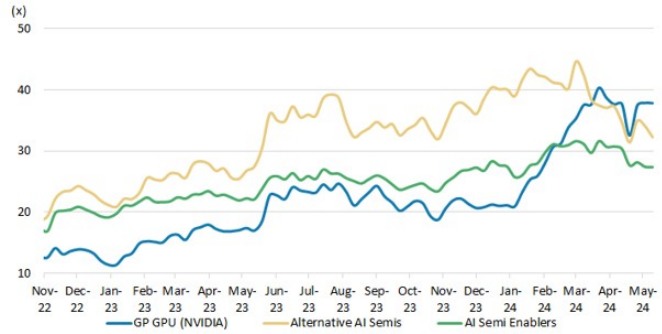
Source: Morgan Stanley Research, FactSet (consensus mean). e = Morgan Stanley Research estimates

Note: Past performance is no guarantee of future results. Results shown do not include transaction costs.

Source: Morgan Stanley Research, FactSet (consensus mean). e = Morgan Stanley Research estimates. Note: Past performance is no guarantee of future results. Results shown do not include transaction costs. Priced as of May 13, 2024.

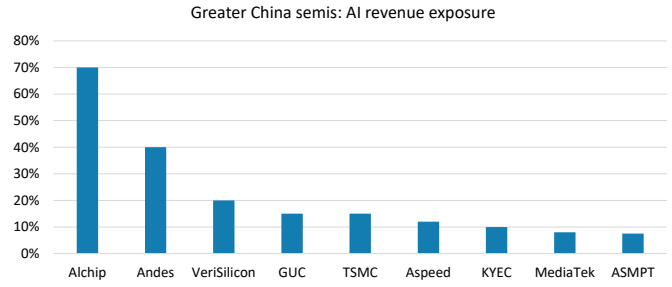
AI semis – P/E multiple and exposure

Exhibit 58: P/E multiple trend of AI semis



Alternative AI semis group: AMD, Alchip, GUC, Andes, Marvell, Broadcom. AI semi enablers group: TSMC, Synopsis, Cadence, ASML, BESI, ASMPT, Ibiden, KYEC, Advantest.
Source: Company data, Morgan Stanley Research.

