

The US Market for AI & Crypto Hardware

By John Benson

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1. Introduction

I don't do a deep dive in the most advanced high-volume computer chips very often, but as important as this technology is to the Electric Utility Industry, I believe it's time now. Also, several good articles on this subject came across my desk recently, so I have added resources to help my readers understand this complex technology / manufacturing landscape.

My last deep dive into a similar topic was in mid-2022, summarized and linked below.

Chips Dip: *Everyone probably has heard about the chip-crisis that the auto industry (and others) has been experiencing. I have been looking for a really good explanation of this that I could share with my readers. I finally found one.*

You probably thought that the Electric Utility Industry was immune from this. Ha! Read Section 2 of this post.

<https://energycentral.com/c/iu/chips-dip>

The micro-electronics industry has evolved since the above post. The main driving force has changed from consumer-goods to massive data centers that enable artificial intelligence (AI) and encryption of sensitive data (crypto). These applications are driven by large data centers using massively parallel processors called graphics processing units (GPUs). These units can address a range of complex problems, including creating images and video (graphics).

2. GPU Companies

As part of the international effort to design and produce GPUs, the companies that perform these functions have also been evolving. Examples of this include two major companies in this sector that have evolved away from direct competition.

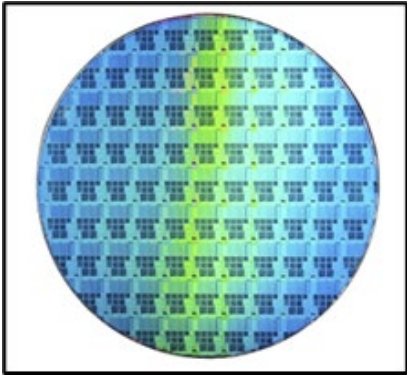
2.1. Taiwan Semiconductor Manufacturing Company (TSMC)

As their name suggest, TSMC started in Tiawan, but have evolved to be a multinational corporation.

Taiwan Semiconductor manufacturers, tests and sells semiconductors, also known as chips, to customers all over the world. Its products are used in gaming consoles, computers, smartphones and high-performance computing applications in the internet of things, autonomous driving and AI markets.¹

In 2022, TSMC produced more than 15 million 12-inch wafer equivalents. (Wafers are thin slices of semiconductor material, usually silicon, and each wafer hosts many chips, See image on the top of the next page.) The company has fabrication facilities in Taiwan, China and the U.S., plus customer service locations in North America, Europe, Japan, China and South Korea.

¹ Catherine Brock, Forbes, "Nvidia Vs. TSMC Stock: Which Is The Better Buy? Oct 10, 2023, <https://www.forbes.com/sites/investor-hub/article/tsmc-vs-nvidia/>



TSMC is the world's largest “pure play” chip foundry. That means TSMC only produces chips under contract for its customers. Those customers are mostly chip designers and electronics brands that use semiconductors in their products. The names on that list include Apple, Advanced Micro Devices, Broadcom and Nvidia. TSMC does not produce chips for its own use or under its own brand name.

Statista reports TSMC's market share at 58.5%. That dwarfs the 15.8% market share of its next closest competitor, Samsung Electronics.

2.2. Nvidia

Nvidia has an entirely different business model. Nvidia is a “fabless” chipmaker, meaning it designs specialized chips and farms out the manufacturing to foundries like TSMC and Samsung. So TSMC and Nvidia are not competitors; they are more like partners.

Nvidia pioneered the GPU (graphics processing unit) in the late-1990s. GPUs are high-powered chips designed to render realistic on-screen graphics quickly. They do so by processing multiple tasks simultaneously. The parallel processing innovation greatly enhanced the video gaming experience in the early 2000s and beyond.

As a result, Nvidia quickly gained a stronghold in gaming, which continues today. The company has since put its technology to work in data centers, autonomous vehicles, artificial intelligence applications and cryptocurrency mining².

