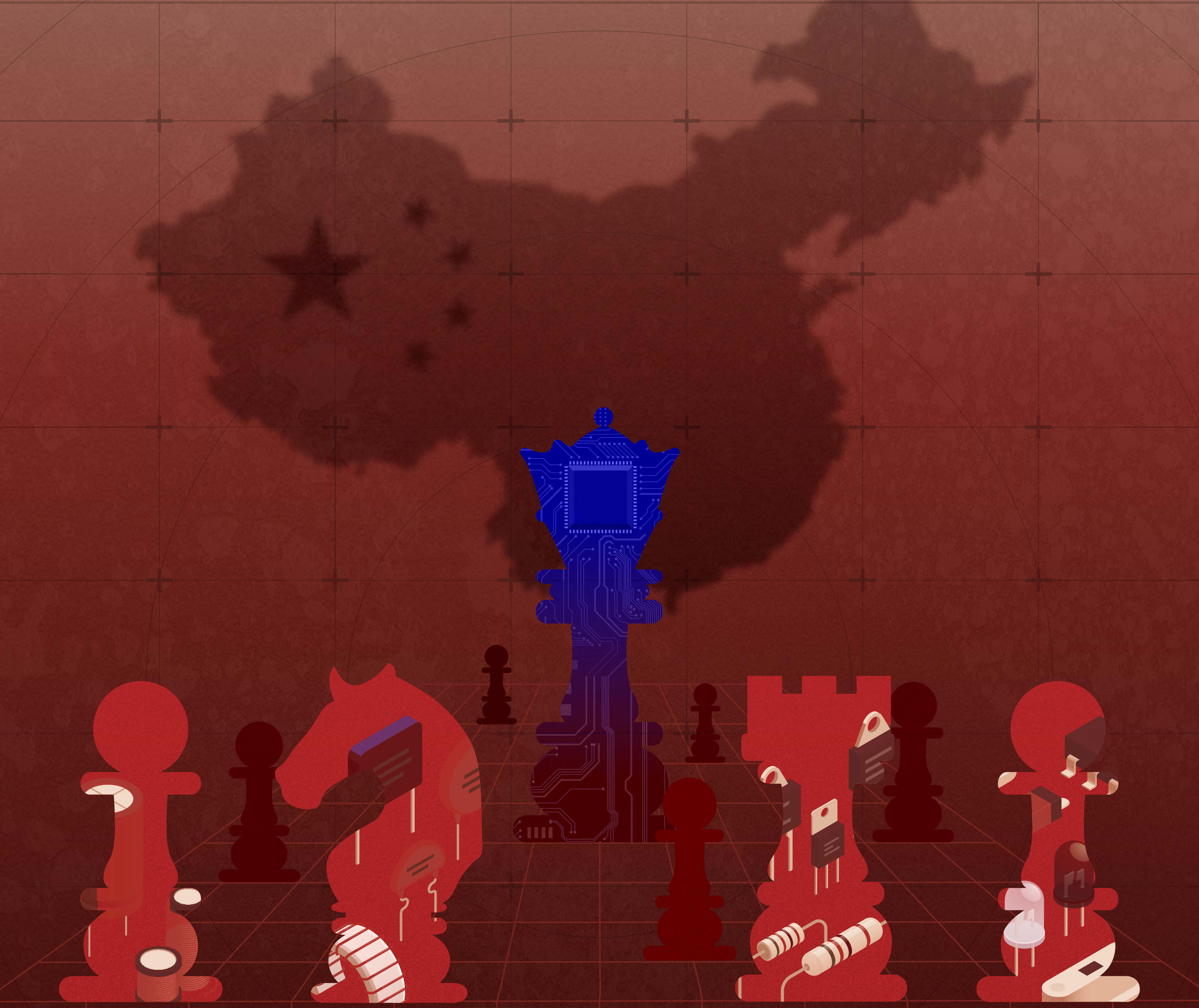
Research Institute for Democracy, Society, and Emerging Technology

Economic Security



The Great Siege

The PRC's Comprehensive Strategy to Dominate Foundational Chips

Research Institute for Democracy, Society, and Emerging Technology (DSET)

Founded in October 2023 by Taiwan's National Science and Technology Council (NSTC), the Research Institute for Democracy, Society, and Emerging Technology (DSET) is Taiwan's first national think tank focused on the intersection of democracy, technology, and public policy. DSET places democratic values at the core of its mission and addresses emerging global challenges through evidence-based research and strategic analysis.

DSET's research focuses on four key areas: Economic Security, Democratic Governance, Climate Resilience and Sustainability, and National Security. It also operates a Non-Resident Fellow program that engages Taiwanese scholars and graduate students based in the United States, Europe, Japan, and other like-minded countries. Through policy research, international dialogue, and Track 1.5 diplomacy, DSET provides strategic recommendations to the public and government, strengthens Taiwan's global engagement, and promotes democratic, future-oriented approaches to technology governance.

Economic Security Research Program

The Economic Security Research Program focuses on Taiwan's economic security reforms and the emerging challenges of international multilateral cooperation. Taiwan's advanced wafer manufacturing capabilities form a critical foundation for maintaining order and security among techno-democracies. As global technological advancements accelerate, Taiwan's semiconductor industry remains a key driver. However, China's pursuit of technological hegemony poses comprehensive threats, making institutional reforms essential not only for Taiwan's survival but also for the broader interests of the international community.

Amid ongoing global supply chain restructuring, Taiwan faces urgent questions about its strategic positioning. How can it adapt to these shifts and work with allies to consolidate shared economic and security interests? In the era of techno-geopolitics, this research program offers policy reports and expert analysis to foster dialogue, inform decision-making, and help shape international consensus.

Disclaimer

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Contents

Part II

Case Studies – How the PRC's State-Driven Model Undermines U.S. and Allies Industries

Part III

List of Tables

List of Figures

Parallel Texts

English	Abbreviation	Mandarin
Powerchip Semiconductor Manufacturing Corporation	PSMC	力積電
chip		芯
display panel		屏
automotive		汽
BOE Technology	BOE	京東方
Novatek Microelectronics	Novatek	聯詠科技
Nexchip Semiconductor Corporation	Nexchip	晶合集成
Powerchip	Powerchip	力晶創新投控
Chip-Display-Auto Integration		芯屏汽合
ChangXin Memory Technologies		長鑫存儲
Concentrated Efforts for Innovation		集中生智
Wanxin Semiconductor		皖芯集成
National Silicon Industry Group	National Silicon	滬硅產業
Zhejiang MTCN Technology	MTCN	中晶科技
Wafer Works (Shanghai)	Wafer Works (Shanghai)	上海合晶
Taiwan-based Wafer Works	Wafer Works	合晶科技
Chiu Tzu-Yin	Chiu Tzu-Yin	邱慈雲
GlobalWafers	GlobalWafers	環球晶
Formosa Sumco Technology Corporation	Sumco Tech	台勝科
SICC	SICC	天岳先進
SICC	TanKeBlue	天科合達
SICC	Chiu Poshun	邱柏順

Introduction

Foundational semiconductor chips, produced primarily using mature-node technologies, are a cornerstone of modern technological infrastructure. Unlike cutting-edge chips—typically associated with advanced processes of 14/16nm and below—foundational chips serve as essential components across a wide array of industries. These semiconductors are embedded in devices ranging from automobiles and home appliances to industrial machinery, telecommunications equipment, and critical defense systems. Their versatility and reliability make them indispensable not only to consumer markets but also to sectors where performance under extreme conditions is paramount, such as aerospace and military applications. According to estimates, foundational chips account for 95% of the global semiconductor market and are integral to 99.5% of the mission-critical capabilities of the U.S. Department of Defense, underscoring their strategic and economic importance.[1]

Despite their ubiquity, foundational chips have long been underrepresented in global semiconductor policy discussions and investment agendas. With the rise of artificial intelligence, quantum computing, and high-performance computing, policy focus has centered overwhelmingly on advanced-node chip development. However, foundational chips remain the workhorses of essential infrastructure, enabling critical functions in sensors, power management systems, and memory modules. The global chip shortage during the COVID-19 pandemic exposed the fragility of the foundational chip supply chain and underscored its vital role in economic continuity and national security.

A more pressing challenge has emerged from the rapid expansion of the People's Republic of China (PRC) in foundational chip manufacturing. Backed by industrial subsidies, state-directed investment, and long-term strategic planning, the PRC is aggressively scaling its presence in this sector. Analysts project that PRC-based firms may account for nearly half of the world's new mature-node manufacturing capacity within the next decade. This trajectory presents a growing risk to the United States, Taiwan, and allied nations that rely on stable, diversified, and market-oriented supply chains. The PRC's increasing leverage in this domain could confer coercive influence over strategic industries and further exacerbate geopolitical tensions.

This report is structured in three parts. The first examines the strategic significance of foundational chips, the evolution of U.S. industrial policy to support domestic semiconductor capacity, and the geopolitical implications of the PRC's rising dominance in this space. By analyzing these developments through the combined lens of economics, innovation, and security, we seek to clarify the stakes involved and the structural vulnerabilities facing democratic economies.

The second part presents three case studies that illustrate how the PRC's state-led industrial strategy is reshaping the global competitive landscape in foundational chips:

1. Wafer Manufacturing: Only Chinese Firms Can Profit in China

This case study analyzes Hefei Nexchip, the PRC's third-largest wafer foundry by revenue, was initially established with technical support from Taiwan's Powerchip. Its growth, however, has been primarily driven by sustained support from the Hefei municipal government. This case illustrates how local authorities in the PRC actively foster semiconductor firms through targeted industrial policies—such as financing, infrastructure support, and procurement incentives—to expand domestic manufacturing capacity. By embedding domestically produced wafers into globally exported end products, firms like Nexchip benefit from downstream market advantages, reinforcing upstream supply chains and ultimately squeezing out non-chinese competitors across both domestic and international markets.

2. Silicon Wafer: State-Led Long-Term Investment Despite Losses

This case presents a comparative analysis of three major PRC-based silicon wafer firms: National Silicon, MTCN, and Wafer Works (Shanghai). Among them, only National Silicon has emerged as a viable player—largely because it has been explicitly designated as a national champion by the PRC government. In contrast, despite operating within China, MTCN and Wafer Works continue to incur losses and struggle to gain meaningful market share. This illustrates that success in the PRC's foundational chip ecosystem is not determined by market competition or operational efficiency, but by political selection. The case underscores a key strategic insight: foreign firms, even if willing to enter the Chinese market, cannot compete on equal footing unless they are integrated into the state-backed hierarchy of national champions.

3. Compound Semiconductors: How the PRC's Strategy Is Squeezing Out a U.S. Company

This study focuses on the competitive interaction between PRC-based SICC and U.S.-based Wolfspeed. It explores how state-backed scaling and aggressive industrial planning are enabling Chinese firms to undercut global competitors in emerging compound semiconductor segments.

Our policy recommendations are centered around proposing a **strategic toolkit to counter the PRC's Pseudo-IDM system.** This frame of two main pillars:

1. Strengthening export controls to disrupt the "Red Supply Chain" and reduce the operational efficiency of the PRC's Pseudo-IDM system.

We identify two key approaches to achieve this:

- First, designating photoresists and laser light sources as chokepoint items for export control. These two categories remain essential inputs that the PRC cannot yet domestically produce at the required quality,It explores how state-backed scaling and aggressive industrial planning are enabling Chinese firms to undercut global competitors in emerging compound semiconductor segments.

- Second, systematically targeting the PRC national champions by adding them to the U.S. Entity List. These firms, hand-picked and promoted by the PRC government, serve as pillars of the Pseudo-IDM model. Whenever a new champion emerges, it should be precisely sanctioned to undermine internal market efficiency and neutralize Beijing's industrial intervention.

2. Implementing a market denial strategy.

This begins with transparency measures that identify and trace the presence of PRC-origin legacy chips in global supply chains, followed by efforts to gradually extract and remove these "Red Chips" from end products in international markets. Key transparency mechanisms include a **HTS-based import disclosure requirement and mandatory SEC filings.** Market denial, in turn, should begin with core sectors, including:

- **Defense and critical infrastructure**
- **Network-connected chips**, due to cybersecurity risks
- **PRC Military-Civil Fusion champions at the terminal brand level**

Together, these actions aim to reduce global reliance on the PRC's Pseudo-IDM system, starting with the most sensitive and security-critical segments of the supply chain.

Reindustrialization is imperative for the United States—not only to restore its global manufacturing leadership, but also to preserve its ability to act as the "arsenal of democracy" in the face of rising authoritarian challenges. The erosion of U.S. manufacturing over the past 30 to 40 years has created structural vulnerabilities now being exploited by the PRC, whose strategy to dominate the global hardware supply chain threatens to displace the United States as the leading force in both technology and global order.

In this context, Taiwan's globally unique, efficiency-driven technology manufacturing ecosystem is indispensable to America's reindustrialization effort. While rebuilding advanced manufacturing capacity in the U.S. will take time, leveraging the strength and resilience of allied supply chains—especially Taiwan's foundational chip sector—offers a critical head start. Deepening economic interdependence between the U.S. and Taiwan is thus not only in America's national interest but is also essential to Taiwan's security and survival.

Given the accelerating risks and narrowing window of strategic opportunity, urgent policy action is needed. The PRC's Pseudo-IDM model, built through non-market practices and industrial coercion, poses a direct existential threat to semiconductor firms in democratic countries. The next four years will be decisive. Without immediate countermeasures, we risk witnessing the financial collapse and disappearance of key American and Taiwanese semiconductor players—undermining the very foundation of free-market innovation. The window to prevent the PRC from using its growing supply chain leverage to dominate next-generation technologies such as AI is rapidly closing.

Part I

Lack of Global Action, the PRC's National-Scale "Pseudo-IDM," and the New Frontier of Foundational Chips

Global Progress and Challenges Ahead for the Backbone of Critical Industries

Foundational chips, produced using mature-node technologies, are essential to industries that require reliability, durability, and cost-efficiency. These semiconductors power automotive electronics, telecommunications, factory automation, and consumer appliances.

In the automotive sector, foundational chips control engine management, braking systems, and airbag deployment. As vehicles integrate electrification and advanced driver-assistance systems (ADAS), demand for automotive-grade foundational semiconductors continues to grow. These chips must withstand extreme temperatures, moisture, and vibration, making them distinct from high-performance consumer electronics chips.

Telecommunications infrastructure also relies heavily on foundational chips, which support 5G base stations, signal processors, and power amplifiers. In factory automation, these chips enable process control, robotics, and data acquisition. Consumer electronics, from washing machines to refrigerators, depend on foundational chips for cost-effective, reliable embedded control systems.

Beyond commercial use, foundational chips are critical for aerospace and defense. Radiation-hardened semiconductors, a specialized subset, are indispensable in satellites, spacecraft, and missile guidance systems. These chips are engineered to endure high radiation levels and extreme environments, ensuring operational integrity in national security and space exploration. The U.S. Department of Defense estimates that 99.5% of its mission-critical systems depend on foundational chips, highlighting their strategic importance.

Although often labeled as "outdated" due to larger node sizes, foundational chips continue to evolve. Advances in lithography and materials engineering have enhanced performance, energy efficiency, and reliability. Silicon carbide (SiC) and gallium nitride (GaN) technologies now enable foundational chips to support emerging applications such as electric vehicles (EVs) and renewable energy systems. These developments reinforce their role in addressing climate change and energy efficiency challenges.

COVID-19: Supply Chain Crisis

The COVID-19 pandemic exposed vulnerabilities in the foundational chip supply chain. A surge in electronics demand and global logistics disruptions led to acute shortages of automotive-grade semiconductors. Automakers halted production lines, delaying millions of vehicles and causing ripple effects across industries.

The automotive industry, where an average vehicle contains over 1,700 semiconductor chips, was hit particularly hard. These include microcontrollers for managing engines, transmissions, and seats; power management chips for ADAS systems; display driver ICs for in-car screens; sensor chips for driver-assistance systems; and Wi-Fi and Bluetooth chips for communication functions. Automakers initially cut orders, anticipating lower demand. Instead, consumer electronics surged, absorbing the limited chip supply. By mid-2022, North American automakers had cut over 4.3 million vehicles from production due to chip shortages.[2]

The medical device sector also suffered. Mature-node chips power ventilators, diagnostic machines, and monitoring systems. Shortages delayed life-saving equipment production, underscoring the broad societal impact of supply chain disruptions. Even consumer electronics giants like Apple scaled back production due to shortages of foundational chips, despite their low cost.