Exhibit 59: Greater China AI semi revenue exposure as of 2024e



Source: Morgan Stanley Research (e) estimates

AI Downstream Tech – Order of Preference

Exhibit 60: Preference table

	Wistron 3231.TW	GCE 2368.TW	FII 601138.SS	Chroma 2360.TW	Sunonwealth 2421.TW	Delta 2308.TW	Quanta 2382.TW	Asustek 2357.TW	Lite-on Tech 2301.TW	AVC 3017.TW
Rating	Overweight	Overweight	Overweight	Overweight	Equal-Weight	Overweight	Overweight	Equal-Weight	Underweight	Equal-Weight
Trading Currency	TWD	TWD	CNY	TWD	TWD	TWD	TWD	TWD	TWD	TWD
Price Target	**158.0**	**245.0**	**31.1**	**320.0**	**130.0**	**355.0**	**305.0**	**405.0**	**88.8**	**520.0**
Current Price	111.0	187.5	24.0	255.5	112.0	316.5	274.5	466.0	105.0	626.0
Upside/(Downside) (%)	42%	31%	30%	25%	16%	12%	11%	-13%	-15%	-17%
Market Cap (in USD mm)	9,690.1	2,989.2	62,375.0	3,354.1	868.3	25,370.2	32,713.9	10,681.3	7,417.7	7,264.6
Avg Daily Traded Vol (in USD mm)	339.4	72.9	409.0	20.5	51.3	88.4	367.8	63.1	101.2	170.1
Street View: Ratings										
Buy/Overweight	79%	91%	100%	100%	71%	86%	77%	47%	75%	69%
Hold/Equal-weight	21%	9%	0%	0%	29%	14%	23%	53%	17%	31%
Sell/Underweight	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%
Bull Case Value	220.0	350.0	44.4	430.0	186.0	434.0	435.0	785.0	124.0	728.0
Upside (%)	98%	87%	85%	68%	66%	37%	58%	68%	18%	16%
Bear Case Value	81.0	148.0	16.7	155.0	78.0	199.0	185.0	230.0	58.0	312.0
Downside (%)	-27%	-21%	-30%	-39%	-30%	-37%	-33%	-51%	-45%	-50%
Risk/Reward Skew	3.6	4.1	2.8	1.7	2.2	1.0	1.8	1.4	0.4	0.3
Morgan Stanley Estimates										
FY24e	TWD	TWD	CNY	TWD	TWD	TWD	TWD	TWD	TWD	TWD
Sales	999,440	41,211	548,449	20,636	15,247	418,649	1,613,034	507,705	137,582	70,536
EBITDA	48,964	10,121	34,643	6,121	2,585	62,868	76,768	18,346	17,250	12,280
EBIT	38,713	9,154	28,577	5,442	1,998	40,632	64,710	17,231	12,980	10,326
EPS	6.36	13.15	1.41	11.47	6.80	11.50	13.57	25.73	5.65	18.98
FY25e										
Sales	1,211,942	48,465	608,031	22,705	16,893	460,627	1,924,202	576,582	148,412	81,210
EBITDA	68,768	13,109	39,979	7,243	2,876	70,603	98,980	24,519	18,376	14,546
EBIT	57,583	12,280	33,938	6,562	2,230	46,538	85,945	23,404	14,020	12,592
EPS	9.81	17.72	1.72	12.97	7.14	13.14	17.74	31.90	5.91	22.60
