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ASIA PACIFIC INSIGHT

September 13, 2026 11:16 PM GMT

Global Materials

AI Infrastructure: The Materials Super-cycle

Our global materials team examines the upstream supply chains supporting the PCB and MLCC ecosystem. We focus on where AI-driven demand could reshape segment growth trajectories, capacity requirements, and competitive positioning.

Key Takeaways

- We see more attractive entry points in select upstream bottlenecks...
- ...than in parts of the downstream AI hardware chain, where expectations are already more demanding.
- We think glass fabric, copper foil, resin, and optic fiber are most in shortage. We expect supply tightness to continue into 2028.
- Our preferred stock exposures are Nittobo, Grace Fabric, Mitsui Kinzoku, Co-Tech, Corning, Furukawa Electric, Mitsubishi Gas Chemical, and Denka.
- They have what we view as the cleanest earnings sensitivity to these bottlenecks.

The AI materials group has re-rated... This group comprises the listed upstream suppliers of key materials across the PCB/CCL, AIDC, and broader AI value chains covered in this report. It is up 91% over the past 12 months. However, as of 10 September 2026, it has corrected ~36% from its 52-week high in May–June 2026.

...but we do not think all of the opportunity is priced in: Importantly, despite the robust rally over the past 12 months, based on our estimates, 2026 P/E for the AI materials group is ~26x, vs. ~35x for PCB/CCL. Both are part of the same AI infrastructure trade — but we see AI/data center PCB and CCL demand growing >6x and >7x, respectively, by 2030. This means stronger demand for upstream materials — and scope for the valuation gap with PCB/CCL peers to narrow.

Segment ranking – high-end glass fabric #1, HVLP4+ copper foil #2, optical fiber #3: For #1 and #2, supply can't respond quickly enough to accelerating AI demand; we see the strongest combination of scarcity, pricing power, and earnings leverage into 2027. Fundamentals for #3 remain strong, but announced capacity additions make medium-term risk/reward less compelling.

CCL still a core preference #4: AI/data center CCL demand up >7x by 2030. Grade migration (M8 → M9/M10) helps sustain volume and product mix growth.

Resins — intact structural growth, less scarcity: Volume growth and product mix upgrades offer support. Less acute supply tightness limits near-term pricing upside.

Synthetic diamonds, tungsten, and molybdenum still offer longer-duration optionality – hinging on technology adoption and material substitution.

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GREATER CHINA MATERIALS

Asia Pacific
Industry View **Attractive**

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Snapshots of Select Upstream Segments and Key Beneficiaries

Tech Diffusion

A Morgan Stanley Research Key Theme of 2026

Glass fabric

Supply shortage deepening in 2027

High-performance glass fabric is a critical reinforcement material for PCB laminates and advanced substrate architectures.

High-performance glass fabric is increasingly constrained by limited availability of Toyota weaving machines, tight high-end yarn supply, and high technical barriers.

Prices in China have more than doubled YTD amid extremely low inventories, with further hikes expected.

We estimate a ~40% supply deficit in 2026, worsening in 2027, before easing to ~30% in 2028.

Key beneficiaries:

- Nittobo (3110.T)
- Asahi Kasei (3407.T)
- China Jushi (600176.SS)
- Taishan/Sinoma (002080.SZ)
- Grace Fabric (603256.SS)
- Kingboard Laminates (1888.HK)

See the following companion reports:

- Initiation of coverage on Grace Fabric
- Foundation report including initiation of coverage on Kingboard Laminates: *Asia Pacific Technology – AI's Hidden Backbone*

Copper foil

Structural undersupply emerging

HVLP4+ copper foil is becoming a key bottleneck in the AI PCB supply chain.

AI server HVLP demand is expected to rise 260% YoY in 2026, to 24kt, according to CBC Metals, and another 108% in 2027, to ~50kt.

With copper foil utilization in China already above 90%, our model points to a ~31% supply deficit in 2027 (3,270t/month demand vs. 2,495t/month capacity)..

Key beneficiaries:

- Mitsui Kinzoku (5706.T)

- Co-Tech (8358.TWO)
- Furukawa Electric (5801.T)
- Fukuda (unlisted)
- Anhui Tongguan Copper Foil (301217.SZ, Not Covered)
- Jiujiang Defu Technology (301511.SZ, Not Covered)
- Lotte Energy Materials (020150.KS)
- Jiangxi Copper (0358.HK)
- Nuode New Materials (600110.SS, Not Covered)

See the following companion report:

- Foundation report including initiation of coverage on Co-Tech: *Asia Pacific Technology – AI's Hidden Backbone*

Electronic-grade resins

Emerging as another key beneficiary of AI and advanced packaging

AI/HPC and advanced packaging are driving structural demand for BC/RDL materials.

Faster data transmission is accelerating adoption of low-loss CCL resins, including PPE/OPE, BMI and cyanate ester.

Key beneficiaries:

- Mitsubishi Gas Chemical (4182.T)
- DIC (4631.T)
- Nippon Kayaku (4272.T)
- Kumiai Chemical Industry (4996.T)
- Nippon Soda (4041.T)
- Denka (4061.T) – also benefits from growing demand for low-dielectric silica

Optical Fiber

Prices at seven-year highs, 2025-30e demand CAGR >20%

The rapid expansion of AI infrastructure is driving a significant increase in data transmission within and between data centers, bringing optical fiber into focus as a key enabling material for next-generation connectivity.

Hyperscale AI data centers can require 5–10x more optical fiber than traditional data centers, with some estimates suggesting 5–36x more fiber per rack.

Against this backdrop, we expect a CAGR of greater than 20% from 2025 to 2030 in AI-driven optical fiber demand in data centers.

The strong demand environment has translated into tighter supply and sharply higher prices.

Key beneficiaries:

- Corning (GLW.N)
- Fujikura (5803.T)
- Furukawa Electric (5801.T)
- YOFC (6869.HK)

CCL

AI demand and grade migration drive structural growth

We estimate that the global CCL TAM will expand at a ~20% CAGR from 2025 to 2030, from ~US$19bn to ~US$47bn.

AI/data-center CCL demand is expected to rise more than sevenfold, from ~US $4bn in 2025 to ~US$30bn by 2030, accounting for ~90% of the industry's net growth over the period.

Grade migration from M8 in Blackwell to M8.5 in Rubin and expected M9/M10 in Feynman is raising specification requirements and value content per system.

Key beneficiaries:

- Murata Manufacturing (6981.T)
- Taiyo Yuden (6976.T)

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A Closer Look

AI represents not only a semiconductor story, but also a materials story

The global race to build AI infrastructure is creating a multi-year investment cycle extending far beyond semiconductors.

While attention has focused on GPUs, advanced packaging, and memory, the expansion of AI data centers, networking equipment, power systems, and edge devices is driving substantial demand for the enabling materials embedded within printed circuit boards (PCBs) and multilayer ceramic capacitors (MLCCs).

As AI servers become increasingly computing-dense and power-intensive, material intensity across these components continues to rise — creating new demand drivers for a broad range of specialty materials and engineered substrates.

PCB and CCL: the AI infrastructure backbone

We estimate that the global PCB addressable market will expand at an 18% CAGR from 2025 to 2030, from approximately US$58bn to US$135bn, driven almost entirely by AI and data center infrastructure. AI/data center PCB demand is expected to increase more than sixfold, from ~US$13bn in 2025 to ~US$86bn by 2030, taking its share of industry revenue from ~20–25% to ~64%. By our estimates, AI/data center applications account for essentially all of the industry's net growth through 2030, with demand across other end markets broadly stable. Growth is expected to be broad-based across general servers, GPU servers, custom ASIC servers, networking switches and optical modules, supported by rising system shipments and continued scaling of compute clusters (see details).

The global CCL addressable market, in our projections, is expected to expand at a CAGR of approximately 20% between 2025 and 2030, increasing from around US$19bn to US $47bn. The AI and data center-related CCL market, by our estimate, is expected to rise from ~US$4bn in 2025 to ~US$30bn by 2030, representing a ~47% CAGR and more than sevenfold growth.

AI and data center applications would contribute ~US$26bn of the industry's ~US$28bn net growth over the period, or ~90%, while demand from other end markets remains broadly stable.

The progression of CCL grades — from M6/M7 in Ampere/Hopper, to M8 in Blackwell, to M8.5 in Rubin, and expected M9/M10 in Feynman — reflects the rising electrical and thermal demands of successive AI server generations.

Advanced AI PCB manufacturing is structurally more complex: end-to-end lead time for an advanced AI PCB is approximately 100 days (14.6 weeks) versus 46 days (6.6 weeks) for a conventional multilayer PCB — a 2.2x longer production cycle. The additional 56 days reflects 15 days for glass-cloth production, 11 days for CCL production, and 30 days for PCB fabrication. An NVIDIA-grade computing board requires 22 layers and five lamination cycles, compared with a single lamination cycle for a standard 12–16-layer board.

Copper foil: structural undersupply emerging

HVLP copper foil is emerging as one of the most acute AI materials bottlenecks. Higher-layer-count boards and the transition to 800G/1.6T networking sharply increase demand for ultra-low-loss foil.

CBC Metals projects the market for HVLP copper foil for AI servers to reach 24,000 metric tons in 2026 (+260% YoY) and 50,000 metric tons in 2027.

China's copper foil industry is operating at nearly full capacity — overall operating rates reached 93.08% in July 2026, with electronic circuit copper foil at 94.09%.

We estimate that HVLP4+ demand will rise from ~1,028t/month in 2026 to ~3,270t in 2027 and ~4,335t in 2028, versus available capacity of ~1,080/2,495/3,600t – implying ~31% undersupply in 2027 and ~20% in 2028.

Supply remains highly concentrated, led by Mitsui Kinzoku (41% of 2026 capacity), with Co-Tech, Furukawa, and Fukuda Metal Foil & Powder among qualified suppliers, while Tongguan, Defu, and Lotte Energy Materials are ramping new capacity.

Chinese producers — including Tongguan, Jiangxi Copper, and Nuode — also offer increasing exposure as high-end product qualification progresses.

Glass fiber & fabric: supply bottleneck deepening

High-performance glass cloth is a critical reinforcement material for PCB laminates and advanced substrate architectures. Weight-based ASP for glass cloth in Japan rose 40%, from ¥3,274/kg in 2023 to ¥4,589/kg in 2025, with sales value reaching a record high of just over ¥60bn in 2025. The high-performance glass cloth market, in our projections, is expected to grow from approximately ¥40bn (2024) to ~¥150bn by 2030.

Three structural supply bottlenecks constrain the segment:

1. **Availability of Toyota weaving machines is limited:** Monthly shipments will reach only 300 units per month by end-2027.
2. **Chinese-made weaving machines are not accepted by fabric producers:** The reason: low yield.
3. **Prices of precious metals (platinum and rhodium) are rising:** This is materially increasing industry capex requirements.

The rapid increase in demand is raising concerns over shortages of glass yarn and high-performance glass cloth, with CCL manufacturers qualifying new suppliers in China and Taiwan to diversify procurement.

Nittobo (3110.T, Overweight) is pursuing aggressive capacity expansion, raising cumulative capex for F3/25–F3/28 from ¥80bn to approximately ¥120bn.

Grace Fabric (603256.SS) is shifting capacity toward higher-margin specialty fabrics and localizing yarn supply, supporting faster ramp-up, margin expansion and stronger earnings visibility.

Other beneficiaries include Asahi Kasei (3407.T), China Jushi (600176.SS), and Taishan/Sinoma (002080.SZ).

Electronic-grade resins: AI drives advanced packaging and low-loss CCL upgrades

Electronic-grade resins — including photosensitive wafer-coating resins used in advanced packaging, as well as epoxy, PPE, OPE and specialty resin systems used in copper clad laminates and high-performance substrates — are emerging as another key beneficiary of AI and advanced packaging.

In advanced packaging, the BC/RDL materials market was worth approximately US $600mn in 2025, with five Japan-affiliated suppliers accounting for a high-90s (%) share by volume. RDL materials, in our estimate, are expected to grow at a high-single-digit rate through 2029, outpacing BC materials, with key suppliers including HD MicroSystems (Resonac/4004.T), Asahi Kasei (3407.T), Sumitomo Bakelite (4203.T), Toray (3402.T), and FUJIFILM Electronic Materials (subsidiary of FUJIFILM Holdings/4901.T, covered by Mie Yamazaki).

In CCLs, rising data speeds are driving a shift from conventional epoxy resin toward increasingly complex low-loss resin systems incorporating PPE and OPE, together with BMI, cyanate ester, and modifiers to improve thermal performance, compatibility, and processability. M8 CCL grade is now standard for Blackwell; Feynman is expected to drive an upgrade toward M9/M10 materials, supporting increased adoption of higher-performance, lower-loss resin systems.

Key CCL resin and related material suppliers include Mitsubishi Gas Chemical, DIC, Nippon Kayaku, Kumiai Chemical, Nippon Soda and Denka.

Optical fiber: prices at seven-year highs, 2025-30e demand CAGR >20%

The rapid expansion of AI infrastructure is driving a significant increase in data transmission within and between data centers, bringing optical fiber into focus as a key enabling material for next-generation connectivity. Hyperscale AI data centers can require 5–10x more optical fiber than traditional data centers, with some estimates suggesting 5–36x more fiber per rack.

YOFC management expects global optical fiber demand to exceed 670mn fiber-km in 2026, with data center-related fiber demand growing 69% YoY.

Against this backdrop, we expect a CAGR of greater than 20% from 2025 to 2030 in AI-driven optical fiber demand in data centers. The strong demand environment has translated into tighter supply and sharply higher prices — optical fiber prices have reached a seven-year high.

Corning (GLW.N) is the preferred US exposure, having committed to a 50% increase in US fiber production capacity and a 10x expansion in US optical/connectivity capacity, with Lumen alone reserving 10% of GLW's global fiber capacity for 2025 and 2026. Additional multi-year agreements with Meta and Amazon, alongside the broader NVIDIA relationship, position Corning as a primary beneficiary.

Other key companies: Fujikura (5803.T), Furukawa Electric (5801.T), and YOFC (6869.HK).

Synthetic diamonds: the next thermal frontier

GPU thermal design power (TDP) continues to escalate — from approximately 1,200W in GB200 to approximately 2,300W in Rubin. Thus, conventional copper-based thermal solutions, with thermal conductivity of ~400 W/(m·K), are becoming inadequate. Inefficient heat transfer from the chip can lead to excessive temperatures and trigger thermal throttling, resulting in significant loss of computing performance.

This is driving increased R&D and adoption of synthetic diamonds and diamond-based composites: diamond-copper composites reach ~600–1,000 W/(m·K), while high-purity CVD diamond offers thermal conductivity of 2,000–2,400 W/(m·K).

NVIDIA's Vera Rubin platform is reportedly adopting diamond-copper composites, while Intel's CEO has disclosed a personal investment in a synthetic diamond wafer company.

As localized heat flux density in AI chips continues to rise and the industrialization of synthetic diamonds advances, the semiconductor industry is likely to see a gradual migration from conventional thermal materials toward diamond-based solutions.

Key beneficiaries include Asahi Diamond Industrial (6140.T) and Henan Liliang Diamond (301071.SZ), China's leading synthetic diamond producer.

Rare earths and scandium oxide: upstream AI power enablers

Rare earth oxides are essential dopants that enhance dielectric performance, reliability and miniaturization of advanced MLCCs.

Separately, scandium oxide (Sc_2O_3) is a key material used in solid oxide fuel cell (SOFC) technologies — one potential solution to the power shortages faced by AI data centers, particularly in North America. Scandium is used to stabilize zirconia, producing scandia-stabilized zirconia (ScSZ), a high-performance oxide-ion electrolyte that enables SOFCs to operate effectively at lower temperatures of roughly 600–800°C rather than ~800–1,000°C for traditional high-temperature designs.

Fuel cell providers can deploy their technology in as little as 50 days, with some customers reaching commercial operations within six months, making them an increasingly attractive on-site power solution for hyperscalers.

Hunan Oriental Scandium, a subsidiary of LB Group (002601.SZ), is a major global supplier of Sc_2O_3 and is expanding capacity from 40 tonnes to 100 tonnes per annum.

Supply constraint spotlight

The most acute near-term supply constraint is HVLP4+ copper foil: Our model implies undersupply widening from late 2026 to approximately 36% in 2027 and approximately 24% in 2028. Mitsui Kinzoku holds 41% of global capacity in 2026 and is the primary pricing and volume beneficiary.

For high-end MLCCs, Murata's April–June book-to-bill ratio reached 1.47 — the highest since 2004 — with utilization already at ~95%, while June 2026 Japanese MLCC export value rose 31.5% YoY versus volume growth of only 6.5%, confirming a powerful mix-driven ASP lift.

For glass fiber, we expect that Toyota weaving machine monthly shipments will reach only 300 units per month by end-2027. Chinese-made alternatives are not accepted by fabric producers because of low yield — a structural bottleneck that cannot be resolved quickly.

Near-term scarcity, long-term technology adoption

In the near term, we are most constructive on high-end glass fabric, HVLP copper foil, and optical fiber: Here AI-related demand is already translating into sustained shipments, higher utilization, and tighter supply.

Resin should also benefit from higher volumes and product-mix upgrades – albeit without the same degree of scarcity.

For CCL materials, the migration toward higher-grade copper-clad laminates and increasing PCB layer counts are raising both material content and value per system. More advanced grades require simultaneous upgrades in low-loss resin, smoother HVLP copper foil, and higher-spec low-Dk glass fabric. Optical fiber is seeing a similar near-term tightening as AI data center expansion drives substantially higher connectivity requirements. Data center-related fiber demand is expected to grow 69% YoY in 2026, while industry commentary points to demand exceeding supply and rising prices across major fiber categories.

We therefore favor materials where AI demand is already converting into shipments against constrained effective capacity. High-end glass fabric, HVLP copper foil, and optical fiber offer the clearest near-term exposure.

Over the longer term, we focus more on materials where evolving AI architectures and semiconductor technologies either:

- **Create new applications,**
- **Drive material substitution, or**
- **Structurally increase material intensity.**

At the chip level, rising power density and heat flux could drive adoption of advanced thermal management materials such as synthetic diamonds and diamond-based composites, whose thermal conductivity materially exceeds conventional copper solutions.

Meanwhile, continued semiconductor scaling should support demand for high-purity tungsten materials used in deposition and interconnect structures. The emerging transition from tungsten to molybdenum in high-layer-count 3D NAND creates an additional material substitution opportunity.

We therefore think that synthetic diamonds and advanced semiconductor materials such as tungsten and molybdenum represent longer-duration opportunities tied more closely to technology adoption and architectural change.

The next leg is content, not units

AI materials have already undergone a meaningful re-rating, shifting the debate from simple AI exposure toward the rising material intensity of each successive generation of AI infrastructure. Our AI materials group has risen 91% over the past 12 months, although this still trails the 147% gain in PCB/CCL companies over the same period. The valuation gap also remains meaningful, with the materials group trading at around 26x 2026E P/E, versus roughly 35x for PCB/CCL peers.

As AI exposure becomes increasingly recognized, we believe the next question is how much additional material value each new generation of AI infrastructure requires.

We think this content effect remains underappreciated: Our estimated 2030 CCL TAM of ~US$47bn is meaningfully above market forecasts of ~US$30–35bn, reflecting not only continued AI infrastructure investment but also increasing material intensity per system. Higher PCB layer counts increase the physical amount of CCL and its constituent materials required, while migration toward lower-loss grades simultaneously raises the value of resin, HVLP copper foil, and low-Dk glass fabric used in each system.

The result is a dual content effect—more material and higher-value material per system—allowing materials demand to grow faster than AI system units. The spending backdrop remains supportive, with our house view for cash cloud capex at ~US$1.2tn in CY26 (+104% YoY) and ~US$1.6tn in CY27 (+38%), leaving scope for further consensus revisions.

The recent correction also changes the setup. Despite the strong re-rating over the past year, the AI materials group is now around 36% below its 52-week highs on average, while the underlying drivers of higher material content and specification upgrades remain intact. This improves the risk/reward relative to the earlier phase of the rally.

Key risks

Optical fiber medium-term normalization: Aggressive capacity additions by Corning, Fujikura, and Furukawa could normalize supply-demand conditions and pressure pricing over the medium term, even as near-term demand remains robust.

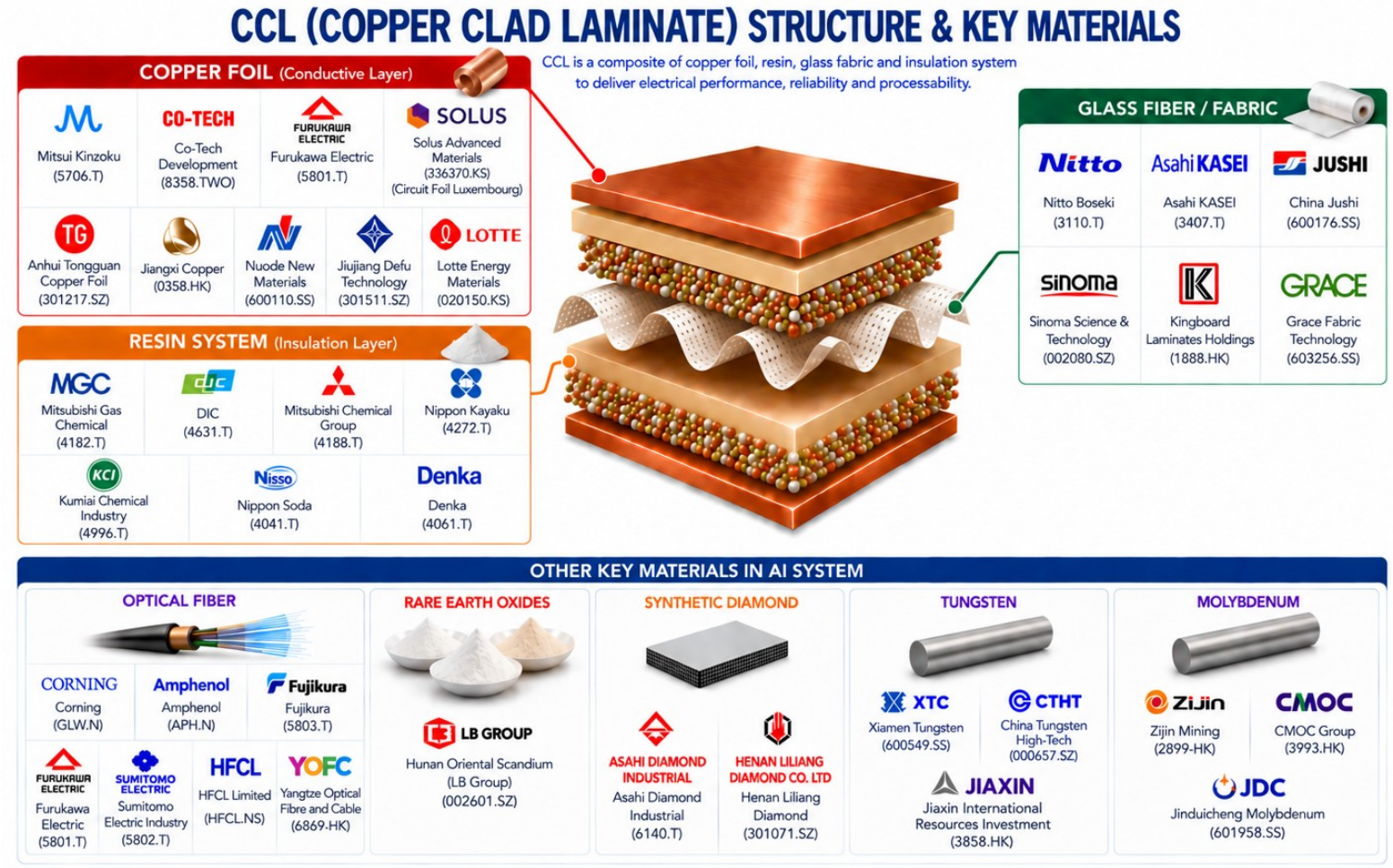
Glass fiber weaving machine bottleneck: Toyota weaving machine monthly shipments will reach only 300 units per month by end-2027. Chinese-made alternatives are not accepted by fabric producers because of low yield, constraining the pace of capacity expansion across the industry.

MLCC powder pricing inelasticity: Despite the current AI-driven up-cycle, MLCC dielectric powder suppliers have not yet raised prices. Any hike requires careful negotiation with downstream customers and could compress margins at the component level.

Geopolitical supply risk: China produced approximately 82% of global mined tungsten in 2024 and has required export licences since February 2025, with Chinese tungsten exports falling 20.7% YoY.

