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China Semicap: Domestic WFE components - Supply shortage driven localization acceleration



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China's semiconductor equipment subsystem, component and module (SCM) localization is accelerating driven by global vendor's shortage, helping address supply constraints faced by domestic wafer fabrication equipment (WFE) vendors. Our 2024 report highlighted that China's SCM supply chain had already achieved de-Americanization, but many segments still rely on non-US global vendors. Based on our latest channel checks, we expect the adoption of local SCM vendors will resolve the component shortage within 1-2 quarters, with no material impact on equipment deliveries in 2027. **We maintain our Outperform ratings on NAURA, AMEC and Piotech.**

SCM localization is a two-phase journey, transitioning from geopolitics-driven substitution to supply-shortage-driven adoption. Phase 1 focused on replacing U.S. components amid geopolitical tensions, while Phase 2 is being driven by tightening supply from Japanese and European suppliers, prompting domestic WFE vendors to accelerate local sourcing. Once this phase is complete, China's semiconductor equipment industry should possess a sufficiently comprehensive local SCM ecosystem capable of mitigating supply constraints across most component categories. In higher-barrier segments where localization remains relatively low, many domestic alternatives have already passed customer qualification, with the remaining challenges centered on long-term reliability, manufacturing consistency and scale-up rather than fundamental product performance.

Low-localization segments offer the greatest incremental import-substitution opportunities. We highlight four segments: RF power, vacuum pump/valve/gauge, mass flow controller (MFC), electrostatic chuck (ESC). RF power remains attractive given its high value-add and customer stickiness, with Injet Electric and CSL Vacuum Science making meaningful qualification progress. Within vacuum tech, localization is slightly higher in vacuum valves, while vacuum gauges and vacuum pumps remain dominated by international suppliers, we believe Kinglai, KYKY and Sky technology is best positioned to gain share. MFC remain dominated by Japanese Vendors, Naura and GaoKai are accelerating in qualification. ESC is also led by Japanese suppliers with high barriers in advanced ceramics, thermal management and process integration, but local leader such as KemaTek is gradually starting to gain momentum. (all companies not covered).

High-localization segments mainly driven by surging order for local WFE vendors. At a high level, segments that primarily rely on materials processing, machining capabilities and manufacturing scale have generally achieved the fastest localization progress. Over the past decade, Chinese suppliers have accumulated extensive experience in precision manufacturing and benefited from a well-developed domestic industrial ecosystem, allowing them to close performance gaps rapidly and gain broad acceptance among local equipment makers. As a result, localization rates for categories such as quartz components, ceramic components, machined metal parts and various consumables have already reached relatively high levels. For many leading domestic WFE vendors, these products are no longer meaningful constraints in the supply chain, and future growth is likely to track overall order growth for domestic WFE vendors rather than incremental import substitution opportunities.

See the Disclosure Appendix of this report for required disclosures, analyst certifications and other important information. Alternatively, visit our Global Research Disclosure Website.

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BERNSTEIN TICKER TABLE

			13 Oct 2026		TTM		Reported EPS			Reported P/E (x)		
Ticker	Rating	Cur	Closing Price	Price Target	Rel. Perf.	Cur	2025A	2026E	2027E	2025A	2026E	2027E
688012.CH (AMEC)	O	CNY	307.69	660.00	34.7%	CNY	2.28	5.30	7.26	134.8	58.1	42.4
002371.CH (NAURA)	O	CNY	591.00	1,380.00	14.9%	CNY	5.66	10.11	19.92	104.4	58.5	29.7
688072.CH (Piotech)	O	CNY	654.23	1,200.00	123.2%	CNY	3.32	10.18	16.61	197.1	64.2	39.4
ASIAX			1,918.33									

O - Outperform, M - Market-Perform, U - Underperform, NR - Not Rated, CS - Coverage Suspended

Source: Bloomberg, Bernstein estimates and analysis.

INVESTMENT IMPLICATIONS

We rate NAURA, AMEC, and Piotech Outperform.

VALUATION COMPS TABLE

TABLE 1: **Summary of China WFE Supply Chain Vendors**

Ticker	Company	Chineses name	Market Cap (US $M)	Forward P/E	Revenue (US $M)		Gross Margin %		EPS (US $)	
					2025	25-28 CAGR	2025	2028E	2025	25-28 CAGR
Precision metal / Structural parts										
688409 CH Equity	Shenyang Fortune Precision	富创精密	7,144	140x	493	44%	22%	30%	0.00	N/A
688605 CH Equity	Sprint Precision Technologies	先锋精科	2,199	61x	172	38%	29%	30%	0.13	36%
003043 CH Equity	Suzhou Huaya Intelligence Tech	华亚智能	1,265	43x	140	44%	27%	N/A	0.09	72%
300666 CH Equity	Konfoong Materials Internation	江丰电子	8,343	63x	641	32%	27%	32%	0.26	48%
RF Generator & match										
300820 CH Equity	Sichuan Injet Electric	英杰电气	1,962	38x	209	19%	35%	38%	0.14	38%
688785 CH Equity	Shenzhen CSL Vacuum Science	恒运昌	3,280	161x	74	28%	48%	N/A	0.31	18%
Vacuum/Fluid/Gas delivery										
300260 CH Equity	Kunshan Kinglai Hygienic Mater	新莱应材	3,060	86x	417	10%	25%	28%	0.06	45%
002158 CH Equity	Shanghai Hanbell Precise Machi	汉钟精机	1,884	19x	407	16%	34%	36%	0.12	27%
688596 CH Equity	Shanghai Gentech	正帆科技	2,597	80x	684	32%	21%	25%	0.07	88%
688835 CH Equity	Jiangsu Gaokai Precision Fluid	高凯技术	5,277	N/A	71	N/A	59%	N/A	0.25	N/A
Silicon, quartz, ceramic process parts										
301611 CH Equity	Suzhou Kematek	珂玛科技	4,976	94x	149	38%	52%	N/A	0.09	49%
688233.CH Equity	Thinkon Semiconductor	神工股份	2,004	52x	61	55%	45%	53%	0.08	82%
300395 CH Equity	Hubei Feilihua Quartz Glass	菲利华	6,260	52x	281	49%	47%	51%	0.12	61%
300408 CH Equity	Chaozhou Three-Circle Group	三环集团	30,172	49x	1,234	39%	40%	46%	0.19	41%
Handling										
603728 CH Equity	Shanghai Moons' Electric Co Lt	鸣志电器	2,972	177x	384	18%	36%	37%	0.02	55%
002747 CH Equity	Estun Automation Co Ltd	埃斯顿	3,537	102x	680	17%	29%	32%	0.01	119%
Thermal										
688652 CH Equity	Beijing Jingyi Automation	京仪装备	3,413	97x	199	42%	33%	36%	0.12	62%
300990 CH Equity	Sanhe Tongfei Refrigeration	同飞股份	2,462	44x	399	46%	22%	24%	0.21	56%

Source: Bloomberg, Wind, Bernstein analysis

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TABLE 2: **Summary of Japan WFE Supply Chain Vendors**

Ticker	Company	Market Cap (US $M)	Forward P/E	Revenue (US $M)			Gross Margin %		EPS (US $)		
				2025	2028E	25-28 CAGR	2025	2028E	2025	2028E	25-28 CAGR
Precision metal / Structural parts											
6890 JP Equity	Ferrotec Corp	3,655	15x	1,801	3,118	20%	28%	31%	2.19	6.13	41%
9962 JP Equity	MISUMI Group Inc	7,435	21x	2,639	3,630	11%	47%	48%	0.87	1.27	14%
RF Generator & match											
6622 JP Equity	Daihen Corp	2,286	17x	1,486	1,978	10%	29%	N/A	0.65	1.18	22%
6742 JP Equity	Kyosan Electric Manufacturing	483	10x	560	659	6%	19%	N/A	0.50	0.81	18%
Vacuum/Fluid/Gas delivery											
6361 JP Equity	Ebara Corp	13,397	18x	6,410	8,607	10%	33%	34%	1.11	2.00	22%
7701 JP Equity	Shimadzu Corp	8,085	20x	3,539	4,136	5%	45%	45%	1.20	1.43	6%
6856 JP Equity	Horiba Ltd	6,828	18x	2,228	2,916	9%	44%	44%	5.91	10.81	22%
6841 JP Equity	Yokogawa Electric Corp	7,430	17x	3,692	4,295	5%	46%	46%	1.32	1.86	12%
6490 JP Equity	PILLAR Corp /Japan	2,003	16x	381	623	18%	41%	47%	2.34	5.46	33%
6407 JP Equity	CKD Corp	2,441	16x	1,022	1,446	12%	30%	31%	1.33	2.49	23%
6273 JP Equity	SMC Corp	29,420	20x	5,200	7,398	12%	45%	46%	16.05	23.11	13%
Silicon, quartz, ceramic process parts											
6971 JP Equity	Kyocera Corp	34,068	29x	13,225	13,894	2%	29%	32%	0.11	0.88	99%
5333 JP Equity	NGK Corp	10,063	17x	4,067	4,808	6%	29%	32%	1.22	2.07	19%
5332 JP Equity	TOTO Ltd	6,318	18x	4,756	5,207	3%	36%	36%	0.47	2.29	69%
6890 JP Equity	Ferrotec Corp	3,655	15x	1,801	3,118	20%	28%	31%	2.19	6.13	41%
4042 JP Equity	Tosoh Corp	5,352	12x	6,981	7,390	2%	26%	26%	1.20	1.37	5%
5344 JP Equity	Maruwa Co Ltd/Aichi	4,367	24x	472	702	14%	53%	N/A	10.24	16.54	17%
Handling											
6323 JP Equity	Rorze Corp	5,660	21x	816	1,273	16%	41%	41%	0.88	1.66	24%
6506 JP Equity	Yaskawa Electric Corp	8,161	24x	3,528	4,068	5%	35%	37%	1.43	1.40	-1%
6902 JP Equity	Denso Corp	34,048	11x	47,016	51,168	3%	16%	16%	0.95	1.15	6%
Thermal											
6273 JP Equity	SMC Corp	29,420	20x	5,200	7,398	12%	45%	46%	16.05	23.11	13%
6367 JP Equity	Daikin Industries Ltd	39,839	20x	31,198	35,236	4%	35%	35%	5.94	7.27	7%

Source: Bloomberg, Bernstein analysis

TABLE 3: **Summary of the U.S. and ROW WFE Supply Chain Vendors**

Ticker	Company	Market Cap (US $M)	Forward P/E	Revenue (US $M)			Gross Margin %		EPS (US $)		
				2025	2028E	25-28 CAGR	2025	2028E	2025	2028E	25-28 CAGR
Precision metal / Structural parts											
ICHR US Equity	Ichor Holdings Ltd	2,037	19x	948	5,235	77%	9%	17%	-1.54	2.97	N/A
UCTT US Equity	Ultra Clean Holdings Inc	2,876	11x	2,054	4,225	27%	16%	18%	-4.00	5.64	N/A
AALB NA Equity	Aalberts NV	5,144	14x	3,494	3,804	3%	63%	65%	1.55	3.48	31%
RF Generator & match											
AEIS US Equity	Advanced Energy Industries Inc	11,245	20x	1,799	3,548	25%	38%	43%	3.95	16.94	62%
MKSI US Equity	MKS Inc	16,898	15x	3,931	6,807	20%	47%	48%	4.39	16.91	57%
COTN SW Equity	Comet Holding AG	3,298	27x	552	1,055	24%	38%	46%	1.89	25.54	138%
XPP LN Equity	XP Power Ltd	740	35x	303	385	8%	42%	46%	-0.55	1.22	-230%
Vacuum/Fluid/Gas delivery											
A US Equity	Agilent Technologies Inc	48,303	25x	6,948	8,484	7%	52%	56%	4.59	6.98	15%
ENTG US Equity	Entegris Inc	24,450	33x	3,197	4,510	12%	44%	51%	1.55	5.50	53%
PH US Equity	Parker-Hannifin Corp	120,676	26x	19,850	26,079	10%	38%	39%	27.52	35.67	9%
VACN SW Equity	VAT Group AG	23,738	42x	1,296	2,664	27%	65%	65%	8.63	25.21	43%
IFCN SW Equity	Inficon Holding AG	5,662	36x	674	1,053	16%	45%	48%	3.51	8.54	35%
PFV GR Equity	Pfeiffer Vacuum Technology AG	1,848	23x	961	N/A	N/A	37%	N/A	6.93	N/A	N/A
Silicon, quartz, ceramic process parts											
6532 TT Equity	Calitech Co Ltd	133	N/A	22	N/A	N/A	37%	N/A	0.24	N/A	N/A
166090 KS Equity	Hana Materials Inc	952	13x	192	375	25%	31%	42%	1.40	4.41	47%
074600 KS Equity	Wonik QnC Corp	631	12x	664	943	12%	26%	30%	0.60	2.76	66%
Thermal											
TMO US Equity	Thermo Fisher Scientific Inc	244,861	24x	44,556	53,461	6%	41%	43%	17.77	26.43	14%

Source: Bloomberg, Bernstein analysis

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DETAILS

OVERVIEW OF THE WFE COMPONENT LOCALIZATION

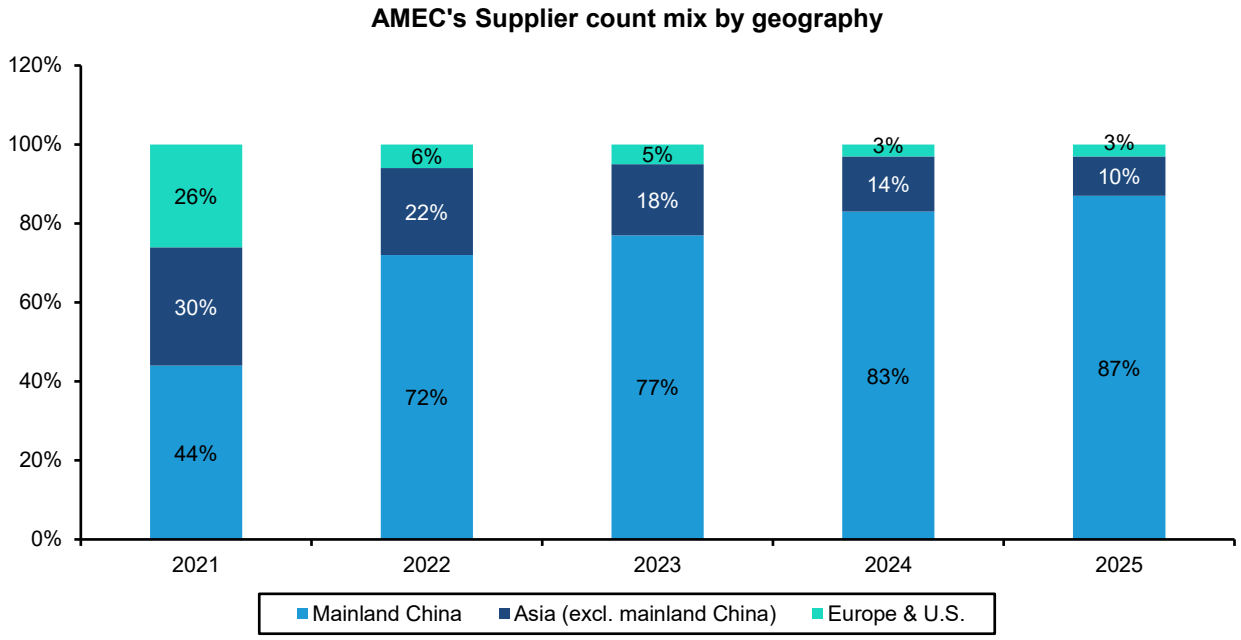
SCM LOCALIZATION: A TWO-PHASE JOURNEY

The semiconductor **subsystems**, **components**, and **modules (SCM)** refers to the instruments, subsystems, and components as well as service and support used in semiconductors and related capital equipment. When we reviewed China's SCM supply chain in Apr 2024 (link), our conclusion was that the industry had largely completed the first stage of localization. The initial wave of substitution was primarily driven by export controls and supply-chain security concerns, prompting Chinese equipment makers to reduce reliance on US-origin components by qualifying Japanese and European alternatives, and increase the adoption for local vendors for the SCM with less tech barrier. At the time, we estimated that roughly 10-30% of critical components still relied on overseas suppliers, suggesting that full localization would remain a multi-year process. AMEC's published supplier mix is one print of that path: proportion of the count of supplier from mainland China rose from 72% in 2022 to 87% in 2025, while that of supplier from Europe and U.S. decreased from 6% to 3% in the same period (Exhibit 1).

