ASML

EU Chips Act

Position paper

February 2022

A Chips Act to secure Europe's relevance in the global semiconductor industry

Executive summary

Global megatrends that shape the intelligent connected world that we live in are fueling a significant increase in demand for microchips. Recent chip shortages highlight the regional interdependencies in the complex global semiconductor ecosystem. Europe has fallen behind in semiconductor manufacturing, declining from 24% of global production capacity in 2000 to 8% today.

Europe harbors industrial champions in the automotive, industrial electronics and wireless infrastructure market segments. These companies depend heavily on a mix of both mature and advanced microchips for the major innovation trends, such as the transition to electric vehicles and autonomous driving in automotive.

The global semiconductor industry is expected to double to approximately $1 trillion of annual revenues by the end of the decade. If no action is taken, the European semiconductor manufacturing capacity will fall below 4%, making it virtually irrelevant on a global scale and creating a structural threat of insufficient chip supplies to European industries. To avoid this undesirable scenario, significant public- and private-sector investments are required.

ASML welcomes and strongly supports the European Commission's proposal for a European Chips Act, with the ambition to more than double Europe's share in global semiconductor production capacity to 20% by 2030. The Chips Act should not only focus on chip production. It needs to secure Europe's relevance in the global semiconductor ecosystem by increasing the capabilities and performance of European products and technologies that others rely on.

Europe needs a long-term semiconductor innovation roadmap to guide investment decisions. To define this roadmap, the European semiconductor alliance should bring together the manufacturers of semiconductors, their customers in the major European end-markets, world-leading equipment and materials suppliers, research and technology organizations and policymakers.

The roadmap should, in any event, support plans to:
1. Maximize the potential of European champions in semiconductor design, manufacturing equipment and materials, on which the global semiconductor ecosystem depends
2. Invest in the European semiconductor ecosystem to boost Europe's strong industrial positions in global end-markets
3. Invest in both mature and advanced semiconductor production in Europe
4. Attract industry frontrunners to build advanced factories (or 'fabs') in Europe
5. Upgrade European semiconductor process technology research facilities

A Chips Act to secure Europe's relevance in the global semiconductor industry

1. Global semiconductor industry dynamics

The semiconductor industry is growing. Global megatrends – such as an increasing use of the cloud as a cost-effective way to store vast amounts of data, the deployment of the 5G infrastructure, artificial intelligence applications, compute capability at the intelligent edge, and virtual and augmented reality – are shaping the intelligent, connected world that we live in and are fuelling a significantly increasing demand for microchips.

With the continued roll-out of the internet of things, the number of connected devices is expected to increase from 40 billion today to 350 billion by the end of the decade. This will have a profound impact on computing and data storage requirements in data centers and cloud, as well as in an exponentially increasing number of applications at the edge, where numerous European companies are active. The demand for all types of microchips (both mature and advanced[1]) for these types of applications in all industry sectors will increase significantly (see Figure 1).

Companies in various industries currently experience economic losses due to global chip shortages – a situation comparable to the oil crisis in 1973. At that time, oil was taken for granted until it was no longer available. The same applies to microchips: they were taken as a given until 2021, when their availability was suddenly threatened. Today's chip shortages will not disappear unless long-term, strategic decisions are made by both the semiconductor industry and governments.

1.1 Europe's declining role in the global semiconductor industry: a call for action

The global semiconductor industry is based on a collaborative system of 'mutual dependencies'. No single region possesses end-to-end capabilities for semiconductor design and manufacturing. The semiconductor value chain "relies on the specialized capabilities of different geographic areas"[2] (see Figure 2). There are interdependencies throughout the global value chain, which means that collaboration is the key to success, provided that you have something to offer that others need.

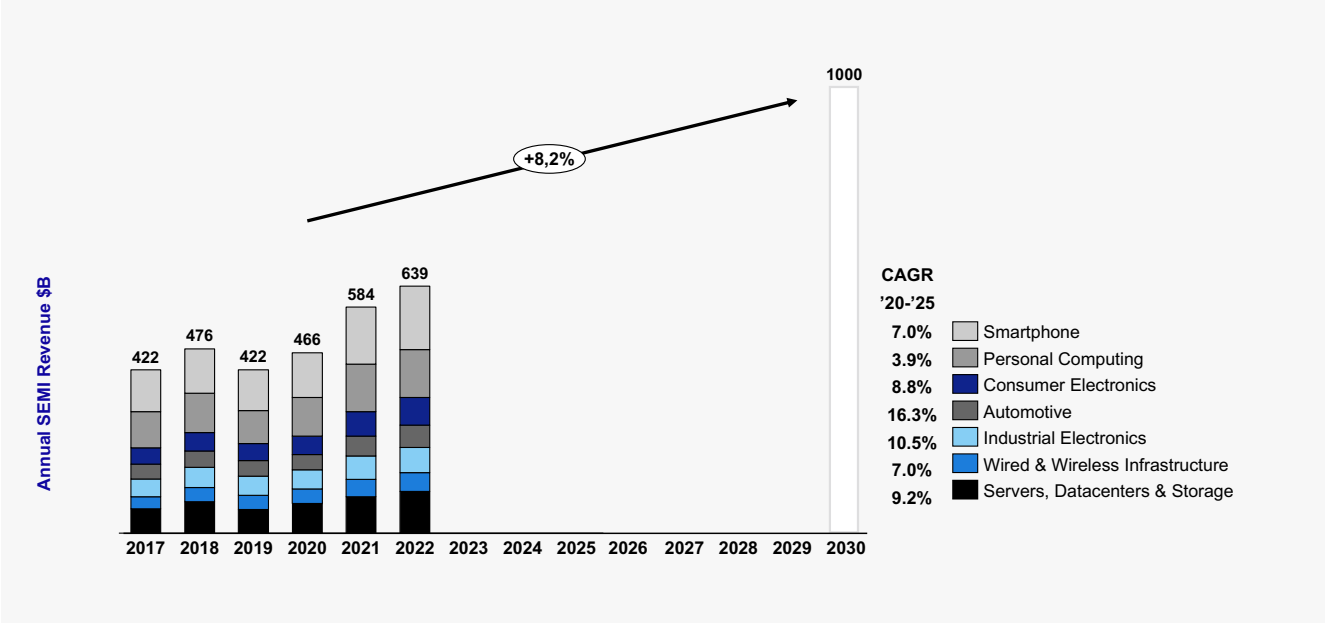


Figure 1: Total semiconductor annual revenues (Gartner 4Q21 Forecast, December 2021).

