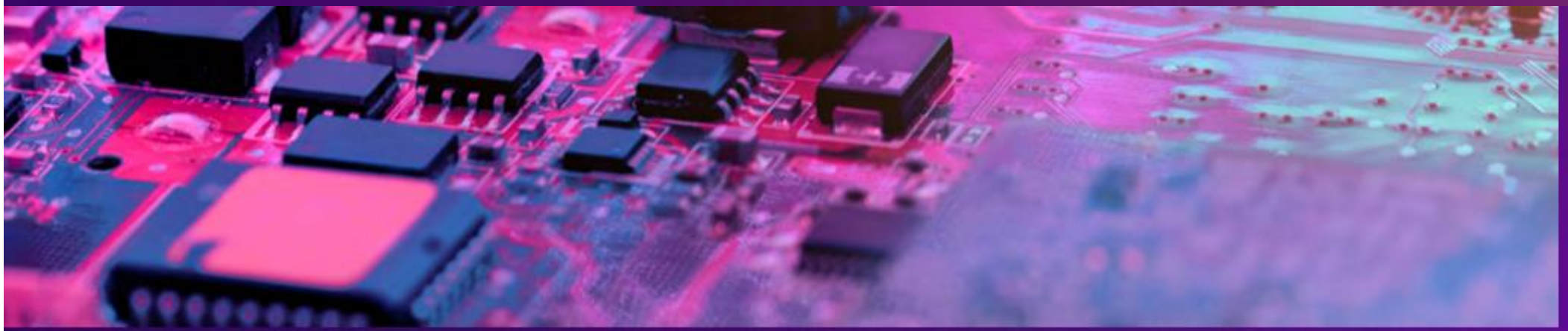
The long view of the chip shortage



Building resiliency in semiconductor supply chains

Hit by a perfect storm

The chip shortage of 2021 sparked a crisis in the global economy. Apple, the world's largest buyer of chips, delayed the launch of the iPhone 12 by two months; Samsung, the second-largest buyer—and also the second-largest producer—will likely have to do the same for its new smartphone.[1] The global auto industry is expected to lose $60.6 billion in revenue in 2021.[2] The semiconductor shortage even caught the attention of US President Joe Biden who hosted a virtual summit with CEOs from affected industries.[3]

So, what caused the shortage?

A perfect storm of skyrocketing chip demand, manufacturing capacity and logistics constraints.

Electronics demand goes into the stratosphere

As working and learning from home became the norm during COVID-19—and dollars went from going out for entertainment to streaming and gaming at home—our behaviors fundamentally changed. This resulted in a booming demand for consumer electronics.[4]

Growing demand for devices in turn drove up demand for semiconductors. Every video game console, TV or tablet required numerous chips that were needed for display, power, connectivity and other functionalities.[5]

Logistics constraints limit chip shipments

To make matters worse, chip shipments themselves were delayed due to the reduced amount of flights and closure of airways. Additionally, global shipments of COVID-19 related items taking up capacity and the global grounding of dozens of B777 due to engine failures further put pressure on air cargo capacity. In total, global air cargo capacity declined a staggering 20% in 2020.[6]

And on top of that, substrates—the basis on which chip components and their connections are built—were limited in supply due to a factory fire in Taiwan, which further impacted chip production.[7]

Long lead times

Strong demand drove an imbalance in supply. For an industry that has long production lead times of ~18 weeks—and where building additional capacity requires 6 to 9 months and billions of dollars of revenue, this meant supply recovery would be slow and costly.

Average Semiconductor Manufacturing Lead Time (weeks)