Key Exhibits

Exhibit 1: Material Stocks around AI Chain



Source: Morgan Stanley Research

Exhibit 2: Material Stocks around AI Chain



Source: Morgan Stanley Research

Rank	Material	Investment View	What isn't priced in	Related Stocks
1	High-end glass fabric	Most attractive	Duration of shortage/inability of supply to respond	Nitto Boseki (3110.T); Asahi Kasei (3407.T); China Jushi (600176.SS); Sinoma Science & Technology (002080.SZ) via Taishan Fiberglass; Kingboard Laminates (1888.HK); Grace Fabric Technology (603256.SS)
2	HVLP4+ copper foil	Very attractive	2027 shortage + pricing + earnings leverage	Mitsui Kinzoku (5706.T); Co-Tech Development (8358.TWO); Furukawa Electric (5801.T); Circuit Foil Luxembourg (part of Solus Advanced Materials, 336370.KS); Anhui Tongguan Copper Foil (301217.SZ); Jiangxi Copper (0358.HK); Nuode New Materials (600110.SS); Jiujiang Defu Technology (301511.SZ); Lotte Energy Materials (020150.KS)
3	Optical Fiber	Positive, but more selective	Near-term pricing/volume; medium-term capacity risk	Corning (GLW); Amphenol (APH); Fujikura (5803.T); Furukawa Electric (5801.T); Sumitomo Electric Industry (5802.T); HFCL (HFCL.NS); Yangtze Optical Fibre and Cable/YOFC (6869.HK)
4	MLCC	Positive	Content/mix lift more than unit growth	Murata Manufacturing (6981.T); Taiyo Yuden (6976.T)
5	Resin	Structural beneficiary, less scarcity	Grade migration/content	Resonac Holdings (4004.T) via HD MicroSystems; Asahi Kasei (3407.T); Sumitomo Bakelite (4203.T); Toray Industries (3402.T); Mitsubishi Gas Chemical (4182.T); DIC (4631.T); Mitsubishi Chemical Group (4188.T); Nippon Kayaku (4272.T); Kumiai Chemical Industry (4996.T); Nippon Soda (4041.T); Denka (4061.T)
6	Diamonds / tungsten / molybdenum / rare earth elements	Longer-duration optionality	Technology adoption still needs to translate into earnings	**Diamonds:** Asahi Diamond Industrial (6140.T); Henan Liliang Diamond (301071.SZ). **Tungsten:** Xiamen Tungsten (600549.SS); China Tungsten High-Tech (000657.SZ); Jiaxin International Resources Investment (3858.HK) **Molybdenum:** Zijin Mining (2899.HK); CMOC Group (3993.HK); Jinduicheng Molybdenum (601958.SS)

Valuation Comparables

Exhibit 3: AI Material Comps

AI Materials	Prices are as of close	10-Sep-26			MCap	EV (Mn)								ROE		
	Company Name	Price Local	Price Target	MS Rating	USD	USD	Last 7 Days	Last Month	Last 3 Months	Last 12 Months	YTD	% Off 52w High	% Off 52w Low	2025e	2026e	2027e
5706-JP	Mitsui Kinzoku Co., Ltd.	24,705.00	56,000.00	OW	9,153	9,121	(10%)	(21%)	(48%)	113%	30%	(60%)	128%	24.5%	20.2%	20.8%
8358-TW	Co-Tech Development Corp.	521.00	NA	NA	4,031	4,170	(3%)	16%	(15%)	95%	75%	(36%)	147%	14.1%	26.7%	44.1%
5801-JP	Furukawa Electric Co., Ltd.	4,024.00	6,600.00	OW	18,332	19,795	3%	(6%)	(6%)	328%	296%	(37%)	359%	13.8%	18.5%	24.6%
336370-KR	Solus Advanced Materials Co., Ltd.	7,560.00	NA	NA	396	1,215	18%	13%	(28%)	13%	20%	(48%)	65%	(11.1%)	8.3%	0.4%
301217-CN	Anhui Tongguan Copper Foil Group Co., L	108.45	NA	NA	13,406	13,447	2%	(15%)	(28%)	209%	199%	(49%)	281%	NA	4.6%	8.2%
358-HK	Jiangxi Copper Company Limited Class H	339,000.00	370,000.00	EW	18,997	26,460	(6%)	(9%)	(0%)	37%	(20%)	(36%)	43%	1.2%	3.6%	3.8%
600110-CN	Nuode New Materials Co., Ltd. Class A	11.25	NA	NA	2,911	4,064	(4%)	2%	(18%)	34%	49%	(43%)	72%	(5.3%)	6.1%	15.7%
301511-CN	Jiujiang Defu Technology Co., Limited Cla	108.68	NA	NA	6,070	11,545	21%	15%	(25%)	185%	188%	(42%)	270%	2.8%	16.0%	28.8%
020150-KR	Lotte Energy Materials Corporation	41,200.00	20,000.00	UW	1,408	1,542	17%	30%	(24%)	81%	41%	(48%)	100%	(10.0%)	(0.6%)	1.7%
3110-JP	Nitto Boseki Co., Ltd.	2,955.00	6,000.00	OW	3,483	3,502	(8%)	(8%)	(24%)	90%	37%	(57%)	126%	3.1%	10.9%	13.7%
3407-JP	Asahi Kasei Corporation	1,566.50	2,200.00	OW	13,760	19,579	(4%)	(11%)	(14%)	29%	11%	(19%)	35%	10.3%	9.9%	10.8%
600176-CN	China Jushi Co., Ltd. Class A	43.46	88.50	OW	25,943	27,415	4%	(3%)	1%	160%	145%	(46%)	183%	10.7%	22.4%	30.6%
002080-CN	Sinoma Science & Technology Co., Ltd. (	50.85	56.03	OW	12,725	15,304	2%	(15%)	(22%)	34%	34%	(52%)	67%	9.5%	12.0%	14.3%
1888-HK	Kingboard Laminates Holdings Limited (H	101.65	115.00	OW	10,514	9,642	5%	20%	(29%)	278%	251%	(57%)	341%	7.3%	10.9%	13.2%
603256-CN	Grace Fabric Technology Co., Ltd. Class	129.10	NA	NA	17,414	17,549	3%	(20%)	(40%)	214%	237%	(59%)	343%	12.1%	33.7%	41.9%
4004-JP	Resonac Holdings Corporation	16,005.00	22,400.00	OW	21,056	25,578	(8%)	(18%)	(16%)	233%	119%	(30%)	229%	4.3%	13.7%	16.1%
4203-JP	Sumitomo Bakelite Co., Ltd.	7,508.00	8,000.00	OW	4,266	3,384	7%	(3%)	17%	48%	47%	(5%)	61%	8.8%	9.0%	10.0%
3402-JP	Toray Industries, Inc.	1,229.00	1,700.00	OW	11,607	14,548	(2%)	(10%)	7%	24%	20%	(12%)	34%	4.5%	6.3%	7.7%
4182-JP	Mitsubishi Gas Chemical Company, Inc.	3,863.00	5,900.00	OW	4,872	4,717	(1%)	(6%)	(22%)	36%	35%	(33%)	57%	4.5%	10.1%	9.6%
4631-JP	Dic Corporation	4,645.00	++	++	2,848	5,109	(5%)	(18%)	(4%)	26%	26%	(22%)	32%	6.5%	6.8%	6.2%
4188-JP	Mitsubishi Chemical Group Corporation	1,184.50	1,550.00	OW	10,424	935	(7%)	(8%)	6%	32%	25%	(12%)	44%	(4.7%)	7.8%	8.1%
4272-JP	Nippon Kayaku Co., Ltd.	2,039.00	NA	NA	1,970	2,065	(1%)	(3%)	(3%)	41%	21%	(7%)	50%	8.6%	8.8%	8.8%
4996-JP	Kumiai Chemical Industry Co., Ltd.	759.00	NA	NA	657	799	(3%)	(1%)	4%	(10%)	7%	(11%)	13%	3.0%	5.1%	4.9%
4041-JP	Nippon Soda Co., Ltd.	3,810.00	NA	NA	1,369	1,532	(2%)	(3%)	7%	11%	5%	(9%)	16%	8.8%	7.8%	8.1%
4061-JP	Denka Co., Ltd.	3,312.00	4,500.00	EW	1,849	3,210	0%	(10%)	(19%)	39%	19%	(31%)	50%	4.5%	7.0%	8.0%
GLW-US	Corning Inc	163.12	165.00	EW	142,730	150,452	6%	(3%)	(9%)	116%	86%	(40%)	115%	19.6%	22.8%	25.8%
APH-US	Amphenol Corporation Class A	8,900.00	10,158.00	OW	13,408	13,668	(3%)	(6%)	4%	34%	19%	(10%)	37%	19.1%	22.1%	24.0%
5803-JP	Fujikura Ltd	5,209.00	6,800.00	EW	55,847	55,807	(2%)	(14%)	17%	113%	71%	(37%)	123%	32.7%	40.5%	36.6%
5802-JP	Sumitomo Electric Industries, Ltd.	2,111.50	3,625.00	EW	42,658	40,863	(3%)	(9%)	(25%)	95%	30%	(45%)	101%	12.6%	11.5%	13.3%
500183-IN	Hfcl Limited	233.60	NA	NA	3,746	3,898	(3%)	2%	31%	220%	227%	(12%)	276%	7.8%	17.8%	19.8%
6869-HK	Yangtze Optical Fibre And Cable Joint St	177.40	230.00	OW	34,312	34,934	9%	32%	(24%)	223%	235%	(43%)	456%	4.9%	35.1%	42.1%
002601-CN	Lb Group Co., Ltd. Class A	15.45	NA	NA	4,579	9,281	(7%)	(8%)	(4%)	(20%)	(25%)	(38%)	8%	5.3%	7.1%	10.6%
6140-JP	Asahi Diamond Industrial Co., Ltd.	1,122.00	1,300.00	EW	357	251	(6%)	(16%)	(12%)	25%	31%	(37%)	38%	3.2%	4.3%	3.3%
301071-CN	Henan Liliang Diamond Co., Ltd. Class A	61.94	33.20	UW	2,404	2,215	(2%)	(2%)	(12%)	93%	65%	(45%)	94%	4.9%	5.4%	5.8%
600549-CN	Xiamen Tungsten Co. Ltd. Class A	49.73	NA	NA	11,773	16,332	(2%)	(16%)	(26%)	51%	16%	(51%)	75%	13.4%	22.5%	23.6%
000657-CN	China Tungsten & Hightech Materials Co.	59.42	NA	NA	20,189	21,479	(2%)	(20%)	(28%)	190%	104%	(50%)	247%	13.2%	34.1%	31.6%
3858-HK	Jiaxin International Resources Investment	57.05	NA	NA	3,316	3,188	(6%)	(15%)	(42%)	71%	11%	(71%)	93%	23.3%	71.1%	55.9%
2899-HK	Zijin Mining Group Co., Ltd. Class H (H)	37.34	61.00	OW	133,245	153,930	(6%)	(4%)	10%	17%	(3%)	(27%)	30%	31.8%	35.0%	30.6%
3993-HK	Cmoc Group Limited Class H (H)	17.34	26.30	OW	58,777	62,846	(5%)	(14%)	(17%)	23%	(19%)	(38%)	29%	26.5%	33.2%	28.3%
601958-CN	Jinduicheng Molybdenum Co., Ltd. Class	21.20	NA	NA	10,200	9,271	(5%)	(14%)	(22%)	27%	28%	(37%)	48%	NA	18.3%	18.3%
	Average						***(1%)***	***(5%)***	***(13%)***	***91%***	***70%***	***(36%)***	***123%***	***9.2%***	***16.7%***	***18.2%***
	Median						***(2%)***	***(8%)***	***(15%)***	***50%***	***32%***	***(38%)***	***74%***	***8.2%***	***11.2%***	***14.0%***

AI Materials		P/E			EV/EBITDA			FCF Yield			P/B			Dividend Yield		
	Company Name	2025e	2026e	2027e	2025e	2026e	2027e	2025e	2026e	2027e	2025e	2026e	2027e	2025e	2026e	2027e
5706-JP	Mitsui Kinzoku Co., Ltd.	17.6	15.6	12.7	11.3	9.5	7.7	1%	(0%)	2%	3.9	2.9	2.4	0.9%	1.0%	1.2%
8358-TW	Co-Tech Development Corp.	NM	50.3	23.2	NM	NA	NA	0%	0%	0%	17.5	13.4	10.2	0.4%	0.6%	1.4%
020150-KR	Lotte Energy Materials Corporation	NM	NM	80.2	NM	16.2	11.7	(2%)	2%	2%	1.0	1.4	1.3	0.0%	0.1%	0.2%
301217-CN	Anhui Tongguan Copper Foil Group Co., L	NM	NM	87.7	NM	NA	NA	(0%)	0%	0%	NA	7.5	7.2	0.0%	0.4%	0.9%
600110-CN	Nuode New Materials Co., Ltd. Class A	NM	53.6	17.3	46.0	NA	NA	(2%)	0%	0%	3.5	3.3	2.7	NA	NA	NA
301511-CN	Jiujiang Defu Technology Co., Limited Cla	NM	88.3	34.4	NM	NA	NA	(1%)	0%	0%	16.7	14.1	9.9	0.1%	0.6%	1.7%
358-HK	Jiangxi Copper Company Limited Class H	35.1	12.7	11.6	5.5	5.5	5.2	(5%)	(26%)	(3%)	0.4	0.4	0.4	4.0%	3.0%	3.4%
5801-JP	Furukawa Electric Co., Ltd.	38.7	34.0	21.2	21.0	20.7	14.6	(2%)	(2%)	(1%)	4.9	5.8	4.7	0.7%	0.5%	0.6%
336370-KR	Solus Advanced Materials Co., Ltd.	NM	11.3	NM	NM	NA	NA	(3%)	0%	0%	1.0	0.9	0.9	0.1%	0.1%	0.1%
3110-JP	Nitto Boseki Co., Ltd.	NM	27.2	19.6	22.7	14.6	11.2	(6%)	(6%)	(1%)	3.9	2.8	2.6	0.7%	1.0%	1.7%
3407-JP	Asahi Kasei Corporation	10.1	10.0	8.6	6.9	6.3	5.8	5%	3%	7%	1.0	1.0	0.9	2.8%	2.8%	3.3%
600176-CN	China Jushi Co., Ltd. Class A	20.8	23.4	14.7	11.3	15.8	10.3	4%	3%	6%	2.2	4.9	4.1	2.1%	1.9%	3.0%
002080-CN	Sinoma Science & Technology Co., Ltd. (	33.5	37.7	27.8	15.4	13.7	10.0	3%	2%	6%	3.1	4.0	3.8	1.6%	0.7%	1.0%
1888-HK	Kingboard Laminates Holdings Limited (H	14.3	13.6	10.2	6.0	6.9	6.0	(1%)	(3%)	(5%)	1.1	1.4	1.3	2.8%	2.9%	3.9%
603256-CN	Grace Fabric Technology Co., Ltd. Class	NM	NM	59.1	NM	NA	NA	0%	0%	0%	69.4	38.1	24.8	0.1%	0.3%	0.5%
4004-JP	Resonac Holdings Corporation	45.6	31.8	23.8	14.4	16.2	12.7	2%	1%	5%	1.9	4.1	3.6	1.0%	0.4%	0.5%
4203-JP	Sumitomo Bakelite Co., Ltd.	15.1	20.5	17.2	5.8	9.8	8.2	5%	(2%)	3%	1.2	1.8	1.7	2.3%	1.6%	2.0%
3402-JP	Toray Industries, Inc.	20.8	15.5	12.0	9.0	7.6	6.9	2%	(6%)	6%	0.9	1.0	0.9	1.8%	2.1%	2.3%
4182-JP	Mitsubishi Gas Chemical Company, Inc.	23.9	11.3	11.3	7.9	6.8	6.1	1%	(3%)	2%	1.1	1.1	1.1	2.8%	2.8%	3.1%
4631-JP	Dic Corporation	12.2	13.5	14.3	6.5	7.0	6.9	10%	7%	6%	0.7	0.9	0.9	5.5%	3.0%	3.2%
4188-JP	Mitsubishi Chemical Group Corporation	NM	11.4	10.5	11.8	6.4	6.2	5%	1%	9%	0.7	0.9	0.8	3.6%	3.0%	3.2%
4272-JP	Nippon Kayaku Co., Ltd.	12.7	11.5	10.8	8.3	NA	NA	9%	0%	0%	1.1	1.0	1.0	3.2%	3.2%	3.4%
4996-JP	Kumiai Chemical Industry Co., Ltd.	20.9	12.1	12.1	7.2	NA	NA	37%	0%	0%	0.6	0.6	0.6	3.2%	3.2%	3.2%
4041-JP	Nippon Soda Co., Ltd.	11.3	12.5	11.6	10.3	NA	NA	10%	0%	0%	1.0	1.0	0.9	4.2%	4.2%	4.4%
4061-JP	Denka Co., Ltd.	22.3	13.0	10.8	9.3	8.7	7.8	(4%)	(12%)	3%	1.0	0.9	0.8	2.8%	3.0%	3.0%
GLW-US	Corning Inc	34.5	49.7	38.7	18.4	25.9	21.2	1%	1%	1%	6.4	NM	9.3	1.3%	0.7%	0.8%
APH-US	Amphenol Corporation Class A	55.0	50.1	38.4	29.3	27.7	22.2	(0%)	0%	1%	NM	NM	8.6	0.0%	0.0%	0.0%
5803-JP	Fujikura Ltd	42.8	33.5	29.9	31.1	23.7	21.2	1%	0%	2%	NM	NM	10.0	0.9%	1.2%	1.5%
5802-JP	Sumitomo Electric Industries, Ltd.	20.5	20.1	16.2	10.0	9.1	7.6	3%	4%	4%	2.4	2.2	2.1	1.8%	2.0%	2.5%
500183-IN	Hfcl Limited	93.4	34.9	25.7	49.3	NA	NA	(2%)	0%	0%	7.3	6.2	5.1	0.0%	0.1%	0.1%
6869-HK	Yangtze Optical Fibre And Cable Joint St	47.3	16.7	9.9	25.4	23.0	14.9	10%	(4%)	5%	2.2	5.0	3.5	1.2%	0.2%	1.8%
002601-CN	Lb Group Co., Ltd. Class A	29.7	22.0	14.2	11.4	NA	NA	11%	0%	0%	1.6	1.6	1.5	3.9%	4.4%	6.3%
6140-JP	Asahi Diamond Industrial Co., Ltd.	29.4	20.3	26.5	7.1	5.4	6.2	3%	4%	2%	0.9	0.9	0.9	2.5%	3.0%	3.2%
301071-CN	Henan Liliang Diamond Co., Ltd. Class A	34.8	52.3	47.3	13.7	22.2	19.7	4%	2%	3%	1.7	2.8	2.7	1.0%	0.7%	0.8%
600549-CN	Xiamen Tungsten Co. Ltd. Class A	34.3	17.4	14.5	19.9	NA	NA	4%	0%	0%	4.6	3.9	3.4	1.6%	2.6%	3.3%
000657-CN	China Tungsten & Hightech Materials Co.	NM	31.1	26.3	NM	NA	NA	0%	0%	0%	13.9	10.6	8.3	NA	1.2%	1.4%
3858-HK	Jiaxin International Resources Investment	NM	21.0	15.4	NM	NA	NA	1%	0%	0%	16.2	6.8	3.9	0.0%	1.0%	1.9%
2899-HK	Zijin Mining Group Co., Ltd. Class H (H)	16.4	11.2	9.8	11.1	7.3	6.0	6%	4%	11%	4.6	3.4	2.7	1.5%	2.3%	3.6%
3993-HK	Cmoc Group Limited Class H (H)	18.4	10.1	9.6	10.5	6.0	5.6	3%	12%	11%	4.5	3.0	2.5	1.5%	1.9%	4.0%
601958-CN	Jinduicheng Molybdenum Co., Ltd. Class	NA	NM	NM	13.6	NA	NA	0%	0%	0%	NA	3.2	2.9	NA	0.1%	0.2%
	Average	***29.0***	***25.6***	***23.3***	***15.2***	***12.9***	***10.5***	***3%***	***(0%)***	***2%***	***5.7***	***4.5***	***3.9***	***1.7%***	***1.6%***	***2.1%***
	Median	***23.1***	***20.2***	***15.8***	***11.3***	***9.5***	***7.8***	***1%***	***0%***	***1%***	***2.0***	***2.8***	***2.6***	***1.5%***	***1.2%***	***1.9%***

Source: Prismark, Morgan Stanley Research estimates.

Exhibit 4: PCB & CCL Comps

Prices are as of close		10-Sep-26														
PCB&CCL Comps					MCap	EV (Mn)							ROE		
	Company Name	Price Local	Price Target	MS Rating	USD	USD	Last 7 Days	Last Month	Last 3 Months	Last 12 Months	YTD	% Off 52w High	% Off 52w Low	2025e	2026e	2027e
6981-JP	Murata Manufacturing Co., Ltd.	7,525.00	12,500.00	OW	88,711	84,167	(0%)	(5%)	(16%)	188%	121%	(44%)	188%	8.8%	12.2%	16.7%
6976-JP	Taiyo Yuden Co., Ltd.	9,403.00	12,500.00	UW	8,383	8,856	(5%)	(13%)	(43%)	194%	153%	(63%)	194%	4.5%	8.7%	12.3%
6762-JP	Tdk Corporation	2,850.50	4,900.00	OW	35,080	31,779	(5%)	(11%)	(21%)	39%	25%	(36%)	46%	9.8%	10.8%	11.2%
6971-JP	Kyocera Corporation	3,469.00	4,000.00	EW	29,595	18,496	(1%)	(8%)	(5%)	70%	58%	(14%)	79%	4.3%	4.3%	4.6%
002465-CN	Guangzhou Haige Communications Gro	10.22	NA	NA	3,506	3,979	0%	(7%)	(27%)	(27%)	(36%)	(62%)	8%	NA	1.6%	3.9%
300476-CN	Victory Giant Technology (Huizhou) Co	229.95	NA	NA	29,667	23,622	1%	(20%)	(32%)	(34%)	(23%)	(45%)	25%	26.0%	20.9%	30.2%
002916-CN	Shennan Circuit Co., Ltd. Class A	392.31	415.00	EW	37,212	37,465	18%	1%	3%	93%	68%	(20%)	114%	20.6%	27.1%	32.2%
603228-CN	Shenzhen Kinwong Electronic Co., Ltd.	110.01	NA	NA	16,424	16,757	15%	13%	52%	77%	52%	(2%)	107%	9.6%	14.2%	18.8%
002384-CN	Suzhou Dongshan Precision Manufactu	193.74	NA	NA	52,914	54,983	6%	(6%)	(13%)	138%	123%	(33%)	220%	6.5%	28.5%	46.6%
002938-CN	Avary Holding (Shenzhen) Co., Ltd. Cla	7.65	9.60	EW	1,766	1,821	8%	(11%)	(12%)	58%	77%	(27%)	113%	(7.2%)	8.7%	7.5%
600601-CN	Founder Technology Group Co. Ltd. Cla	14.82	NA	NA	9,216	10,501	11%	12%	13%	41%	24%	(9%)	67%	NA	NA	NA
002815-CN	Suntak Technology Co., Ltd. Class A	18.25	NA	NA	3,359	3,279	32%	47%	12%	17%	41%	(7%)	80%	NA	NA	NA
1888-HK	Kingboard Laminates Holdings Limited	101.65	115.00	OW	10,514	9,642	5%	20%	(29%)	278%	251%	(57%)	341%	7.3%	10.9%	13.2%
600183-CN	Shengyi Technology Co., Ltd. Class A	146.96	74.00	EW	50,050	50,005	2%	(2%)	(7%)	166%	96%	(27%)	175%	19.0%	24.6%	29.1%
688519-CN	Nanya New Material Technology Co., Lt	309.59	NA	NA	10,857	10,872	13%	1%	1%	314%	273%	(31%)	405%	8.7%	NA	NA
603186-CN	Zhejiang Wazam New Material Co., Ltd	64.68	70.00	OW	56,903	68,992	25%	36%	24%	446%	327%	(21%)	465%	4.2%	5.8%	9.6%
002636-CN	Goldenmax International Group Ltd. Cla	76.45	NA	NA	8,299	8,392	15%	8%	(17%)	447%	344%	(40%)	559%	NA	NA	NA
	Average						***8%***	***3%***	***(7%)***	***147%***	***116%***	***(32%)***	***187%***	***9.4%***	***13.7%***	***18.1%***
	Median						***6%***	***(2%)***	***(12%)***	***93%***	***77%***	***(31%)***	***114%***	***8.7%***	***10.9%***	***13.2%***

