Semiconductor- 2025F outlook

Focus on area with most demand sustainability

Companies mentioned

Sector	Company	Ticker	Rating	TP
Foundry	TSMC	2330 TT	Buy	1440
IC design	Airoha	6526 TT	Buy	770
IC design	Mediatek	2454 TT	Buy	1500
IC design	Aspeed	5274 TT	Buy	5000
IC design	Realtek	2379 TT	Buy	580
Testing interface	Winway	6515 TT	Buy	1650
Testing equipment	Kinik	1560 TT	Buy	375
Semi equipment	Foxsemicon	3413 TT	Buy	380

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Our View

- **Broad-based demand recovery to drive 2025 semi industry growth of 14% YoY, with the year to see a back-end loaded trend.**
- **AI server remains the undoubted center of attention for 2025, and major beneficiaries are TSMC, ASPEED and WinWay.**
- **Networking applications will see a resurgence as enterprise demand bottoms. We believe Realtek and Airoha will be the main beneficiary.**

Broad-based demand recovery will drive 2025 semi industry growth of 14%

After a slow demand recovery in 2024, we believe that with an improving macro environment, broad-based demand will show a moderate recovery into 2025. We expect the semi industry will grow 14% in 2025F, with logic semi to outperform memory thanks to strong AI and HPC demand. Data processing will continue outgrowing the market and also benefit from continued robust AI demand and a sustained migration trend to more advanced nodes, like N3 for smartphone, PC and regular server.

For auto applications, given still lukewarm demand and inventory adjustments from customers, we believe inventory levels for auto semi will return to a healthy level into 1H25.

AI server remains the undoubted center of attention for 2025

We have witnessed significant AI server shipment growth in 2024. After GB200 ramp-up, we foresee NVIDIA's AI accelerator shipments growing further, by 62.8% YoY to 7mn vs. 4.3mn in 2024. Main growth drivers include 1) CSP's CY2025 capex to grow 21.8% YoY, mostly for AI infrastructure build-up; 2) as well as training use, inference use for enterprise and neocloud needs more computing capability to tune models; and 3) broader applications needing computility have sprung up, such as robotics etc. We expect leading players in the AI supply chain to continue benefitting most. We recommend **TSMC (foundry and advanced packaging), ASPEED (BMC) and WinWay (VPC and socket)**

Networking application resurgence amid bottoming enterprise demand

Networking applications have suffered from a muted demand recovery until 1H24. However, we have seen a demand trough in 3Q24, and global leading players like Intel also indicated 5G infrastructure demand is warming up. With a better macro environment and continued spec migration, we see not only volume but also ASP increases benefitting related names' 2025 business outlooks. We recommend **Realtek and Airoha** in networking.

Choose sectors with highest YoY sales growth momentum in 2025

Overall, we are still optimistic on the 2025 outlook, but suggest investors should be more selective given some sectors with high bases in 2024. We like AI and consumer networking most, two sectors that see strong YoY growth in 2025, and prefer leading names that can capture key trends best.

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Where are we now?

Inventory adjustment coming to an end with easing impact

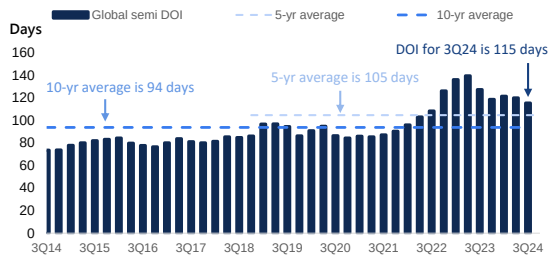
Following nearly two years of sector inventory correction, most subsectors are seeing DOI (days of inventory) gradually fall from the peak. However, the overall market is still recovering modestly with no notable recovery yet for end demand.

Breaking down DOI by application, smartphone semi inventory adjustment began in 2022, with more notable end demand recovery only from 2H23, thanks to new product launches by various brands and rush order demand from some companies. Inventory level thus began to fall from high levels, approaching the historical five-year average level currently, highlighting active downstream client inventory adjustment. Smartphone-related supply chains favor rush orders in recent years, in order to control inventory levels intensively. Looking forward, MediaTek and Qualcomm see a promising 2025F outlook for smartphone demand, and are positive on the development of flagship handset models. We expect relative weakness for the smartphone supply chain in the near-term, mainly given new model inventory preparation has peaked, with weak seasonality in 4Q24F. However, we also expect weakness to be partially offset by flagship model demand.

PC semi DOI has fallen to around its historical five-year average level currently, driven by 1) inventory burn accelerating with a narrowing gap between sell-in and sell-through; 2) increasing rush orders amid recovering PC demand; and 3) strong inventory build-up demand amid peak seasonality.

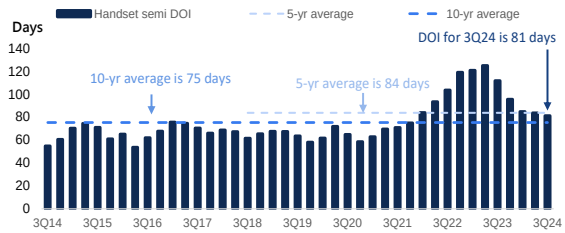
Datacenter semi DOI is falling gradually, mainly thanks to 1) AI demand growing rapidly, boosting AI accelerator shipment growth; and 2) easing of the crowding-out effect from AI server for regular server. Some component suppliers have seen regular server demand recover, with the strongest demand from China and some US CSPs. Sequential ramp-up of servers based on China players' self-developed chips is also driving mild growth in regular server orders. With an intact recovery trend for regular server and sustained growth strength for AI server, along with gradual new platform ramp-up, we expect the server sector to continue robust growth in 2025F.

Figure 1: Global semi DOI has stabilized in 3Q24



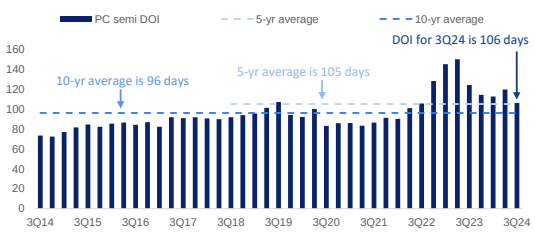
Source: TEJ, Bloomberg, Yuanta Investment Consulting

Figure 2: Handset semi inventory has declined in 3Q24



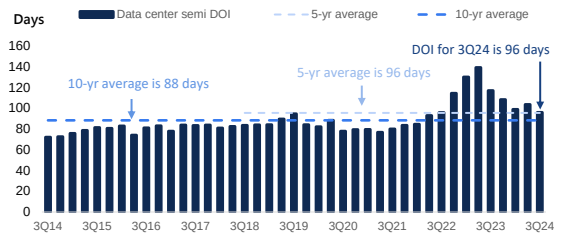
Source: TEJ, Bloomberg, Yuanta Investment Consulting

Figure 3: PC semi DOI has declined in 3Q24



Source: TEJ, Bloomberg, Yuanta Investment Consulting

Figure 4: Datacenter semi DOI has declined in 3Q24



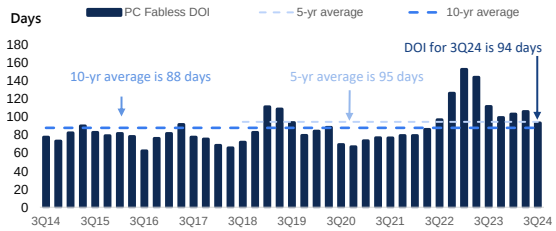
Source: TEJ, Bloomberg, Yuanta Investment Consulting

Largest decline in fabless DOI

IC design company, OSAT, and foundry DOIs have fallen significantly from the 1H23 peak, with fabless DOI seeing the largest decline, followed by OSAT DOI and then foundry DOI. IC design companies began inventory digestion the earliest, followed by OSAT names and lastly foundry. IDMs are still seeing relatively high inventory, with slower-than-expected inventory digestion amid still-unclear industrial and automotive demand visibility, despite mild recovery for consumer applications. Overall IDM inventory thus remains at high levels.

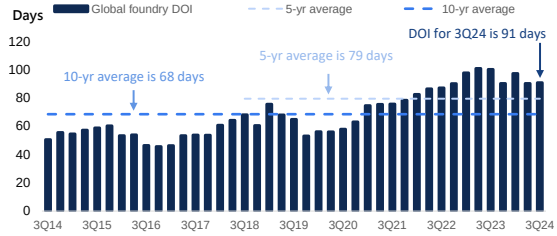
We have also seen divergence in guidance by sector, such as in foundry or OSAT, which we attribute to differing inventory levels. Amid weaker-than-expected consumer demand recovery, suppliers and distributors are unwilling to raise inventory to a higher or even normal level. We expect vendors will need to restock when demand really recovers. Inventory levels of high-ASP components is low, including CPU, GPU, ASIC, smartphone SoC, high-resolution CIS, and BMC. Driven also by the booming AI development, and new models forcing smartphone or PC OEMs to adopt new wafers to obtain advanced node components, TSMC's 4Q24 sales and GM guidance is thus significantly higher than consensus. On the other hand, suppliers of mature node products, such as PMIC, low-resolution CIS, MCU, and TDDI, have relatively higher inventory levels. Coupled with intensifying competition in both the mature node foundry and OSAT segments, leading to a slower-than-expected UTR recovery, mature-node wafer foundries UMC and Vanguard and OSAT name ASEH all guided for 4Q24F sales to be flat or fall QoQ, missing consensus expectation.

Figure 5: Fabless DOI has declined in in 3Q24



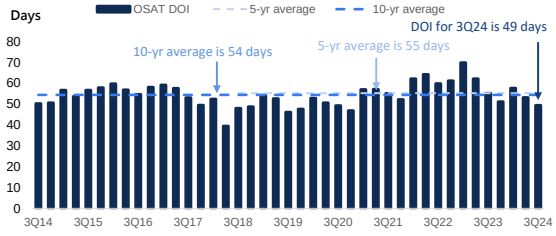
Source: TEJ, Bloomberg, Yuanta Investment Consulting

Figure 6: Foundry DOI remained stable in 3Q24



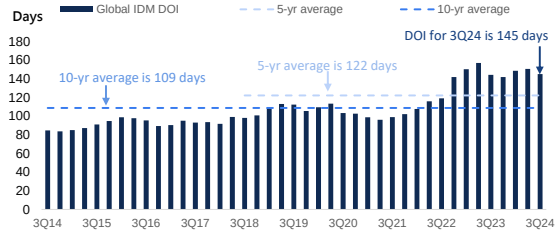
Source: TEJ, Bloomberg, Yuanta Investment Consulting

Figure 7: OSAT DOI stably optimized in 3Q24



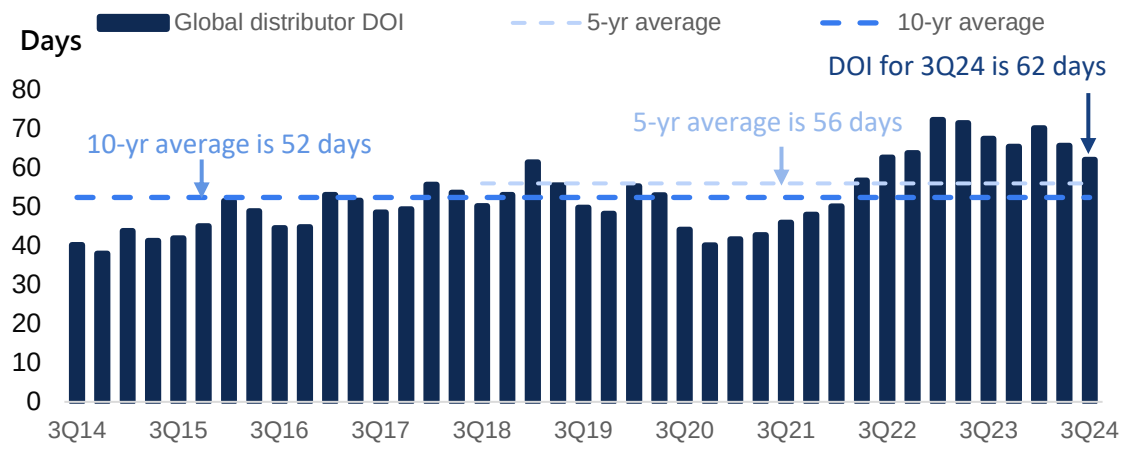
Source: TEJ, Bloomberg, Yuanta Investment Consulting

Figure 8: IDM DOI has improved in 3Q24



Source: TEJ, Bloomberg, Yuanta Investment Consulting

Figure 9: Distributor DOI has improved in 3Q24



Source: TEJ, Bloomberg, Yuanta Investment Consulting

Inventory no longer the sector focus in 2025F

In the current market, most subsectors have seen inventory issues ease gradually. Based on major IDMs' analyst meetings, only auto and industrial applications are seeing slower-than-expected inventory adjustment currently, with end demand remaining weak and yet to recover. After two years of inventory adjustment, we believe all industries will be more cautious with inventory management going forward. We expect semi inventory impact to gradually ease. We also expect AI to continue to drive growth for major subsectors in 2025F, with server sector to see robust growth. Coupled with AI handset and AI PC spec upgrades, the overall semi industry should see relatively significant growth amid the AI megatrend.