These examples demonstrate that foundational chips, while less glamorous than cutting-edge semiconductors, are indispensable. Their widespread use across industries necessitates continued investment, innovation, and strategic policymaking to ensure supply chain resilience and global stability.

U.S. Policy Debate on China's Foundational Chip Dominance: Risks, Responses, and Industry Perspectives

The ongoing expansion of China's foundational semiconductor manufacturing capacity has catalyzed a strategic policy debate in the United States. Industry experts, government officials, and nonprofit representatives have increasingly voiced concern over the risks posed by China's dominance in foundational semiconductor technologies—chips that, while based on mature nodes, remain vital across industries from automotive and energy to defense and consumer electronics. This literature review synthesizes diverse perspectives from recent policy hearings and public commentary, focusing on the implications of China's market strategy, the potential fallout of U.S. policy responses, and the broader global stakes.

I. China's Foundational Chip Strategy and Its Global Reach

There is a broad consensus among U.S. stakeholders that China's state-backed expansion into the foundational semiconductor segment is part of a long-term industrial strategy. This approach, often characterized as "non-market" in nature, involves massive subsidies, strategic patent accumulation, and overcapacity that floods global markets with low-cost chips. Lawmakers argue that this has already led to significant price collapses in areas such as silicon carbide substrates and threatens to crowd out foreign competitors. As Rep. John Moolenaar, (Chairman of the House Select Committee on the CCP) warned, the PRC is flooding global markets with low-cost foundational semiconductors, facilitated by billions in government subsidies and a long-term commitment to supply chain domination.[3] This approach is seen not merely as economic competition but as a form of "state-sponsored economic warfare," with existential implications for U.S. technological leadership, defense readiness, and economic sovereignty.

This market dominance is viewed not only as an economic issue but as a potential national security risk. Foundational semiconductors power critical systems ranging from missile guidance to communications infrastructure and electric vehicles. Some national security analysts have emphasized that this level of supply chain dependency on an authoritarian state could expose the U.S. and its allies to vulnerabilities in times of crisis.

II. Industry Caution: Economic Impacts and Strategic Tradeoffs

Despite widespread concern over China’s approach, there is considerable divergence among stakeholders on how the U.S. should respond. Industry representatives have cautioned that broad punitive measures, particularly tariffs, may backfire by increasing the cost of consumer technology products and disrupting carefully calibrated global supply chains.

Some experts from the technology and manufacturing sectors have noted that foundational chips are deeply embedded in a wide range of industries. Actions taken without a clear, narrow definition of national security risk could inadvertently impact sectors unrelated to defense or critical infrastructure. According to Consumer Technology Association (CTA) research, 55% of industry experts believe tariffs would raise retail prices, while 72% reported that their firms would continue sourcing foundational semiconductors from China due to quality, performance, and reliability factors. These stakeholders recommend a more risk-based, strategic policy framework that avoids collateral damage to U.S. competitiveness.

In addition, industry voices have stressed the need for careful coordination with private sector supply chains. Businesses—not governments—operate these global networks, and any disruptive measures could hinder innovation, slow production, and hurt downstream industries, particularly small and medium-sized manufacturers.

III. Challenges of Reshoring and Transitioning Supply Chains

Some U.S.-based companies with a significant footprint in Asia, particularly in China and Korea, have expressed support for U.S. efforts to rebuild domestic semiconductor capacity. However, they have underscored the complexity and time required to reshore production. Transitioning specialized manufacturing operations and meeting “Copy Exactly” standards demanded by semiconductor customers often requires years of planning, investment, and workforce development.

These companies argue that near-term trade restrictions, if applied without exemptions or grace periods, could disrupt ongoing reshoring efforts and even undermine U.S. domestic semiconductor manufacturing goals. They recommend transitional support and policy flexibility to maintain operations while scaling up U.S. capacity.

IV. Downstream Industry Implications and Supply Chain Fragility

Industries that rely heavily on foundational chips—such as the electrical, automotive, and industrial equipment sectors—have warned that any disruption in supply could severely affect domestic production. Stakeholders from these sectors have pointed out that foundational semiconductors are present in tens of millions of American-manufactured goods and remain essential for economic growth, energy infrastructure, and electrification goals.

Some of these industry voices have explicitly opposed the initiation of trade actions, including investigations or tariff proposals, warning that such steps could lead to shortages or increased costs. Instead, they advocate for deeper collaboration with the U.S. government, better traceability tools for supply chains, and a focus on certification and compliance mechanisms to reduce dependency on Chinese-origin components.

V. Divergent Approaches: Aggressive Action vs. Strategic Patience

On the more hawkish end of the spectrum, national security advocates have called for immediate and forceful action, including targeted tariffs on foundational chips fabricated in China—whether sold directly or embedded within finished products imported into the U.S. These advocates argue that unilateral action may be necessary to prevent market distortion and industrial erosion in critical technologies.[4] They also emphasize that foundational chip production should not be excluded from export controls, noting that the foundational nature of these chips makes them just as essential to national defense and infrastructure as advanced semiconductors.

On the other hand, many in the private sector caution that reactive, broad-based trade restrictions may create unintended economic harm and do little to alter China's long-term strategic behavior. They advocate instead for a multilateral approach—working closely with allied nations to build alternative supply chains, align regulatory responses, and pool investment into strategic R&D.

Current U.S. CHIPS Policies

The CHIPS and Science Act of 2022 aims to revitalize U.S. semiconductor manufacturing, allocating $52 billion for domestic chip production, research, and workforce development. This legislation addresses decades of offshoring that have left the U.S. vulnerable to supply chain disruptions.

Of this funding, $2 billion is dedicated to foundational chip technologies, recognizing their irreplaceable role in automotive, telecommunications, and defense. This investment seeks to strengthen the foundational chip supply chain, mitigating risks posed by overreliance on foreign sources, particularly China.

The CHIPS Act offers financial incentives to attract private investment in U.S. chip fabs. These include grants, subsidies, and tax credits, such as the 25% advanced manufacturing investment tax credit for both foundational and advanced chips. Since its passage, billions in new investments have been announced for fabs in Arizona, Texas, and Ohio. Intel is investing $20 billion in two Ohio fabs, while TSMC and Samsung plan to produce both advanced and mature-node chips in the U.S.

The Act also prioritizes workforce development. The semiconductor industry faces a severe skilled labor shortage. Resources are being allocated to train engineers, technicians, and specialists, with universities and technical colleges creating talent pipelines to support industry growth.

Beyond financial incentives, the U.S. is leveraging trade policies and international partnerships to counteract China's dominance in foundational chip production.

- Section 5949 of the National Defense Authorization Act (NDAA) bans the procurement of products containing Chinese semiconductors starting in 2027. This directly targets SMIC and Hua Hong Group, which have expanded mature-node production with state subsidies.
- Tariffs on Chinese semiconductors are increasing from 25% to 50% by 2025, aiming to level the playing field for domestic manufacturers and counteract China's state-driven overproduction and price suppression.

Allied Collaboration

Recognizing that semiconductor supply chains are global, the U.S. is strengthening partnerships with allies to reduce reliance on China. Such partnerships not only enhance supply chain resilience but also ensure that advancements in semiconductor technology are aligned with democratic values and shared strategic interests.

- Friendshoring/reshoring initiatives relocate chip production to geopolitically aligned nations, fostering mutual economic growth.
- Japan and the U.S. are co-developing next-generation semiconductor technologies.
- The U.S. and India will jointly establish their first national security chip plant to supply military hardware and critical telecom systems.[5]
- The U.S.-EU Trade and Technology Council (TTC) promotes market intelligence sharing, export control coordination, and joint R&D investments.[6]

The Overlooked Importance

A persistent gap in U.S. policy is the underestimation of foundational semiconductors. Policymakers focus heavily on advanced chips for AI, high-performance computing, and quantum computing, while neglecting foundational chips that power critical industries. Unlike leading-edge chips, which drive innovation, foundational chips sustain key sectors such as 5G infrastructure, EVs, and defense systems. Many policymakers dismiss China's dominance in this area as a minor issue since these chips contribute less to the overall semiconductor market value. However, this overlooks the long-term risks of China's expanding control.

As China increases its mature-node capacity, it gains leverage over global semiconductor equipment suppliers like ASML, Applied Materials, and Tokyo Electron. With its dominance as a buyer, China could pressure these firms to prioritize its needs, reinforcing its strategic advantage. If left unchecked, this could allow China to not only control foundational chip markets but also accelerate its advancements in AI, telecommunications, and defense.

Beyond economic concerns, China's foundational chip strategy has significant geopolitical implications. These semiconductors are central to China's Military-Civil Fusion (MCF) strategy, which integrates civilian technology into military applications. Reliable and durable foundational chips are critical for radar, satellite communications, and avionics. By dominating both production and innovation, China enhances its military capabilities and creates a potential chokepoint for nations reliant on these components for defense and critical infrastructure. Adding to the complexity, foundational chips are far from "low-tech." Their durability, reliability, and cost-efficiency make them essential for industries requiring rugged and affordable solutions.

- Automotive applications depend on foundational chips for EV powertrains, ADAS, and battery management.
- Telecommunications infrastructure relies on mature nodes for 5G base stations, IoT devices, and mid-tier smartphones.
- Defense and aerospace require them for radar systems, missile guidance, and space technologies.

China's ability to innovate and adapt foundational chips for emerging industries strengthens its long-term economic and strategic position, boosting competitiveness across multiple sectors. Despite these risks, U.S. policy has yet to adequately address China's dominance in foundational chips, reflecting a critical blind spot. Current export controls focus on restricting advanced semiconductors while overlooking the challenge posed by China's expansion in mature-node technologies. This policy gap creates vulnerabilities in industries that depend on these chips, exposing the U.S. to economic and strategic risks.

A deeper understanding of China's foundational chip ecosystem is essential. Chinese firms have built an integrated supply chain, extending from foundries to end-product manufacturing, reinforcing their dominance in domestic and global markets. Mapping these stakeholders will allow policymakers to assess the scale of China's influence and develop countermeasures. The underestimation of foundational chips represents a critical failure in current policy and industry narratives. As China's control over this sector grows, risks to U.S. and allied industries will intensify, extending beyond economic competition to national security and technological leadership.

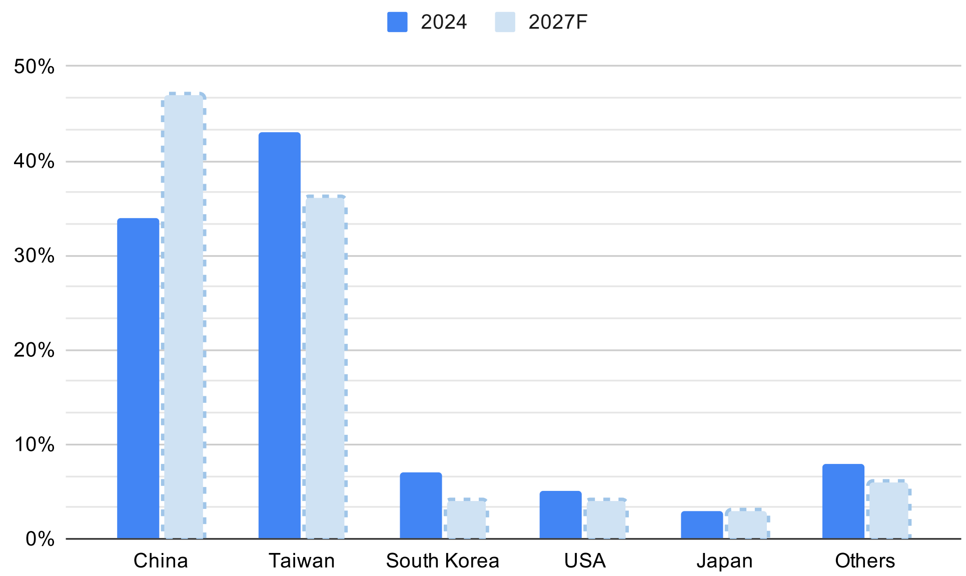
China's Expanding Ambition: A National-Scale "Pseudo-IDM"

China's Grip on Mature Chips Tightens, U.S. Running Out of Time

China's deliberate and aggressive investment in semiconductors, particularly foundational chip production, is reshaping the global industry. In the next 3-5 years, Chinese firms are expected to account for nearly 50% of all new mature-node manufacturing capacity. This growth is driven by massive state subsidies, strategic incentives, and targeted investments.[7] Beijing has allocated over $150 billion to build its semiconductor ecosystem, with a significant portion focused on foundational chip production.[8] This strategy aligns with China's goal of technological self-sufficiency and global competitiveness.

According to Taiwanese market intelligence firm TrendForce, the 28nm process marks the divide between mature and advanced semiconductor manufacturing. In 2023, China held a 34% market share in this segment, while Taiwan led with 43%, and the U.S. trailed at just 5%. By 2027, China's share is projected to rise to 47%, while Taiwan's falls to 36%, and the U.S. stagnates at 4%.[9] (See Figure 1-1) Despite U.S. efforts to revive domestic chip manufacturing through the CHIPS Act, tariffs, and reshoring policies, these initiatives largely overlook foundational semiconductors. Unlike TSMC, which can invest $165 billion more in the U.S. thanks to its financial strength, the cost structure of U.S. manufacturing makes scaling mature-node production even more difficult.

Figure 1-1: Foundational Chip Production Share: 2024 vs. 2027 (Forecast)



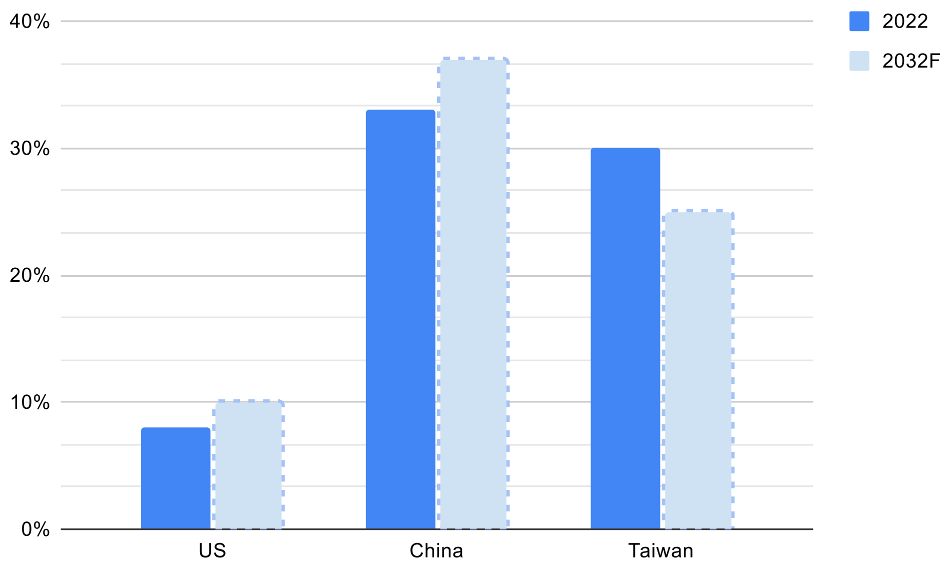
Source: Trendforce

However, the 2021 pandemic, the CHIPS Act prioritized funding for advanced-node manufacturing. The policy rationale likely focused on national security concerns tied to advanced chips. But this overlooks the fact that mature-node chips are also used in critical national security applications—including AI data centers and military drones. At Computex 2023 in Taipei, NVIDIA founder Jensen Huang emphasized the importance of ensuring mature-node chip supply. He noted that even advanced chips rely on thousands of supporting chips manufactured with 90nm or even 0.15-micron processes. Without these mature-node chips, advanced chips alone cannot make systems work.

A May 2024 report by the U.S. Semiconductor Industry Association (SIA) offered a more optimistic view of domestic chip manufacturing than the figures provided by Taiwan's TrendForce. However, compared to China's dominance in mature-node chip supply, there is little reason for optimism. In 2022, the U.S. held just 8% of the global market share for chips made on 28nm and above. By 2032, that is projected to grow only slightly to 10%. China, by contrast, is projected to reach 37%, surpassing Taiwan's 25%. (See Figure 1-2)

In other words, if another pandemic were to strike, the U.S. could once again face severe shortages of automotive chips. Worse still, if the next disruption is caused by war rather than disease, can the U.S. afford to run out of military drones or fail to supply AI data centers in time?