1 In this paper, 'advanced' chip technology refers to process technology for 28 nm (nanometers) and below. 'Mature' refers to older generations ≥40 nm.
2 BCG & SIA report, *Strengthening the Global Semiconductor Supply Chain*, April 2021.

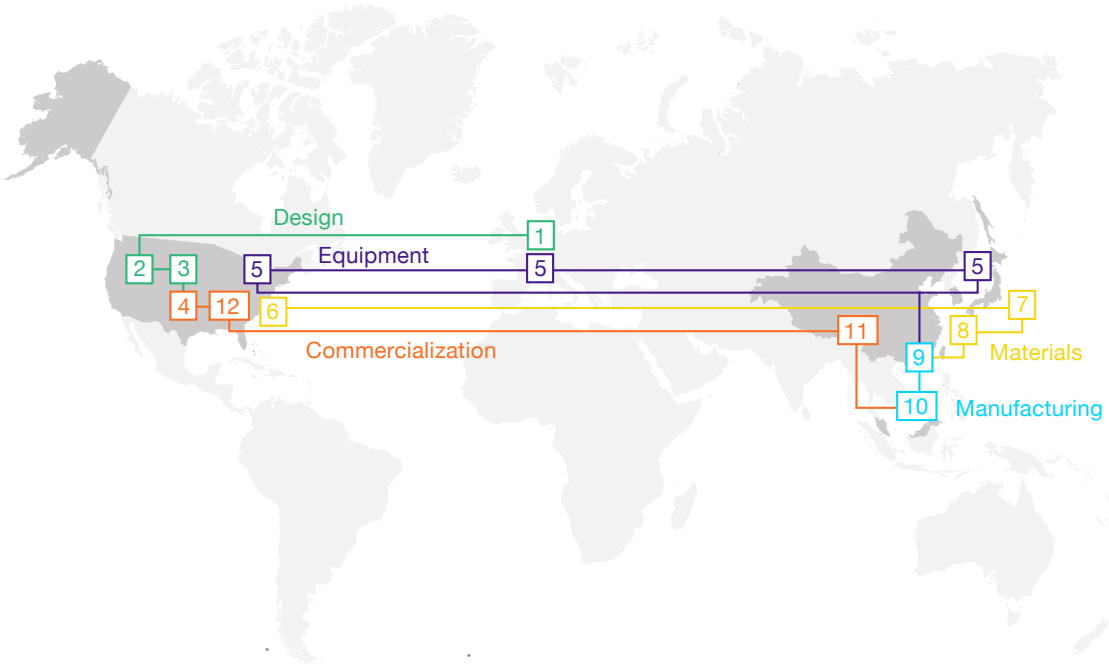
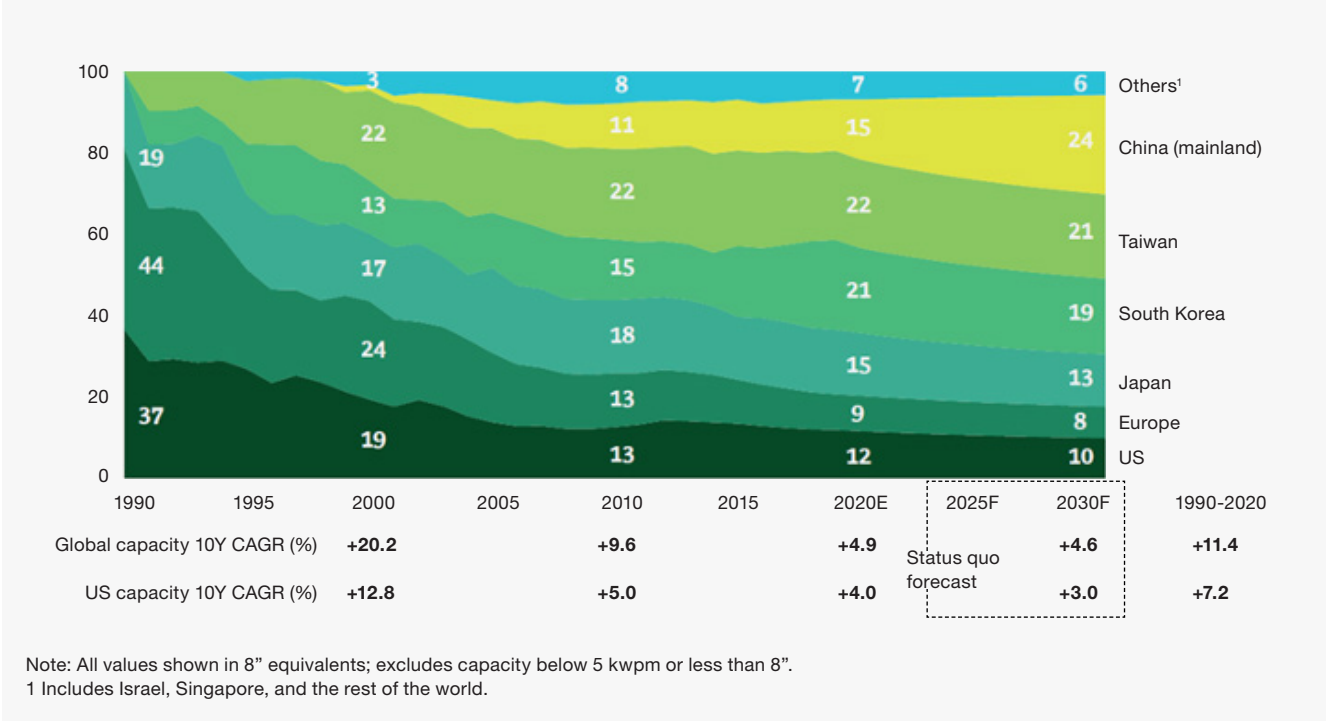


Figure 2: Illustration – 'The global journey of a smartphone application processor' (BCG SIA report: Strengthening the Global Semiconductor Supply Chain, April 2021).

