Global Fabs
The Worldwide Semiconductor Production Platform
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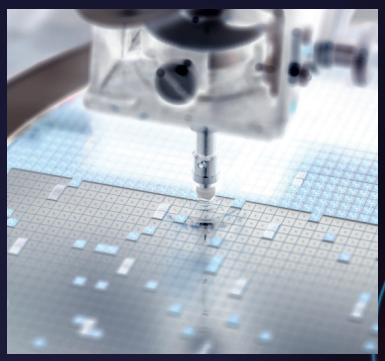
A Global Fabs Exclusive

THE REBIRTH OF GLOBAL SEMICONDUCTOR MANUFACTURING

An analysis for Global Fabs by Chris Edwards

US president Joe Biden's administration signalled a pause in mid-October in the progressive attempts to restrict semiconductor manufacturing in China with the decision to provide South Korean companies Samsung Electronics and SK Hynix with waivers to equip memory fabs in the country.



But the trend towards a globalised supply chain has shifted for the foreseeable future, and geographic regions are vying to become less dependent on supply chains that can be broken by government sanctions with little warning.

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Global Fabs digs below the announcements to understand the drivers, benefits and obstacles that come with a much-trumpeted return to global manufacturing.

Chips Acts herald the rebirth of global semiconductor manufacturing

<< from Front Cover

The waivers granted to the two Korean chipmakers are an indication as to how capacity expansions are likely be handled now that respective Chips Acts have been passed in the US and Europe. The US legislation has promised more than $40bn to chipmakers until the programme finishes in 2027. Samsung looks set to secure a grant for the $17bn expansion of its fab operations in Texas...even though guardrails put into the US act mean subsidies will depend on chipmakers not putting more capacity into China.

The involvement of governments in the semiconductor industry is not new. The period before the turn of the millennium saw state actors such as Japan and South Korea pump money into semiconductor production in order to upgrade their economies.

Similar over-capacity situations to those seen in the 1980s and 1990s could be the result of the current investment campaigns, though many in the industry believe demand will comfortably absorb the additional production coming on-stream over the next three or four years.

Much of the expansion in Europe, for example, is aimed at technologies that are not leading-edge logic, nor memory, but devices such as power semiconductors needed for electric vehicles.

"That capacity is not available: we are still busy building it. In my view we are years away from over-capacity for that growing demand. It is a great place to be for Europe because economically it's a fantastic opportunity," NXP Semiconductors CEO Kurt Sievers claimed during an on-stage interview at the Bloomberg New Economy Gateway Europe event earlier this year.

In the summer, TSMC agreed to work with Bosch, Infineon and NXP on a plant dedicated to automotive which is expected to need around €10bn in buildings and equipment.

And in Dresden, Germany, Infineon Technologies broke ground in May on a 300mm fab dedicated to power semiconductors. In June, building work started on a €7.5bn fab owned jointly by STMicroelectronics and GlobalFoundries that will focus on fully depleted silicon-on-insulator (FD-SOI) beyond the 28nm node running at the nearby ST plant at Crolles, France.

The most advanced fabs to be built following the European Chips Acts are those planned by Intel in the province of Saxony-Anhalt. German chancellor Olaf Scholz claimed the total cost of more than €30bn represents the largest single foreign direct investment in the country. Expected to start production by 2027, these fabs will supplement Intel's existing Ireland facility, which was the first in the region to introduce manufacturing based on EUV-based lithography.

In the US, the investments announced so far in the US are expected to result in the building of at least five leading-edge fabs, including another two for Intel. A further two will produce memories.

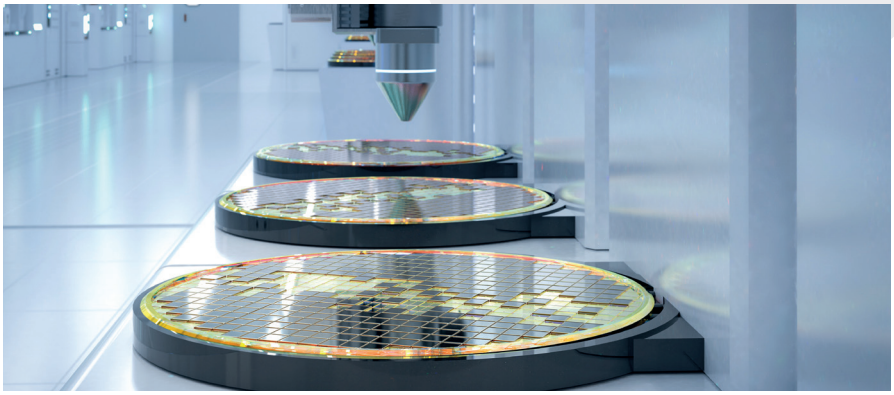
> We need to attract new students. And we need to reskill and upskill the people already in the industry to meet these goals.

But the subsidies in the US will also be spread across a wide range of technologies, including sensors and power devices based on silicon carbide, among others.