What can we expect in 2025?

Semi industry growth of 14% YoY in 2025F thanks to consumer recovery

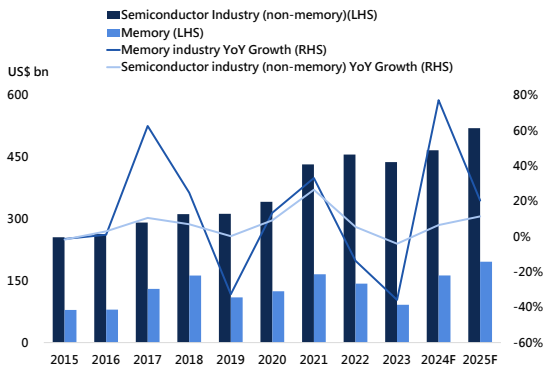
Based on IDC and our forecasts, the semiconductor industry will grow 14% YoY in 2025F vs. 18.8% YoY growth in 2024, mainly supported by logic semi. If we divide the sector into logic semi and memory, we expect logic semi to grow 11.5% YoY in 2025, thanks to a consumer demand recovery and rising AI demand to bolster not only mature but also advanced node demand. On the other hand, memory will only see 20.5% YoY growth in 2025, dragged by 1) weakening NAND Flash supply-demand dynamics, leading to pricing declines for NAND Flash; 2) lower than expected consumer demand resulting in less legacy DRAM demand, offsetting DRAM growth from skyrocketing HBM demand. Therefore, we prefer logic semi over memory for 2025, believing it will benefit more from rising AI demand.

Within logic semi, data processing applications will continue to see the fastest growth, up 22.7% YoY, thanks to 1) sustained growth in AI demand for training and inference use; 2) a gradual economic recovery leading to regular server shipment growth of 10.6%, returning to a normal pattern; 3) a warming macro economy helping drive a PC and smartphone demand recovery; 4) new technology proliferation, such as Wi-Fi 7 and 800G/1.6T optical spec to drive spec upgrades; and 5) higher performance and transmission speed further increasing demand for more advanced node and advanced packaging technologies. We still hold an optimistic view on the long-term outlook for data processing when deployment of AI models into end device becomes more comprehensive, but the actual impact still depends on the developments for edge AI, such as for smartphone or PC. We expect this to be the next growth engine for the data processing sector in the long run.

Investors will be curious when the auto semi sector will complete inventory digestion. Answer seems divergent among vendors. Until now, UMC and Vanguard have had the most bearish view, believing auto clients' inventory levels will return to normal levels in 2Q25. For IDMs TI and STMicro, both are seeing auto demand deteriorating, but TI believes we should be near a bottom for auto demand. In contrast, STMicro believes auto business will continue declining into 4Q24, and foresees sell-through weakness persisting into 1H25. Renesas also expects its auto business to slow down in 4Q24-1Q25. Therefore, we are relatively conservative about the speed of inventory depletion, and expect the correction to be completed in 1H25.

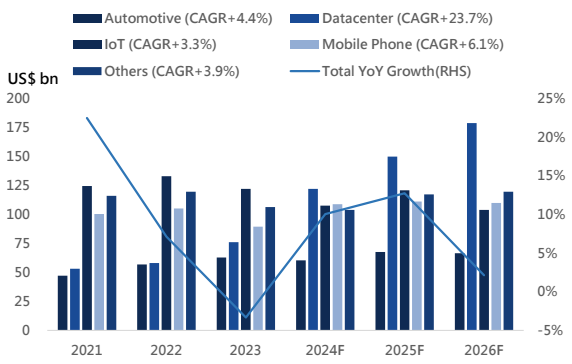
Overall, we are optimistic about a 2025 semi industry rebound, and expect it to be backend loaded, as per the historical pattern. Among sectors, we prefer data processing applications most thanks to AI and HPC having the largest growing potential, and recommend investors revisit the auto semi sector in end-2024 to 1Q25 when inventory correction has been already priced in.

Figure 10: Logic semi will grow 13.8% YoY



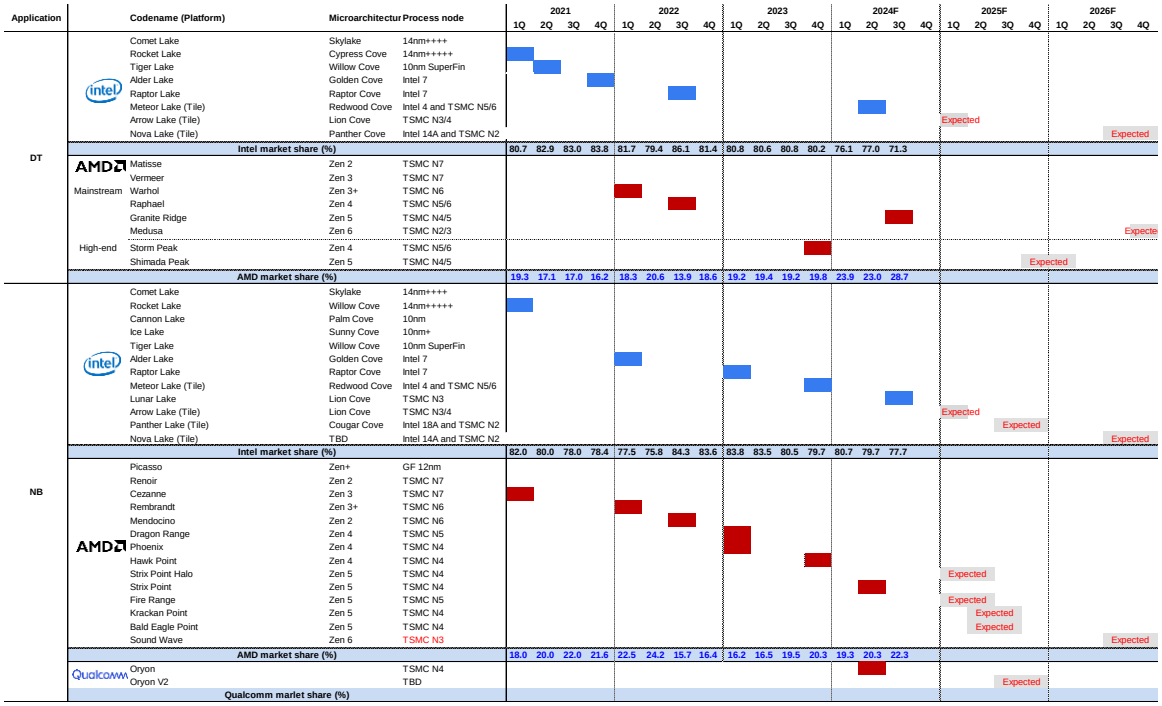
Source: IDC, Yuanta Investment Consulting estimates

Figure 11: Data processing will outgrow other applications in 2025 thanks to remaining strong AI demand



*Source: IDC, Yuanta Investment Consulting estimates; *IMA includes Industrial and Military/Civil Aerospace Electronics.*

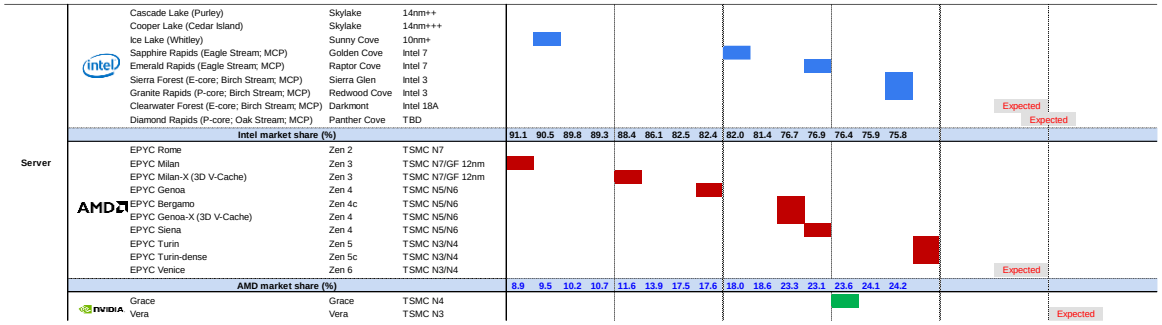
Figure 12: Roadmap for PC CPU



Application		Codename (Platform)	Microarchitecture	Process node	2021 1Q	2Q	3Q	4Q	2022 1Q	2Q	3Q	4Q	2023 1Q	2Q	3Q	4Q	2024F 1Q	2Q	3Q	4Q	2025F 1Q	2Q	3Q	4Q	2026F 1Q	2Q	3Q	4Q
DT	intel	Comet Lake	Skylake	14nm++++																								
		Rocket Lake	Cypress Cove	14nm+++++																								
		Tiger Lake	Willow Cove	10nm SuperFin																								
		Alder Lake	Golden Cove	Intel 7																								
		Raptor Lake	Raptor Cove	Intel 7																								
		Meteor Lake (Tile)	Redwood Cove	Intel 4 and TSMC N5/6																								
		Arrow Lake (Tile)	Lion Cove	TSMC N3/4																	Expected							
		Nova Lake (Tile)	Panther Cove	Intel 14A and TSMC N2																								Expected
		Intel market share (%)			80.7	82.9	83.0	83.8	81.7	79.4	86.1	81.4	80.8	80.6	80.8	80.2	76.1	77.0	71.3									
	AMD	Matisse	Zen 2	TSMC N7																								
		Vermeer	Zen 3	TSMC N7																								
	Mainstream	Warhol	Zen 3+	TSMC N6																								
		Raphael	Zen 4	TSMC N5/6																								
		Granite Ridge	Zen 5	TSMC N4/5																								
		Medusa	Zen 6	TSMC N2/3																								Expecte
	High-end	Storm Peak	Zen 4	TSMC N5/6																								
		Shimada Peak	Zen 5	TSMC N4/5																				Expected				
		AMD market share (%)			19.3	17.1	17.0	16.2	18.3	20.6	13.9	18.6	19.2	19.4	19.2	19.8	23.9	23.0	28.7									
NB	intel	Comet Lake	Skylake	14nm++++																								
		Rocket Lake	Willow Cove	14nm+++++																								
		Cannon Lake	Palm Cove	10nm																								
		Ice Lake	Sunny Cove	10nm+																								
		Tiger Lake	Willow Cove	10nm SuperFin																								
		Alder Lake	Golden Cove	Intel 7																								
		Raptor Lake	Raptor Cove	Intel 7																								
		Meteor Lake (Tile)	Redwood Cove	Intel 4 and TSMC N5/6																								
		Lunar Lake	Lion Cove	TSMC N3																								
		Arrow Lake (Tile)	Lion Cove	TSMC N3/4																	Expected							
		Panther Lake (Tile)	Cougar Cove	Intel 18A and TSMC N2																			Expected					
		Nova Lake (Tile)	TBD	Intel 14A and TSMC N2																								Expected
		Intel market share (%)			82.0	80.0	78.0	78.4	77.5	75.8	84.3	83.6	83.8	83.5	80.5	79.7	80.7	79.7	77.7									
	AMD	Picasso	Zen+	GF 12nm																								
		Renoir	Zen 2	TSMC N7																								
		Cezanne	Zen 3	TSMC N7																								
		Rembrandt	Zen 3+	TSMC N6																								
		Mendocino	Zen 2	TSMC N6																								
		Dragon Range	Zen 4	TSMC N5																								
		Phoenix	Zen 4	TSMC N4																								
		Hawk Point	Zen 4	TSMC N4																								
		Strix Point Halo	Zen 5	TSMC N4																	Expected							
		Strix Point	Zen 5	TSMC N4																								
		Fire Range	Zen 5	TSMC N5																	Expected							
		Krackan Point	Zen 5	TSMC N4																								
		Bald Eagle Point	Zen 5	TSMC N4																	Expected							
		Sound Wave	Zen 6	TSMC N3																	Expected							
		AMD market share (%)			18.0	20.0	22.0	21.6	22.5	24.2	15.7	16.4	16.2	16.5	19.5	20.3	19.3	20.3	22.3									
	Qualcomm	Oryon		TSMC N4																								
		Oryon V2		TBD																				Expected				
		Qualcomm market share (%)																										