Europe has fallen behind in semiconductor manufacturing, declining from 24% of global production capacity in 2000 to 8% today (see Figure 3). Nowadays, semiconductor manufacturing in Europe primarily concerns mature microchip technology, with only a small fraction in advanced technologies.

Over the past decade, investments in new chip production facilities were mostly made in Asia (see Figure 4), and the only places in the world where mature chip fabs are currently being built are in eastern Asia. Consequently, there is a real risk that European industries' dependence on Asian chip suppliers will further increase in the years to come. Given this dependence on Asian chipmakers, policymakers may, from a risk-management perspective, seek to rebalance production capacity throughout the world (e.g., by on-shoring chip production to Europe).



Note: All values shown in 8" equivalents; excludes capacity below 5 kwpm or less than 8".
1 Includes Israel, Singapore, and the rest of the world.

Figure 3: Global chip production capacity by region (BCG & SIA, 2020).

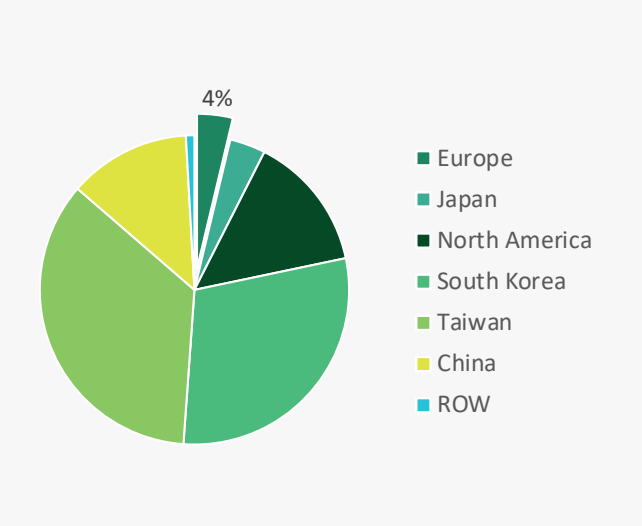


Figure 4: ASML System sales per region over the last 10 years (Source: ASML)

Assuming that the semiconductor industry will double by the end of the decade to approximately $1 trillion, if nothing is done, the European semiconductor manufacturing capacity will fall below 4% of worldwide production capacity, making it virtually irrelevant on a global scale.

1.2 Europe needs to increase its relevance in the global semiconductor ecosystem

The European Commission's proposal for a European Chips Act (the "Chips Act") aims to more than double Europe's share in global semiconductor production capacity to 20% by 2030. ASML welcomes and strongly supports the Chips Act initiative. In light of the global semiconductor industry's fast pace of growth and given where Europe stands at this point in time, the objective to more than double Europe's share in microchip production is very ambitious – some might even say unrealistic – but our view is this: without healthy ambition, there can be no progress.

The Chips Act should, however, not only focus on increasing Europe's chip production capacity: it should aim to double Europe's relevance in the global semiconductor industry.

Building a European-only, self-sufficient semiconductor value chain would be virtually impossible, given the extensive and complex global ecosystem that the industry has built over the last 40 years. But it also wouldn't be necessary, as long as European semiconductor technology stays relevant from an innovation and manufacturing capacity point of view. Europe should therefore strengthen its position in the global semiconductor ecosystem by increasing the capabilities and performance of European products and technologies that others rely on.

Despite the EU having lost ground in chip production compared to other regions, the continent does harness several critical parts of the semiconductor value chain. Europe is home to global powerhouses in chip design, R&D and state-of-the-art semiconductor manufacturing equipment and materials, as illustrated in Figure 2. Europe's competitiveness in these parts of the semiconductor value chain will need to be further strengthened. Both the public and private sectors will have to invest in this.

1.3 Investing in the semiconductor industry is a long-term attractive play

Automotive, industrial electronics and wired and wireless infrastructure are strategic European industries with strong competitive positions on a global scale. These industries are increasingly dependent on semiconductor technology, with double-digit growth rates both in automotive and industrial electronics (see Figure 1). Investments in the European semiconductor ecosystem will strengthen the global competitiveness of these European industries, through a front-row seat and/or easier access to semiconductor technology.

In order to succeed in the long term, European policy makers will need to inject significant public funds and attract large private investments both from within and outside the EU, over a substantial time horizon.

The necessity for government funding is based on the risk that the required European investments in advanced and mature chip manufacturing will have, what we call, an 'uneconomical top'. For investments in advanced chip production, that 'uneconomical top' relates to the current lack of advanced chip manufacturing experience on European soil. Setting up an advanced semiconductor fab in Europe, means that an advanced semiconductor manufacturing ecosystem will need to be built from the ground up, which increases the complexity, costs and related investment risks.

The 'uneconomical top' risk for additional European mature manufacturing expansion relates to the fact that mature semiconductors come from fully depreciated fabs in other parts of the world, whereas the same semiconductors coming from a greenfield mature fab investment in Europe would face a factor 2.5 time higher costs. Furthermore, the build-up of the mature production capacity has historically been based on the re-use of manufacturing equipment that would come from dismantled leading edge fabs. That re-use of manufacturing equipment has virtually stopped since those machines will stay at the original fabs due to the high semiconductor demand. This development results in further increases of the initial investments required to build a mature semiconductor fab, which calls for a different investment approach by semiconductor manufacturers. Market growth and increased pricing in the

mature semiconductor segment will help over time, but do not sufficiently mitigate the increasing short-term risks of the very significant initial investments in new fabs.

