Semiconductor shortage: A different kind of trouble ahead

Not over yet: Shortage, oversupply and excess inventory at the same time

October 2022

Roland Berger

Demand for consumer electronics is under pressure, but for legacy nodes, we expect the supply/demand and imbalance to remain for several years

Consumer electronics shipments are decreasing by up to 30%

As consumer demand softens, chip makers are building-back their inventories from historic lows. This has effectively ended the short-term chip shortage in the consumer, computer, and communication segments. Consequently, global semiconductor revenue growth is expected to decline in 2022 and 2023.

The good news is declining consumer demand has improved supply of leading-edge and advanced-node semiconductors. The bad news: this will not improve the low supply of legacy chips (based on 8" and 6" wafers) that are most relevant for automotive and industrial companies.

Semiconductor users now have to walk a tight ridge: managing an inventory correction and supply bottlenecks are simultaneously required for sustainable financials.

MARKET SIGNS INDICATE A RELIEF FOR SEMICONDUCTOR SHORTAGE, AS DEMAND FOR CONSUMER ELECTRONICS HAS SLUMPED THE LAST QUARTERS
Implications

Consumer electronics demand had decreased significantly after an acceleration during the pandemic, causing loading of front-end and especially back-end fabs dropping significantly

Improvements in semiconductor supply chain expected for the automotive industry as more chip capacity is available, e.g., chipmakers as TSMC and NXP have reported increased automotive business for the latest quarters

Access inventories in the electronic manufacturing industry may surface short-term

Source: Bloomberg, Wall Street Journal, MarketWatch, Roland Berger

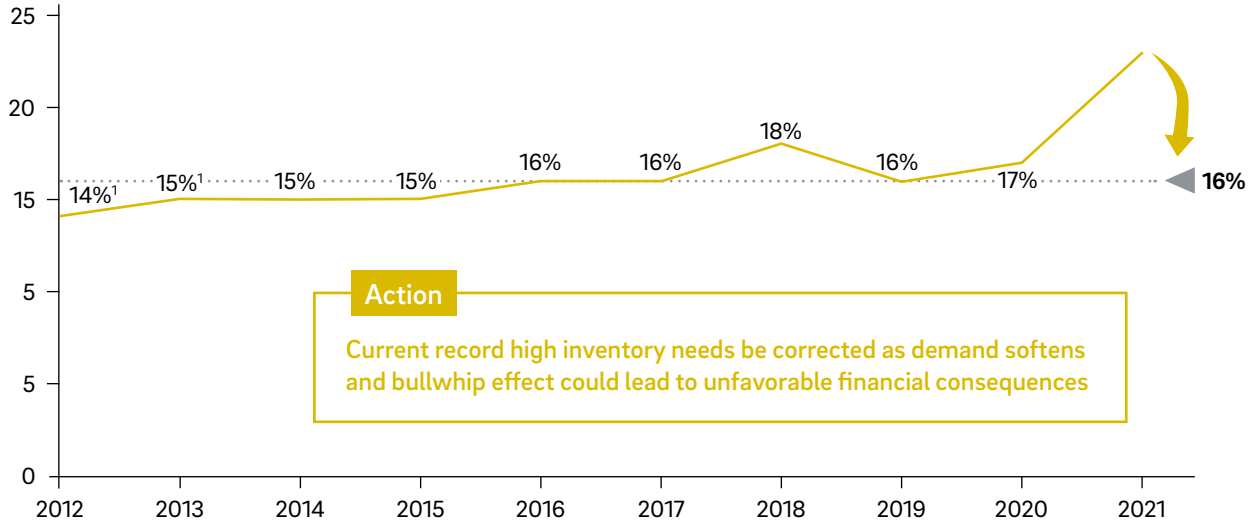
Excess inventory – which semiconductor companies, EMS providers, and some Tier-1 companies recently built up to safeguard production – could become an issue
As global demand decreases, we expect a significant bullwhip effect

Many automotive and industrial OEMs and their Tier-1 suppliers have ordered surplus chips to increase safety stocks and ensure ongoing production during the pandemic. For example, key EMS players increased their inventory from a historic average of 16% to 23%. These surplus chips could turn into excess inventories when demand slows down.