PCB&CCL Comps		P/E			EV/EBITDA			FCF Yield			P/B			Dividend Yield		
	Company Name	2025e	2026e	2027e	2025e	2026e	2027e	2025e	2026e	2027e	2025e	2026e	2027e	2025e	2026e	2027e
6981-JP	Murata Manufacturing Co., Ltd.	26.7	40.6	27.7	12.0	21.4	16.0	3%	2%	2%	2.3	4.9	4.5	1.9%	0.9%	1.0%
6976-JP	Taiyo Yuden Co., Ltd.	34.3	42.0	27.6	8.4	14.3	10.9	3%	4%	2%	1.5	3.6	3.3	2.4%	1.1%	1.2%
6762-JP	Tdk Corporation	19.1	22.1	19.7	6.8	8.4	7.6	6%	2%	3%	1.7	2.3	2.1	1.8%	1.4%	1.5%
6971-JP	Kyocera Corporation	23.2	32.5	29.6	5.1	11.6	11.5	2%	0%	(3%)	0.9	1.4	1.3	2.2%	1.9%	2.0%
002465-CN	Guangzhou Haige Communications Gro	NM	NM	57.8	NM	NA	NA	(2%)	0%	0%	NA	2.3	2.2	NA	NA	NA
300476-CN	Victory Giant Technology (Huizhou) Co	47.2	27.3	14.1	25.8	NA	NA	2%	0%	0%	12.3	5.7	4.3	0.2%	0.6%	0.9%
002916-CN	Shennan Circuit Co., Ltd. Class A	47.3	50.4	33.5	32.6	39.0	27.3	(0%)	2%	1%	6.6	9.1	7.0	0.5%	0.4%	0.7%
603228-CN	Shenzhen Kinwong Electronic Co., Ltd.	86.3	50.8	31.4	49.5	NA	NA	2%	0%	0%	8.3	7.2	5.9	NA	NA	NA
002384-CN	Suzhou Dongshan Precision Manufactu	NM	43.2	16.3	NM	NA	NA	2%	0%	0%	16.5	12.3	7.6	0.0%	0.3%	1.1%
002938-CN	Avary Holding (Shenzhen) Co., Ltd. Cla	NM	5.2	5.8	4.2	3.5	3.2	13%	16%	5%	0.4	0.4	0.4	0.6%	4.9%	4.4%
600601-CN	Founder Technology Group Co. Ltd. Cla	NA	NA	NA	NM	NA	NA	1%	0%	0%	NA	NA	NA	NA	NA	NA
002815-CN	Suntak Technology Co., Ltd. Class A	NA	NA	NA	19.7	NA	NA	2%	0%	0%	NA	NA	NA	NA	NA	NA
1888-HK	Kingboard Laminates Holdings Limited	14.3	13.6	10.2	6.0	6.9	6.0	(1%)	(3%)	(5%)	1.1	1.4	1.3	2.8%	2.9%	3.9%
600183-CN	Shengyi Technology Co., Ltd. Class A	51.1	71.3	51.7	36.2	NM	38.0	6%	1%	2%	9.2	NM	NM	0.6%	0.6%	0.8%
688519-CN	Nanya New Material Technology Co., Lt	NM	NM	59.4	NM	NA	NA	0%	0%	0%	25.3	NA	NA	NA	0.5%	0.7%
603186-CN	Zhejiang Wazam New Material Co., Ltd	16.0	17.7	10.1	7.3	8.4	6.0	3%	2%	6%	0.6	1.0	0.9	1.3%	0.8%	0.9%
002636-CN	Goldenmax International Group Ltd. Cla	NA	NA	NA	NM	NA	NA	0%	0%	0%	NA	NA	NA	NA	NA	NA
	Average	***36.6***	***34.7***	***28.2***	***17.8***	***14.2***	***14.0***	***2%***	***2%***	***1%***	***6.7***	***4.3***	***3.4***	***1.3%***	***1.4%***	***1.6%***
	Median	***30.5***	***36.5***	***27.6***	***10.2***	***10.0***	***10.9***	***2%***	***0%***	***0%***	***2.3***	***2.9***	***2.8***	***1.3%***	***0.9%***	***1.0%***

Source: Prismark, Morgan Stanley Research estimates

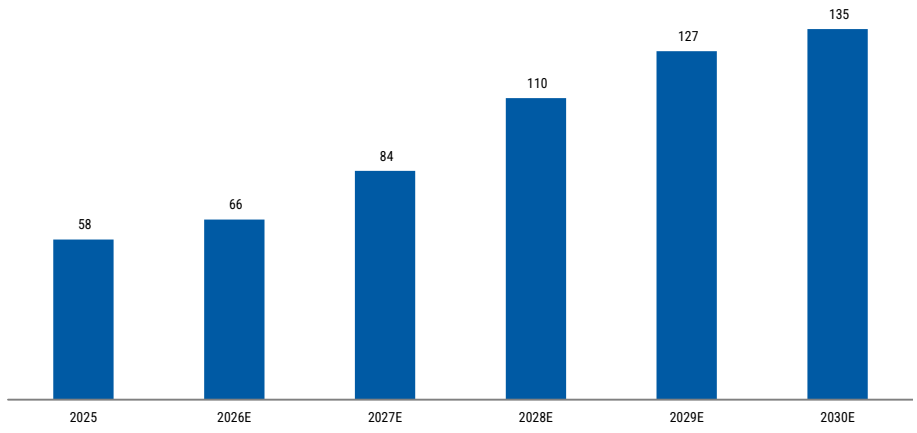
PCB Demand Outlook

Howard Kao

We estimate the global PCB addressable market will expand at an 18% CAGR from 2025-30, from ~US$58bn to ~US$135bn: This projected increase is driven almost entirely by AI and data center infrastructure. As shown in Exhibit 5 , AI/data center PCB demand is expected to increase more than sixfold, from ~US$13bn in 2025 to ~US$86bn by 2030, taking its share of industry revenue from ~20-25% to ~64%. By our estimates, AI/data center applications account for essentially all of the industry's net growth through 2030, with demand across other end markets broadly stable (see details).

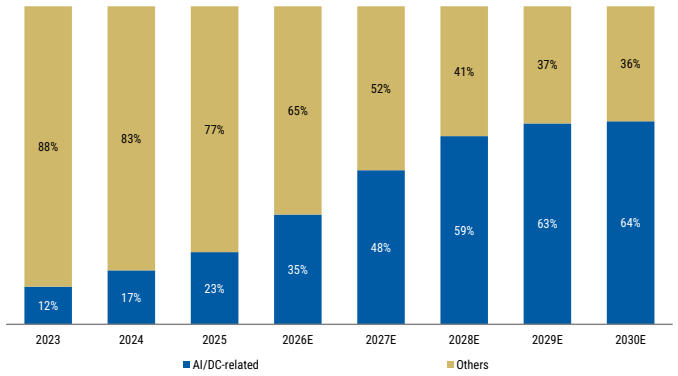
We expect growth to be broad-based across general servers, GPU servers, custom ASIC servers, networking switches, and optical modules, supported by rising system shipments and continued scaling of computing clusters. PCB content per system should also increase materially, reflecting larger board sizes, higher layer counts, more advanced materials, tighter electrical requirements, and greater manufacturing complexity. The combination of higher volumes and rising PCB value per system underpins the sharp expansion we expect in AI/data center PCB demand through 2030.

Exhibit 5: We estimate the global PCB TAM will expand at an 18% CAGR from ~US $58bn in 2025 to ~US$135bn in 2030



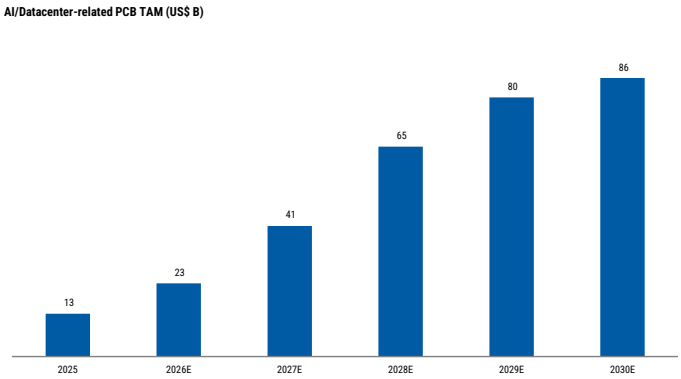
Source: Prismark, Morgan Stanley Research estimates.

Exhibit 6: AI/data center-related PCB will rise to ~64% of the mix by 2030



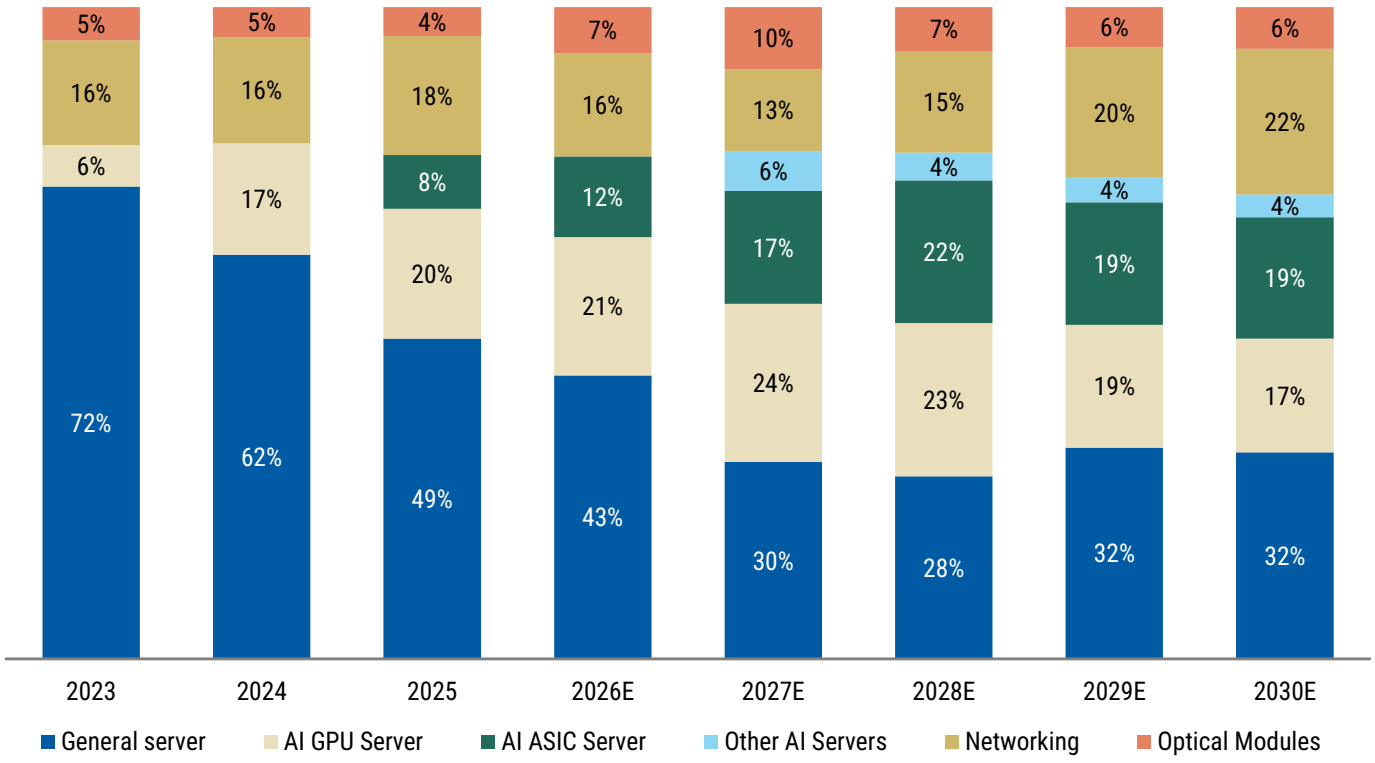
Source: Morgan Stanley Research estimates.

Exhibit 7: We estimate that the AI/data center-related PCB TAM will expand at a 45% CAGR from 2025-2030



Source: Morgan Stanley Research estimates.

Exhibit 8:
Our estimate of breakdown of different end segments of the AI/data center-related PCB TAM



Source: Morgan Stanley Research estimates.

Advanced AI PCB manufacturing requires a longer cycle

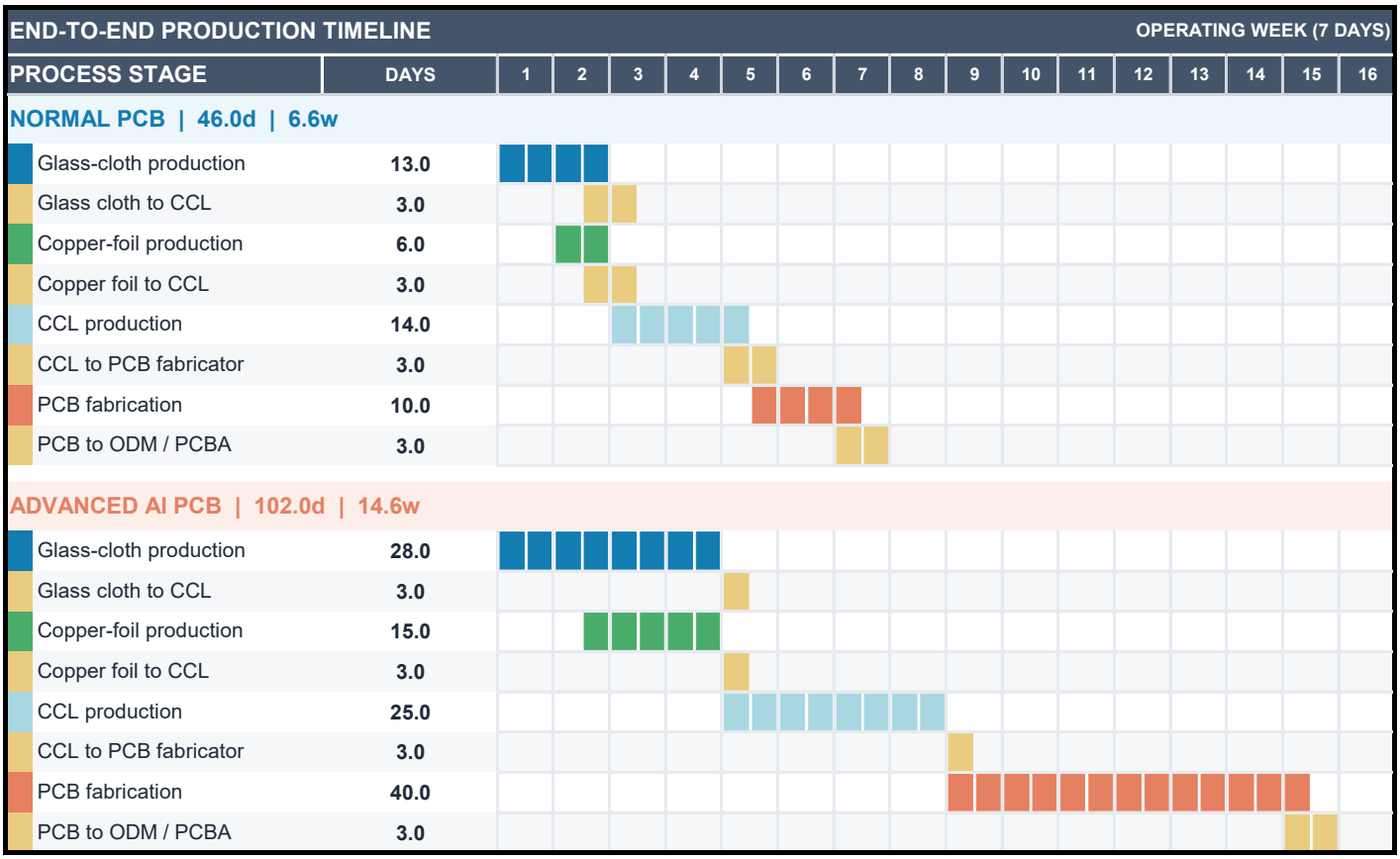
Advanced AI server PCBs take ~2.2x longer to produce than a normal PCB: Based on our assumptions, the end-to-end lead time for an advanced AI PCB is approximately 100 days, or 14.6 weeks, compared with 46 days, or 6.6 weeks, for a conventional multilayer PCB. This represents an incremental lead time of 56 days, or eight weeks, meaning that an AI PCB takes ~2.2x as long to produce and deliver to the ODM.

- Transportation lead times are assumed to be the same for both products, so the full difference reflects the longer manufacturing cycle for the advanced AI PCB. The additional lead time consists of approximately 15 days for glass cloth production, 11 days for CCL production, and 30 days for PCB fabrication.

The primary driver is the greater manufacturing complexity of the advanced AI PCB: Higher-performance materials, including low-Dk+ glass cloth and HVLP+ copper foil, require longer production cycles, although these materials are produced in parallel and therefore do not add to lead time sequentially. The largest difference arises during PCB fabrication. Our estimate assumes an NVIDIA-grade computing board with 22 layers and five lamination cycles, compared with a conventional 12–16-layer multilayer board requiring a single lamination cycle.

Each additional HDI build-up cycle may involve another round of lay-up, lamination, cooling, laser drilling, copper plating or via filling, imaging, and inspection before the next layer sequence can begin. Advanced AI boards also require tighter layer-to-layer registration, finer circuitry, stricter impedance control, and more extensive quality assurance. Together, these requirements extend the manufacturing cycle and increase the risk of yield loss or rework.

Exhibit 9: An advanced AI PCB takes ~2.2x more time to produce vs the average normal PCB



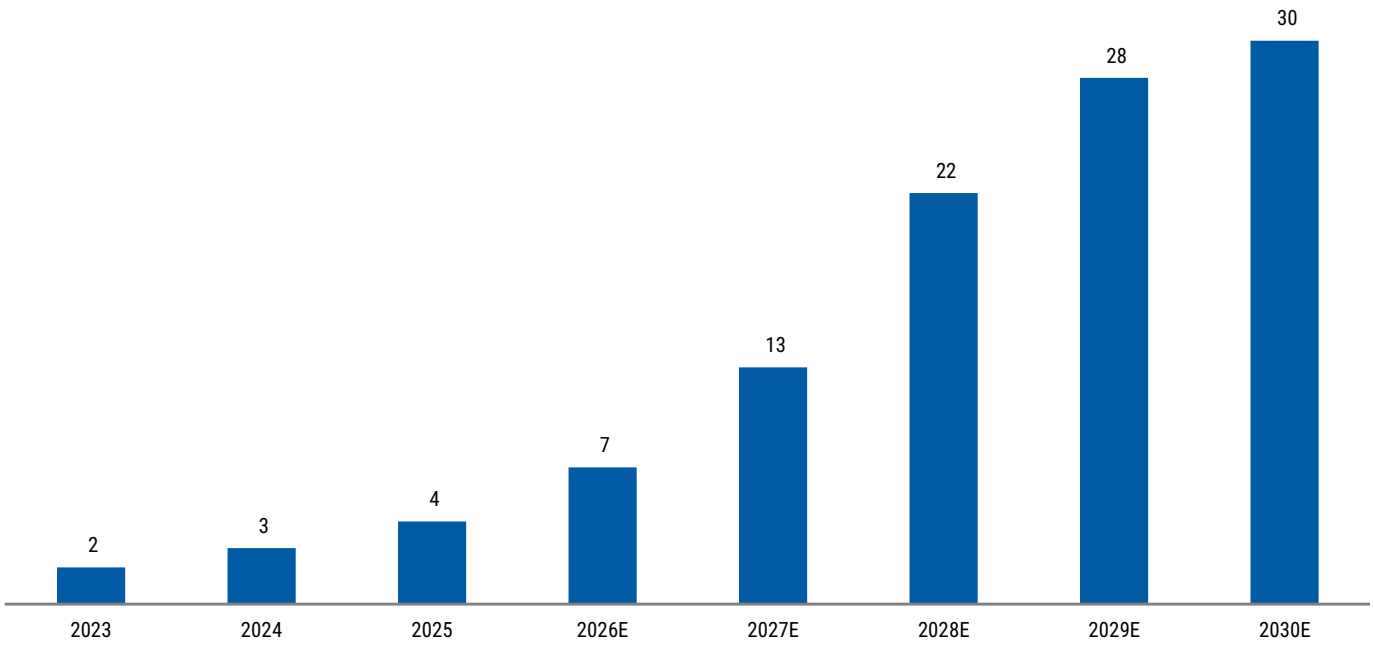
Source: Morgan Stanley Research.

Copper-Clad Laminates

We estimate the global CCL addressable market will expand at a ~20% CAGR between 2025 and 2030, from around US$19bn to US$47bn: This expansion is expected to be driven overwhelmingly by AI and data center infrastructure. As shown in Exhibit 10 , the AI and data center-related CCL market is projected to rise from ~US$4bn in 2025 to ~US $30bn by 2030, representing a ~47% CAGR and more than sevenfold growth. Its share of the overall CCL market would consequently increase from 23% in 2025 to 63% by the end of the decade. Based on these assumptions, AI and data center applications would contribute ~US$26bn of the industry's ~US$28bn net growth over the period, or ~90%, while demand from other end markets remains broadly stable at approximately US$15-18bn.

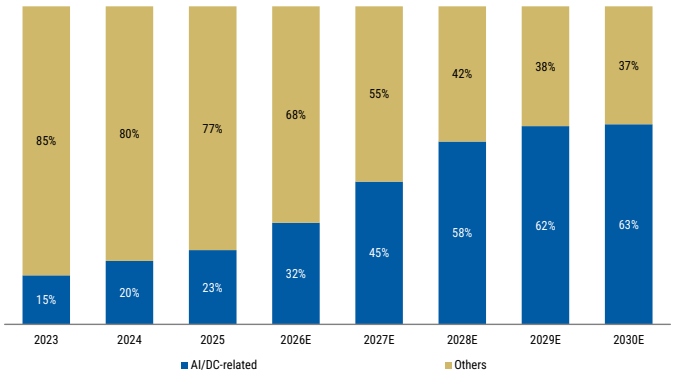
In addition to higher shipment volumes, these applications carry greater CCL dollar content per system in view of more complex board designs, higher layer counts, and larger board sizes (potentially), which drives increased laminate usage and greater adoption of higher grade low-loss and high-speed CCLs. The combination of continued computing cluster deployment, rising CCL content per system, and a mix shift toward higher-performance materials underpins the sharp expansion expected in AI and data-center-related CCL demand through 2030.

Exhibit 10: We estimate AI/data center-related CCL TAM to expand at a 47% CAGR from 2025-2030



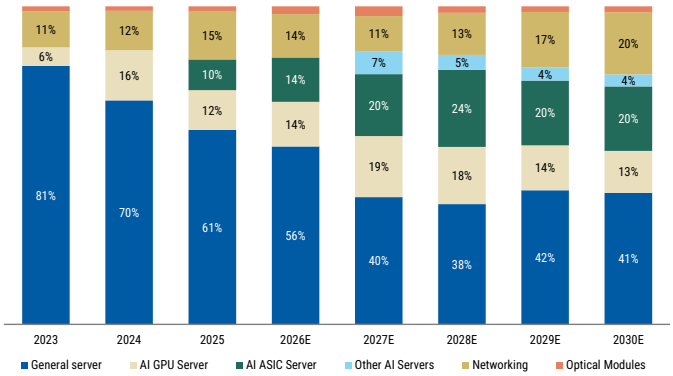
Source: Morgan Stanley Research estimates.

Exhibit 11: AI/data center-related CCLs will rise to ~63% of the mix by 2030



Source: Morgan Stanley Research estimates.

Exhibit 12: Our estimate of breakdown of different end segments of the AI/data center-related CCL TAM



Source: Morgan Stanley Research estimates.

Structural growth drivers

Higher-grade copper-clad laminates (CCLs) reduce dielectric loss and improve signal integrity at the high frequencies used by AI accelerators, HBM, PCIe, and high-speed networking: Taking Nvidia's platform roadmap as an example, the earlier eight-GPU HGX systems used M6/M7-grade CCL across both the Ampere and Hopper generations. With Blackwell, M8 became the primary grade used in NVL72 systems. Rubin is expected to bring another modest step up: most PCBs should remain on M8, while selected boards, such as the midplane, move to M8.5. Looking further ahead, we expect Feynman to drive another upgrade toward M9/M10 materials (Exhibit 13).