We believe that government funding will (partially) mitigate these "uneconomical top" risks, which will make investments in mature and advanced semiconductor fabs in Europe more attractive.

Currently, semiconductor incentives from European governments for the 2020–2030 period are only 10% and 50% of what China and the US, respectively, have promised over the same period[3]. Europe will need to step up its game, and we are glad to see that European policymakers recognize this[4].

Furthermore, it is important to point out that semiconductor technology is an essential enabler of low-carbon and energy-efficient innovative solutions and will help reduce society's environmental footprint – for example, by optimizing energy usage in transportation, manufacturing and consumer products and services. The energy and materials used by semiconductors, both to manufacture and to operate, more than compensate the energy and material-intensive applications they optimize or substitute[5]. The success of the EU Green Deal will thus depend on more significant investment in the European semiconductor ecosystem.

2. Major European industries depend heavily on microchips

Europe has a strong position in global end-markets such as automotive, as well as in various industrial markets such as wired and wireless infrastructure, medical technology, lighting and smaller business-to-business niches (see Figure 5). Europe's strengths in these market segments is often across the full value chain from chip design to end product. Dependencies on semiconductors are rapidly growing due to the 'electrification of energy' and automation (IoT, AI, factory automation). This is also illustrated by the expected double-digit semiconductor growth in these markets, outpacing the already fast-growing total semi market (as shown in Figure 1). All types of semiconductors – from mature technologies to advanced – will be required.

When we look at the largest buyers of semiconductors in Europe, we see that Continental and Bosch are first and second (see Figure 6). These two companies are active in the automotive and industrial electronics segments. Ericsson and Nokia are responsible for a significant chunk of the European chip demand for wired and wireless infrastructure. Major European industrial end users such as Siemens, Philips, Signify and ABB are active in the industrial electronics domain, which covers a wide variety of applications.

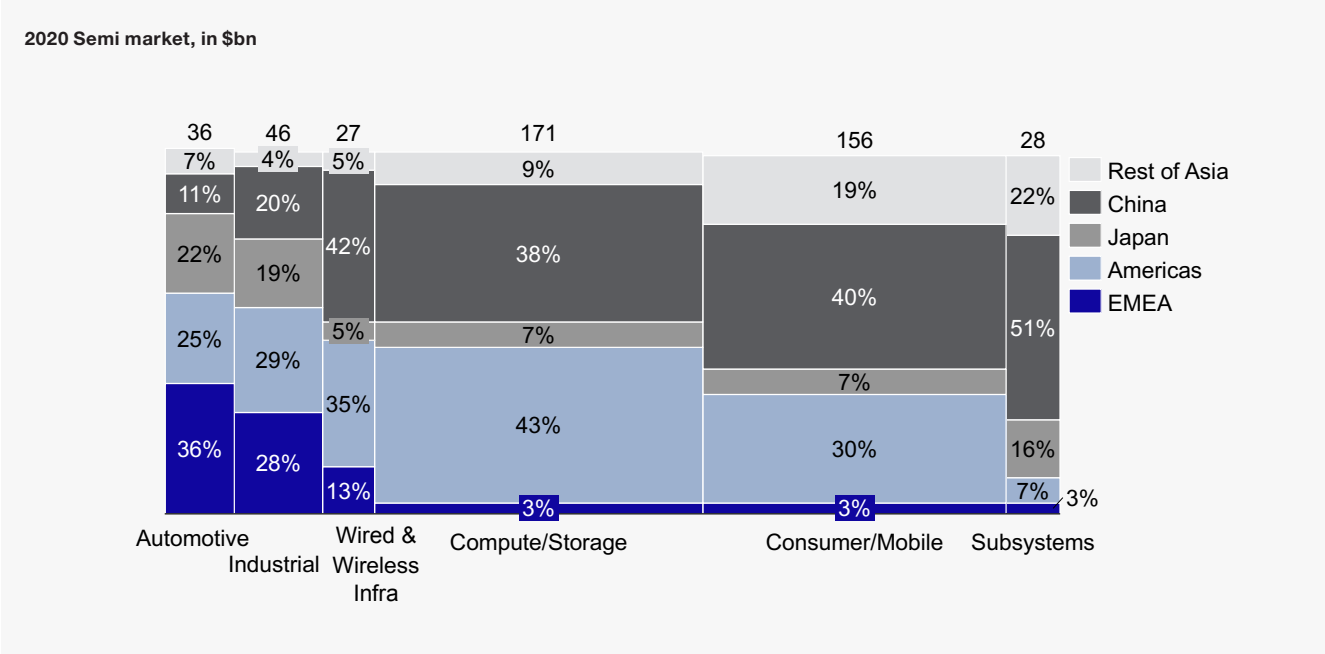


Figure 5: Semiconductor markets by region (Gartner, April 2021 and ASML analysis)

3 DIGITALEUROPE *Recommendations on semiconductor priorities for the EU*, November 4, 2021.
4 European Commission, *2021 State of the Union Address by President von der Leyen*, September 15, 2021.
5 ESIA, *European Semiconductor Industry: A strong contributor to reducing carbon emissions*, September 29, 2021