FY24 MSe vs. Consensus Mean										
Sales	-0.6%	4.0%	-0.6%	-2.2%	1.8%	-2.0%	9.8%	-4.7%	-4.3%	0.8%
EBITDA	-7.5%	2.1%	3.2%	-2.4%	-0.2%	-6.4%	7.5%	-21.1%	-5.1%	-6.0%
EBIT	-4.7%	4.6%	-0.6%	-2.7%	-3.0%	-8.3%	9.8%	-22.4%	-9.9%	-1.9%
EPS	-3.5%	5.7%	7.0%	-0.2%	2.8%	-13.0%	7.3%	-14.3%	-9.4%	0.2%
FY25 MSe vs. Consensus Mean										
Sales	2.6%	4.4%	-11.4%	-6.0%	-3.2%	-4.3%	-2.1%	-1.7%	-5.1%	-8.5%
EBITDA	4.5%	6.5%	1.0%	-6.1%	-10.9%	-11.0%	6.0%	-17.0%	-17.4%	-18.0%
EBIT	10.2%	10.8%	-4.6%	-6.1%	-16.1%	-14.4%	13.8%	-11.4%	-17.8%	-11.7%
EPS	12.1%	11.2%	7.3%	-5.2%	-11.2%	-17.9%	11.9%	-5.8%	-14.9%	-16.0%
Valuation Multiples at Last Close										
FY24e										
P/E	17.5x	14.3x	17.0x	22.3x	16.5x	27.5x	20.2x	18.1x	18.6x	33.0x
EV/EBIT	8.9x	9.4x	12.9x	18.8x	12.0x	18.4x	17.3x	14.2x	13.2x	20.6x
EV/EBITDA	7.1x	8.5x	10.7x	16.7x	9.3x	11.9x	14.6x	13.3x	10.0x	17.3x
EV/Sales	0.3x	2.1x	0.7x	5.0x	1.6x	1.8x	0.7x	0.5x	1.2x	3.0x
FCF Yield	6.0%	6.4%	7.0%	4.9%	5.8%	2.5%	-0.3%	5.3%	4.3%	3.6%
FY25e										
P/E	11.3x	10.6x	13.9x	19.7x	15.7x	24.1x	15.5x	14.6x	17.8x	27.7x
EV/EBIT	6.2x	6.4x	10.5x	15.2x	10.5x	16.0x	13.0x	9.5x	11.9x	16.4x
EV/EBITDA	5.2x	6.0x	9.0x	13.8x	8.1x	10.6x	11.3x	9.0x	9.1x	14.2x
EV/Sales	0.3x	1.6x	0.6x	4.4x	1.4x	1.6x	0.6x	0.4x	1.1x	2.5x
FCF Yield	2.2%	8.9%	5.3%	5.3%	6.9%	3.9%	3.6%	6.4%	6.1%	4.2%
Implied Multiples on MS Price Target										
FY24e										
P/E	47.2x	18.6x	22.0x	27.9x	19.1x	30.9x	22.5x	15.7x	15.7x	27.4x
EV/EBIT	28.22	12.62	17.60	23.85	14.31	20.88	19.13	11.52	10.38	16.71
EV/EBITDA	27.12	11.41	14.52	21.21	11.06	13.49	16.12	10.82	7.81	14.05
EV/Sales	5.45	2.80	0.92	6.29	1.87	2.03	0.77	0.39	0.98	2.45
FY25e										
P/E	41.9x	13.8x	18.1x	24.7x	18.2x	27.0x	17.2x	12.7x	15.0x	23.0x
EV/EBIT	28.86	10.56	19.06	21.26	15.06	20.36	14.09	13.31	15.04	16.12
EV/EBITDA	27.81	9.89	16.18	19.26	11.67	13.42	12.23	12.71	11.47	13.95
EV/Sales	5.46	2.67	1.06	6.14	1.99	2.06	0.63	0.54	1.42	2.50
Stock Price Performance										
1 Month	(9.4%)	(18.3%)	7.8%	(1.5%)	(8.9%)	(0.2%)	1.3%	5.1%	1.9%	(0.3%)
3 Month	(14.9%)	(31.3%)	39.0%	23.7%	(18.8%)	11.2%	3.0%	0.4%	(3.2%)	17.2%
1 Year	121.6%	96.3%	67.1%	35.5%	72.3%	6.4%	170.4%	65.5%	38.0%	252.7%
YTD	12.6%	(14.0%)	58.7%	20.0%	4.2%	1.0%	22.3%	(4.8%)	(10.3%)	86.0%