Excess ordering had a significant impact on increasing chip shortages in the last two years. Now, as global demand for chips decreases, there is an elevated risk for a bullwhip effect. To avoid an unfavorable financial situation, or even scrapping stocks, manufacturing companies must take action to ready their inventories for tomorrow.

BRINGING INVENTORY LEVEL BACK TO NORMAL WILL BE KEY IN THE SHORT-TERM TO AVOID AN UNFAVORABLE SITUATION IN FINANCIALS

The aggregate average inventory to sales ratio for the select 22 EMS, [%]



"Given the level of shortage, double ordering [...] we believe the forthcoming inventory correction could be quite sharp, leading to potentially greater earnings cuts [...] than the 2019 and 2016 downcycles."
Investment Analyst

"The demand boost for smartphones and PCs from remote working is clearly disappearing. And we should be wary of risks that inventory adjustments are not as mild as [some companies] were hoping for just a couple of months ago." Chief analyst at Rakuten

Source: Companies' public information, Roland Berger

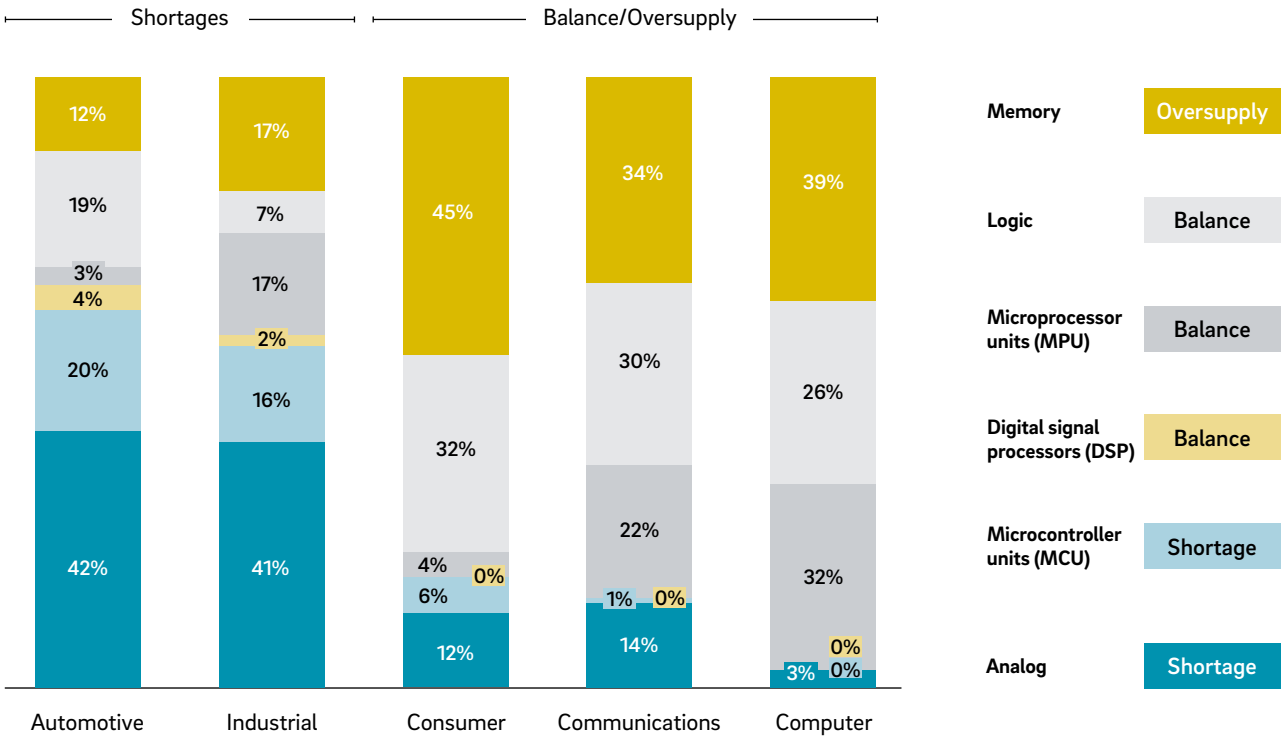
Supply-demand imbalances in mature and legacy nodes are expected to continue, despite decreasing demand and increased investments
Capacity expansion primarily focuses on leading edge and advanced node sizes