Today, we believe the industry is transitioning into a second phase of localization. While export-control risks remain relevant, the key driver has increasingly shifted toward supply availability. Following the rapid expansion of China's wafer-fab-equipment (WFE) industry, demand for several critical semicap components has outpaced capacity additions by incumbent overseas suppliers. As lead times extend, domestic equipment vendors are experiencing supply shortages, and also accelerating qualification of local alternatives, creating a new pathway for localized suppliers to gain market share.

In our view, the current tightness should be viewed as a capacity issue rather than a structural technology barrier. Domestic SCM suppliers have significantly improved their technical capabilities over the past few years and are expanding capacity aggressively. At the same time, fabs and WFE vendors are increasingly willing to qualify local suppliers to improve supply-chain resilience. We therefore expect most of the current bottlenecks to ease over the next few quarters and do not believe component shortages will materially affect China's semicap products shipments in 2027. Instead, the current environment is likely to accelerate the next leg of high-end component localization.

EXHIBIT 1: **AMEC's suppliers count from mainland China increased consistently from 2021-25**



Source: AMEC ESG report, Bernstein analysis

LOCALIZATION PROGRESS VARIES SIGNIFICANTLY ACROSS PRODUCT CATEGORIES

The conclusion we had in 2024 still holds, and the mix has moved further in the same direction. De-Americanization of the critical SCM parts has been finished. What remain is the non-US overseas residual, mainly from Japan and Europe, and it is being replaced gradually.

As the SCM industry consists of a highly diverse set of products with different technical barriers, qualification requirements and competitive dynamics. Localization progress therefore varies significantly across component categories. Broadly speaking, China's SCM supply chain can be divided into two groups: **(1) low-localization segments**, where overseas suppliers still dominate due to technological complexity, reliability requirements and lengthy customer qualification cycles, but local vendors are emerging. **(2) high-localization segments**, where domestic suppliers have already established meaningful market share and local alternatives are widely adopted.

For **low localization segments**, a number of high-end system-level modules continue to rely on overseas suppliers due to a combination of performance requirements, qualification hurdles and local production capacity constraints. These are usually the more complex SCM that connects to electricity and perform some sort of critical functionality, span across four key segments (Exhibit 2): RF Power, Vacuum, Fluid Management, and Ceramics. These segments represent bigger growth opportunities after local vendors got qualified, as the localization is still relatively low. Investors are generally more concern about the capabilities of local vendors in these categories, and whether local vendors are already good enough to replace the global vendors.

These mission-critical system-level components that directly affect process stability, equipment productivity and yield performance. Unlike structural parts, these products typically integrate multiple technologies spanning materials science, precision engineering, power electronics, software control and process know-how. Reliability requirements are considerably more stringent, qualification cycles are longer, and customer switching costs are substantially higher. As a result, leading Japanese and European suppliers have maintained dominant market positions despite the rapid development of China's domestic semiconductor equipment industry.

To be more specific, as shown in Exhibit 2, there are four subsystems with higher technology barriers which are also critical components that China's semicap vendors are capped with. These areas include RF-related power management subsystems, vacuum subsystems (including valves, gauges, and pumps), mass flow controllers (MFC), and electrostatic chuck (ESC). After "de-Americanized" had been achieved by sourcing from East Asian/European suppliers in the past few years, supply chain tightness is still a real threat for Chinese semicap vendors when encounter with worldwide demands explosive, the situation

they have been undergoing since the beginning of 2026. Therefore, localization is still a key topic in the industry and there is still a performance gap between Chinese vendors and overseas suppliers.

Importantly, the gap in these categories does not necessarily stem from a lack of domestic suppliers. In many cases, local companies have already developed commercially available products and achieved initial customer penetration. The remaining challenge is often the gradual process of validating long-term reliability, replicating process performance across different tool platforms, and scaling production capacity to support broader industry adoption. This explains why localization rates can remain relatively low even when domestic alternatives are technically available, they are good enough, but the uncertainty on stability remain a barrier for adoption.

On the other hand, for **high localization segments**, many structural and consumable components have already achieved high domestic penetration (Exhibit 3), as a result, the key question today is not whether localization will continue, but rather how fast the demand will expand and whether they have the flexibility in capacity expansion to support the demand.

At a high level, segments that primarily rely on materials processing, machining capabilities and manufacturing scale have generally achieved the fastest localization progress. Over the past decade, Chinese suppliers have accumulated extensive experience in precision manufacturing and benefited from a well-developed domestic industrial ecosystem, allowing them to close performance gaps rapidly and gain broad acceptance among local equipment makers. As a result, localization rates for categories such as quartz components, ceramic components, machined metal parts and various consumables have already reached relatively high levels. For many leading domestic WFE vendors, these products are no longer meaningful constraints in the supply chain, and future growth is likely to track overall WFE demand rather than incremental import substitution opportunities.

From an investment perspective, we believe the industry's center of gravity is shifting from high-localization segments toward these lower-penetration, higher-barrier categories. The first phase of China's localization story was largely driven by replacing overseas suppliers in relatively mature component markets. The next phase is likely to be defined by breakthroughs in a handful of critical system-level modules where domestic penetration remains low but industry demand for localized solutions is rising rapidly.

This shift is being further reinforced by recent supply-chain dynamics. As overseas suppliers have been slow to expand capacity amid rising demand from China's WFE sector, domestic equipment makers have become increasingly willing to accelerate local qualification efforts. While this has raised concerns about potential component shortages and shipment bottlenecks, our conversations with industry participants suggest that the issue is primarily one of capacity and qualification timing rather than a structural technology deficit. Given the industry's ability to expand local capacity and accelerate customer validation, we expect most bottlenecks to ease over the coming quarters, allowing localization to continue progressing without materially constraining China's WFE shipment outlook in 2027.

EXHIBIT 2: **Low localization segments: Four subsystem where "de-Americanization" has been achieved, but emerging Chinese vendors still have some gap but are cathing up to achieve full localization**

Subsystem	Product	U.S. Supplier	Japanese Supplier	Other Overseas Supplier	Chinese Supplier
RF Power	RF Generator / Match	Advanced Energy (AEIS) MKS Incorporated (MKSI)	DAIHEN (6622.JP) Kyosan Electric (6742.JP)	Comet PCT (COTN.SW) TRUMPF Huettinger (private) XP Power (XPP.LN)	NAURA (002371.CH) Injet Electric (300820.CH) CSL Vacuum Science (688785.CH) SZ Semicon (private) IME(1)
Vacuum	Vacuum Valve	MKS Incorporated (MKSI) HVA (private)	Fujikin (private)	VAT (VACN.SW) Pfeiffer Vacuum (PFV.GR)	Kinglai (300260.CH) Gaokai (688835.CH) Jiasheng (private) KVTS (private)
	Vacuum Gauge	MKS Incorporated (MKSI) Agilent Technologies (A)	--	INFICON (IFCN.SW) Pfeiffer Vacuum (PFV.GR) Edwards (private) Leybold (private)	Shanghai Zhentai (private) SiCarrier (private) Xiamen Mibay (private)
	Vacuum Pump	Agilent Technologies (A)	Ebara (6361.JP) Osaka Vacuum (private) Shimadzu (7701.JP)	Edwards (private) Pfeiffer Vacuum (PFV.GR) Leybold (private)	KYKY (private) Hanbell Precise (002158.CH) Beijing Jingyi (6888652.CH) Sky Technology (920186.CH)
Fluid Management	Mass Flow Controller (MFC)	Brooks Instrument (private) MKS Incorporated (MKSI)	HORIBA (6856.JP) Fujikin (private) Yokogawa (6841.JP)	Bronkhorst (private)	NAURA (002371.CH) Gaokai (688835.CH) Compart Systems (private) (2)
Ceramics	Electro-Static Chuck (ESC)	CoorsTek (private) InVax (private)	Kyocera (6971.JP) NGK (5333.JP) TOTO (5332.JP) NTK (private)	CeramTec (private) Calitech (6532.TT)	KemaTek (301611.CH) Junyuan Electronics (private) SeaTools (private) Xinna (private)

Note that the vendor list is not comprehensive

(1) IME: Institute of Microelectronics of The Chinese Academy of Sciences

(2) Compart Systems is indirectly controlled by Fortune Precision (688409.CH Equity, not covered) via a SPV
Source: IR communications, Company websites, Bernstein analysis

EXHIBIT 3: **High localizatin segments: Components that has been achieved significant localization progress by Chinese vendors**

Subsystem	Product	U.S. Supplier	Japanese Supplier	Other Overseas Supplier	Chinese Supplier
Structural Components	Precision Metal / Structural Parts / Metal Process Parts, Chambers & Chamber Assemblies	Ichor Holdings (ICHR) Ultra Clean Holdings (UCTT)	Ferrotec (6890.JP) MISUMI (9962.JP)	Aalberts (AALB.NA) Hittech (private)	Fortune Precision (688409.CH) Sprint Precision (688605.CH) Huaya Intelligent (003043.CH) Konfoong Materials (300666.CH)
Vacuum/ Fluid/ Gas delivery	Vacuum Piping, Fittings, Flanges & Connection Assemblies	Kurt J. Lesker (private) Nor-Cal Products (private)	MIRAPRO (private) Irie Koken (private) COSMOTEC (private)	Leybold (private)	Kinglai (300260.CH) Fortune Precision (688409.CH)
	High-purity Liquid Components, Filters & Fluoropolymer Fittings	Entegris (ENTG) Parker Hannifin (PH)	PILLAR (6490.JP) CKD (6407.JP)	--	Kinglai (300260.CH) Gentech (688596.CH)
	Gas Delivery Modules, Gas Panels, UHP Fittings, Pressure Regulators	Ichor Holdings (ICHR) Ultra Clean Holdings (UCTT) Parker Hannifin (PH) Swagelok (private)	Fujikin (private) CKD (6407.JP) SMC (6273.JP) KITZ SCT (private)	Ham-Let (private)	Kinglai (300260.CH) Gentech (688596.CH) Compart Systems (private)
Silicon/ Quartz/ Ceramic process parts	Silicon Electrodes, Rings & Other Si Process Parts	CoorsTek (private)	Ferrotec (6890.JP)	Hana Materials (166090.KS)	Thinkon Semiconductor (688233.CH)
	Quartz Rings, Tubes, Boats, Liners & Other Fabricated Parts	Momentive (private) CoorsTek (private)	Tosoh (4042.JP) Shin-Etsu Quartz (private) Ferrotec (6890.JP)	WONIK QnC (074600.KS) QSIL (private)	Feilihua (300395.CH)
	Ceramic Rings, Liners, Insulators & Structural Components	CoorsTek (private)	Kyocera (6971.JP) NGK (5333.JP) Maruwa (5344.JP) ASUZAC Fine Ceramics (private)	CeramTec (private)	KemaTek (301611.CH) Three-Circle (300408.CH)
	Chamber & Chamber Assemblies	Ichor Holdings (ICHR) Ultra Clean Holdings (UCTT)	Ferrotec (6890.JP)	Aalberts (AALB.NA) Hittech (private)	Fortune Precision (688409.CH) Sprint Precision (688605.CH) Konfoong Materials (300666.CH)
Handling	Wafer Handling Robots & Motion Control	Brooks Automation (private)	RORZE (6323.JP) Yaskawa (6506.JP) Denso (6902.JP) MISUMI (9962.JP)	Stäubli (private)	Moons' Electric (603728.CH) Estun (002747.CH) Guona Semiconductor (private)
Thermal	Chillers, Heaters, TCU, Thermal Management Systems	ATS (private) Thermo Fisher Scientific (TMO) Watlow (private)	ORION Machinery (private) SMC (6273.JP) Daikin (6367.JP)	Backer Group (private)	Beijing Jingyi (688652.CH) Tongfei Refrigeration (300990.CH)

Source: IR communications, Company websites, Bernstein analysis

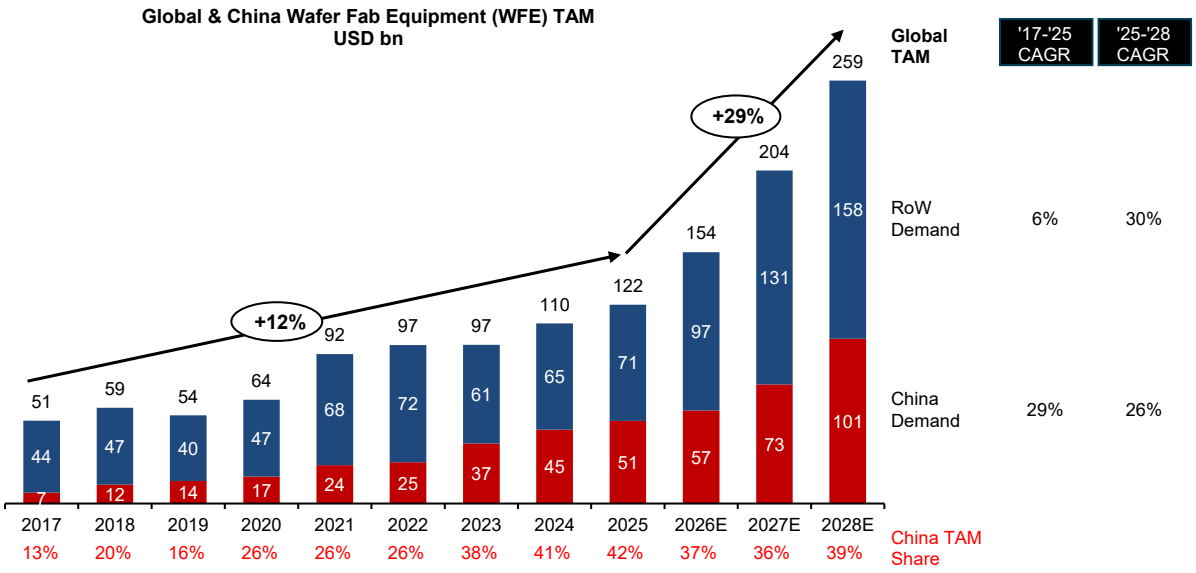
CHINA'S SCM DEMAND SURGE DRIVEN BY STRONG WFE SPENDING

The SCM supply chain is the bill of materials inside a semicap equipment, not a separate end market. In terms of functions, the SCM products can be categorized as 1) mechanical components, 2) electrical components, 3) electro mechanical components, 4) gas/liquid/vacuum systems, 5) instrumentation, 6) optical components, and 7) other components. Mechanical components (metal/non-metal structural components) and electro mechanical components (such as wafer-handling robots) are used in all equipment. SCM demands therefore have two legs: components that go into newly shipped equipments, which scale with WFE, and spares and service on equipments already in the fab, which scale with the installed base.

Within our latest global WFE forecast (link), we estimate WFE spending will increase 26.3% YoY to $154bn in 2026. And the WFE spending will further accelerate to $ 204bn in 2027 and $259bn in 2028, increasing 32.6% and 27.0% YoY separately (Exhibit 4). As for China market, our forecast for China WFE demands reached $57bn/$73bn/$101bn in 2026-28, indicating a 26% CAGR from 2025 to 2028 (link). Together with promising upside on China TAM, we expect self-sufficiency will keep increasing as well, from 28% in 2026 to 37% in 2027 and 52% in 2028 (Exhibit 5).