Figure 1-2: Wafer Fabrication Capacity (28nm+): 2022 vs. 2032 (Forecast)



Source: SIA

China's Coordinated Pseudo-IDM Strategy

China's dominance in foundational chip production is driven by state-owned enterprises (SOEs) and government-backed firms like SMIC, Hua Hong Group, and YMTC. These companies use massive state funding to expand capacity and enhance mature-node technologies at 28nm, 40nm, and 130nm. Some have also developed specialized innovations, such as advanced silicon carbide chips, strengthening their role in electric vehicles and renewable energy.

China's subsidy-driven strategy extends beyond chip manufacturing. The country is creating new chokepoints and targeting vulnerabilities across the global semiconductor supply chain. State-backed enterprises operate in multiple key sectors, including IDM, foundries, memory, compound semiconductors, assembly and testing, materials, substrates, and PCBs. Many of these firms receive direct funding from China's "Big Fund," have state capital involvement, or are listed on the U.S. Entity List due to links to China's military modernization efforts. Notably, every Chinese semiconductor firm listed in the table 1-1 competes directly with Taiwanese companies. However, China's subsidies and state intervention distort the market, making it harder for Taiwanese firms to remain profitable. At the same time, developing fully independent and competitive semiconductor industries within the U.S. market remains unrealistic.

Table 1-1: China's "Full-Supply-Chain" Semiconductor Strategy

Type	Company	Products	Background
IDM	YanDong MicroElectronic	Signal Amplifier, RF Power Device	State-Owned Shareholding Ratio: 76.38%
Foundry	SMIC	Wafer Foundry Services	US Entity List
	Nexchip Semi	Wafer Foundry Services	Hefei Govt
Memory	ChangXin Memory	DRAM (DDR4, LPDDR4X, LPDDR5)	US Entity List
	Yangtze Memory	3D NAND	US Entity List
	Giga Device	NOR Flash, Specialty DRAM, MCU	Big Fund
	Dosilicon	Small to Medium Capacity Memory Design	Guided by Government Policy
Compound	Silan	Power Semiconductor, Compound Semiconductor Devices	Big Fund
Assembly & Testing	JCET Group	WLP, SiP, Flip-Chip, Sensor and MEMS Packaging	SMIC network
	TongFu Microelectronics	CPU & GPU Testing	Big Fund
Materials	National Silicon Industry Group	Wafers for 12-Inch Logic and Memory Manufacturing	State-Owned Shareholding Ratio: 61.79%
	Cai Qin Tech	Electronic Ceramic Materials	Government Subsidy
Substrate	Shenzhen Fastprint Circuit Tech	PCB, IC Packaging Substrate, Semiconductor Test Board	Government Subsidy
PCB	Shennan Circuits	PCB, SiP, Flip-Chip Substrate	Big Fund

Sources: Compiled by Authors

Examining China's "Big Fund" investment list reveals the broad scope of its subsidies. Simply put, China aims to build a fully self-sufficient semiconductor ecosystem, eliminating any U.S.-controlled chokepoints in chip technologies. (See Table 1-2)

Table 1-2: "Big Fund" Investment List

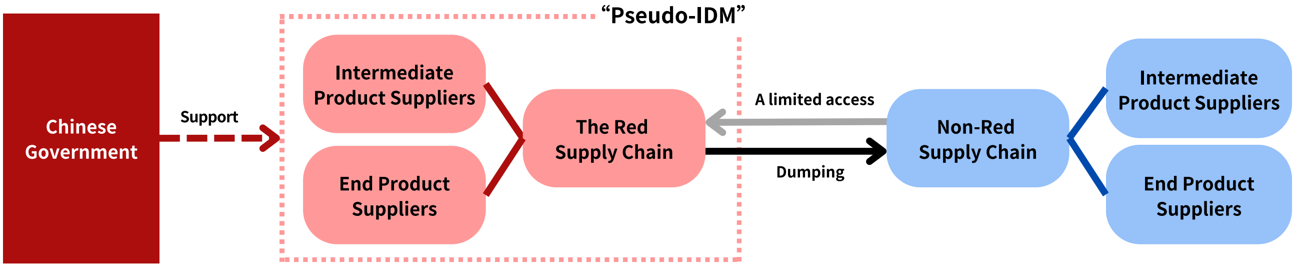
company	Industry	Core Business	State Ownership
EDA & Testing			
Empyrean	EDA	EDA software for IC design & verification	53.58%
Semitronix	EDA Testing	EDA testing & verification services	1.72%
IC Design			
Telink	IC Design	Specializes in low-power Bluetooth chip design & development	11.56%
Smarter Micro	IC Design	Develops wireless connectivity and IoT chips	8.39%
Anlogic	IC Design	FPGA chip design & solutions	51.67%
Goke Micro	IC Design	Provides storage, video, and communication chips	11.34%
C*Core	IC Design	Specializes in embedded security chip development	4.45%
VeriSilicon	IC Design	Provides one-stop ASIC and IP licensing services	21.43%
Rockchip	IC Design	Develops multimedia processing chips and applications	7.57%
Centec	IC Design	Provides network switching chips and solutions	62.84%
Jingjia Micro	IC Design	Focuses on GPU and military electronics chips	9.81%
Integrated Device Manufacturers (IDM)			
YDME	IDM	Semiconductor manufacturing	76.38%
CR Micro	IDM	Power devices & IDM semiconductor manufacturing	76.34%
Silan	IDM	IDM model and covers a wide range of chip products	13.54%
PCB & Materials			
SCC	PCB	High-end PCB design & production	67.88%

National Silicon	Materials	High-purity semiconductor silicon	61.79%
ANJI	Materials	Semiconductor chemical & polishing materials	11.6%
Darbond Tech	Materials	Electronic-grade chemical materials	18.65%
Yoke Tech	Materials	Semiconductor encapsulation & specialty materials	5.98%
Semiconductor Manufacturing, Equipment & Packaging			
SMIC	Foundry	China's largest wafer foundry	28.53%
Huahong	Foundry	Specialty process wafer manufacturing	36.55%
SMEI	Foundry	Specializes in MEMS and wafer foundry services	13.17%
AMEC	Equipment	Semiconductor manufacturing equipment	45.69%
NAURA	Equipment	Semiconductor equipment & technology	52.49%
CCTECH	Equipment	Develops semiconductor testing and manufacturing equipment	9.56%
JCET Group	Packaging	Advanced packaging & system-level packaging	21.78%
Tongfu Microelectronics	Packaging	Semiconductor packaging & testing	17.61%
HT-Tech	Packaging	Semiconductor packaging & testing	31.58%
Memory			
Longsys	Memory	Storage chip solutions	6.18%
BIWIN	Memory Solutions	NAND & DRAM memory solutions	23.29%
Compound Semiconductors			
Chipown	Power Semiconductors	Develops power management and power supply chips	6.51%
Sanan	Compound Semiconductors	Manufactures compound semiconductor materials and chips	3.84%
Other Key Sectors			
BD Star	Satellite Systems	Satellite navigation & positioning solutions	7.58%
CECport	Distribution	Semiconductor component distribution & supply chain	70.13%
Peric	Electronic Specialty Gases	Specialty gases & chemicals for semiconductor production	81.8%

Source: Company financial reports

China aims to transform its semiconductor industry into a national-scale "pseudo-integrated device manufacturer (IDM)." In a traditional IDM model, companies manufacture end-products containing multiple chips and electronic components of various specifications. Applying this analogy to China's industrial strategy, Beijing is not just focused on semiconductor production—it seeks to dominate global markets across a broad range of electronic end-products by controlling their entire supply chains.

Figure 1-3: China's "Pseudo-IDM" Strategy



Source: Made by Authors

To achieve this, the Chinese government intervenes directly at every stage of the supply chain to ensure self-sufficiency in components, production processes, and key suppliers. Through subsidies and state support, China enables domestic manufacturers to sell at artificially low prices, undercutting competitors worldwide. This influence extends beyond individual chips—it disrupts entire industries by embedding China's supply chains into global end-product markets. By manipulating market demand for these end-products, China gives its state-backed firms a strategic advantage, allowing them to scale rapidly.

China's dominance in solar panel manufacturing exemplifies this approach. Generous subsidies helped China build the world's largest solar panel production base, where domestic firms control the entire supply chain, from polysilicon, wafers, and solar cells to modules, inverters, and energy storage systems. This vertical integration lowers costs, reduces supply chain risks, and eliminates foreign competition.

Simultaneously, China is advancing beyond traditional monocrystalline and polycrystalline silicon, investing in next-generation perovskite solar cells to maintain its competitive edge. This multi-layered strategy—market dominance, cost reduction, technological leadership, and supply chain control—has propelled China to an 80% global market share in solar panels by 2024 (See Table 1-3). In contrast, Germany's Q CELLS, once a global leader, filed for bankruptcy in 2012.

China is applying this same model to foundational semiconductors, including microcontrollers, power management ICs, and sensors—critical components in electric vehicles (EVs) and other industries. State subsidies drive cost suppression, allowing Chinese firms to sell these chips below market rates, forcing global automakers into reliance on Chinese suppliers. China already leads the global EV industry and battery production. If this dominance extends to semiconductor supply, Beijing could gain unprecedented control over the future of global transportation. A case study below

Table 1-3: China's Market Share in End-Products and Relevant Mature-Node Chips (2024)

Product Category	Market Share	Relevant Mature-Node Chips
Solar Panels	80%	Compound semiconductors, Power control chips
Mobile Phones	56%	Wi-Fi chips, Power management chips, Display driver chips, Touch controller chips, Memory
Electric Vehicles	73%	Power management chips, MCUs, Communication chips
Display Panels	66%	Display driver chips

Source: TIME Magazine[10], RHO Motion[11] [12], IDC[13], Forbes[14]

in China's wafer manufacturing industry further illustrates this coordinated Pseudo-IDM strategy. The Hefei municipal government strategically leveraged demand from display and EV industries, enabling local foundry Nexchip to overtake Taiwanese competitors.

According to the U.S. Department of Commerce's Bureau of Industry and Security (BIS), over two-thirds of surveyed U.S. companies rely on Chinese-manufactured chips, despite China's semiconductors representing only a fraction of total chip value.[15] Aggressive price suppression forces global competitors into unsustainable margins, driving non-Chinese firms out of the market. This trend is evident in compound semiconductors. A case study below comparing China's SICC and U.S.-based Wolfspeed highlights this strategy. Wolfspeed cannot compete with China's artificially low prices and is locked out of the Chinese market, while SICC steadily gains global market share.

China's overproduction and price suppression tactics pose severe risks to semiconductor manufacturers in the U.S., Europe, and Taiwan. While companies like TSMC and Samsung maintain dominance in advanced nodes, they pay less attention to mature-node production, leaving the foundational chip sector vulnerable to Chinese control. For smaller foundational chipmakers, the situation is even more dire. China's state-backed firms can absorb short-term losses to capture market share—a luxury unavailable to non-Chinese competitors. The silicon wafer industry (as the case study below) provides a clear example: despite operating at a loss, China's state-owned National Silicon continues massive long-term investments to secure market control.

Meanwhile, Western private investors hesitate to fund non-Chinese foundational chip industries, seeing no viable future. In contrast, China's state-backed model attracts both local governments and private investors, further accelerating its dominance in mature-node semiconductor production.

China's growing control over foundational chips presents a major geopolitical risk. These semiconductors are essential for defense, telecommunications, and energy infrastructure. Former U.S. Deputy National Security Adviser Matt Pottinger cautioned that controlling the global supply of mature-node chips would give China "coercive leverage over every country and industry.[16]" A supply disruption—whether through export restrictions or supply chain manipulation—could cripple industries worldwide.

China is also expanding its influence through regional supply chain dependencies. Under the Belt and Road Initiative (BRI), China is investing in semiconductor infrastructure in developing nations, integrating them into its supply chain. Joint ventures in Africa and Southeast Asia ensure these regions become reliant on Chinese technology, further eroding the market share of U.S.-aligned suppliers.

China assesses whether a firm should remain in or exit its market based on two key factors: the firm's nationality and its contributions to China's interests. Figure 1-4 categorizes the Chinese government's incentives ("carrots") and penalties ("sticks"). Chinese firms, which are registered in China and operated by Chinese residents, are expected to emerge from intense domestic competition and be elevated as "national champions." In addition, non-Chinese firms, including Taiwanese firms, are evaluated based on their ability to advance China's technology development.

"C1," "C2," and "C3" respectively refers to case studies "Wafer Manufacturing: Only Chinese Firms Can Profit in China," "Silicon Wafer: State-Led Long-Term Investment Despite Losses," and "Compound Semiconductors: How China's Strategy Is Squeezing Out the U.S. Company." Details and implementations could be found in the case study noted.

Figure 1-4: China's "Carrots and Sticks" to Manage Tech Firms

	Chinese Firms	Non-Chinese Firms
Carrots	**Support (C1, C2, and C3)** • Receive financial supports • Earn orders from other national champions • Expand to the overseas market	**Trade (C1)** • Gain investment by providing certain resources, typically know-how
Sticks	**Fall out (C2)** • Fail to accquire government support • Become marginalized	**Squeeze out (C1, C2, and C3)** • Lose the Chinese market • Face challenges from the Chinese national champions in the overseas market

Source: Made by Authors

Old Nodes, New Frontiers: Foundational Chips and Their Role in Shaping PRC's Space and Radar Technologies

In the realm of satellites, radar systems, and satellite communications (SatCom), the choice of semiconductor technology is not just a technical matter—it is a strategic imperative. While much of the global attention focuses on cutting-edge chips manufactured at 5nm and below, mature process chips—produced using mature nodes such as 28nm to 180nm—are considered as providing unmatched advantages in some critical, high-risk environments.

For instance, UCAS (国科环宇) has emerged as a pivotal player in China's expansive space initiatives by pioneering the development of cost-effective, radiation-hardened chips tailored for commercial aerospace applications. By integrating radiation-resistant techniques from aerospace chip manufacturing with the stringent safety standards of automotive-grade chips, UCAS has successfully introduced a series of domestically produced chips priced in the hundred-RMB range. [17]

Positioning itself as China's counterpart to the American company Texas Instruments (TI), UCAS focuses on delivering mass-produced, low-cost chip products for safety-critical sectors, including commercial aerospace. Among their notable offerings are radiation-hardened RISC-V microcontroller units (MCUs) with extensive input/output resources, as well as specialized power management and interface chips designed for seamless integration into satellite electronic systems.[18]

Radiation Resistance in Space

One of the most pressing challenges in space is radiation exposure. Satellites are bombarded by cosmic rays, solar flares, and charged particles that can cause malfunctions in sensitive microelectronics.[19] [20] Foundational chips, with their larger transistor geometries, are considered more robust against these radiation-induced phenomena. Specifically, they are less susceptible to Single-Event Upsets (SEUs) and Single-Event Latchups (SELs), two common failure modes in the aerospace domain.[21] Foundational chips are fundamental to satellite systems due to their proven radiation resilience and long operational history.[22]

Thermal and Environmental Stability

Radar systems and satellites must endure extreme environmental conditions. In orbit or on high-altitude platforms, temperature swings can range from -55°C to +125°C, while terrestrial radar systems may encounter constant vibration, moisture, or electromagnetic interference.[23] Mature process chips have a long record of maintaining operational stability under such extremes.[24] Their physical and electrical characteristics remain predictable and reliable—an essential feature for systems that cannot afford even momentary failures. These same chips are integral to aircraft and industrial machinery for similar reasons.

Power Efficiency and Longevity in SatCom

Satellites operate in isolated conditions with limited power budgets and zero maintenance. In such an environment, every watt saved contributes to mission life.[25] Foundational chips, with their simplified circuit designs and lower leakage currents, can be more power-efficient and tend to have longer mean time between failures (MTBF). A 130 nm CMOS design can have far less subthreshold leakage than a 32 nm design, allowing it to operate at a much lower supply voltage for an optimal energy point.[26] The lower complexity also means fewer things can go wrong—making them ideal for SatCom and other long-duration deployments.

Manufacturing Maturity and Supply Chain Security

Unlike leading-edge chips that require cutting-edge fabrication equipment and complex global supply chains, foundational chips are made using well-established, mature processes. This results in higher yields, fewer defects, and lower costs per unit.[27] These attributes are critical for aerospace or even nuclear systems. The MESA fabrication facility at the U.S.Department of Energy's Sandia National Laboratories produces chips for U.S. nuclear weapons still using a 350-nanometer manufacturing process, a technology originally introduced in 1994.However it operates reliably for decades—even under intense nuclear radiation.[28]

Case 1: ASP4644 Series – Powering Radar and Satellites

One of the clearest examples of how foundational chips are being used in critical systems is China's ASP4644 series, developed by the domestic chip company ANSILIC (国科安芯). The ASP4644 is a highly integrated power management module—a type of chip responsible for efficiently distributing electrical power to different parts of a larger system, like a satellite or radar array.