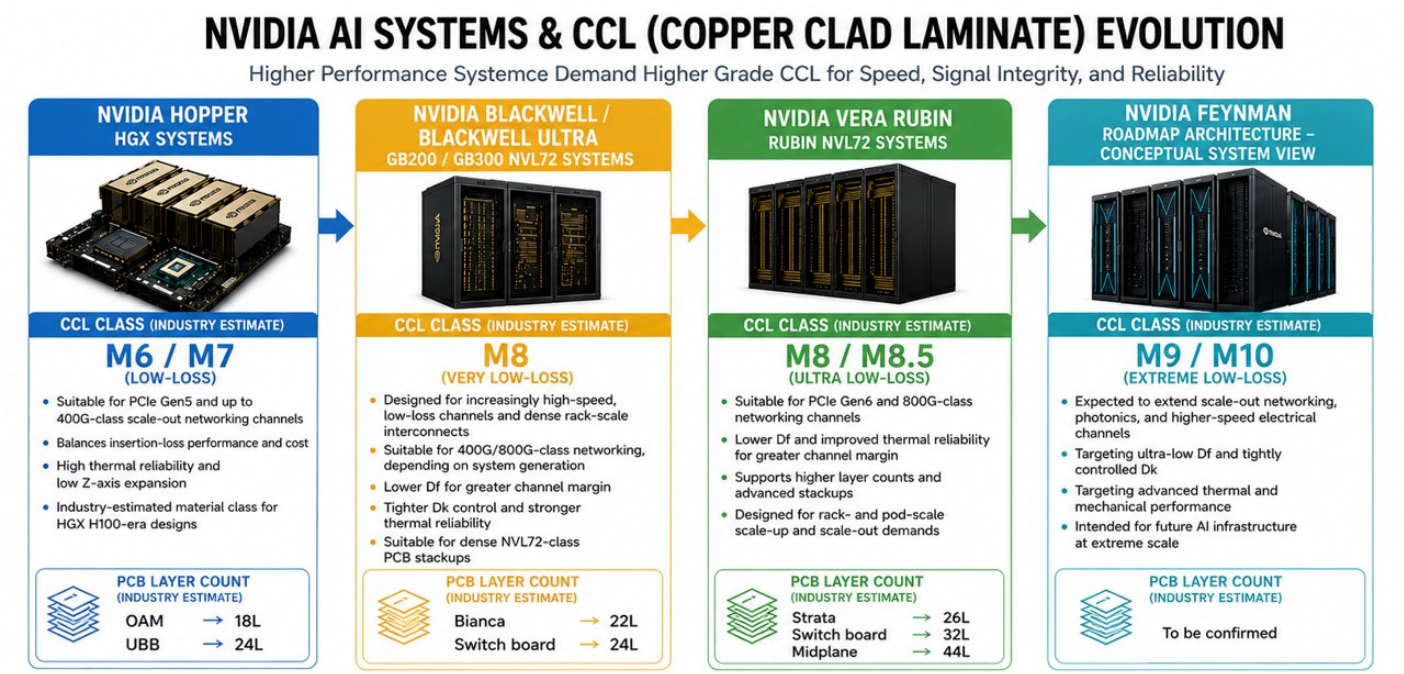
The progression reflects the rising electrical and thermal demands of AI servers. As data rates increase and power density climbs, the PCB laminate plays a more critical role in maintaining signal integrity, managing heat, and ensuring system reliability.

However, better material does not reduce the number of electrical connections that must be routed: AI boards are becoming larger and more complex, with wider memory buses, more accelerator-to-accelerator links, dense BGA packages, and thousands of high-speed signals. Designers therefore need additional signal layers to provide enough routing space while maintaining controlled impedance, limiting crosstalk, and giving critical signals clean ground references.

AI systems also require increasingly demanding power delivery networks: That's because accelerators consume very high currents at low voltages. More power and ground planes help reduce resistance, inductance, and voltage fluctuations, while also improving electromagnetic shielding and heat spreading.

Higher-grade CCLs and higher layer counts are therefore complementary: The CCL supports faster signal transmission, while the additional layers handle greater routing density, power demand, and overall system complexity.

Exhibit 13: Nvidia AI Systems' CCL Evolution



Source: Morgan Stanley Research.

MLCC Demand Outlook

Shoji Sato, Howard Kao

Capacitors, including MLCCs (multilayer ceramic capacitors), store electricity temporarily, playing the role of a dam. They are electronic components that are indispensable in suppressing noise and stabilizing voltage in electronic circuits in all kinds of items including computers, smartphones, and automobiles.

MLCCs serve to stabilize power supplies locally in the vicinity of semiconductors such as GPUs, CPUs, and FPGAs by instantaneously supplying current and suppressing noise. GPUs, CPUs, and FPGAs repeatedly cycle on and off in nanoseconds, demanding large currents instantly. MLCCs meet these transient electrical demands by immediately releasing stored electrical charges, while also bypassing AC waveform components such as noise and current fluctuations. Their low ESR (low resistance) and low ESL (low inductance) allow MLCCs to keep up with the nanosecond current fluctuations of advanced semiconductors.

Shoji Sato estimates that AI server mainboards contain 15,000-25,000 MLCCs, approximately 10x the number used in general-purpose servers, with large numbers mounted around GPUs, ASICs and other devices operating at low voltages of approximately 1.0V.

As semiconductors shrink, running voltages get lower in order to increase circuit running speed. However, as voltages fall, tiny fluctuations in voltage can cause the semiconductor to malfunction, creating the need for more stable voltage from the power supply than previously. At the same time, demands on capacitor capacity are rising as AI server computation ability and power consumption increase, while mountable space on the boards remains limited.

Shoji Sato therefore expects increased sales of compact, high-capacitance, high-value-added products for AI servers/data centers to have a major effect on MLCC demand growth. This trend is already visible across leading suppliers: AI/data-center products accounted for 10-15% of Murata's MLCC sales and 5-10% of Taiyo Yuden's in F3/26, with the respective weightings expected to rise to 20-25% and around 15% in F3/27 as AI/DC MLCC sales grow rapidly.

Shoji Sato estimates that global MLCC shipment value fell for two consecutive years, from $17.47bn (+26.0% YoY) in 2021 to $14.32bn (-18.1%) in 2022 and $12.64bn (-11.7%) in 2023, before recovering to $13.30bn (+5.2%) in 2024 and $14.67bn (+10.3%) in 2025.

Sato raised his shipment value forecasts from $17.43bn (+18.8% YoY) to $18.48bn (+26.0%) for 2026, from $20.89bn (+19.9%) to $22.16bn (+19.9%) for 2027, and from $24.25bn (+16.1%) to $25.73bn (+16.1%) for 2028. This represents a sharp acceleration from the historical market growth rate, with global MLCC shipment value having risen at a 6.5% CAGR over 2015-25. Increased sales of compact, high-capacitance products for AI server and data-center applications are expected to contribute substantially to the acceleration in growth (see details).

Exhibit 14: Global MLCC market forecasts

Base Case	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026e	2027e	2028e	2029e	2030e	2031e
Total worldwide shipment quantity (Bil pcs)	1,504	1,480	1,640	2,050	2,029	2,167	2,293	2,605	2,735	3,080	3,480	3,828	3,254	3,695	4,446	3,572	3,187	3,386	3,773	4,037	4,360	4,709	5,086	5,493	5,932
YoY (%)	14.9%	-1.6%	10.8%	24.9%	-1.0%	6.8%	5.8%	13.6%	5.0%	12.6%	13.0%	10.0%	-15.0%	13.5%	20.3%	-19.7%	-10.8%	6.2%	11.4%	7.0%	8.0%	8.0%	8.0%	8.0%	8.0%
CAGR (1991~)	14.9%	13.8%	13.7%	14.2%	13.4%	13.1%	12.8%	12.8%	12.5%	12.5%	12.5%	12.4%	11.3%	11.4%	11.6%	10.5%	9.7%	9.6%	9.7%	9.6%	9.6%	9.5%	9.5%	9.4%	9.4%
ASP in worldwide shipment (Cent)	0.47	0.42	0.36	0.38	0.39	0.36	0.33	0.30	0.29	0.26	0.27	0.37	0.39	0.38	0.39	0.40	0.40	0.39	0.39	0.46	0.51	0.55	0.57	0.59	0.60
YoY (%)	-0.2%	-10.1%	-14.0%	6.8%	1.2%	-7.7%	-7.2%	-10.6%	-4.1%	-7.2%	3.8%	34.3%	4.6%	-2.8%	4.7%	2.0%	-1.0%	-1.0%	-1.0%	17.7%	11.0%	7.5%	4.0%	3.0%	3.0%
CAGR (1991~)	-8.6%	-8.7%	-9.0%	-8.2%	-7.8%	-7.8%	-7.7%	-7.9%	-7.7%	-7.7%	-7.3%	-6.0%	-5.6%	-5.5%	-5.2%	-5.0%	-4.9%	-4.8%	-4.6%	-4.1%	-3.7%	-3.4%	-3.2%	-3.0%	-2.9%
Total worldwide shipment value (Bil $)	7.00	6.19	5.90	7.87	7.89	7.77	7.63	7.75	7.80	8.15	9.56	14.13	12.56	13.86	17.47	14.32	12.64	13.30	14.67	18.48	22.16	25.73	28.89	32.14	35.76
YoY (%)	14.6%	-11.6%	-4.7%	33.4%	0.2%	-1.5%	-1.8%	1.6%	0.7%	4.5%	17.3%	47.7%	-11.1%	10.3%	26.0%	-18.1%	-11.7%	5.2%	10.3%	26.0%	19.9%	16.1%	12.3%	11.2%	11.2%
CAGR (1991~)	5.0%	4.0%	3.5%	4.8%	4.6%	4.3%	4.0%	3.9%	3.8%	3.8%	4.3%	5.7%	5.0%	5.2%	5.8%	5.0%	4.4%	4.4%	4.6%	5.1%	5.5%	5.8%	6.0%	6.1%	6.2%

Note: e=Morgan Stanley Research estimates

Source: Morgan Stanley Research

Sato expects demand growth for high-value-added AI/DC products to continue beyond 2H26. Importantly, the increase in MLCC shipment value should be driven not only by higher volumes but also by a richer product mix. While same-product MLCC prices are likely to continue declining gradually over longer periods, blended ASPs should continue to rise as compact, high-capacitance, high-value-added products for AI servers/data centers account for a larger share of overall MLCC demand.

Recent Japanese trade data are consistent with this mix effect: June 2026 MLCC export volume increased 6.5% YoY, while export value rose 31.5% and reported ASP increased 23.5%. Though the trade data do not provide a fully accurate picture of ASP changes on a same-product basis, Sato believes such price declines have moderated compared with previous periods, while ASPs have risen YoY due to an improved product mix.

Supply-demand conditions for high-end MLCCs are also becoming increasingly tight. Murata's April-June MLCC book-to-bill ratio reached 1.47, the highest level since 2004, while utilisation was already around 95%. Sato believes the strong order environment reflects robust demand for high-value-added AI/DC products as well as precautionary orders for general-purpose products amid concerns over future shortages and price increases. Against this backdrop, Sato expects high-value-added MLCC unit prices to continue to receive downside support from tight supply-demand conditions. (see details)

AI accelerators are becoming increasingly transient current-intensive

Peak current densities on modern AI accelerator boards have reached levels that place significant demands on the power delivery network (PDN). AI workloads' highly dynamic nature causes rapid current excursions (high di/dt), resulting in voltage transients that can persist from sub-microsecond to multi-microsecond timescales (see details).

As accelerator power levels continue to rise while operating voltages remain extremely low, maintaining voltage stability within increasingly tight tolerance bands has become a critical design challenge. During these transient events, the power delivery network must supply large amounts of charge before voltage regulators can fully respond. Consequently, board designers are relying on greater amounts of local decoupling capacitance to support transient load requirements and preserve power integrity.

This trend is driving increased adoption of higher-capacitance MLCCs, including 47µF, 100µF, and larger devices, in addition to traditional high-frequency decoupling capacitors. As a result, total installed capacitance per accelerator and per rack is growing faster than MLCC unit count, reflecting a shift toward higher-capacitance content rather than simply a larger number of components.

This aligns with our supply chain checks on the MLCC content growth for VR200 (vs GB300), which we mentioned in our previous report.

Total MLCC unit demand is expected to increase approximately 80% in a VR200 NVL72 rack relative to a GB300 NVL72 rack: Based on our estimates, a complete Rubin NVL72 rack contains approximately 570,000 MLCCs, compared with roughly 320,000 MLCCs in a GB300 NVL72 rack (Exhibit 5). The increase is driven by higher MLCC content across both computing and switch boards, as well as additional PCB content throughout the system, including modules such as the CX9 Orchid. We believe this increase in unit volume represents a key contributor to the estimated 182% increase in total MLCC dollar content per rack.

A richer mix of high-capacitance MLCCs appears to account for the remaining increase in dollar content: In addition to higher unit volumes, we are seeing a meaningful shift toward higher-value MLCCs (47μF+) within the Rubin platform. Our supply chain checks suggest that 47μF+ MLCCs could represent more than 30% of total MLCC units in a fully configured Rubin system, compared with less than 20% in GB300 (Exhibit 18).

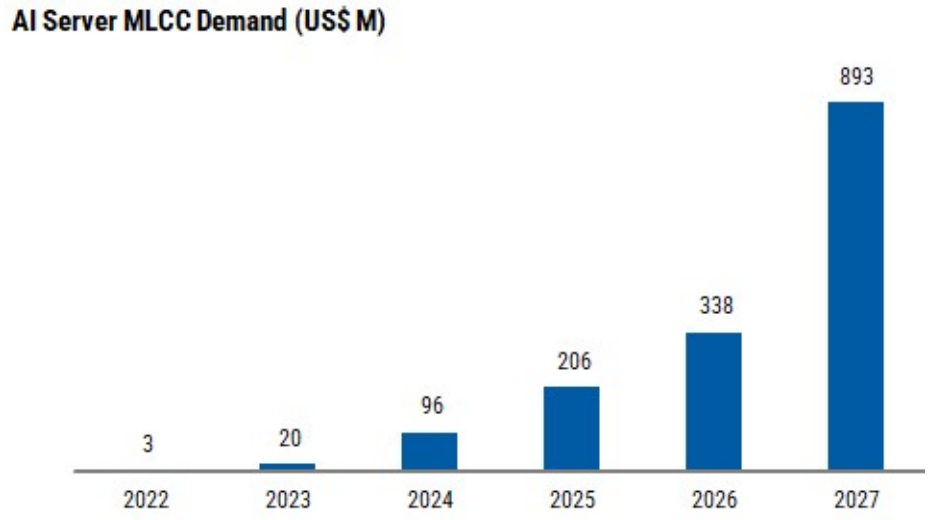
This mix shift materially increases capacitance content and value per rack. Under our assumptions, unit demand for 47μF+ MLCCs increases approximately 210% in a VR200 rack relative to GB300, while demand for MLCCs rated at 47μF and below grows a more modest ~50%. This stronger growth (relative to total MLCC unit growth per rack) for higher capacitance MLCCs fully aligns with the trend mentioned above.

For more analysis of our Rubin Rack BOM analysis, please see here: Greater China Technology Hardware: Analysis of Rubin rack BOM, component content, and ODM value-added (20 May 2026)

We believe our prior assessment materially underestimated the MLCC opportunity driven by Cloud AI demand: In our 2024 report, which represented our first attempt to quantify the Cloud AI opportunity for the MLCC industry, we estimated that Cloud AI would contribute approximately US$550 million of incremental TAM to the MLCC market by 2030.

Based on our latest analysis, and a significantly improved understanding of AI system architectures and much stronger end demand, we now believe that number will be surpassed, hitting approximately US$900 million by 2027. It should reach well over US$1 billion by 2030 should AI infrastructure demand continue to exceed expectations.

Exhibit 15: By 2027, AI server MLCC demand will likely already reach nearly US$1bn, tracking meaningfully above our previous forecast of ~US$550mn by 2030



Source: Company data, Morgan Stanley Research estimates.

High-capacitance MLCCs (47µF+) are likely to capture a disproportionate share of this incremental opportunity: Our analysis suggests that 47µF+ MLCCs could account for approximately 50-60% of the incremental Cloud AI MLCC TAM, representing an additional US$500-600 million market opportunity alone. This reflects both the increasing use of high-capacitance devices within AI accelerator systems and a growing mix shift toward higher-value MLCC content.

From a volume perspective, we estimate that Cloud AI demand for 47µF+ MLCCs could increase from approximately 4 billion units in CY25 to roughly 38 billion units by CY30: Such a rapid increase would represent a meaningful step up in industry demand and could require substantial capacity reallocation or expansion among leading suppliers.

Based on our industry discussions, the market for high-capacitance MLCCs remains concentrated among a limited number of suppliers, primarily Japanese and Korean manufacturers, including Murata, Taiyo Yuden, and Samsung Electro-Mechanics (SEMCO). As demand from AI infrastructure accelerates, we believe capacity utilization for these products could tighten, *raising the possibility of capacity crowding-out effects* across other end markets and applications.

Exhibit 16: VR200 MLCC content is 180%+ higher compared to GB300

MLCC content per board (US$)	GB300	VR200
Compute PCB	$25	$90
Switch PCB	$20	$45
BlueField DPU Module	$5	$5
ConnectX Orchid Module	$5	$5
Other peripheral PCB	$5	$5
Units per rack	**GB300**	**VR200**
Compute PCB	36x	36x
Switch PCB	9x	9x
BlueField DPU Module	0x	18x
ConnectX Orchid Module	0x	72x
Other peripheral PCB	90x	45x
Total MLCC Content per rack	**GB300**	**VR200**
Compute PCB	$900	$3,240
Switch PCB	$180	$405
BlueField DPU Module	$0	$90
ConnectX Orchid Module	$0	$360
Other peripheral PCB	$450	$225
Total MLCC Content per rack	**$1,530**	**$4,320**

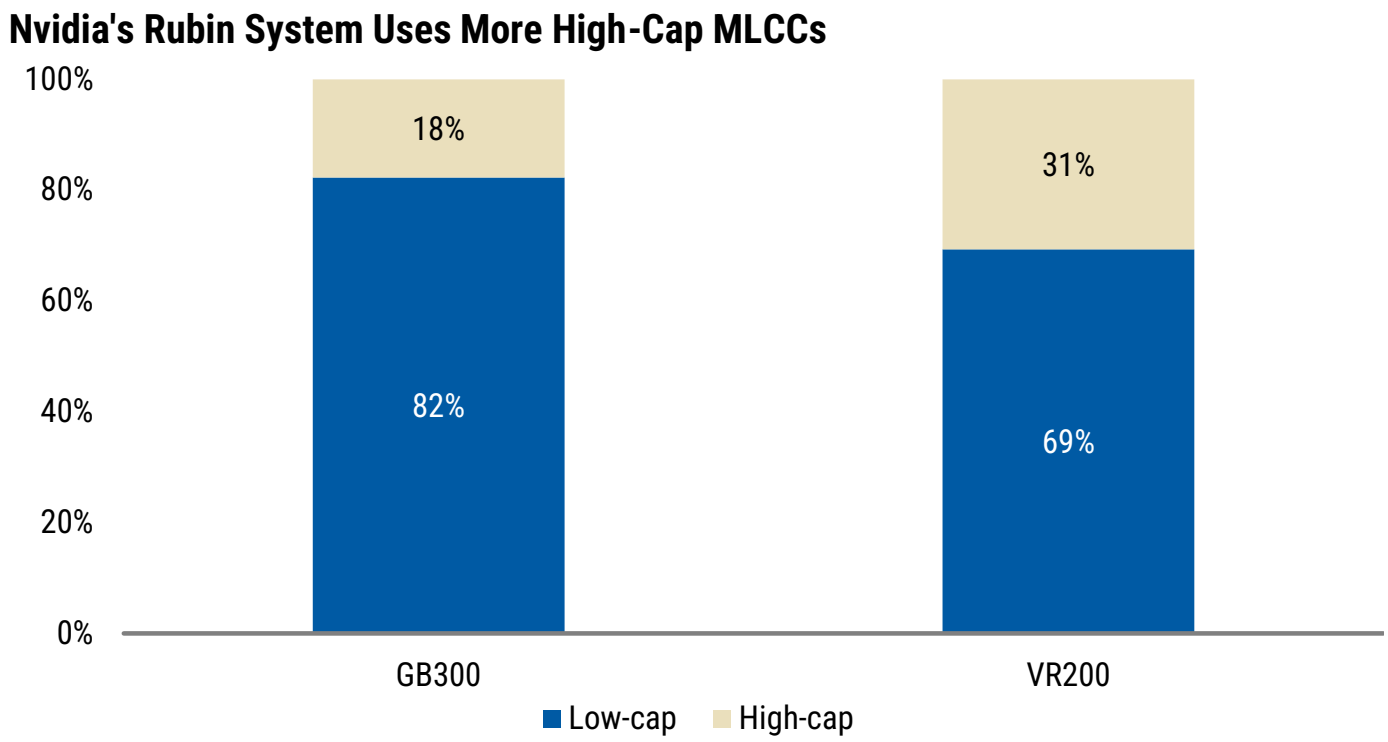
Source: Morgan Stanley Asia Pacific Research estimates based on supply chain checks.

Exhibit 17: VR200 MLCC unit demand is rising to 570K+, up close to 80% vs. a GB300 rack

Server Assumptions		# of MLCCs		US$	
General server			**2,000**		**30**
HGX Hopper AI server (8x GPU)			**22,000**		**190**
GPU module (OAM)	8x	1,300	10,400	10	80
GPU baseboard (UBB)	1x	4,900	4,900	45	45
CPU motherboard	1x	1,500	1,500	25	25
Peripheral boards	8x	650	5,200	5	40
HGX B200 AI server (8x GPU)			**36,000**		**317**
GPU module (OAM)	8x	3,000	24,000	24	192
GPU baseboard (UBB)	1x	5,300	5,300	60	60
CPU motherboard	1x	1,500	1,500	25	25
Peripheral boards	8x	650	5,200	5	40
HGX B300 AI server (8x GPU)			**48,000**		**435**
GPU module (OAM)	8x	4,400	35,200	40	320
GPU baseboard (UBB)	1x	6,100	6,100	50	50
CPU motherboard	1x	1,500	1,500	25	25
Peripheral boards	8x	650	5,200	5	40
GB200 (NVL72)			**337,500**		**1,710**
Bianca	36x	6,800	244,800	30	1,080
Switch board	9x	3,800	34,200	20	180
Peripheral boards	90x	650	58,500	5	450
GB300 (NVL72)			**319,500**		**1,530**
Bianca	36x	6,300	226,800	25	900
Switch board	9x	3,800	34,200	20	180
Peripheral boards	90x	650	58,500	5	450
VR200 (NVL72)			**571,050**		**4,320**
Strata	36x	11,000	396,000	90	3,240
Switch board	9x	7,000	63,000	45	405
BlueField Module	18x	2,000	36,000	5	90
CX9 Orchid Module	72x	650	46,800	5	360
Peripheral boards	45x	650	29,250	5	225
Vera Rack			**494,048**		**3,060**
Vera MGX	128x	3,316	424,448	20	2,560
Switch board	4x	7,000	28,000	45	180
Peripheral boards	64x	650	41,600	5	320
STX Rack			**326,256**		**2,415**
Mainboard	16x	4,791	76,656	31	495
Peripheral boards	384x	650	249,600	5	1,920
LPX Rack			**581,024**		**4,326**
LPX UBB	16x	5,374	85,984	35	559
LPX Module	256x	1,705	436,480	14	3,527
BF4	16x	2,000	32,000	5	80
x86 CPU Module	16x	1,660	26,560	10	160

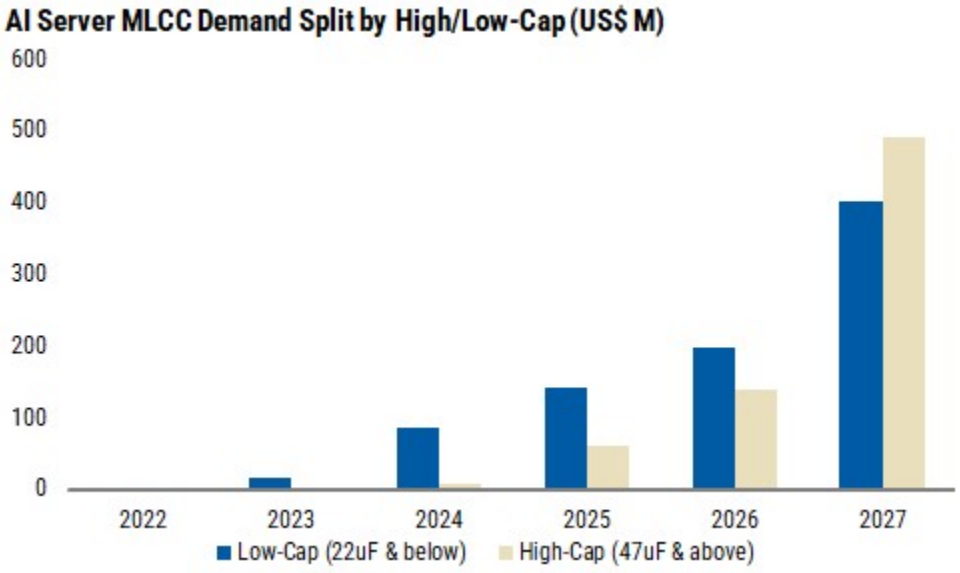
Source: Morgan Stanley Asia Pacific Research estimates based on supply chain checks.