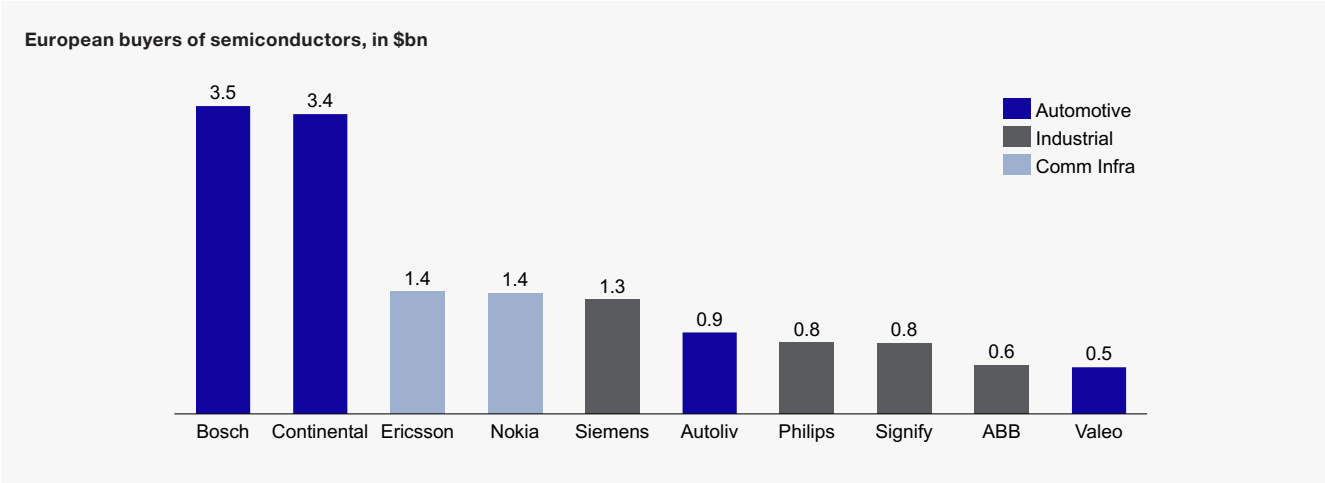


Figure 6: Largest semiconductor buyers in Europe (Gartner, April 2021 and ASML analysis).

European chipmakers such as NXP, Infineon, ST Microelectronics and Robert Bosch have strong ties with the three major European end-markets, since they design and supply a significant portion of their semiconductors. Europe's semiconductor capital expenditure (CapEx) is only between 3% and 4% of the global industry expenditure. In 2019, the top five global semiconductor CapEx spenders, which are all based outside the EU, accounted for 69% of the total spend, or $71.2 billion. Such spending cannot be matched by European chipmakers without state backing[6].

Under the assumption that the semiconductor industry will double from approximately $500 billion/year (2020) to $1 trillion/year by 2030, the associated CapEx that will have to be spent to realize this growth is roughly $825 billion. In order to keep its share at 8%, Europe will need to invest 8% of $825 billion – $66 billion. To grow its share to 20%, the European total investment would have to be roughly $264 billion. As mentioned above, government funding is needed to (partially) mitigate the "uneconomical top" risks, which will make the required significant investments in mature and advanced semiconductor fabs in Europe more attractive.

In the appendices, you will find case studies on the three major European end-markets, spelling out the trends, strengths within the European semiconductor ecosystem and projected semiconductor demand.

- Appendix A: The automotive industry requires mature and advanced chips for the transition to electric vehicles and autonomous driving
- Appendix B: The industrial electronics sector requires mature and advanced chips for a wide variety of sustainable and secure applications
- Appendix C: The wired and wireless infrastructure industry requires mature and advanced chips for 5G/6G deployment and broadband expansion

3. How to strengthen the European semiconductor ecosystem

Looking at the semiconductor needs for the end-market segments where Europe has a strong presence (automotive, industrial electronics and wired and wireless infrastructure), we see an increasing need for a mix of mature and advanced chips. Since Europe has a strong industrial base in these end-market segments, it will be easier to draw up semiconductor innovation and investment roadmaps for these specific end-market segments in comparison to others (such as personal computing, cloud and data storage), where Europe does not play a leading role at this point time. It is important to have a strong upstream and downstream connection in the development and implementation of Europe's long-term semiconductor manufacturing strategy.

The EU is home to global powerhouses in semiconductor R&D, semiconductor design, and state-of-the-art semiconductor manufacturing equipment and materials. Europe will need to invest heavily to further bolster these current strengths, which will secure the continent's relevance in the global semiconductor ecosystem by increasing the reliance of others on European semiconductor products and technologies. For example, dedicated European semiconductor ecosystem subsidy programs, and member states' tax incentives for investments in research & development are very important instruments to help reach that goal.

World-class education in science, technology, engineering and mathematics (STEM), workforce availability and flexibility, continued focus on R&D to keep the innovation pipeline going, as well as effective & efficient local and national government regulatory support (e.g., to expedite fab construction processes) will be crucial success factors in Europe's plans to strengthen the semiconductor ecosystem.

6 Roland Berger, *How partnerships with non-European providers and the EU's new initiative can forge a global powerhouse*, February 12, 2021.

3.1 Involve EU industry to define a roadmap for the 'mature' semiconductor ecosystem

Investments to strengthen the ecosystem for mature semiconductors in Europe should be based on a long-term EU semiconductor strategy (or 'roadmap'), which needs to be defined by European end users in automotive, industrial electronics and wired and wireless infrastructure, together with representatives of the various parts of the semiconductor value chain in Europe, from semiconductor manufacturing equipment and materials to chip design and manufacturing.
Strategic questions that will need to be answered in the roadmap definition process:

- What are the technology requirements of the products of the future (5–10 years from now) in the relevant end-market segments?
- What needs to be done in the European mature semiconductor ecosystem to meet these technology requirements?

3.2 Attract industry frontrunners to build advanced fabs in Europe

Europe also needs to invest in the advanced semiconductor ecosystem. Europe's own demand for advanced semiconductors is expected to increase over the coming decade at five times the rate of demand for other, more mature, semiconductors[7].

In the past two decades, European chipmakers have effectively stopped investing in advanced manufacturing capabilities by outsourcing the production of their advanced chip designs to so-called 'foundries'. Europe has virtually no manufacturing capacity for chips in advanced nodes.

Setting up advanced semiconductor fabs in Europe can only be done by teaming up with industry frontrunners such as Intel, Samsung and TSMC. These three companies are defining plans to significantly increase capital expenditure in order to boost global production capacity to address the increasing chip demand. TSMC, for instance, has announced plans to invest more than $107 billion in its foundries between 2020 and 2023[8], with $40–44 billion in 2022 alone. Intel and Samsung are also developing plans for significant capital expenditure. Europe is therefore presented with a major opportunity to attract some of these investments – European policymakers should push harder to attract these companies' production capacity investments on European soil.