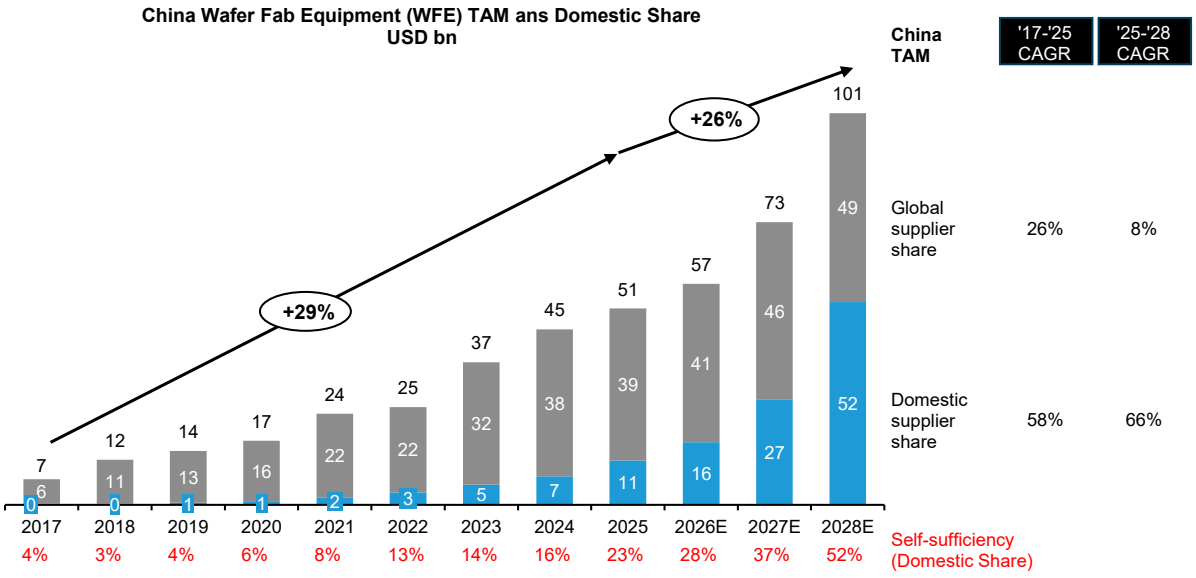
According to Yole's Semiconductor Equipment Subsystems Market Monitor (link), the SCM market represents an estimated ~ $55bn annual market and has grown +4.5% QoQ in Q1 2026 to $15.3bn. Driven by the AI inflection and record order books, the subsystem along is expected to grow 22% YoY in 2026. Such a strong momentum aligns with both our optimism on the WFE future outlook and our observations on worldwide supply chain tightness during recent China Semiconductors Tour. For China domestic WFE vendors, Japanese and European suppliers still hold the critical content on their products, and have been slow to add capacity to answer existing strong demands. In addition, Chinese vendors also face the risk that overseas suppliers may allocate first to global original WFE manufacturers. China domestic SCM demand is therefore rising faster than the overseas supply that can serve China names. The gap will drive self-sufficiency increase: both domestic WFE vendors and fabs are now more willing to put domestic SCM on WFEs for further verification. Once the domestic SCMs successfully pass verification and are added to the bill of materials, it will be difficult to be switched out. Resulting from self-sufficiency rises, the TAM for China SCM will grow faster than China WFE itself.

EXHIBIT 4: **Global WFE: China demand expected to be continue strong while non-China will grow stronger going forward**



Source: Gartner, SEMI, Bernstein estimates and analysis

EXHIBIT 5: **China WFE: Acceleration in domestic substitution continues, expect the self-sufficiency to reach 52% by 2028**



Source: Gartner, SEMI, Company reports, Bernstein estimates and analysis

WHAT STILL STANDS IN THE WAY OF CHINA'S SCM VENDORS

Taken together, these component categories illustrate the uneven nature of China's semiconductor equipment localization journey. Mechanical, machining-intensive and consumable products have generally achieved significantly higher localization rates, benefiting from China's manufacturing scale and industrial ecosystem. In contrast, categories requiring advanced materials, process-control expertise or extensive reliability validation continue to exhibit lower domestic penetration.

This divergence explains why the industry's investment focus has increasingly shifted away from mature categories such as quartz components and precision machined parts toward higher-barrier subsystems including RF generators, ESCs and MFCs. While the first phase of localization was largely defined by the substitution of manufacturing-intensive components, the next phase is expected to be driven by breakthroughs in process-critical technologies where overseas suppliers continue to maintain strong competitive positions.

Two constraints sit on that path. One is verification. A domestic valve, ESC, or RF unit that works on a demo line has not yet become a qualified copy-exact part on a leading-edge fab process. The last 20-30% of the bill of materials still has to be accepted by the fab, not only by the original equipment manufacturers. The other is domestic capacity and yield, plus the people who run it. Once a domestic SCM has already met spec, it still has to be made at the volume to meet the strong demands from local semicap vendors. That cap includes the yield of the line and technicians who run it. A chuck or heater can hold the chamber spec and still scrap too much of the lot, and a line tooled for one semicap vendor's cavity is not easily switched to another. The people who run those lines are the other cap. For instance, process technicians and ceramic operators take longer to hire and train than a cleanroom takes to build, so capacity that liiks available on paper may still cannot ship under human resources constraints.

We should also keep in mind that specific situations at each semicap vendors may vary, as does the supply-and-demand balance for different SCMs. Localization is not a single percentage, and the part that binds is not the same on every tool. What is common is the second stage problem this note has been about: replacing the Japan- and Europe-origin residual, and then getting those domestic parts accepted by the fab as copy-exact and shipped at yield. That work will not print evenly across the industry. It is nonetheless the constraint on 2026-27 shipments.

DEEP DIVE ON SCM SEGMENTS WITH LOW LOCALIZATION

RF GENERATOR & MATCH

Sector Primer: The Critical Power Delivery System in Semiconductor Manufacturing

RF generators and matching networks are among the most critical power-delivery subsystems used across semiconductor manufacturing equipment. Their primary function is to generate, regulate and transfer high-frequency electrical power to process tools, enabling a wide range of semiconductor fabrication processes that require precise energy control. Within a WFE, the RF generator converts electrical power into radio-frequency energy, while the matching network continuously optimizes impedance between the RF source and the process chamber to maximize power transfer and minimize reflected power. Together, these components ensure stable delivery of RF energy under changing process conditions and directly influence equipment performance and process consistency.

While RF systems are used in several semiconductor manufacturing applications, their most important role is found in plasma-based processes such as dry etch, PECVD, PEALD, HDP-CVD, plasma cleaning and various advanced packaging applications. In these systems, RF power is used to ionize process gases and sustain plasma inside the chamber. Since plasma characteristics directly determine etch rate, deposition uniformity, critical dimension control and wafer yield, precise RF control becomes increasingly important as process complexity rises.

As plasma-based etch and deposition equipment represents some of the largest and most technologically demanding segments of WFE spending, demand for RF generators and matching networks is closely linked to the growth of these process categories. Consequently, RF power systems have become one of the most strategically important component categories within the WFE supply chain despite representing only a relatively small percentage of total equipment cost. Successful RF suppliers must combine expertise in power electronics, high-frequency circuit design, control algorithms, thermal management and semiconductor process physics. More importantly, RF performance is ultimately measured not by electrical specifications alone but by its ability to maintain stable plasma behavior and deliver repeatable process results across different process recipes and customer platforms.

EXHIBIT 6: **RF Generator**



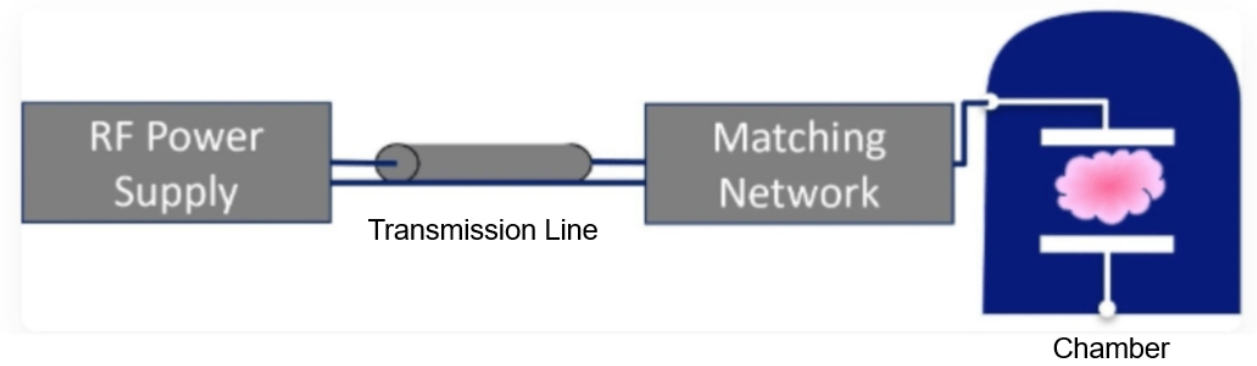
Source: Advanced Energy, Bernstein analysis

EXHIBIT 7: **RF Matching Networks**



Source: Advanced Energy, Bernstein analysis

EXHIBIT 8: **Components of the RF power delivery path**



Source: Bird, Bernstein analysis

Competitive Landscape

The global RF power market remains highly concentrated and has historically been dominated by a limited number of suppliers from the United States, Europe and Japan.

At the highest end of the market, suppliers from the United States, including Advanced Energy and MKS Instruments, maintain clear leadership positions through decades of accumulated application expertise, extensive installed bases and deep integration with leading semiconductor equipment manufacturers. Their products are widely deployed across global etch and deposition platforms and continue to serve as industry benchmarks in advanced plasma processing applications.

Outside the United States, Comet Plasma Control Technologies (PCT), TRUMPF Huettinger and DAIHEN represent the most important overseas competitors. These companies have developed strong capabilities in RF generators, impedance matching systems and plasma power-control technologies, allowing them to establish meaningful positions across both global and regional semiconductor equipment markets. Compared with US leaders, these companies generally possess smaller installed bases but remain highly competitive in selected high-end applications where matching performance and plasma control are critical.

China's domestic RF ecosystem remains at an earlier stage of development. However, a growing number of local suppliers have entered the market over the past decade and are increasingly participating in qualification programs among leading domestic equipment manufacturers. As domestic WFE vendors seek to strengthen supply-chain resilience and reduce reliance on overseas components, localization momentum has accelerated across the RF segment.

From a regional standpoint, RF generator and matching networks remain the few SCM categories where overseas suppliers continue to maintain a meaningful technology and qualification advantage. Nevertheless, the gap has narrowed steadily as local suppliers improve product performance, expand installed bases and accumulate process know-how through increasing customer deployments.

Leading Global Vendors

Advanced Energy (AEIS, not covered)

Headquartered in the United States, Advanced Energy is widely regarded as the global leader in semiconductor RF power systems and is commonly viewed as the industry's technology benchmark. The company maintains one of the broadest RF product portfolios, including RF generators, matching networks, remote plasma sources and advanced power-control solutions. Its competitive advantages stem from decades of application experience developed alongside leading WFE manufacturers. The company's substantial installed base has allowed it to accumulate extensive process data and customer know-how, reinforcing its leadership position across advanced etch and deposition applications. As process requirements become increasingly stringent, Advanced Energy continues to benefit from strong customer stickiness and high barriers to switching.

MKS Instruments (MKSI, not covered)

MKS, also from the United States, established its position in the RF power market through the acquisition of ENI, one of the industry's longstanding RF technology providers, and became the second major force in the RF power market. A key differentiator for MKS is its broader semiconductor subsystem portfolio, which extends beyond RF power into vacuum measurement, pressure control and process management solutions. This enables the company to provide integrated subsystem offerings to semiconductor equipment manufacturers and strengthen customer relationships across multiple parts of the equipment architecture. MKS remains particularly well positioned among customers seeking tightly integrated process-control solutions rather than stand-alone RF products.

Comet Plasma Control Technologies (COTN.SIX, not covered)

Comet PCT, a division of Switzerland-based Comet Holding, has emerged as one of the most important RF suppliers outside the United States. The company is particularly recognized for its expertise in plasma-control technologies and advanced impedance matching systems. Comet's products are widely used in demanding semiconductor applications where matching accuracy, power efficiency and process repeatability are critical. As semiconductor manufacturing becomes increasingly dependent on precise plasma control, Comet continues to strengthen its position within advanced process applications. In addition, the company has been particularly successful in RF matching solutions, where deep application know-how and long-term customer qualification are often key competitive differentiators.

TRUMPF Huettinger (private company)

TRUMPF Huettinger, headquartered in Germany and part of the broader TRUMPF Group, leverages decades of experience in industrial power electronics and plasma power systems to maintain a strong position within the RF generator market. The company is particularly known for high-performance RF generators and power-conversion technologies that emphasize efficiency, reliability and operational stability. While its semiconductor exposure is smaller than that of Advanced Energy and MKS, TRUMPF remains an important supplier in advanced plasma-processing applications. Its strong engineering capabilities in power management and industrial electronics have allowed the company to remain competitive in a market characterized by demanding performance requirements and lengthy qualification cycles.

DAIHEN (6622.JP, not covered)

Headquartered in Japan, DAIHEN is one of the country's most established RF power suppliers and maintains long-standing relationships with Japanese WFE manufacturers. The company has developed significant expertise in plasma-generation technologies and RF power systems, allowing it to secure a meaningful position within the global semiconductor SCM industry. Although its overall scale is smaller than that of the leading US suppliers, DAIHEN remains an important participant in high-end RF applications, particularly among Japanese OEM customers. The company's strength lies in its deep understanding of plasma processing and its close collaboration with Japan's semiconductor manufacturing ecosystem.

Kyosan Electric (6742.JP, not covered)

Headquartered in Japan, Kyosan Electric is a long-standing participant in the RF power market with capabilities spanning RF generators, matching networks and plasma power solutions. The company has historically maintained a presence in semiconductor and industrial plasma applications, leveraging expertise in high-frequency power technologies and close relationships with Japanese customers. Compared with industry leaders such as Advanced Energy and MKS, Kyosan operates on a smaller scale and occupies a more specialized position within the RF ecosystem. Nevertheless, its products continue to be used in selected semiconductor applications where reliability, customization and long-term customer relationships remain important purchasing considerations. The company represents one of the established Japanese suppliers within the global RF market and continues to participate in selected high-value plasma-processing applications.

XP Power (XPP.L, not covered)

XP Power, headquartered in Singapore, is primarily known for its high-reliability power-conversion solutions serving industrial, healthcare and semiconductor end markets. While the company is not traditionally considered a core semiconductor RF leader, it maintains exposure to selected RF and plasma power applications through its broader power-electronics portfolio. The company's strength lies in power-supply design, system integration and engineering customization, allowing it to support specialized customer requirements across a range of advanced manufacturing environments. Within the semiconductor industry, XP Power's presence is more niche compared with the dominant RF suppliers, but it remains a relevant participant in

certain plasma-processing and high-reliability power applications.

Leading Local Vendors

NAURA (002371.CH)

NAURA's participation in the RF market is primarily driven by its role as China's leading semiconductor equipment 002371.manufacturer. The company has built RF capabilities through a combination of internal development, strategic investments and acquisitions as part of its broader subsystem localization strategy.

Rather than positioning RF generators and matching networks as standalone products, NAURA focuses on integrating these technologies within its own etch and deposition platforms. This allows subsystem development to be closely coordinated with chamber design, process optimization and overall tool architecture. Compared with independent RF suppliers, NAURA benefits from direct access to equipment platforms and customer process data, enabling faster product validation and iteration.

From a strategic perspective, RF localization is less about generating component revenue and more about improving supply-chain security, reducing reliance on foreign vendors and enhancing overall equipment competitiveness. As domestic equipment shipments continue to expand, internally sourced RF solutions are expected to play an increasingly important role in supporting NAURA's long-term growth and margin profile.

Injet Electric (300820.CH, not covered)

Injet Electric is widely regarded as one of China's most commercially advanced independent RF suppliers. Leveraging its longstanding expertise in industrial power electronics and precision power-control systems, the company has successfully expanded into semiconductor RF generators and plasma power solutions.

The company's core strength lies in its experience with high-power conversion, system reliability and manufacturing scalability, all of which are critical requirements for semiconductor RF applications. Unlike equipment OEMs, Injet operates primarily as a third-party subsystem supplier and works closely with domestic semiconductor equipment manufacturers on qualification and product development.

As China's localization drive accelerates, Injet has benefited from increasing customer willingness to qualify domestic RF products. Industry participants generally view the company as one of the local players the furthest along in the commercialization process. Looking ahead, the key growth driver will be the conversion of qualification programs into large-volume production orders, particularly across etch and deposition platforms where RF content and technical barriers are highest.