Exhibit 18: High-cap (47uF+) MLCC usage to increase to 30%+ in VR200 (vs. <20% for GB300)



Source: Morgan Stanley Asia Pacific Research estimates based on supply chain checks. Note: High-cap refers to 47uF+ MLCCs.

Exhibit 19: Demand for high-cap (47uF+) MLCC is growing faster



Source: Morgan Stanley Research estimates.

Contextualizing the AI server MLCC opportunity

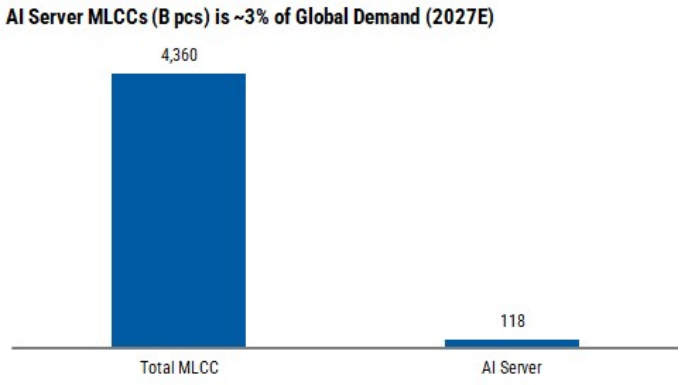
According to our colleague Shoji Sato, the global MLCC market is expected to reach approximately 4.36 trillion units and US$18.3 billion in value by CY27. Based on our estimates, AI servers would account for roughly 3% of total MLCC unit demand and approximately 5% of industry revenue by that time.

These percentages may appear modest in the context of the overall MLCC market, but we believe they understate the significance of the AI opportunity. AI server demand has emerged from a near-zero base just five years ago and is growing at a pace well above the broader industry. More importantly, the impact extends beyond its direct contribution to market size and increasingly influences industry capacity allocation.

In our view, the more important consideration is the pressure AI demand places on manufacturing capacity and the potential crowding-out effect on other MLCC categories. High-capacitance MLCCs used in AI infrastructure are substantially more manufacturing-intensive than mainstream MLCC products, often requiring several hundred to well over 1,000 dielectric layers, depending on capacitance, voltage rating, and package size. By comparison, many commodity MLCCs used in consumer electronics utilize materially fewer layers. As a result, each high-capacitance MLCC consumes a disproportionate amount of manufacturing capacity relative to its unit volume.

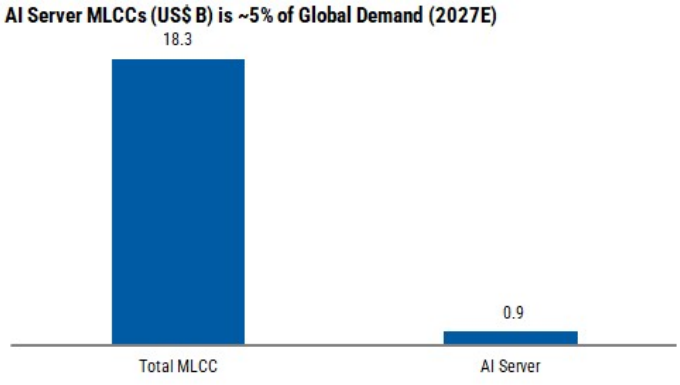
Consequently, even if AI servers represent only a mid-single-digit percentage of industry revenue, the associated capacity consumption is likely substantially higher. As AI-related demand continues to accelerate, suppliers may increasingly reallocate production capacity toward higher-value products, potentially tightening supply conditions and supporting pricing across broader segments of the MLCC market.

Exhibit 20: We estimate that AI server MLCC demand accounts for ~3% of total MLCC demand, in units



Source: Morgan Stanley Research estimates.

Exhibit 21: We estimate that AI server MLCC demand accounts for ~5% of total MLCC demand, in value



Source: Morgan Stanley Research estimates.

MLCC Powder (Titanium Dioxide + Barium Carbonate)

Kaylee Xu

MLCC powder: MLCC (Multilayer Ceramic Capacitor) powder generally refers to dielectric ceramic powder based primarily on barium titanate ($BaTiO_3$). There are multiple methods to produce MLCC powder, but the raw materials are typically high purity titanium dioxide and barium carbonate. To produce high-capacitance MLCC components which are used in AIDCs, high-capacitance MLCC powder is needed. High-capacitance powder requires MLCC powder producers to simultaneously control powder characteristics, formulation, microstructure, and batch-to-batch consistency at the nanoscalehigh-capacitance, which creates high barriers to entry. So far, the production high-capacitance MLCC powder is still dominated by Japanese companies.

Sinocera's MLCC powder expansion plan: Sinocera is one of the few Chinese MLCC powder producers. The company is not involved in the MLCC component business. Its major customers are SEMCO, as well as Taiwanese and some mainland Chinese MLCC component producers. Sinocera had ~10,000t of consumer electronics grade MLCC powder capacity as of end-2025. The company is adding another 5,000t of capacity tailored for automotive and AIDC use. It plans to ramp up the 5,000t of new capacity in 2026 and 2027.

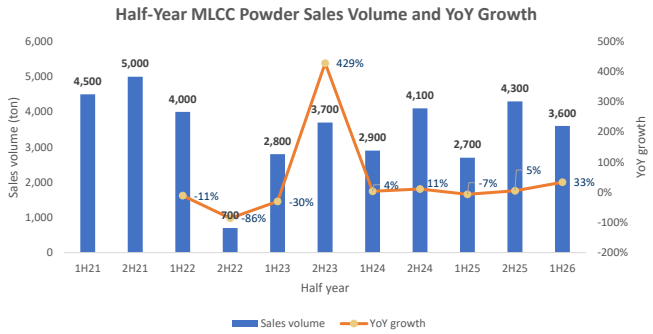
MLCC powder prices can vary significantly depending on product grades

The price differentials can be significant for different grades of MLCC powder. According to Sinocera, the MLCC powder used for consumer electronics is about Rmb60-70/kg, while automotive-grade and AIDC grade MLCC prices can range between Rmb80kg and Rmb200/kg. We believe these prices are still at meaningful discounts to ASPs of Japanese MLCC powder peers. Based on industry data, the MLCC powder can account for ~25-45% of total MLCC components' cost, depending on the type of MLCCs.

MLCC powder price has been stable and the margin is mainly driven by utilization rate for Chinese producers

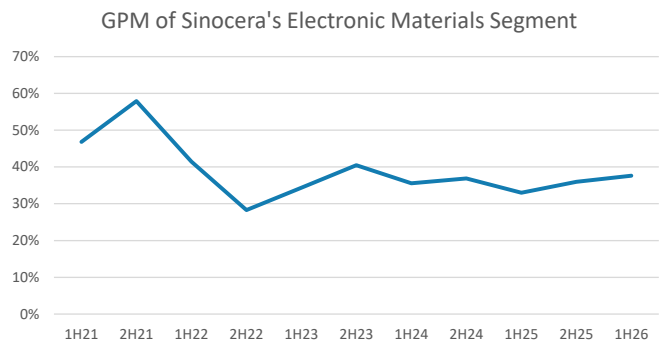
For consumer electronics grade MLCC powder, the price has been quite stable. Even during the last MLCC up-cycle in 2020-21, which was driven by consumer electronics, it was not easy for Sinocera to hike MLCC powder prices because of the long-term cooperation relationship with downstream MLCC component customers. In the current up-cycle driven by AIDC MLCC demand, we still haven't seen a powder price hike so far from Sinocera's 1H26 results. Management of Sinocera did not rule out the possibility of a price hike later in 2026, but also admitted that any potential hike requires careful negotiations with downstream customers.

Exhibit 22: Sinocera's MLCC powder sales volume



Source: Company data, Morgan Stanley Research

Exhibit 23: Sinocera's Electronic Materials Segment GPM



Source: Company data, Morgan Stanley Research

Reflecting the price inelasticity of MLCC powder in the case of Sinocera, MLCC powder profitability for this company has been typically a function of utilization rate and product mix. We observe that the GPM for Sinocera's consumer electronics grade MLCC powder has typically ranged between 30% and 50% since 2020. If Sinocera adds automotive-grade and AIDC-grade MLCC powder, the GPM will likely expand because the GPM of automotive-grade and AIDC-grade MLCC powder can be ~10ppt higher than that of consumer electronics grade.

Copper Foil

Yu Shirakawa, Irene Yen, Rachel Zhang

Copper foil serves as the fundamental conductive layer within printed circuit boards (PCBs), enabling the transmission of power and high-speed signals throughout AI servers, networking switches, accelerators, and storage systems. The rapid scaling of AI infrastructure is driving a structural increase in copper consumption at the PCB level, supported by rising board complexity, higher layer counts, and larger form factors. Compared with traditional enterprise servers, AI servers require significantly more complex PCBs to support advanced GPUs, high-bandwidth memory (HBM), high-speed interconnects, and elevated power delivery requirements. This has led to greater adoption of high-layer-count PCBs, often exceeding 20-30 layers in AI and networking applications, increasing copper foil intensity per board.

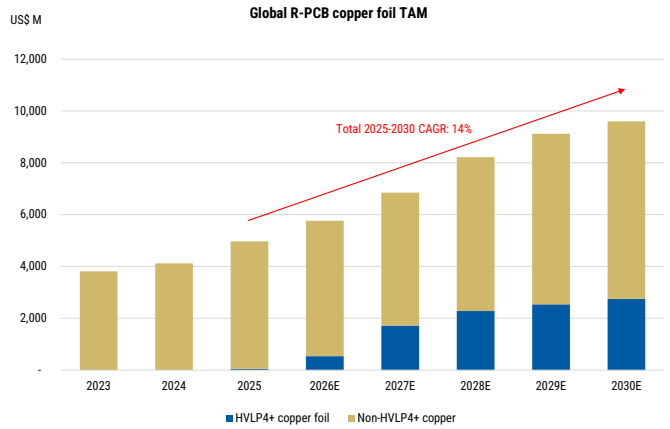
In parallel, the migration toward 400G, 800G and eventually 1.6T networking equipment is raising performance requirements for signal integrity and power management, driving demand for increasingly sophisticated copper foil products with tighter thickness tolerances, lower surface roughness, and improved high-frequency characteristics. The growing size of AI server motherboards, accelerator cards and network switches further amplifies copper foil usage on a per-system basis.

As a result, copper foil suppliers are positioned to benefit not only from higher unit shipments of AI hardware but also from increasing material content per device, making copper foil one of the most direct upstream material beneficiaries of the AI infrastructure build-out.

We estimate the global R-PCB (excluding substrate copper foil) copper foil addressable market will expand at a 14% CAGR from 2025-30, from ~US$5.0bn to ~US$9.6bn, driven almost entirely by AI and data center infrastructure. As shown in Exhibit 24, HVLP4+ copper foil demand is expected to grow ~123% over 2025-2030, to ~US$2.8bn, taking its value share of industry revenue from low single digits to ~29% (Exhibit 25). On our estimates, AI/data center applications account for essentially all of the industry's net growth through 2030, with demand across other end markets (PC, smartphone, tablets, consumer electronics, etc.) broadly stable (see details).

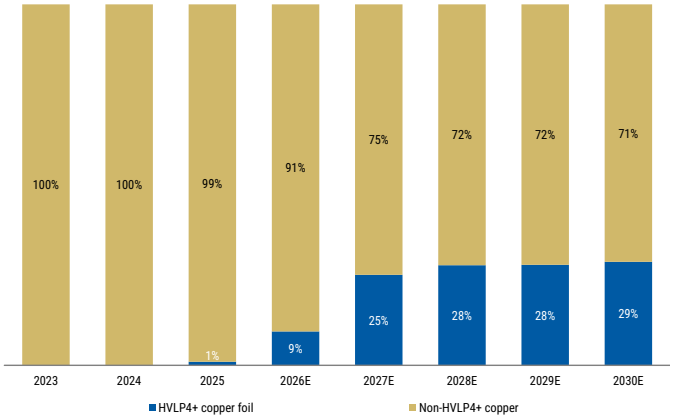
We expect the R-PCB copper foil TAM growth to be tracking global R-PCB market growth, which is driven by broad-based demand across general servers, GPU servers, custom ASIC servers, networking switches, and optical modules, supported by rising system shipments and continued scaling of computing clusters (see Exhibit 26).

Exhibit 24: We estimate global R-PCB copper foil TAM to expand at a ~14% CAGR over 2025-2030, to US$9.6bn



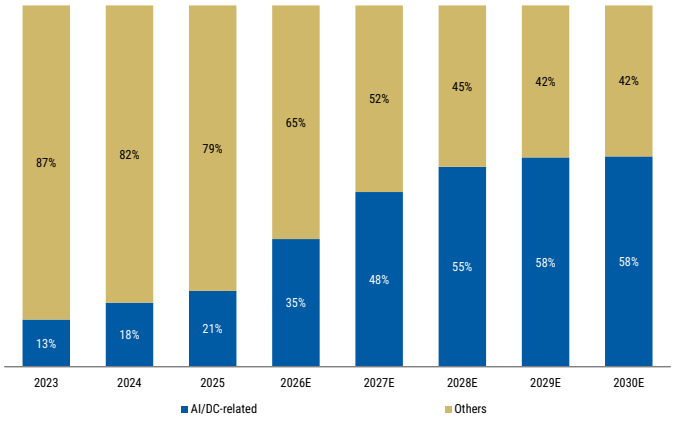
Source: Morgan Stanley Research estimates.

Exhibit 25: We estimate global HVLP4 copper foil to account for ~29% of the global R-PCB copper foil TAM by 2030



Source: Morgan Stanley Research estimates.

Exhibit 26: We expect AI/DC-related circuit copper foil to account for ~58% of the total R-PCB copper foil market by 2030



Source: Morgan Stanley Research estimates.

Is a bottleneck emerging?

HVLP4 (hyper very low profile) copper foil

This is the enabling material for the fastest copper interconnects in AI infrastructure: It is laminated into high-speed copper-clad laminate (CCL) and then fabricated into the high-layer-count PCBs — computing boards, switch boards, and midplanes — that carry the newest high-speed signals at acceptable insertion loss. The direct buyers are therefore CCL producers. End demand is pulled almost entirely by the leading AI accelerator and networking programs.

On the demand side, our bottom-up build shows HVLP4 adoption across NVIDIA Rubin/successors and LPX racks, AWS Trainium3/4, Google TPU v8/successors, AMD Helios, Meta MTIA Iris, and 800G/1.6T/3.2T Ethernet switches.

Supply remains more concentrated and, in our view, is the binding constraint.

- *Mitsui Kinzoku* (covered by Yu Shirakawa) is the clear leader, with 41% of global HVLP4 capacity in 2026 and ~33% in 2028.
- *Co-Tech* (covered by Howard Kao) is the fastest follower, scaling from <50 tons/ month in 2025 to ~800 by end-2028, lifting its share to ~21% in 2028, from 13% in 2026.
- *Furukawa* (covered by Yu Shirakawa), *Fukuda*, and *Copper Foil Luxembourg* add qualified supply and remain the leading suppliers.
- New qualified suppliers, including *Tongguan* (Not Covered), *Defu* (Not Covered), and *Lotte Energy Materials* (covered by Ryan Kim), are expanding capacity for HVLP4 too.

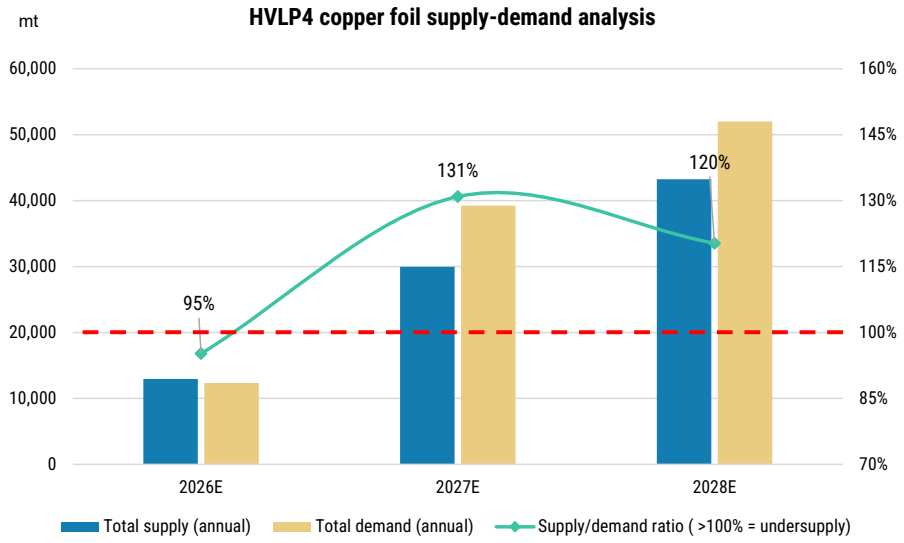
Our model applies engineered foil consumption per rack/switch to shipment forecasts, incorporating board area, layer count, HVLP4 coverage, copper density and process scrap.

We estimate monthly demand at 1,028 tons in 2026, 3,270 tons in 2027 (+218% y/y), and 4,335 tons in 2028 (+33%), implying TAM of ~$540mn, ~$1.7bn, and ~$2.3bn.

Against average monthly capacity of 1,080, 2,495, and 3,600 tons in 2026, 2027, and 2028, this implies the balance moving from a c.5% surplus in 2026 to an undersupply gap of ~31% in 2027 and ~20% in 2028.

In our base case, we therefore see HVLP4 undersupply emerging in 2026, deepening sharply in 2027, and persisting through 2028.

Exhibit 27: HVLP4+ copper foil supply-demand analysis



Source: Company data, Morgan Stanley Research estimates.

Mitsui Kinzoku (5706.T, covered by Yu Shirakawa): This company's copper foil business is its primary long-term growth engine, driven by surging AI-related demand for its VSP (HVLP) foil used in AI servers and MicroThin foil for DDR5 DRAM. AI-related copper foil products are forecast to generate recurring profit CAGRs of approximately +80% over F3/26-28, growing from ~¥16bn (14% of total RP) in F3/26 to ~¥53bn (38%) in F3/28, with AI-related products accounting for roughly 60% of copper foil segment RP by F3/27.

This demand trajectory is corroborated by Malaysian copper foil export data — a key leading indicator — which has shown sustained triple-digit year-on-year growth, reaching +105% YoY in June 2026, with shipments to Taiwan (the primary destination for CCL using Mitsui Kinzoku's foil) hovering around record-high levels throughout 2026.

To meet this demand, Mitsui Kinzoku announced in August 2026 a major new production site targeting 1,200 mt/month of VSP foil and 4mn m²/month of MicroThin foil from 2031, with the potential to scale VSP capacity to 5,000 mt/month, representing a +210% increase in VSP capacity versus F3/27 levels. The projected incremental investment is approximately ¥100bn, and management targets ROIC of 52% in F3/28 and 64% in F3/31, underpinned by phased capacity additions and price increases. We maintain an Overweight rating with a price target of ¥56,000, viewing the long-term growth story as intact and likely to accelerate despite near-term noise around quarterly sales plan revisions.

Alongside F3/27 1Q results, the company announced a ¥42bn capacity expansion: MicroThin from 4,900K m²/month (F3/27) to 8,000K m²/month (F3/31), VSP from 840 mt/month to 1,400 mt/month, and FaradFlex from 85K m²/month to 355K m²/month.

In addition, on August 17, Mitsui Kinzoku announced plans to establish a new production site with capacity of 1,200 mt/month of VSP foil and 4mn m²/month of MicroThin foil from 2031. It also indicated that it is considering building a production system capable of scaling VSP foil capacity to as much as 5,000 mt/month. The projected investment for this expansion is around ¥100bn. By F3/34, production capacity is expected to reach 2,600 mt/month for VSP foil (+210% vs. F3/27) and 12mn m²/month for MicroThin foil (+145% vs. F3/27).

Co-Tech (8358.TWO, covered by Howard Kao): This company is a professional supplier of electrodeposited (ED) copper foil for copper-clad laminate (CCL) and printed circuit boards (PCB). To produce a CCL, the laminator bonds foil onto resin-impregnated glass cloth to form the core, so foil surface roughness (Rz) sets the floor on insertion loss at high frequency. Co-Tech's ladder runs from LP310/HG310 (standard to mid-loss, outer layer) through the RT/RG reverse-treated family into the HVLP series (up to HVLP5).

Co-Tech fully stopped supplying conventional HTE and standard RTF in 3Q26, redirecting all capacity to the RG (advanced RTF) and HVLP series. Co-Tech estimates that its RG series holds over 60% share of the general server market, while HVLP is aimed more at AI servers and high-end switches.

We estimate Co-Tech's RG capacity to reach 1,000, 1,200, and 1,200 tons per month and its HVLP3+ capacity will reach 340, 890, and 1,150 tons per month by the end of 2026, 2027, and 2028, of which 210, 740, and 1,000 will be HVLP4+ capacity. Today, we estimate that the RG family remains Co-Tech's single largest revenue line at 73%, while HVLP revenue is at ~14% of the mix in 2026. We expect Co-Tech HVLP3+ to reach 14%, 34%, and 46% of sales in 2026, 2027, and 2028, primarily driven by AI server boards and 800G/1.6T/3.2T switches.

Chinese producers: from capacity to capability in high-end copper foil

Against this backdrop, Chinese AI copper foil producers are experiencing a structural demand boom driven by AI server buildout, with the market for HVLP copper foil for AI servers projected to reach 24,000 metric tons in 2026, according to CBC Metals, a 260% increase year-on-year, growing to 50,000 metric tons by 2027. China's copper foil industry as a whole is operating at near-full capacity — overall operating rates reached 93.08% in July 2026, with electronic circuit copper foil at 94.09% — and producers remain cautious about adding new capacity, raising the likelihood of sustained supply-demand imbalances and further price increases.

Anhui Tongguan Copper Foil (301217.SZ, Not Covered): This company is the most prominent Chinese pure play on AI PCB copper foil. It recorded copper foil production of 71,462 tonnes and sales of 72,070 tonnes in 2025, achieving revenue of RMB6.689bn and returning to profitability with net profit of RMB 62.6mn after a prior-year loss.

Momentum has accelerated sharply in 2026: 1Q2026 revenue reached RMB1.842bn (+32% YoY), driven by higher copper foil product prices, with net profit of RMB106.3mn. In its 1H2026 profit forecast (July 2026), the company guided for net profit of RMB205-225mn, representing growth of +487% to +544% YoY, attributing the surge to supply-demand tightness in high-frequency, high-speed copper foil and a rising share of high-value-added products in its mix.

As for product technology, Tongguan has completed customer supply arrangements for its full HVLP1-4 product range, with HVLP2 currently the primary shipping product. HVLP5 is in R&D and has already broken through key performance indicators. The company's overseas revenue is primarily generated through processing trade with Taiwanese enterprise customers, and its high-end product capacity and structure will be dynamically optimised based on market order demand.

Jiangxi Copper (0358.HK covered by Rachel Zhang): This company participates in the PCB copper foil market through its subsidiary Jiangxi Jiangtong Copper Foil Technology, with products spanning standard electronic circuit foil as well as high-frequency and high-speed grades.

The company currently has 100ktpa of total electrolytic copper foil capacity, comprising 35ktpa of electronic circuit copper foil and 65ktpa of lithium-battery copper foil. Within electronic circuit foil, Jiangtong has developed high-end and specialty products including RTF high-speed copper foil, VLP copper foil, and HVLP nickel-plated copper foil. Its electronic circuit products cover applications including high-speed servers, 5G communications and cloud computing. The company's high-speed product portfolio includes RTF R1/R2 and VLP R3/R4, providing product exposure to increasingly stringent signal-loss requirements in high-speed PCB applications.

Nuode New Materials (600110.SS, Not Covered): This company operates across both the lithium battery and PCB copper foil segments, with AI server demand increasingly driving its high-end PCB foil business.

By 1H2026, Nuode had shipped over 50,000 tonnes of copper foil across its four domestic production bases (Guangdong Huizhou, Qinghai Xining, Hubei Huangshi, and Jiangxi Guixi).