Source: Company data, Yuanta Investment Consulting estimates

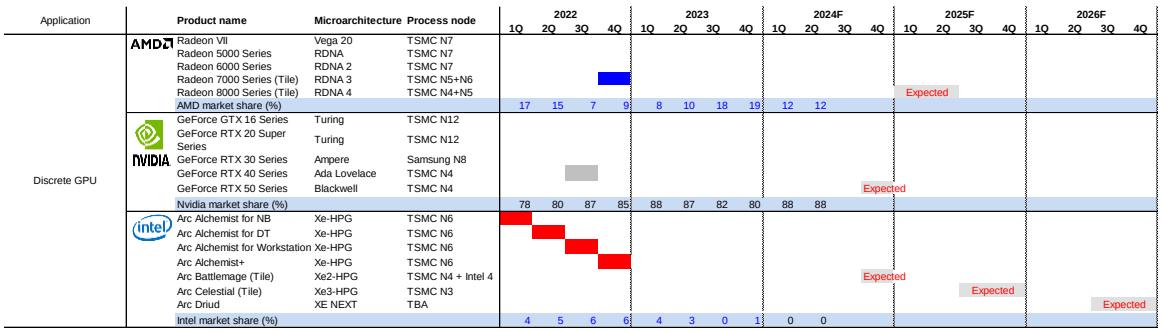
Figure 13: Roadmap for server CPU



Application		Codename (Platform)	Microarchitecture	Process node	2021 1Q	2Q	3Q	4Q	2022 1Q	2Q	3Q	4Q	2023 1Q	2Q	3Q	4Q	2024F 1Q	2Q	3Q	4Q	2025F 1Q	2Q	3Q	4Q	2026F 1Q	2Q	3Q	4Q
Server	intel	Cascade Lake (Purley)	Skylake	14nm++																								
		Cooper Lake (Cedar Island)	Skylake	14nm+++																								
		Ice Lake (Whitley)	Sunny Cove	10nm+																								
		Sapphire Rapids (Eagle Stream; MCP)	Golden Cove	Intel 7																								
		Emerald Rapids (Eagle Stream; MCP)	Raptor Cove	Intel 7																								
		Sierra Forest (E-core; Birch Stream; MCP)	Sierra Glen	Intel 3																								
		Granite Rapids (P-core; Birch Stream; MCP)	Redwood Cove	Intel 3																								
		Clearwater Forest (E-core; Birch Stream; MCP)	Darkmont	Intel 18A																								
		Diamond Rapids (P-core; Oak Stream; MCP)	Panther Cove	TBD																								
		Intel market share (%)			91.1	90.5	89.8	89.3	88.4	86.1	82.5	82.4	82.0	81.4	76.7	76.9	76.4	75.9	75.8									
	AMD	EPYC Rome	Zen 2	TSMC N7																								
		EPYC Milan	Zen 3	TSMC N7/GF 12nm																								
		EPYC Milan-X (3D V-Cache)	Zen 3	TSMC N7/GF 12nm																								
		EPYC Genoa	Zen 4	TSMC N5/N6																								
		EPYC Bergamo	Zen 4c	TSMC N5/N6																								
		EPYC Genoa-X (3D V-Cache)	Zen 4	TSMC N5/N6																								
		EPYC Siena	Zen 4	TSMC N5/N6																								
		EPYC Turin	Zen 5	TSMC N3/N4																								
		EPYC Turin-dense	Zen 5c	TSMC N3/N4																								
		EPYC Venice	Zen 6	TSMC N3/N4																				Expected				
		AMD market share (%)			8.9	9.5	10.2	10.7	11.6	13.9	17.5	17.6	18.0	18.6	23.3	23.1	23.6	24.1	24.2									
	NVIDIA	Grace	Grace	TSMC N4																								
		Vera	Vera	TSMC N3																								Expected

Source: Company data, Yuanta Investment Consulting estimates

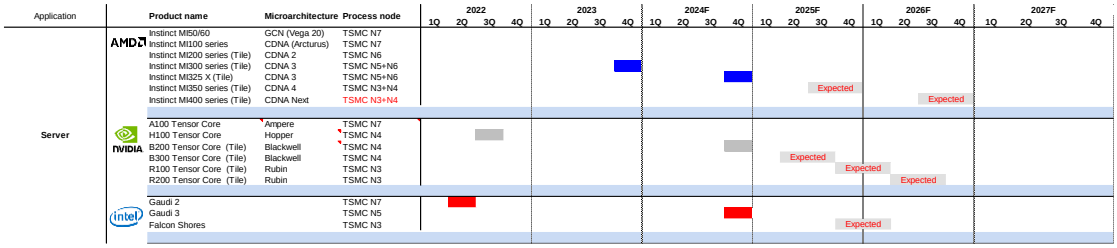
Figure 14: Roadmap for PC GPU



Application		Product name	Microarchitecture	Process node	2022 1Q	2Q	3Q	4Q	2023 1Q	2Q	3Q	4Q	2024F 1Q	2Q	3Q	4Q	2025F 1Q	2Q	3Q	4Q	2026F 1Q	2Q	3Q	4Q
Discrete GPU	AMD	Radeon VII	Vega 20	TSMC N7																				
		Radeon 5000 Series	RDNA	TSMC N7																				
		Radeon 6000 Series	RDNA 2	TSMC N7																				
		Radeon 7000 Series (Tile)	RDNA 3	TSMC N5+N6																				
		Radeon 8000 Series (Tile)	RDNA 4	TSMC N4+N5														Expected						
		AMD market share (%)			17	15	7	9	8	10	18	19	12	12										
	NVIDIA	GeForce GTX 16 Series	Turing	TSMC N12																				
		GeForce RTX 20 Super Series	Turing	TSMC N12																				
		GeForce RTX 30 Series	Ampere	Samsung N8																				
		GeForce RTX 40 Series	Ada Lovelace	TSMC N4																				
		GeForce RTX 50 Series	Blackwell	TSMC N4																				
		Nvidia market share (%)			78	80	87	85	88	87	82	80	88	88										
	intel	Arc Alchemist for NB	Xe-HPG	TSMC N6																				
		Arc Alchemist for DT	Xe-HPG	TSMC N6																				
		Arc Alchemist for Workstation	Xe-HPG	TSMC N6																				
		Arc Alchemist+	Xe-HPG	TSMC N6																				
		Arc Battlemage (Tile)	Xe2-HPG	TSMC N4 + Intel 4														Expected						
		Arc Celestial (Tile)	Xe3-HPG	TSMC N3																		Expected		
		Arc Driud	XE NEXT	TBA																				Expected
		Intel market share (%)			4	5	6	6	4	3	0	1	0	0										

Source: Company data, Yuanta Investment Consulting estimates

Figure 15: Roadmap for server GPU



Source: Company data, Yuanta Investment Consulting estimates

Figure 16: Leading vendors comments on auto business outlook

Company	Comment
UMC	● Auto market was expected to undergo a inventory digest till 2Q25.
VIS	● Auto customers still holding high inventory in hand. Management expected the inventory adjustment will last till 2Q25.
ON Semi	● 1H25 the market will still face a inventory adjustments, yet when entering in 2H25, company expects to see a recovery from SiC application in high voltage EV platform. ● Company forecasts EV penetration will increase to 18-20% in 2025.
Infineon	● Some products like MCUs and high voltage semi are still seeing tight supply, but traditional auto businesses ex China are facing inventory adjustments that will remain till 2H25.
TI	● TI foresee a strong growth in China car market, contrary to the other car markets around the world.
NXP	● Auto market will return to normal seasonality after 3Q24. ● Supply-demand situation for China auto market is better than Europe and USA. ● Expects car market will realize a 4-6% YoY growth in 2025, thanks to the acceleration in auto electrification.

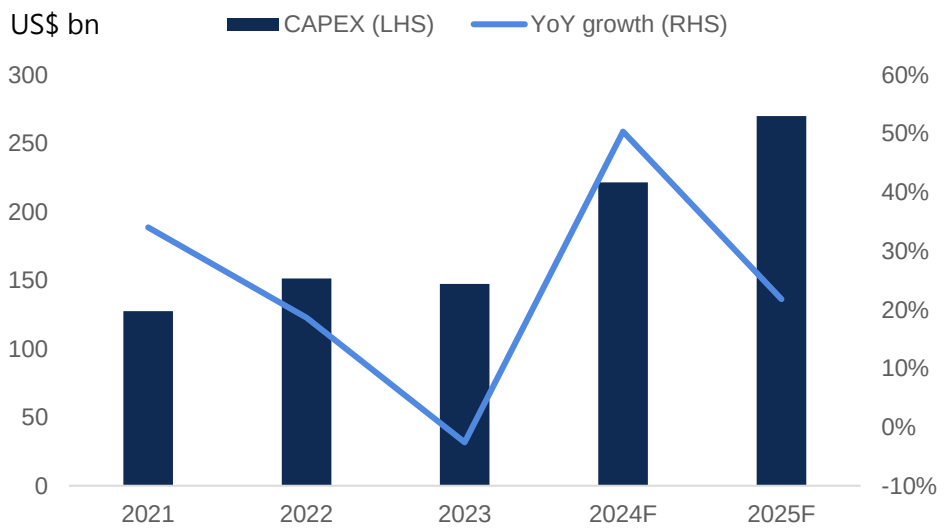
Source: Company data, Yuanta Investment Consulting

What will take the spotlight into 2025?

AI server still the remaining undoubted center of attention for 2025

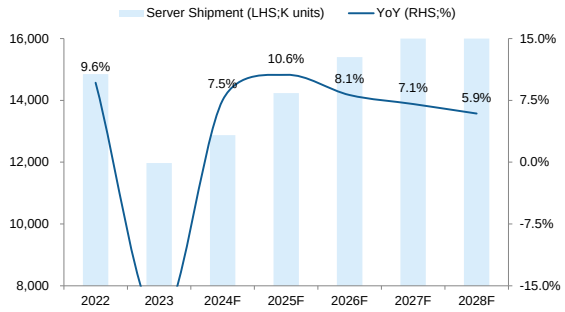
After large-scale shipment expansion in 2024, thanks to GB200 ramp-up, we expect AI accelerator shipment will further grow 62.8% YoY to 7mn vs 148.6% YoY growth in 2024. Why do we still hold a very optimistic view on AI server demand? Our positive view is owing to 1) we expect CSP's CY2025 capex will grow 21.8% YoY, and most of it is for AI infrastructure build-up; 2) demand not only for training use, but also as inference for enterprises and neocloud needs more computing capability to tune the model. In addition, fine tuning has higher requirements for computility, and 3) broader applications needing computility have sprung up, such as robotics etc.

Figure 17: Hyperscalers' capex to return to 21.8% YoY increase in 2025



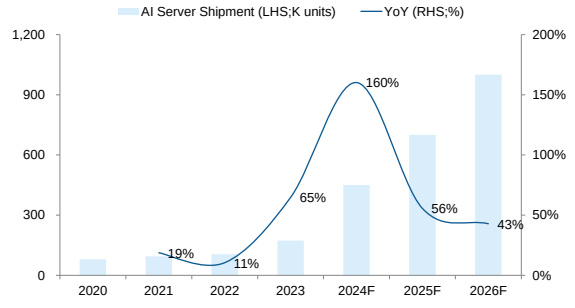
Source: Company data, Yuanta Investment Consulting estimates

Figure 18: 2025 server shipment to grow 11% YoY



Source: IDC, Yuanta Investment Consulting estimates

Figure 19: 2025 AI server shipment to grow 56% YoY



Source: IDC, Yuanta Investment Consulting estimates

NVIDIA still leads the AI era into 2025

Looking into 2025, NVIDIA's Blackwell's performance maintains its leading position vs. AMD's MI325X and Intel's Gaudi. If we compare with next generation product, NVIDIA's roadmap and visibility is well ahead of the other two, and we expect Rubin to launch in early-2026. In addition to hardware, NVIDIA's software and ecosystem, such as NVLink, still leads the market. We now have not seen similar solutions from peers. Therefore, we believe NVIDIA will continue to hold the lion's shares of the AI market in 2025, and we are constructively positive on its related Taiwan supply chain for the long term.

Figure 20: NVIDIA's latest GPU product performance is still undefeatable vs. peers

GPU	AMD MI 325X	Nvidia B200	Intel Guadi 3
Release Date	4Q24	4Q24	4Q24
Process	TSMC N5+N6	TSMC 4nm	TSMC 4nm
Architecture	CDNA 3	Blackwell	-
Transistor	153bn	208 bn	TBA
Performace (TF 32)	653.7 TFLOPS	1100 TFLOPS	459 TFLOPS
Memory	256 GB HBM3e	192 GB HBM3e	128 GB HBM2e
TDP	750W	1000W	600W
Die size	1017 mm²	1465 mm²	TBA
Interconnectivity	Infinity Fabric Link: 896GB/s PCIe Gen5: 128GB/s	Nvlink: 1800GB/s PCIe Gen5: 128GB/s	200Gb Ethernet: 1200GB/s PCIe Gen5: 128GB/s

Source: Company data, Yuanta Investment Consulting

Major AI beneficiaries to be advanced node related plays

For every AI accelerator product, all processes are based on advanced node. The current mainstream is the N5 family, with migration to N3 after 2H25-2026. Globally, we expect TSMC's global AI market share to reach around 100%, rising semi content and increasing sales contribution from AI applications will also boost TSMC's GM. Besides front-end technology, TSMC also provides advanced packaging technology for AI and HPC applications, and we also expect its share here to be above 90%. Therefore, we see TSMC as the purest play in the AI market, not only for manufacturing but also for packaging.

