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Investor Presentation | Asia Pacific

Greater China Semis: AI Packaging Innovation: CoWoS, CPO and WoW

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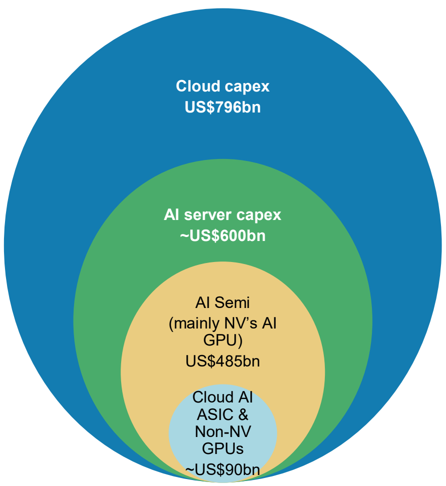
GREATER CHINA TECHNOLOGY SEMICONDUCTORS

Asia Pacific

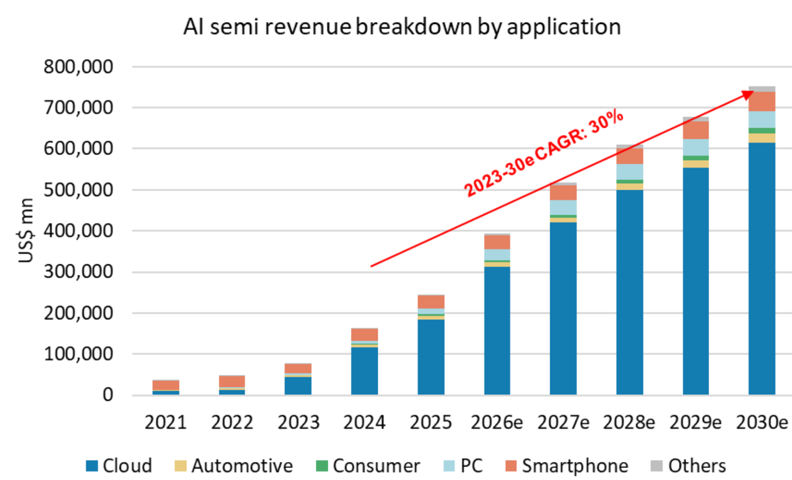
Industry View **Attractive**

Global Semi Industry Market Could Reach US$1.5tn by 2030, with AI Semis Contributing Half

Our supply chain data-driven bull case assumes cloud AI Semi TAM could grow to US$485bn in 2026e



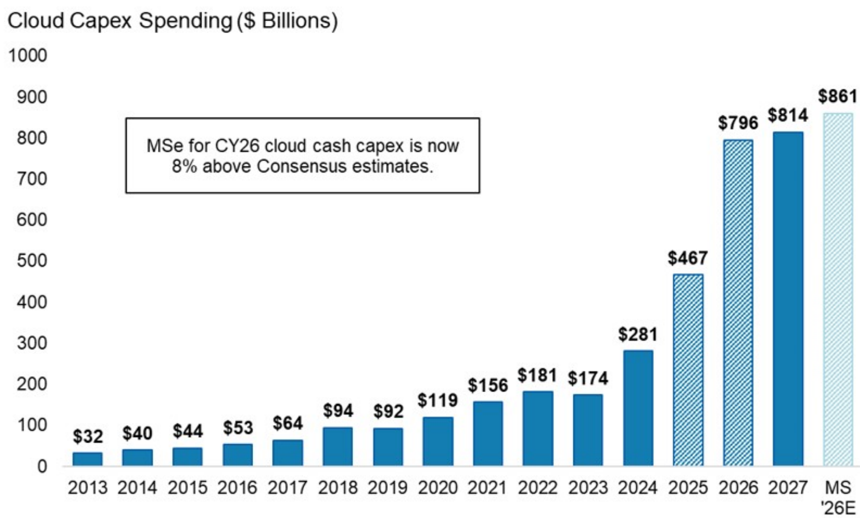
We expect AI semi TAM to reach ~US$753bn by 2030



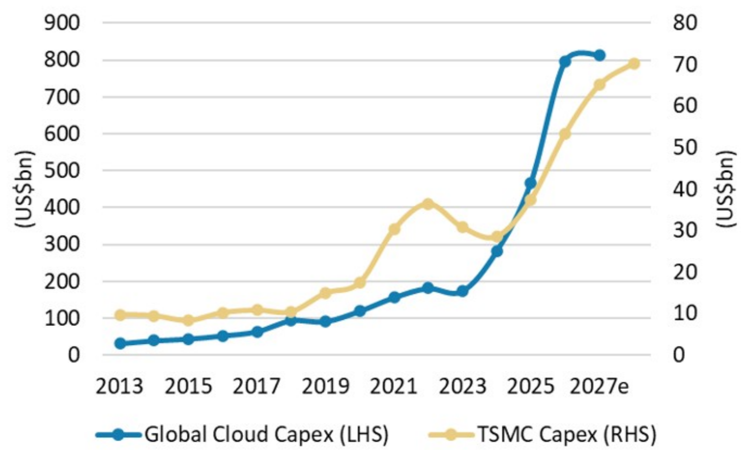
Source: Nvidia, Morgan Stanley Research. e = Morgan Stanley Research estimates.

Cloud Capex Remains Robust Among Major CSPs

Morgan Stanley cloud capex tracker estimates nearly US$811bn of cloud capex spending in 2026 (Top 11 listed global CSPs; no sovereign AI)



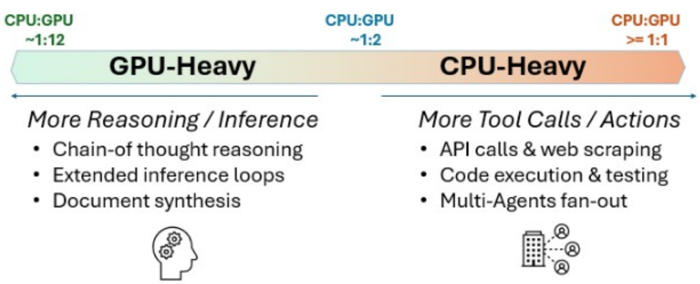
Global Cloud Capex vs. TSMC capex



Source: FactSet, company data, Morgan Stanley Research. E = Morgan Stanley Research estimates. Note: Estimates are top-down and from our US tech team.