It expects total copper foil capacity to reach 170,000 tonnes/year by end-2026, of which 30,000 tonnes can be dedicated to high-end electronic circuit copper foil.

In AI-specific products, Nuode's RTF-3 and HVLP-1/HVLP-2 are already in small-batch supply to leading PCB enterprises in mainland China and Taiwan. HVLP-3 and HVLP-4 are in advanced customer sampling and reliability verification, with some customers already in small-batch testing.

The company guided for ~80% YoY sales volume growth in 2026, driven primarily by strong ESS demand, with AI server orders providing an additional incremental driver.

Jiujiang Defu Technology (301511.SZ, Not Covered): Defu is one of China's largest copper foil manufacturers, with 195ktpa of installed capacity, ranking among the world's leading copper foil producers by production capacity.

The company has historically had significant exposure to lithium-battery copper foil, but it is increasingly expanding into higher-value electronic-circuit copper foil as AI servers, high-speed switches, optical modules and advanced packaging drive demand for lower-loss materials.

Defu's electronic-circuit portfolio is focused primarily on RTF and HVLP copper foil. Its RTF-3 and RTF-4 products have been qualified by multiple leading CCL manufacturers and entered batch supply, targeting high-speed servers, AI accelerator cards and other high-end applications. Its HVLP1-4 series is already in batch supply for high-end AI servers, switches and optical modules, and HVLP5 has completed sample qualification and is progressing through customer introduction.

The company has also extended into advanced substrate applications, with its C-IC2 carrier foil entering mass production for a 1.6T optical-module project and 9–12μm ultra-thin foil supporting BT/modified-BT substrate systems.

Defu has established relationships with major CCL and PCB customers including Shengyi Technology, Taiwan Union Technology, Panasonic, ITEQ, Shennan Circuits and Victory Giant Technology, with the share of high-end electronic-circuit foil shipments continuing to rise.

In May 2026, the company announced a RMB3.1bn investment to construct a 50,000-tonne/year high-end AI electronic circuit copper foil project in the Jiujiang Economic and Technological Development Zone, to be implemented in two phases of 10,000 tonnes each by subsidiary Amber New Materials. This signals the scale of greenfield investment being committed to the AI copper foil opportunity by second-tier Chinese producers.

Combined with its existing large-scale manufacturing base and established lithium-battery copper foil franchise, we believe Defu's progression from conventional copper foil toward RTF-3/4, HVLP1-4, and next-generation HVLP5 positions it as one of the key Chinese beneficiaries of high-end copper foil localization across AI servers, high-speed networking, and optical connectivity.

Japan – Glass Fiber/Fabric

Yoshihito Hasegawa, Takato Watabe

The electronic-grade glass fiber industry sits upstream from the CCL and PCB industries. The supply chain runs as follows:

Electronic Yarn → Electronic Fabric → Copper-Clad Laminate (CCL) → Printed Circuit Board (PCB) → End Applications.

Market capacity of the electronic-grade glass fiber industry is directly linked to downstream CCL and PCB demand.

Our view across both Japan and China is that AI infrastructure build-out is the dominant force reshaping the glass fiber and glass cloth industry. We prefer glass fiber over other materials in view of AI spillover effects, noting that AI-related demand is driving high-end glass fiber and fabric demand and prices, leading to incremental capacity shifts toward high-end products, tightening supply availability for standard products such as 7628 electronic fabric, the price of which has increased more than 200% YTD. And industry inventory is at historical low.

Nitto Boseki (3110.T, covered by Yoshihito Hasegawa): Nittobo is the world's largest manufacturer of T-glass (low-CTE glass) for advanced semiconductor package substrates. The company operates across four primary segments, namely Electronic Materials, Medical, Composite Materials/Materials Solution, and Insulation Materials. Its specialty glass franchise — encompassing low-CTE glass (T-glass), low-dielectric glass (NE/NER), and next-generation products — is the dominant earnings driver.

Nittobo reported F3/27 1Q sales of JPY34.0bn (+21% YoY) and OP of JPY7.94bn (+85% YoY), meaningfully exceeding market consensus. The company raised its full-year F3/27 guidance: sales from JPY137bn to JPY141bn and OP from JPY26bn to JPY30bn, with the FX assumption adjusted from JPY153 to JPY158/US$. By segment, Electronic Materials OP guidance was raised to JPY28bn (from JPY26bn), Medical to JPY2.8bn (from JPY2.5bn), and the combined other segments to -JPY0.8bn (from -JPY2.5bn). The 1H plan calls for sales of JPY69.3bn (+21% YoY) and OP of JPY15.3bn (+62%).

According to management, the company intends to expand T-glass production capacity in order to maintain its share of a growing market. While market share based on production capacity could decline as competitors add capacity, management emphasized that maintaining its share of actual market demand remains the top priority. Accordingly, the company is currently conducting detailed studies on capacity expansion beyond F3/29 and has clearly indicated its willingness to further increase output. Regarding pricing, management commented that there are currently no firm plans for additional T-glass price increases.

For low-dielectric glass products, demand remains robust and management is equally eager to expand production capacity. The company has already secured materials and other inputs in advance, allowing capacity expansions to proceed smoothly. Unlike T-glass, management does not expect supply chain disruptions stemming from tight industry supply-demand conditions, and therefore believes sales can continue to grow steadily without major bottlenecks.

Our OW thesis rests on Nittobo's dominant position as the world's largest T-glass manufacturer, with approximately 90% market share and a structural demand tailwind from AI-driven semiconductor package complexity. We believe the recent weakness in Nittobo's share price reflects news flow surrounding the lack of a firm additional price increase plan, the absence of a finalized capacity expansion plan, and reports that competing low-CTE glass suppliers have obtained product qualifications from CCL manufacturers and semiconductor packaging companies and are increasing production capacity.

However, we believe it is unlikely that Nittobo's existing or future production capacity will become excessive. In our view, the industry remains supply-constrained, and earnings will continue to be primarily determined by the amount of capacity the company can bring to market. As such, we do not believe the fundamental investment case has changed.

We expect investor sentiment to improve as the company continues to show strong earnings progress each quarter and as management provides greater clarity on end-market conditions and the competitive landscape through earnings briefings and other communications.

Asahi Kasei (3407.T, covered by Takato Watabe) — beneficiary of AI-driven low Dk demand: We expect the market for high-performance glass cloth (low Dk/low CTE) to sustain rapid growth, supported by expanding AI server demand and mix improvement toward thinner and next-generation products. We estimate the market will expand from approximately ¥40bn in 2024 to around ¥150bn in 2030, implying low-20s (%) annual growth.

The main growth driver is low Dk. We expect the low Dk market to expand from approximately ¥30bn to the low-¥100bn range over the same period, representing mid-20s (%) annual growth. The low CTE market should also grow from around ¥10bn to roughly ¥20bn, or about 10% per year. While low Dk materials should drive most of the market expansion as transmission speeds increase, we also expect steady low CTE growth as larger and denser AI/HPC package substrates raise requirements for warpage control and interconnect reliability.

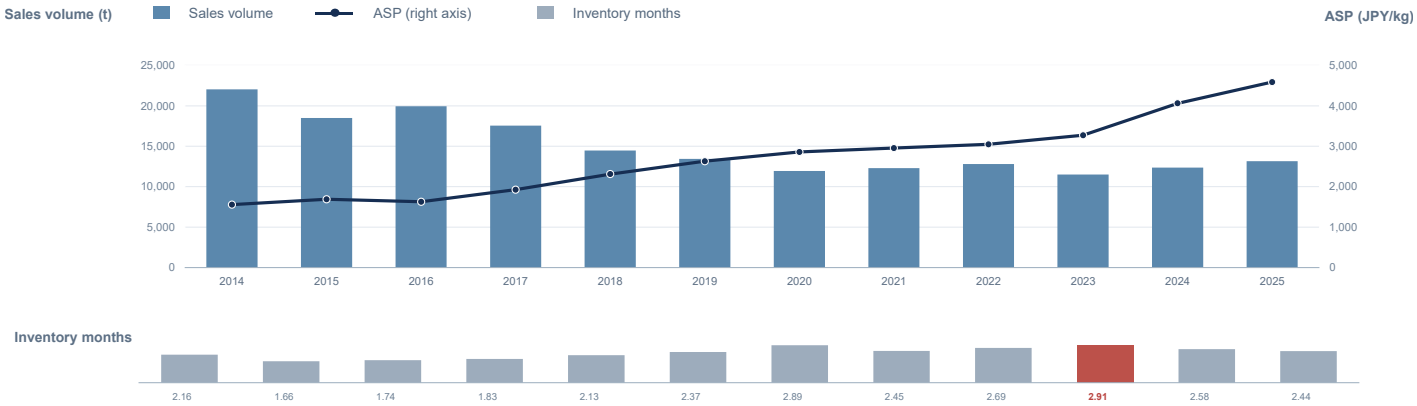
Recent domestic statistics also point to a tightening supply-demand balance. According to the Ministry of Economy, Trade and Industry's Current Survey of Production, sales volume of glass cloth in Japan rose about 14% in 2025. Months of inventory declined from 2.9 to 2.4 over the same period. The production-to-sales ratio improved from 0.91 to 0.97 but remained below 1.0, indicating that sales continued to exceed production. Although production is recovering, it has not kept pace with demand, and we believe the market remains tight, with inventories continuing to be drawn down.

In addition to the recovery in sales volume, mix improvement toward thinner products and next-generation low Dk grades is lifting market value. Weight-based ASP for glass cloth in Japan rose 40% from 2023 to 2025. Sales value increased about 24% YoY in 2024 and 13% in 2025, recording double-digit growth for two consecutive years. With volume growth and ASP expansion occurring together, sales value reached a record high of just over ¥60bn in 2025..

Price dispersion across glass cloth product types is wide. Thin and next-generation low Dk products command clear premiums over commodity grades, with particularly large pricing

gaps for thin cloth. In addition to a higher price per unit area, thin products allow a larger area of cloth to be produced from the same weight of glass yarn; a rising mix of thin grades therefore lifts ASP. We expect the share of next-generation low-Dk products to rise from the low single digits in 2024 to the mid-teens by 2030. We therefore expect thinning and the transition to next-generation grades to drive future market growth.

Exhibit 28: Japan – glass cloth: sales volume, ASP, and inventory months



Source: METI, Company data, Various data, Morgan Stanley Research

Meanwhile, the rapid rise in demand is raising concerns over shortages of glass yarn and high-performance glass cloth. With AI server demand contributing to persistent glass-yarn tightness, CCL manufacturers are qualifying new suppliers in China and Taiwan to diversify procurement. Glass cloth manufacturers are also building new plants, expanding capacity, and converting existing lines from commodity to high-performance products.

While competitors are expanding supply through new capex, Asahi Kasei intends to capture demand growth by upgrading the product mix at its fully utilized existing facilities. As of F3/26, commodity E-glass accounted for roughly half of its annual glass cloth output. The company plans to replace it progressively with low Dk L and L2 grades and, ultimately, quartz-based Q-Glass, which offers low Dk, low loss, and low CTE.

Q-Glass is a high-purity quartz glass cloth and a strategic product for Asahi Kasei as it enters the low CTE market for AI substrates. Whereas Nitto Boseki lowers thermal expansion by modifying glass composition, Asahi Kasei uses a different approach based on quartz. As transmission speeds rise, Df requirements for glass cloth become increasingly stringent with each generation, strengthening the relative advantage of low-loss quartz cloth. We expect adoption opportunities for Q-Glass to broaden in next-generation substrates. The company began customer evaluations in F3/26 and advanced qualification activities. In April 2026, at the start of F3/27, it formally announced its entry into the AI substrate materials market, positioning F3/27 as the period for customer qualification and adoption expansion, and F3/28 as the start of earnings contribution.

Under its F3/26-F3/28 medium-term management plan, Trailblaze Together, Asahi Kasei has designated Electronics as one of four First Priority businesses. Assuming progress in the growth initiatives under the plan, we forecast Electronics operating profit of approximately ¥50bn in F3/28, more than double the ¥22.1bn recorded in F3/25. In glass cloth, we believe mix enhancement through the shift from E-glass to L/L2 and expansion into ultra-low Dk and low CTE applications with Q-Glass will be one contributor to this earnings growth.

China – Glass Fiber/Fabric

Howard Kao, Rachel Zhang

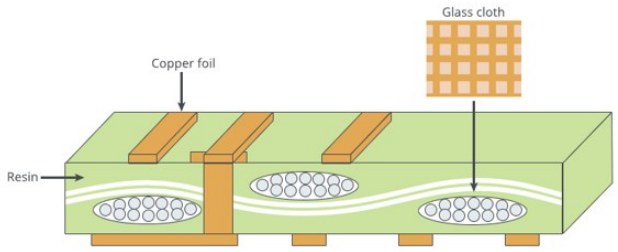
Glass fiber cloth is a woven material that provides structural rigidity and electrical insulation as the core reinforcement layer within CCLs and PCBs. Its underlying glass characteristics and weaving precision directly determine Dk, Df and thermal stability of the PCB/CCL. Historically, electrical-grade glass fiber cloth was deemed a highly cyclical, low-margin commodity — but now with AI infrastructure advancing data transfer rates, such glass fiber cloth has emerged as a primary gatekeeper of signal integrity, and the advanced electronic grade market is generally deemed as high-barrier and oligopolistic.

Exhibit 29: Glass fiber cloth



Source: Taiwan Glass.

Exhibit 30: PCB cross-section



Source: Nittobo.

Below are common types of electrical-grade glass fiber:

- Electrical-grade glass fiber (E glass): The industry standard for general-purpose PCBs. Widely used in consumer electronics, automotive applications and standard PCs.
- Low Dk (LDK) glass fiber
  - NE glass (LDK1): The new E glass was originally primarily developed by Nittobo, but now several suppliers in the Greater China region can produce it. This is the benchmark for high-speed, low loss applications.
  - NER glass (LDK2): This is the specialized, "higher-end" variation of NE glass; thus, fewer suppliers are capable of producing it. NER glass is opted for high-layer-count server and switch PCBs where thermal stress and dimensional stability are major concerns during the lamination process.
  - NEZ glass: A high-performance material developed by Nittobo, this material boasts an even lower Dk/Df compared to NER.

- Quartz glass fiber (Q glass): This consists of high-purity silica (SiO2 > 99.9%) and showcases the lowest Dk, Df and CTE among all glass types. That said, this material is mainly reserved for extreme high-end or niche applications because of the much higher costs, such as 1.6T+ networking, satellite communications, aerospace electronics and some AI servers. Compared to other types of glass fiber, Q glass has not been widely adopted and there are not many capable suppliers.
- Low CTE glass fiber (T glass): This is widely used in IC substrates and mobile device components. Its primary advantage is extremely low CTE. Nittobo used to control 90%+ of T glass supply, and the rest of share went to Unitika (3103.T, not covered) for thin T glass, but new suppliers are coming into this supply chain because of worsening supply shortage, such as Taiwan Glass (1802.TW, Not Covered), Nan Ya Plastics (1303.TW, Not Covered), Grace Fabric (603256.SS, covered by Rachel Zhang), Taishan Fiberglass (subsidiary of Sinoma Science & Technology, covered by Eva Hou), etc.

Exhibit 31: Glass fiber cloth specifications by grade

Type	E-glass	T-glass (Low CTE)	NE-glass (Low Dk)	NER-glass (Low Dk2)	NEZ-glass	Q-glass
Dk @ 10 GHz	6.6	5.3	4.7	4.5	4.0	3.7
Df @ 1 GHz	0.006	0.007	0.0025	0.0018	0.001	0.0005
CTE (ppm/°C)	5.6	2.8	3.3	3.4	3.1	0.5
Tensile Modulus	75 GPa	86 GPa	64 GPa	50 GPa	46 GPa	78 GPa
Composition (SiO_2)	52–56%	64–66%	45–55%	45–55%	50–55%	99.9%
Composition (Al_2O_3)	12–16%	24–26%	10–15%	10–18%	10–18%	—
CCL Application	M4–M6	—	M7–M8		M9–M10	
End Application	Commodity	IC Substrate	AI Server, 400G switch, HDI/PTH	AI Server, 800G switch, HDI/PTH	AI Server, 1.6T switch, HDI/PTH	

Source: TrendForce (April 2026).

Exhibit 32: Glass fiber by type and application

Application		Device/ component	Substrate type		Required performance	Glass fiber type	
						High-end	Middle-end
Telecom/ infra-structure	• Base stations • Data center Switch/Router Server • AI servers	Processor· controller	Semiconductor package substrate	CPU/GPU/ASIC	Low CTE	T	E
				NAND memory	Low CTE	T	E
				LPDDR memory	Low CTE	T	
				DDR memory	Low dielectric tangent	NE / NER	E
		Motherboard	Servers (AI, General)		Low dielectric tangent	NE / NER	E
			Switch (Core, AI)		Low dielectric tangent	NE / NER / NEZ	E
			Network card (NIC)		Low dielectric tangent	NE / NER	E
Edge equipment	Smartphone Tablet Mobile PC Edge AI device	Processor	Semiconductor package substrate	AP·CPU/NPU	Low CTE	Ultra-thin T, T	Ultra-thin E
		Non-volatile memory		NAND memory	Low CTE	Ultra-thin T	Super ultra-thin E
		Volatile memory		DDR memory	Low CTE	Ultra-thin T (Smartphone)	
		Volatile memory		DDR memory	Low dielectric tangent	NE (PC)	
		Motherboard	Motherboard		Low dielectric tangent	Ultra-thin NE	Ultra-thin E
		Wireless communication	RF package substrate		Low dielectric tangent	Ultra-thin NE	Ultra-thin E
	Desktop· Laptop PC	CPU·memory	Semiconductor package substrate	CPU/GPU/NPU	Low CTE	T	E
		Motherboard		DDR memory	Low dielectric tangent	NE (PC)	E
	AR/VR·Drone	Advanced SoC	Semiconductor package substrate		Low CTE	T	Ultra-thin E
Automobile	EV·ADAS	Advanced SoC	Semiconductor package substrate		Low CTE	T	E
		Millimeter wave radar	Module board		Low dielectric tangent	Ultra-thin NE	E

Source: Nittobo.

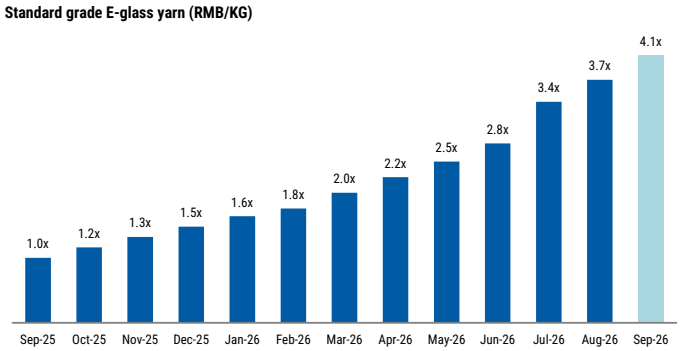
Standard E-glass: a DDR4-like supply squeeze

The similarity to DDR4 lies in supply reallocation rather than a step-change in end demand: In memory, suppliers have prioritized higher-value DDR5 and HBM, reducing the capacity available for DDR4 even as a meaningful installed base continues to require the legacy product. A similar dynamic is visible in electronic glass cloth: strong AI-related demand and materially higher pricing for low-Dk and other advanced grades are encouraging producers to move yarn, looms, and related resources up the specification curve, leaving less capacity for standard E-glass.

This is creating a legacy-product supply squeeze: Standard E-glass demand does not need to accelerate materially for pricing to rise; supply only needs to contract faster than demand. As capacity is redirected toward higher-end cloth, availability tightens for standard E-glass, extending lead times and driving price increases unrelated to AI.

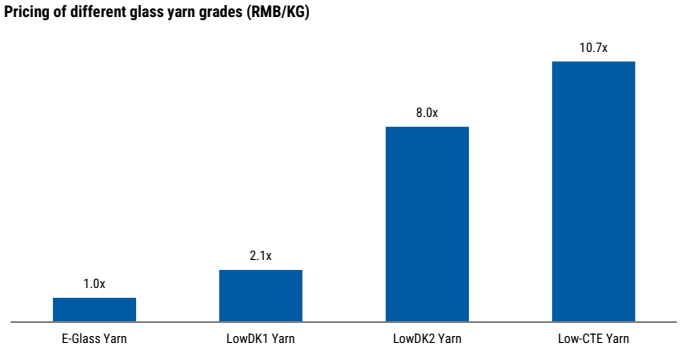
The earnings implications are also similar: Tightness in a mature product can provide an incremental pricing and margin tailwind to suppliers with meaningful legacy exposure, even though the underlying market is not structurally high growth. For Kingboard Laminates, vertical integration in glass yarn and cloth provides both supply security and direct exposure to margin and pricing tailwinds from standard grade E-glass.

Exhibit 33: We think pricing for E-glass yarn has been rising every month for some time now and we believe September will show a continued rise as well



Source: Morgan Stanley Research estimates.

Exhibit 34: Pricing of different glass yarn grades



Source: Morgan Stanley Research estimates.

We expect supply tightness to continue to 2028/29

The overarching theme across all Chinese glass fiber and fabric companies in recent months is a structural supply-demand imbalance driven by AI infrastructure buildout. AI-related demand is driving high-end glass fiber and fabric demand and prices, leading to incremental capacity shifts toward high-end products and tightening supply availability for standard products such as 7628 fabric. 7628 prices have rallied 170% YTD. while 2110 fabric prices increased even more amid tighter supply.

With inventory for industry leaders such as Jushi at only three days vs. the norm of one month, downstream customers have no push back on price hikes and are focusing only on securing supply. We expect continued price upside for glass fabric — new yarn supply is very limited for 2027 and likely still tight in 2028.

Three structural supply bottlenecks constrain China's glass fiber industry:

1. **Availability of Toyota weaving machines is limited:** Monthly shipments will reach only 300 units per month by end-2027; Chinese-made weaving machines are not considered by fabric producers because of low yield and low efficiency.
2. **Supply tightness of yarn is another important bottleneck:** New capacity build-out needs 18-24 months and requires high capex owing to rising prices of precious metals (platinum and rhodium). Total electronic yarn capacity in China stands at approximately 1.13mnt. The industry got 293kt of new yarn capacity in 2026, but the market is still very tight. Only 50kt of new capacity is likely to come onstream in 2026, so we expect the market to remain in shortage.
3. **Know-how is another high barrier to entry in electric yarn:** This is on tip of the high capex.

China's domestic Generation 1 low DK production stands at ~8mn meters per month and effective supply for Generation 2 is only ~600k meters per month. We believe the deficits for low DK G 1 & 2, L CTE, and Q glass are around 40% in 2026-27, 35% in 2028.

China Jushi (600176.SS, covered by Rachel Zhang)

Capacity leader riding the AI up-cycle: Within the materials sector, we view Jushi as one of the key beneficiaries of the AI infrastructure build-out. With AI-related demand driving up high-end glass fiber consumption, industry supply-demand dynamics appear healthy and are likely to remain supportive over the next 1–2 years.

The most recent briefing note (August 21, 2026) confirms that regular glass fiber looks "stronger for longer" — even after more than doubling YTD, prices are still enjoying more upside in 2H26, as customers compete for volume. Jushi can fulfill only ~80% of orders, with inventory at just 3.9 days.

Pricing is particularly strong for finer electronic-glass products, with 2116/1080 ASPs at ~Rmb14–15/m and price increases exceeding those for 7628, which itself is up ~170% YTD.

Jushi currently operates around 5,000 weaving machines and has placed orders for another 3,900 units — a significant scale advantage vs. peers constrained by machine availability. The company is currently undergoing certification for low DK Gen 2, low CTE, and Q-glass AI-related products, with commercial production expected around end-2026.

Taishan Fiberglass, a wholly-owned subsidiary of Sinoma Science & Technology (002080.SZ, covered by Eva Hou)

An industry leader in the glass fiber business: Taishan's product structure has been continuously optimized, with special electronic fabric sales volume rising YoY. The company holds a leading position (~70% global share) in special electronic fabrics. Taishan's products include low Dk, ultra-low-loss, low-dielectric fiberglass fabrics for high-speed CCLs, and low-expansion fiberglass fabrics for packaging applications.

Special electric fabric revenue was Rmb530mn in 1H26, up 114% YoY, with shipments of 13.5mn meters, up 50% YoY. Fiberglass revenue was Rmb4.8bn, up 16.3% YoY, with shipments of 760kt, up 13% YoY.

In June 2026, Sinoma Science & Technology announced plans to raise up to Rmb4.48bn via a private placement for specialty fiber fabric projects, mainly funding:

- A low-dielectric fiber fabric project of 35 million meters (phase 1 is slated to start production by the end of 2026, with phase 2 starting production 1H 2027); and
- A 24-million-meter ultra-low-loss variant (scheduled to start production in mid-2027).