Due to limited capacity build-ups in the last decade and insufficient expansions going forward, we expect ongoing shortages for legacy and mature node chips that are primarily used by automotive and industrial companies.

For example, 62% of the automotive market and 57% of the industrial market relies on analog/mixed signal chips, microcontroller units, or specialty components such as MEMS. These are at an increased risk of being short in supply as chip manufacturers increasingly look to "future proof" investments in advanced chips. At the same time, obsolescence announcements of IDMs for their legacy portfolios create added pressure (and cost) for OEMs and Tier-1 to re-design their devices when reconsidering their hardware architectures.

"The automotive segment is a key end-market using analog and microcontroller semiconductors," one market expert told us. "This is the root cause for their dependence on older nodes."

AUTOMOTIVE AND INDUSTRIAL ARE PARTICULARLY AFFECTED BY SEMICONDUCTOR SHORTAGE, DUE TO HIGH USE OF ANALOG AND MCU CHIPS IN CRITICAL APPLICATIONS
Total IC sales by type and end-industry [in % of total spend, 2020][1]



[1] Analysis not including passive components (discrete, optoelectronics, sensors)

Source: IC Insights (The Mclean report), Roland Berger

Japan, South Korea and Taiwan have more efficient semiconductor policies than the upcoming CHIPS acts in Europe and the US

They will have limited impact on legacy chip production, relevant to automotive industry

Asian countries, especially Korea, Taiwan, and Japan, are already ahead on their semiconductor investments in an effort to improve their global positioning and protect supply chains. On the other hand, the US automotive industry has not (yet) benefited from the recently signed US CHIPS Act. The majority of funds are allocated towards advanced nodes, while any actual improvement on capacity will only come after 2025. Similarly, the European Union's announced investments are expected to have no impact on improving EU's semiconductor supply.

EUROPEAN UNION SEMICONDUCTOR POLICIES FALLING BEHIND BENCHMARKS
Benchmarking of semiconductor policies

Sucess factors	Japan	South Korea	Taiwan	United States	China	Europe
1 Focus on market requirements and specialize	●	◕	●	●	◑	◔!
2 Focus on local needs	●	◕	◕	◕	●	○!
3 Technology partnership with leading countries	●	●	●	◕	◔!	◑
4 Build a regional cluster	◕	●	●	◑	◑	◕
5 Fast and pragmatic funding of high investments	◕	●	●	◑	●	◔!
6 Continuous operational subsidies	◕	◑	◑	◑	◕	◔!

Recommendation for EU

- Further drive innovativeness in More than Moore technologies
- Focus on manufacturing relevant for automotive and industrial – Mature and advanced nodes rather than high-end
- Allocate and channel funds much faster
- Consider more operational subsidies
- Improve on secondary decision criteria such as regulations, energy supply, and education

● best in class policy ○ policy with improvement need

Source: Roland Berger

Recently signed US CHIPS Act is expected to improve advanced semiconductor capacity only after 2025
Process to access the available funding not clearly defined yet