For testing, KYEC will still remain the largest supplier for NVIDIA's AI accelerator. Although the market still has concerns about share loss to ASEH, we expect KYEC to maintain almost the entire share of Blackwell series orders. Even if ASEH has penetrated this supply chain, it should only start testing business from Hopper and GB300A (B210) from 2H25 at the earliest, not only for mainstream Blackwell products. Therefore, we maintain our view that KYEC will be the large beneficiary of the secular AI testing growth trend.

Advanced packaging becomes more crucial amid the AI trend

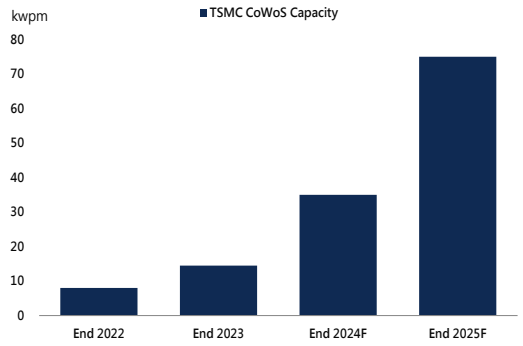
To meet explosive AI demand, we expect CoWoS capacity to continue expanding toward at least 2026. We now forecast TSMC's CoW capacity to reach 35/75/95kwpm at end-24/25/26, and NVIDIA will acquire around 60% of its CoW capacity. ASEH will also receive more oS outsourcing orders from TSMC as a strategic partner. Equipment vendors will also benefit from this trend.

As for SoIC, we mentioned in our previous note, we believe it will be the next growth pillar for advanced packaging business. Currently, only AMD adopts SoIC solution for DT CPU, server CPU and GPU. We foresee Apple being the second adopter. Apple will adopt SoIC technology for its N3P-based M5 chip for PC application in 2H25. After Apple's introduction, we expect more and more HPC vendors will adopt SoIC technology for more powerful product and easier design solutions. With Apple's introduction and persistent product migration from AMD, we expect SoIC capacity to reach 5kwpm/~10kwpm at end-24/25.

Equipment vendor also benefitting from capacity expansion

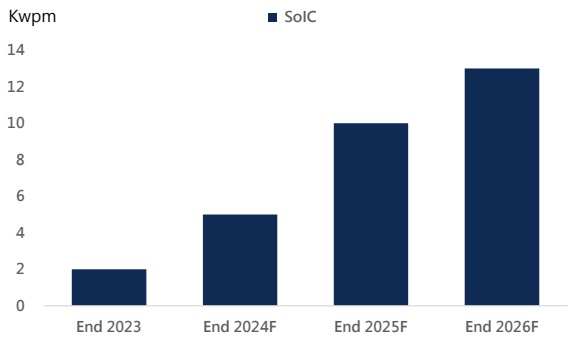
To support strong testing demand, NVIDIA generally consigns equipment to OSAT partners to ensure supply chain security and cost structures. Therefore, sole SLT equipment supplier Chroma will be the largest beneficiary considering 1) longer testing times for Blackwell will drive more testing demand; 2) NVIDIA's leading position in AI server to ensure Chroma's future growth; 3) higher AI demand & faster CoWoS capacity expansion will stimulate greater tester needs; and 4) penetration at AMD and other AI names can broaden its TAM.

Figure 21: TSMC will expand CoWoS capacity to 75kwpm at end-25



Source: Company data, Yuanta Investment Consulting estimates

Figure 22: TSMC's SoIC capacity will reach 10kwpm at end-25



Source: Company data, Yuanta Investment Consulting estimates

Figure 23: Apple will adopt SoIC solution in 2H25F

	AMD				
Application	Server CPU	Server CPU	Server CPU	Server GPU	Server GPU
Chip name	Genoa	Bergamo-X	Siena	MI300	MI400
Process node	N5+N6	N5+N6	N5+N6	N5+N4	N5+N4

	AMD			Apple
Application	PC GPU	DT CPU	DT CPU	PC CPU
Chip name	Navi 31	Raphael	Granite Ridge	M5
Process node	N5+N6	N5+N6	N4+N5	N3

Source: Company data, Yuanta Investment Consulting estimates

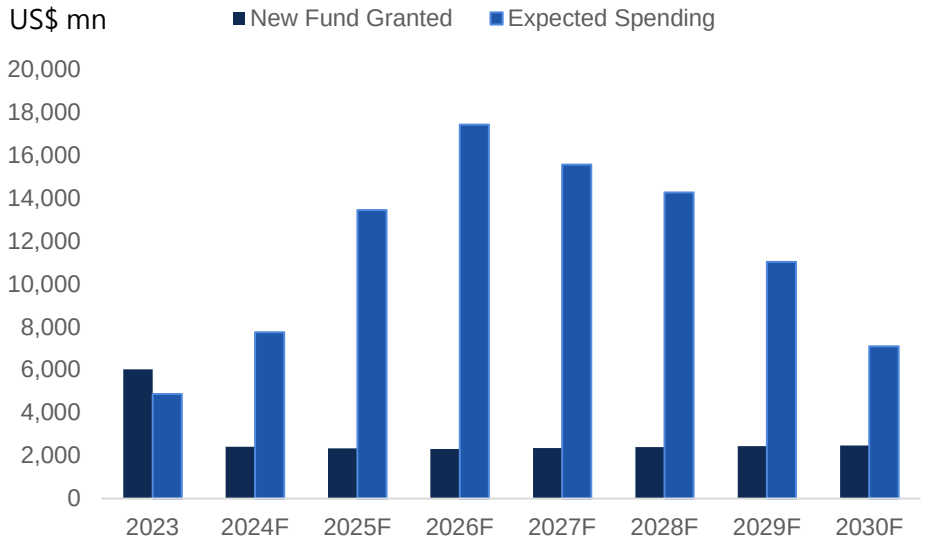
Networking recovery across the board in 2025

It is a cliché that optical telecom will benefit from the AI server boom, with more datacenter construction and higher transmission speed requirements to drive spec upgrades. Enterprise and bidding demand remained relatively muted in 1H24. However, we have witnessed demand start to recover driven by US infrastructure and warmer 5G demand. After the US presidential election, we expect uncertainties to fade out. On top of that, a better macro economy should boost enterprise demand in 2025, after its 2024 trough. As such, we see opportunities for networking IC vendors like leading plays Broadcom and Marvell, but also for Taiwan suppliers like Realtek and Airoha.

Bidding market demand to grow significantly in 2025

After the US election, US infrastructure construction should again accelerate. Looking into 2025, we forecast the US bidding market will grow73.5% YoY vs. 59% in 2024, thanks to unwinding political uncertainties and an improving economic environment. For the Taiwan supply chain, we have seen the trend of Taiwan networking ODM gradually increasing MediaTek IC adoption rate for the US bidding market. This has thus helped MediaTek to gain market share in the US, and also helped Airoha to penetrate the US market. The US bidding market should see a recovery from 4Q24, and we believe Airoha will be the major beneficiary of the trend.

Figure 24: US bidding market will grow 73.5% YoY in 2025



Source: CBO, Yuanta Investment Consulting estimates

Enterprise demand rebound the next area of focus

Enterprise demand has suffered from rising interest rates, with higher interest expenses and a muted demand recovery trend. Enterprises thus had to cut capex. However, we have witnessed the trend reverse in 2H24, based on leading vendors such as Intel and Marvell. Enterprise demand appears to have bottomed out in 3Q24, and amid an interest cut cycle, we are positive we will see an enterprise demand recovery into 2025. In addition, potential tax reductions will spur enterprises' willingness to invest more on infrastructure or equipment upgrades. This should further bring the upside to demand growth. We believe Realtek will be the one of the beneficiaries in the Taiwan supply chain to benefit from an enterprise demand revival.

Figure 25: Leading vendors comments on networking business outlook

Company	Comment
Realtek	● Benefited from global bidding market, expects networking business to grow in 2025. ● Management foresees sales growth in switch, Wi-Fi, and Ethernet sector, thanks to spec upgrade. ● Expects PON market to grow 73% YoY to US$ 260mn in 2025, in which China accounts for 60% of PON demand.
MediaTek	● Has acquired several design-wins in Wi-Fi 7 and 10G PON projects, and expects networking business to growth in 4Q24.
Intel	● Networking business was coming to its bottom, yet still expected a flat quarter in 4Q24.
Marvell	● After several quarters of inventory digestion, company saw signs of recovery and expected sequential growth in 2H24.

Source: Company data, Yuanta Investment Consulting

Foundry – advanced nodes the only shining star

Gradual broad-based demand recovery in 2025F

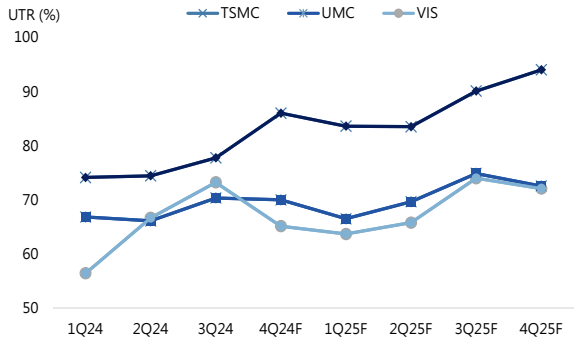
After lackluster demand in 2024 dragged by the macro economy and conservative pull-in from customers, we expect the semi industry will return to normal in 2025 with healthy inventory levels. Based on IDC, we forecast the semi industry will grow 13.8% YoY in 2025, and the foundry sector will outgrow the whole semi sector, to reach 17.2% YoY growth. With normal seasonality, we foresee growth being back-end loaded.

Advanced node demand far stronger than mature node

We believe advanced nodes (below N7) will see stronger growth than mature nodes, given 1) the largest demand driver is AI, with most chips produced using advanced nodes; 2) more new products for smartphone, PC and server will migrate its SoC to more advanced nodes **such as N3;** 3) novel applications like high-level autonomous driving, robotics and CPO also require advanced nodes. Therefore, we expect advanced nodes will grow 28.6% YoY in 2025 vs. 8.1% YoY growth for mature nodes.

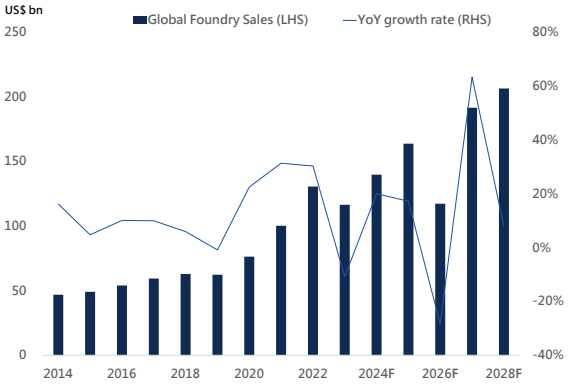
In contrast, mature nodes are still being capped by 1) China foundries' still aggressive capacity expansion, especially for 40nm to 28nm. Therefore, 40nm UTRs are also a threat for Taiwan foundries, like UMC; 2) China foundry pricing is still below Taiwan's by at least 10-15%, thus Taiwan fabless companies are gradually transferring wafer placement from Taiwan to China; SMIC and Hua Hong's high UTR in 3Q24 is evidence of this phenomenon, which will likely continue limiting Taiwan mature node foundries' UTRs; and 3) a moderate demand recovery outlook to slowly help UTR increase.

Figure 26: TSMC will first show UTR rebound



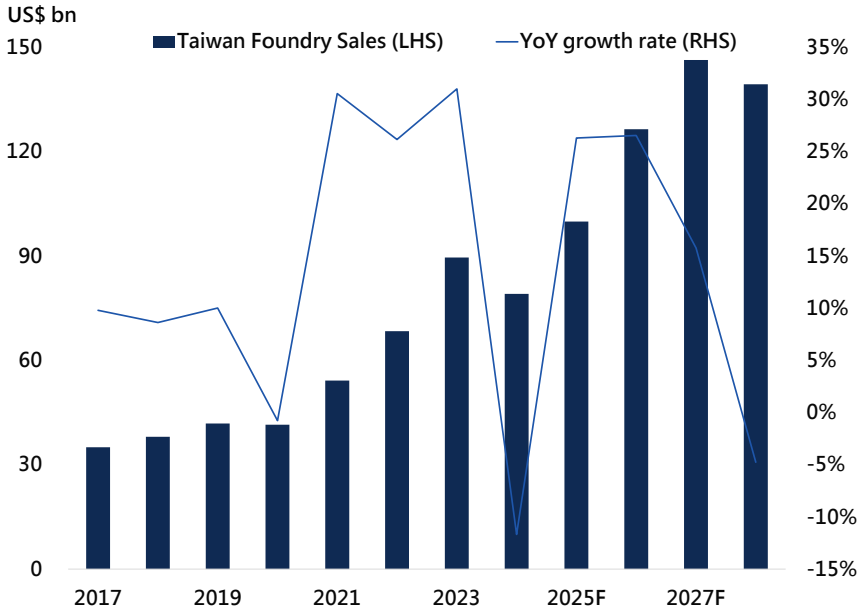
Source: Company data, Yuanta Investment Consulting estimates

Figure 27: Global foundry sales to grow 17% YoY in 2025



Source: Company data, Yuanta Investment Consulting estimates

Figure 28: Taiwan foundry sales will grow 27% YoY in 2025



Source: Company data, Yuanta Investment Consulting estimates

TSMC's impenetrable position firmly intact; oversupply risk lingers for mature nodes

For leading foundries, only TSMC's capacity expansion progress is as was planned one year ago. Peers such as Intel and Samsung have suffered from a milder demand recovery and business development obstacles, which have slowed their overseas capacity expansion in the US and Europe. We now believe that given its capacity base and technology nodes, TSMC is undoubtedly the leading player globally, and there is still no peer able to compete with it. Therefore, we are not concerned about oversupply risks for TSMC, and foresees advanced nodes, especially for N5/N3, will maintain high UTR going forward.