Kingboard Laminates (1888.HK, covered by Howard Kao)

KB Laminates is the world's largest CCL producer by volume. It is differentiated by its vertical integration across copper foil, glass yarn and cloth, epoxy resin, and paper-based materials, providing advantages in cost, supply security and production planning.

Although it does not sell a lot of electronic yarn or cloth externally (we estimate only ~20% of its production output), we believe there is room for it to increase this exposure

as it continues to expand its glass yarn and cloth capacity. We estimate the company will expand its cloth capacity ~70% by the end of 2028 (vs. end-2025) to reach approximately 100mn meters/month of capacity. Within this, we believe it will have 5-10% of that capacity allocated to specialty cloth.

Grace Fabric Technology (603256.SS, covered by Rachel Zhang)

Specialty fabric specialist riding the AI up-cycle: We view Grace Fabric as a direct beneficiary of the AI infrastructure buildout within the electronic glass fiber fabric market. With AI-related demand driving structural growth in high-end electronic cloth consumption, industry supply-demand dynamics appear healthy and are likely to remain supportive over the next 1–2 years.

Grace Fabric's 1H26 results confirm the strength of the up-cycle: revenue reached Rmb1.05bn, up 90.4% YoY, with both E-glass and specialty electronic cloth demand described as "robust" and capacity running tight.

The company has been actively optimizing its product structure — reducing output of standard thick and thin E-glass cloth and redirecting capacity toward specialty electronic cloth, ultra-thin, and extremely thin high-end grades, which command meaningfully higher ASPs and margins.

On the product side, Grace Fabric's low DK Gen 1 and Gen 2 products obtained customer certification and entered batch production in 2025. Low CTE electronic cloth successfully entered the IC packaging substrate supply chain in the same year.

The company is one of the few domestic suppliers capable of providing stable supply of low DK, low CTE and other high-end specialty electronic cloth at scale. Lookig at capacity, Grace Fabric has committed to two major expansion projects under its subsidiary Huangshi Honghe:

- A high-performance electronic yarn Plant 2 (budgeted at Rmb3.0bn) and
- A high-performance electronic cloth Plant 4 (budgeted at Rmb2.0bn)

Alongside a cold-repair upgrade of existing yarn lines (Rmb163mn), this brings total planned capex across active projects to approximately Rmb5.9bn.

The broader industry supply bottleneck — driven by limited availability of Toyota weaving machines, whose monthly shipments will only reach 300 units per month by end-2027, and the rejection of Chinese-made alternatives by fabric producers due to low yield — creates a durable competitive moat for established players with existing machine fleets.

The global specialty electronic cloth market, which registered a 28.4% CAGR from 2021 to 2025 to reach US$623mn, is projected to expand to US$6.0bn by 2030 at a 15.4% CAGR on the basis of total electronic cloth basis, according to Frost & Sullivan, as cited in Grace Fabric Technology's prospectus. Specialty grades should capture a disproportionate share of that growth.

Resin

Takato Watabe, Ryoichi Watanabe

The build-out of AI and high-performance computing infrastructure is driving structural growth across two related but distinct high-performance electronic material markets:

1. BC/RDL materials used in advanced packaging;
2. Low-loss resin systems used in high-performance CCLs.

Increasing package complexity and rising RDL content are supporting growth in advanced packaging materials, while higher data rates and increasingly stringent signal-integrity requirements are accelerating resin system upgrades in CCLs.

AI/HPC demand growth and increasing sophistication in advanced packaging are driving structural growth in buffer coat (BC) and redistribution layer (RDL) materials. Five Japan-affiliated suppliers accounted for a high-90s (%) share of the global market by volume in 2025. Combined with their strengths in material design and formulation technology, this high market share places Japanese suppliers in a strong position to capture medium- to long-term market expansion.

BC and RDL materials

HD MicroSystems (a 50-50 JV between Qnity Electronics and Resonac) ranked first in 2025 with a low-30s (%) share of the global market by volume, followed by Asahi Kasei at ~20% in second place. Sumitomo Bakelite, Toray, and FFEM followed. The market was worth approximately US$600mn, and the five Japan-affiliated suppliers together accounted for a high-90s (%) share.

We expect the market to grow ~5% per year in both volume and value terms over 2025-29. RDL materials should grow at a high-single-digit rate, outpacing the low-single-digit growth expected for BC materials. As a result, we expect RDL's share of total BC/RDL volume to increase from the low 30s to the high 30s.

RDL growth should also outpace BC in value terms. RDL materials generally command higher prices than BC materials, with a particularly large premium over memory-oriented BC products. However, some logic-oriented BC products overlap with RDL materials in price, and pricing varies substantially by application and specification.

We believe overall volume growth and the shift toward higher-priced RDL materials will support medium-term market value growth.

- By application, memory is the largest category at around 30%. Logic and fan-in wafer-level packaging (FI-WLP) each account for roughly 20%, followed by fan-out WLP (FO-WLP)/panel-level packaging (PLP) in the low teens.
- By region, Taiwan is the largest consuming market at just under 40%, while South Korea and China each account for around 20%.
- By product type, negative-tone materials represent about half of the market, positive-tone materials just over 40%, and non-photosensitive materials less than 10%.

HD MicroSystems

This Qnity-Resonac JV held a low-30s (%) share of the global market in 2025, ranking first. It has strong positions in BC materials for logic and power semiconductors and in RDL materials for FI-WLP. The company offers a broad range of photosensitive and non-photosensitive polyimide materials and has production bases in Hitachi, Ibaraki Prefecture, Japan (within Resonac's Yamazaki Works), and Parlin, New Jersey.

U.S. sales volume increased at a high-single-digit rate over 2023-25, slightly below market growth, resulting in a modest share decline. Resonac also offers phenolic grades outside the HD MicroSystems product portfolio; these are not included in the market share above.

Asahi Kasei (3407.T)

Asahi Kasei ranked second in 2025 with around 20% of the global market by volume. It also holds a strong position in the faster-growing RDL segment, particularly in fan-out WLP, and is believed to be one of the main vendors for TSMC's InFO packaging platform.

The company offers both PBO- and phenolic-based BC materials. Its low-temperature-curable positive-tone photosensitive phenolic material is used as a standard material at TSMC.

In RDL materials, the company has also built adoption track records in antenna-in-package (AiP) and 2.5D interposer applications. Sales volume grew at a high-single-digit rate over 2023-25, slightly ahead of the overall market. Although its share was broadly flat, we view its strong position in RDL materials, particularly FO-WLP, which should outgrow BC, as a relative strength.

Asahi Kasei identifies advanced logic as a strategic growth area and is using its Taiwan sales base to increase its focus on the segment. In PIMEL, it completed a new plant in Fuji City, Shizuoka Prefecture, in December 2024. In August 2025, it decided on a further expansion at its existing site in the same city, investing approximately ¥16bn, with commercial start-up scheduled for 1H FY2028. The company plans to double output by 2030 versus FY2024, positioning itself to capture growing demand from AI accelerators and next-generation advanced packaging.

Sumitomo Bakelite (4203.T)

Sumitomo Bakelite has a strong competitive position, particularly in BC materials for memory applications. According to the company, it was the first in the world to begin mass production of a positive-tone photosensitive semiconductor wafer-coating resin in 1997, and its flagship product is SUMIRESIN EXCEL CRC.

Given its high exposure to Korean memory manufacturers, it was affected by customer production cuts in 2023, followed by a strong recovery. Sales volume grew at a low-teens rate over 2023-25, outpacing the overall market. Its share also rose around 1ppt, the largest increase among the top five suppliers.

At its Utsunomiya Plant, which serves as both a production and development base, the company expanded capacity in 2022. The site also houses the Information and Communication Materials General Research Center, enabling integrated development and mass production of advanced packaging materials.

Toray (3402.T)

Toray offers PHOTONEECE photosensitive polyimide and has an established presence in memory and power semiconductor applications. It is believed to have strengths with major Japanese and Korean memory manufacturers.

Sales volume increased at a mid-single-digit rate over 2023-25, but lagged market growth, resulting in a modest decline in share.

In December 2025, the company developed a negative-tone photosensitive polyimide sheet for glass-core substrates. At the time of the announcement, samples were being provided, and the material was under evaluation by substrate manufacturers, with mass production targeted for F3/27.

Glass-core substrates are attracting attention as a next-generation technology for advanced AI packaging, and the product could provide a foothold for a recovery in Toray's market position.

Resins for CCLs

To understand the resin specifications required by the latest CCLs, we take a brief look back at the history of CCLs.

- Until around 1960, CCLs mainly used wood pulp base materials and phenolic resin.
- Subsequently, the base material shifted from paper to glass fiber, and the resin from phenolic resin to epoxy resin, but through the 1970s the key focus was essentially cost.
- In the 1990s, as package substrate materials for PC CPUs shifted from ceramics to organic materials, reliability became more important than ever. Requirements for CCLs became particularly stringent with regard to aspects such as low coefficient of thermal expansion, rigidity, and insulation properties.

BT laminate supplied by *Mitsubishi Gas Chemical* is a CCL made from resin that blends bismaleimide and cyanate ester (which forms a triazine ring). It is particularly suited to the needs of semiconductor package substrates.

From the 2000s onward, as demand for high-speed communications increased, the most important issue became how to minimise transmission loss. There are two factors in transmission loss: conductor loss and dielectric loss. Dielectric loss is expressed as the product of frequency, the square root of relative permittivity, and dielectric dissipation factor. As a result, there has been increasing demand for resins with lower dielectric dissipation factor (Df) in CCLs for advanced PCBs.

Companies generally do not disclose the composition of their CCLs, but we estimate that the approximate breakdown of a CCL by weight is about 50% copper foil, 20% glass fiber cloth, 20% resin, and 10% silica and other materials. In thinner products (such as those for FC-CSPs), the weighting of copper foil is higher, while the weighting of glass cloth and resin is higher in thicker products (such as those for FC-BGAs).

Epoxy resin has become, and remains, the principal resin used in CCLs. This is because epoxy resin offers strong adhesion to copper foil and glass cloth as well as good processability for pressing and drilling.

The largest supplier of epoxy resin for CCLs is Taiwan's Chang Chun Group.

Japanese companies with strengths in this field include *DIC*, *Mitsubishi Chemical Group*, and *Nippon Kayaku*.

To reduce transmission loss in high-speed communications, however, CCLs need to be manufactured using resins with low dielectric properties. In ultra-low-loss and extreme-low-loss grades, we understand that resins such as PPE and OPE, which have low dielectric dissipation factors, are being used as the main materials. Suppliers include SABIC of Saudi Arabia and *Mitsubishi Gas Chemical* of Japan.

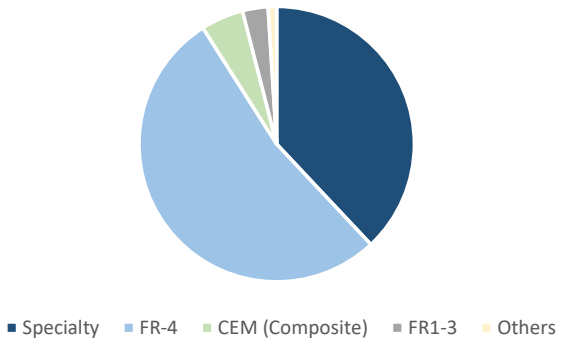
That said, while PPE alone lowers the dielectric dissipation factor, it lacks sufficient heat resistance and processability. For this reason, bismaleimides (BMIs) and cyanate ester are sometimes added. Japan's *Kumiai Chemical* is a leading producer of BMIs (through subsidiary K-I Chemical), while the main producers of cyanate ester are Huntsman in the US and *Mitsubishi Gas Chemical* in Japan.

However, cyanate ester and BMI do not blend easily with PPE, and using them as is results in phase separation. Therefore, modifiers that bring epoxy, PPE, BMI, and cyanate ester together into a single network have become important. Major modifiers include *Nippon Soda*'s NISSO-PB and *Denka*'s SNECTON.

Mitsubishi Gas Chemical not only provides BT laminate, a CCL for semiconductor packages, but also handles a broad range of materials well suited to CCLs for high-speed communications, including low-dielectric OPE and low-dielectric, high-Tg cyanate monomers.

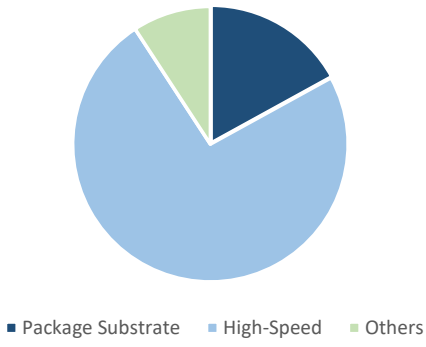
Meanwhile, modifiers play an important role in bringing together these multiple resins. We think *Denka*'s SNECTON (Soft) has significant potential as a modifier. Denka also supplies silica for CCLs, and its low-dielectric silica has shown substantial growth of late.

Exhibit 35: Rigid PCB Laminates (CCL & Prepreg) by Material Type (CY2024, USD15.0bn)



Source: Prismark, Morgan Stanley Research

Exhibit 36: Specialty Laminates (CCL & Prepreg) by Application (CY2024, USD5.7bn)



Source: Prismark, Morgan Stanley Research

Exhibit 37:

Types of CCLs and their development

Period	Era		CCL	Reinforcement	Tg (℃)	Dk	Df (Tan δ)	Application
1950s	Low-cost		FR-1	Paper	125-135	4.8-5.2	0.020-0.030	-
1960s			FR-2		105-110	4.8-5.3	0.020-0.030	TVs, Consumer Electronics
1970s			FR-3, FR-4	Paper, Glass cloth	120-150	4.2-4.8	0.015-0.022	Industrial, Aerospace
1980s	Reliability		FR-5, CEM-3, BT	Glass cloth, Glass cloth+Glass non-woven	140-255	3.7-4.5	0.006-0.015	Semiconductor Packaging
1990s		Low-loss	High Tg FR-4, PPO/PPE, Cyanate Ester	Glass cloth	135-290	2.9-4.5	0.002-0.015	Networking Equipment
2000s			M4, M6		175-185	3.4-3.7	0.002-0.007	Networking
2010s			M7		200	3.3-3.4	0.002-0.003	Cloud, HPC
2020s		AI	M8		220	3.0-3.2	0.001-0.002	AI Servers

Source: Company data, JPCA, Morgan Stanley Research

Exhibit 38: Breakdown of resins used in major types of CCLs (our estimates)

	Approximate Data Rate	Df (Tan δ)	Reinforcement	Estimated Resin Composition (%) Epoxy	PPE/OPE	Cyanate	BMI	Others	Importance of Reactive Modifiers	Key Challenge
for PCB										
FR-4	10 Gbps	0.018-0.020	Glass cloth	90-95	0-5	0	0	5-10	*	Processability, Cost
High Tg FR-4	20-25 Gbps	0.014-0.017		80-90	5-10	0-5	0	5-10	**	Heat Resistance
M4	25-56 Gbps	0.009-0.011		60-75	25-40	0-5	0	5-10	***	Lower Df Requirements
M6	56-112 Gbps	0.004-0.006		35-50	40-55	5-10	0-5	5-10	****	Balancing Low Df and Processability
M7	112 Gbps (800GbE)	0.002-0.004		20-35	45-60	10-20	5-10	5-10	*****	Ultra-Low Df and High Reliability
M8	224 Gbps (1.6TbE)	0.001-0.003		5-20	50-65	10-20	10-20	5-10	*****	Extremely Low Df and Ultra-High-Density Packaging
for Substrate										
FC-BGA	-	-	Glass cloth	25-35	0	20-30	15-25	5-10	*****	Low CTE
FC-CSP				15-25	0	40-45	25-30	5-10		

Source: Company data, JPCA, Morgan Stanley Research

Exhibit 39: Advantages/disadvantages of various resins used in CCLs

	Epoxy	PPE/OPE	Cyanate Ester	BMI	Reactive Modifier Nisso PB	SNECTON (Soft)	SNECTON (Hard)
Df	0.012-0.020	0.003-0.006	0.002-0.004	0.003-0.006	0.0001-0.0018	0.0004-0.0007	0.0003-0.0004
Tg (℃)	160-200	180-230	220-300	220-280	-51<Tg<-7	-20<Tg<20	190
Advantages	Processability Adhesion	Low Df High Tg	Low Df High Tg	Low Df High Tg	Low-Df, Network formation		
Disadvantages	High Df Low Tg	Adhesion Flowability	Rigidity. Brittleness	Rigidity. Processability	Low Tg		
Electrical	**	*****	*****	****	****		
Thermal	***	****	*****	*****	****		
Mechanical	****	**	**	*****	*****		
Manufacturing	*****	**	**	*	*****		
Cost	*****	***	**	**	***		

Note: * indicates the relative contribution of each resin to the corresponding property (***** = highest, * = lowest).

Source: Company data, Morgan Stanley Research

Exhibit 40: Resin Systems Comparison Table

Resin system	Loss tier	Processing difficulty (1-5)
Epoxy (FR-4 / modified)	Standard - Low	**1**
CE / BT	Low - Very low	**3**
PPO / PPE	Low - Extreme low	**3.5**
Hydrocarbon (ceramic-filled)	Very low - Extreme low	**2**
PTFE	Extreme low and beyond	**5**

Source: Morgan Stanley Research.

US – AI Materials

Meta Marshall

Corning (GLW.N)

AI-driven optical demand increasingly looks supply-constrained, with U.S. capacity expansion supporting a multi-year volume runway. Corning remains our preferred U.S. exposure to the tightening optical-fiber market as large customer commitments absorb a meaningful portion of available supply and provide the visibility needed to support a material step-up in domestic capacity.

Corning ended 2025 with 14.5mn sq. ft. of U.S. manufacturing space across an implied ~44 facilities, including core optical fiber and cable operations in North Carolina, while its NVIDIA partnership contemplates a >50% increase in U.S. fiber production capacity and a 10x expansion in U.S. optical-connectivity capacity.

Corning does not disclose its share of global fiber supply, although it has historically identified itself as the world's largest optical fiber and cable producer, and the scale of its existing commitments is notable, with Lumen alone reserving 10% of Corning's global fiber capacity for 2025 and 2026. Additional multi-year agreements with Meta and Amazon, alongside the broader NVIDIA relationship, suggest that Corning is deliberately allocating a meaningful share of incremental capacity toward the hyperscalers and AI infrastructure customers driving the strongest demand growth. Such prioritization should strengthen long-term volume visibility and strategic positioning, but may also constrain supply allocation to other customers and help explain why fiber tightness remains visible across the broader market despite substantial capacity investment.

Peer commentary reinforces our view that the current constraint is capacity rather than demand, with Fujikura operating near full utilization and customers paying ~25% higher like-for-like prices in certain cases for shorter lead times. CommScope continues to describe fiber supply as tight despite having secured enough external supply to support current growth.

Corning's relative lack of comparable spot pricing upside therefore appears more reflective of capacity already committed under large customer agreements than weaker underlying demand, creating stronger volume visibility but potentially limiting near-term pricing upside.

With Corning planning ~$2.0bn of FY26 capex, incremental capacity should create a favorable setup for operating leverage as those assets ramp against an increasingly committed demand base, while AI-related fiber requirements broaden beyond inside-the-data-center connectivity into long-haul routes linking major computing and power corridors.



Amphenol (APH.N, Not Covered)

CommScope adds a scaled U.S. optical platform and provides a second read-through on accelerating AI fiber intensity: Acquisition of CommScope's Connectivity and Cable Solutions business materially increases Amphenol's exposure to advanced optical interconnect, particularly for AI scale-out and scale-across architectures, while also expanding its domestic manufacturing base.

Pro forma for CCS, we estimate that Amphenol now has ~7.4mn sq. ft. of U.S. manufacturing capacity, up from 6.0mn previously, equivalent to ~22 Corning-sized U.S. facilities on a normalized square-footage basis, with acquired assets in North Carolina. Commercial momentum has strengthened alongside the added capacity, with Amphenol raising expected FY26 CommScope revenue to $4.6bn from $4.1bn as IT datacom sales nearly double y/y and move toward half of the acquired business's revenue mix.

Fiber supply remains tight, but broader sourcing has so far allowed CommScope to support growth without shipment constraints, creating somewhat greater near-term flexibility than Corning and reinforcing the broader industry message that demand is running ahead of available fiber capacity.

Amphenol's expected capex near or above the high end of its 3-4% of sales range in 2H further supports the view that the optical supply chain is entering a sustained investment cycle.

Optical Fiber

Andy Meng, Yu Shirakawa

The rapid expansion of AI infrastructure is driving a significant increase in data transmission within and between data centers, bringing optical fiber into focus as a key enabling material for next-generation connectivity.

Data centers are increasingly running into bandwidth constraints, with optics emerging as the solution. The rapid scaling of AI clusters is driving an exponential increase in data traffic, pushing traditional electrical interconnects toward their bandwidth, power, and distance limits. Each successive generation of AI infrastructure therefore requires more optical connectivity—translating into greater fibre density, more optical transceivers and, ultimately, a shift toward next-generation architectures such as co-packaged optics (CPO), where optical engines are integrated alongside computing and switching silicon.

Optical fiber can transmit data across tens of metres to kilometers without meaningful signal loss, and as bandwidth per lane continues to increase, the economics tilt further in its favour. Optical connectivity already dominates inter-rack (scale-out) connections over distances of 10 metres to 10 kilometers, while continued expansion of AI clusters should further increase the amount of fiber deployed within data centers – creating a structural growth opportunity for optical fiber and related components.

AI data center expansion to drive >20% optical fiber demand CAGR over 2025-30e

Against this backdrop, we expect AI-driven optical fiber demand in data centers to register a CAGR of >20% from 2025 to 2030. Hyperscale AI data centers can require 5–10x more optical fiber than traditional data centers, with some estimates suggesting 5–36x more fiber per rack.

The acceleration is already becoming visible in near-term industry demand. YOFC management expects global optical fiber demand to exceed 670mn fiber-km in 2026, with data center-related fiber demand growing 69% YoY.

Optical fiber prices reach a seven-year high

The strong demand environment has translated into tighter supply and a sharp increase in optical fiber prices. Corning noted during its 3Q results call that "demand exceeds supply and the market is in a very tight state." And we have observed significant price increases across several major fiber categories in recent months:

1. G.652D fiber, a mainstay in the carrier market, rose 75% in January 2026, reaching its highest level in seven years.
2. G.657A single-mode fiber (used in drones and data centers) rosese >80%, from >30 yuan per core-km in mid- to late December 2025 to >50 yuan per core-km, with some high-end models exceeding 55 yuan per core-km.
3. Multimode (OM3/4/5) spot prices rose from Rmb200 to Rmb300–400 per fiber-km in response to AI data center demand.
4. Some types of single-mode fiber are up 400% to 650% compared to late 2025.

Capacity expansion underway, overseas players moving more aggressively

The tight optical fiber supply-demand environment and improving industry returns have triggered a new round of capacity investment globally. Major suppliers across the US, Japan, India and China have announced or begun capacity additions, although the scale and timing of expansion vary considerably. Overseas players have so far taken a more aggressive approach, led by Corning and Fujikura, while Chinese suppliers remain relatively disciplined in adding new capacity (see details).

Fujikura (5803.T, covered by Yu Shirakawa)

This company is a major Japanese optical fiber and cable supplier, offering high-density optical fiber cables using its SWR/WTC technologies, which allow more fibers to fit within limited cabling space as AI data centers require more optical connections.

The company has already announced two additional rounds of capacity expansion for optical fiber cable.

- The first phase involves an investment of ¥45bn at the Sakura plant in Japan, raising SWR/WTC capacity to approximately 2x versus F3/23 levels, with ramp-up starting from 2029.
- The second phase involves an investment of ¥40bn domestically and up to ¥260bn in the US, raising SWR/WTC capacity to approximately 4x versus F3/23 levels. The second phase is planned to be ramped up in stages starting from 2030.

On October 28, 2025, the US and Japanese governments released a "Joint Fact Sheet for Japan-US Investment." Fujikura was mentioned under the part titled "Strengthening AI Infrastructure." The company has been qualified as a supplier of optical fiber cable for the build-out of AI infrastructure in the US.

Furukawa Electric (5801.T, covered by Yu Shirakawa)

This company is also a major Japanese optical fiber and cable supplier. Near-term investment is focused primarily on cable production, with the company increasingly using internally produced fiber for its own cable products, while full-scale optical fiber capacity expansion is expected from F3/29 onward. Current plans include a roughly 2–3x increase in rollable ribbon cable capacity and around a 2x increase in MT ferrule capacity.