Source: Morgan Stanley Research, FactSet (consensus mean). e = Morgan Stanley Research estimates

Note: Past performance is no guarantee of future results. Results shown do not include transaction costs.

Source: Morgan Stanley Research, Refinitiv (consensus mean). e = Morgan Stanley Research estimates. Note: Past performance is no guarantee of future results. Results shown do not include transaction costs. Prices as of May 13, 2024.

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Stock Rating Category	Count	% of Total	Count	% of Total IBC	% of Rating Category	Count	% of Total Other MISC
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Equal-weight/Hold	1746	46%	336	45%	19%	725	46%
Not-Rated/Hold	2	0%	0	0%	0%	1	0%
Underweight/Sell	606	16%	70	9%	12%	221	14%
Total	3,810		749			1592	

Data include common stock and ADRs currently assigned ratings. Investment Banking Clients are companies from whom Morgan Stanley received investment banking compensation in the last 12 months. Due to rounding off of decimals, the percentages provided in the "% of total" column may not add up to exactly 100 percent.

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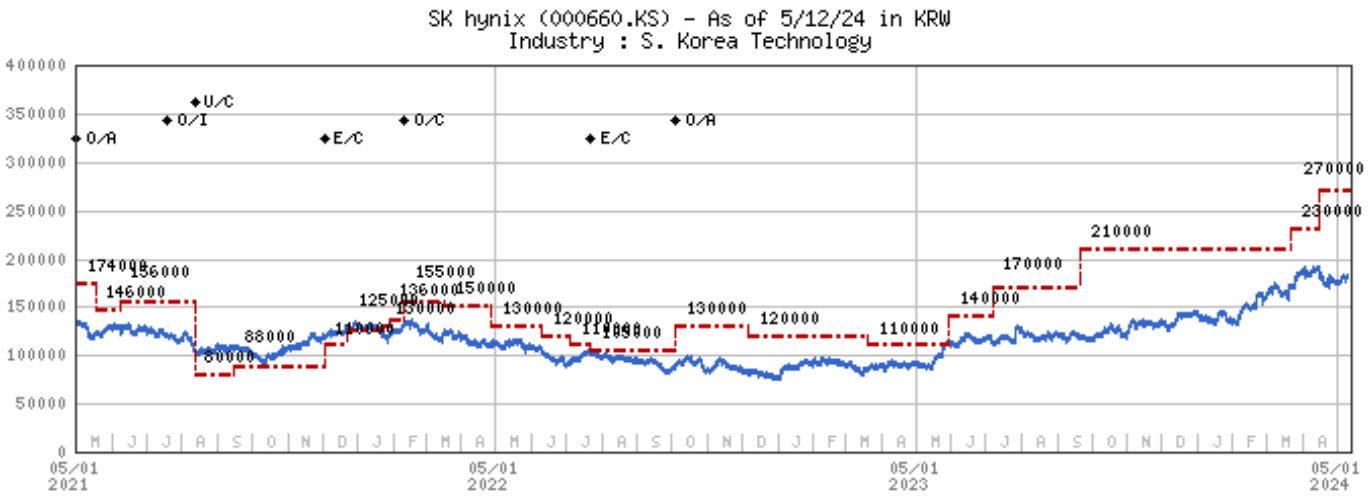
Stock Price, Price Target and Rating History (See Rating Definitions)



Stock Rating History: 5/1/19 : U/C; 7/30/19 : E/I; 11/18/19 : O/A; 7/19/21 : O/I; 8/12/21 : U/C; 12/3/21 : E/C; 2/11/22 : O/C; 7/22/22 : E/C; 10/4/22 : O/A

Price Target History: 4/25/19 : 70000; 6/4/19 : 61000; 7/25/19 : 70000; 7/30/19 : 85000; 8/16/19 : 80000; 9/10/19 : 81000; 11/18/19 : 95000; 1/14/20 : 115000; 2/26/20 : 120000; 3/19/20 : 110000; 8/21/20 : 93000; 10/23/20 : 100000; 12/2/20 : 160000; 1/12/21 : 170000; 2/25/21 : 174000; 5/18/21 : 146000; 6/8/21 : 156000; 8/12/21 : 80000; 9/15/21 : 88000; 12/3/21 : 110000; 12/23/21 : 125000; 1/24/22 : 130000; 1/28/22 : 136000; 2/11/22 : 155000; 3/18/22 : 150000; 4/27/22 : 130000; 6/10/22 : 120000; 7/5/22 : 110000; 7/22/22 : 105000; 10/4/22 : 130000; 12/7/22 : 120000; 3/21/23 : 110000; 5/30/23 : 140000; 7/7/23 : 170000; 9/21/23 : 210000; 3/22/24 : 230000; 4/16/24 : 270000

Source: Morgan Stanley Research Date Format : MM/DD/YY Price Target No Price Target Assigned (NA)
Stock Price (Not Covered by Current Analyst) Stock Price (Covered by Current Analyst)
Stock and Industry Ratings (abbreviations below) appear as ◆ Stock Rating/Industry View
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INDUSTRY COVERAGE: Greater China Technology Hardware

