

The Silicon Chip Shortage

Tejash Gupta*

Semiconductors power the modern world, from consumer devices to the machines that manufacture them. These microprocessors are used in phones, computers, cars, household appliances, televisions, advanced medical equipment, and many other electrical devices. However, there is a problem: the world is in the midst of a large-scale, global Silicon Chip Shortage.

1 Foundries, the Pandemic, and Other Disasters

The modern semiconductor industry is massive, consisting of companies like Taiwan Semiconductor Manufacturing Company (TSMC) and Samsung, who own the world's largest semiconductor foundries. There are also "semiconductor companies that design the chips called fabless companies" including Qualcomm, Broadcom, Nvidia, MediaTek, AMD, and Apple[1]. Fabless companies all rely on large foundry companies (who own factories that fabricate the chips) to supply them with resources to manufacture products. Because this network of interdependence relies so heavily on a concentrated industry, the world's production of electronics that harness these chips is extremely fragile.

Heavy reliance on one main foundry, TSMC, has led to a chip shortage during the COVID-19 pandemic. In early 2020, as the pandemic started, many workplaces and schools moved to an online work environment. In turn, TSMC also slowed production. This resulted in an overall lower supply for all of the companies that rely on TSMC to manufacture chips. Additionally, there was an

*Freshman Student, Fulton Science Academy.

Contact: tgupta@fultonscienceacademy.org

immense increase in demand for electronics such as video game consoles, DIY PCs, and televisions due to working and learning from home.

Other events which amplified the shortage were the drought in Taiwan, and a fire at a chip factory in Japan. A record drought in Taiwan during 2021 affected the production semiconductors, since TSMC uses around 156,000 tons of water a day to manufacture these chips[2]. However, heavy rains through august of 2021 has helped ease the situation and has lead to an increase in production. Complicating matters further, Renesas Electronics Corps suffered a fire at one of its chip plants in Japan during 2021. This was a major blow to the car manufacturing industry, and Renesas lost from \$177.4 million to \$236.5 million as a result [3].

2 Industries Impacted

As stated, one industry that was heavily hit by this shortage was the car manufacturing industry. During the initial phase of the pandemic, many car manufacturers assumed more people would stay indoors, not commute to work, and therefore purchase fewer cars. Instead, people wanted to buy cars instead of using public transportation which increased demand for vehicles. As a result, many car manufacturers including Ford, General Motors, and Fiat Chrysler have shut down factories due to the scarcity of semiconductors[4]. This slowdown delayed the production of one million vehicles in the first quarter of 2021, costing the automotive industry \$210 billion in revenue that year[5].

The Personal Computer(PC) industry also saw an increase in demand during COVID, rising by 11% last year[4]. As people started to video call for work and school, game on computers and consoles, and stream live video, demand for PCs soared. This immediate influx of buyers put pressure on large computer companies to produce more. Companies like Nvidia and AMD both use TSMC as their main source of microprocessors and have been able to sell more chips than ever during 2020 and 2021. However, large foundries could not supply the necessary quantities, leading to a shortage of products including laptops, game consoles, graphics cards, and CPUs. For example, although new gaming consoles have been released by Microsoft, Nintendo, and Sony, the games industry has seen underwhelming launch performance due to supply issues. Additionally, cryptocurrency “miners” have been buying up large stocks of these chips in order to make money off of digital coins, further restricting supply to other

consumers.

3 The Chip Industry and its Future

Due to these supply issues, American companies have begun looking for other sources of semiconductors. During early 2021, President Joe Biden signed an executive order to conduct a review of supply chains in four sets of products including computer chips and batteries used in electric vehicles[4]. The administration also emphasized the glaring issue of semiconductor manufacturing being a weak spot in the economy. To create more semiconductors, TSMC has plans to build a \$12 billion dollar plant in Arizona. Samsung also has plans for a new foundry costing \$17 billion in the United States[6]. However, creating more foundries will not fully resolve the supply problems. Even after manufacturers receive these chips, there are extensive steps in order to create a finished consumer product. Factories creating these products are running at capacity, and will not be able to fully accommodate higher amounts of semiconductors. All parts of the supply chain will need to be upgraded in order to increase the total output of products, so this shortage will continue for quite some time.

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