What sets the ASP4644 apart is how many functions it packs into one small unit. Instead of needing multiple separate chips for tasks like voltage regulation, current control, and filtering, the ASP4644 combines them into a single module. It has four output channels, each capable of supplying up to 4 amps of current, and it works across a wide voltage range—from 4 to 15 volts on the input side and from 0.6 to 5.5 volts on the output side. That flexibility makes it easy to use in many different systems.[29]

This chip is especially useful in military and space environments. For example, one variant called the ASP4644S is hardened against radiation, a key requirement for space missions. Space radiation can damage sensitive electronics, but the ASP4644S is built to withstand those conditions.[30] It is tested to endure radiation levels rated at SEU and SEL thresholds of 75 MeV·cm^2/mg or more, which are standard metrics for measuring how well a chip resists radiation-induced errors.

Table 1-4: Key Chinese Foundational Chips Powering Radar and Satellites

Parameter	ASP4644A3B	LTM4644MPY	HCE4644MLMB	SPES4644UT	ACP4644NM	FHT4644MY
Producer	ANSILIC 国科安芯	Analog Devices (ADI)	Sevenstar 七星华创	SPES 大能智创	Aerochip Micro 航芯微	Guangdong Fenghua 风华高科
Input Voltage	4V – 15V	4V – 14V 2.375V – 14V	4.0V – 14V	4V – 14V	4V – 20VExt. 2.375V – 20V	4.0V – 15V
Output Voltage Range	0.6V – 5.5V	0.6V – 5.5V	0.6V – 5.5V	0.6V – 5.5V	0.6V – 5.5V	0.8V – 5.5V
Ripple	4.5mV	5mV	20mV (typical)	10mV	10mV	10mV
Max Efficiency	94.50%	95.00%	94.50%	95.00%	95.00%	92.00%
Operating Temperature	-55°C to 125°C	-55°C to 125°C	-55°C to +125°C	-55°C to 125°C	-55°C to 125°C	-40°C to 125°C
Package Type	BGA-77	BGA-77	BGA-77	BGA-77	BGA-77	BGA-77
Dimensions (mm)	15 × 9 × 4.46	9 × 15 × 5.01	15 × 9 × 5	15 × 9 × 2.5	9 × 15 × 5.01	9 × 15 × 4.329 × 15 × 5.01
Notes / Features	Radiation-hardened model; for high reliability environment	Industry standard	Ultra-thin package	High durability	Multiple packaging types	Multiple packaging types

Source: Compiled by authors, CNKI

Case 2: ASM1042 – Replacing Texas Instruments' TCAN1042

Another important example is the ASM1042 chip, a CAN (Controller Area Network) transceiver developed in China as a domestic alternative to chips like Texas Instruments' TCAN1042 and NXP's TJA1049.[31] A CAN transceiver is a small but vital component in many modern electronic systems, especially in vehicles, industrial equipment, and satellites. It allows different electronic modules to talk to each other over a shared communication line, ensuring smooth coordination between systems. The ASM1042 is built to meet international CAN FD (Flexible Data-Rate) standards, meaning it can handle more data at higher speeds—up to 5 megabits per second. It's also designed to withstand harsh electrical environments. It includes ±70V bus fault protection, which means it can survive sudden electrical spikes that would destroy more delicate components. Its ±30V common-mode voltage range helps it maintain stable communication even in the presence of electrical noise, which is common in industrial and aerospace applications.

What really sets the ASM1042 apart is its ruggedness. It has been certified to AEC-Q100 Grade 1, an automotive industry standard that ensures reliability at temperatures ranging from -40°C to 125°C. Even more importantly, certain versions of the ASM1042 are radiation-hardened—designed specifically to survive the high-radiation environment of space. Like the ASP4644S, the radiation-tolerant versions meet SEU and SEL thresholds of ≥75 MeV·cm²/mg.[32]

This chip has already been adopted in high-reliability systems including aerospace platforms, smart vehicles, and industrial control units. By matching or even exceeding the performance of its Western counterparts while offering localized production and supply chain stability, the ASM1042 represents a key component for the industry in China to build and sustain its own secure tech ecosystem.

Part II

Case Studies – How the PRC's State-Driven Model Undermines U.S. and Allies Industries

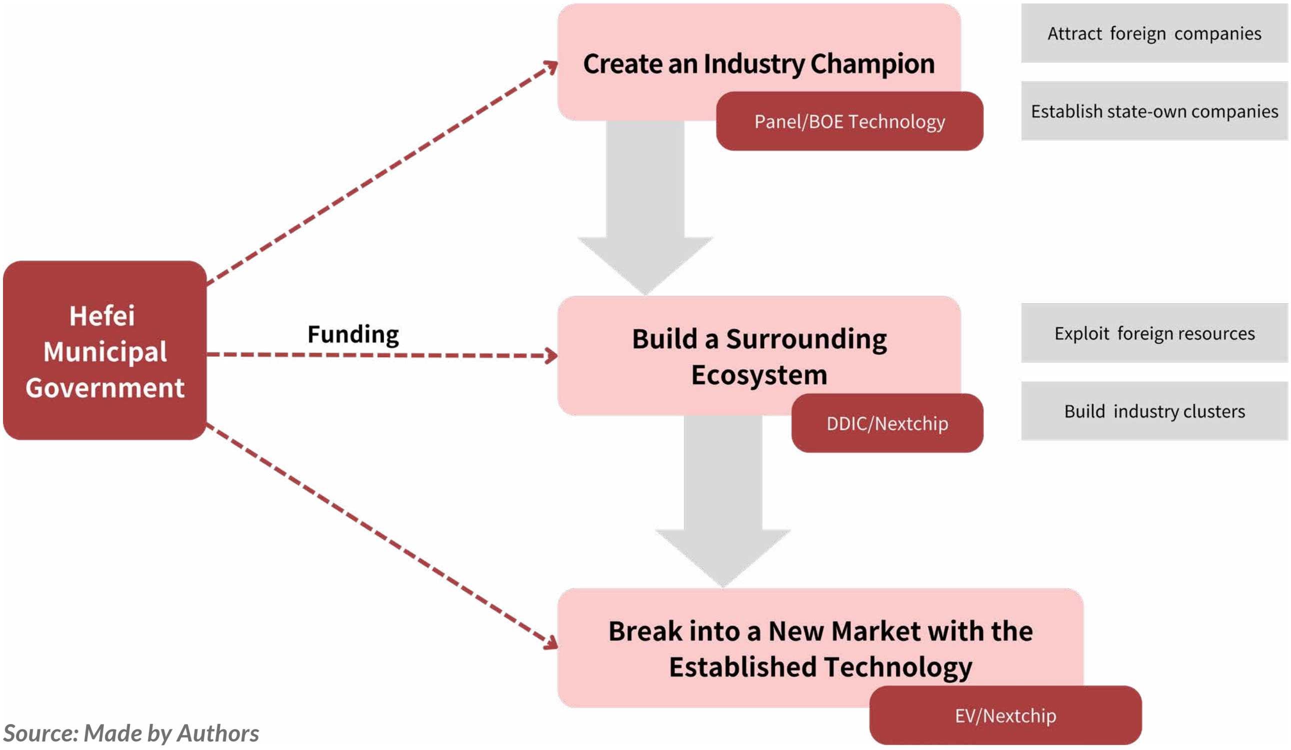
Case 1
Wafer Manufacturing: Only Chinese National Champions Can Profit in China

Under Hefei's industrial policy, the city has become a global hub for display panel manufacturing, now producing 20% of the world's LCDs. The Hefei government invests heavily in technology companies, aiming to integrate chip (芯), display panel (屏), and automotive (汽) industries. Its goal is to build a fully self-sufficient technology supply chain, from chip manufacturing to end products. Having already dominated the display panel industry, Hefei is now shifting focus to electric vehicles.

Display panels have widespread demand in tech products and are less affected by U.S. export controls since they do not require advanced chips. Hefei's early investment in the display industry began before 2010. By 2007, the city committed one-third[33] of its fiscal budget to attract state-owned BOE Technology (京東方, BOE) to establish a plant in Hefei. The display panel industry relies heavily on display driver ICs (DDICs) to control LED color and brightness, but Hefei initially lacked DDIC production capacity. To solve this, the government facilitated a partnership with Taiwan's Novatek Microelectronics (聯詠科技, Novatek) to design DDICs for BOE.[34] Meanwhile, Hefei planned for long-term self-sufficiency, leading to the creation of its own DDIC manufacturer—Hefei Nexchip (晶合集成, Nexchip).

In 2015, Hefei partnered with Taiwan's Powerchip Group (力晶創新投控, Powerchip) to establish Nexchip, creating Anhui Province's first 12-inch wafer fab.[35] By 2024, Powerchip's stake in Nexchip had dropped to 19.08%[36], significantly lower than in the early years. Over the years, with massive government subsidies, Nexchip's monthly production capacity skyrocketed from 10,000 wafers[37] in 2018 to 115,000[38] in August 2024, fully meeting Hefei's display industry demand for DDICs. This successfully fulfilled Hefei's long-term industrial development strategy.

Figure 2-1: Hefei Government's Industrial Strategy



Source: Made by Authors

The "Hefei Model" is a microcosm of China's state-driven strategy for expanding foundational chip industries globally. This model follows three key phases:

First, the Hefei government attracts foreign firms or fosters local startups to create an industry champion. Next, it channels resources into this leading company, building a surrounding ecosystem of supporting firms. Finally, it leverages accumulated technology and expanded production capacity to break into the next industry, such as shifting from display panels to electric vehicles.

For over a decade, Hefei has branded this strategy as "Chip-Display-Auto Integration" (芯屏汽合). In Chinese, the phrase sounds like a traditional idiom, while literally referring to the integration of chips, display panels, and EVs. This approach has propelled Hefei into the PRC's top 20 cities,[39] transforming it into a new first-tier city.

After securing dominance in display panels, Hefei applied its aggressive investment model to semiconductors, including memory chips, leading to the 2016 establishment of ChangXin Memory Technologies (長鑫存儲).[40] Its next phase, "Concentrated Efforts for Innovation" (集中生智), reinforces the PRC's nationalized push for technological breakthroughs. In practice, Hefei aims to replicate its success in integrated circuits, biotechnology, and AI.[41] Regardless of the slogan, the driving force behind the Hefei Model is aggressive government investment. The city allocated over $1.448 billion to semiconductors in 2011 and new energy vehicles in 2019, demonstrating how Hefei's financial backing ensures the rise of industry champions and the completion of supply chains.

In wafer manufacturing, Hefei Nexchip's rise highlights how the PRC government resources distort market competition, weakening Taiwan's Powerchip Semiconductor Manufacturing Corporation (PSMC). In recent years, Nexchip has gained ground over PSMC in market share, production capacity, and technology.

Since Powerchip has investments in both Nexchip and PSMC, the two companies share technology, products, and personnel. Both specialize in foundational semiconductor manufacturing and compete in the same market. The key difference is ownership—Nexchip's largest shareholder is the Hefei municipal government, which holds controlling power over the company. This makes Nexchip a critical case study in comparing semiconductor industry development across the Taiwan Strait. (See Table 2-1)

Founded in April 2008, PSMC rebranded in 2018. It operates two 8-inch and four 12-inch fabs, providing advanced memory, custom logic ICs, and discrete semiconductor foundry services. [42] Historically, PSMC far outperformed Nexchip in revenue and net profit, but declining smartphone and PC demand led to losses in 2023. In 2024, its financial struggles worsened due to low capacity

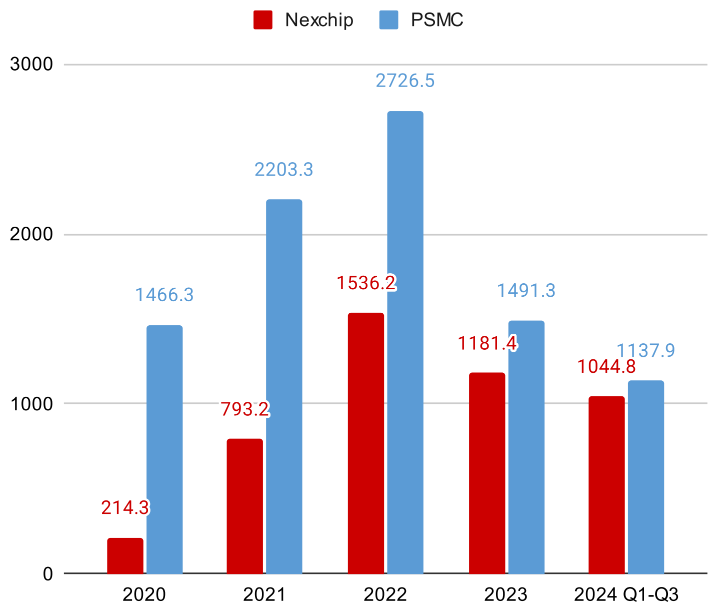
Table 2-1: Hefei Nexchip and Taiwan PSMC

	PSMC	Nextchip Semi
Country	Taiwan	The PRC
Year of Establishment	April 2008	May 2015
Capital Amount	41.5 billion NTD	2 billion RMB
Major Shareholders	-Powerchip (20.33%) -Frank Huang (2.83%)	-Hefei Construction Investment and Holding Co., Ltd (23.35%) -Hefei Chip Display Industry Investment Fund (16.39%) -Powerchip (20.58%)
Technology	-28nm Process (Under Development) -22/28nm DRAM & NAND -40 nm Logic and High-Voltage Manufacturing Technology	-28nm Process Successfully Verified -40nm High-Voltage Process -55nm Image Sensor Process -40nm LED Driver IC Technology

Source: Wealth Magazine, Issue 726, Page 93 utilization at its newly built Miaoli Tongluo fab, marking two consecutive years of losses.

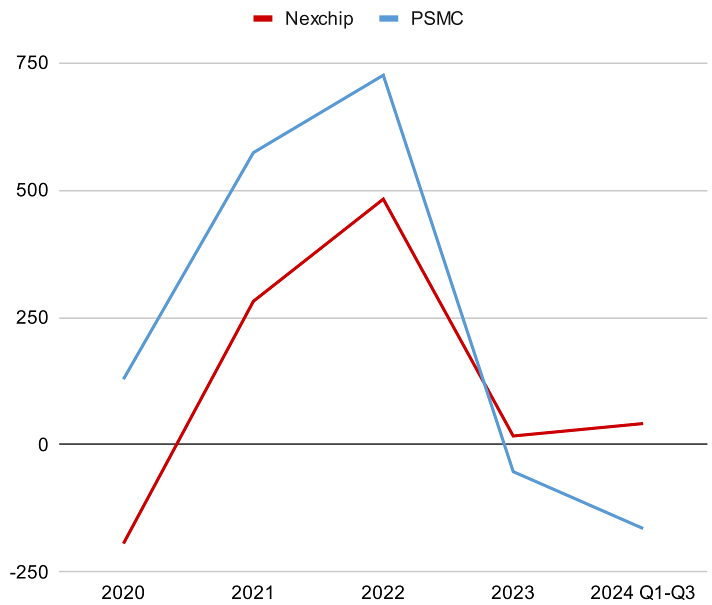
While PSMC struggled, Nexchip benefited from Hefei's booming display industry, which created steady demand for DDICs. As a result, Nexchip's revenue gap with PSMC shrank from $1.303 billion in 2022 to just $86 million in 2024 Q1-Q3. (See Figure 2-2) Nexchip also turned profitable in 2021 and continued growing its net profit, surpassing PSMC by 2023. (See Figure 2-3) With Hefei's push into the automotive sector, Nexchip established Wanxin Semiconductor (皖芯集成) in 2022, expanding into automotive chips.[43] In September 2024, TrendForce ranked PSMC ninth in global foundry revenue for Q2 2024, with Nexchip close behind in tenth place.[44] The gap is closing rapidly. In market value, the contrast is even starker. PSMC's valuation stood at $2.424 billion, while Nexchip soared to $6.903 billion—three times PSMC's market value.