Furukawa Electric announced a ~¥100bn investment to expand optical fiber and optical fiber cable production capacity across four countries (the US, Brazil, Japan, and India). Operations are scheduled to start sequentially from 2H F3/29. The investment is expected to roughly double rollable ribbon cable manufacturing capacity in fiber volume terms versus end-F3/26.

We view this announcement as consistent with the company's medium-term plan, which flagged that near-term capacity additions would focus on cable, with more substantial fiber capacity expansion from F3/29 onward.

Sumitomo Electric Industry (5802.T, covered by Yu Shirakawa)

Sumitomo Electric is also a major Japanese optical fiber and cable supplier. For optical fiber cable, the company retains some spare capacity in its preform process and plans to expand its downstream optical fiber cable operations. Under its capacity expansion plan, over the F3/27–F3/29 period the company intends to increase capacity for optical connectors by 2x, optical fiber by 1.5x, optical devices by 2x, and InP substrates by 1.7x.

HFCL Limited (HFCL, Not Covered)

HFCL is an Indian telecom equipment and optical fiber/cable supplier that is expanding capacity across both fiber and cable. Optical fiber capacity has doubled from 14mn to 28mn fiber km and is expected to reach 33.9mn fiber km by December 2026. Optical fiber cable capacity stood at 34mn fiber km as of April/May 2026 and is expected to increase to 39mn by July and 42.36mn by December 2026, according HFCL Q4 FY26 Earnings Call.

Yangtze Optical Fibre and Cable (YOFC; 6869.HK, covered by Andy Meng)

YOFC is a leading Chinese optical fiber and cable supplier and a direct beneficiary of the current improvement in the fiber cycle. Management expects global optical fiber demand to exceed 670mn fiber-km in 2026, with data center-related fiber demand growing 69% YoY. However, Chinese capacity additions remain relatively disciplined at this stage, with suppliers focusing more on yield and utilization improvements alongside selective new capacity.

Strong near-term fundamentals, but capacity expansion raises risk of medium-term normalization

We remain positive on near-term optical fiber fundamentals, supported by robust AI demand and tight supply. However, the strong pricing and margin environment is driving new capacity additions, particularly among overseas suppliers. Chinese players have remained relatively disciplined so far, but could accelerate expansion if overseas capacity growth leads to market-share pressure.

As more capacity comes online globally, we expect supply-demand conditions to gradually normalize, creating potential pressure on fiber pricing and margins over the medium term.

Rare Earth Oxides

Rachel Zhang, Kaylee Xu

Application in MLCCs

Rare earth elements (REEs) play an important role in the production of high-performance $BaTiO_3$-based MLCCs, serving as dopants that enhance the electrical stability and reliability of ceramic dielectrics. As AI server upgrades lead to higher power consumption and more complex power delivery architectures, demand is shifting toward higher-capacitance MLCCs with tighter performance specifications to support transient current requirements.

Barium titanate ($BaTiO_3$), the primary dielectric material in most high-capacitance MLCCs, is generally insufficient in its pure form to deliver the required electrical characteristics. Rare earth oxides are therefore incorporated into $BaTiO_3$-based ceramic material to control its microstructure, thereby improving insulation resistance, temperature stability and long-term durability.

Rare earth oxides (Y_2O_3, Ho_2O_3, Nd_2O_3, Dy_2O_3 and Gd_2O_3): Common rare earth dopants in these formulations include yttrium (Y), holmium (Ho), neodymium (Nd), dysprosium (Dy), and gadolinium (Gd), typically introduced as Y_2O_3, Ho_2O_3, Nd_2O_3, Dy_2O_3 and Gd_2O_3, respectively.

The choice and concentration of dopants vary according to the targeted electrical characteristics and manufacturing process. As AI servers increase MLCC content per system while accelerating the migration toward more sophisticated component specifications, we expect high-purity rare earth materials used in advanced electronic ceramics to see structural demand growth, albeit from a relatively small volume base.

AI power application

With the rapid deployment of AI data centers, power demand from these facilities is rising significantly. However, new power supply from nuclear, wind, coal-fired and gas-fired generation typically takes years to develop, creating a mismatch between the pace of data center expansion and power availability.

Fuel cells offer an alternative source of electricity through a controlled electrochemical process and can be deployed within a much shorter timeframe. According to Rabobank, fuel cells can be deployed in as little as 90 days. Given the shorter deployment cycle and ability to provide on-site power, fuel cells are increasingly being adopted by hyperscalers to meet their growing electricity needs.

This emerging demand also has implications further upstream, particularly for scandium oxide (Sc_2O_3), a key material used in certain solid oxide fuel cell (SOFC) technologies.

Scandium oxide (Sc_2O_3): Scandium oxide (Sc_2O_3) is relevant to solid oxide fuel cells (SOFCs). SOFCs is one potential solution to the power shortages faced by AIDCs, particularly in North America. Scandium is used to stabilize zirconia, producing scandia-stabilized zirconia (ScSZ)—a high-performance oxide-ion electrolyte. Adding Sc_2O_3 to zirconia creates oxygen vacancies and stabilizes a highly conductive zirconia phase. ScSZ

generally has higher oxide-ion conductivity than conventional yttria-stabilized zirconia (YSZ), which can enable SOFCs to operate effectively at lower temperatures—roughly 600–800°C rather than ~800–1,000°C for traditional high-temperature designs.

Hunan Oriental Scandium, a subsidiary of LB Group (002601.SZ, Not Covered, a global leader of titanium dioxide), is a major supplier globally of Sc_2O_3. Although the revenue from Sc_2O_3 accounts for only a small portion of LB Group's total revenue, Hunan Oriental Scandium is critical in global Sc_2O_3 supplies. Hunan Oriental Scandium currently has 40t per annum Sc_2O_3 capacity, which is likely >50% of global supplies. The company is expanding Sc_2O_3 capacity to 100t per annum in the next 12 months. Further expansion plan is not clear at the moment.

Synthetic Diamonds

Rachel Zhang, Yoshihito Hasegawa

Synthetic diamond is emerging as a next-generation thermal management material for the semiconductor industry, supported by superior thermal conductivity: 2,000–2,400 W/(m·K), ~5x that of copper. It can efficiently transfer heat from high-performance chips to cooling systems, helping address the rapidly rising localized heat flux density of AI chips.

Growing market demand for AI computing power is driving continuous upgrades in per-chip performance, bringing with it higher chip power density and GPU thermal design power (TDP). GPU TDP is rising significantly from around 1,200W for GB200 to ~2,300W for Rubin, representing a near-doubling in just one generation. At ~2,300W per chip, localized heat flux density could reach ~1,000 W/cm^2, placing increasing pressure on conventional copper-based thermal solutions, given copper's thermal conductivity of ~400 W/(m·K).

Inefficient heat transfer from the chip can lead to excessive temperatures and trigger thermal throttling, resulting in a significant loss of computing performance. Upgrading thermal management materials has therefore become an increasingly important priority. This is driving increased R&D and adoption of synthetic diamond and diamond-based composites, underpinned by their superior thermal performance, with diamond-copper composites reaching ~600–1,000 W/(m·K) and high-purity CVD diamond offering thermal conductivity of 2,000–2,400 W/(m·K).

Leading technology companies and their management are increasingly exploring the use of these materials for advanced chip thermal management. NVIDIA's Vera Rubin platform is reportedly adopting diamond-copper composites, while Intel's CEO has disclosed a personal investment in a synthetic diamond wafer company whose products could potentially be used for chip-level thermal management.

As localized heat flux density in AI chips continues to rise and the industrialization of synthetic diamond advances, the semiconductor industry is likely to see a gradual migration from conventional thermal materials toward diamond-based solutions. This could create a structural growth opportunity for synthetic diamond suppliers over the medium to long term. Moreover, apart from thermal management usage, more demand is also witnessed amid semiconductor equipment sector driven by AI expansion.

Asahi Diamond Industrial (6140.T, covered by Yoshihito Hasegawa)

Asahi Diamond Industrial has been improving its earnings quality through the reorganization of its production footprint, the withdrawal from unprofitable products, and ongoing price revisions. In its medium-term business plan, the company has outlined a strategy to accelerate investment in the semiconductor and electronics sectors, where it expects strong long-term growth.

The company's five key focus products are wafer grinding tools, wafer edge-trimming tools, electroplated wire tools, CMP conditioners, and dicing blades. In particular, it aims to expand the application of its wafer grinding tools beyond wafer manufacturing processes into device fabrication processes, including hybrid bonding applications.

More recently, demand has been strong for applications such as panel processing for PLP, PCB drills, and the machining of showerheads used in semiconductor process chambers, driving higher utilization rates. Supported by these factors, the company delivered strong results in 1Q F3/27 and raised its full-year earnings guidance.

However, even after the raise, 1Q operating profit represented 58% of the company's first-half operating profit target and 29% of its full-year forecast. Given the continued strength in semiconductor-related demand, the revised guidance still appears to be based on relatively conservative assumptions.

Henan Liliang Diamond Co. Ltd (301071.SZ, covered by Rachel Zhang)

China's leading synthetic diamond producer: Henan Liliang Diamond Co., Ltd. is a China-based manufacturer specializing in synthetic diamond and superhard materials. Its business is centered around three main product categories: synthetic diamond single crystals, diamond micropowder, and lab-grown gem-quality diamonds. These products serve a broad range of applications, including precision machining, geological drilling, photovoltaics, consumer electronics, semiconductor processing and jewelry.

Against the backdrop of the AI boom, synthetic diamond is finding applications in the semiconductor segment as a high-precision cutting, grinding, and drilling material, as well as functional materials for thermal management in power semiconductors, optical windows, and semiconductor materials.

The AI wave accelerates the development of third-generation semiconductor materials, including silicon carbide (SiC) and gallium nitride (GaN), which offer a wider bandgap, higher breakdown electric field, better high-temperature performance, and higher power-handling capability.

Henan Liliang Diamond currently focuses on the research and development of diamond micropowder specifically for processing third-generation semiconductor materials, as an effort to tap into high-end downstream segments and facilitate corporate transformation. Once commercialized, we expect further revenue contributions from the leg. In 1H26, diamond micropowder segment realized 44.45% YoY revenue growth, accounting for c. 9% of total revenue.

We see potential growth catalysts including 6G progresses and continued evolution in structural materials for smartphones and other consumer electronics.

Tungsten

Rachel Zhang

Tungsten is a strategic metal with a high melting point, high density, excellent hardness and wear resistance, as well as favorable electrical and thermal properties. It is primarily used in cemented carbides, cutting and drilling tools, high-temperature materials, electronics, aerospace, and other advanced industrial applications.

In AI infrastructure, tungsten has exposure across both PCB manufacturing and advanced semiconductor fabrication. Tungsten carbide is a key material used in PCB drill bits, with increasingly complex, higher-layer-count AI PCBs requiring intensive precision drilling, while high-purity tungsten materials are increasingly important in advanced semiconductor manufacturing. With the continued development of high-performance computing, artificial intelligence and advanced semiconductor technologies, demand for tungsten-related materials in the semiconductor industry has become increasingly important.

In semiconductor manufacturing, tungsten is commonly used in contacts, vias, and certain interconnect structures thanks to its high thermal stability, relatively low electrical resistivity, and compatibility with advanced semiconductor fabrication processes. High-purity tungsten materials and tungsten-based precursors, including tungsten hexafluoride (WF_6), are used in deposition processes for the fabrication of logic and memory devices.

As AI drives demand for increasingly advanced logic and high-performance memory, tungsten and WF_6 provide upstream material exposure to continued semiconductor scaling and increasingly complex interconnect structures.

China is by far the most consequential player. It produced roughly 82% of the world's mined tungsten in 2024, according to the USGS. Since February 2025, China has required export licences for several important tungsten products, including ammonium paratungstate (APT), tungsten oxide, tungsten carbide, certain high-purity/solid tungsten and tungsten alloys, as well as related production technology. Chinese exports of tungsten products (excluding cemented carbide tools and tungsten halogen lamps) totaled 15,300 tons, representing a YoY decrease of 20.71% compared to the same period in 2024.

Xiamen Tungsten (600549.SS, Not Covered)

This company is one of China's leading vertically integrated tungsten producers, with operations spanning tungsten mining, smelting and refining, tungsten powders, cemented carbide, and downstream tungsten products. The company participates across a significant portion of the tungsten value chain, converting tungsten concentrates into intermediate products such as APT and tungsten oxides, and subsequently into tungsten and tungsten carbide powders and higher-value-added products. Its downstream activities include cemented carbide and cutting-tool materials serving industrial applications such as automotive, machinery, mining and manufacturing.

In its tungsten mining business, Xiamen Tungsten owns three operating tungsten mines—Luoyang Yulu, Ninghua Xingluokeng and Duchang Jinding—as well as one tungsten mine

under development, Bobai Judian. Its operating mines have combined annual production of approximately 12,000 tonnes of tungsten concentrate (65% WO_3), providing a stable source of feedstock for the company's downstream tungsten processing operations. As of 2025, the tungsten and molybdenum segment accounted for 43.6% of Xiamen Tungsten's revenue.

China Tungsten High-Tech (000657.SZ, Not Covered)

This company is China Minmetals' integrated tungsten industry operating platform and one of the world's largest vertically integrated tungsten companies.

The company operates across the tungsten value chain, spanning tungsten mining and beneficiation, smelting and powder production, cemented carbide, cutting tools and precision tools, refractory-metal products, equipment and trading. Its principal products include tungsten concentrate, APT, tungsten and tungsten-carbide powders, cemented carbide products, CNC cutting inserts and tools, PCB micro-drills, tungsten/molybdenum products and tantalum/niobium products. These products serve traditional industries including automotive, machinery, mining and oil drilling, as well as higher-growth applications such as aerospace, AI servers and electronics, semiconductors, new energy and nuclear fusion.

The company's position in the tungsten industry was strengthened substantially through the injection of upstream mining assets. Following the inclusion of Hunan Shizhuyuan Nonferrous Metals in 2024 and the acquisition of Hengyang Yuanjing Tungsten in 2025, China Tungsten High-Tech has developed a much more integrated exposure from tungsten resources through downstream high-value-added products. In 2025, it produced 11.1kt of tungsten concentrate, 16.6kt of APT and 16.3kt of cemented carbide, representing 8.5%, 12.2% and 25.5% of Chinese production, respectively.

Jiaxin International Resources Investment (3858.HK, Not Covered)

This is a tungsten mining company focused on the development and operation of the Boguty tungsten mine in Kazakhstan. According to Frost & Sullivan, as of end-2025 Boguty was the world's largest open-pit tungsten mine by tungsten trioxide (WO_3) mineral resources and the fourth-largest tungsten mine globally including both open-pit and underground mines. It also has the world's largest designed tungsten concentrate production capacity among single tungsten mines. Phase I commercial production commenced in April 2025, with the company mining and processing 2.80Mt of tungsten ore and producing 5,008 tonnes of 65% scheelite concentrate during the year.

Jiaxin currently sits at the upstream end of the tungsten value chain, with tungsten concentrate serving as feedstock for downstream conversion into ammonium paratungstate (APT) and subsequently other refined tungsten materials.

The company is looking to extend its presence downstream, with APT feasibility studies and project planning forming part of its 2026–28 priorities, followed by potential project implementation and greater integration across mining, beneficiation, and smelting.

Over the longer term, Jiaxin plans to explore higher-end tungsten processing such as tungsten powder, with new energy and semiconductors identified among its target applications.

Molybdenum

Rachel Zhang

As 3D NAND continues to scale toward higher layer counts, conventional tungsten word-line metallization is increasingly facing physical scaling constraints. As word-line dimensions shrink to accommodate additional layers while limiting total stack height, tungsten resistivity rises significantly, increasing resistance-capacitance (RC) delay and ultimately constraining NAND performance and further vertical scaling.

Against this backdrop, the NAND industry is beginning to transition from tungsten to molybdenum for selected word-line applications. Molybdenum offers more favorable resistivity at increasingly narrow dimensions and can reduce word-line RC delay, enabling faster signal transmission and supporting continued scaling of high-layer-count 3D NAND.

Samsung pioneered adoption of molybdenum in its 286-layer Gen 9 V-NAND, followed by Micron in mass production, while SK hynix has validated adoption of molybdenum in its 375-layer NAND, targeting mass production by end-2026. We expect adoption of molybdenum in 3D NAND to broaden as layer counts continue to increase and word-line dimensions become increasingly constrained. This creates a sustained volume growth opportunity for molybdenum, driven by increasing penetration and content per NAND wafer, alongside continued growth in advanced NAND output.

Zijin Mining Group (2899.HK/601899.SS, covered by Rachel Zhang)

This company is emerging as a rapidly growing molybdenum producer alongside its core copper and gold businesses, with mined molybdenum output increasing from 9.0kt in 2024 to 11.5kt in 2025. The company targets 15kt in 2026 and 25–35kt by 2028, implying a 48–75% CAGR from 2025 and materially outpacing the near-term production profile of more established producers.

Growth is supported by large copper-molybdenum assets including Julong, which produced 8.0kt of molybdenum in 2025 and is undergoing a major expansion, as well as Duobaoshan/Tongshan. Zijin also holds 5.0mt of molybdenum resources, providing a sizable resource base for further growth.

Amid rising molybdenum adoption in advanced 3D NAND, Zijin offers increasing upstream exposure to the theme, with its rapidly expanding production base positioning the company to capture incremental demand from semiconductor applications alongside broader industrial demand.

CMOC Group Ltd (3993.HK, covered by Rachel Zhang)

CMOC is one of the world's leading molybdenum producers, with an integrated presence spanning mining, processing and smelting in China. Its core molybdenum operations are centered on the Sandaozhuang and Shangfanggou mines in Luanchuan, one of the world's major molybdenum resource regions. Molybdenum production reached 13.9kt in 2025, down from 15.4kt in 2024 because of declining ore grades, although improving recovery rates helped offset part of the pressure.

While semiconductor applications remain a relatively small part of overall molybdenum demand today, increasing adoption of molybdenum in high-layer-count 3D NAND provides an incremental demand driver as the industry transitions from tungsten to molybdenum for selected word-line applications.

Jinduicheng Molybdenum (601958.SS, Not Covered)

This company is a leading integrated molybdenum producer in China, with a full value chain spanning mining, beneficiation, smelting, chemical processing, and downstream molybdenum metal fabrication. The company controls the Jinduicheng and Donggou molybdenum mines and held approximately 2.27mt of contained molybdenum resources at end-2025, while its products account for around 13% of the global molybdenum market.

In downstream operations, the company produces molybdenum powder, sintered products, targets, rods and wires, alloys and precision components. Molybdenum powder production reached 5.0kt in 2025; the company has developed high-purity molybdenum powder with purity above 99.995% for high-end electronic applications including chips and semiconductor devices. The company continues to expand its high-value-added molybdenum metal portfolio, including ultra-fine and specialty molybdenum powders, molybdenum alloys and precision components.

Disclosure Section

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(as of August 31, 2026)

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	Coverage Universe		Investment Banking Clients (IBC)			Other Material Investment Services Clients (MISC)	
Stock Rating Category	Count	% of Total	Count	% of Total IBC	% of Rating Category	Count	% of Total Other MISC
Overweight/Buy	1555	42%	450	48%	29%	767	44%
Equal-weight/Hold	1577	43%	395	42%	25%	770	44%
Not-Rated/Hold	3	0%	1	0%	33%	1	0%
Underweight/Sell	559	15%	93	10%	17%	216	12%
Total	3,694		939			1754	

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

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INDUSTRY COVERAGE: Greater China Materials

COMPANY (TICKER)	RATING (AS OF)	PRICE* (09/11/2026)
Chris Jiang		
Anhui Honglu Steel Construction (002541.SZ)	U (12/16/2025)	Rmb18.70
CGN Mining Co Ltd (1164.HK)	O (01/18/2023)	HK$2.28
Chengxin Lithium Group Co. Ltd. (002240.SZ)	E (12/16/2025)	Rmb27.25
GEM Co Ltd (002340.SZ)	U (04/20/2026)	Rmb6.24
Shenzhen Kedali Industry Co Ltd (002850.SZ)	O (08/21/2023)	Rmb171.40
Sinomine Resource Group Co Ltd (002738.SZ)	O (12/16/2025)	Rmb43.90
Yongxing Special Materials Technology (002756.SZ)	E (11/25/2022)	Rmb41.12
Zhejiang Huayou Cobalt Co Ltd (603799.SS)	O (10/08/2025)	Rmb36.06
Hannah Yang, CFA		

China Hongqiao Group (1378.HK)	O (09/15/2023)	HK$22.50
Chuangxin Industries Holdings Ltd. (2788.HK)	O (03/19/2026)	HK$16.90
Flat Glass Group Co Ltd (6865.HK)	O (07/30/2020)	HK$6.21
Flat Glass Group Co Ltd (601865.SS)	O (07/30/2020)	Rmb9.47
MMG Ltd (1208.HK)	O (12/16/2024)	HK$9.07
Shandong Pharmaceutical Glass Co. Ltd. (600529.SS)	U (04/20/2026)	Rmb18.54
Shenhuo Coal and Power (000933.SZ)	O (09/02/2025)	Rmb27.15
Tianshan Aluminum (002532.SZ)	E (07/08/2026)	Rmb13.22
Xinyi Glass Holding Limited (0868.HK)	U (05/14/2024)	HK$8.79
Zhongfu Shenying Carbon Fiber Co Ltd (688295.SS)	O (08/25/2023)	Rmb37.44
Rachel L Zhang		
Aluminum Corp. of China Ltd. (601600.SS)	O (11/30/2020)	Rmb9.44
Aluminum Corp. of China Ltd. (2600.HK)	O (11/30/2020)	HK$8.35
Baoshan Iron & Steel (600019.SS)	O (01/16/2016)	Rmb5.84
Beijing New Building Materials (000786.SZ)	O (04/09/2024)	Rmb15.80
Beijing Oriental Yuhong Waterproof Techn (002271.SZ)	E (09/25/2024)	Rmb10.33
China Jushi (600176.SS)	O (12/22/2020)	Rmb44.66
China Lesso Group Holdings Ltd (2128.HK)	U (10/08/2025)	HK$3.20
China Steel Corp. (2002.TW)	U (12/16/2025)	NT$18.90
CMOC Group Ltd (3993.HK)	O (09/24/2019)	HK$16.00
CMOC Group Ltd (603993.SS)	O (06/21/2024)	Rmb18.15
CNGR Advanced Material Co., Ltd. (300919.SZ)	E (01/12/2026)	Rmb37.62
CNGR Advanced Material Co., Ltd. (2579.HK)	O (01/12/2026)	HK$23.00
FangDa Carbon New Material Co. Ltd. (600516.SS)	U (12/16/2024)	Rmb5.21
Ganfeng Lithium Co. Ltd. (002460.SZ)	O (04/20/2026)	Rmb46.67
Ganfeng Lithium Co. Ltd. (1772.HK)	O (12/16/2025)	HK$34.66
Henan Liliang Diamond Co. Ltd (301071.SZ)	U (04/20/2026)	Rmb60.30
Jiangsu Dingsheng New Materials (603876.SS)	U (04/20/2026)	Rmb19.07
Jiangxi Copper (0358.HK)	O (10/08/2025)	HK$34.96
Jiangxi Copper (600362.SS)	O (10/08/2025)	Rmb45.78
JL Mag Rare-Earth Co. Ltd (6680.HK)	O (04/23/2025)	HK$15.83
JL Mag Rare-Earth Co. Ltd (300748.SZ)	O (04/23/2025)	Rmb24.78
Nine Dragons Paper (2689.HK)	E (01/04/2023)	HK$6.30
PT Merdeka Gold Resources Tbk (6228.HK)	O (08/04/2026)	HK$39.18
Shandong Gold Mining Co. Ltd (600547.SS)	E (07/09/2026)	Rmb34.67
Shandong Gold Mining Co. Ltd (1787.HK)	E (07/09/2026)	HK$24.40
Shandong Nanshan Aluminium Co. (600219.SS)	E (07/08/2026)	Rmb4.82
Tianqi Lithium Industries Inc. (9696.HK)	O (12/16/2025)	HK$31.82
Tianqi Lithium Industries Inc. (002466.SZ)	O (04/20/2026)	Rmb43.00
Weixing New Building Materials (002372.SZ)	U (10/08/2025)	Rmb8.21
Zhaojin Mining Industry (1818.HK)	E (07/09/2026)	HK$21.30
Zijin Gold International (2259.HK)	O (11/06/2025)	HK$160.10
Zijin Mining Group (2899.HK)	O (11/06/2025)	HK$34.82
Zijin Mining Group (601899.SS)	O (11/06/2025)	Rmb32.26

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