Investments in advanced fabs in Europe are riskier than investments in mature fabs because the advanced manufacturing ecosystem will have to be built from scratch and will take longer to produce a return on investment. Consequently, foreign investments in advanced fabs in Europe need to be strongly incentivized to mitigate the high risks involved. If European policymakers do not provide sufficient incentives, these advanced fabs will be built elsewhere (such as in Asia and the US), where advanced semiconductor manufacturing ecosystems already exist.

Advanced manufacturing facilities will function as a magnet for innovation spill-overs and talent attraction across the entire European ecosystem. We therefore strongly support European funding to prioritize breakthrough technologies and 'first-of-a-kind' facilities[9].

3.3. Upgrade European semiconductor process technology research facilities

The EU is home to global powerhouses in semiconductor R&D, semiconductor design and state-of-the-art semiconductor manufacturing equipment and materials. European end users and technology providers can use so-called extended pilot lines to test, implement and embrace new chip design and manufacturing technologies to go from lab demonstration to production. Europe is a clear global leader in pre-competitive research on advanced semiconductor technology, and such pilot lines with advanced suppliers' hubs can help the European ecosystem to become early adopters of new chip designs and manufacturing technologies, and to jointly drive innovation – in a system integration approach – in all parts of the global value chain.

Europe has existing pilot lines at research and technology organizations ('RTOs') such as imec (Belgium), Fraunhofer (Germany) and CEA-Leti (France). These facilities need substantial upgrades, including a professional design enablement infrastructure, to become the proving ground for new advanced system designs in Europe and to bring together the industrial base and the existing semiconductor know-how in the EU.

The development of new pilot lines for future advanced semiconductor technology
(e.g., <2 nm nodes, heterogeneous systems integration and advanced packaging) will make significant contributions to the EU innovation roadmap and strengthen European intellectual property in production processes and advanced manufacturing equipment and materials.

7 Kearney, *Europe's urgent need to invest in a leading-edge semiconductor ecosystem*, November 10, 2021.
8 Nikkei Asia, *Chipmakers' nightmare: Will shortages give way to a supply glut?*, and TSMC press release, January 13, 2022.
9 European Commission, *Competition: Commission outlines contribution of competition policy and its review to green and digital transition, and to a resilient Single Market*, November 18, 2021.

State-of-the-art semiconductor manufacturing equipment will have to be sourced from all over the world to maintain the global leadership position of these European semiconductor pilot lines. Competing efforts are being considered and are already underway in other parts of the world, including the United States (e.g., the National Semiconductor Technology Center initiative) and Japan. Europe now has an opportunity to strengthen its competitive position through considerable investments in this domain.

4. How to organize and deliver on sustainable EU Chips Act ambitions

Europe needs a long-term semiconductor innovation roadmap on which investment decisions can be based. We believe that a European semiconductor alliance can play an important role in this process. To define the long-term European semiconductor roadmap, such an alliance should bring together the potential manufacturers of mature and advanced semiconductors, their potential customers (e.g., automotive, industrial electronics and wired and wireless infrastructure), leaders in equipment and materials, research and technology organizations and policy makers. For alliance membership, European presence and investment should be applied as the guiding principle, rather than the corporate headquarters location.

In the global semiconductor ecosystem, based on mutual dependencies, a continued open dialogue among the governments of countries active in the semiconductor domain remains vital. The European Union has set up various multilateral initiatives, for example:

- The EU-US Trade & Technology Council (TTC) has dedicated discussions to semiconductors, and the European Commission should continue to seek, preferably in the form of industry roundtables, semiconductor-specific input ahead of its interactions with its US counterparts, possibly through the above-mentioned alliance.
- The EU-China dialogue: the semiconductor industry in China is a key chip supplier to European industries. This means that open borders and free trade remain important agenda items.

In its interactions with foreign countries, the EU should continue to stress transparency, coordination, a level playing field and global interdependence as key pillars of semiconductor policy discussions.

5. Concluding statement on securing Europe's relevance in semiconductors

ASML welcomes and strongly supports the European Commission's proposal for the EU Chips Act. In order to succeed, policy makers in the EU will need to invest significant public funds and attract large private investments both from within and outside the EU. The Chips Act should not only be about increasing Europe's chip production capacity: it should aim to secure Europe's relevance in the global semiconductor industry, which is and will continue to be based on a collaborative ecosystem of 'mutual dependencies'.

Building a European-only, self-sufficient semiconductor value chain would be virtually impossible, given the extensive and complex global ecosystem that the industry has built over the last 40 years. We will continue to depend on non-European semiconductor companies, and others will continue to depend on EU technology.

Through the EU Chips Act, Europe will strengthen its position in the global semiconductor ecosystem by supporting the leading capabilities and performance of European products and technologies that others rely on, incentivizing R&D and manufacturing in the EU and encouraging the development of new technologies and innovation.

Appendix A

The automotive industry requires mature and advanced chips for the transition to electric vehicles and autonomous driving

The automotive industry is fundamentally changing through the electrification of vehicles and the autonomization of transport. In the next 15 years, original equipment manufacturers will have to switch from producing combustion engine vehicles to electric vehicles on a global scale. This change will generate more demand for semiconductors, which will lead to new dynamics in the field of automotive semiconductors.

With brands such as Volkswagen, Daimler, Stellantis, Renault and BMW, Europe has strong automotive giants that are driving this transition. System integrators such as Continental, Bosch, Autoliv, Veoneer and Valeo are key contributors to this transition within the automotive domain. The world's leading designers and manufacturers of semiconductors to the automotive industry are in Europe, with Infineon and NXP in first and second place, and with ST Microelectronics and Bosch also in the top 10 (Figure 7).