CSL Vacuum Science (688785.CH, not covered)

CSL Vacuum Science is one of the more specialized domestic suppliers focused on RF generators and matching networks for semiconductor plasma-processing equipment. The company's strategy centers on serving semiconductor customers directly rather than leveraging a broader industrial power background.

A key differentiator is its close collaboration with equipment manufacturers during product development and qualification. In semiconductor RF systems, engineering support and process optimization are often just as important as hardware specifications, making customer engagement a critical competitive advantage.

While Hengyunchang remains significantly smaller than international leaders, it has gradually expanded participation in localization programs across domestic equipment makers and continues to improve product performance through a growing installed base. The company's long-term opportunity depends on accumulating reliability data and expanding customer penetration, both of which are essential prerequisites for larger-scale adoption in mission-critical process applications.

SZ Semicon (private company)

SZ Semicon is an emerging domestic supplier focused on RF generators, matching networks and plasma-related subsystems for semiconductor manufacturing equipment. The company has positioned itself within the RF localization value chain by targeting applications in plasma-based etch and deposition tools, where demand for locally sourced critical subsystems

continues to increase.

From a technology perspective, SZ Semicon concentrates on RF power delivery, impedance matching and plasma-control related solutions. Similar to other domestic RF suppliers, a key part of the company's development strategy involves close collaboration with equipment manufacturers during qualification and process optimization stages. As RF performance is ultimately evaluated based on process stability and repeatability rather than electrical specifications alone, customer verification and platform-level validation remain critical milestones for commercialization.

Commercially, SZ Semicon remains earlier in its development cycle than more established players such as Injet Electric, with growth primarily driven by qualification progress and penetration into domestic OEM platforms. However, the company's focus on semiconductor-specific RF applications positions it to benefit from increasing localization efforts across China's plasma-processing equipment market. As installed base and field-operating data continue to accumulate, SZ Semicon could gradually improve its competitive standing within the domestic RF ecosystem and participate in future market-share gains as localization advances.

VACUUM VALVES

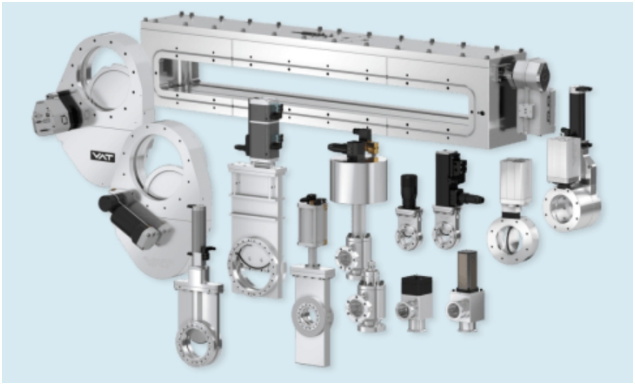
Sector Primer: The Gatekeeper of Semiconductor Vacuum Systems

Vacuum valves are among the most critical flow-control components within semiconductor manufacturing equipment. Their primary function is to regulate, isolate and control gas flow and chamber pressure throughout the wafer fabrication process. Virtually every major WFE category, including etch, deposition, ion implantation, metrology and vacuum transfer systems, relies on complex vacuum architectures to maintain highly controlled processing environments. Within these systems, vacuum valves serve as the key interface between process chambers, vacuum pumps and gas-delivery subsystems, ensuring stable pressure control and contamination-free operation. Different process applications require different valve configurations, with gate valves, slit valves, angle valves and control valves representing some of the most commonly used products within WFE.

The importance of vacuum valves stems from the industry's increasingly demanding process requirements. As semiconductor geometries continue to shrink and process complexity rises, even minor fluctuations in chamber pressure or particle contamination can directly impact process performance and wafer yield. Consequently, vacuum valves are often regarded as safety-critical and yield-critical components despite accounting for only a small portion of overall equipment cost. As semiconductor manufacturing continues to migrate toward more advanced process technologies, vacuum control requirements have become increasingly stringent, reinforcing the strategic importance of vacuum valves within the broader semiconductor equipment supply chain.

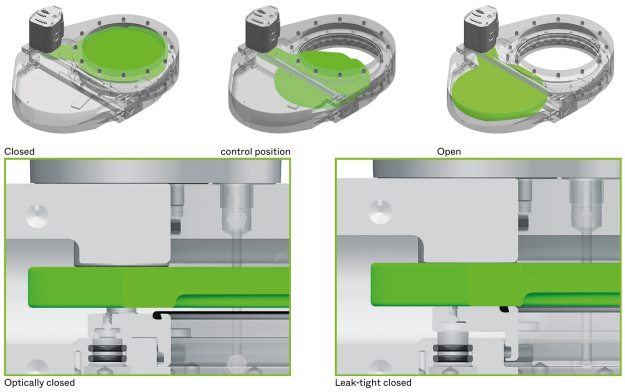
Compared with consumable components such as quartz parts or ceramics, vacuum valves face significantly higher technical and qualification barriers. The primary challenge lies in maintaining stable mechanical performance under ultra-high vacuum environments while simultaneously meeting strict requirements for particle generation, leakage rates, response speed and operational lifetime. Semiconductor processes can involve millions of valve cycles over a product's operating life, making durability and reliability fundamental purchasing criteria. And because vacuum valves are deeply integrated into equipment platforms and directly influence uptime and reliability, WFE manufacturers tend to adopt a conservative approach when approving alternative suppliers. Validation typically requires extensive lifetime testing and qualification across multiple process environments, resulting in long customer adoption cycles. As a result, despite several years of progress in domestic development, high-end semiconductor vacuum valves remain one of the less-localized component categories within China's semiconductor equipment ecosystem.

EXHIBIT 9: **Vacuum Valves**



Source: VAT Group, Bernstein analysis

EXHIBIT 10: **Vacuum Valve Appearance**



Source: VAT Group, Bernstein analysis

Competitive Landscape

The global semiconductor vacuum valve market is highly concentrated and has historically been dominated by a small number of international suppliers.

Among all competitors, Switzerland-based VAT Group occupies a uniquely dominant position and is widely regarded as the industry's benchmark supplier. Thanks to decades of application experience, a broad product portfolio and extremely high customer switching costs, VAT has maintained leadership across nearly all major semiconductor equipment platforms.

Outside of VAT, Japanese suppliers, such as Fujikin, have established strong positions in selected valve categories and continue to benefit from close relationships with Japanese equipment manufacturers. European and US suppliers including Pfeiffer Vacuum, MKS and Nor-Cal also maintain presence in various vacuum-control applications, although their market positions are generally more fragmented compared with VAT.

China's domestic vacuum valve ecosystem has developed rapidly over recent years, supported by growing semiconductor equipment localization efforts and increasing demand for supply-chain diversification. Companies such as Kinglai, Jiasheng and KVTS have progressively expanded their product portfolios and qualification activities, gradually narrowing the gap with overseas suppliers.

Leading Global Vendors

VAT Group (VACN.SIX, not covered)

Headquartered in Switzerland, VAT Group is the undisputed global leader in semiconductor vacuum valves and is widely considered the industry's benchmark supplier. The company specializes in high-performance vacuum valve solutions designed for the most demanding semiconductor manufacturing environments. Its extensive product portfolio covers gate valves, transfer valves, isolation valves and pressure-control valves that are widely deployed across etch, deposition and vacuum-transfer platforms. VAT's competitive advantage stems from decades of accumulated application experience, superior sealing technologies, exceptional reliability and a massive installed base across global semiconductor fabs. These factors create significant customer stickiness and represent major barriers for new entrants attempting to gain market share.

Fujikin (private company)

Japan-based Fujikin is one of the most established players in the semiconductor fluid-control and vacuum valve market. The company possesses deep expertise in precision flow-control technologies and benefits from long-standing relationships with Japanese WFE manufacturers. Fujikin products are widely used across semiconductor gas-delivery systems, vacuum processes and advanced manufacturing applications. Its strengths lie in engineering precision, manufacturing quality and long-term reliability, making it one of the most important competitors within the global vacuum valve market.

Pfeiffer Vacuum (PFV.FRA, not covered)

Headquartered in Germany, Pfeiffer Vacuum is best known for its vacuum technology portfolio, including vacuum pumps, gauges and valve systems. Compared with VAT, Pfeiffer offers a broader vacuum-system platform rather than focusing exclusively on vacuum valves. This integrated vacuum technology expertise allows the company to provide comprehensive solutions across multiple parts of the semiconductor vacuum ecosystem. The company maintains a strong market position in advanced vacuum applications and continues to benefit from increasing demand for sophisticated vacuum-control technologies.

MKS Instruments (MKSI, not covered)

The American manufacturer MKS participates in the vacuum valve market through its broader vacuum and process-control portfolio. Unlike pure-play valve manufacturers, the company's strategy focuses on delivering integrated solutions spanning vacuum measurement, pressure control and process management. This broader subsystem offering enables MKS to establish strong relationships with WFE OEMs and participate in multiple stages of the vacuum-control architecture.

HVA (private company)

HVA is a specialized supplier of high-vacuum valves for semiconductor, research and industrial applications. Compared with broader vacuum-system providers, HVA focuses specifically on vacuum valve technologies, including gate valves, slit valves and transfer valves widely used in semiconductor process and vacuum-transfer systems. The company's products are recognized for high reliability and customized engineering solutions, enabling it to maintain a meaningful presence in selected semiconductor applications despite its smaller scale relative to industry leader VAT.

Leading Local Vendors

Kinglai (300260.CH, not covered)

Kinglai is widely regarded as one of the leading domestic suppliers of semiconductor-grade vacuum components and has gradually expanded its capabilities into high-end vacuum valve products. The company benefits from a longstanding presence in high-purity fluid systems, vacuum piping and process equipment components, providing a strong manufacturing foundation and a deep understanding of semiconductor process requirements.

Compared with many emerging valve suppliers, Kinglai's key advantage lies in its broad customer coverage across China's semiconductor ecosystem. The company already serves a wide range of domestic equipment manufacturers, allowing it to leverage existing customer relationships when promoting higher-value valve products. This customer access significantly lowers barriers to qualification and accelerates product adoption.

From a technology perspective, Kinglai has focused on improving sealing performance, cleanliness control and product reliability, which represent some of the most important qualification criteria in semiconductor vacuum environments. While there remains a gap versus global leaders such as VAT in the most demanding applications, the company has continued to expand its product portfolio and increase localization content within domestic equipment platforms.

As China's WFE vendors further localize critical subsystems, Kinglai is well positioned to benefit due to its manufacturing scale, established industry relationships and broad exposure across the semiconductor supply chain.

Gaokai Precision (688835.CH, not covered)

Gaokai Precision is a domestic supplier focused on semiconductor vacuum and fluid-control components, with product offerings covering vacuum valves, pressure-control solutions and related process-control applications. The company has benefited from increasing localization efforts among Chinese semiconductor equipment manufacturers and has gradually expanded its participation in customer qualification programs.

A key strength of Gaokai lies in its focus on semiconductor-specific applications rather than broader industrial valve markets. This has enabled the company to develop expertise in contamination control, sealing performance and reliability requirements that are critical for semiconductor equipment. While commercialization remains at an earlier stage than established international suppliers, Gaokai is increasingly viewed as one of the domestic participants positioned to benefit from the ongoing localization of vacuum-control subsystems.

Jiasheng (private company)

Jiasheng is one of the domestic companies specifically targeting semiconductor vacuum-control applications and has emerged as an increasingly visible participant in China's vacuum valve localization effort. The company's strategy focuses on developing semiconductor-grade vacuum valves capable of addressing the stringent requirements of WFE.

A key differentiator for Jiasheng is its emphasis on product reliability and application-specific development. Unlike standard industrial valve markets, semiconductor customers place significant weight on lifetime performance, particle control and process stability. As a result, Jiasheng has focused on close cooperation with equipment manufacturers throughout the qualification process, enabling products to be optimized around specific platform requirements.

From a commercial perspective, the company remains in the market-share expansion phase rather than the maturity stage. Customer qualification and installed-base growth continue to be the primary drivers of adoption. As more domestic equipment manufacturers increase local sourcing requirements, Jiasheng has gained opportunities to participate in localization programs that were previously dominated by overseas suppliers.

Looking ahead, the company's growth will depend on its ability to convert qualification success into larger-volume production programs and expand penetration into higher-end process applications where localization rates remain relatively low.

KVTS (private company)

KVTS is widely viewed as one of the more technologically focused challengers within China's semiconductor vacuum valve industry. The company specializes in semiconductor-grade vacuum valve products and has concentrated its efforts on applications that demand high reliability, precise pressure control and long operational lifetimes.

Compared with broader component manufacturers, KVTS is often perceived as having a stronger specialization in vacuum valve technologies. The company's development efforts have focused on narrowing performance gaps with international leaders through continuous improvements in sealing technology, actuator performance, particle control and product consistency.

These areas remain critical because semiconductor customers typically prioritize reliability and process stability over cost considerations.

The company's commercial strategy centers on deep participation in domestic equipment qualification programs. As China's leading WFE manufacturers continue expanding shipments and reducing dependence on imported components, KVTS has benefited from increasing opportunities to validate products in production environments.

Among domestic suppliers, KVTS is often regarded as one of the companies with the potential to penetrate higher-end semiconductor applications as qualification efforts mature. While significant barriers remain before domestic suppliers can challenge VAT's dominant market position, KVTS appears well positioned to participate in the next phase of vacuum valve localization, particularly in process-critical applications where value-added content and barriers to entry are higher.

VACUUM GAUGE

Sector Primer: The “Eyes” of Semiconductor Vacuum Systems

Vacuum gauges are critical sensing components used to measure and monitor pressure conditions throughout WFE products. Their primary function is to provide real-time pressure feedback to equipment control systems, enabling precise regulation of vacuum environments during wafer processing. Modern semiconductor fabrication relies extensively on vacuum-based processes. Equipment such as etchers, deposition tools, ion implanters, metrology systems and vacuum transfer modules all require tightly controlled pressure conditions to ensure stable process performance. Vacuum gauges continuously monitor chamber pressure and provide feedback to process-control systems, allowing equipment to maintain the operating conditions necessary for consistent manufacturing results.

Similar with vacuum valves, the importance of vacuum gauges has increased alongside the growing complexity of semiconductor manufacturing. As process nodes continue to shrink and manufacturing tolerances tighten, even small deviations in chamber pressure can affect etch rates, deposition uniformity, plasma stability and ultimately wafer yield. Accurate pressure measurement is therefore essential for maintaining process repeatability and achieving high production yields. A wide range of vacuum gauge technologies are used throughout semiconductor manufacturing, including capacitance manometers, Pirani gauges, cold cathode gauges and hot cathode gauges. Different technologies are optimized for different pressure ranges, requiring equipment manufacturers to deploy multiple gauge types across a single tool platform. Although vacuum gauges typically represent a relatively small portion of overall equipment cost, they are indispensable components within the semiconductor vacuum ecosystem and play a critical role in enabling stable process control.

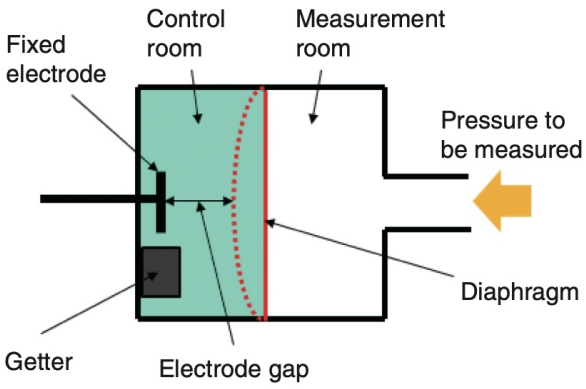
Compared with traditional industrial pressure sensors, semiconductor vacuum gauges face significantly higher performance and reliability requirements. The primary challenge lies in achieving high measurement accuracy and long-term stability across a wide pressure range. Semiconductor manufacturing processes often demands measurement accuracy at pressures ranging from atmospheric conditions down to ultra-high vacuum environments. Maintaining consistent performance under these conditions requires expertise in sensing technologies, electronics design, calibration methodologies and contamination control. Beyond measurement accuracy, reliability represents another major barrier. Vacuum gauges operate continuously within production equipment and directly influence process-control decisions. Any measurement drift or instability can result in pressure-control errors that negatively impact process performance and tool productivity. Customer qualification further raises entry barriers. Because vacuum gauges are deeply integrated into equipment control architectures, replacing an incumbent supplier often requires extensive system-level validation. Semicap vendors therefore tend to favor established suppliers with proven field reliability and large installed bases.