Agentic AI - Growing CPU Opportunities

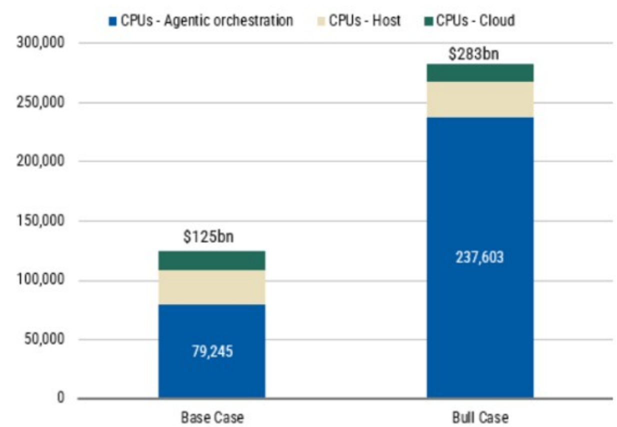
Cluster-level CPU: GPU intensity rises as AI moves from reasoning to action



We lift our base case Orchestration CPU TAM to $79bn (prior $60bn)…

TAM 2030 ($bn)	Orch.	Host + cloud	Total
Bear Case	32	45	**77**
Base (current) model	60	45	**105**
Base (new) Bottom-Up model	79	45	**125**
Bull Top-Down model	238	45	**283**

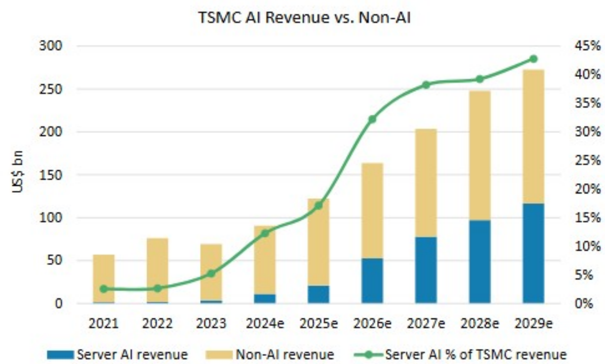
… and our bull case implies a $238bn CPU orchestration TAM



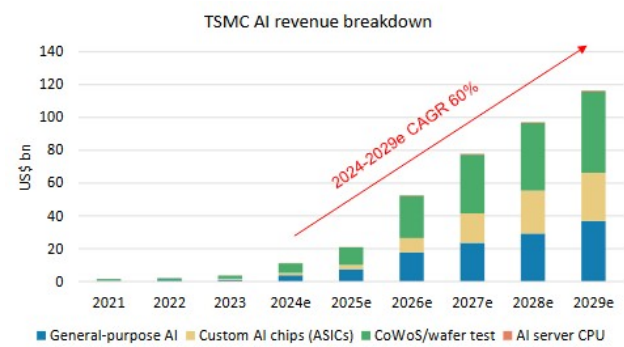
Source: Morgan Stanley Research (e) estimates

TSMC AI Semis Revenue 2024-29e CAGR Could Reach 60%

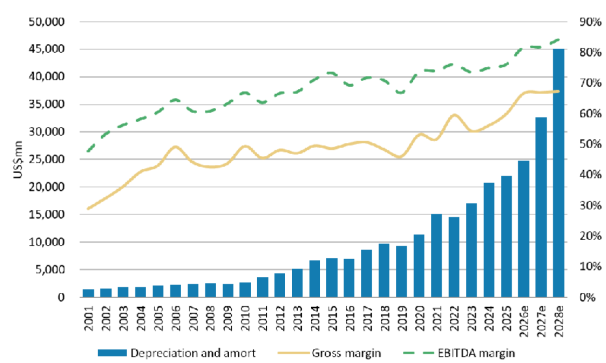
TSMC – AI semis revenue could account for >30% of 2026e revenue



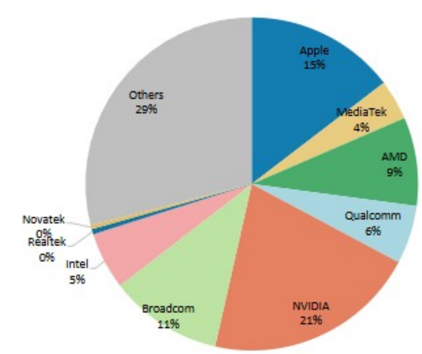
TSMC – AI semis revenue breakdown



TSMC – margin expansion



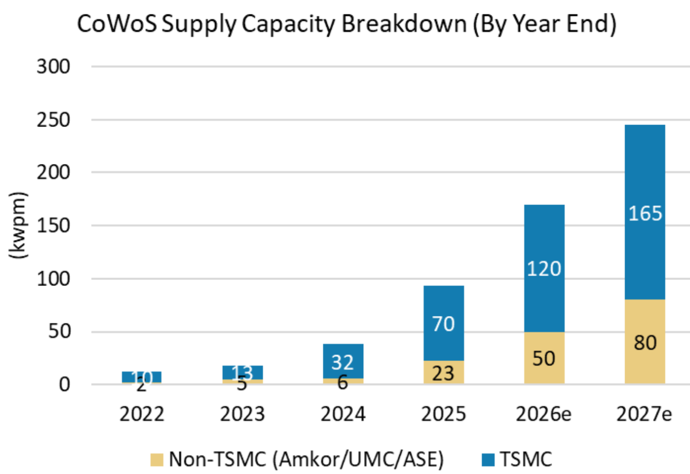
TSMC – 2026e revenue breakdown by customer



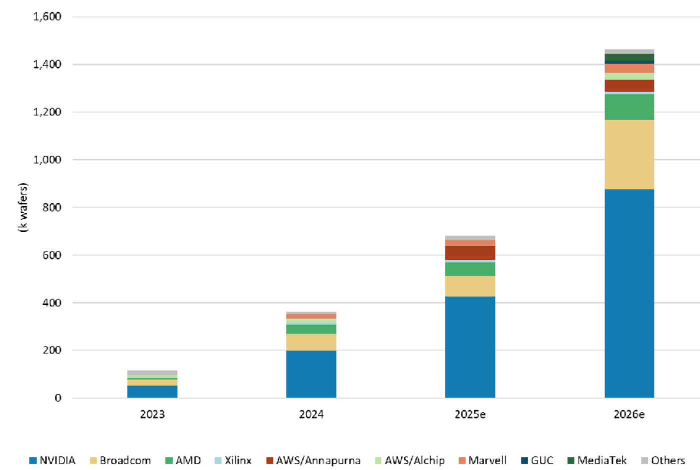
Source: Company data, Morgan Stanley Research (e) estimates

TSMC Could Expand CoWoS Capacity to 165kwpm by 2027 Given Continued Strong AI Demand