Figure 2-2: 2020-2024 Q3 Revenue Comparison: Nexchip and PSMC (in Million USD)



Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)

Figure 2-3: 2020-2024 Q3 Profit Comparison: Nexchip and PSMC (in Million USD)



Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)

Table 2-2: 2020-2024 Q3 Government Subsidy Comparison: Nexchip and PSMC (in Thousand USD)

Year	Nextchip	PSMC
2024 Q1-Q3	8,027	111
2023	15,509	1,066
2022	15,867	390

Unit: Thousand USD
Source: Company financial reports (converted using the annual average exchange rate)

PSMC is struggling against intense competition from Hefei Nexchip in the Chinese driver IC market, one of its core product lines. Nexchip, heavily reliant on driver ICs, has long derived over 80% of its revenue from them, peaking at 99.99%[45] in 2019. As the PRC integrates its chip and display industries into a state-backed supply chain, PSMC finds it increasingly difficult to compete in the PRC.[46]

In March 2024, PSMC's chairman announced plans to exit the PRC's driver IC and sensor markets. Although the company later clarified that it was undergoing a strategic transformation rather than a full withdrawal,[47] The message was clear—the PRC favors domestic firms, placing foreign competitors at a disadvantage. Beyond shifting procurement preferences, government subsidies further tilt the playing field. Nexchip receives tens of millions of dollars in subsidies annually, while PSMC's highest government subsidy in 2023 was only $1.066 million. Without subsidies, Nexchip would be unprofitable every year, but with state support, it continues expanding capacity and advancing technology. (See Table 2-2)

Nexchip continues to advance its technology. In 2024, it successfully produced a 180MP full-frame image sensor on a 55nm process and plans to mass-produce OLED driver ICs on a 28nm node in 2025.[48] It now offers photomask services from 28nm to 150nm, with mass production starting in Q4 2024 and an annual capacity target of 40,000 wafers. This breakthrough fills a gap in Anhui Province's photomask industry and strengthens the PRC's semiconductor sector.[49] Nexchip also completed functional verification for 28nm chips in Q3 2024, moving forward with commercializing its 28nm process.[50] In contrast, PSMC remains behind at 40nm. In a

Wealth Magazine interview, a PSMC leadership revealed the company's goal of developing 28nm technology by 2026[51] —a target that Nexchip has already surpassed. As a result, the PRC is emerging as the winner in the foundational chip market.

To counter Nexchip's rise, PSMC is pursuing new strategies, focusing on non-red supply chains, Silicon Interposer, and Wafer-on-Wafer (WoW) technology.[52] With escalating U.S.-China tech rivalry, PSMC hopes to capture orders shifting from the PRC to Taiwan, particularly for power management ICs used by Western companies. Additionally, in May 2024, PSMC's new 12-inch fab (P5) in Miaoli Tongluo began operations. The Chairman aims to combine PSMC's experience in memory and logic chip manufacturing with advanced stacking technology, targeting the AI chip foundry market.[53] If successful, Taiwan can continue supplying secure, cost-effective semiconductor manufacturing to democratic nations, strengthening the resilience of the global chip supply chain.

However, this battle mirrors the solar panel industry, where the PRC's low-cost products flooded global markets and crushed foreign competitors. Nexchip's rapid technological progress and government-backed expansion have not only disrupted global competition but also secured a major victory for Hefei's semiconductor ecosystem. This is the core goal of the PRC's foundational chip strategy—making U.S. tech firms increasingly dependent on the PRC's manufacturing. Taiwan is the first to be hit, but the long-term impact threatens the security of the U.S. semiconductor supply chain.

Case 2
Silicon Wafer: State-Led Long-Term Investment Despite Losses

The global foundational chip supply chain faces increasing threats from the PRC's aggressive, state-subsidized competition—extending beyond semiconductor manufacturing. One critical sector under pressure is silicon wafer production, a key material supplier for semiconductor fabrication.

A comparative analysis of three major the PRC's wafer manufacturers—National Silicon Industry Group (滬硅產業, National Silicon), Zhejiang MTCN Technology (中晶科技, MTCN), and Wafer Works (Shanghai) (上海合晶)—illustrates the detrimental effects of the PRC's industrial policies. Among these, Shanghai Silicon, a state-owned enterprise, enjoys significant government support. Despite lower production efficiency, it continues to deploy substantial investments, securing an advantageous position in the industry's future. In contrast, MTCN, a private Chinese firm, and Wafer Works (Shanghai), a Taiwanese-owned company operating in the PRC, struggle to compete. Without state backing, both face increasing challenges in sustaining operations within the Chinese market, regardless of their capital origins. The PRC's state-driven policies distort competition, favoring selected enterprises while marginalizing others.

National Silicon was established in 2015[54] and has received 20.64% investment from the PRC's "Big Fund". State-owned capital now holds a 61.79% stake, which underscores the company's close ties to the PRC's government.[55] MTCN was founded in 2010 as a privately owned Chinese company.[56] Its shareholders are mostly individual investors.[57] The company went public on the Shenzhen Stock Exchange in 2020.[58] Wafer Works (Shanghai) was originally established in 1994 as Shanghai Jinghua Electronic Technology Co., a joint venture between U.S. and the PRC's investors. In 2004, Taiwan-based Wafer Works (合晶科技) acquired a controlling stake, renaming it Wafer Works (Shanghai). Wafer Works currently holds a 48.03% stake.[59]

Wafer Works specializes in silicon wafers for power semiconductors. Its customers include leading global power device manufacturers such as Infineon, Onsemi, and STMicroelectronics, as well as foundries in Taiwan and the PRC, including TSMC and SMIC. The company holds approximately 30% of the global market share.[60] In recent years, Wafer Works has aimed to capitalize on the growing EV market, aggressively expanding its presence in the PRC. Its subsidiary, Wafer Works (Shanghai) was listed on the Shanghai STAR Market in February 2024. It is the only silicon wafer company publicly traded in both Taiwan and the PRC.[61] However, Wafer Works (Shanghai)'s

2024 earnings fell short of expectations. The rise of National Silicon—a state-backed competitor—has created unfair market pressure, squeezing Wafer Works (Shanghai)'s position in the PRC.

Over the past five years, National Silicon has shown the strongest revenue growth. Its revenue increased from $261.73 million in 2020 to $345.07 million in the first three quarters of 2024. According to its latest report, full-year revenue for 2024 reached $471.79 million, marking a 6.18% increase from 2023 and an 86% surge compared to 2020. (See Table 2-3)

Wafer Works (Shanghai) reported $154.43 million in revenue for 2024, an 18% decline from 2023 but a 17% increase from 2020. (See Table 2-3) While Taiwan-based Wafer Works holds a 30% global market share in silicon wafers for power semiconductors,[62] it struggles in the PRC. Lacking local recognition as a domestic company, it cannot compete on equal footing for the PRC's government subsidies. To overcome these barriers, Wafer Works (Shanghai) went public in the PRC in 2024, aiming to integrate into the PRC's semiconductor supply chain and secure government support.[63] Similarly, MTCN does not rely on state funding and faces the same challenges. Over the past five years, its growth has lagged behind National Silicon, which benefits from government backing.

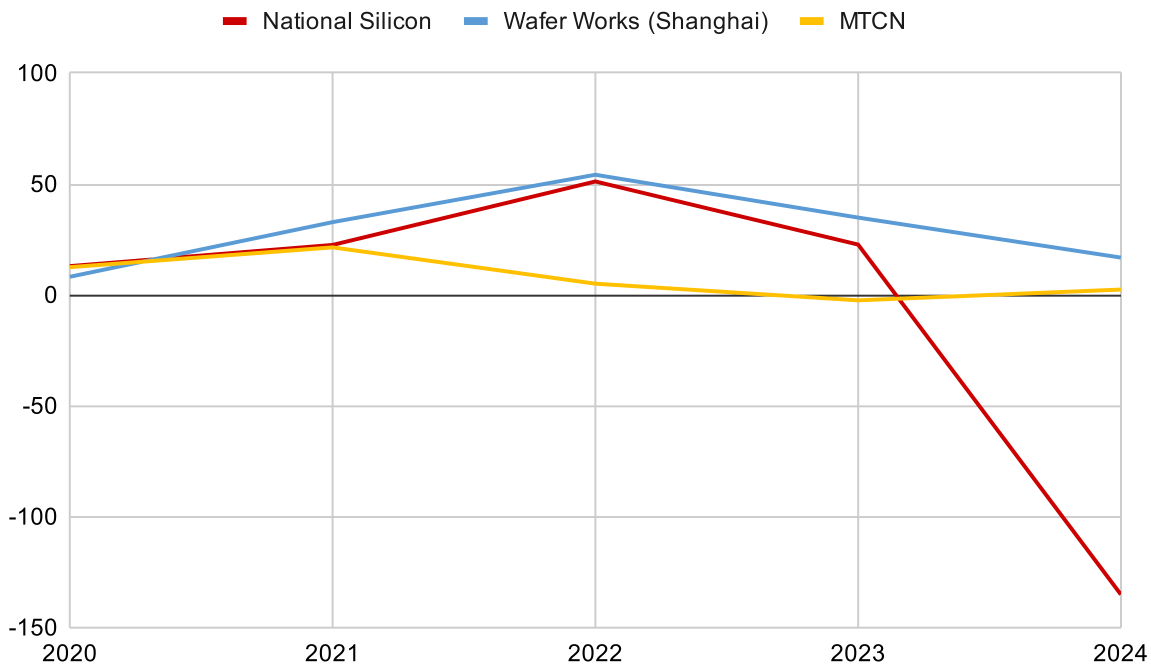
On the customer side, SMIC, the PRC's largest foundry, has expanded aggressively over the past five years, driving increased demand for silicon wafers. This demand has benefited National Silicon, which maintains close ties with SMIC. National Silicon's CEO, Chiu Tzu-Yin (邱慈雲), was previously SMIC's Vice Chairman.[64] The company has also invested in SMIC and publicly emphasized their strong business relationship.[65] The PRC's government-backed semiconductor ecosystem ensures that state-designated companies support one another, creating a closed-loop supply chain. As a result, "national team" customers preferentially source from "national team" suppliers, effectively excluding foreign and non-preferred domestic firms from fair competition.

Table 2-3: Revenue Comparison of Silicon Wafer Companies (in Million USD)

Year	National Silicon	Wafer Works (Shanghai)	MTCN
2024	471.79	154.43	N/A
2024 Q1-Q3	345.07	117.53	44.56
2023	450.73	190.47	49.17
2022	534.70	231.11	50.20
2021	382.27	205.86	67.59
2020	261.73	135.92	39.29

Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)

Figure 2-4: 2020-2024 Net Profit Comparison (in Million USD)



Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)
Note: MTCN estimates its net profits of 2024 to be between 15 and 20 million RMB. The Figure uses the average – 17.5 million RMB and converts it to USD.

Despite National Silicon's strong revenue growth, its profitability remains unstable. In 2020, the company turned profitable after years of losses. Profits surged over the next two years but declined in 2023 and fell back into negative in 2024. In contrast, Wafer Works (Shanghai) and MTCN, as privately-owned companies, prioritize operational efficiency and shareholder accountability, leading to more stable profitability. Notably, Wafer Works (Shanghai) outperformed National Silicon in four of the past five years, demonstrating its superior ability to generate profit. (See Figure 2-4)

Unlike private firms, National Silicon's priority is not profitability but fulfilling the PRC's industrial policy objectives. As part of the PRC's "national team," its success is measured by advancing state-driven political and economic goals, rather than delivering stable financial returns.

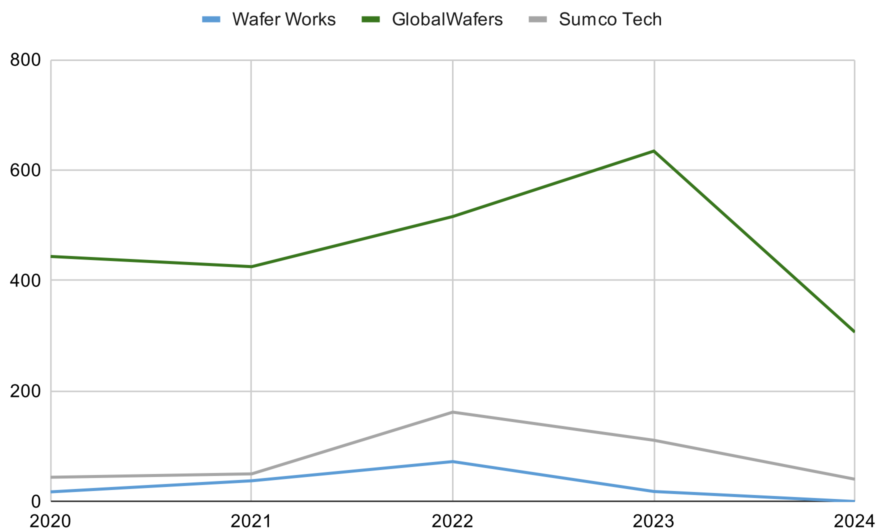
Table 2-4: Comparison of Government Subsidies (Left) and After-Tax Net Profit (Right) (in Million USD)

Year	National Silicon		Wafer Works (Shanghai)		MTCN	
2024 Q1-Q3	20.35	-90.24	1.41	10.96	0.30	3.17
2023	27.52	22.71	5.39	34.89	0.52	-2.44
2022	25.34	51.17	2.16	54.20	0.35	5.08
2021	45.16	22.55	N/A	32.83	1.70	21.45
2020	27.07	13.00	N/A	8.20	0.80	12.53

Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)

When factoring in government subsidies, it becomes evident that National Silicon's financial health is weak from a commercial perspective. In some years, government subsidies exceeded its net profit. For example, in 2023, National Silicon received $27.52 million in subsidies, surpassing its net profit of $22.71 million. Without subsidies, the company would have been in a continuous state of loss. In 2024, without subsidies, its financial performance would have been even worse. (See Table 2-4) While Wafer Works (Shanghai) and MTCN also received government support, their subsidies were never large enough to turn losses into profits. This contrast highlights how the PRC's subsidies for state-owned silicon wafer firms distort financial statements and mislead the market. Beneath these skewed figures lies the reality of unfair competition.

Figure 2-5: 2020-2024 After-Tax Net Profit of Wafer Works, GlobalWafers, and Sumco Tech (in Million USD)



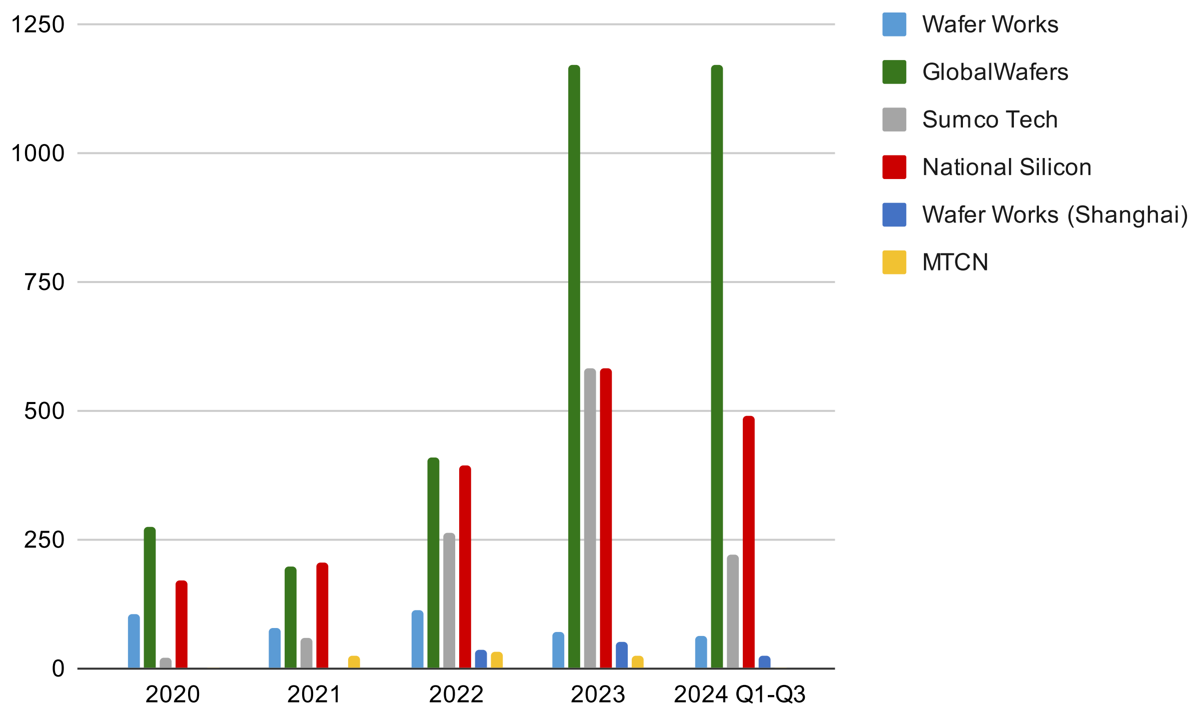
Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)

Including two more Taiwanese wafer manufacturers—GlobalWafers (環球晶) and Formosa Sumco Technology Corporation (台勝科, Sumco Tech)—alongside Wafer Works reveals a broader impact of the PRC's expansion strategy. By scaling up production and driving down margins, the PRC is not only reshaping its domestic industry but also disrupting Taiwan and other international markets. As global competitors are squeezed out, the PRC moves from lagging behind to dominating the market.

