China's accelerated bid for semiconductor self-sufficiency will have a global impact from 2021

May 2021

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The Chinese government has set a target of becoming 70% self-sufficient in semiconductor production within a decade. Trade tensions and restrictions on access to key US technology during 2020 redoubled China's desire to reduce its dependence on imported semiconductors. In addition, China aspires to lead the world in developing the chip technology that will power platforms, such as those for 5G and artificial intelligence (AI), that are central to the country's economic and hi-tech goals.

Significant investment is starting to close the semiconductor gap

These two goals, for greater self-reliance and for technology leadership, are driving a significant increase in investment and innovation, which will, over time, transform China's hi-tech sector and affect the global ecosystem. Many start-ups and large companies are contributing to the effort, and investment in the semiconductor industry in the last quarter of 2020 was 10 times what it was in the same quarter in 2019.

Progress is not only driven by the current geopolitical situation, but also by broader ambitions to be at the cutting edge of technologies that will transform society and the economy, such as 5G, AI, robotics and green energy. In an assessment carried out by Analysys Mason, memory technology and AI platforms were judged to be the areas where Chinese companies had made the most significant progress, by 2020, in closing the gap with international suppliers in terms of technology and production scale.

China's hi-tech vendors will continue to experience challenges in the near term

In some areas of chip development, China is close to equalling the international market. It is ahead of the world in some applications, such as chips for advanced video transcoding and crypto-mining; and in some broader categories, including some types of memory technology, it is levelling with the global giants.

However, the challenge for China's ambitions lies not in a lack of hi-tech capabilities, but in the time it will take to scale up its innovations and processes to support huge levels of demand. Chinese companies purchased chips worth USD380 billion in 2019, so the goal of self-sufficiency is a challenging one.

Individual vendors can rely on in-house teams or key partners to develop the semiconductor technology they require quickly, on a proprietary basis, but to achieve the bigger national goals, and deliver affordable chips for the hi-tech industry as a whole, open ecosystems with massive scale are needed. Only these will be able to support the extremely high demands of vendors in sectors such as telecoms or cloud, at price points that are comparable to those paid by hi-tech suppliers in other countries.

It is particularly critical that China makes progress in the processes that will enable advanced 5G applications

This is a multiyear journey, so it is important that efforts are prioritised effectively. In reality, China does not need to achieve self-sufficiency and technology parity across the whole vast range of semiconductors. The biggest impact on its economy will be felt if it focuses innovation on chips that power the most critical advanced technologies. In our view, the five chip technologies that China should focus on are those in the following categories:

- 5G system-on-chip (SoC)
- AI (including automotive and robotics)
- cloud processors and accelerators
- ultra-low power chips for mass-scale IoT use cases.

In addition, China should focus on memory chips, which are essential in the five categories above, and the foundry process that will enable the country to produce even the most advanced semiconductors itself.

China's hi-tech giants and start-ups, as well as major technology buyers such as cloud providers, are focusing on these technologies. Analysys Mason has assessed the timescale according to which China could achieve self-sufficiency in these areas, with the main opportunities and risks (see Figure 1).

Figure 1. Estimated time to achieve 75% self-sufficiency and technical leadership in five key semiconductor categories

Category	Time to 75% self-sufficiency	Time to technical leadership[1]	Opportunities	Risks
Memory	1 year	1.5 years	Well-established sector and processes	Fluctuating demand and pricing
5G SoC	2–3 years	4 years	High level of investment, influence of HiSilicon	Relies on most-advanced processes
AI (including automotive and robotics)	0–3 years depending on application	1 year in some applications	Rich ecosystem, open platforms (Alibaba)	Fragmentation
Cloud processors and accelerators	3–4 years	3–4 years	Breakthroughs in some advanced applications (for example, crypto mining)	Potential acquisition of ARM by Nvidia
IoT	3 years	1 year	Accelerated by open initiatives (for example, RISC-V)	Diversity of requirements

1 In an open ecosystem – it may be quicker when working with proprietary systems.

Source: Analysys Mason

Just as important as progress in individual semiconductor design, is that the chips can be manufactured using the most advanced, scalable processes, which enable technologies to deliver the highest performance at the lowest cost and power consumption.

The main Chinese foundries, Semiconductor Manufacturing International Corporation (SMIC) and Hua Hong Semiconductor, are expected to achieve domestic self-sufficiency in the 28nm process technology this year. This is now implemented at mass scale and China is poised to activate its first homegrown 28nm lithography machine this year, a key step to independence from external suppliers. Most advanced chips that are in use worldwide are manufactured using the 28nm and 40nm processes, and China is poised to be self-sufficient in these processes by the end of 2021.

For the most advanced categories, however, all eyes are on SMIC's FinFET N+1 process, which was unveiled in mid-2020, delivering 57% lower power consumption and 55% smaller chip size than 28nm, and achieving levels similar to that of a 7nm process. The success of this process at scale will be critical to achieving China's semiconductor ambitions in the next few years.

Accelerated innovation, and a return to international co-operation, will deliver the best results for the whole ecosystem

The acceleration of Chinese investment and development in semiconductors will deliver benefits for its own technology vendors and consumers, and for national socioeconomic objectives. It will also have an international impact. For instance, China may adopt a new approach to a semiconductor design challenge in order to leapfrog existing technologies, and that would affect the whole industry. Strong support for the open RISC-V processor architecture is an example.

However, the maximum impact will be felt with a return to international co-operation, enabling the hi-tech industry worldwide to take advantage of China's innovations, and allowing Chinese companies to access markets and hi-tech developments on a global basis.