EXHIBIT 11: **Vacuum gauges and related products**



Source: MKS Instructions, Bernstein analysis

EXHIBIT 12: **Design of a diaphragm vacuum gauge**



Source: HORIBA STEC, Bernstein analysis

Competitive Landscape

The global semiconductor vacuum gauge market is characterized by a relatively concentrated group of suppliers with strong technological expertise in vacuum measurement and control. Historically, suppliers from the United States, Europe and Japan have dominated the sector, with market leadership supported by decades of experience in vacuum technology and extensive relationships with semicap manufacturers. Companies such as MKS Instruments, INFICON, Pfeiffer Vacuum and Edwards have established large installed bases across semiconductor fabs worldwide and remain the preferred suppliers for many high-end applications.

Unlike vacuum valves, where VAT has emerged as a clear industry leader, the vacuum gauge market is more balanced among several established players. Competition is often driven by measurement accuracy, long-term reliability, product breadth and the ability to integrate with broader vacuum-control systems.

China's domestic vacuum gauge industry remains in an earlier stage of development. While local suppliers have achieved progress in selected applications and pressure ranges, overseas vendors continue to dominate the most demanding semiconductor processes. Nevertheless, increasing localization efforts and growing domestic equipment shipments are creating new opportunities for Chinese suppliers to expand their market presence.

Leading Global Vendors

MKS Instruments (MKSI, not covered)

MKS is one of the most important suppliers of vacuum measurement solutions for the semiconductor industry and maintains a leading position in capacitance manometer technology. Through decades of development, the company has established a broad portfolio of pressure-measurement, vacuum-control and process-management products that are widely deployed across semiconductor manufacturing equipment. A key advantage for MKS is its ability to provide integrated process-control solutions encompassing vacuum gauges, pressure controllers and related subsystems. This broad product offering has enabled the company to build deep relationships with major WFE manufacturers and maintain a significant installed base across global fabs.

INFICON (IFCN.SIX, not covered)

Switzerland-based INFICON is widely regarded as one of the global leaders in vacuum measurement and leak-detection technologies. The company possesses deep expertise in vacuum instrumentation and has built a strong reputation for measurement accuracy, reliability and long-term stability. Its vacuum gauges are extensively used throughout semiconductor manufacturing, particularly in applications where precise pressure control is required. The company's strong technology position and long operating history have made it one of the preferred suppliers among semiconductor equipment manufacturers worldwide.

Pfeiffer Vacuum (PFV.FRA, not covered)

Pfeiffer Vacuum is one of the industry's most recognized vacuum technology companies and offers a comprehensive portfolio spanning vacuum pumps, gauges, leak detectors and vacuum-system components. Unlike pure-play gauge suppliers, Pfeiffer leverages its broader vacuum-system expertise to provide integrated vacuum solutions. This allows the company to maintain strong positions across multiple categories of semiconductor vacuum infrastructure while benefiting from deep technical knowledge of vacuum-system performance.

Edwards (private company)

Headquartered in the United Kingdom and currently part of Atlas Copco Group, Edwards is best known for its leadership in vacuum pumps, but also maintains a meaningful presence in vacuum measurement and monitoring technologies. The company's products are widely used across semiconductor manufacturing and vacuum-processing applications. Its strength lies in its broad vacuum ecosystem and close relationships with semicap manufacturers. By combining vacuum pumps, abatement systems and measurement technologies, Edwards is able to provide highly integrated solutions to semiconductor customers.

Agilent Technologies (A, covered by Eve Burstein)

Agilent Technologies participates in the vacuum gauge market through technologies inherited from Varian, a long-established provider of vacuum instrumentation and measurement solutions. The company offers a range of vacuum gauges, leak detectors and vacuum monitoring products serving semiconductor, analytical and industrial applications. While vacuum measurement represents only a portion of Agilent's broader instrumentation portfolio, the company's strengths in precision measurement, calibration and sensor technologies have enabled it to maintain a recognized position within the vacuum ecosystem. Although its semiconductor vacuum gauge presence is smaller than that of MKS or INFICON, Agilent remains an established supplier of high-performance vacuum measurement solutions and continues to serve a range of semiconductors and research-oriented customers.

Leybold (private company)

Leybold is one of the longest-established names in vacuum technology and offers a broad portfolio spanning vacuum pumps, gauges, leak detection systems and complete vacuum solutions. The company is part of Atlas Copco Group and benefits from decades of expertise in vacuum engineering and high-vacuum applications. Unlike pure-play vacuum gauge suppliers, Leybold's vacuum measurement business is integrated within a broader vacuum technology portfolio. This allows the company to provide customers with comprehensive vacuum solutions rather than standalone measurement products. While its position in semiconductor vacuum gauges is generally less prominent than industry leaders, Leybold remains an important participant in the global vacuum ecosystem and maintains a meaningful presence across semiconductor, scientific and industrial vacuum applications.

Leading Local Vendors

Shanghai Zhentai (private company)

Shanghai Zhentai is widely regarded as one of the earliest domestic companies focused on vacuum measurement technologies and remains among the most established local suppliers in China's vacuum gauge market. The company specializes in vacuum gauges, vacuum instrumentation and pressure-measurement systems used across semiconductor, scientific research and industrial vacuum applications.

A key strength of Shanghai Zhentai lies in its long operating history and accumulated expertise in vacuum sensing technologies. Compared with many newer entrants, the company has developed a relatively comprehensive product portfolio spanning multiple vacuum ranges and measurement principles, allowing its products to address a broad spectrum of semiconductor process requirements. The company has also benefited from long-term cooperation with domestic research institutions and WFE manufacturers, which has helped establish a meaningful installed base within the local market.

From a commercialization perspective, Shanghai Zhentai is among the domestic players furthest along in the qualification process. While a gap remains compared with leading international suppliers in the most demanding applications, the company is well positioned to benefit from increasing localization demand as Chinese equipment makers seek to reduce dependence on

imported vacuum monitoring solutions.

SiCarrier (private company)

Scicarrier is one of China's emerging semiconductor-component suppliers and has gradually expanded into vacuum sensing and measurement technologies as part of its broader localization strategy. The company focuses on developing critical semiconductor subsystems and seeks to participate in areas where domestic penetration remains relatively low.

Within the vacuum gauge market, Scicarrier's strategy centers on building semiconductor-specific capabilities rather than targeting broader industrial applications. This approach allows the company to focus product development around the reliability, accuracy and contamination-control requirements of semiconductor manufacturing. As advanced process tools become increasingly dependent on precise pressure control, locally developed vacuum measurement solutions are receiving greater attention from domestic customers.

Commercially, Scicarrier remains in the customer qualification and validation stage, with future growth largely dependent on successful adoption by domestic equipment vendors. Although current market penetration remains relatively limited, the company is benefiting from a favorable industry backdrop characterized by accelerating localization efforts and expanding demand for domestic semiconductor subsystems. Over time, qualification progress and installed-base growth will likely become the most important indicators of its competitive positioning.

Xiamen Mibay (private company)

Xiamen Mibay is another emerging participant in China's vacuum measurement ecosystem and has focused on the development of vacuum instrumentation and sensing technologies for semiconductor and high-end industrial applications. The company's efforts are aligned with the broader trend of increasing localization across semiconductor SCM supply chains.

Compared with larger and more established players, Xiamen Mibay remains at a relatively early stage of commercialization. The company has concentrated on building technical capabilities in vacuum sensing, calibration and measurement accuracy, while working with domestic customers to validate products across different equipment platforms. As is common in the vacuum gauge industry, customer adoption depends heavily on long-term stability and reliability rather than simply meeting technical specifications.

The company's business expansion is therefore closely linked to its ability to progress through qualification cycles and establish a larger installed base. As domestic semicap manufacturers continue expanding local sourcing initiatives, Xiamen Mibay could benefit from growing opportunities to participate in production platforms and gradually increase market penetration. While meaningful scale may still take time to achieve, the company represents part of the broader wave of domestic suppliers targeting high-value semiconductor measurement technologies.

VACUUM PUMP

Sector Primer: The Power Source Behind Semiconductor Vacuum Systems

Vacuum pumps are among the most critical subsystems in WFE, serving as the foundation of virtually all vacuum-based processes. Their primary function is to generate and maintain the vacuum environment required for semiconductor fabrication by continuously removing gases and process by-products from chambers and transfer modules. As we have emphasized in the earlier parts, modern semiconductor manufacturing relies heavily on vacuum technology. Critical process steps including etch, deposition, ion implantation, metrology and wafer transfer all require tightly controlled vacuum environments to ensure process stability and contamination control. Vacuum pumps are therefore deployed throughout semiconductor fabs and equipment platforms, continuously working to maintain pressure levels required by different manufacturing processes.

Vacuum pumps used in semiconductor manufacturing can generally be divided into three categories:

Dry pumps are typically used as roughing or backing pumps and are responsible for evacuating chambers from atmospheric pressure (~760 Torr) down to the rough-vacuum regime, generally around **10^{0} to 10^{-3} Torr**. These pumps handle large gas volumes and serve as the first stage of the vacuum generation process. Because dry pumps do not use oil inside the pumping chamber, they are widely adopted in semiconductor manufacturing where contamination control is critical.

Turbo molecular pumps (TMPs) operate at extremely high rotational speeds, often exceeding tens of thousands of revolutions per minute, and are used to generate high and ultra-high vacuum environments, typically in the range of **10^{-3} to 10^{-9} Torr**. TMPs are normally paired with dry pumps, which act as backing pumps. Due to their ability to provide clean, stable and high-vacuum conditions, TMPs are extensively used in etch, deposition, metrology and wafer-transfer applications and represent the most important category of vacuum pumps in semiconductor equipment.

Cryogenic pumps (Cryopumps) create vacuum through condensation and adsorption of gas molecules on surfaces maintained at extremely low temperatures. These systems are capable of achieving high and ultra-high vacuum levels comparable to, and in some applications exceeding, TMP-based systems, generally operating in the **10^{-6} to below 10^{-10} Torr** range. Cryopumps are typically used in selected semiconductor applications requiring exceptionally clean vacuum environments and high pumping speeds, such as certain PVD, ion implantation and advanced deposition processes.

Among the three categories, dry pumps have achieved the highest level of commercialization among domestic suppliers, while turbo molecular pumps remain the primary focus of semiconductor localization efforts due to their broad adoption across etch, deposition and transfer applications. Cryopumps, by contrast, remain at a relatively earlier stage of localization and continue to be dominated by established international suppliers. TMPs operate at extremely high rotational speeds, often exceeding tens of thousands of revolutions per minute, and are capable of generating the high and ultra-high vacuum environments required for advanced semiconductor manufacturing. TMPs are typically used together with backing pumps, forming a complete vacuum generation system.

As process complexity continues to increase, vacuum requirements have become increasingly stringent. Modern process tools require not only lower pressure levels, but also higher pumping efficiency, lower vibration, better contamination control and greater operational reliability. Consequently, vacuum pumps have evolved from relatively standardized hardware into performance-critical subsystems that directly influence tool uptime, throughput and yield. Although vacuum pumps generally represent only a small portion of overall tool BOM cost, they remain among the most technologically demanding and strategically important components within the semiconductor equipment supply chain.

Compared with many other mechanical components, semiconductor vacuum pumps face exceptionally high engineering and manufacturing barriers. The core challenge lies in achieving stable operation under extreme vacuum environments while maintaining long-term reliability. TMPs rely on ultra-high-speed rotating assemblies, precision bearings, sophisticated balancing technologies and advanced motor control systems. Any deviation in rotor stability, vibration control or thermal management can significantly affect product performance and operational lifetime. In addition, semiconductor customers demand exceptionally high standards for cleanliness and contamination control. Because vacuum pumps operate directly within critical process environments, particle generation and material compatibility become key qualification metrics. This requirement significantly raises barriers for new entrants and contributes to the industry's historically concentrated market structure.

EXHIBIT 13: **Turbo Molecular Pump**



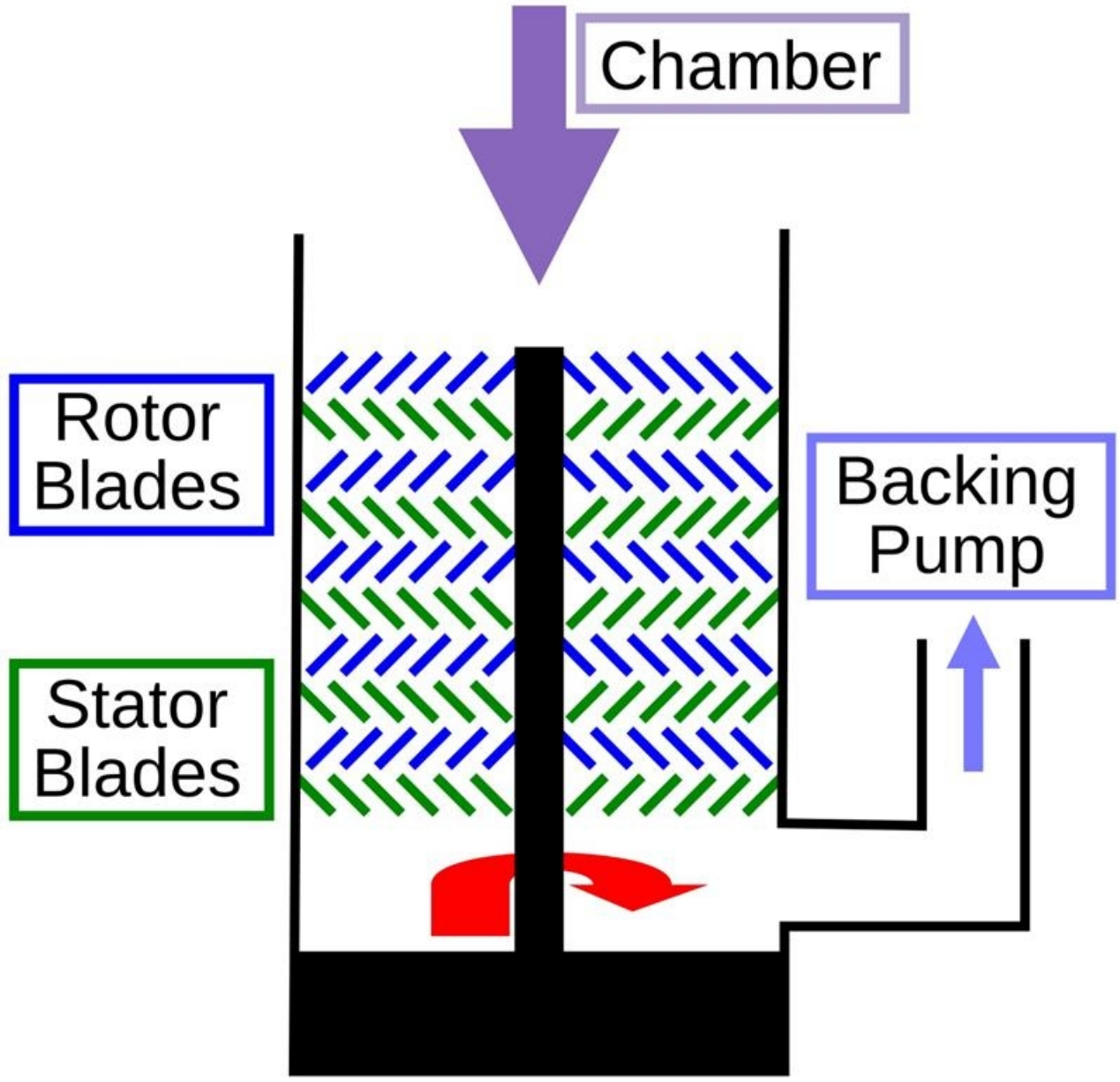
Source: Edwards, Bernstein analysis

EXHIBIT 14: **Interior view of a turbo molecular pump**



Source: Wikipedia, Bernstein analysis

EXHIBIT 15: **Schematic of a turbo molecular pump**



Source: Wikipedia, Bernstein analysis

Competitive Landscape

The global semiconductor vacuum pump market has historically been dominated by a small group of suppliers from Europe and Japan. Among international players, Edwards, Pfeiffer Vacuum, Ebara and Leybold have established leading positions through decades of technological accumulation, extensive installed bases and close relationships with major WFE manufacturers. These companies collectively account for the majority of the high-end semiconductor vacuum pump market and remain the preferred suppliers for many global OEMs.