2.3. TSMC Expanding in US

After years of planning, building, geopolitical wrangling, and workforce challenges, the world's largest semiconductor foundry, Taiwan Semiconductor Manufacturing Co. (TSMC), is officially starting mass production at an advanced chip-manufacturing facility in Phoenix in 2025. The fab represents the arrival of advanced chip manufacturing in the United States and a test of whether the 2022 CHIPS and Science Act can help stabilize the semiconductor-industry supply chain for the United States and its allies.³

In late October 2024, the company announced that yields at TSMC's Arizona Fab were 4 percent higher than those at plants in Taiwan, a promising early sign of the fab's efficiency. The current fab is capable of operating at the 4-nanometer node, the process used to make Nvidia's most advanced GPUs. A second fab, set to be operational in 2028, plans to offer 2- or 3-nm-node processes. Both 4-nm and more advanced 3-nm chips began high-volume production at other TSMC fabs in 2022, while the 2-nm node will begin volume production in Taiwan this year. In the future, the company also has plans to open a third fab in the United States that will use more advanced technology.

² <https://hackr.io/blog/best-gpu-for-mining>

³ Katherine Bourzac, IEEE Spectrum, Top Tech 2025, “The U.S. Will Start Manufacturing Advanced Chips,” Jan, 2025 Issue. <https://spectrum.ieee.org/amp/tsmc-arizona-2670491914>



TMSC's Arizona Fab

The chip-manufacturing giant is currently set to receive US \$6.6 billion in CHIPS Act funding for building the first Arizona plant. But government funding isn't the only reason semiconductor manufacturing is coming back to the United States. TSMC makes 90 percent of the world's advanced chips, and U.S.-based companies including Apple, Nvidia, Google, Amazon, and Qualcomm rely on them. The chip shortages during the economic shock of the early COVID years, and Chinese president Xi Jinping's increasingly aggressive rhetoric about Taiwan, have made TSMC's customers and international policymakers uncomfortable.

TSMC announced their intention to invest in Arizona in 2020. "The CHIPS Act didn't make it happen—companies have largely moved on their own," says Tech-Insights semiconductor analyst Dan Hutcheson. Big customers like Apple have been pushing TSMC to build fabs elsewhere to minimize risk, he says.

Hutcheson says having TSMC fabs outside Taiwan is good for the company's customers and good for Taiwan. The island's "silicon shield" against China has done its work—TSMC's dominance in advanced chip manufacturing gives the United States and other countries a reason to support Taiwan. But going forward, Hutcheson says the shield could turn into a target. If the United States and its allies are increasingly dependent on chips made only in Taiwan, then China can cause major damage to the U.S. economy by targeting Taiwan. Hutcheson says TSMC's geographical diversification will make its home country less of a target. The company has also opened a fab in Japan and is building one in Germany.

Author's comment: One big advantage in being a multinational company is the increased resilience, and the ability to go where the company's best customers are. Not only will this make TSMC (and thus Taiwan) less of a target by bad actors as pointed out above. It will also help TSMC better understand their best customers' markets, politics, and constraints. See the excerpt below.

*Reaction to the Arizona fab in Taiwan has been mixed. An investigation published in Rest of World in April 2024 featured American workers sent to Taiwan to train for a year complaining about poor working conditions and inadequate training; in the same article, Taiwanese workers complained that Americans are arrogant and don't have the work ethic for a semiconductor fab.*³

"TSMC is operated like a military organization. Decisions are top-down and you are not to ask questions," says University of Chicago economics professor Chang-Tai Hsieh, who once worked at the company.

On the other hand, many American engineers espouse the Silicon Valley attitude of "move fast and break things," says Jason Hsu, a former legislator in Taiwan who is now a specialist in the Indo-Pacific technology industry at the Hudson Institute, a Washington, D.C., think tank. But that's not an easy fit with a process that can be disrupted by a single speck of dust.

Hutcheson says these kinds of culture clashes are to be expected—and he says TSMC seems to have worked through them. The problem may have been that the company set unrealistic goals and timelines. TSMC saw building a fab in the United States "as a simple technology problem," says Hutcheson. "They see it as a skill set that's universal, but it's not universal. It's very culturally and legally dependent." Each city in the United States may have different building codes and permitting processes, for instance—and that's different from how things work in Taiwan, he says...