Looking at Figure 8, traditional car content is mainly mature, but ongoing node transitions have already moved it toward 28 nm for some components, followed by more advanced nodes to replace the internal combustion engine with electric motors. Advanced chips are increasingly needed for autonomous driving and on-board computing. This automotive graph shows a growth of mature and advanced demand simultaneously.

The automotive industry is becoming increasingly assertive in its adoption of advanced chips, a trend recently confirmed through the collaboration between Tesla and Samsung on the development of self-driving chips based on the 7 nm process[10]. Players within the automotive industry are exploring the introduction of advanced semiconductors to manage the increasing number of tasks that a car's electronic control units need to perform.

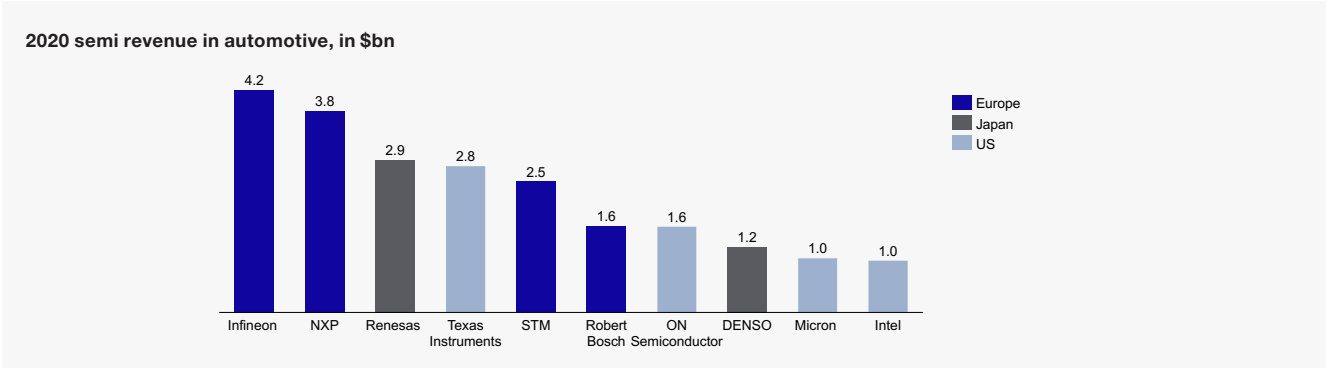


Figure 7: Largest semiconductor companies in automotive (Gartner, March 2021 and ASML analysis).

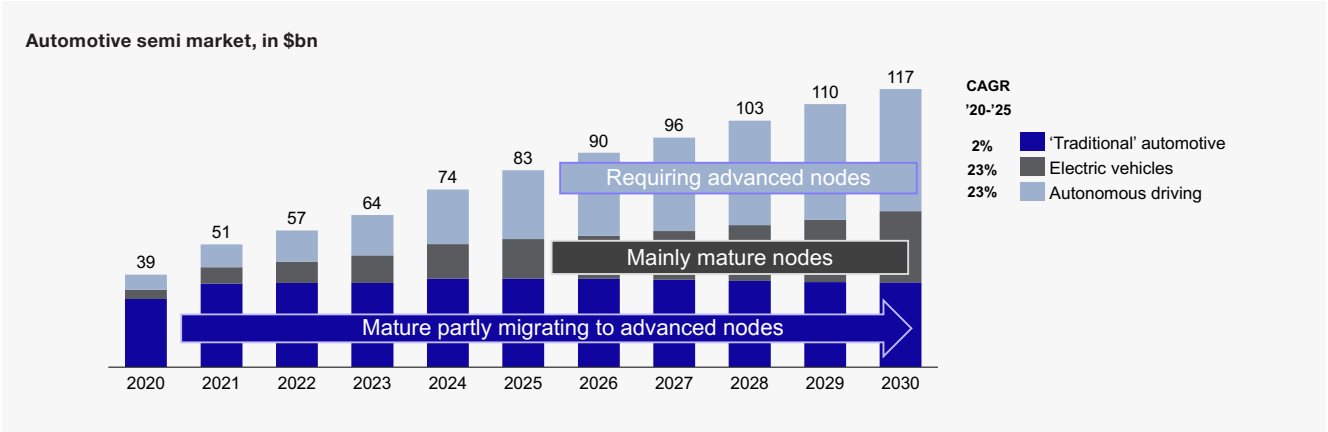


Figure 8: Automotive semiconductor market – chip demand segments for a car (Gartner, January 2022 and ASML analysis).

10 Reuters, *Samsung in talks with Tesla to make next-gen self-driving chips*, September 23, 2021.

Appendix B

The industrial electronics sector requires mature and advanced chips for a wide variety of sustainable and secure applications

Major trends in the industrial electronics sector will boost the demand for both mature and advanced chips. Firstly, IoT (the internet of things) will trigger the rise of connectivity and sensors in devices, leading to an explosion of data. Secondly, the transition from carbon-based-energy-dominated to electricity-dominated industries will lead to an increased use of power electronics. And lastly, next-generation robots and autonomous machines, fueled by incremental changes in machine vision, AI and motion systems, will pave the path to new application areas[11].

Traditionally, this sector has been a stronghold for Europe, with industrial champions such as Philips, Siemens, ABB, Signify, Airbus and Bosch having established globally competitive positions within this domain. The European chipmakers Infineon, STM and NXP are among the top 10 world-leading designers and manufacturers of semiconductors to the industrial electronics industry (Figure 9).