Unlike the vacuum valve market, where VAT occupies a uniquely dominant position, the vacuum pump industry is relatively more balanced among several leading suppliers. Competition is typically driven by pumping performance, reliability, contamination control, energy efficiency and total cost of ownership.

China's domestic vacuum pump ecosystem remains relatively concentrated, with only a handful of suppliers capable of producing semiconductor-grade TMPs. However, growing semiconductor equipment localization efforts and increasing demand from domestic fabs have accelerated qualification activities, creating a favorable environment for local suppliers to expand market share. Among domestic companies, KYKY, Beijing Jingyi and Sky Technology have emerged as the most important participants. While a technology gap remains relative to global leaders, domestic suppliers have demonstrated meaningful progress and are increasingly benefiting from China's broader localization trend.

Leading Global Vendors

Edwards (private company)

As we have discussed previously, Edwards is widely regarded as one of the global leaders in semiconductor vacuum technology. The company offers a comprehensive portfolio spanning vacuum pumps, abatement systems and vacuum-monitoring solutions, allowing it to provide highly integrated vacuum platforms for semiconductor manufacturers. Edwards' TMPs are widely used across etch, deposition and other advanced process applications where reliability and uptime are critical. A major strength of Edwards lies in its extensive semiconductor installed base and deep relationships with leading OEMs and fabs. This installed-base advantage has allowed the company to accumulate decades of operational experience, creating strong customer stickiness and high switching costs.

Pfeiffer Vacuum (PFV.FRA, not covered)

Germany-based Pfeiffer Vacuum is often considered a technology leader in TMPs as well. The company is particularly known for its expertise in high-vacuum and ultra-high-vacuum applications, supported by decades of innovation in rotor design, bearing systems and vacuum engineering. Unlike some competitors that emphasize broader vacuum-system integration, Pfeiffer's reputation is closely tied to its leadership in core vacuum technologies. Pfeiffer remains a preferred supplier in applications requiring high pumping performance, low vibration and exceptional reliability.

Ebara (6361.JP, not covered)

Japan's Ebara is one of the most important players in the semiconductor vacuum pump market and has established particularly strong positions in Asian semiconductor supply chains. The company leverages extensive expertise in precision machinery and industrial vacuum systems to offer high-performance dry pumps and TMPs for semiconductor applications. Ebara benefits from close relationships with Japanese equipment manufacturers and leading Asian semiconductor customers, making it a significant competitor across multiple process segments. Its products are particularly valued for long-term reliability and operational stability in high-volume manufacturing environments.

Leybold (private company)

Leybold, now part of Atlas Copco Group, is another long-standing participant in the global vacuum technology market. The company offers a broad portfolio of vacuum solutions including pumps, gauges and leak detection systems. Compared with larger market leaders, Leybold's semiconductor exposure is somewhat smaller, but the company remains an important supplier within high-vacuum applications and continues to benefit from its extensive expertise in vacuum engineering.

Osaka Vacuum (private company)

Osaka Vacuum is a specialized Japanese supplier of turbo molecular pumps and high-vacuum solutions serving semiconductor, scientific research and advanced industrial applications. The company has built a strong reputation in high-vacuum engineering and precision manufacturing, with products widely used in semiconductor process equipment, analytical instruments and research facilities. Compared with larger global players, Osaka Vacuum operates on a smaller scale but maintains a strong position in selected high-vacuum applications. Its competitive strengths lie in product reliability, vacuum performance and long-standing expertise in turbo molecular pump design. The company continues to benefit from demand for high-performance vacuum solutions across both semiconductor manufacturing and research-oriented end markets.

Shimadzu (7701.JP, not covered)

Shimadzu is best known as a global leader in analytical and scientific instruments, but the company also participates in selected vacuum pump and vacuum-system applications. Leveraging decades of experience in precision engineering and scientific instrumentation, Shimadzu has developed vacuum technologies serving semiconductor, research and industrial

customers. Within the semiconductor vacuum pump market, Shimadzu's presence is more limited compared with leading suppliers. Nevertheless, the company remains a recognized participant in high-vacuum applications and benefits from strong technical capabilities in precision manufacturing and vacuum-system integration. Its vacuum products are typically associated with specialized applications where performance, reliability and integration with analytical systems are important customer considerations.

Leading Local Vendors

KYKY (private company)

KYKY is widely regarded as China's leading domestic supplier of semiconductor-grade TMPs and represents one of the country's most successful localization efforts in vacuum technology. Originating from the Chinese Academy of Sciences system, the company possesses decades of technical accumulation in vacuum science and has developed capabilities spanning rotor dynamics, magnetic bearing technology, precision motor control and complete TMPs' design.

Unlike many emerging domestic suppliers, KYKY's competitive advantage is built upon a strong technology foundation rather than solely benefiting from localization demand. The company has developed a broad portfolio of turbo molecular pumps addressing semiconductor manufacturing, scientific research and industrial vacuum applications, allowing it to accumulate significant operating experience across multiple end markets.

Commercially, KYKY has become one of the most widely adopted domestic vacuum pump suppliers among Chinese semicap manufacturers. As local OEMs increasingly prioritize domestic sourcing, the company has benefited from growing qualification opportunities across etch, deposition and vacuum-transfer platforms. While international leaders still maintain advantages in certain high-end applications, KYKY is generally viewed as the domestic company with the strongest positioning to capture future import-substitution opportunities within the semiconductor vacuum pump market.

Hanbell Precise (002158.CH, not covered)

Hanbell Precise is one of China's leading vacuum equipment suppliers and has established a meaningful presence in semiconductor vacuum applications through its vacuum pump product portfolio. Leveraging its long-standing expertise in industrial compressors and vacuum technologies, the company has expanded into semiconductor-grade vacuum pumps and become an important participant in China's localization effort.

Compared with KYKY, which is primarily recognized for its turbo molecular pump technology, Hanbell's strength lies in its manufacturing scale, commercial execution and broad customer reach. The company has developed capabilities across multiple vacuum pump categories and has benefited from increasing demand from both semiconductor equipment manufacturers and semiconductor fabs. As domestic semiconductor investment continues to expand, Hanbell has emerged as one of the key beneficiaries of localization within the vacuum subsystem market.

From an investment perspective, Hanbell is often viewed as one of the most commercially mature domestic vacuum players. While a technology gap remains relative to leading international suppliers in certain high-end applications, the company is well positioned to capture incremental market share as domestic customers continue diversifying their supplier base and increasing adoption of localized vacuum solutions.

Beijing Jingyi (688652.CH, not covered)

Beijing Jingyi is one of the emerging domestic participants in China's semiconductor vacuum pump industry and has focused on developing high-performance vacuum solutions for semiconductor and research-oriented applications. The company has concentrated its efforts on TMP technologies, seeking to capitalize on the growing demand for localized vacuum subsystems within China's WFE ecosystem.

Technically, Beijing Jingyi has been investing in core areas such as rotor design, vibration control, bearing systems and vacuum-system integration. These capabilities are particularly important because semiconductor customers prioritize operational stability, contamination control and long-term reliability over simple cost competitiveness. As a result, the company's development trajectory has been closely tied to qualification progress rather than pure shipment volume growth.

From a commercial perspective, Beijing Jingyi remains at an earlier stage than established global leaders and domestic front runner KYKY. However, the company has steadily increased participation in customer validation programs and has benefited

from growing willingness among domestic equipment manufacturers to qualify local suppliers. Looking forward, broader platform adoption and the accumulation of field reliability data will be key factors determining its ability to expand market share within the semiconductor vacuum pump industry.

Sky Technology (920186.CH, not covered)

Sky Technology is another domestic supplier targeting opportunities within China's vacuum equipment and semiconductor subsystem market. The company focuses on vacuum technologies and related equipment solutions, with TMPs representing one of its key areas of development under the broader semiconductor localization trend.

Compared with larger incumbents, Sky Technology remains in a relatively early commercialization stage. The company's strategy emphasizes close cooperation with domestic equipment manufacturers and participation in localization programs where customer qualification and long-term validation play a critical role. As semiconductor vacuum pumps are highly reliability-driven products, successful adoption depends significantly on field performance and operational track record rather than solely on initial technical specifications. Sky Technology has focused on leveraging China's rapidly expanding domestic semiconductor ecosystem. While its current installed base remains relatively limited, continued progress in customer validation and production deployment could support future expansion within the domestic semiconductor vacuum pump market.

MASS FLOW CONTROLLERS (MFC)

Sector Primer: The Critical Control Point of Process Gas Delivery

Mass Flow Controllers (MFCs) are among the most important fluid-control components used in semiconductor manufacturing equipment. Their primary function is to precisely measure and regulate the flow of process gases into semiconductor process chambers, ensuring stable and repeatable manufacturing conditions throughout wafer fabrication. Virtually all major semiconductor manufacturing processes rely on tightly controlled gas delivery. Whether in etch, CVD, ALD, oxidation, diffusion or cleaning applications, process gases must be delivered at precisely defined flow rates in order to achieve target process performance. MFCs serve as the key control point within the gas-delivery system, continuously monitoring gas flow and adjusting valve positions to maintain the desired setpoint.

The importance of MFCs has increased significantly as semiconductor manufacturing has become more complex as well. Advanced process nodes often require tighter process windows, more sophisticated gas chemistries and greater process repeatability. Under these conditions, even small variations in gas flow can influence deposition thickness, etch uniformity, critical dimensions and ultimately wafer yield. Unlike conventional industrial flow-control systems, semiconductor-grade MFCs are designed to operate with extremely high precision, fast response times and exceptional long-term stability. In many applications, flow control accuracy is measured in fractions of a percent, making MFCs one of the most critical process-control components within the WFE architecture. MFCs directly affect process consistency and tool performance, making them one of the most strategically important subsystems within the broader WFE supply chain.

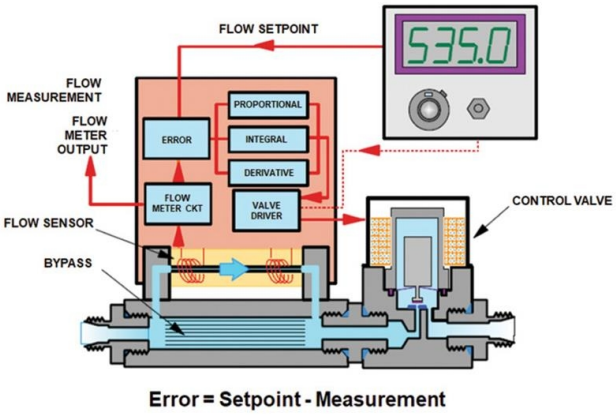
Compared with conventional flow-control products, semiconductor MFCs face substantially higher technological and qualification barriers. At the technical level, MFC performance depends on the integration of precision flow sensors, control electronics, software algorithms, valve technologies and calibration capabilities. In addition, MFCs are considered process-critical components. Unlike structural components that primarily affect equipment uptime, MFC performance directly influences process outcomes. Leading suppliers have accumulated decades of proprietary know-how in flow measurement, sensor design and process control, creating significant barriers for new entrants. Consequently, MFCs remain one of the lower-localization component categories within China's semiconductor equipment ecosystem.

EXHIBIT 16: **Mass Flow Controllers**



Source: Horiba, Bernstein analysis

EXHIBIT 17: **Basic components of a thermal mass flow controller**



Source: MKS Instruments, Bernstein analysis

Competitive Landscape

The global semiconductor MFC market is highly concentrated and has historically been dominated by a small group of suppliers from Japan and the United States.

Among international suppliers, HORIBA, Brooks Instrument and Fujikin collectively represent the industry's leading players and account for a substantial portion of global semiconductor MFC installations. These companies have benefited from decades of technological development, extensive installed bases and close relationships with global semiconductor equipment manufacturers. Outside the leading tier, companies such as Bronkhorst, MKS Instruments and Yokogawa maintain positions in selected flow-control applications and continue to benefit from strong engineering capabilities and established customer relationships.

Compared with other SCMs, the MFC industry exhibits particularly strong customer stickiness. Once qualified on a production platform, suppliers often remain embedded within equipment architectures for many years due to the complexity of requalification and the critical role MFCs play in process performance.

China's domestic MFC market remains in the early stages of import substitution relative to categories such as vacuum valves or vacuum pumps. However, increasing localization efforts and growing demand from domestic equipment makers have accelerated customer qualification activities, creating a favorable environment for domestic suppliers to improve market penetration.

Leading Global Vendors

HORIBA (6856.JP, not covered)

Japan-based HORIBA is widely regarded as one of the global leaders in semiconductor MFCs and has maintained a dominant position in the industry for decades. Leveraging deep expertise in flow measurement, sensing technologies and analytical instrumentation, the company has developed a broad portfolio of semiconductor-grade MFC products covering a wide range of gases and process applications. HORIBA's competitive advantage stems from its measurement technology, extensive installed base and long-standing relationships with semiconductor equipment manufacturers. The company's products are widely used across leading WFE platforms and are often viewed as the benchmark for high-performance flow control.

Brooks Instrument (private company)

The U.S. company Brooks Instrument, a division of Illinois Tool Works Inc. (ITW, not covered), is another leading supplier of semiconductor MFCs and one of the industry's most established participants. The company has built a strong reputation for flow-control technologies, process reliability and application-specific solutions. Brooks products are widely deployed across etch, deposition and advanced process applications where precise gas control is critical. Its extensive semiconductor customer base and long operating history continue to support strong market positioning.

Fujikin (private company)

Fujikin is one of Japan's most important fluid-control technology companies and maintains a leading position in semiconductor gas-delivery systems. The company's product portfolio spans ultra-high-purity valves, regulators and MFCs, enabling it to provide highly integrated gas-delivery solutions to semiconductor manufacturers. Fujikin's strengths lie in precision engineering, manufacturing quality and deep knowledge of semiconductor process requirements.

MKS Instruments (MKSI, not covered)

MKS participates in the MFC market through its broader portfolio of vacuum and process-control solutions. While the company is better known for its leadership positions in RF power and vacuum measurement, it also maintains a meaningful presence within the flow-control segment. Its ability to provide integrated subsystem solutions spanning pressure, vacuum and gas delivery allows MKS to maintain strong relationships with WFE manufacturers.

Bronkhorst (private company)

Bronkhorst is a well-known Netherlandish supplier of precision flow-control products and has established a presence in semiconductor and high-tech industrial applications. The company is particularly recognized for its expertise in low-flow

measurement and customized flow-control solutions, enabling it to compete effectively in selected niche applications.

Yokogawa (6841.JP, not covered)

Yokogawa is a leading Japanese provider of industrial automation, measurement and process-control solutions and maintains a presence in the semiconductor flow-control market. Leveraging its expertise in precision instrumentation and process automation, the company offers flow measurement and control products serving semiconductor and other high-technology industries. While its market position in semiconductor MFCs is smaller than that of global leaders, Yokogawa remains a recognized participant in high-precision flow-control applications and benefits from its longstanding reputation in measurement accuracy and process reliability.

Leading Local Vendors

NAURA (002371.CH)

NAURA produces MFCs via a subsidiary, and has become one of China's most important domestic MFC suppliers, representing the country's most established localization platform in semiconductor flow-control technologies.

The company benefits from decades of experience in semiconductor components and process-control systems, allowing it to accumulate significant expertise in precision flow measurement, control algorithms and semiconductor-grade manufacturing. A key advantage lies in its close relationship with domestic semiconductor equipment makers, particularly within the NAURA ecosystem, providing direct opportunities for product validation and platform penetration. Beyond internal demand, the company has also expanded customer engagement across China's broader semiconductor equipment industry.