Global CoWoS capacity expansion by vendor



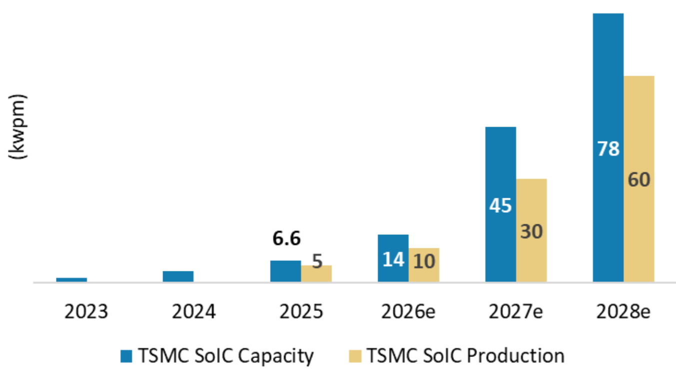
Global CoWoS consumption, by customer



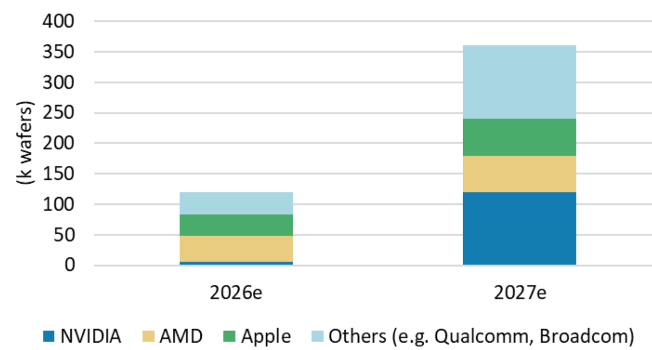
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

SoIC Expansion Will Be a Key Focus Area for TSMC in the Coming Years

TSMC SoIC Supply Capacity Breakdown (by year-end)



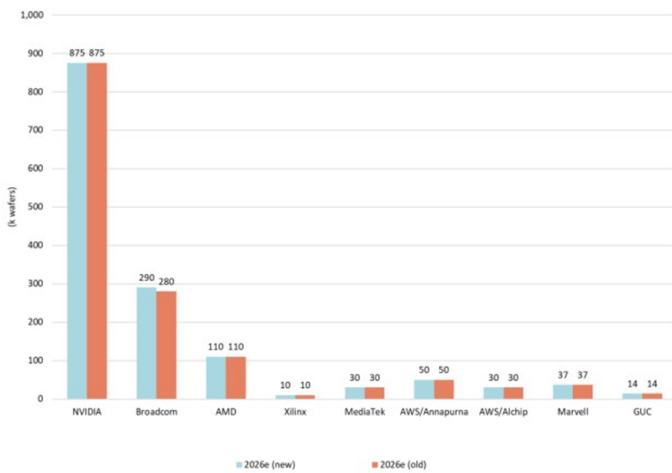
SoIC demand breakdown, by customer



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

TSMC Likely Doubled CoWoS and SoIC Capacity in 2025, and We Expect this to Continue into 2026

Key changes in 2026e CoWoS allocation in a chart



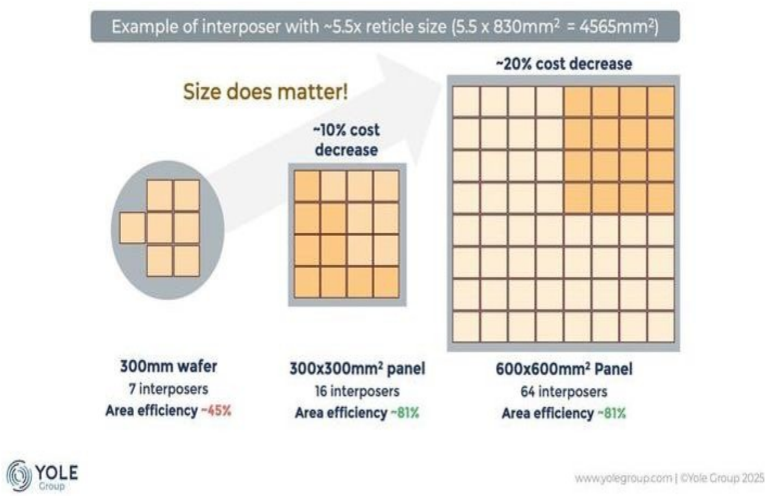
Key changes in 2026 CoWoS allocation in a table (see numbers marked in red)

(k wafer)	2023	2024	2025e	2026e	2023	2024	2025e	2026e
NVIDIA	53	200	425	875	45%	54%	62%	60%
TSMC			390	680				
CoWoS-L			390	650				
CoWoS-S			0	20				
CoWoS-R			0	10				
Non-TSMC			35	165				
Amkor			35	135				
CoWoS-S			20	75				
CoWoS-R			15	60				
ASE/SPIL			0	30				
CoWoS-S			0	0				
CoWoS-R			0	30				
Broadcom	23	68	85	290	20%	18%	12%	20%
TSMC			83	230				
CoWoS-L			0	15				
CoWoS-S			83	215				
ASE/SPIL			2	30				
CoWoS-L			0	0				
CoWoS-S			2	30				
Amkor				30				
CoWoS-L				30				
AMD	7	40	60	110	6%	11%	9%	8%
TSMC			60	80				
CoWoS-L			0	70				
CoWoS-S			60	10				
ASE/SPIL			0	30				
CoWoS-L			0	30				
CoWoS-S			0	0				

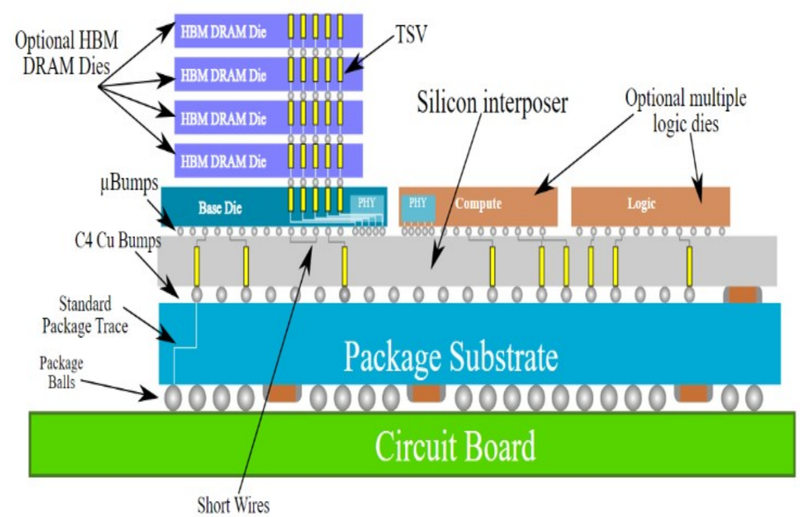
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

What About the Competition Between TSMC CoWoS and Intel EMIB?