COMPANY (TICKER)	RATING (AS OF)	PRICE* (05/13/2024)
Andy Meng, CFA		
AAC Technologies Holdings (2018.HK)	O (01/29/2024)	HK$27.40
Accelink Technologies Co. Ltd. (002281.SZ)	U (05/12/2022)	Rmb33.65
BYD Electronics (0285.HK)	O (04/28/2023)	HK$34.90
China TransInfo Technology Co Ltd (002373.SZ)	E (07/18/2023)	Rmb9.17
Dahua Technology Co. Ltd. (002236.SZ)	U (07/18/2023)	Rmb17.67
Eoptolink Technology Inc Ltd (300502.SZ)	O (11/06/2023)	Rmb83.48
Genius Electronic Optical Co. Ltd. (3406.TW)	O (05/16/2023)	NT$453.00
Gosuncn Technology Group Co Ltd (300098.SZ)	U (11/07/2022)	Rmb3.24
HIKVision Digital Technology (002415.SZ)	O (11/02/2015)	Rmb33.22
Largan Precision (3008.TW)	O (01/31/2024)	NT$2,240.00
LianChuang Electronic Technology Co Ltd (002036.SZ)	E (05/16/2023)	Rmb7.20
OFILM Group Co Ltd (002456.SZ)	E (11/04/2021)	Rmb8.21
Q Technology (Group) Company Ltd (1478.HK)	E (11/10/2023)	HK$3.87
Quectel Wireless Solutions Co Ltd (603236.SS)	O (11/07/2022)	Rmb44.01
Shenzhen Transsion Holdings Co Ltd (688036.SS)	O (10/24/2023)	Rmb147.51
Sunny Optical (2382.HK)	O (05/16/2023)	HK$41.95
Suzhou TFC Optical Communication Co Ltd. (300394.SZ)	E (11/06/2023)	Rmb135.01
Wingtech Technology Co Ltd (600745.SS)	E (11/10/2023)	Rmb31.74
Xiaomi Corp (1810.HK)	O (04/14/2021)	HK$19.36
Yangtze Optical Fibre and Cable JSC Ltd (601869.SS)	U (10/13/2021)	Rmb27.83
Yangtze Optical Fibre and Cable JSC Ltd (6869.HK)	E (04/20/2023)	HK$9.14
Yongxin Optics Co Ltd (603297.SS)	E (11/15/2022)	Rmb72.61
YuTong Optical Technology Co Ltd (300790.SZ)	E (04/05/2022)	Rmb13.59
Zhejiang Crystal-Optech Co Ltd (002273.SZ)	O (11/15/2022)	Rmb14.85
Zhongji Innolight Co Ltd (300308.SZ)	O (11/06/2023)	Rmb171.55
ZTE Corporation (0763.HK)	E (03/11/2024)	HK$17.94