For mature node capacity expansion, the situation differs from advanced nodes. Due to relatively lower entry barriers for technology and easier to acquire related equipment, China remains aggressive in terms of expanding capacity, especially for 28/40nm. This rubs salt in the wounds of the pricing and supply environments. As for IDMs, excluding existing capacity expansion plans, we believe they will speed down the pace of expansion to ensure UTRs remain high. Therefore, we are more conservative on the mature node pricing and UTR outlook, and expect slow recovery momentum into 2025.

Figure 29: Capacity expansion plan for foundry

Company	Location(s)	Technology node	Applications	Announced plans for fab capacity build/addition
TSMC	Hsinchu/Taichung/Tainan/Kaohsiung, Taiwan	2/3/5nm	HPC/AP	1) Kaohsiung and Hsinchu (Baoshan) fab will focus on 2nm. 2) Taina fab will focus on 3nm. 3) The Taichung fab is still under evaluated, and the progress is in lin with expactation, mainly for 2nm or below nodes. 4) Some 7nm capacity expansion has been pushed off given weak demand situation.
	Arizona, US	2/3/5nm	HPC	1) TSMC will invest over US$ 65bn to build three fabs in Phoenix, Arizona, and total and total capacity will be over 50k wpm. 2) The first fab will invest US$12bn in the Arizona fab to ramp up 20k wpm in 1H25 with its 4nm technology. 3) The second fab will focus on 2nm and start production in 2028 with an additional US$25+bn investments. 4) The third fab will focus on 2nm or more advanced node and start production by the end of the decade. 5) TSMC estimates that end-product value will be more than US$40bn per year when all the
	Nanjing, China	28nm	Embedded memory/Auto-related chip	The board has approved capital budget of US$2.9bn for 28nm process capacity expansion, will start production in 2H22 and target 40k wpm by mid-2023.
	Kumamoto, Japan	6/7/12/16/ 22/28/40nm	ISP/CIS/Auto-related chip	1) Expects to start Fab1 construction in 2022 and mass production in 4Q24. 2) Fab 2 with 6/7nm is scheduled to commence construction by the end-24 and begin operation by the end-27. 2) Announces to found the JV JASM with key clients like Sony and Denso. 3) Total investment amount is expected to reach US$20bn. TSMC/Sony/Denso/Toyota will hold 86.5%/6.0%/5.5%/2.0% shares in JASM, respectively. 4) Design capacity: 22/28nm of 45k wpm plus 6/7/12/16nm of 55k wpm
	Dresden, Germany	12/16/28/22nm	Auto/Industrial chip	1) TSMC has collaborated with Robert Bosch, Infineon, and NXP to found a joint venture called the European Semiconductor Manufacturing Company (ESMC). 2)Total investment in ESMC will reach over EUR10bn. ESMC will receive a government subsidy under the European Chips Act. 3) TSMC will own 70% of ESMC at below EUR3.5bn. Robert Bosch, Infineon, and NXP will each hold 10% stakes. 4) ESMC's planned capacity is 40kwpm for 28/22/16/12nm nodes.
UMC	Tainan, Taiwan	22/28nm	OLED DDIC/ ISP/TV SoC/IoT	1) UMC added 10k wpm capacity in P5 for 28nm in 2022. 2) UMC announced US$3bn to add 32.5k wpm in its Fab 12A P6 in Tainan, and entered mass production in mid-23. 3) For 32.5k wpm capacity,12k wpm came online at end-4Q23. 4) In Sep-24, P6 capacity will reach 31.5 kwpm. 5) UMC expects overall capacity to grow at 4.9% YoY in 2023, mainly for P6.
	Xiamen, China	22/28nm		Expects 5k wpm expansion in 12X P1 in 2022.
	Mie, Japan	90/65/40nm	IGBT	1) Will construct one IGBT production line with Denso, targeting to enter mass production in 1H23. 2) Planned capacity will be 10k wpm in 2025.
	Singapore	22/28nm	OLED DDIC/non-volatile embedded memory/RFSOI/mixed-signal	1) Total investment in Fab 12i P3 will be US$5bn. 2) Plans to add 30k wpm capacity in phase 1, and will commence in late-2024. 3) Will MP in Jan-26, and ramp up in 2H26.
	Crolles, France	18nm	FD-SOI Autotmotive/IoT/mobile	1) Targets annual capacity to reach 620k by 2026. 2) Total investment amount will be above EUR5.7bn. 3) The fab will be joint venture from GlobalFoundries and STMicro. GlobalFoundries will hold 58% shares, and STMicro will account for 42% shares.
	New York, US Singapore Dresden, Germany	12-90nm FD-SOI	RF SOI/BCD/FDX/NVM	1) Announced to invest US$4bn to build 37.5k wpm capacity in Singapore, focusing on auto, mobile and IoT applications. 2) Finished installation at new fab in Singapore in 2H22, and started mass production in 1H23. 3) The output in 2023 was triple compared to 2020 in New York, Germany and Singapore. 4) Annual capacity target of over 3mn in 2024 is still on track.
Company	**Location(s)**	**Technology node**	**Applications**	**Announced plans for fab capacity build/addition**
SMIC	China	12"	RF/MCU/ High voltage DDI/CIS	1) Expects 30kwpm in 4Q24. 2) Will add 50kwpm capacity every year.
	Shenzhen, China	28nm and above	DDI/CIS/PMIC	1) SMIC has entered into the Cooperation Framework Agreement with Shenzhen government to build a facility focusing on 28nm-and-above process with 40k wpm capacity by US$2.35bn. 2) Has entered MP. 3) Plans to add 20k wpm in 3Q24, reaching 40k wpm for overall capacity.
	Beijing, China	28nm and above	Not specific mention	1) Expects to build phase 1 for FAB3P1 in Beijing, and will complete construction in 2024 with 12" capacity of 100k wpm. 2) Has entered trail production in 4Q22. 3) Added 20k wpm in 2Q23, and will add another 40k wpm in 2Q24.
	Shanghai, China	28nm and above	Not specific mention	1) SMIC has entered into the Cooperation Framework Agreement with Lin-Gang FTZ Administration to build a facility focusing on 28nm-and-above process with 100k wpm capacity with investment amount at US$8.87bn. 2) Plans to add 40k wpm in 2Q24, and another 30k wpm in 4Q24.
	Tianjin, China	28-180nm	Communication, automotive, consumer and industrial applications	1) SMIC has entered into the Cooperation Framework Agreement with government of Tianjin's Xiqing district to build a facility by US$7.5bn. 2) Target capacity is 100k wpm. 3) JV's initial registered capital will be US$5bn. 4) Plans to add 20k wpm in 4Q24.
HHGrace	Wuxi, China	40/55/65nm	RF/NOR Flash/CIS/IGBT/Super-junction	1) Wuxi Fab 2 phase 1 capacity has reached 95k wpm by 1H24. 2) Wuxi Fab 2 capacity will reach 25kwpm at end-25. 2) Wuxi Fab 9 will start production in 2H24 for 40/55nm nodes. 4) Capacity for Wuxi Fab 9 at phase 1 will be 60-70k wpm, and maximum capacity will be 83k wpm. 5) For Fab 9, 20 kwpm for power discrete, and others for specialty process Flash and PMIC.
PSMC	Miaoli, Taiwan	40/55nm	PMIC/MCU/RF IC	1) PSMC has begun the construction of a 12" fab in Miaoli (total outlay is around NT$287bn, or US$10.3bn). 2) Targets 35k wpm capacity at phase 1, Total capacity is planned to be 50kwpm. 3) Entered risk production for 40/55nm in 3Q23. 4) Will start production in 4Q24. 5) Capacity will reach 8.5kwpm in 4Q24. 6) P5 will reach breakeven capacity at 20Kpm, and attain same GM level as Zhunan fab at 30kwpm.
	Zhunan, Taiwan	0.11/0.18um	MOSFET/IGBT	Expanded 10k wpm capacity in 2022, and ramped up in 2H22.
Tower	Agrate, Italy	65/90/130nm	Analog Mixed Signal/RF	1) Tower installed equipment in Agrate R3 fab, which is shared by STMicro. 2) Designed capacity for Agrate R3 fab is 60k wpm, and Tower acquired 20k wpm. 3) Finished equipment installation in end-21, and started production in 2H22. 4) Targets automotive, industrial and consumer electronics applications.
	Migdal Haemek, Israel	0.13/0.18/0.35/1um	CMOS image sensor/embedded flash/ mixed-signal technologies	1) acquired by the time Tower semiconductor was founded.
	California and Texas, USA	0.13/0.18um	CMOS, CIS, RF Analog, MEMS, and Power	1) specialized foundry services focused on the Aerospace and Defense industry.
	Uozu, Japan	45/65nm	Analog, CMOS, CIS, RFCMOS/ SOI	1) TPSCo was established in 2014. The company is 51% owned by Tower, and have been manufacturing large scale integrated circuits (ICs) for over 35 years.
	Tonami, Japan	0.15/0.35 um	Analog, Power Discrete, NVM, CCD	1) TPSCo was established in 2014. The company is 51% owned by Tower, and have been manufacturing large scale integrated circuits (ICs) for over 35 years.
	New Mexico, US	N.A.	Analog Mixed Signal	Signed an agreement with Intel that Intel will provide foundry services and 300mm wafer capacity, and Tower Semiconductor will invest US$ 300mn to own equipment and fixed assets in the facility.
Nexchip	Hefei, China	40/55/80/90nm	LCD/OLED DDI/CIS/MCU/PMIC	1) Nexchip's installed capacity reached 100k wpm by year end of 2021 for Fab N1. 2) Has filed IPO documents in May 11, and expects to fund by RMB9.5bn, down from previous RMB12bn for CIS, MCU, logic IC and OLED DDI 3) Current capacity: 120k wpm in June, 2024 4) Fab N2: new 12" fab with 45k wpm in 2024, which mainly produces PMIC/DDI/MCU/CIS at 40/55nm. 5) Fab N3: equipment move-in now.
DB HiTek	South Korea	12"	DDI/PMIC	1) DB HiTek targets to spend KRW4tn to expand its foundry business. 2) Will spend KRW2.5tn to secure 20k wpm capacity, and KRW1tn to seek potential M&A.
	Emseong, South Korea	8"	CIS, Mixed signal, BCDMOS, RF, MEMS, DDI and MCU	1) DB HiTek expects to increase monthly capacity from 140k wpm to 151k wpm in 2024. 2) With the expansion, Fab 1 capacity will reach 91k wpm, Fab 2 capacity will reach 60k wpm.
VIS	Hsinchu/Taoyuan, Taiwan	0.5/0.35/0.25/ 0.18 um	DDI/PMIC/GaN	1) At the end of 2024, VIS's capacity will be expanded to ~3,387k wpy, mainly contributed by the expansion of Fab 5. 2) Fab 5 capacity will reach 15k wpm in Aug-24. 3) GaN on QST, targeting >650V high voltage niche market, Gen 1.0 has MP, Gen 2.0 will finished qualification in 3Q24 and expected to enter trial production in 4Q24. 4) GaN on silicon has entered final qualification stage, and will enter MP in 3Q24.
	Singapore	8"	DDI/PMIC/MEMS/Auto	1) Constantly benefited from the outsourcing of IDM.
		40-130nm	Mixed-signal, power management, and analog	1) Plant construction is scheduled to begin in 2H24F, with mass production from 2027F. 2) Equipment installation is scheduled to begin in 2026F at the earliest. 3) Capacity will reach 55kpwm in 2029. 4) Total investment amount will be US$7.8bn, and VIS/NXP will take 60/40%, respectively.
xfab	Sarawak, Malaysia	0.35/0.25/0.18/0.13 um	Logic/Mixed signal/Emedded Flah/CIS/CCD/High voltage/Flash	1) Total investment US$1bn from 2023-25 will be mainly invested in capacity expansion in Malaysia, and capacity conversion in French. 2) The total capacity excluding SiC will leap from 530wpm in 2022 to 1,700 wpm in end-26.
	Corbeil-Essonnes, French	0.18/0.13 um	Analog/Mixed signal	
	Erfurt, Dresden, Itzehoe Germany	1.0/0.8/0.6/0.35 um	Analog/Mixed signal/EEPROM/SOI /MEMS/RF	
	Texas, US	6" SiC	Not specific mention	1) Will spend US$ 200mn to expand capacity and produce 8" SiC wafer. 2) SiC Fab capacity will reach 12kwpm in end-24.
ZENSEMI	Guangzhou, China	12"	MEMS/ Mechanic, acoustics, Microfluidic Flow, and Bio Sensor IC/ ASIC	1) Expected to Initiate porduction in the end of 2024 2) Capacity expect to reach 20kpm in the end of 2025 3) Total investment for zsemi's project will be $RMB 37bn; zsemi already invested 7bn in first investment phase.