TSMC CoWoS can support up to 9.5x reticles, or four chips per wafer



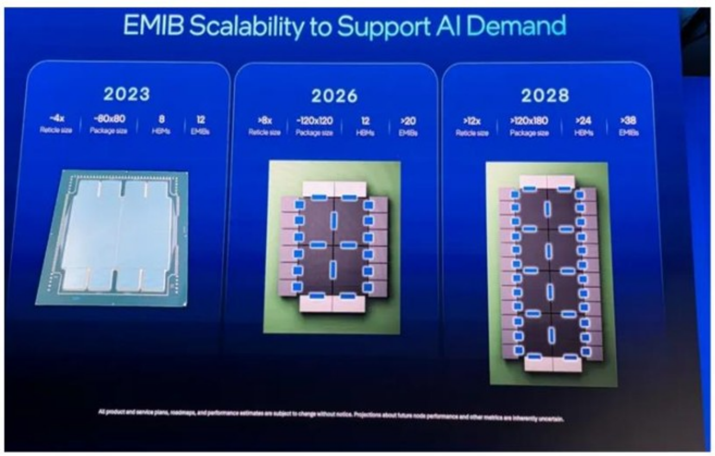
TSMC's CoWoS-S (silicon interposer) packaging architecture



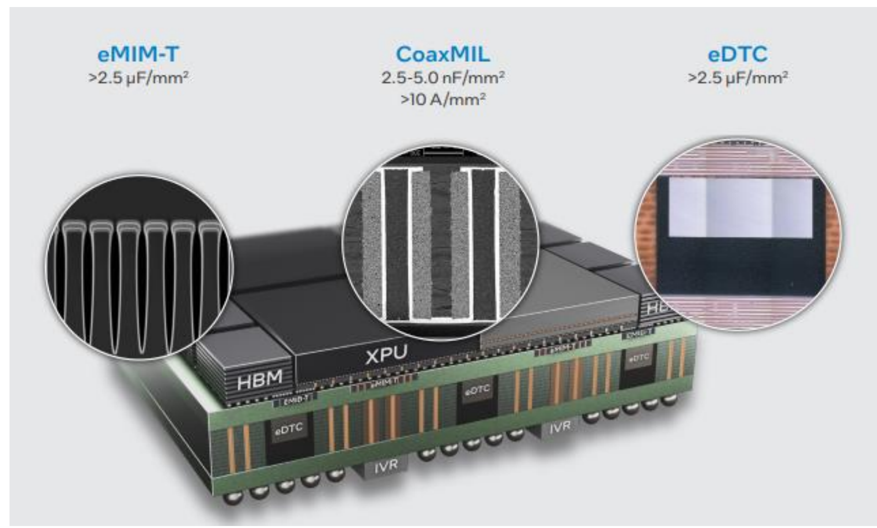
Source: Intel, Yole, Morgan Stanley Research

What About the Competition Between TSMC CoWoS and Intel EMIB?

Intel's EMIB can easily support larger chips with more reticles (>12) if its supply chain executes well



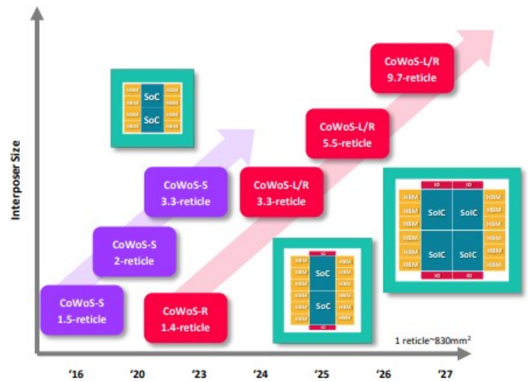
EMIB architecture



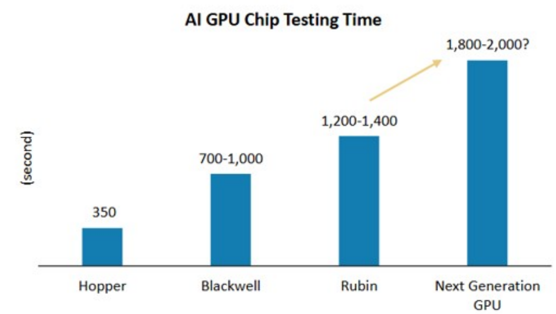
Source: Intel, Yole, Morgan Stanley Research

Larger Package Size is Emerging as a Key Industry Trend

TSMC's roadmap for interposer size

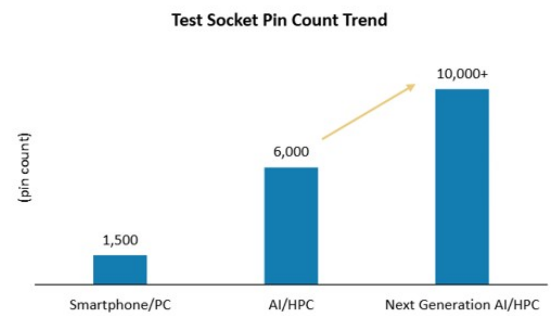


Chip testing time continues to trend up



We expect the testing equipment market to grow at 35% CAGR during 2024-27e

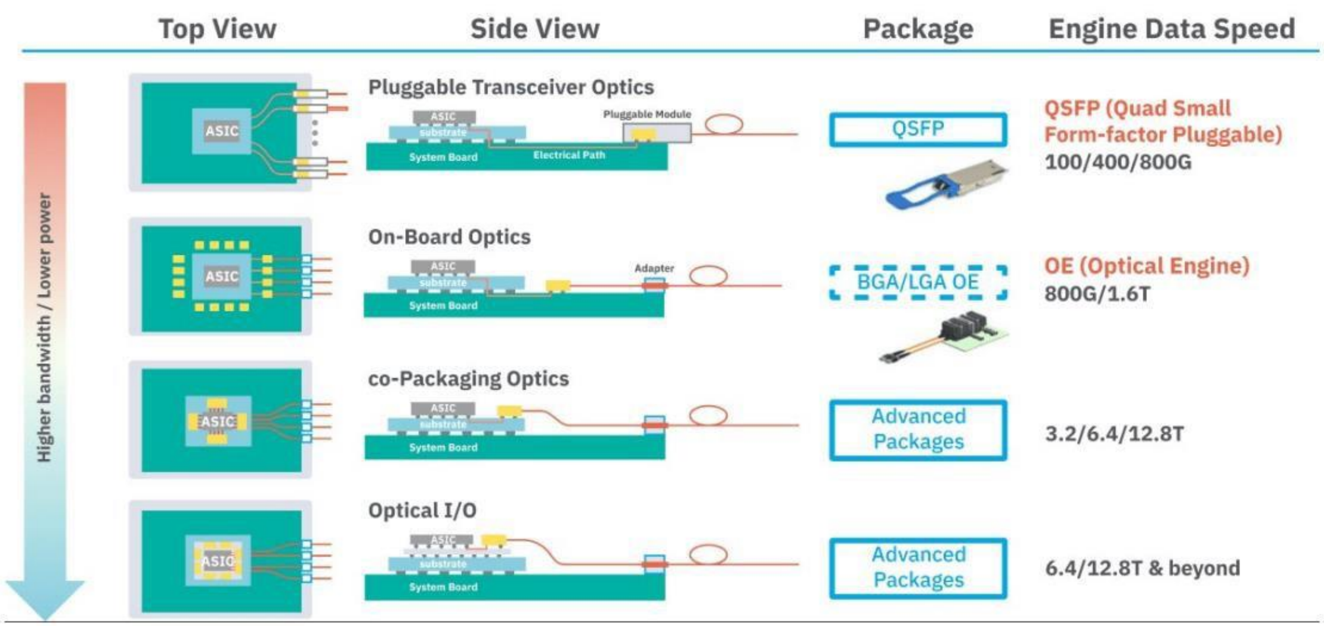
AI/HPC test socket requires higher pin counts vs. traditional consumer tech applications