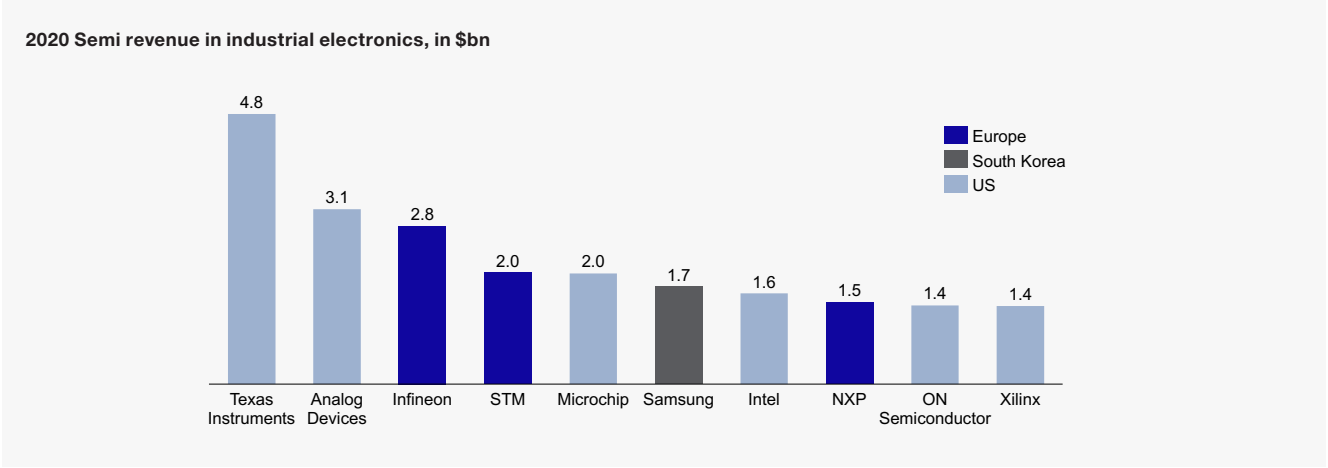


Figure 9: Largest semiconductor companies in industrial electronics (Gartner, March 2021 and ASML analysis).

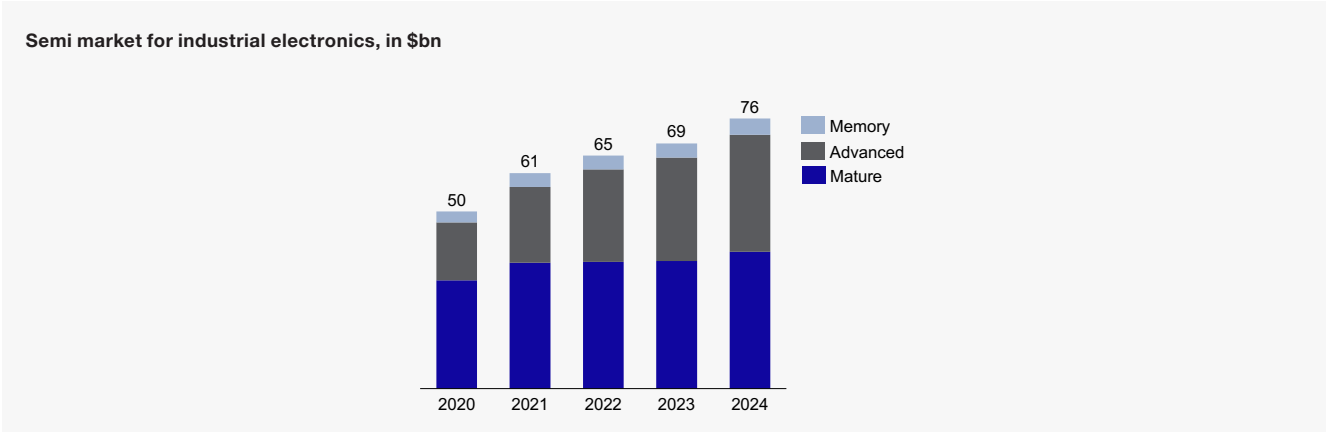


Figure 10: Industrial electronics market development (ASML analysis using third-party research and external consultants).

11 ASML study, with third party advisors.

Appendix C

The wired and wireless infrastructure industry requires mature and advanced chips for 5G/6G deployment and broadband expansion

Major trends in the wired and wireless infrastructure sector will boost the chip demand for mature as well as advanced technology. Firstly, 5G/6G deployment will lead to massive investments in infrastructure, such as an increased number of smaller base station units aiming for better coverage to support various applications. Secondly, continuous growth in data traffic and computing demand for data centers, enterprises and homes is driving a growing demand for high-performance IP routers and switches. As a consequence, a significant infrastructure investment is being made on an increased number of smaller base station units offering better coverage to support various applications, which pushes an increase in both mature and advanced chips[12].

This sector shows strategic potential for Europe, as it is a foundational element for the other end-market segments described above, with the automotive and industrial electronics segments generating more robust connectivity needs, particularly as the 5G and 6G rollout and cloud and edge computing become more essential. Hence, an investment in chip design and manufacturing for wired and wireless infrastructure becomes a strategic choice, supplementing the increase in relevance in other end-market segments.

Europe has several key companies in this ecosystem, such as Nokia, Ericsson, Deutsche Telekom/T-Mobile, Vodafone and production and design companies such as NXP, ST Microelectronics and Infineon. The wired and wireless infrastructure industry will require both mature and advanced chips. From a mature perspective, NXP, as the leading supplier for base station antennas, uses the technology for RF power chips. In terms of advanced, Nokia recently announced a shift to a 7 nm design to increase the performance and energy savings of its new FP5 Processor[13].

12 ASML study, with third party advisors.
13 EE Times Asia, *Nokia Focuses on Security, Energy Saving with FP5 Processor*, September 27, 2021.

About ASML

ASML is a global leader in advanced manufacturing equipment for the semiconductor industry. Headquartered in Veldhoven, the Netherlands, we employ more than 32,000 people (FTE) at 60 locations across the globe. Key 2021 financial figures include €18.6 billion in global sales, and a €2.5 billion R&D spend. ASML is a complex system architect and integrator – our lithography machines are developed and manufactured together with our supply chain partners, mainly in Europe. Our most advanced EUV (extreme ultraviolet) lithography machines consist of 95% European technology. ASML exists not just as one company, but as a collaborative innovation network consisting of large companies, small- and medium-sized enterprises, and applied research organizations such as imec in Belgium, CEA-Leti in France, and Fraunhofer in Germany.