In 2024, all three Taiwanese wafer companies saw declining net profit growth. GlobalWafers reported its lowest-ever annual profit of $307 million, a 50.2% drop from 2023. (See Figure 2-5) Meanwhile, the company is investing in a major wafer plant in Texas, aiming to support U.S. semiconductor reshoring efforts. As Taiwan's most advanced wafer manufacturer and a key global supplier, GlobalWafers produces wafers of all sizes, with 2024 revenue reaching $1.95 billion. However, National Silicon's rapid expansion is closing the gap—its 2024 revenue of $472 million almost reaches one-fourth of GlobalWafers'. The PRC's aggressive strategy could challenge GlobalWafers' U.S. expansion and pose risks to the stability of the American semiconductor supply chain.

Sumco Tech, another major Taiwanese wafer producer, does not operate in the PRC. However, falling global wafer prices in 2024 led to a sharp profit decline. Wafer Works (Shanghai) also suffered, with 2024 net profit plummeting 99% year-over-year due to the PRC's state-backed competition. (See Figure 2-5) In response, Wafer Works launched a transition plan in 2024, shifting from 8-inch to 12-inch wafer production in both Taiwan and the PRC.[66] However, semiconductor investments take time to yield results, meaning Wafer Works will struggle to reverse its losses in the next three years.[67] The cases of GlobalWafers, Sumco Tech, and Wafer Works highlight a wider profitability decline in Taiwan's wafer industry. Meanwhile, the PRC's state-supported wafer manufacturers continue rapid expansion, widening the competitive gap.

Figure 2-6: 2020-2024 Q3 Comparison of Long-Term Investments by Wafer Manufacturers (in Million USD)



Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)ww

When comparing profit growth rates across these five wafer manufacturers, not only Taiwanese companies but also National Silicon are facing losses. However, National Silicon continues to make significant long-term investments in new facilities and equipment, thanks to the PRC's state subsidies. Under normal market conditions, economic downturns and company losses should lead to reduced long-term investments. Yet, National Silicon defies this commercial logic, increasing investments despite operating at a loss.

Other companies show more predictable investment trends:

- Wafer Works and Sumco Tech expanded to build new fabs, leading to higher long-term investments in recent years.
- MTCN, as a small private Chinese company, took a cautious approach. Its long-term investment dropped from $33.42 million in 2022 to $3.48 million in 2024 Q1-Q3 due to poor economic conditions.
- GlobalWafers benefited from U.S.-the PRC tech rivalry, securing U.S. investment for a new Texas fab. Its long-term investment[68]

surged from $410.99 million in 2022 to $1.17 billion in 2024 Q1-Q3. (See Figure 2-6)

These trends highlight the PRC's state-driven industrial strategy. State-backed companies like National Silicon expand aggressively, regardless of market demand or profitability, using subsidies to disrupt commercial logic. While GlobalWafers' U.S. expansion presents an opportunity, industry sources estimate that U.S. manufacturing efficiency is only one-third of Taiwan's. In contrast, National Silicon enjoys lower costs in the PRC. As its expansion accelerates, its returns could soon surpass GlobalWafers, pushing the PRC closer to dominating the global wafer market.

Taiwanese wafer manufacturers face growing disadvantages in the PRC's silicon wafer market, which is evident in their declining China revenue share. Wafer Works' revenue from China has been decreasing, while GlobalWafers does not disclose China-specific revenue, instead reporting overall Asian sales, which have also declined. Since the PRC is the largest market in Asia for silicon wafers, this suggests that GlobalWafers is also losing ground there. Sumco Tech primarily serves Taiwan's domestic market and does not break down revenue outside Taiwan, but its overall export sales have also been shrinking. (See Table 2-5) In contrast, National Silicon revealed in its 2023 annual report that overseas sales accounted for 41% of its total revenue. This increase is largely due to its aggressive low-price strategy in the global market, where it can undercut competitors. Since most silicon wafer products are not subject to trade controls, Taiwanese manufacturers have little protection against the PRC's low-cost dumping practices. Therefore, they are losing competitiveness both in the PRC and internationally.

Table 2-5: China Revenue Share (%)

Year	Wafer Works	GlobalWafers (Asia)	Sumco Tech (Overseas Sales)
2023	28.0	46.7	23.0
2022	28.6	50.8	26.5
2021	34.3	51.6	26.9
2020	32.6	50.3	21.9

Unit: %

Source: Company financial reports (converted using the annual average exchange rate)

Case 3 Compound Semiconductors: How the PRC's Strategy Is Squeezing Out a U.S. Company

The importance of compound semiconductors is rising. Historically, high manufacturing costs limited their use to military and aerospace applications. However, with rapid growth in the global EV market and the maturation of 5G technology, demand for compound semiconductors has surged.[69] Compared to silicon (Si), germanium (Ge), gallium arsenide (GaAs), and indium phosphide (InP), the most widely watched compound semiconductors today are gallium nitride (GaN) and silicon carbide (SiC). These materials handle higher power and frequencies while offering superior heat dissipation, making them ideal for communications, aerospace, and clean energy applications.[70] Recognizing their strategic value, The PRC is aggressively expanding into this sector, using state-backed resources to establish dominance.

SiC and GaN each have distinct properties and applications. SiC excels in high-temperature, high-voltage environments, with fast heat dissipation and switching speeds, making it ideal for EVs, renewable energy, and rail transport. GaN features high frequency, high efficiency, and durability under extreme conditions, making it a key material for fast charging, 5G/6G communications, and satellite systems. Currently, fast charging for smartphones and laptops is GaN's most popular application.[71]

Since 2019, the compound semiconductor market has grown rapidly. According to Yole Group's 2024 report, SiC surpassed 10% market share in power devices in 2023 and is projected to reach nearly 30% by 2029, with the market exceeding $10 billion. GaN is expected to surpass $2.25 billion by 2029.[72] TrendForce's 2025 report also highlights SiC's growing adoption, driven by Tesla and Chinese EV makers, with global traction inverter penetration reaching 16% in Q4 2024.[73] Encouraged by this growth, major automotive semiconductor firms—including Infineon, STMicroelectronics, and Onsemi—announced €15 billion investments in Q2 2024 for SiC R&D and production in Catania, Dresden, and the Czech Republic.[74]

Beyond its commercial value, compound semiconductors are critical national security assets. SiC is used in specialized defense components, satellites, and aerospace engineering,[75] while GaN has potential applications in AI server power conversion.[76] In today's technology-driven geopolitical landscape, SiC and GaN are essential strategic materials. Recognizing this, Taiwan designated SiC and GaN manufacturing technologies as "national core critical technologies" in late 2024, granting them higher regulatory protection.[77]

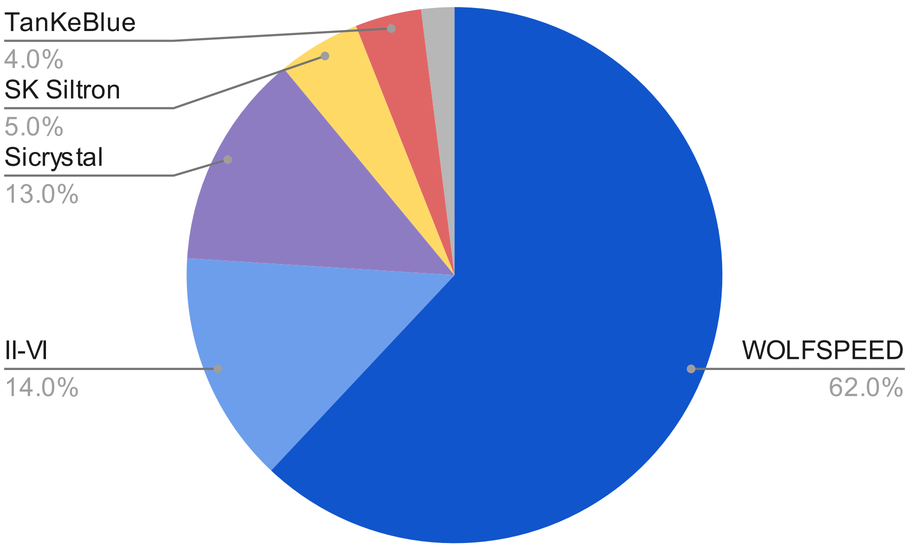
The PRC has aggressively expanded its compound semiconductor production and technology advancements in recent years. In the PRC, these semiconductors are referred to as "third-generation semiconductors," a term with political significance. The name suggests that while the PRC lags behind the U.S. and other democracies in first- and second-generation semiconductor technologies, it is determined to take the lead in this emerging field.

In 2021, the Chinese government outlined its 14th Five-Year Plan and 2035 Vision, which includes large-scale investments in third-generation semiconductors.[78] The PRC's confidence in this sector comes from three key factors:

1. No single company can sustain the domination of compound semiconductor technology or market share, unlike the silicon semiconductor industry, which is led by Taiwanese and U.S. firms.
2. The PRC's massive EV market, combined with government subsidies and protectionist policies, ensures strong domestic demand to support local compound semiconductor production.
3. Compound semiconductors require only basic fabrication processes, which are not yet restricted by U.S. export controls, allowing the PRC room to accelerate development.[79]

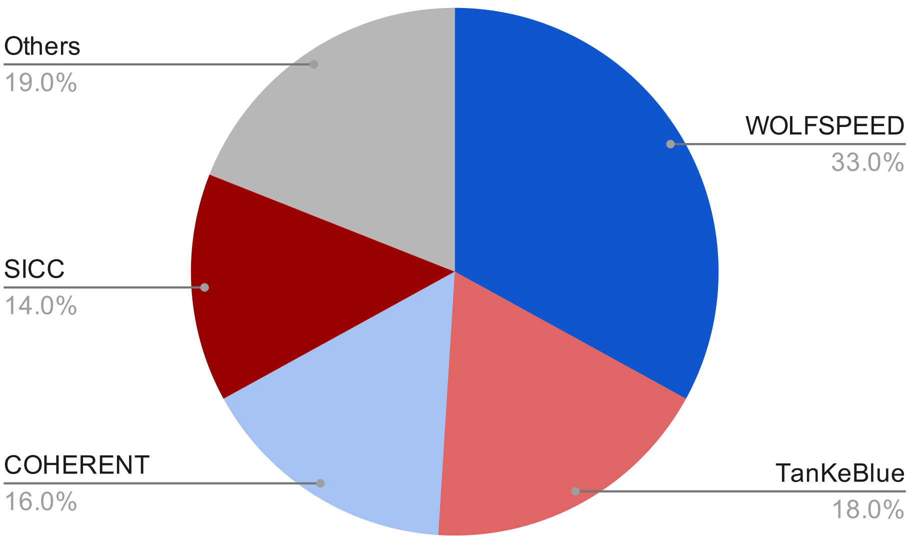
The PRC's aggressive backing of compound semiconductors is rapidly reshaping the industry. A comparison between the PRC's SICC (天岳先進) and the U.S.-based Wolfspeed illustrates how the PRC's state-driven supply chain strategy has propelled SICC while putting Wolfspeed under global market pressure.

Figure 2-7: SICC Market Share in 2021 (%)



Source: Yole and company estimates

Figure 2-8: SICC Market Share in 2023 (%)

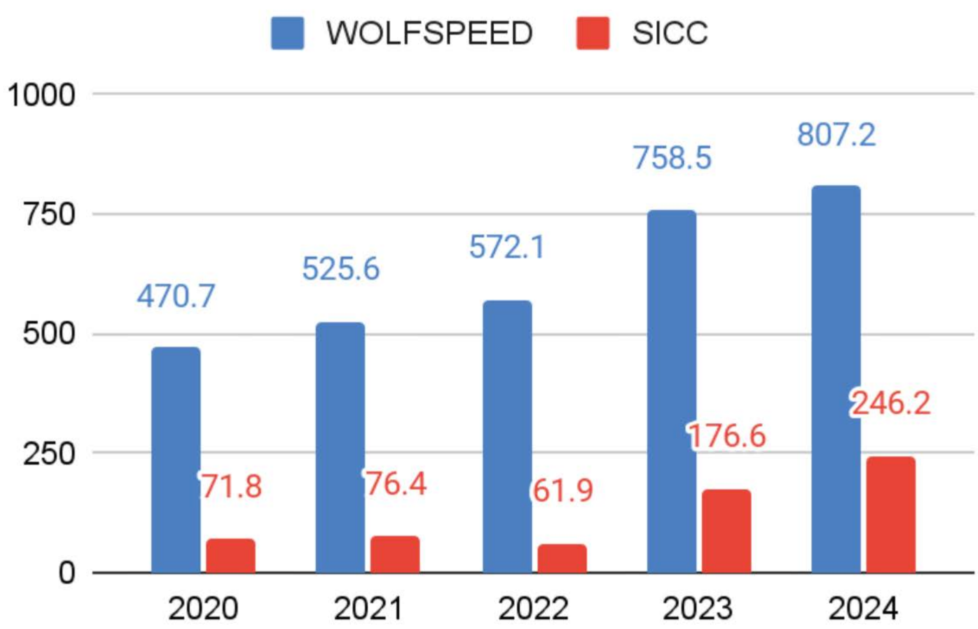


Source: Yole and company estimates

Founded in 1987 in Durham, North Carolina, Wolfspeed is the world's only fully integrated SiC company, producing SiC substrates, power modules, and power devices for automotive, aerospace, and renewable energy applications.[80] By 2021, Wolfspeed dominated the global SiC substrate market with a 62% share. (See Figure 2-7) However, Wolfspeed's market dominance is eroding due to rising competition from Chinese firms SICC and TanKeBlue (天科合達).[81]

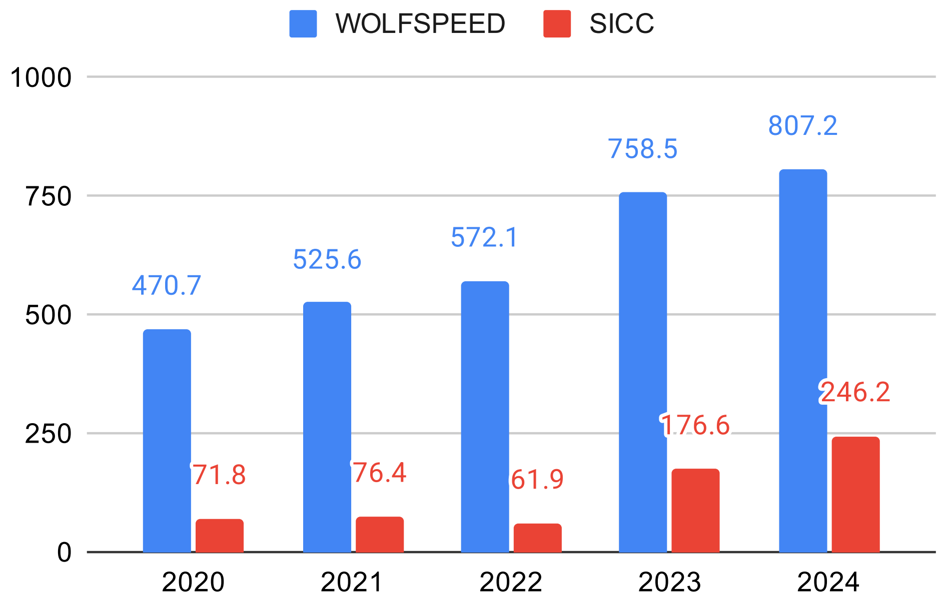
Founded in 2010 in Shandong, SICC specializes in SiC substrates and has expanded its presence with factories in Jinan, Shanghai, and Jining, along with a subsidiary in Japan.[82] In 2021, SICC's market share was below 2%, but by 2023, it had surged to 14%, making it the world's second-largest SiC substrate supplier by 2024.[83] At the same time, Wolfspeed's market share plummeted from 62% to 33% in just two years, threatening its position as the industry leader. (See Figure 2-8)

Figure 2-9: 2020-2024 Revenue Comparison: SICC and Wolfspeed (in Million USD)