Source: Company data, Morgan Stanley Research estimates

Optics integration has evolved to CPO

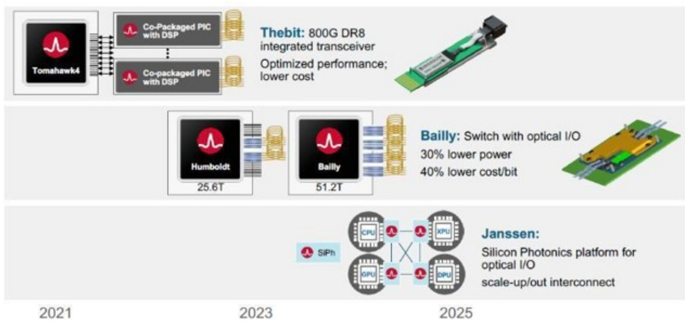
Evolution of fiber optics integration



Source: ASE

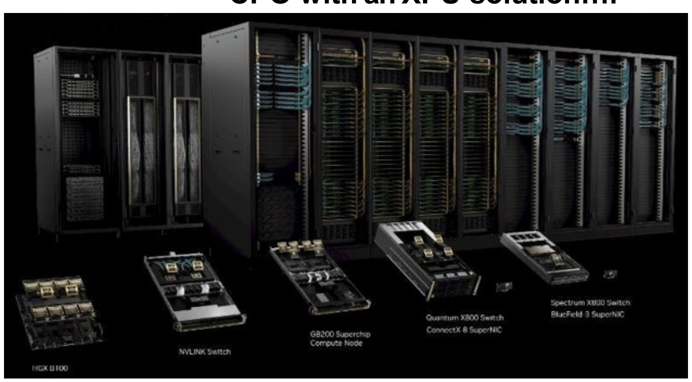
Broadcom is the first mass producing CPO with a switch solution; while NVIDIA's Rubin server rack system is expected to be the first CPO with an XPU solution

Broadcom is the first mass producing CPO with Switch solution

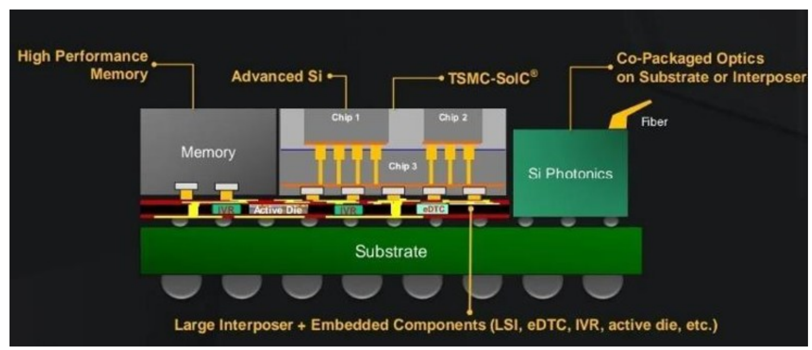


Cisco's OFC 2023 CPO Demo System

NVIDIA's Rubin server rack system to be the first CPO with an XPU solution….



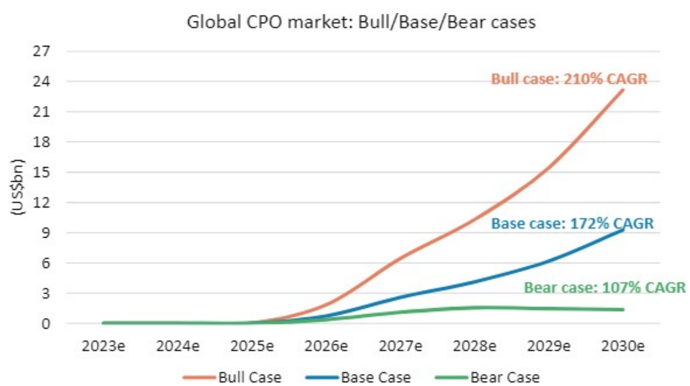
…which leverages TSMC's COUPE technology



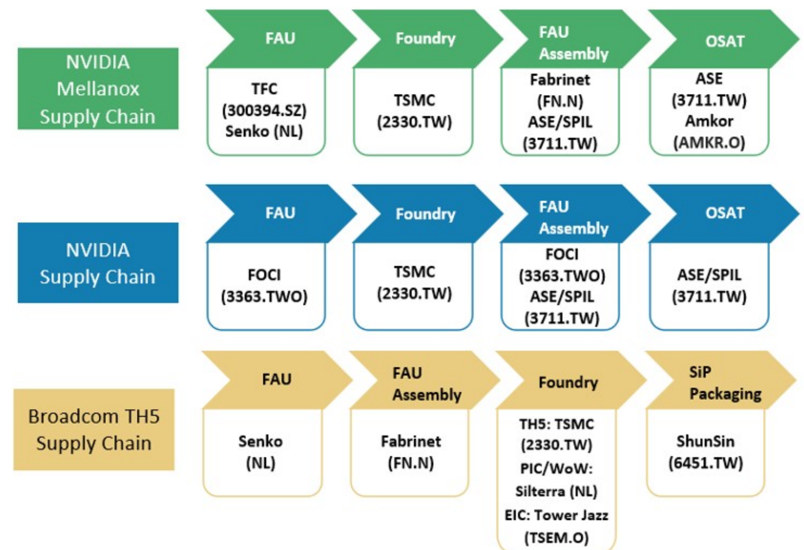
Source: Broadcom, Cisco, NVIDIA, TSMC

Our Base Case expects CPO TAM to grow at a 172% CAGR in 2023-2030e, reaching US$9bn in 2030e