The programmes will need additional work to deliver on the stated ambitions of government officials and politicians. "It is big money from a government perspective but very little money from an industry perspective," Sievers claims, pointing to the situation facing the European Union. NXP's calculations estimated the continent would need to see investment on the order of half a trillion euros in order to push its market share in semiconductor production from its existing position of less than 10% of global production to a planned 20% by 2030.

The Semiconductor Industry Associated has calculated that the total of announced investments by chipmakers in the US following the Chips Act has surpassed $200bn. South Korea said in 2021 that a survey of 150 companies in the country indicated its package of long-term tax credits will attract more than $400bn in private investment by 2030, though the bulk would likely come from Samsung and SK Hynix.

If the other elements of the European and US programmes pay off, the proportion that would need to come from government may be significantly lower than implied by the initial funding rounds, which might in any case be stymied by deeper structural issues, such as the lack of local supply-chain partners, both upstream and downstream.



Though the value-add effect calculated by Deloitte of assembly, test and packaging is only a third that of front-end wafer fabrication and chip design, from the perspective of supply-chain security a lack of local assembly and test also represents a potential hazard. Most of the available assembly and test plants are in south-east Asia and China, though some investments are now focusing on building packaging plants in the US and Europe. In addition to its leading-edge fabs, Intel has agreed to build an assembly and test plant in Poland. TSMC's front-end fab in Phoenix, Arizona will be accompanied by an advanced-packaging plant nearby.

SEMI and the Center for Security and Emerging Technologies (CSET) pointed to similar weaknesses in the supply of key materials to fabs in the US in separate reports published ahead of the passing of the Chips Act. A follow-up published by CSET in September found the uptick in construction had convinced several Taiwanese chemicals and materials suppliers to establish plants in the country. Late last year, TSMC also applied to create a Foreign Trade Zone near Phoenix to facilitate access to materials not made in the US to reduce import costs.

A bigger, longer-term issue faced by Europe and the US is of significant shortages in availability of skilled staff able to support a rapid enlargement of manufacturing capacity. For this reason, the Chips Acts on both sides of the Atlantic sets aside sizeable funds for education, in addition to R&D.

In the US, for example, students have increasingly turned to computer science rather than electronics engineering when they select courses at university, with interest in AI now providing a strong pull factor. The American Society for Engineering Education reported in 2020 that the number of degrees awarded for electrical and electronics engineering fell by 75% in the five years from 2015, while computer engineering saw a rise of almost 40%, with computing degrees outnumbering electronics by a significant ratio at the end of the period.

Figures from Eurostat suggest the EU has seen less of a switch, with more than 50,000 degrees awarded for electronics and automation in 2021 compared with around 35,000 for software development. But a large increase in electronics production will demand more graduates. "We need to attract new students.

And we need to reskill and upskill the people already in the industry to meet these goals," says Mikael Östling, professor of solid-state electronics at the KTH Royal Institute of Technology in Stockholm.

The US Chips Act allocated $13bn to the National Science Foundation to spend on science and technology education hoping this, among other measures, will increase the number of semiconductor-manufacturing and design engineers. Several programmes are now underway in the EU to improve education in electronics. The METIS4Skills initiative uses the concept of massive open online courses (MOOCs) to deliver content, with an emphasis on upskilling existing electronics engineers. Dominik Zupan, assistant at TU Graz and responsible for developing several of the courses says most of those in the METIS4Skills tend to focus on theory much of the time. "It is not that easy to teach practical examples just by online courses."

Speaking at the International Solid State Circuits Conference in February, Imec chief strategy officer Jo de Boeck said he saw an expanded role for the Europractice low-cost prototyping vehicle in letting student engineers gain experience in chip design, but also that access to leading-edge technologies needs to improve. He pointed to data that indicated all the designs taped out through the Europractice shuttles in 2021 were on 22nm and older nodes.

"We need to find a way to train people in these leading-edge technologies," he said. Access to prototyping by companies has been factored into both the US and EU Chips Acts, with a focus on establishing a wider range of pilot lines, expanding on those set up over the past decade under schemes such as the EU's Key Enabling Technologies (KET) programme.

These centres were established to try to bridge the "chasm" that faces hardware startups as they move from exploratory experiments to trying to make prototypes. Among its own efforts, the US Department of Defense put up $240m in funding for eight "lab to fab" centres around the country that will focus on support for prototyping.

In a speech at the EuroNanoForum in the summer, Frank Tillman, head of integrated radio systems at Ericsson, emphasised the role that pilot lines will play in the long-term evolution of technology in Europe, and the importance of creating them well in advance of industrial scale-up. "Industry needs to have access to technology almost a decade in advance. It takes a long time because you need to develop architectures that might be specific for a certain technology, so it's really important to have these pilot lines in place," he said, adding that heterogeneous integration and advanced packaging will be equally important.