UNITED STATES

Only 5% of public funding will go towards legacy chip production

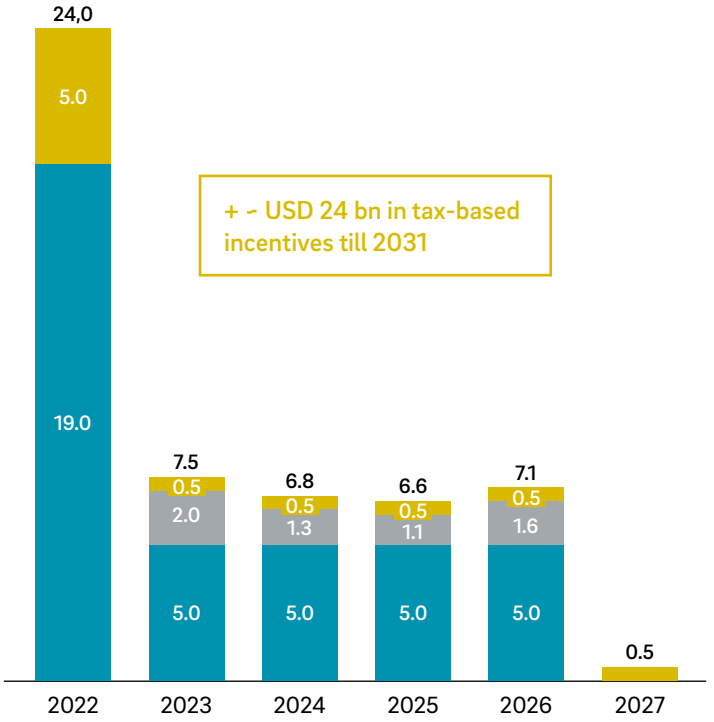
The recently signed US CHIPS Act will provide more than $52 billion to help boost the US semiconductor market, including $39 billion for semiconductor manufacturing, $11 billion for R&D, and $2.7 billion for supplementary programs. It will not resolve the shortage in automotive and industry applications, however, due to its focus on advanced technology. Out of the $39 billion in subsidies for semiconductor manufacturing, just $2 billion (or 5%) has been secured for legacy chip production.

Furthermore, the specific rules, application process, and timing of funding is vague. This will likely to cause further delays in alleviating ongoing shortages for the automotive and industrial markets. We expect limited improvement on the US semiconductor market before 2024–2025 driven by the CHIPS Act.

CHIPS ACT IS CONSISTED OF 3 MAJOR PROGRAMS RUNNING FOR A 5-YEAR PERIOD AND THE TAX INCENTIVE PROGRAM RUNNING FOR A 10-YEAR PERIOD

Allocation of CHIPS Act funds

Allocation of funds over time, 2022-2027 [USD bn]



Allocation of funds by program, [USD bn]

Semiconductor Incentives Programs ('22–'26)	**39.0**
Semiconductor subsidies	37.0
Subsidies for legacy chips	2.0
R&D and Workforce Development Programs ('22–'26)	**11.0**
Advanced packaging (2022)	2.5
NSTC[1] (2022)	2.0
Other related programs (2022)	0.5
Use across all programs ('23–'26)	6.0
Supplementary Programs ('23–'27)	**2.7**
America Defense Fund	2.0
America International Security and Innovation Fund	0.5
America Workforce and Education Fund	0.2

[1] National Semiconductor Technology Center

Source: U.S. Senate Committee on Commerce, Science & Transportation

The European chips act is not sufficient in terms of volume to support the required growth
Significant increase in funding required to accelerate growth

EUROPE

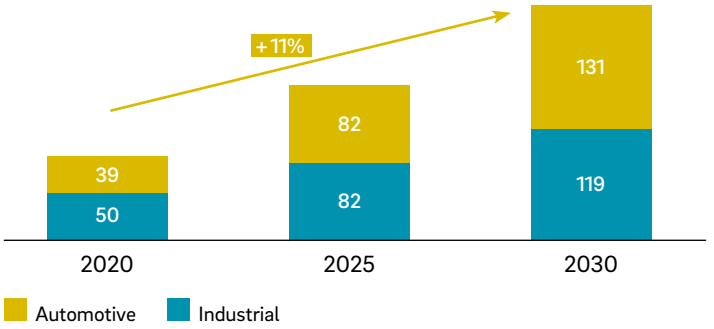
The budget for the European Chips Act is unlikely sufficient to secure risk-free operations and for Europe to achieve 20% of the global market share by 2030