Global CPO market TAM: Bull/Base/Bear Cases



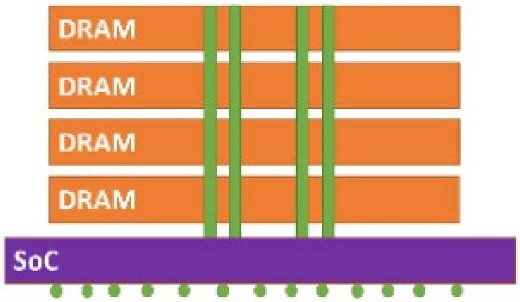
We expect FOCI, TSMC and SPIL to be the major partners in NVIDIA's Rubin server rack system supply chain



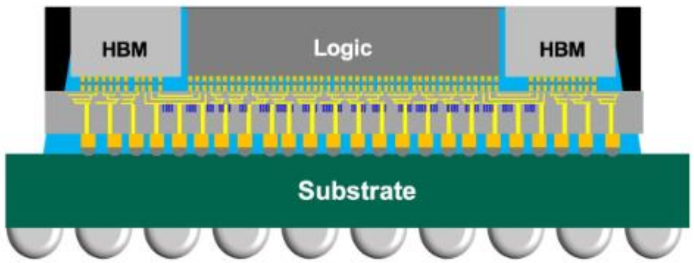
Source: Yole, Morgan Stanley Research estimates