From a localization perspective, NAURA is generally viewed as one of the leading domestic challengers to established international suppliers. While gaps remain in certain high-end applications, the company has achieved meaningful progress in customer qualification and continues to benefit from growing demand for localized semiconductor subsystems.

Gaokai Precision (688835.CH, not covered)

Gaokai Precision is an emerging domestic supplier participating in China's localization efforts across semiconductor fluid-management and process-control components. The company has been developing products related to gas-flow control, pressure management and semiconductor fluid-delivery systems, allowing it to participate in selected MFC and gas-delivery applications.

Compared with established global leaders such as HORIBA, Brooks and Fujikin, Gaokai remains at a relatively early stage of commercialization. However, growing demand for localized gas-control solutions and increasing qualification activity among domestic equipment manufacturers have created additional opportunities for the company to expand its customer base. As China's semiconductor ecosystem continues prioritizing supply-chain localization, Gaokai could emerge as another beneficiary within the broader fluid-management segment.

Compart Systems (private company)

Compart Systems, which is indirectly controlled by Fortune Precision (688409.CH, not covered) is one of China's most recognized participants in semiconductor gas-delivery and flow-control systems. The company has gradually expanded from fluid-control solutions into higher-value components, including semiconductor-grade MFCs. Leveraging its long-standing expertise in gas-delivery systems and close relationships with WFE manufacturers, Compart has established a strong foundation for further expansion into process-critical flow-control applications.

A major strength of the company lies in its deep understanding of semiconductor gas-delivery architectures. By leveraging its installed base in related fluid-control products, Compart has been able to accelerate product development and qualification within the MFC segment. The company continues investing in flow-control technologies, sensor development and system integration capabilities to improve competitiveness against overseas incumbents.

Following its corporation with Fortune Precision, Compart also benefits from broader exposure to China's WFE localization ecosystem. The integration provides additional manufacturing resources, customer access and subsystem collaboration opportunities, potentially accelerating commercialization of higher-value semiconductor components. As domestic semiconductor investment continues to expand, Compart is positioned to benefit from increasing localization demand,

particularly in applications where integrated gas-delivery solutions are favored by equipment manufacturers.

ELECTROSTATIC CHUCKS (ESC)

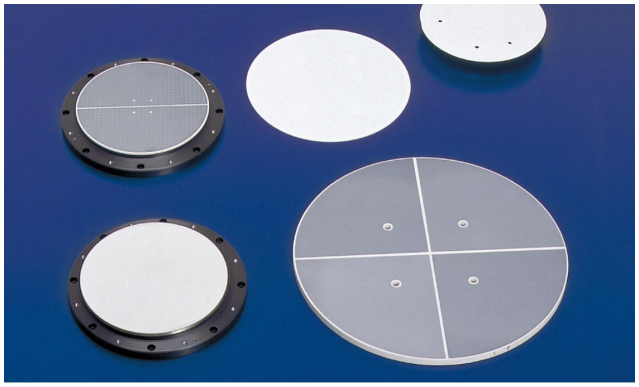
Sector Primer: The Wafer-Holding Platform at the Heart of Process Chambers

Electrostatic chucks (ESCs) are among the most critical components used in semiconductor process chambers. Their primary function is to securely hold semiconductor wafers in place during processing through electrostatic forces while simultaneously enabling temperature control and maintaining process stability.

ESCs are widely used across plasma-based manufacturing equipment, particularly in etch, deposition and advanced packaging applications. During wafer processing, the chuck must firmly secure the wafer under vacuum conditions while exposing it to plasma, reactive gases and elevated temperatures. Any instability in wafer positioning or thermal control can directly affect process uniformity, critical dimension control and ultimately manufacturing yield. Beyond wafer clamping, ESCs also play an important role in thermal management. Modern semiconductor processes require precise temperature control across the entire wafer surface, particularly as device geometries continue to shrink and process windows become increasingly narrow. ESCs therefore function not only as wafer-holding devices but also as critical thermal-control platforms that directly influence process outcomes.

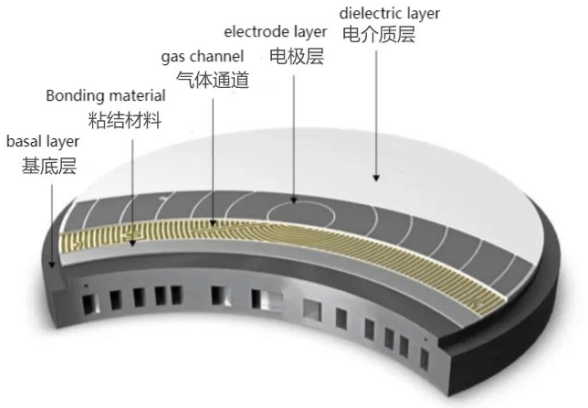
As semiconductor technology advances, requirements for temperature uniformity, plasma resistance, contamination control and long-term reliability have become increasingly stringent. As a result, ESCs have evolved from relatively simple mechanical components into highly engineered subsystems that integrate advanced ceramic materials, precision manufacturing and process-specific design expertise. The technological challenge begins with materials. Most high-performance ESCs utilize advanced ceramic materials such as aluminum nitride (AlN) or alumina ceramics, which require exceptional purity, thermal conductivity and mechanical stability. The manufacturing process is highly complex and involves ceramic formulation, precision sintering, embedded electrode integration and ultra-high-flatness machining. Beyond material technology, ESC performance depends heavily on the ability to simultaneously optimize multiple parameters, including clamping force, thermal conductivity, temperature uniformity, dielectric performance and plasma resistance. Improving one performance metric often creates trade-offs in another, requiring significant process know-how and engineering experience. Given their direct impact on process performance and wafer yield, ESCs are widely regarded as one of the most critical and technologically demanding components within semiconductor manufacturing equipment.

EXHIBIT 18: **Electrostatic Chucks (ESCs)**



Source: Kyocera, Bernstein analysis

EXHIBIT 19: **A simplified ESC cross-section; production layer arrangements vary with the process tool**



Source: Cersol, Bernstein analysis

Competitive Landscape

The global ESC market is highly concentrated and has historically been dominated by Japanese suppliers. Companies such as Kyocera, NGK Insulators, TOTO and NTK have accumulated decades of expertise in advanced ceramics and semiconductor process technologies, allowing them to establish dominant positions across major semiconductor equipment platforms. Their products are widely deployed by leading equipment manufacturers and semiconductor fabs worldwide.

Compared with RF generators or MFCs, ESC suppliers benefit from particularly strong customer stickiness. Once qualified on a production platform, switching suppliers is difficult due to extensive process requalification requirements and direct implications for wafer yield.

China's domestic ESC industry remains at a relatively early stage of development. Nevertheless, increasing localization efforts and growing demand from domestic equipment makers have accelerated product qualification and customer engagement. Several domestic suppliers have emerged over recent years and are gradually expanding their capabilities in advanced ceramic materials and ESC manufacturing. While significant performance gaps remain in the most demanding applications, the localization opportunity remains substantial given the current dominance of overseas suppliers and the strategic importance of ESCs within semiconductor manufacturing tools.

Leading Global Vendors

Kyocera (6971.JP, not covered)

The Japanese vendor Kyocera is widely regarded as the global leader in electrostatic chuck technologies and remains one of the most important suppliers of ceramic components for the semiconductor industry. The company's competitive advantage stems from decades of expertise in advanced ceramic materials, precision manufacturing and semiconductor process engineering. Its ESC products are widely used across etch and deposition systems, where temperature uniformity and long-term reliability are critical performance requirements. Kyocera's extensive installed base, broad product portfolio and deep customer relationships have enabled the company to maintain strong market leadership and establish high barriers to entry for competitors.

NGK Insulators (5333.JP, not covered)

NGK, also from Japan, is another leading supplier of semiconductor-grade electrostatic chucks and advanced ceramic technologies. The company leverages its extensive materials-science capabilities to develop high-performance ESC products characterized by strong plasma resistance, excellent thermal conductivity and high reliability. NGK products are widely adopted in advanced semiconductor process applications requiring tight process control and long operational lifetimes. Its strengths in ceramic engineering and large-scale manufacturing continue to support a leading market position.

TOTO (5332.JP, not covered)

Although widely known for its sanitary products business, Japan-based TOTO is also one of the most important participants in the semiconductor ceramics market. The company's semiconductor division has developed significant expertise in advanced ceramic substrates and electrostatic chuck technologies. TOTO's ESC products are recognized for their high precision and strong performance in demanding plasma-processing environments. With a long history of supplying semiconductor equipment manufacturers, the company remains an important player in the global ESC market.

NTK (private company)

NTK, part of the Niterra Group (5334.JP, not covered), is a well-established supplier of advanced ceramic components for semiconductor applications. The company has developed a broad portfolio of ceramic solutions including electrostatic chucks, ceramic heaters and related process components. Its expertise in ceramic processing and thermal management enables the company to compete effectively in advanced wafer-processing applications where durability and process consistency are critical.

CoorsTek (private company)

The US-based CoorsTek is one of the leading non-Japanese suppliers of advanced ceramic solutions for semiconductor manufacturing. The company focuses on high-performance ceramic materials and components, including electrostatic chucks used in selected semiconductor applications. While its overall semiconductor market share is smaller than the leading Japanese suppliers, CoorsTek remains an important participant in advanced ceramic technologies and specialty semiconductor components.

CeramTec (private company)

CeramTec is one of the world's leading advanced ceramics companies from Germany and a key supplier of high-performance ceramic components for semiconductor manufacturing equipment. The company possesses deep expertise in alumina,

aluminum nitride (AlN) and other engineered ceramic materials that serve as the foundation for high-end electrostatic chuck technologies. Leveraging decades of experience in advanced ceramics, CeramTec has established strong capabilities in thermal management, dielectric materials and precision ceramic manufacturing. While its semiconductor exposure is smaller than that of Kyocera or NGK, the company remains an important participant within the global ESC ecosystem and is recognized for its materials-science expertise and high-performance ceramic solutions.

InVax (private company)

InVax is a specialized supplier of electrostatic chucks and ceramic process components serving semiconductor manufacturing applications. The company focuses on plasma-facing ceramic technologies and has established positions in selected etch and deposition applications. While its scale remains significantly smaller than the leading suppliers, InVax represents an important niche participant within the global ESC market.

Calitech (6532.TT, not covered)

Calitech is a supplier of advanced ceramic components for semiconductor equipment, including electrostatic chucks and related thermal-management products. The company primarily serves selected semiconductor process applications and benefits from expertise in ceramic-material processing and precision manufacturing. Calitech remains a smaller participant focused on niche opportunities within the semiconductor ceramics market.

Leading Local Vendors

KemaTek (301611.CH, not covered)

KemaTek is widely regarded as one of China's leading domestic ESC suppliers and is among the companies furthest along in the localization process. The company focuses on semiconductor-grade electrostatic chucks and related ceramic technologies, targeting applications in etch, deposition and other plasma-based process equipment.

A key strength of KemaTek lies in its emphasis on advanced ceramic materials and process integration. The company has invested heavily in areas such as ceramic formulation, embedded electrode design and thermal management, which are among the most critical technologies determining ESC performance. Compared with many emerging competitors, KemaTek has achieved broader customer engagement and accumulated meaningful qualification experience within domestic semiconductor equipment programs.

From a commercialization perspective, the company has benefited from increasing localization demand and growing willingness among Chinese equipment makers to evaluate domestic alternatives. While gaps remain relative to leading Japanese suppliers in the most demanding applications, KemaTek is generally viewed as one of the domestic players best positioned to capture future import-substitution opportunities in the ESC market.

Junyuan Electronics (private company)

Junyuan is one of the emerging domestic suppliers targeting semiconductor electrostatic chuck technologies. The company focuses on high-performance ceramic process components and has gradually expanded its presence within China's semiconductor equipment ecosystem.

The company's development strategy emphasizes customer qualification and product reliability rather than aggressive market-share expansion. Given the critical role ESCs play in determining process performance, Junyuan has devoted significant resources to improving ceramic material quality, thermal uniformity and long-term product stability. These areas remain among the most important qualification criteria for semiconductor equipment manufacturers.

Although commercialization remains at an earlier stage compared with international leaders, Junyuan has increasingly participated in localization programs across domestic equipment makers. As qualification data accumulates and process validation expands, the company could benefit from growing demand for localized ESC solutions within China's semiconductor supply chain.

SeaTools (private company)

SeaTools is another domestic participant in China's ESC localization effort and focuses on advanced ceramic technologies and semiconductor process components. The company is positioning itself as a localized supplier capable of supporting China's expanding semiconductor equipment industry.

A notable characteristic of SeaTools is its focus on engineering collaboration with equipment manufacturers during product development and qualification. Because ESC performance is closely linked to chamber design and process conditions, customer-specific optimization is often required to achieve commercial deployment. This makes technical support and application engineering important competitive factors in addition to product performance itself.

While the company's current scale remains relatively modest, SeaTools has continued to expand participation in domestic qualification programs and strengthen its capabilities in ceramic manufacturing and thermal management technologies. Its long-term growth opportunity is closely tied to the pace of ESC localization across Chinese semiconductor equipment platforms.

Xinna (private company)

Xinna is an emerging supplier of semiconductor ceramic components and electrostatic chuck technologies. The company is focused on serving the growing demand for localized semiconductor subsystems and has been actively pursuing qualification opportunities with domestic equipment manufacturers.

Compared with more established competitors, Xinna remains at an earlier stage of commercialization. As a result, customer validation, reliability testing and installed-base expansion remain the primary drivers of its development. The company's efforts are concentrated on improving ceramic-material performance, manufacturing consistency and process compatibility, all of which are critical factors for semiconductor ESC applications. Although meaningful scale may still require time to achieve, Xinna reflects the broader expansion of China's domestic ESC ecosystem and the growing number of companies attempting to penetrate one of the highest-barrier component categories within the WFE industry.

OTHER SCMS

While this report focuses primarily on several high-value and low-localization component categories, a broad range of other components are also essential to semiconductor equipment performance and supply-chain resilience. These products span vacuum systems, process chambers, fluid delivery, thermal management and consumable components, collectively accounting for a meaningful portion of equipment bill-of-materials costs. Compared with RF power systems, ESCs and MFCs, many of these categories have already achieved relatively high levels of localization and therefore offer smaller import-substitution opportunities. Nevertheless, they remain important enablers of China's semiconductor equipment industry and continue to benefit from domestic equipment growth.

Quartz Components

Quartz components are widely used throughout WFE products, particularly in etch and deposition chambers where high purity, thermal stability and plasma resistance are required. Typical products include quartz rings, quartz liners, showerheads, windows and process tubes.

Compared with many other semiconductor components, quartz has been one of the earliest successful localization stories in China. Domestic suppliers, such as **Feilihua (300395.CH, not covered)**, have accumulated years of manufacturing experience and have largely established competitive positions across mainstream process applications. Localization rates are already relatively high among leading domestic equipment manufacturers, and future growth is increasingly tied to wafer-fab-equipment demand rather than incremental import substitution. As a result, quartz represents a useful example of China's first phase of localization, where manufacturing capabilities and process know-how have largely converged with international standards.

Advanced Ceramic Components

Beyond ESCs, semiconductor equipment relies on a variety of advanced ceramic components, including focus rings, ceramic rings, showerheads, ceramic heaters and insulating components. These products operate in harsh plasma environments and require exceptional thermal stability, dielectric performance and contamination control.

Advanced ceramics remain one of the more technologically demanding areas within the semiconductor equipment supply chain, as product performance depends heavily on material science, ceramic formulation and precision manufacturing capabilities. Domestic suppliers including **KemaTek (301611.CH, not covered)** and **Three-Circle (300408.CH, not covered)** have achieved meaningful penetration in selected ceramic consumables and structural ceramic applications.

Nevertheless, the high-end segment continues to be dominated by Japanese suppliers including Kyocera (6971.JP, not covered), NGK (5333.JP, not covered), and Maruwa (5344.JP, not covered). Going forward, continued progress in semiconductor ceramics is expected to play an important role in supporting localization across multiple component categories, particularly ESCs and advanced thermal-management systems.

Chambers, Process Kits and Precision Machined Parts

Process chambers and related precision-machined components form the physical foundation of semiconductor equipment. Products in this category include chamber assemblies, liners, shields, baffles and various process kit components that are routinely replaced throughout the equipment lifecycle.

