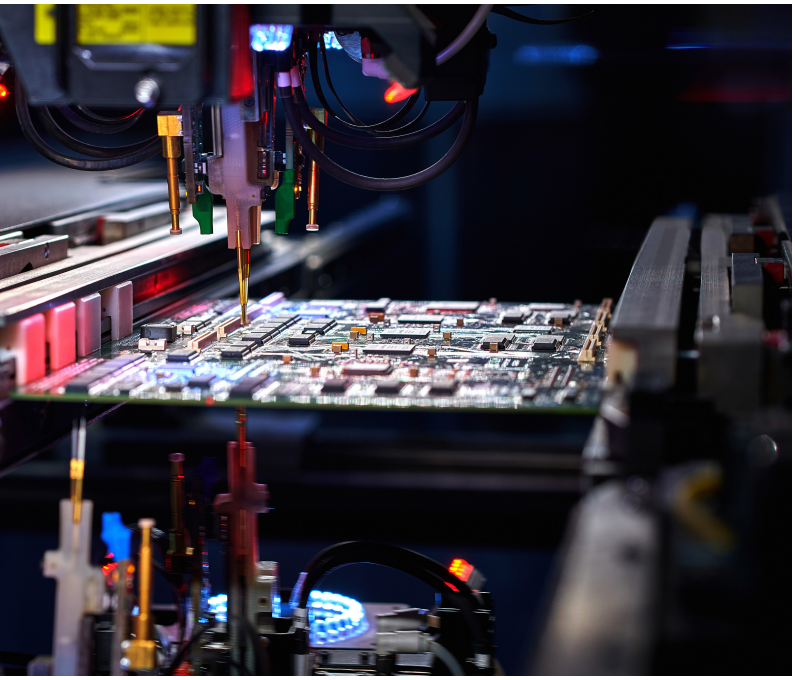
CURRENT- AND FUTURE-STATE LEGACY SEMICONDUCTOR MANUFACTURING CAPACITY

By Will Kirkman, Graham Newell, Ph.D., and Dr. Dan Brown



Legacy semiconductors, defined for the purposes of this briefing* as logic chips with a transistor architecture geometry of 28 nm or higher, compose a significant part of the global semiconductor industry. These chips are vital to economic and social productivity—powering vehicles, medical devices, machinery, consumer electronics, and more.

* This definition excludes analog semiconductors, discrete semiconductor devices, memory, microelectromechanical systems (MEMS), optoelectronics, optical semiconductors, epi wafers, sensors, and actuators.

[1] https://www.semi.org/en

This briefing addresses two primary questions: First, it seeks to understand the current market share environment and production capacity for legacy chips by country. Second, it aims to establish a timeline for building additional manufacturing capacity, including where and when production is expected to start.

MITRE researchers analyzed data from the World Fab Forecast from Semi.org,[1] a leading microelectronics market intelligence provider, to answer these questions, drawing on expertise in semiconductor technologies, economics, and supply chains.

China holds a large portion of the global capacity for legacy chips, accounting for 39.3% of the total. This equates to roughly 1.66 million units per month. By contrast, just 7.5% of global capacity is in the United States.

Since 2019, China has been responsible for between 75% to 97% of new legacy fab capacity each year, indicating strong investment in this sector. Chip manufacturers outside of China are generally hesitant to invest in new legacy capacity given low margins for these product lines.

China has announced plans to continue rapid expansion of legacy chip capacity, adding more pressure to already low industry margins. This further reduces private industry's incentive to build capacity elsewhere; significant expansions outside of China are not planned to begin production until 2027.

Market Share Insights

Previous generations of legacy chip manufacturing used 200 mm silicon wafers, whereas the current generation uses 300 mm (12-inch) wafers. The world's monthly production capacity for these legacy chips is approximately 4.2 million 12-inch equivalent wafers—produced across 263 fab lines.

The top 20 firms, largely based in China, followed by Taiwan and Japan, account for 74.2% of global production capacity. The remaining 104 companies account for 25.8%. (See Figure 1.)