Introduction of 3D Wafer on Wafer (WoW) stacking vs. 2.5D CoWoS

Wafer on Wafer solutions; DRAM on top of the SOC die

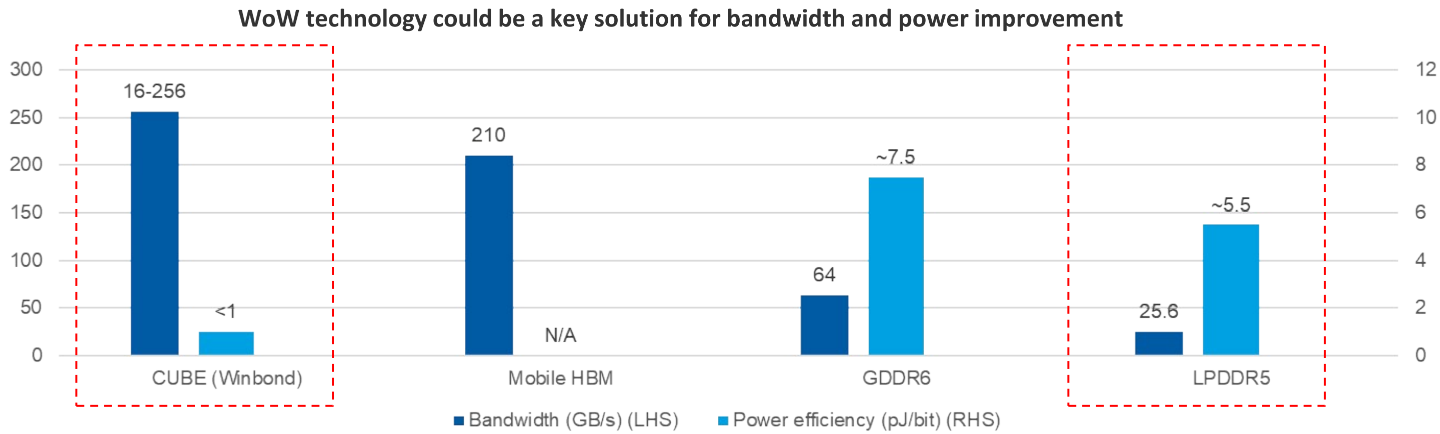


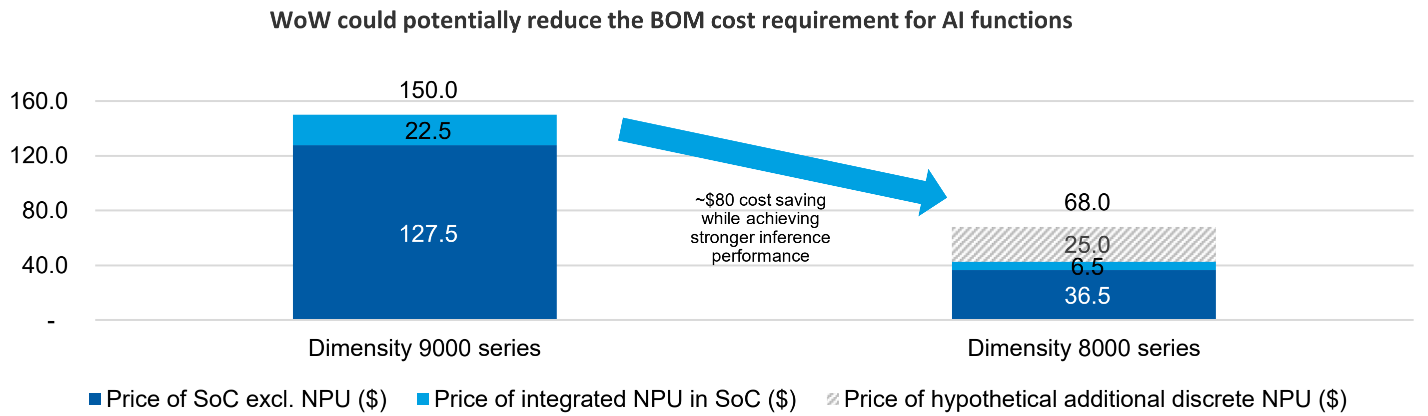
2.5D CoWoS solution



Source: Company data, Morgan Stanley Research

Benefits from WoW stacking

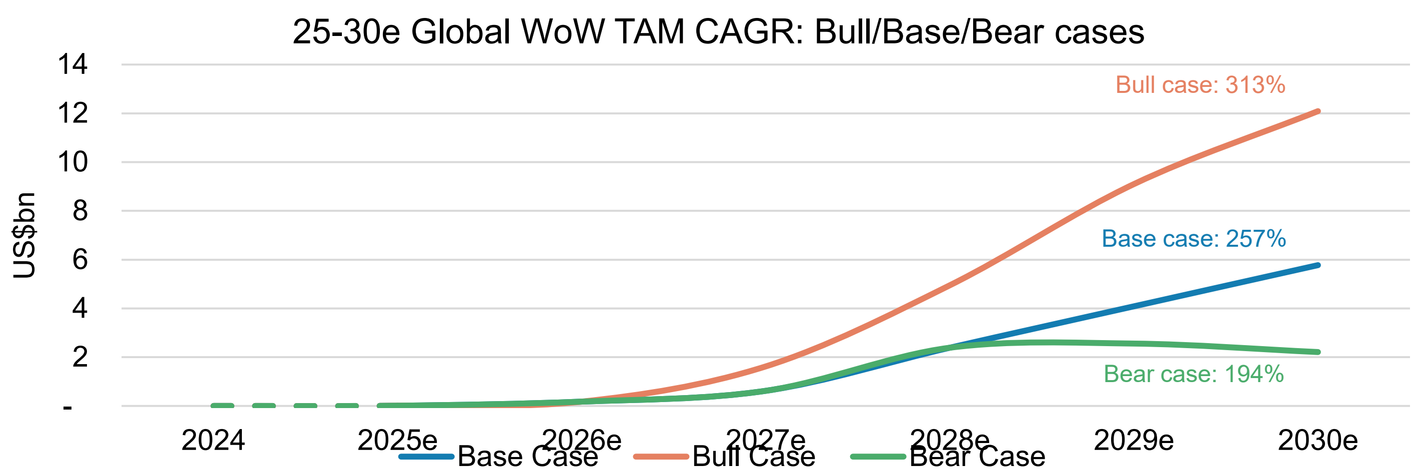




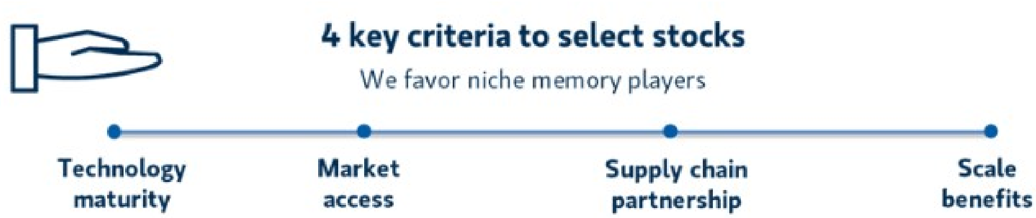
Source: Company data, Morgan Stanley Research estimates

We estimate a USD6bn WoW TAM by 2030 - substantial for niche memory players

In our base case, we assume 257% market CAGR, 2025-30e, for WoW stacking products

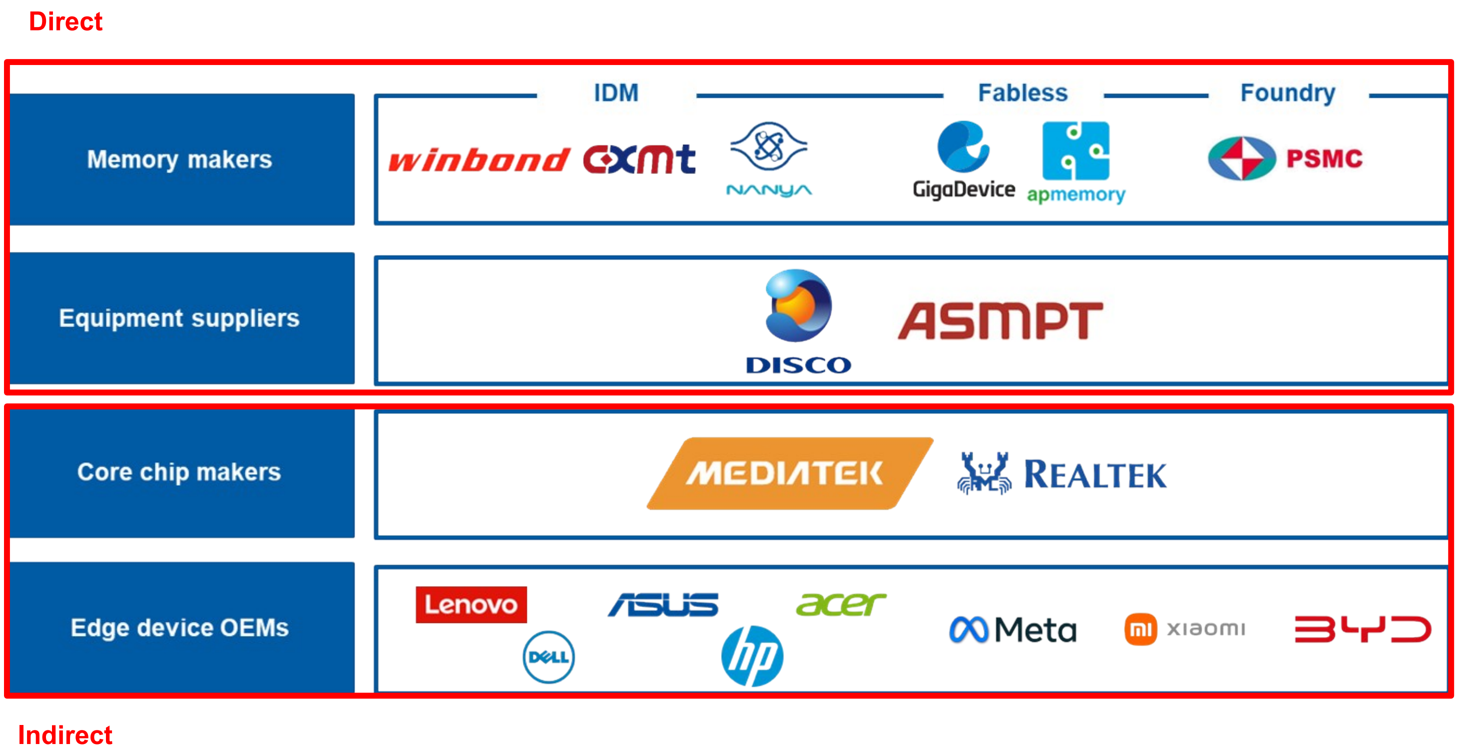


Criteria for stock selection



Source: Company data, Morgan Stanley Research estimates

Global beneficiaries of WoW technology



Source: Company data, Morgan Stanley Research

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Overweight/Buy	1546	42%	467	51%	30%	709	44%
Equal-weight/Hold	1568	43%	358	39%	23%	715	44%
Not-Rated/Hold	4	0%	0	0%	0%	1	0%
Underweight/Sell	555	15%	84	9%	15%	202	12%
Total	3,673		909			1627	

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.

Analyst Stock Ratings

Overweight (O). The stock's total return is expected to exceed the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Equal-weight (E). The stock's total return is expected to be in line with the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Not-Rated (NR). Currently the analyst does not have adequate conviction about the stock's total return relative to the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Underweight (U). The stock's total return is expected to be below the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Unless otherwise specified, the time frame for price targets included in Morgan Stanley Research is 12 to 18 months.

Analyst Industry Views

Attractive (A): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be attractive vs. the relevant broad market benchmark, as indicated below.

In-Line (I): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be in line with the relevant broad market benchmark, as indicated below.

Cautious (C): The analyst views the performance of his or her industry coverage universe over the next 12-18 months with caution vs. the relevant broad market benchmark, as indicated below.