Unlike RF systems or vacuum pumps, the primary barriers in this segment are precision manufacturing, contamination control and process consistency rather than advanced electronics or materials science. China's machining ecosystem and supply-chain infrastructure have enabled domestic companies such as **Fortune Precision (688409.CH, not covered)**, **Sprint Precision (688605.CH, not covered)**, **Huaya Intelligent (003043.CH, not covered)** and **Konfoong Materials (300666.CH, not covered)** to make substantial progress in these areas, resulting in relatively high localization rates among leading equipment manufacturers.

Many domestic suppliers have evolved beyond simple machining services and increasingly participate in higher-value subsystem manufacturing, chamber assemblies and integrated modules. Consequently, this segment has become one of the most mature areas of China's semiconductor equipment component industry and is increasingly driven by WFE demand growth

rather than incremental import substitution.

Gas Delivery and Fluid Management Components

Semiconductor manufacturing requires precise delivery of specialty gases and chemicals throughout the production process. In addition to MFCs and vacuum valves, gas delivery systems consist of ultra-high-purity fittings, regulators, tubing, manifolds and gas panels that collectively ensure stable gas transport and contamination-free operation.

Although individual components often have lower technical barriers than MFCs, reliability and cleanliness requirements remain exceptionally demanding due to direct interaction with process gases. Domestic suppliers including **Kinglai (300260.CH, not covered)**, **Gentech (688596.CH, not covered)**, **Compart Systems (private)** and **Fortune Precision (688409.CH, not covered)** have made meaningful progress over the past decade and have significantly expanded participation across semiconductor gas-delivery infrastructure.

In many cases, localization rates for these supporting fluid-management components are already substantially higher than those observed in MFCs or other process-control devices. As a result, future growth is expected to be driven mainly by capacity expansion of domestic fabs and equipment manufacturers rather than further import substitution.

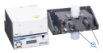
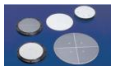
Thermal Management Components

Temperature control has become increasingly important as semiconductor manufacturing processes grow more complex. Equipment therefore incorporates a variety of thermal-management components, including ceramic heaters, heated pedestals, chillers, temperature-control units (TCUs) and thermal interface materials.

These products directly influence process uniformity and repeatability, particularly in deposition, advanced packaging and plasma-processing applications. Domestic suppliers such as **Beijing Jingyi (688652.CH, not covered)** and **Tongfei Refrigeration (300990.CH, not covered)** have established meaningful positions in thermal-management systems and have benefited from growing demand from domestic semiconductor equipment manufacturers.

While localization rates vary by product category, domestic suppliers have generally made faster progress in thermal-management components than in RF or ESC technologies. Continued development in this area remains important as advanced-node manufacturing places greater emphasis on precise thermal control and temperature uniformity.

EXHIBIT 20: **The glossary of semiconductor subsystems, components, and modules (SCM)**

Subsystems	Components/Parts		Application
Process Monitoring	Gas analyzer		A gas analyzer measures the concentration of gases in a semiconductor manufacturing process to ensure the quality and reliability of the final product.
	Liquid analyzer		A liquid analyzer is used to measure and analyze the chemical composition of liquids used in the semiconductor manufacturing process, including chemical concentration monitors, hydrofluoric acid concentration monitors, etc.
	Particle analyzer		A particle analyzer is used to measure and analyze the size, shape, zeta potential, molecular weight, and distribution of particles in a semiconductor manufacturing process. In particular, the particle size in the CMP slurry plays a critical role in determining the performance of the CMP process.
Power	RF generator		An RF generator is a device that converts AC power into RF high-frequency power. The RF generator helps turn the gas inside the chamber into a special kind of gas called plasma, which is needed in dry etch process during the semiconductor and panel manufacturing.
	RF Match		An RF match is used to match the impedance of the etch chamber to the RF generator in semiconductor manufacturing to prevent damage to the wafers or the RF generator.
Wafer Handling	Vacuum wafer transfer robot		A vacuum wafer transfer robot is used to pick up and move wafers between different stages of the semiconductor manufacturing process. It uses a vacuum suction cup to securely hold and move wafers between processing tools, while a computer system controls its movements to ensure safe and efficient handling.
	Atmospheric wafer transfer robot		An atmospheric mechanical arm is used to pick up and move wafers between different stages of the semiconductor manufacturing process.It works by creating a low-pressure area above the object, which causes the atmospheric pressure to push the object upwards.
Thermal Control	Chillers		Chiller is part of temperature control system, which is to maintain precise temperatures required for the equipment to function optimally. Chillers controls the temperature of heat sources in equipment using temperature-controlled circulating fluid.
Fluid Management	Mass Flow Controller (MFC)		MFC is used to measure and control the flow rate of gas/liquid in a system. It is commonly used in the semiconductor manufacturing process to precisely control the flow of gases used in various processes such as chemical vapor deposition, etching, and ion implantation.
Vacuum	Dry pumps		Dry pumps use non-reactive gases to create a vacuum by compressing and pumping out gas molecules.It is extensively used in the semiconductor manufacturing process to control the flow of gases used in various processes such as chemical vapor deposition, etching, and ion implantation.
	Turbopumps		Turbopumps use high-speed rotating blades to create a vacuum by pushing gas molecules out of the system. They are typically used in high vacuum applications and can achieve very low pressures.
	Cryopumps		Cryopumps use extremely low temperatures to trap and freeze gas molecules, creating a vacuum. They are often used in ultra-high vacuum applications and can achieve even lower pressures than turbopumps.
	Vacuum valve		A vacuum valve is used in a vacuum system to isolate vacuum areas or control gas volumes. It can be operated manually, pneumatically, electropneumatically, electrically or electromagnetically. Vacuum valves are essential components of vacuum systems used in various industrial production applications.
	Vacuum gauge		Vacuum gauges is used in a vacuum system to provide key information that is used to trigger different actions in a process sequence.
Optical	Lithographic lenses		Lithography lenses are used to focus light onto a photosensitive material, such as a photoresist, to create a pattern on a semiconductor wafer. They are designed to have a high numerical aperture (NA) and a low distortion, which allows for the creation of smaller and more precise patterns on the wafer. There are various types of lithography lenses used in semiconductor manufacturing, including projection lenses, reduction lenses, and imaging lenses.
	Light sources		Lithography light sources are high-intensity light sources used in the lithography process to expose a photosensitive material and create a pattern on a semiconductor wafer. They produce light in the ultraviolet or deep ultraviolet range and are passed through a series of optical components to shape and direct the light onto the wafer. The choice of lithography light source depends on the specific requirements of the lithography process, such as the desired resolution, throughput, and cost. Lithography light sources are an essential component of the lithography process, as they play a critical role in determining the resolution and accuracy of the final product.
Other	Electrostatic Chuck (ESC)		ESC uses electrostatic attraction to hold a semiconductor wafer in place during processing, eliminating the need for mechanical clamps or vacuum suction. It consists of a metal plate with an insulating layer and electrodes that create an electrostatic field to hold the wafer securely. ESC technology offers advantages such as improved process uniformity, reduced particle contamination, and increased throughput, and is commonly used in processes such as etching, deposition, and ion implantation.
	Ceramic components		Ceramic semiconductor components are electronic components made of ceramic materials that are designed to withstand high temperatures, high voltages, and harsh chemical environments. They are used in the manufacturing of semiconductor devices as insulators, substrates, and packaging materials. Examples of ceramic semiconductor components include ceramic substrates, capacitors, resistors, insulators, and ESC, which are made of materials such as alumina, zirconia, and silicon nitride.
	Metal components		Metal components include various metal parts and structures, which can include reaction chambers, transfer chambers, plates, trays, bases, and other metal parts that are essential for the proper functioning of semicap (picture shown is a gas distribution plate).
	Quartz components		Quartz products are key consumables and can be used in key processes such as diffusion, oxidation, deposition, photolithography, dry etch, and cleaning. Quartz glass products used in semiconductors have excellent characteristics such as high purity, no pollution, and high temperature resistance.

Source: EQ Global, Semi Group, Horiba, Hirata, LairdThermal, Edwards, Robots & Design, CryoSciences, VAT, MKS, Demcon, Intel, St. Cera, Feilihua, eBay, Bernstein analysis

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VALUATION METHODOLOGY

Advanced Micro-Fabrication Equipment Inc China

We value AMEC at a PT of CNY 660 with 39x Price to EPS multiple, based on our estimate of 2028 earnings per share of RMB 16.89.

NAURA Technology Group Co Ltd

We value NAURA at a PT of CNY1,380 with 32x Price to EPS multiple, based on our 2028 earnings per share of RMB 43.56.

Piotech Inc

We value Piotech at a PT of CNY 1,200 with 36x Price to EPS multiple, based on our estimate of 2028 EPS of RMB 33.74.

RISKS

Advanced Micro-Fabrication Equipment Inc China

Downside risks:

- Worse-than-expected MOCVD revenue decline due to sluggish LED equipment demand.
- The capital expenditure for fabs in China did not meet the expected targets.
- Slower-than-expected domestic equipment localization progress due to unforeseen technical difficulties in specific manufacturing processes or production capacity bottlenecks of domestic equipment manufacturers.

NAURA Technology Group Co Ltd

Downside risks:

- Prolonged down cycles in LED and photovoltaic (PV) industries could negatively impact NAURA's non-Wafer Fab Equipment and electronic components businesses.
- The capital expenditure for fabs in China did not meet the expected targets.
- Slower-than-expected domestic equipment localization progress due to unforeseen technical difficulties in specific manufacturing processes or production capacity bottlenecks of domestic equipment manufacturers

Piotech Inc

Downside risks:

- Unexpected order losses from key clients due to over-reliance on a few large clients.
- The capital expenditure for fabs in China did not meet the expected targets.
- Slower-than-expected domestic equipment localization progress due to unforeseen technical difficulties in certain manufacturing processes or production capacity bottlenecks of domestic equipment manufacturers

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The Autonomous brand rates common stocks as indicated below. As our benchmarks we use the Bloomberg Europe 600 Financials Price Return Index (E600BK) and Bloomberg Europe Dev Mkt Financials Large and Mid Cap Price Ret Index EUR (EDMFI) index for developed European banks and Payments, the Bloomberg Europe 600 Insurance Price Return Index (E600IN) for European insurers, the S&P 500 and S&P Financials for US banks and Payments coverage, S5LIFE for US Insurance, the S&P Insurance Select Industry (SPSIINS) for US Non-Life Insurers coverage, the Bloomberg Emerging Markets Financials Large, Mid and Small Cap Price Return Index (EMLSF) for emerging market banks and insurers and Payments, and the Bloomberg Japan Financials Large & Mid Cap Price Return Index (JPFILM) for Japanese Financials. Ratings are stated relative to the sector (not the market).

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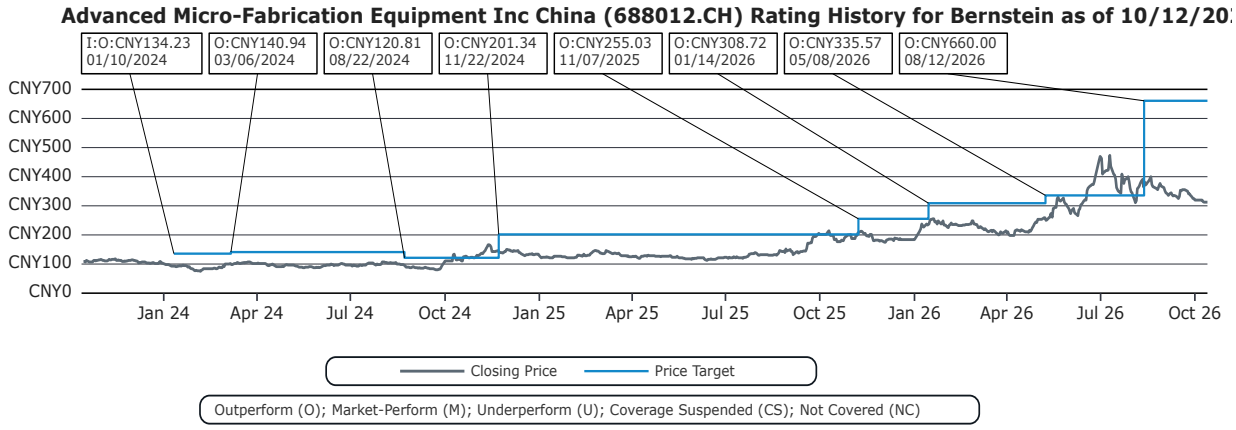
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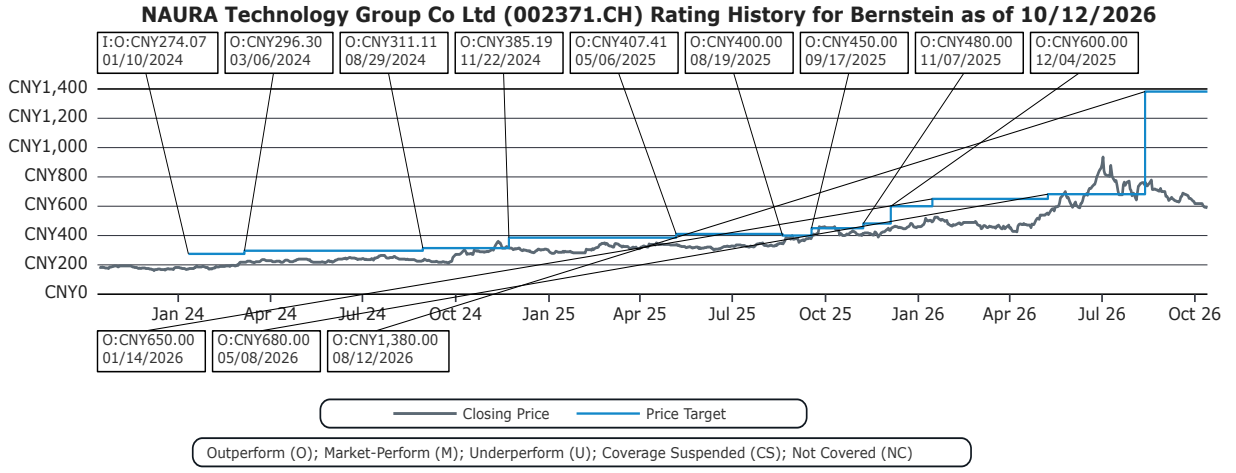
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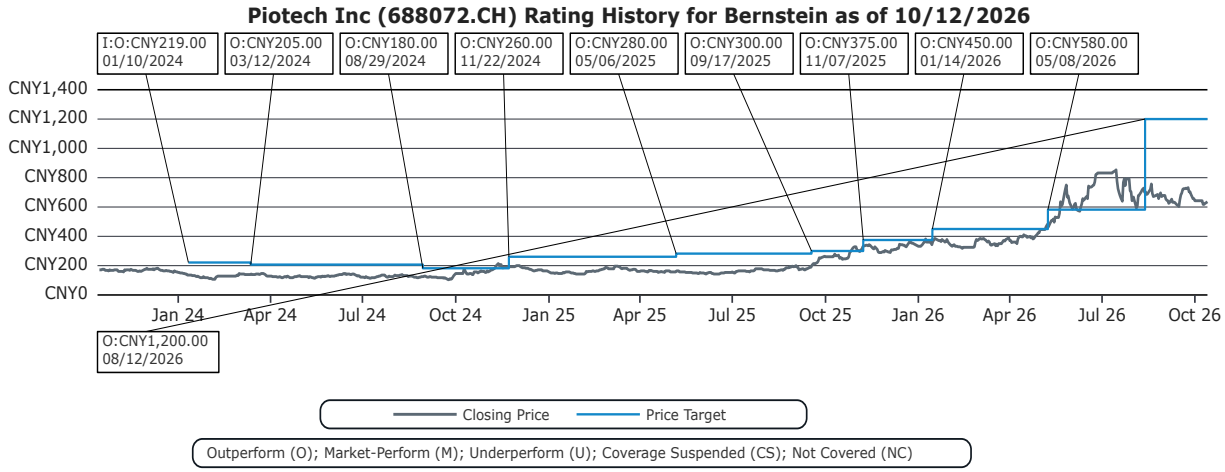
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