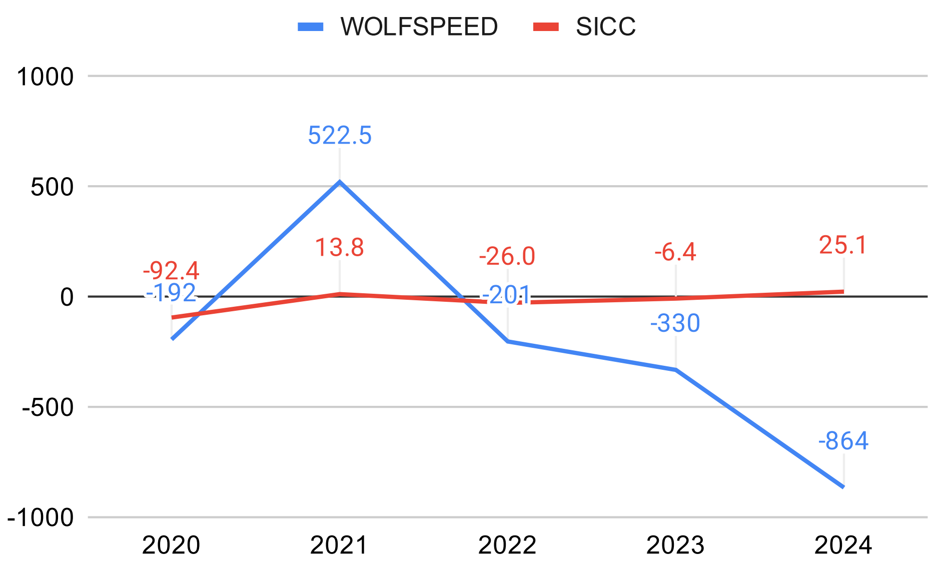
Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)

Figure 2-10: 2020-2024 Fixed Capital Formation Comparison: SICC and Wolfspeed (in Million USD)



Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)
Note: SICC data as of Q3 2024

Figure 2-11: 2020-2024 After-tax Net Profit Comparison: SICC and Wolfspeed (in Million USD)



Unit: Million USD
Source: Company financial reports (converted using the annual average exchange rate)

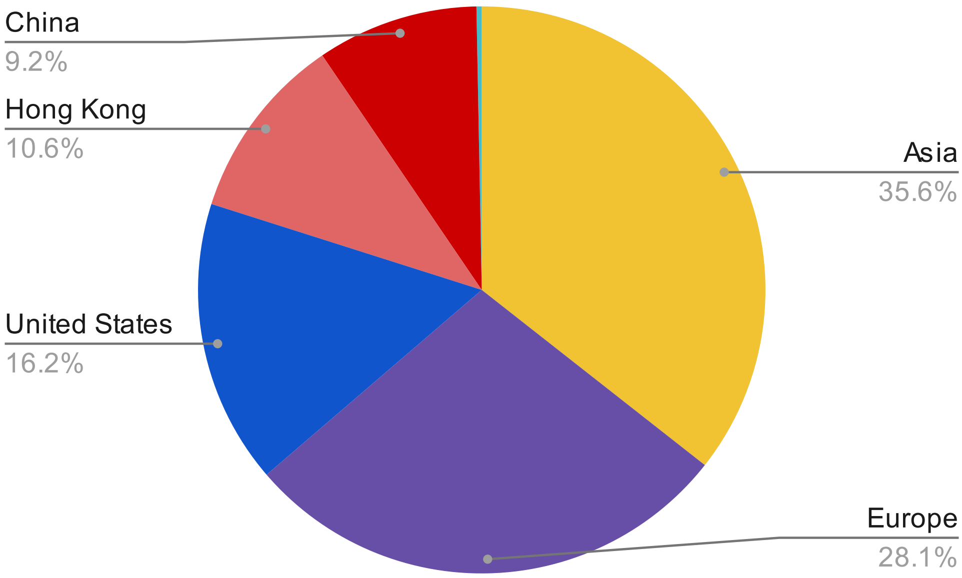
Over the past five years, Wolfspeed's revenue grew from $470 million to $807 million, a 72% increase. However, SICC's revenue surged by 243%, far outpacing Wolfspeed. (See Figure 2-9) Wolfspeed invested heavily in new fabs, leading to a 993% increase in fixed capital formation by 2024 compared to 2020. (See Figure 2-10) However, these investments did not translate into revenue or profitability. Wolfspeed continued to report massive losses, with its 2024 losses doubling compared to 2020. (See Figure 2-11)

In contrast, SICC benefited from the PRC's aggressive EV expansion and semiconductor localization policies. In 2020, SICC's long-term investment in fab construction reached around 88% of its revenue—an extraordinary scale, especially considering the company lost $92.44 million that year, exceeding its total revenue.

Despite its poor financial performance, SICC maintained an aggressive investment strategy, supported by the PRCs control over its EV market and export channels. This policy-backed expansion ensured demand for its compound semiconductors. In 2023, SICC experienced explosive growth, and by 2024 Q3, its operating margin turned positive, with a post-tax net profit margin reaching 10%. This success secured even more resources for future expansion, reinforcing its state-driven investment model. In 2023, SICC's capital investment was nearly four times higher than in 2020.

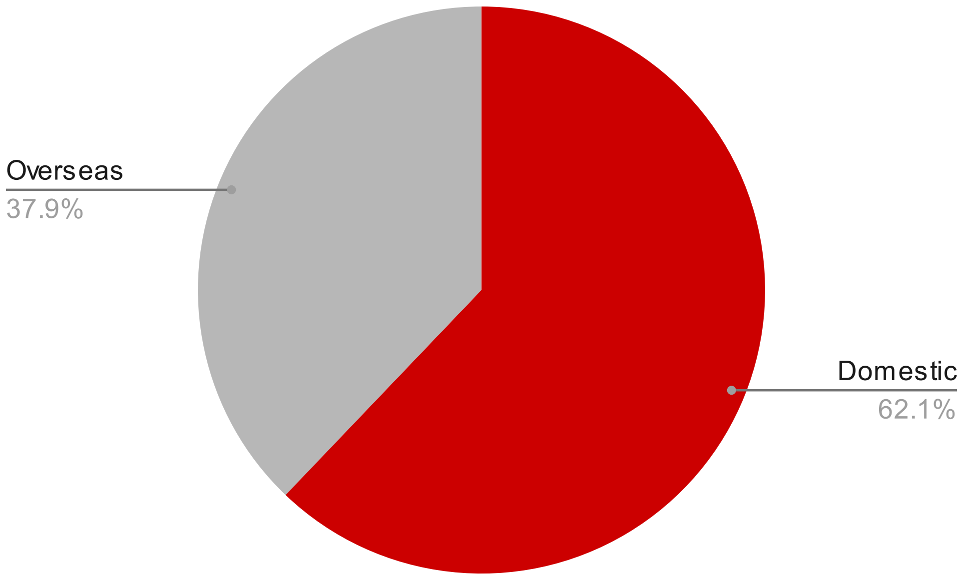
Despite expected to receive $75 million from the CHIPS Act,[84] Wolfspeed cannot match the scale of the PRC's state-backed semiconductor strategy.[85] The PRC's EV industry is tightly integrated with its domestic "red supply chain," creating a powerful advantage. According to ITRI's Industry, Science, and Technology International Strategy Center, The PRC's SiC semiconductor dominance is driven by major EV makers like BYD.[86] BYD generates massive chip demand and prioritizes domestic suppliers, securing a fully localized supply chain from SiC substrates to EV production. This model benefited SICC, which derived 62% of its 2023 revenue from The PRC's domestic market. (See Figure 2-13) At the same time, Chinese SiC manufacturers aggressively expanded production, using high-capacity output to drive down global prices, further undermining Wolfspeed's competitiveness.[87]

Figure 2-12: 2024 Wolfspeed Revenue Breakdown (%)



Source: Company financial reports

Figure 2-13: 2023 SICC Revenue Breakdown (%)



Source: Company financial reports

By 2024, Chinese companies controlled nearly 50% of global SiC substrate production.[88] SICC expanded rapidly, completing two fabs in the past five years—its Jining plant began production in 2019, and its Shanghai facility started deliveries in 2023.[89] According to Yole analyst Chiu Poshun, SICC aims to reach 300,000 6-inch wafers per year by 2026.[90] Meanwhile, it is aggressively transitioning to 8-inch substrates, with Shanghai Tianyue achieving 300,000 annual 8-inch SiC wafers in mid-2024, and plans to double capacity to 600,000 wafers per year.[91]

This explosive capacity expansion has caused a price collapse. TrendForce reports that 6-inch SiC wafer prices dropped from $1,000 per wafer in 2022 to $600 in 2024, with Chinese firms offering record-low prices of $400 per wafer.[92] These unsustainable prices make SiC manufacturing nearly unprofitable, exacerbated by slowing EV demand in the U.S. and Europe, further pressuring Wolfspeed and other non-Chinese competitors. In contrast, Chinese firms survive market downturns through state subsidies and strong domestic demand. SICC turned profitable in 2024, despite the price war. (See Figure 2-11)

At the same time, Chinese firms are using low prices to penetrate global markets, squeezing out Wolfspeed and other Western competitors. Wolfspeed relies on U.S. and European orders, with 16% of its 2024 revenue from the U.S. and 28% from Europe. However, European semiconductor firms like Infineon began sourcing SiC wafers from SICC and TanKeBlue in 2023 to reduce supply risks.[93] SICC, backed by domestic orders, is expanding into Western markets, but Wolfspeed has no access to the Chinese market in return. The PRC's industrial policies shield local suppliers, ensuring that once its SiC technology and capacity reach maturity, domestic EV makers will prioritize Chinese substrates, permanently locking out Western competitors from the PRC's market. To counter the PRC's strategy of using end-product exports to strengthen its supply chain, the U.S. must take a more proactive approach. Coordinating with Taiwan, the EU, and other allies is essential. A comprehensive strategy, spanning market dynamics to manufacturing, is necessary to curb the PRC's ambitions. Strengthening U.S.-Taiwan semiconductor and security cooperation is more urgent than ever.

Part III

Policy Recommendations

The goal of this report is to use Open-Source Intelligence (OSINT) methods to examine specific cases that highlight how the Chinese government is pursuing its national strategy through its complex semiconductor policies. By better understanding these strategies and tactics, the report aims to suggest practical ways to stop the PRC from gaining dominant control over the global production of mature-node semiconductors.

Limitations of Traditional Trade Measures and the Need for Precision Tools

To date, the PRC has pursued a core strategy of cultivating "national champions" across every segment of the semiconductor supply chain—from raw materials and manufacturing equipment to chip fabrication. The objective is to construct a **"Pseudo-IDM"** model, where Chinese firms dominate each critical stage of the value chain, including intermediates and end-product branding. Supported by a wide array of state-driven policy tools, this Pseudo-IDM system enables Chinese companies to compete unfairly with firms from democratic countries—rapidly expanding their global market share and moving toward full supply chain control.

Among the policy tools discussed to date, tariffs have been one of the most debated options in Washington—from broad, country-specific tariffs to more targeted, component-level measures. However, a key concern remains: tariffs often raise costs for end-product consumers, potentially contributing to inflation in major consumer economies like the United States. Even targeted component tariffs don't fully eliminate this risk. To minimize the economic burden on consumers and businesses while still addressing national security concerns, the U.S. should adopt a more precise, component-specific tariff strategy. Tariffs should be applied using Harmonized Tariff Schedule (HTS) codes to focus specifically on legacy semiconductor components either made in the PRC or containing PRC-origin chips. These include analog ICs, power management chips, microcontrollers, and automotive-grade chips. To prevent circumvention through downstream integration, these tariffs should also cover finished products and subsystems that incorporate such components—such as circuit boards, automotive ECUs, and industrial modules—effectively closing the current "integration loophole" in import oversight.

Additionally, the United States should establish a "tiered strategic tariff framework" based on the application and sensitivity of these products. For example:

- Tier 1: Chips with high national security relevance, including defense, aerospace, and communications applications, should be subject to high tariffs of 25% to 50%.
- Tier 2: Chips used in industrial, automotive, and energy infrastructure should be subject to moderate tariffs of 10% to 25%.
- Tier 3: Chips used in general consumer electronics should be subject to lower tariffs or conditional temporary exemptions to avoid undue price impacts on consumer goods.

On export controls, the Biden administration has adopted the "small yard, high fence" strategy. However, this strategy has been effective primarily in advanced-node technologies where PRC still relies on foreign monopolized or oligopolized suppliers of essential equipment and materials. Therefore, while both tariffs and export controls remain valid policy instruments worthy of continued exploration, we argue that a fundamental shift in strategic thinking is required to counter PRC's dominance in foundational chips.

Strategic Disruption of the PRC's National Champions to Restore Market Integrity

The core argument of this report is that the most effective strategy is to disrupt PRC's "Pseudo-IDM" model and directly target the national champions it has built through state-led industrial policy.

The PRC's approach to foundational chips is not efficient in the early stages. The government absorbs the financial losses of selected firms through heavy subsidies and other support, keeping them afloat until they can undercut and replace more efficient private competitors in democratic countries. Although this strategy has involved waste, fraud, and large-scale subsidies, the Chinese government is learning from experience and getting better at choosing which firms to back. It is now using more strategic and refined methods to funnel resources into selected companies across each segment of the supply chain.

The key challenge for the U.S. and its allies is that Chinese firms are now distorting the global market through price dumping—essentially subsidizing end consumers of Chinese-made semiconductors. This makes it nearly impossible for Western firms to compete on price. Worse still, the flood of cheap products from PRC is driving away private investment in foundational chip production outside of PRC. Without strong private investment—something governments alone can't fully replace—non-Chinese foundational chipmakers risk disappearing altogether.

To protect and strengthen the global semiconductor ecosystem, it is critical to restore investor confidence in non-PRC chip ventures. This report recommends that the United States and its allies make it a central policy objective to disrupt the PRC's state-engineered industrial architecture—specifically targeting the Pseudo-IDM model and the national champions that sustain it.

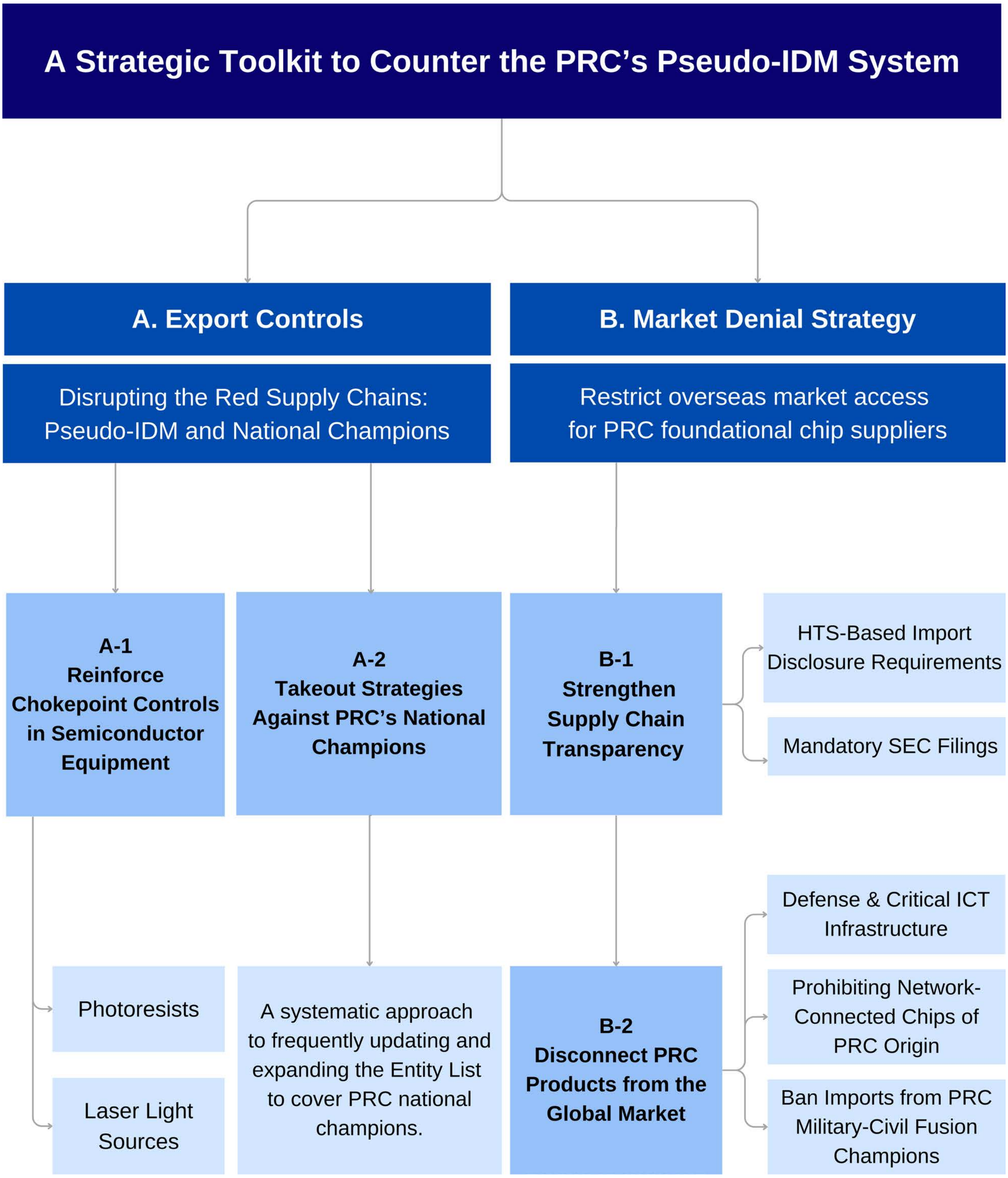
The most effective way to achieve this is by undermining the efficiency and commercial viability of these PRC-backed firms. This includes severing their business ties with companies in democratic nations and creating strong incentives for continued investment in non-PRC alternative suppliers. Only through such measures can we ensure the long-term survival and competitiveness of legacy semiconductor producers outside the PRC.