ZTE Corporation (000063.SZ)	U (07/02/2021)	Rmb28.59
Derrick Yang		
Advantech (2395.TW)	O (01/20/2021)	NT$352.00
AirTAC International (1590.TW)	E (08/04/2022)	NT$1,175.00
AU Optronics (2409.TW)	U (04/23/2024)	NT$17.75
BOE Technology (000725.SZ)	O (09/06/2019)	Rmb4.36
BOE Varitronix Ltd (0710.HK)	O (06/20/2023)	HK$5.93
Chroma Ate Inc. (2360.TW)	O (10/05/2021)	NT$255.50
E Ink Holdings Inc. (8069.TWO)	E (04/30/2024)	NT$219.00
Ennostar Inc (3714.TW)	U (09/23/2022)	NT$42.85
GIS Holding Limited (6456.TW)	E (05/06/2023)	NT$62.70
Hiwin Technologies Corp. (2049.TW)	E (08/11/2023)	NT$235.00
Innolux (3481.TW)	E (04/23/2024)	NT$13.50
King Slide Works Co. Ltd. (2059.TW)	O (11/08/2023)	NT$1,250.00
Lens Technology (300433.SZ)	E (07/22/2020)	Rmb14.67
Leyard Optoelectronic Co Ltd (300296.SZ)	E (11/03/2020)	Rmb4.82
Radiant Opto-Electronics Corporation (6176.TW)	E (03/01/2024)	NT$198.00
Sanan Optoelectronics (600703.SS)	U (08/21/2023)	Rmb12.40
TCL Corp. (000100.SZ)	E (06/11/2019)	Rmb4.68
Tianma Microelectronics (000050.SZ)	U (01/24/2018)	Rmb7.87
Wuhan Jingce Electronic Group Co Ltd (300567.SZ)	E (11/26/2021)	Rmb56.44
Howard Kao		
Acer Inc. (2353.TW)	E (05/01/2023)	NT$47.75
Asustek Computer Inc. (2357.TW)	E (03/16/2024)	NT$466.00
Compal Electronics (2324.TW)	E (05/01/2023)	NT$36.50
Giga-Byte Technology Co. Ltd. (2376.TW)	O (12/15/2022)	NT$313.00
Gold Circuit Electronics Ltd. (2368.TW)	O (10/06/2022)	NT$187.50
Guangdong Fenghua Adv. Tech. (Hldg) Co (000636.SZ)	E (05/12/2021)	Rmb12.37
Inspur Electronic Information (000977.SZ)	E (08/28/2023)	Rmb38.27
Kinsus Interconnect Tech. (3189.TW)	U (12/21/2022)	NT$95.80
Lenovo (0992.HK)	E (01/29/2024)	HK$10.16
Lotes Co. Ltd. (3533.TW)	O (10/06/2022)	NT$1,500.00
Nan Ya PCB (8046.TW)	U (12/21/2022)	NT$190.50
Pegatron Corporation (4938.TW)	E (03/07/2022)	NT$99.40
Quanta Computer Inc. (2382.TW)	O (05/01/2023)	NT$274.50
Shengyi Technology Co Ltd. (600183.SS)	E (05/26/2022)	Rmb20.22
Shennan Circuits Co Ltd (002916.SZ)	E (08/24/2023)	Rmb88.65
Unimicron (3037.TW)	U (02/22/2023)	NT$186.50
Wistron Corporation (3231.TW)	O (07/12/2023)	NT$111.00
Wiwynn Corp (6669.TW)	E (10/17/2023)	NT$2,385.00
Yageo Corp. (2327.TW)	O (01/04/2022)	NT$636.00
Zhen Ding (4958.TW)	E (08/02/2022)	NT$122.00
Sharon Shih		
Asia Vital Components Co. Ltd. (3017.TW)	E (02/23/2024)	NT$626.00
Auras Technology Co Ltd (3324.TWO)	E (05/04/2023)	NT$801.00
Catcher Technology (2474.TW)	U (04/23/2021)	NT$229.50
Delta Electronics Inc. (2308.TW)	O (07/13/2017)	NT$316.50
Foxconn Industrial Internet Co. Ltd. (601138.SS)	O (07/10/2019)	Rmb24.00
Foxconn Technology (2354.TW)	E (08/16/2016)	NT$60.10
GoerTek Inc (002241.SZ)	E (12/05/2022)	Rmb16.80
Guangzhou Shiyuan Electronic Tech Co Ltd (002841.SZ)	E (10/28/2021)	Rmb32.58
Hon Hai Precision (2317.TW)	O (03/15/2024)	NT$169.50
HTC Corporation (2498.TW)	E (12/06/2023)	NT$42.00
LandMark Optoelectronics Corporation (3081.TWO)	U (04/27/2023)	NT$121.50
Lingyi Itech Guangdong Co (002600.SZ)	E (08/28/2023)	Rmb4.92

Lite-On Technology (2301.TW)	U (03/28/2024)	NT$105.00
Luxshare Precision Industry Co., Ltd. (002475.SZ)	O (10/24/2016)	Rmb30.58
Sunonwealth Electric Machine Industry Co (2421.TW)	E (02/23/2024)	NT$112.00
Tong Hsing (6271.TW)	E (03/18/2019)	NT$144.50
Visual Photonics Epitaxy Co Ltd (2455.TW)	E (09/11/2023)	NT$137.50

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