2.4. Microsoft massive Nvidia AI chip orders

*Nvidia Corporation is a US multinational corporation and technology company headquartered in Santa Clara, California. Founded in 1993 by Jensen Huang (president and CEO), Chris Malachowsky, and Curtis Priem, it is a software company which designs and supplies graphics processing units (GPUs), application programming interfaces (APIs) for data science and high-performance computing, and system on a chip units (SoCs) for mobile computing and the automotive market. Nvidia is also a dominant supplier of artificial intelligence (AI) hardware and software. Nvidia outsources the manufacturing of the hardware it designs.*⁴

*Microsoft has secured its spot at the top of the AI hardware food chain, outspending every tech giant in the game and buying 485,000 Nvidia Hopper chips this year. This leaves competitors like Meta, Amazon, and Google gasping for air in the AI arms race.*⁵

⁴ Wikipedia Article on Nvidia, <https://en.wikipedia.org/wiki/Nvidia>

⁵ Jai Hamid, Cryptopolitan, "Microsoft outbuys tech giants with massive Nvidia AI chip orders," Dec 18 2024, <https://www.cryptopolitan.com/microsoft-massive-nvidia-ai-chip-orders/>

Meta came closest but still trailed far behind, with 224,000 chips. Amazon and Google? Not even close, with orders of 196,000 and 169,000 Hopper chips respectively.

Nvidia's GPUs have become Silicon Valley's gold standard, driving a frenzy of data center investments to support cutting-edge AI models like ChatGPT. Microsoft, with its Azure cloud infrastructure, is going all in, betting big on AI as the future of tech.

Nvidia's Hopper chips, hailed as the crown jewels of AI processing, have been the hottest tech commodity for two years. They've become critical tools for training and running next-gen AI models.

Analysts at Omdia estimate that the company's purchases more than tripled compared to last year, a direct response to skyrocketing demand following ChatGPT's breakout success.

"Good data center infrastructure... takes multi-years of planning," said Alistair Speirs, senior director of Azure Global Infrastructure at Microsoft. The company is also positioning itself to dominate the cloud market, renting out its hardware to customers through Azure.

Omdia's analysis shows that Microsoft's Hopper haul dwarfs the 230,000 chips bought by ByteDance and Tencent combined. However, the chips shipped to China were modified H20 models—downgraded to comply with US export restrictions.

Nvidia tweaked these chips to limit their capabilities, but even with reduced power, Chinese companies are snapping them up.

This year alone, tech companies have shelled out a jaw-dropping \$229 billion on servers, with Microsoft leading the charge. The company's \$31 billion capital expenditure makes it the biggest spender in the global AI infrastructure boom, overshadowing Amazon's \$26 billion.

According to Omdia, Nvidia GPUs accounted for 43% of server spending in 2024, cementing the company's dominance in AI hardware. Nvidia's Hopper chips may be the star, but Microsoft isn't putting all its eggs in one basket. It has begun rolling out its own Maia chips, installing 200,000 units this year.

Meanwhile, Amazon has been ramping up production of its Trainium and Inferentia chips, deploying 1.3 million units to fuel its AI ambitions. It's even building a new AI cluster featuring hundreds of thousands of Trainium chips for Anthropic, an OpenAI competitor it has backed with an \$8 billion investment.

Meta and Google are also doubling down on their in-house chips, each deploying around 1.5 million units of their custom designs.

Final author's comment: I've tracked AI for a few years, and:

Your author has been using an AI-based utility for several months (Microsoft Bing generative AI), and find it very useful, but also flawed tool (as most tools are), and thus the OI (organic intelligence, a.k.a. your author) always checks and edits its responses.⁶

By the way, I believe that "Microsoft Bing generative AI" in the above paragraph heavily uses ChatGPT by OpenAI. Further:

⁶ <https://energycentral.com/c/ec/fool-self-driving-%E2%80%93-half-baked-ai-technology>

OpenAI is an American artificial intelligence (AI) research organization founded in December 2015 and headquartered in San Francisco, California. Its stated mission is to develop "safe and beneficial" artificial general intelligence (AGI), which it defines as "highly autonomous systems that outperform humans at most economically valuable work". As a leading organization in the ongoing AI boom, OpenAI is known for the GPT family of large language models, the DALL-E series of text-to-image models, and a text-to-video model named Sora. Its release of ChatGPT in November 2022 has been credited with catalyzing widespread interest in generative AI.⁷

OpenAI consists of the non-profit OpenAI, Inc., registered in Delaware, and its for-profit subsidiary introduced in 2019, OpenAI Global, LLC. Microsoft owns roughly 49% of OpenAI's equity, having invested US\$13 billion. It also provides computing resources to OpenAI through its cloud platform, Microsoft Azure.

⁷ <https://en.wikipedia.org/wiki/OpenAI>