Source: Company data, Yuanta Investment Consulting estimates

Figure 30: Capacity expansion plan for IDMs

	Location(s)	Technology node	Applications	Announced plans for fab capacity build/addition
intel	Arizona, US	Intel 3/20A and below	HPC	Intel will invest in US$20bn to build two new fabs (Fab52/62) that are set to start production in 2H25.
	New Mexico, US	45/32/22nm	IoT/Ethernet controller /Connectivity/Analog	1)Intel announced a US$3.5bn upgrade to a fab in Rio Rancho, which is mainly for advanced packaging including a boost to its Foveros technology. 2) Signed an agreement with Tower Semiconductor that Intel will provide foundry services and 300mm wafer capacity, and Tower Semiconductor will invest US$ 300mn to own equipment and fixed assets in the facility. 3) Came into full production in 1Q24
	Ohio, US	Intel 20A and below	HPC	1) Intel will invest in at least US$20bn for the first two fabs for construction. 2) Started construction in late-2022, and expect to start operation in end-2025. 3) Expects total investment to reach US$100bn at most for eight fabs over the next decade. 4) The advanced node will be Intel 20A when the fab starts operation, and plans to support Intel 18A as well.
	Oregon, US	Intel 18A/20A/3/4	HPC	1) Intel plans to invest US$3bn to expand Fab D1X to accelerate advanced nodes development. 2) Fab area will increase by 20%, equal to 270k ㎡. 3) Only the fab can support high-NA EUV equipment.
	Israel	10nm and Intel 7	Automotive	1) Intel confirmed a US$10bn manufacturing plant investment in Israel, and the first phase of construction has begun. The company will invest another US$600mn in Israel for Mobileye R&D.
	Magdeburg, Germany	Intel 20A/14A/10A	Automotive, Smartphone, Computing	1) The original plan is to construct two fabs from 2Q24, and expects to start production in late-2027 - early-2028, but now postpone 2 years due to financial difficult. 2) Total investment amount will be above EUR30bn.
	Leixlip, Ireland	Intel 3/4	Mobile, HPC and AI	1) Intel 4 began MP on Oct.23, and will be adopted for AI, advanced mobile networks, autonomous driving, and new data center and cloud applications. 2) Intel plans capacity expansion for automotive in Ireland. 3) Expects to complete construction in 2023 with investment amount at EUR5bn. 4) Expects to double manufacturing space for Intel 4 in Leixlip, Ireland at EUR12bn. 5) Accelerating intel 3/4 production transfer from Oregen to Ireland, causing higher production fee in near term and 1bn Capex saving. 6) Receiving 11.5bn in grants from Apollo's SCIP investment.
	Rome, Italy	N.A.	Automotive	1) Intel potentially invests of EUR$4.5bn to build a new packaging fab in Rome. 2) Potential clients will be STMicro and Stellantis. 3) Expects to start production between 2025 and 2027.
	Wrocław, Poland	N.A.	N.A.	1) Original plan postponed for two years from original plans, due to financial difficulty. 2) Intel previously planned to invest US$4.6bn for the assembly and testing fabs. 3) The facility will meet critical demand for Intel by 2027 based on original plan.
	Plateau de Saclay, France Barcelona, Spain Europe	Intel 4/3	HPC, AI	1) Expects to invest in EUR80bn in next ten years. 2) Plans for R&D hub in France by end-2024, and it will target HPC and AI applications. 3) Plans to establish joint fabs in Barcelona to advance computing. 4) Total investment amount for France, Germany, Ireland, Italy, Portland and Spain will reach EUR33bn, and all is phase 1 of capex plan in Europe. 5) Will construct two fabs in phase 1, and overall fab number will be eight.
	Penang and Kulim, Malaysia	Advanced packaging, assembly and testing	HPC, AI	1) Intel expects to invest US$ 14 bn in Malaysia. 2) Penang fab is expected to complete construction in 2024-25 and mainly for advanced packaging. 3) Plan to build assembly and testing fab in Kulim.
SAMSUNG	Pyeongtaek, South Korea	7/5/3nm and below	HPC/AP	1) Samsung announced it will spend KRW171tn (US$151bn) for its LSI and foundry business in 2021-2030. 2) Plans to expand by three times before 2026. 3) Expects to expand 5nm or below capacity in 2022. 4) Entered mass production for 3GAE in 1H22. 5) Expanded 30kwpm capacity for 4nm in 2023 in P3. 6) Restart construction of P5 in 3Q24 and plan to complete construction in April 2027.
	South Korea	8" and 12"	HPC	1) Added 30-40k wpm for 12" in 2022. Most of it is advanced nodes, and some is 14/28nm. 2) Added 15-20k wpm for 8" in 2022, and total capacity reach 265-270k wpm in 8".
	Texas, US	5nm	HPC	1) Samsung announced a US$17bn investment plan in Austin, Texas. 2) Started construction in 1H22, and postponed production to 2025, while considering upgrade the prodcution from 4nm to 2nm. 3) But currently expansion plan has been pushed out.
Texas Instruments	Germany	180nm	Analog Mixed Signal/ Logic	TI announced capacity expansion plan in Germany on April 27, 2021.
	Texas, US	45/65nm	Industrial/Automotive	1) New fab RFAB2 came online in 3Q22. 2) Expects analog capacity to double when fab RFAB2 construction completes. 3) Announced four new fabs construction plan on Nov 18, 2021, and total investment amount will reach US$30bn.(SM1, SM2, SM3, SM4) 4) Started two new fabs construction in 2022, and expects to start production in 2025 for Fab 1 in Sherman, Texas. The remaining two are expected to start contruction between 2026 and 2030. 5) Has 12" fab roadmap from 2025-2035 with Sherman Complex. 6) Will continue increasing capacity incrementally in 2022. 7) Received US1.6 $bn funding from Chips and science act and expects to receive additional US 6-8$bn from Investment Tax credit.
	Utah, US	45/65nm	Analog/Embedded product	1) Purchased from Micron 2) LFAB Started production in 1Q23. 3) Second fab started construction in 2H23, and will enter mass production in 2026 at the earliest with overall capex of US$11bn.
	Kuala Lumpur and Melaka, Malaysia	Assembly and Testing	Analog/Embedded product	1) Expects to start in 2025 at the earliest with overall investment up to MYR14.6bn, and Kuala Lumpur and Melaka taking around MYR9.6bn and MYR5bn, respectively. 2) Will support TI to have 90% internal assembly and testing capaicty by 2030.
Infineon	Dresden, Germany	90nm	Analog Mixed Signal/ Power IC	1) Infineon plans to spend EUR5bn for new plant, and started construction in 2023 & production in 3Q26. 2) Will continue expanding capacity in existing fab.
	Villach, Austria	TBA	Power IC (SiC and GaN) for EV/data center/solar and wind energy	1) The new factory will provide Infineon with an additional sales potential of around EUR2bn per year. 2) Total investment for the new fab costs EUR1.6bn.
	Kulim High Tech Park, Malaysia	8"	Power IC (SiC and GaN)	1) Infineon expects to transfer its SiC and GaN epitaxy production to Kulim Hi-Tech Park and expand its manufacturing base, whose investment is above EUR2bn. 2) Infineon will start shipment by 3Q24 as scheduled. 3) Infineon expects sales amount to reach EUR2bn for new fab every year when equipment is fully loaded. 4) Targets revenue to reach EUR3bn by 2027.
SONY	Nagasaki, Japan	45nm	CIS	1) Sony invested JPY100bn (around US$920mn) to expand Fab5 capacity. 2) Fab5 has started operation since April, 2021. 3) Capacity expansion at next stage has started in May, 2022. 4) Sony expects to invest JPY900bn for semiconductor business in FY2021-23 vs. JPY580bn in
	Crolles/Tours, France Agrate/Catania, Italy Bouskoura, Morocco Singapore Shenzhen, China	32-150nm	Analog Mixed Signal/Logic/ Discrete	1) STMicro will invest US$3.4-3.6bn in 2022, and US$2.1bn for capacity additions and mix change in our manufacturing footprint. 2) US$2.1bn capex will be used for 12" capacity expansion in Crolles, Italy, 8" analog in Singapore , 6" SiC in Catania and Singapore, testing and assembly business in Shenzhen and Bouskoura. 3) US$900mn for new 12" fab build in Agrate and GaN & SiC initiatives 4) STMicro expects its 12" capacity to double by 2025 vs. 2022 level. 5) New fab in Tours, France entered mass production in 2023.
	Catania, Italy	8"	SIC	1) The total investment is expected to be US $5.4 bn, with a support of around US $2.2bn. 2) Production at the site is expected to begin in 2026, ramping up to full capacity 60kpm by 2033.
	Agrate/Catania, Italy	32-90nm	Analog Mixed Signal/BCD/eNVM	1) The fab had wafer-start in 3Q22, and ramp up in 1H23. 2) STMicro will acquire 40k wpm capacity in Agrate R3 fab.
RENESAS	Yamanashi, Japan	12" (55/90nm)	Power IC (IGBT and MOSFET) for ADAS	1) Will invest at JPY90bn to reopen a 12" Kofu fab in 2024 in Kai City, Yamanashi, Japan. 2) The capacity of power IC will double when Kofu fab completes. 3) Will complete equipment move-in for 10kwpm capacity before August 2026.
	Kumamoto, Japan	130nm	MCU for automotive	1) Will complete equipment move-in for 29.1kwpm capacity before March 2025.
	Ibaragi, Japan	40nm	MCU for automotive	1) Will complete equipment move-in for 10kwpm capacity before February 2025. 2) For equipment capex for three fabs, overall investment amount will reach JPY47.7bn, and subsidy from Japan government will be JPY15.9bn.
ROHM	Fukuoka, Japan	6"/8"	SiC	1) New fab entered mass production in December 2022 in Fab Apollo in Chikugo. 2) Targets to produce 8" SiC before 2025. 3) Targets 2025 capacity to become six times to that in 2021.
Silan 士兰微电子	Hangzhou, China	12"	Power IC	1) Will invest CYN 6.5bn for 30 kwpm 12", SiC Power discrete, and auto semi back-end packaging capacity. 2) Plan to invest CYN 12bn for 8" 60kwpm capacity, in which phase 1 will account for CYN 7bn investment. 3) Phase 1 investment plan to start production in 3Q25 and reach total capacity at 35kwpm in 2028
	Xiamen, China	8"	SiC	
華虹集團	Shenzhen, China	12"	Power IC (IGBT and MOSFET	1) Invested CYN 22bn. 2)Capacity will reach 40 kwpm in end-24

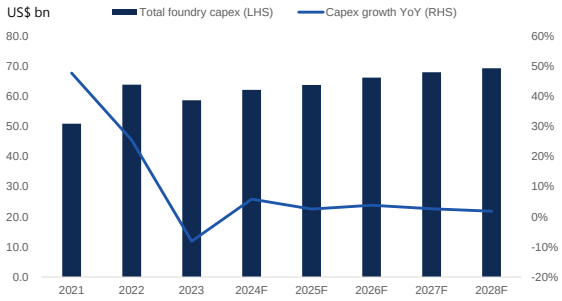
Source: Company data, Yuanta Investment Consulting estimates

2025 foundry capex growth to decelerate to 2.6% YoY, after the 2024 peak

For foundry, the main contributor to capex is still TSMC. We expect TSMC to slow down its capex growth pace going forward because of no significant capacity build-up plan and a high base in 2024. Therefore, we expect 2025 foundry capex to grow 2.6% YoY vs. 5.9% in 2024.

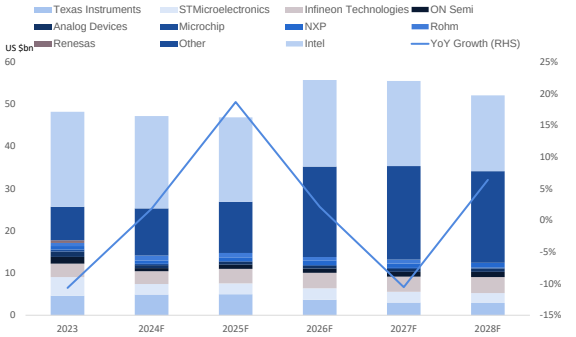
For IDMs, especially memory vendors, as they are active in developing HBM to fulfill strong AI demand, we forecast 2025 capex will further grow by 10.1% YoY, mainly for HBM capacity expansion and migration to HBM4. Logic IDMs, like Samsung and Intel, are now seeing some capacity build-up progress for advanced nodes. We believe logic semi IDM will see moderate 2025 capex growth.