Production Timeline Realities

It typically takes around 2.5 years from the start of construction to upgrade or change a fab to begin commercial production. Given this reality, current plans offer only limited new capacity beginning in 2026 and beyond. (See Figure 2.)

As industrial policy becomes increasingly linked to new investments, additions to capacity should be vetted on both the commercial feasibility and strategic merits of any proposed expansion. Specifically, the need to increase resilience and preserve market access will likely have to be weighed against operating in less favorable business conditions.

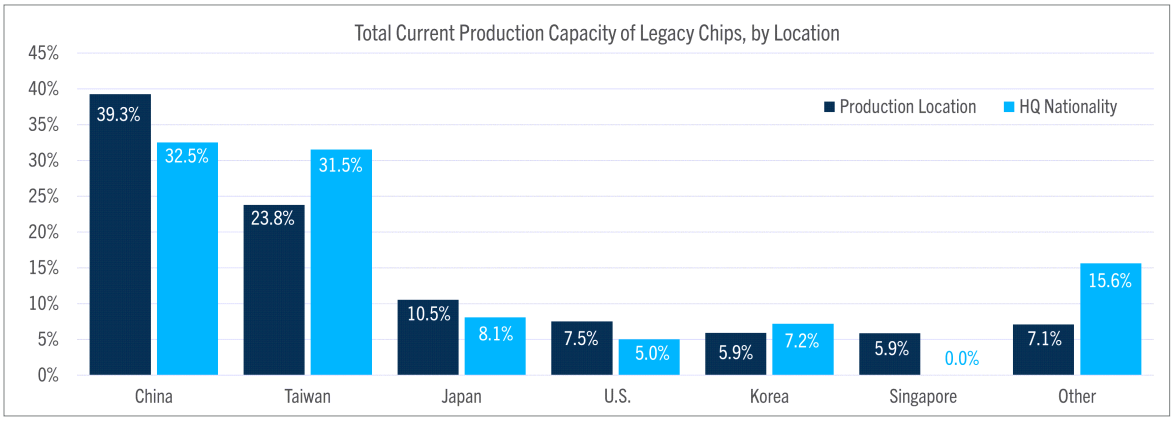


Figure 1: MITRE Analysis of SEMI World Fab Forecast, Q1 '24

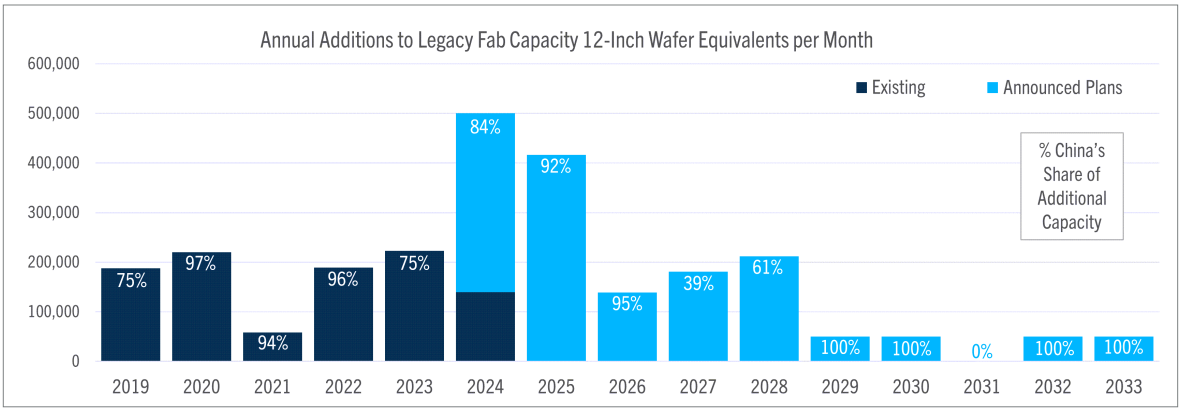


Figure 2: MITRE Analysis of SEMI World Fab Forecast, Q1 '24

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