To highlight the contrast between broad and targeted responses, the report's lead author, Jeremy Chih-Cheng Chang, offers the following analogy:

> **"If tariffs are like the indiscriminate strategic bombing campaigns of World War II, then a focused strategy against sector-specific national champions within the PRC's Pseudo-IDM structure is more akin to precision Tomahawk strikes on terrorist cells."**

The PRC's national champions are the product of a highly visible, state-directed system. This visibility is also their vulnerability. Because these firms rely so heavily on state planning and support, they can be precisely identified and strategically targeted. To counter this model effectively, the policy response from the United States and its allies must also be multifaceted—combining targeted trade measures, technology controls, and investment strategies.

Figure 3-1: A Strategic Toolkit to Counter the PRC's Pseudo-IDM System



Source: Made by Authors

A. Export Controls: Disrupting the PRC's Pseudo-IDM

Since the beginning of the tech competition with the PRC, export controls have emerged as one of the most important tools in economic statecraft. However, when it comes to mature-node semiconductor manufacturing, these controls are far less effective than in the case of advanced-node technologies. This is because the PRC has already built domestic capabilities to produce most of the tools and materials needed for mature-node chip production. In addition, the PRC has spent the past several years preparing for future export restrictions by stockpiling large volumes of semiconductor equipment from key suppliers in the United States, the Netherlands, and Japan. Export controls are further undermined by the fact that nearly all semiconductor tools have active second-hand markets. This allows PRC entities to bypass restrictions through various means, including smuggling, illicit procurement, and the use of complex networks of shell companies—tactics that have previously been used by firms like Huawei.

Efforts to restrict the PRC's access to semiconductor design software—such as EDA tools—face serious limitations. Because software services are intangible and often cloud-based, it is extremely difficult to enforce export controls that can fully block PRC firms from accessing them.

Given these enforcement challenges, export controls on foundational semiconductor technologies should not aim for total denial of access. Instead, the strategic goal should be to degrade the operational efficiency of the PRC's Pseudo-IDM model, which relies on national champions across the value chain.

This can be achieved by:

- Cutting off these firms' access to key inputs and services from the U.S. and allied countries, and
- Disrupting their ability to interact with global markets, thereby eroding their long-term commercial viability.

While it is true that the PRC may respond by using smuggling networks or reallocating subsidies to support sanctioned firms or build up new ones, targeted, precision-style measures can still weaken the operational efficiency of these state-backed champions. Such actions would raise barriers in supply chains, reduce access to international customers, and increase commercial isolation.

In addition, intra-provincial competition inside the PRC remains fierce. Local governments and their affiliated firms are constantly vying for national recognition and funding. By targeting entrenched champions, external measures can disrupt this internal competition, destabilize local support systems, and discourage further provincial investment in specific firms.

Ultimately, reducing the incentives for international clients to source PRC-made chips is essential for ensuring the long-term survival of private-sector semiconductor companies in the U.S. and allied countries. To this end, the report outlines two actionable pathways for applying export controls against PRC's foundational chip strategy:

- A-1: Chokepoint-based restrictions – targeting technologies or inputs the PRC cannot yet produce on its own.

- A-2: Decapitation targeting – directly weakening the leading PRC national champions that anchor the Pseudo-IDM system.

A-1. Reinforcing Chokepoint Controls in Semiconductor Equipment

Although the PRC has nearly completed its domestic capacity for manufacturing foundational chips, this report identifies two remaining chokepoints that—if subject to coordinated export controls—could still have meaningful strategic impact:

1. Photoresists, which are primarily supplied by a small group of Japanese firms, including JSR, Tokyo Ohka Kogyo, Shin-Etsu Chemical, and Fuji Electronic Materials.
2. Laser light sources used in EUV and DUV lithography, which are monopolized by Japan's Gigaphoton and Cymer, a U.S.-based company acquired by ASML (Netherlands) in 2012.

Both photoresists and laser light sources are consumable items essential to lithography processes. Laser sources typically need replacement every six months, and high-purity photoresists have a shelf life of about six months—using expired materials can significantly reduce chip yields. Unlike lithography equipment, these items cannot be stockpiled in large quantities.

Therefore, if exports of photoresists and laser light sources are effectively restricted, they could severely disrupt the PRC's mature-node semiconductor production, given its ongoing inability to manufacture these inputs domestically.

To achieve this, the report recommends that the United States work closely with Taiwan to encourage governments and companies in Japan and the Netherlands to align on export control enforcement. Providing diplomatic support and targeted incentives will be critical to building and sustaining this coalition.

A-2. Takeout Strategies Against PRC's National Champions

The U.S. federal government should take a more systematic approach to updating and expanding the Entity List in order to impose targeted sanctions on national champions cultivated under the PRC's Pseudo-IDM model. The objective is not just to penalize individual companies, but to weaken the structural framework through which the PRC promotes and protects its champions.

Unlike export controls on advanced-node semiconductors—which aim to block the PRC's access to critical tools and materials needed to achieve cutting-edge capabilities—takeout targeting focuses on identifying and disrupting PRC-backed firms that have been strategically positioned to dominate specific segments of the foundational chip market through state subsidies and unfair competition.

Given the difficulty of executing airtight chokepoint controls across the mature-node supply chain, disrupting the operations of PRC's national champions serves a different but complementary purpose: it reduces the incentive for local governments within the PRC to invest in and promote national champions, and discourages private capital from investing in PRC-based firms. Conversely, it increases investor motivation to support legacy chips manufacturers outside of the PRC.

B. Market Denial Strategy for PRC Products

The United States and its allies should adopt a multi-pronged strategy to limit the ability of PRC-based foundational chip suppliers to access global markets. Restricting these connections would weaken the PRC's Pseudo-IDM model and reduce the competitive edge of its state-backed national champions. This strategy should be built on two main pillars:

- Improving supply chain transparency and traceability, and
- Gradually reducing the use of PRC-made semiconductors in global markets.

The first and most critical step is to improve visibility across semiconductor supply chains. This report recommends implementing two key transparency tools (outlined in detail in the following sections) to track the origin and flow of chips and components.

With greater visibility, regulators can then begin a phased effort to limit the use of PRC-manufactured foundational chips and related downstream tech products. A sweeping embargo or blanket tariffs would risk major supply chain disruptions or inflationary pressure, especially given current global interdependence. Instead, this report recommends a gradual, targeted approach—beginning with sectors critical to national and economic security or with PRC firms that pose serious threats to U.S. and allied industries. The ultimate goal is to reduce long-term dependence on PRC suppliers and create stronger incentives for private investment in trusted, non-PRC semiconductor sources.

B-1 Strengthening Supply Chain Transparency

B-1-1 HTS-Based Import Disclosure Requirements

As an initial and actionable step, the U.S. federal government should legislate mandatory country-of-origin disclosure requirements for all importers of electronic goods, specifically requiring the identification of any PRC-manufactured chips.

This requirement can be operationalized through the existing Harmonized Tariff Schedule (HTS) framework by assigning detailed, component-level HTS codes to semiconductor products. Doing so would enable more granular tracking of legacy chips across supply chains, facilitate precise enforcement of tariffs or restrictions, and ensure customs agencies can systematically identify and intercept high-risk items originating from the PRC.

Drawing from the precedent set by the 2022 ***Uyghur Forced Labor Prevention Act (UFLPA)***, which imposed customs enforcement obligations against products made with forced labor, this requirement should be expanded to include PRC-manufactured foundational chips—especially in high-value, high-risk sectors such as electric vehicles, robotics, and smartphones. The U.S. should mandate that importers declare the country of origin for all semiconductors used in their products, particularly legacy chips. This would:

- Improve visibility into the movement of PRC-manufactured chips across supply chains;
- Allow customs and regulatory agencies to more precisely apply tariffs or restrictions;
- Enable downstream manufacturers (e.g., in the automotive, defense, and

industrial sectors) to assess and mitigate their exposure to high-risk components.

To ensure effectiveness, U.S. Customs and Border Protection (CBP) should be granted additional authority and funding to audit compliance. Additionally, a federal registry or tracking platform could be established to verify and monitor the origin of semiconductors used in critical industries.

B-1-2 Mandatory SEC Filings

As a complementary step, the U.S. federal government should legislate mandatory disclosure requirements for U.S.-listed companies, compelling them to report the presence of PRC-manufactured foundational chips in the products they handle. Given the dominant role that U.S.-listed firms play in the global trade of technological goods, this measure would significantly enhance supply chain transparency—particularly regarding the penetration of Chinese components into both U.S. and international markets. It would also incentivize non-PRC buyers to reduce reliance on Chinese components and shift procurement to U.S. and allied suppliers.

There is precedent for such regulatory action. The 2010 Dodd–Frank Wall Street Reform and Consumer Protection Act requires publicly traded companies to annually disclose to the U.S. Securities and Exchange Commission (SEC) their use of "conflict minerals" (3TG). Following this model, the semiconductor-origin disclosure requirement could initially target high-value, high-security sectors—such as electric vehicles, robotics, and smartphones—where the national and economic security stakes are highest.

B-2: Disconnecting PRC Products from the Global Market

There is legislative precedent for this approach, most notably the ***Uyghur Forced Labor Prevention Act (UFLPA)*** enacted in 2022, which introduced customs-based restrictions on PRC-made products and created a framework for enforcement. **Given the high cost of comprehensive enforcement, this report recommends a more pragmatic strategy: requiring importers to submit affidavits of compliance, with enforcement carried out through randomized audits. This approach would both lower administrative costs and exert psychological and legal pressure to weaken commercial ties between PRC suppliers and non-PRC markets.**

B-2-1. Defense and Critical ICT Infrastructure

As the first step in "cleaning" supply chains, the U.S. should urgently legislate a ban on the use of PRC-made chips in sectors related to national defense, aerospace, and critical ICT infrastructure. These applications often involve government funding and are relatively insulated from commercial market constraints, making legislation in this area both feasible and urgent.

B-2-2. Prohibiting Network-Connected Chips of PRC Origin

Washington should consider enacting legislation and working with allies to establish baseline cybersecurity standards that would exclude PRC-made legacy chips with network connectivity from usage in the U.S. and allied countries. The rationale is clear: chips with networking capabilities present serious cybersecurity risks to both national and allied infrastructures.

In March 2025, Spanish cybersecurity firm Tarlogic[94] revealed that the ESP32[95], a low-cost Wi-Fi/Bluetooth chip developed by PRC firm Espressif Systems, contains undisclosed "hidden features." These functions, accessed via manufacturer-specific HCI commands, allow attackers to directly read memory, implant malicious code, impersonate devices, and exfiltrate data—without altering the firmware. Priced at just USD 2 per unit, the ESP32 is widely used in consumer IoT products such as smart home appliances, medical devices, and smart locks. As of 2023, global shipments of the chip exceeded one billion units.

Excluding insecure PRC products with embedded networking capabilities would not only mitigate national security threats, but also create a revival opportunity for U.S. and allied suppliers struggling to survive. If current trends continue, many Western firms are on the brink of collapse or have already exited the market.

B-2-3. Ban Imports from PRC Military-Civil Fusion Champions

Finally, the U.S. and its allies should impose import bans on PRC end-products that serve as key commercial channels for state-backed national champions. These end-product brands—especially in business-to-business (B2B) sectors—are critical to helping upstream PRC firms gain market access and expand their global footprint. In many ways, they are the commercial lifeline of the PRC's Pseudo-IDM model and central to its strategy to challenge U.S. and allied leadership in global technology.

This report recommends targeted import restrictions on PRC end-products that are engaged in dual-use technologies or aligned with military-civil fusion strategies. These measures would limit their ability to unfairly dominate consumer markets outside the PRC. While companies like Huawei are already under scrutiny, other major firms such as BYD (electric vehicles) and DJI (drones) should also be evaluated for coordinated restrictions by the U.S. and its allies.

Maintaining leadership in end-user application markets is essential to countering the PRC's tech ambitions. At this critical moment, democratic firms are losing ground across key sectors—ranging from robotic vacuums and smartphones to electric vehicles and industrial automation—largely due to the aggressive pricing and global expansion of PRC brands. They strengthen PRC national champions by creating exclusive supply partnerships, enabling them to squeeze out democratic firms across the supply chain. Cutting off access to U.S. and allied markets would disrupt these relationships, weaken the Pseudo-IDM system, and slow the PRC's rise in foundational chip capabilities by undercutting its investment pipeline.

Reindustrializing America Requires the Efficiency and Resilience of Taiwan's Tech Ecosystem

The United States must pursue reindustrialization. History shows that America's leadership in defeating authoritarian regimes during the major conflicts of the twentieth century depended heavily on its ability to act as the "arsenal of democracy." Today, the erosion of U.S. leadership in manufacturing has become a strategic vulnerability. Without reclaiming its position as a manufacturing powerhouse—particularly in the domains that will define the next generation of technological advancement—the United States risks ceding global leadership to the PRC, which is steadily advancing a strategy of dominating hardware supply chains to encircle and displace the industries and technological capabilities of the United States and its allies.

The decline of U.S. manufacturing capacity is the result of a decades-long globalization process spanning over 30 to 40 years. Even as political leaders in Washington now commit to reversing this trend, the restructuring of global supply chains will take time. In this race against time and amid intensifying strategic competition with the PRC, the United States cannot reindustrialize alone. It must work closely with key allies that already possess robust, high-performing manufacturing ecosystems. Among them, Taiwan stands out as a singular partner. Its globally unique and market-efficient technological manufacturing ecosystem offers both the capability and the resilience needed to complement and accelerate U.S. reindustrialization efforts.

Taiwan, once a crucial enabler of PRC industrialization, must now play a pivotal role in assisting the United States in its return to manufacturing leadership. A renewed industrial partnership between the U.S. and Taiwan would deepen economic interdependence, reinforce mutual national interests, and strengthen long-term national and economic security for both parties.

A Narrowing Window: The Urgency of Counter PRC's Semiconductor Offensive

Taking immediate and decisive action against the PRC's pseudo-IDM model and its state-backed national champions—engineered through distorted and unfair competitive practices—is essential. The fundamental objective is to deploy policy tools to safeguard semiconductor companies in the United States, Taiwan, and other democratic nations that rely on free-market principles and fair competition, ensuring their continued survival and capacity for innovation.

The next four years will be pivotal. If no concrete measures are taken, we risk witnessing the collapse of a significant number of semiconductor firms across the United States, Taiwan, and the broader democratic world within a short span of time, driven by deteriorating financial viability. Such a scenario would shift the trajectory of U.S.-PRC strategic competition. Today, while a narrow window of policy options remains to contain the PRC's ambitions in critical, civilization-defining technologies such as artificial intelligence, inaction would enable Beijing to leverage its vast supply chain arsenal to launch a systematic encirclement—transitioning from industrial policy to active economic coercion. This would allow the PRC to eliminate efficiency-based competitors and ultimately establish itself as the dominant force in global technology and geopolitical order.

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