Figure 31: Foundry capex will increase 2.6% YoY in 2025



Source: Company data, Yuanta Investment Consulting estimates

Figure 32: Intel will be main capex contributor for logic IDM



Source: Company data, Yuanta Investment Consulting estimates

Smartphone semi - demand back to normal in 2025

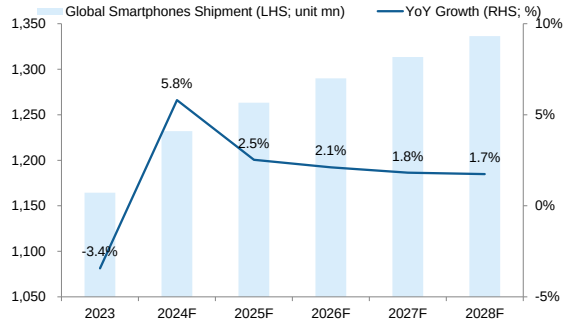
Demand to return to normal in 2025

After a slow demand recovery in 2024, we believe inventory issues for smartphone are behind us. Although iPhone sell-through seems still muted in 4Q24, we believe with more functional LLM launches in 2025 will drive iPhone demand going forward. As for Android, low-end and flagship model demand is getting even stronger, but mid-end demand has decreased. We can see this trend from recent earnings calls for Qorvo, MediaTek and Qualcomm. With a warming macro environment into 2025, we believe smartphone shipments will also return to a normal trend with low-single digit YoY growth. We thus expect 2025 smartphone shipments to grow 2.5% YoY.

Content value increase more important to semi plays; MediaTek our top pick in smartphone semi

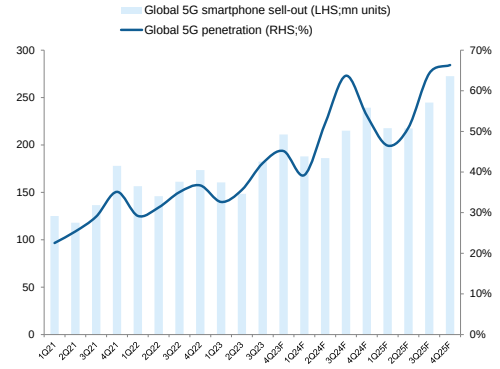
While 5G penetration rate will maintain gradual growth, from 54% to 66% in 2025, we believe semi content growth will be far larger than shipment growth. Take flagship models as an example, Qualcomm's Snapdragon 8 Elite's ASP has reached US$180 vs. US$150-160 for Snapdragon 8 Gen 3. Content increases and node migration have driven ASP and margin upside for SoC vendors. We are also seeing a similar trend for MediaTek, especially for flagship model upgrades to N3E. Therefore, we are still positive on the outlook for SoC vendors. Amid continued share gain momentum, we reiterate our BUY rating on MediaTek.

Figure 33: 2025F smartphone shipments will grow 2.5% YoY growth



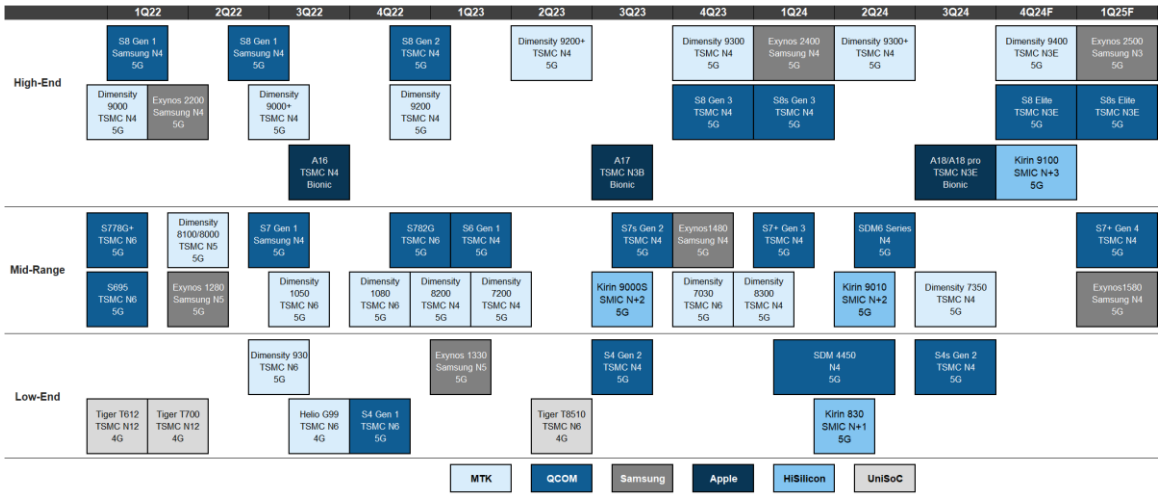
Source: IDC, Yuanta Investment Consulting estimates

Figure 34: 5G penetration rate will grow to 66% in 2025



Source: IDC, Yuanta Investment Consulting estimates

Figure 35: Roadmap for smartphone SoC vendors



Source: Company data, Yuanta Investment Consulting estimates

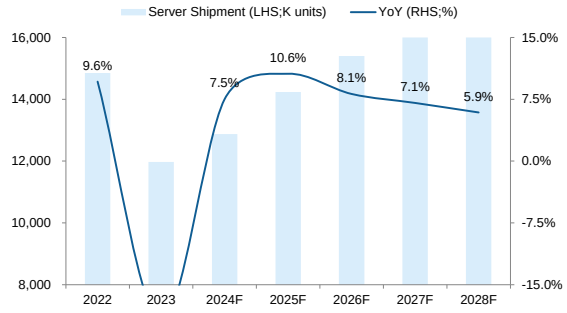
Server semi sector – regular and AI server both on the rise in 2025

Server shipment growth of 10.6% in YoY thanks to both regular and AI server growth; ASPEED our top pick

In 2024, AI server shipments saw explosive growth. Looking into 2025, we expect momentum to continue thanks to further deployment for datacenter and rising training & inference AI model demand. We expect AI GPU server shipment to grow from 450k units in 2024 to 700k units in 2025. For regular server, we believe capex cannibalization will fade away. With increasing data storage demand, we expect regular server shipment to continue growing, by 6.0% YoY in 2025. Therefore, we expect overall server shipment will grow 10.6% YoY to 14.9mn. Server will still see the most promising end demand amid all applications.

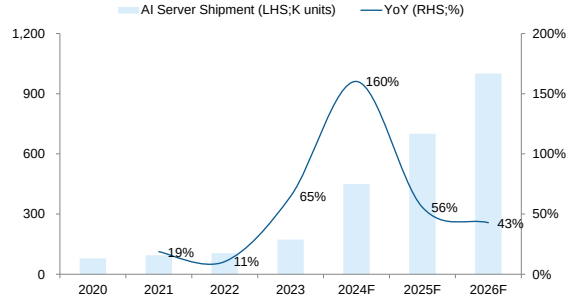
In the Taiwan supply chain, ASPEED is our top recommendation in server semi, with a leading position in both regular and AI server. Although there has been recent market noise about share loss for ASPEED in the AI server arena, we believe competitor Nuvoton has just passed verification from Microsoft. Vendor's product adoption will still depend on Microsoft. We estimate ASPEED will lose about 8-9% order volume for AI server at most. Thus, we expect impact to be limited, and still see ASPEED's current valuation as attractive.

Figure 36: 2025 server shipment to grow 11% YoY



Source: IDC, Yuanta Investment Consulting estimates

Figure 37: 2025 AI server shipment to grow 56% YoY



Source: IDC, Yuanta Investment Consulting estimates

Figure 38: 2026 Aspeed TAM will be 3.6x that of 2023

Oak Stream TAM Analysis		2026F	
Regular BMC	ASP (US$)	25	*AST 2700 pricing at $25*
	Server Motherboard shipment (mn unit)	21.6	
	Server BMC adoption rate in server	100%	
	Server shipment (mn unit)	15.4	
	Storage & Switch shipment (mn unit)	7.7	*Storage & Switch shipment ~50% of server shipment*
	BMC adoption rate in storage/swtich	30%	*Assume adoption rates increase to 30% from 15% now*
	TAM (US$ mn)	**597**	
Mini BMC	ASP (US$)	6.5	*$6.5 from Yuanta model*
	Server Motherboard shipment (mn unit)	21.6	
	Mini BMC adoption rate in server	20%	*Assume Meta, Google and other vendors adopt mini-BMC*
	Number of mini BMC per server	4	
	TAM (US$ mn)	**112**	
Secutrity chip (RoT)	ASP (US$)	9.0	*$9-9.5 from company guidance*
	Server Motherboard shipment (mn unit)	21.6	
	Secutrity chip adoption rate	55%	*Assumes 45% vendors use inhouse solutions*
	TAM (US$ mn)	**107**	
I/O Expander	ASP (US$)	7	*$7 from company guidance*
	Server Motherboard shipment (mn unit)	21.6	
	I/O Expander adoption rate	100%	
	TAM (US$ mn)	**151**	
	Total 2026F TAM (US$mn)	***966***	
	Cuurent 2023 TAM (US$mn)	***267***	
	Times for 2026F TAM vs. 2023F TAM	***3.6***	

Eagle Stream TAM Analysis		2023	
Regular BMC	ASP (US$)	13	*AST 2600 pricing at $11-13*
	Server Motherboard shipment (mn unit)	17.2	
	Server BMC adoption rate in server	100%	
	Server shipment (mn unit)	12.0	
	Storage & Switch shipment (mn unit)	5.99	*Storage & Switch shipment ~50% of server shipment*
	BMC adoption rate in strage/swtich	15%	*~15% adoption rate now*
	TAM (US$ mn)	**236**	
Mini BMC	ASP (US$)	6.5	*$6.5 from Yuanta model*
	Server Motherboard shipment (mn unit)	17.2	
	Mini BMC adoption rate in server	7%	*Currently only Mata adopted mini BMC (ASPEED guides ~1.2mn mini BMC shipment this year)*
	Number of mini BMC per server	4	
	TAM (US$ mn)	**31**	
	Total 2023 TAM (US$ mn)	***267***	

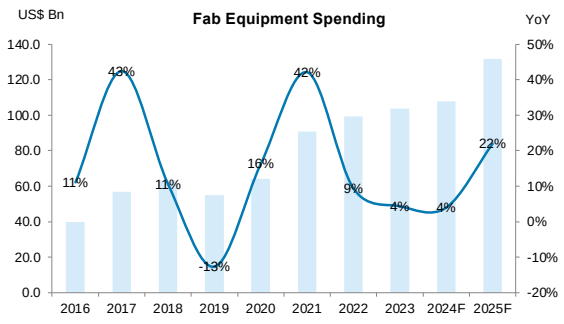
Source: Company data, Yuanta Investment Consulting estimates

Equipment and material sector – AI applications and supply chain localization still major trends

Inventory adjustment nears an end; global semi equipment spending to reclaim highs in 2025F

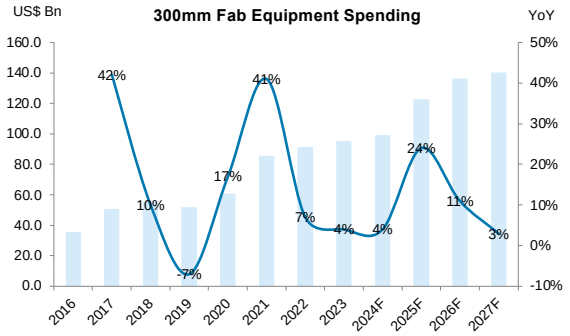
Front-end semiconductor equipment spending grew 9% YoY to ~US$99.5 bn in 2022, a record high for the third consecutive year, supported by pandemic-driven acceleration of the digital transformation since 2020, supply shortages amid demand recovery for automobile parts, industrial products and consumer electronics, and local supply chain establishment in various countries due to geopolitical risk. Memory and wafer fabs have seen substantial capex cuts in 2H22 given a deteriorating macro environment, weak consumer electronics demand, supply chain inventory adjustment, and new regulatory bans by the US. Semiconductor equipment spending only grew by a low-single digit % YoY in 2023/24 but is estimated to grow 22% YoY to US$131.8 bn in 2025F after the end of semiconductor inventory adjustment in 2024, and an overall industry demand recovery. Investment will mainly come from foundries, whose investment amount is estimated to grow 29% YoY to US$75 bn, with global foundry capacity to further expand 11% YoY. There will also be investments from memory makers, whose investment amount is estimated to grow 25% YoY to US$35 bn, with global memory capacity to grow 4% YoY.