Among made-in-the-EU industrial and automotive products, only 17% and 37% of semiconductor parts are delivered by EU suppliers, respectively. To address the remaining EU demand and enable the expected demand growth for automotive semiconductors, further production capacity will be needed immediately for mature and advanced nodes. While the European Chips Act is an important first step, the assigned budget of EUR $43 billion is insufficient and too stringent. For comparison, Korea, China, and USA all aim or significantly higher budgets to become the market leader in the semiconductor industry.

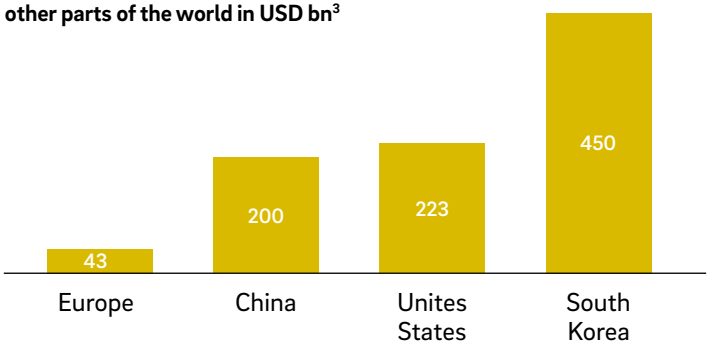
BUDGET OF THE EUROPEAN CHIPS ACT IS LIKELY INSUFFICIENT FOR EUROPE TO SECURE RISK-FREE OPERATIONS AND ACHIEVE 20% OF THE GLOBAL MARKET SHARE BY 2030

European Chips Act impact evaluation

Semiconductor market size forecast by application in USD bn[1,2]



European Chips Act funding comparison with other parts of the world in USD bn[3]



European Chips Act is a good initiative but likely insufficient

- Amid made-in-EU industrial and automotive products, only 17% and 37% of semiconductor parts are delivered by EU suppliers, respectively. These segments need to be targeted
- Semiconductor growth for automotive chips will be driven by xEVs and ADAS. Requires immediate focus into building further production capacity for needed mature and advanced node chips
- Korea, China and USA intended for significantly higher budget to become the market leader in the semiconductor industry

Therefore, the budget of EUR 43 bn is too stringent to build an ecosystem, secure the supply chain and operate a crisis mechanism while achieving 20% market share by 2030

Source: [1] Statista, ASML 2021, [2] Decision, ZVEI, 2019, [3] Staff Working Document (SWD) European Chips Act v15, [4] Roland Berger

Despite signs of short-term relief, affected companies will face new troubles ahead
Decision-makers must rethink their chip inventory management

In the short-term, companies must focus on correcting and optimizing their inventory to improve their cash balance and eliminate unnecessary costs, while still maintaining bottleneck management of spare parts used in production. In the mid- to long-term, companies must address the structural imbalances that continue to affect legacy chip availability. This is especially true for automotive and industrial companies who are at the greatest risk in facing future shortages. In our view, this requires continuous improvement to supply strategies and a design to risk engineering approach that includes:

1. Multi-sourcing supply strategy
2. Partnerships with semiconductor companies
3. Active reduction of legacy semiconductor content/proactive swaps
4. Sprint substitutions/new ways of qualifications
5. Centralized and modular E/E architectures with SW defined functionality
6. Alignment of design process with the lifecycle management of product and components

Summary
Automotive and industrial companies continue to be confronted by short supply of “legacy nodes” – despite an easing of demand in consumer electronics. Newly passed government funding will have a limited impact in the near term, due to the relatively small budgets, focus on leading edge technology, and long lead times. To overcome this new kind of trouble, semiconductor producers and Tier-1 suppliers will need to manage the building inventories in consumer and digital applications, while automotive and industrial players must manage ongoing shortages of traditional semiconductor chips.

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