Some of that work is already underway through the Key Digital Undertaking set up before the Chips Act. One example, which follows a number of earlier pilot lines focused on photonics, was the launch of the PhotonixFAB initiative earlier this year. This brings together a group of suppliers who will support the production of chiplets and assemble them into multichip packages. The European Commission has identified three pilot-line areas it expects to have strategic importance: sub-2nm nanosheet technology; FD-SOI at 10nm and below; and heterogeneous integration.

The US and Europe in particular face an uphill struggle in winning back chip-making, but both have taken a long-term view in determining what goes into the immediate five-year plans. The world seems to have woken up to its over-reliance on one region and a few players, and suddenly there is global semiconductor manufacturing activity - or at least talk of it. Expect interesting times ahead.

Chris Edwards is a respected and influential freelance journalist, editor and electronics industry commentator. His work has appeared in numerous leading industry titles over the last 30 years including IET Engineering & Technology, Communications of the ACM, New Electronics and Electronics Times.

Join the discussion

Stakeholders in semiconductor manufacturing come from a wide base:

- Executives and technical staff at IDMs;
- Third-party service providers;
- Policy decision makers in global, regional, national and local government;
- Private and public finance;
- Education & training institutions.

The publishers of Global Fabs believe that in the last 25 years, as semiconductor production has become focused in Asia, the once-strong media that supported this sector has withered. As we see an inexorable move to redress the balance with the recognition at the highest levels that all global regions must have a viable and energetic chip-making industry, our aim is to give global semiconductor manufacturing a powerful voice once more.

Launching Q1 2024, Global Fabs will provide a platform for stakeholders at all levels in semiconductor manufacture in all worldwide regions. Global Fabs combines a continuously updated news website; lively Social Media presence, weekly enewsletter and monthly digital magazine.

Our editorial policy will be to provide news updates covering legislation, investment, technology, products and services, combined with in-depth articles that dig below the announcements to understand and explain the drivers, benefits and obstacles that come with a much-trumpeted return to global manufacturing. We will initiate research and discussion via reader surveys.

Get involved

We encourage all those who care about the semiconductor industry to become a part of Global Fabs. We are looking for contributions, ideas and feedback from all interested parties, no matter where you are located.

Meet the Team

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Orhan Erenberk is an electronics engineer hailing from the N7 in Toulouse, France. He earned his Master of Science degree from the University of Michigan, setting the stage for a career in B2B media. With decades of experience, Erenberk has worn multiple hats in the industry, including editorial, marketing, and publishing roles principally at Europe's number 1 electronics publication, EPN. In 1990, he launched Electronics Manufacturing International under the Reed-Elsevier banner. His expertise led to a seat on the board of Reed Electronics Group from 2000 to 2003.

In 2003, Erenberk assumed the role of CEO at Thomas Industrial Media, a position he held until 2013. In the same year, he founded TIMGlobal Media, where he currently serves as CEO and Owner. TIMGlobal Media is a global powerhouse based in Brussels, delivering trade magazines, websites, and in-person events in five languages, catering to industrial markets across Europe and worldwide.

Peter Rogerson
Publisher
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Peter Rogerson began a career in national news media in London, England in the mid 1980s before joining the electronics community with leading publications including New Electronics in the UK, and EPN and Electronics Manufacturing International in Brussels, Belgium and San Jose, California. He spent 12 years working directly for a leading Silicon Valley-based semiconductor company as Worldwide Director of Marketing Communications. During this time, Rogerson put together an international team and had responsibility for multi-million-dollar budgets. He oversaw the introduction of many initiatives including marketing automation and a complete company rebrand, and was also responsible for channel partner sales with leading high-service vendors.

After successfully launching a leading Chinese semiconductor producer in Europe and the USA, Rogerson resumed his media career, with a key role at video production company, Breadboard Media.

Nick Foot
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Nick Foot graduated with honours in Engineering and Business Studies in Sheffield, England. He immediately began a career in technical media focusing on electronics and has spent his entire career in this vibrant sector. Key highlights include launching Components in Electronics which became one of the UK's most successful electronics titles in the 1990s and then producing the largest ever issue of EPN, the Pan-European powerhouse for the 1998 Electronica exhibition.

Shortly after, Foot joined leading technical B2B marketing agency, BWW Communications, as PR Director. Since that time, his role has expanded to cover all marketing communications services, and in 2016 he took over full ownership of the company. BWW now has a presence in the UK, Germany and the USA, and has strong ties with partner agencies in Japan, China and Korea, positioning it to support global brands on a worldwide basis. Clients range from start-ups to multi-billion-dollar corporations in the semiconductor, electronic component, test, distribution and IC manufacturing sectors.

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Educated at Boise State University, Idaho, USA, Chris Anderson graduated with a BSc in Electrical Engineering before serving as a Research Assistant in the University's non-volatile memory laboratories. He then went on to work at leading memory IC maker, Micron Technology in senior engineering and supervisor roles, including EMC and RF characterization.

In 2014, Anderson joined leading teardown analyst company, Aspen Labs as Director of Engineering. Three years later he co-founded Breadboard Media, a company that blends technical expertise with exceptional creativity to create engaging content that informs and educates engineers, where he is currently technical director.

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