Figure 39: Global fab equipment spending to grow 22% YoY in 2025F



Source: SEMI, Yuanta Investment Consulting compiled

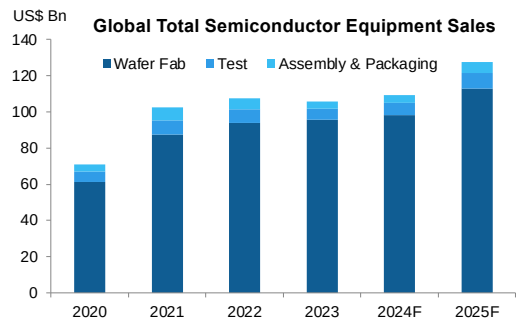
Figure 40: Global 12" fab equipment spending to grow 24% YoY in 2025F



Source: SEMI, Yuanta Investment Consulting compiled

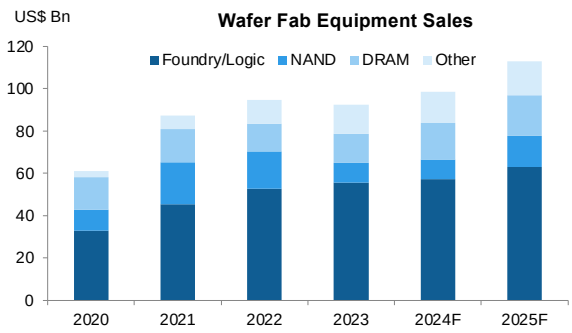
According to data from SEMI, global total semiconductor manufacturing equipment sales declined 1.4% YoY to US$105.9 bn in 2023, but will resume growth in 2024F, with semi equipment sales to likely rise 3.4% YoY to NT$109.5 bn in 2024F and to grow strongly by 17% YoY in 2025F. Wafer fab equipment sales are also expected to grow 7%/15% YoY in 2024/25F.

Figure 41: Semi equipment sales to grow 3%/17% YoY in 2024/25F



Source: SEMI, Yuanta Investment Consulting compiled

Figure 42: Wafer fab equipment sales to grow 7%/15% YoY in 2024/25F

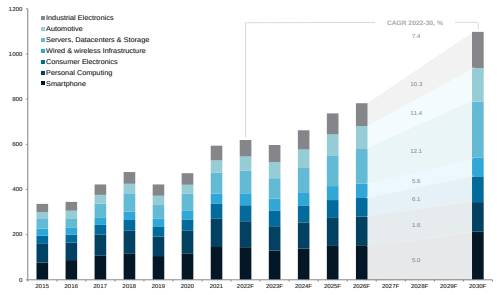


Source: SEMI, Yuanta Investment Consulting compiled

Advanced nodes and supply chain localization remain major trends

We have seen strong demand for advanced node/packaging-related equipment & materials in recent years driven by maturing AI, HPC, 5G, and automotive applications amid a digital transformation. Wafer fabs and equipment suppliers are seeing a positive outlook for the advanced node trend and growth potential in new applications. As such, TSMC announced it would invest US$100 bn in three years, mainly for capacity expansion for advanced nodes (N7/N5/N3/N2), specialty nodes, and back-end INFO/CoWoS/2.5D/3D packaging, as well as for establishment of overseas fabs. Additionally, given chip supply chain disruptions caused by capacity tightness and geopolitical factors in recent years, various countries began to see the importance of local supply chains and have actively launched subsidy policies for establishment of more flexible supply chains. Mid-to-long-term, we believe advanced nodes and supply chain localization will be the main drivers of semi equipment demand.

Figure 43: Semi end application growth 2020-30F



Source: Yuanta Investment Consulting compiled

Figure 44: Subsidy policies in various countries

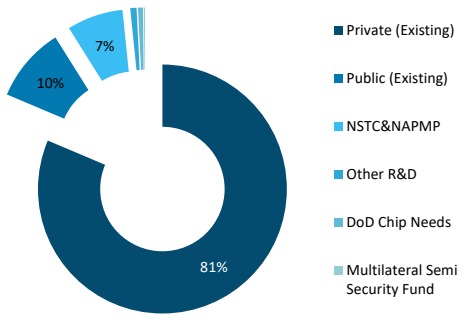
Country	Subsidy for R&D investment	Tax credit	Subsidy for fab establishment
US	•	•	•
China	•	•	
EU	•		
Japan	•		•
South Korea	•	•	
India	•		•
Taiwan	•	•	

Source: MIC, Yuanta Investment Consulting

US CHIPS Act focuses on rewarding chip fabrication and R&D for advanced technology

President Joe Biden signed the CHIPS and Science Act in Aug 2022, authorizing a total amount of ~US$52.7 bn, of which ~US$39 bn will be used to subsidize foundries and US$11 bn will be used to research and develop advanced technology. Additionally, the US Internal Revenue Service (IRS) already confirmed semi manufacturing can enjoy a 25% tax credit according to the Advanced Manufacturing Investment Tax Credit (AMIC) Act, hoping to increase semi capacity in the US and reduce dependence on other countries. Vendors such as Intel, TSMC, Samsung, Micron, and Globalwafers are already qualified for subsidies, supporting their fab expansion plans in the US.

Figure 45: CHIPS Act – capital breakdown



Source: Yuanta Investment Consulting compiled

Figure 46: Beneficiaries from CHIPS Act

Beneficiaries	Subsidy amount
Intel	US$8.5 bn
TSMC	US$6.6 bn
Samsung	US$6.4 bn
Micron	US$6.1 bn
Texas Instruments	US$1.6 bn
GlobalFoundries	US$1.5 bn
Global Wafers	US$400 mn
Microchip Technology	US$162 mn

Source: SIA, Yuanta Investment Consulting

Content value to increase, helped by AI-driven advanced node migration and strong HBM demand

Amid AI's continued development, we are most positive on developments in advanced node, BSPD and HBM supply chains. According to AMAT, GAA, BSPD, advanced packaging and HBM will be key future drivers. As FinFET moves to GAA, AMAT's market size is estimated to expand from US$6 bn to US$7 bn. Driven by BSPD, wiring market size is also estimated to increase from US$6 bn to US$7 bn. For advanced packaging, we expect wider applications of heterogeneous integration and new solutions will expand the potential market. Overall, we expect AI applications to see a CAGR of 30-50% in the next few years, with AMAT to see further share gains for AI-related applications.

Foxsemicon Integrated Technology (3413 TT; BUY) has >90% of AMAT OEM sales, and will likely grow alongside client expansion. Its current order visibility already extends from year-end to 2025F, with 2024F sales likely to far surpass its previous target of a low double-digit% growth. Its sales outlook is even more positive for 2025F thanks to new AI/HPC applications. Additionally, we believe Kinik (1560 TT; BUY) will benefit notably from BSPD and N2 node migration. Given increasing CMP griding layer count for advanced nodes, content value for each node generation has grown 5%-10% on average, with an estimated further 20%-30% content value growth for N2 BSPD products. We expect Kinik to have 70% share in the N3 node diamond disk market and 80% share in N2. Currently, ~40% of diamond disk sales are from its major client's N3 nodes, with small-volume shipments of N2 products. We believe continued advanced node migration will drive further content value upgrade for diamond disk. We estimate Kinik's N2 BSPD-related sales to reach double-digit% in 2026F.

Restocking demand for raw materials driven by semi demand recovery and new capacity ramp-up

Based on our supply chain checks, foundries are seeing advanced node capacity shortages currently, whereas mature node capacity demand is at low levels amid end demand weakness. However, in the long term, we expect mature node demand to rise gradually alongside continued growth in advanced nodes, as semi end products become increasingly diverse in application, targeting lower-power-consumption, higher integration, and high-performance. We believe Marketech (6196 TT; BUY) and Topco (5434 TT; BUY) will benefit from the equipment OEM and materials agency opportunity driven by capacity ramp-up at multiple foundries amid a strong semi demand recovery and more new applications in 2025F.

Topco has seen sequential sales growth QoQ YTD, with 3Q24 sales hitting a new high thanks to strong demand for advanced processes and China's new foundry capacity ramp-up. In terms of raw materials for advanced nodes, Topco is a base-line supplier with a high market share, and will likely see content value growth driven by node migration and advanced packaging. Moreover, it has seen ongoing project wins in Southeast Asia in recent years, thanks to the shift of plant construction to Southeast Asia by some electronics and semi companies owing to the geopolitical environment.

Marketech's near-term sales are mainly affected by the US plant of its major client. 2024 sales booking from Phase I turnkey project for the US plant is coming to an end, which should help improve its earnings structure notably. Going forward, Marketech will book sales mainly from Phase II Baoshan plant in Hsinchu Science Park, packaging plant, and Kaohsiung plant. We see a positive outlook on equipment OEM and materials agency opportunity following new plant construction in 2025F. In the mid-to-long term, we expect Marketech to benefit from the sector upcycle driven by expanding auto/AI/HPC applications, supply chain localization trend, and clients' continued strategic investment.

Overall, we expect to see a more solid semi growth outlook amid a sector upcycle in 2025F, with AI/HPC/auto new applications to facilitate development and content value growth for new semi materials. New foundry capacity ramp-ups and additional overseas operations should also support even stronger sales growth for semi equipment and consumables suppliers.

Top picks

Figure 47: 2024F semi industry top picks

Segment	Company	Ticker	Mkt cap (US$ mn)	EPS (NT$)		EPS growth (%)		Description
				2024F	2025F	2024F	2025F	
Foundry	TSMC	2330 TT	836280	44.93	60.04	39%	34%	● 4Q24 guidance of 13% sales QoQ growth in USD and GM of 58% were another strong upside surprise, above consensus by 4.9% and 3.2 ppt, respectively. ● 2024 capex guidance of slightly above US$30 bn was a slight miss, but does not impair its strong growth trajectory. ● The AI era is just at the beginning, and TSMC will be the major beneficiary. It remains our top pick, with now a higher TP of NT$1,440, based on 24x 2025F EPS.
IC design	Airoha	6526 TT	3231	15.09	19.21	128%	27%	● Airoha, a Taiwan communications IC vendor, provides comprehensive solutions for applications such as Bluetooth, switch, PON, GNSS and Ethernet. ● One of the beneficiaries of warmer networking demand in 2025. Broadband business to thus outperform other segments. ● Rising star to capture the AI megatrend; initiate with BUY rating and a TP of NT$770, based on 40x 2025 EPS of NT$19.21
IC design	Mediatek	2454 TT	65061	66.70	68.45	37%	3%	● 4Q24F guidance of 3% sales QoQ decline and GM of 47.5% are largely in line with consensus. ● Business diversification will start bearing fruit in 2025 with launches of new ASIC, PC SoC, and auto-related chips. ● Long-term growth visibility looks clearer. Maintain BUY with a new target price of NT$1,500, based on 22x 2025 EPS of NT$68.45.
IC design	Aspeed	5274 TT	4861	63.44	91.03	138%	43%	● 4Q24 sales and GM may both beat consensus again. Our forecasts are higher than consensus, by 7% and 0.4 ppts. ● Impact from potential share losses for AI server to be limited. We forecast that in 2025, ASPEED can still hold over 90% share of the AI market . ● AI server remains a growth pillar for 2025F; maintain BUY with a new TP of NT$5000, based on 55x 2025 EPS of NT$91.03.
IC design	Realtek	2379 TT	7705	29.12	32.48	63%	12%	● 3Q24 EPS of NT$8.53 beat consensus by 5% but missed our estimate by 17%. Weak seasonality in 4Q24F amid consumer demand weakness and clients' conservative inventory building. ● 2025F sales to hit a new high driven by networking, automotive specs upgrade, and new applications. ● Cut 2024/25F EPS by 13%/8%. Reiterate BUY given continued benefits from networking spec upgrades. Our TP of NT$580 is based on 18x 2025F EPS.
Testing interface	Winway	6515 TT	1439	37.72	56.51	179%	50%	● Lift 3Q24F EPS by 22% to reflect strong demand for AI GPU and handset AP socket. ● Lift 2024/25F EPS by 16%/12%, given new RTX 50 product launches to boost gaming business upcycle and growing socket demand driven by AI chip demand growth. ● Given intact sales growth driven by AI chips mid-to-long-term, we lift our TP from NT$1,350 previously to NT$1,650, based on 35x 2H24-1H25F EPS of NT$47.2; reiterate BUY.
Testing equipment	Kinik	1560 TT	1363	7.48	10.71	27%	43%	● 3Q24 EPS of NT$1.96 and mild sales growth & flat GM QoQ in 4Q24F missed our previous estimates. ● Node migration to N3/N2 to help content value growth for diamond disk and reclaimed wafer, as well as share gains. Mid/long-term drivers include advanced nodes and supply chain localization. ● Reiterate BUY and lift our target P/E to 35x, reflecting a major client recently highlighting the clear N2>N3 trend. We continue to see a bright outlook for Kinik as one of few beneficiaries in the BSPD field.
Semi equipment	Foxsemicon	3413 TT	1051	24.15	25.48	18%	6%	● 2024F sales growth to exceed previous guidance of low-teens% YoY notably, given order visibility extending to late-2024F or 2025F. ● 2025F sales to hit a new high given new capacity and new AI applications, which drive foundry UTR growth and strong demand for advanced logic processes and HBM equipment. ● Lift 2024/25F earnings by 12%/5%. Reiterate BUY with

Segment	Company	Ticker	Mkt cap (US$ mn)	EPS (NT$)		EPS growth (%)		Description
				2024F	2025F	2024F	2025F	
								a TP of NT$380 based on 15x 2025F EPS, given a positive sales outlook and with a high dividend yield.

Source: Company data, Yuanta Investment Consulting estimates

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