Typical duration weeks

Wafer Fabrication	Assembly	Test
10-14	1-2	1-2

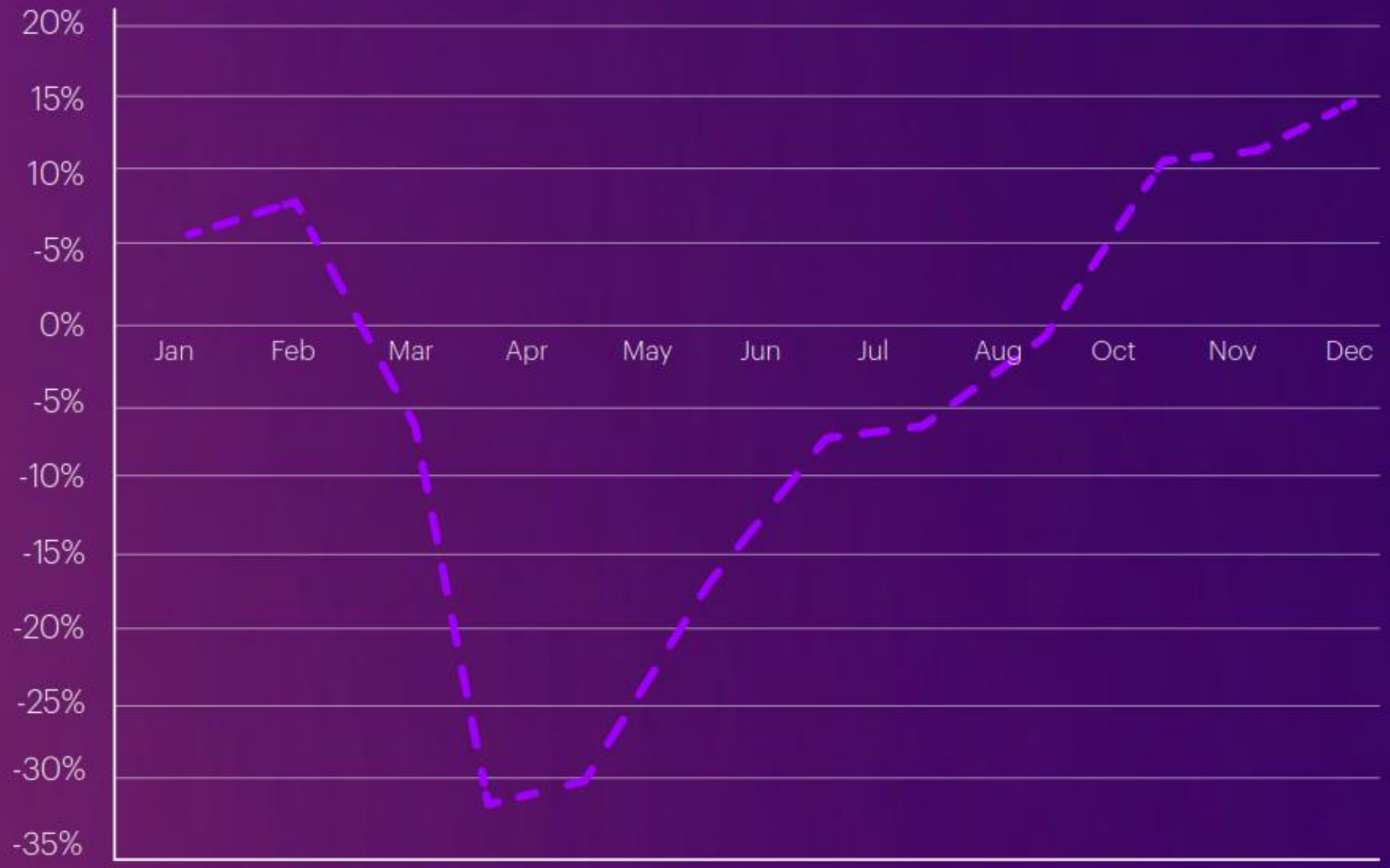
Shortage strikes automakers first

In the spring of 2020, automobile sales began to drop precipitously as showrooms closed their doors. With a bleak outlook for the automotive industry due to the pandemic, companies forecasted a sustained drop in demand for their products and made decisions to reduce their demand for chips. This capacity was quickly claimed by the boom in electronics and other markets.

But contrary to forecasts, vehicle sales rebounded incredibly fast, within just a few months, as a V-shaped recovery (see chart below). Imperfect inventory planning caused chip shortages and halted production.

“The problem is even if that 10-cent chip is missing, you can’t sell your $30,000 car,” said Gaurav Gupta, semiconductor analyst at Gartner.

Year-over-year (2020 vs. 2019) monthly sales growth percentage change in automotive ICs



Source: World Semiconductor Trade Statistics Bluebook sales data 2020-2019

Limited number of wafer fabrication companies supporting the semiconductor ecosystem

470
Semiconductor companies

188
Test engineering

150
Design

101
Package engineering

31
Fabrication

Rethinking supply networks and co-location

Owning fabrication houses is a costly investment, which is why many semiconductor firms prefer to outsource to major foundries overseas—particularly in Taiwan. Taiwanese contract manufacturers such as TSMC dominate semiconductor manufacturing, accounting for over 60% of total global foundry revenue in 2020.[11]

But as we've witnessed with the pandemic of 2020—and the abrupt halt to overseas transit—dependencies on overseas vendors for critical supplies are a vulnerability.

Companies should give serious consideration to not only multi-sourcing strategies but also to a hybrid of insourcing and outsourcing. While building or procuring domestic fabrication houses is costly, investing in on-premises manufacturing can add supply assurance and increase leverage over supply during times of spiking demand. This type of co-location strategy would shrink the length of trade routes and move end points closer on the supply chain network.

Increasing capacity utilization for fabrication houses is just as critical to diversifying supply networks—and enabling greater speed. Over the past two decades, the semiconductor industry has been increasing utilization to keep pace with demand, but this effort takes time. A renewed focus on higher utilization is key to increasing chip output and allowing companies to fully meet the increased demand in the market.