Benchmarks for each region are as follows: North America - S&P 500; Latin America - relevant MSCI country index or MSCI Latin America Index; Europe - MSCI Europe; Japan - TOPIX; Asia - relevant MSCI country index or MSCI sub-regional index or MSCI AC Asia Pacific ex Japan Index.

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INDUSTRY COVERAGE: Greater China Technology Semiconductors

COMPANY (TICKER)	RATING (AS OF)	PRICE* (05/22/2026)
Charlie Chan		
ACM Research Inc (ACMR.O)	O (03/07/2023)	US$71.59
Advanced Micro-Fabrication Equipment Inc (688012.SS)	O (11/06/2023)	Rmb469.60
Advanced Wireless Semiconductor Co (8086.TWO)	U (07/14/2025)	NT$159.50
Alchip Technologies Ltd (3661.TW)	O (05/14/2021)	NT$4,895.00
ASE Technology Holding Co. Ltd. (3711.TW)	O (09/15/2024)	NT$561.00
Cambricon Technology Corporation (688256.SS)	O (04/27/2026)	Rmb1,286.00
Global Unichip Corp (3443.TW)	O (07/27/2024)	NT$5,140.00
GlobalWafers Co Ltd (6488.TWO)	E (05/19/2026)	NT$717.00
Gudeng Precision (3680.TWO)	O (11/25/2025)	NT$568.00
Hua Hong Semiconductor Ltd (1347.HK)	E (03/12/2026)	HK$128.00
Iluvatar CoreX Semiconductor Co., Ltd. (9903.HK)	O (04/27/2026)	HK$444.20
King Yuan Electronics Co Ltd (2449.TW)	O (03/03/2023)	NT$296.00
Maxscend Microelectronics Co Ltd (300782.SZ)	U (01/11/2021)	Rmb125.51
MediaTek (2454.TW)	O (11/28/2025)	NT$3,860.00
MetaX Integrated Circuits (688802.SS)	E (04/27/2026)	Rmb728.45
Nanya Technology Corp. (2408.TW)	E (03/20/2026)	NT$310.50
NAURA Technology Group Co Ltd (002371.SZ)	O (11/06/2023)	Rmb669.00
OmniVision Integrated Circuits Group Inc (603501.SS)	E (11/17/2025)	Rmb104.25
Phison Electronics Corp (8299.TWO)	E (02/25/2026)	NT$2,430.00
SG Micro Corp. (300661.SZ)	E (11/03/2025)	Rmb111.01
Silergy Corp. (6415.TW)	U (05/19/2026)	NT$562.00
SMIC (0981.HK)	O (10/21/2025)	HK$74.20
TSMC (2330.TW)	O (02/07/2022)	NT$2,255.00
UMC (2303.TW)	O (05/19/2026)	NT$114.00
Vanguard International Semiconductor (5347.TWO)	E (01/14/2026)	NT$162.00
WIN Semiconductors Corp (3105.TWO)	U (07/14/2025)	NT$531.00
Daisy Dai, CFA		
ASMPT Ltd (0522.HK)	O (07/24/2025)	HK$174.90
China Resources Microelectronics Limited (688396.SS)	U (03/02/2026)	Rmb62.40

Elan Microelectronics Corp (2458.TW)	O (10/03/2025)	NT$162.00
Empyrean Technology Co Ltd (301269.SZ)	E (01/17/2025)	Rmb108.69
Hangzhou Silan Microelectronics Co. Ltd. (600460.SS)	U (08/25/2025)	Rmb32.16
Innoscience (2577.HK)	E (10/13/2025)	HK$65.25
JCET Group Co Ltd (600584.SS)	E (01/16/2026)	Rmb72.88
Shanghai Fudan Microelectronics (1385.HK)	O (03/07/2025)	HK$36.32
SICC Co Ltd (688234.SS)	O (03/20/2026)	Rmb153.74
StarPower Semiconductor Ltd (603290.SS)	E (05/14/2026)	Rmb131.75
Unigroup Guoxin Microelectronics Co Ltd (002049.SZ)	U (01/10/2023)	Rmb79.73
Universal Scientific Ind. (Shanghai) (601231.SS)	O (11/05/2025)	Rmb39.45
Yangjie Technology (300373.SZ)	O (06/10/2022)	Rmb86.38
Daniel Yen, CFA		
AP Memory Technology Corp (6531.TW)	O (07/11/2025)	NT$963.00
ASMedia Technology Inc (5269.TW)	U (10/03/2025)	NT$1,480.00
Aspeed Technology (5274.TWO)	O (06/09/2025)	NT$17,780.00
Egis Technology Inc (6462.TWO)	E (01/28/2026)	NT$144.50
Espressif Systems (688018.SS)	O (05/15/2023)	Rmb183.00
GigaDevice Semiconductor Beijing Inc (603986.SS)	O (05/15/2025)	Rmb468.74
Macronix International Co Ltd (2337.TW)	O (09/18/2025)	NT$149.50
Montage Technology Co Ltd (6809.HK)	O (03/18/2026)	HK$446.20
Montage Technology Co Ltd (688008.SS)	O (03/18/2026)	Rmb271.83
Novatek (3034.TW)	U (02/04/2026)	NT$485.50
Nuvoton Technology Corporation (4919.TW)	U (11/10/2025)	NT$199.50
Parade Technologies Ltd (4966.TWO)	E (01/30/2026)	NT$795.00
Powerchip Semiconductor Manufacturing Co (6770.TW)	O (10/27/2025)	NT$63.80
Realtek Semiconductor (2379.TW)	E (01/30/2026)	NT$578.00
Shenzhen Goodix Technology Co Ltd (603160.SS)	U (07/14/2025)	Rmb64.60
Winbond Electronics Corp (2344.TW)	E (03/20/2026)	NT$125.00
WPG Holdings (3702.TW)	O (03/16/2026)	NT$118.00
WT Microelectronics Co. Ltd. (3036.TW)	O (01/27/2026)	NT$289.00
Duan Liu		
Dosilicon Co Ltd (688110.SS)	U (09/06/2024)	Rmb138.83
Shenzhen Longsys Electronics Co Ltd (301308.SZ)	E (02/25/2026)	Rmb549.50
Tiffany Yeh		
AllRing Tech Co. (6187.TWO)	O (09/23/2025)	NT$1,140.00
FOCI Fiber Optic Communications Inc (3363.TWO)	O (01/15/2025)	NT$852.00
Himax Technologies Inc (HIMX.O)	E (02/04/2026)	US$19.89
Hon Precision (7769.TW)	O (04/17/2026)	NT$7,730.00
MPI Corporation (6223.TWO)	O (04/17/2026)	NT$6,035.00

Silicon Motion (SIMO.O)	O (05/06/2024)	US$263.51
WinWay Technology Co Ltd (6515.TW)	O (04/17/2026)	NT$8,700.00

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