

INCREASING CHIP PRODUCTION

INDUSTRY SHOULDERING IN TO ADDRESS SHORTAGES

Packed with up to tens of billions of transistors on a piece of real estate the size of a quarter, semiconductors are perhaps the world's most complex, costly, and research-intensive product humankind has ever manufactured. Global demand for semiconductors is at an all-time high, and global chip shortages have impacted a range of industries. The semiconductor industry has taken extraordinary measures to address the shortage in the short, medium, and long term.

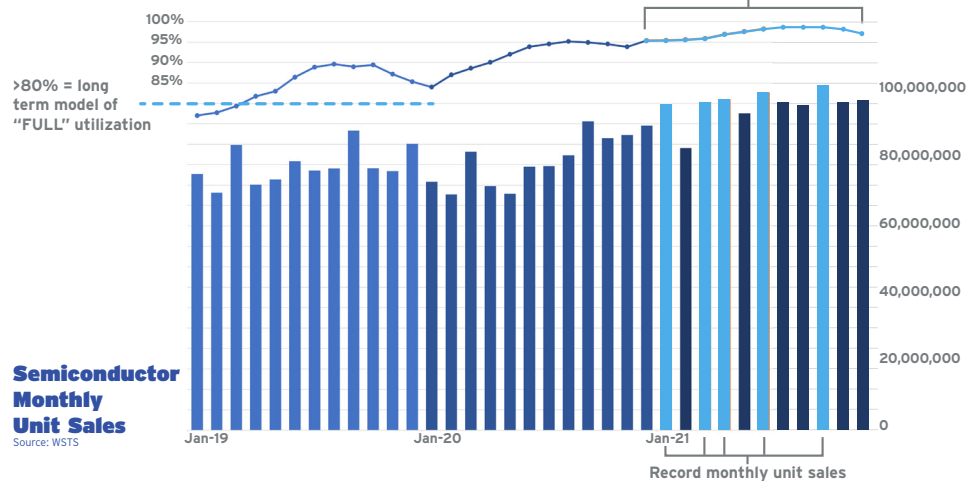
THE SHORT TERM: UTILIZE ALL THE CURRENT CAPACITY AVAILABLE

Building a new semiconductor fab takes 18-24 months on average.

To increase chip production in the short term, fab capacity utilization needs to increase, and this is what the industry has been doing. Since the first quarter of 2019, quarterly fab capacity utilization has run well above the "full" rate, and in recent quarters it has been over 95%.

Monthly Fab Utilization

Source: VLSI Research



Semiconductor Monthly Unit Sales

Source: WSTS

This increased utilization has resulted in:

Ramped Up Wafer Starts:

Between January 2020 and January 2022, the global industry is projected to have added enough manufacturing capacity to produce an additional 4 million wafers per month, an increase of over 20%. Three-fourths of this new manufacturing capacity had already come on-line as of October 2021.

Record Chip Sales:

There were more semiconductor units sold in 3Q2021 than during any other quarter in history. In fact, five of the first 11 months of 2021 set new records for monthly semiconductor units sold. September 2021 unit sales were the highest ever at 103 billion. And over 1 trillion semiconductors were sold in 2021, easily the highest total on record.

Record Auto Chip Sales:

For every month from September 2020 through November 2021 (the last month of available data), the monthly total of automotive application-specific semiconductors sold has surpassed the previous record total set in September 2018.

THE MEDIUM TERM: COMPLETE CURRENT CONSTRUCTION AND RAMP UP NEW FAB OUTPUT

For fab projects that are under construction or recently finished, the industry's goal has been to get them completed and ramped up to full capacity as quickly as possible.

New Fab Construction:

In 2021, the global semiconductor industry announced plans to construct 39 new fabs globally (4 in the U.S.), and more than a dozen of these projects are already under construction. Additional announcements have already been made early in 2022.

THE LONG TERM: INCREASE CAPITAL SPENDING

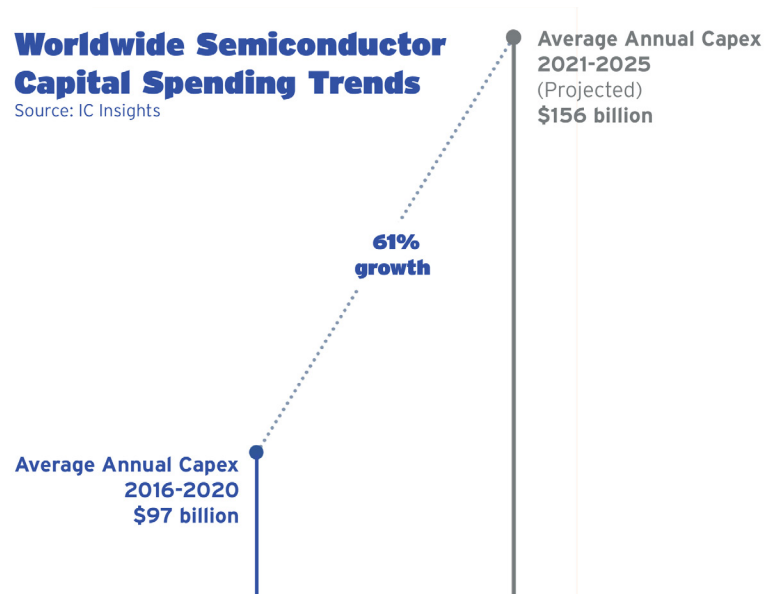
For increasing production two and more years out, a good indicator the industry is taking steps to do that is through capital spending rates (capex). Starting in 2021, there is clearly a trend toward increased and sustained levels of capex.

Record Capital Spending:

Global semiconductor industry capex in 2021 is forecast to reach its highest level on record at \$148 billion and to grow by 30% compared to 2020 spending levels. And the amount of annual industry capex projected over the next five years represents a significant jump from previous annual levels. Annual spending rates are projected to average \$156 billion from 2021-2025, while the annual average from 2016-2020 was \$97 billion. This change represents an increase in capex growth of 61%.

Worldwide Semiconductor Capital Spending Trends

Source: IC Insights



Sources: VLSI Research, The Chip Insider; IC Insights, the McClean Report 2021, Mid-Year Update; World Semiconductor Trade Statistics (WSTS) monthly Bluebook sales data; and SIA-derived estimates.

