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The European semiconductor ecosystem: Regional development in a geopolitical context

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ABSTRACT: Human society is increasingly dependent on electronic devices, from phones and laptops to renewable energy and electric vehicles. Semiconductors are essential materials for these devices due to their electrical properties. The manufacture of semiconductors, such as chips, is one of the most complex and sophisticated processes in the manufacturing industry and requires numerous precision steps and many actors involved. This research aimed to analyse the European semiconductor ecosystem in terms of its regional development, Europe's position in the supply chain and the measures taken to reduce dependence on external markets. The results show a diversified but unbalanced European semiconductor ecosystem, with research and development activities in almost all European countries, but the production of semiconductor equipment and devices is concentrated in a few countries in central and western Europe. It also shows that Europe's dependence on external markets for semiconductor supplies is considerable and, although significant measures have been adopted to support the European semiconductor ecosystem, achieving the objectives proposed by the EU Chips Act will be difficult to achieve.

KEYWORDS: Europe, semiconductor ecosystem, dependence, EU Chips Act, global chip market

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1. INTRODUCTION

A semiconductor is a material with an electrical conductivity that lies between that of a conductor and that of an insulator. This unique property allows for precise control of electric current, making semiconductors the fundamental material for almost all modern electronic devices. Their key function is the ability to control the flow of electric current. Pure semiconductor materials are poor conductors, but their conductivity can be adjusted by adding impurities (doping) or by changing the temperature. They are doped with elements with three valence electrons (trivalent, e.g. boron), to create P-type semiconductors, or with five valence electrons (pentavalent, e.g. phosphorus), to create N-type semiconductors (Streetman, 2002; Tolasa, 2025).

Semiconductors are classified according to their composition, but also according to the way they conduct electric current. Depending on their composition, semiconductors can be elementary, compound, organic or layered. Elementary semiconductors are made up of a single chemical element, such as: silicon (the most widespread and used material in modern microchip technology, due to its stability and abundance), germanium (used for specialized circuits), carbon, selenium, tellurium or tin. Compound semiconductors are made up of several chemical elements: gallium arsenide (GaAs), gallium nitride (GaN), copper indium diselenide (CuInSe2), silicon carbide (SiC), indium phosphide (InP) or alloys of aluminum, gallium and indium. Organic semiconductors include amorphous or liquid semiconductor materials, and layered semiconductors have a layer-type structure. Depending on how they conduct electric current, semiconductors are intrinsic (without impurities) and extrinsic (semiconductors doped with controlled

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impurities to modify their electrical properties), the latter being the most common in applications (Streetman, 2002; Bird, 2002; Spain & Venkatanarayanan, 2014; Poplavko, 2019; Terna et al., 2021).

Semiconductor manufacturing is one of the most complex and sophisticated industrial processes, requiring hundreds of high-precision manufacturing steps to transform raw semiconductor material into the chips that power electronic devices. At the most basic level, sand is used to make ultra-pure silicon. The refined material is melted into single-crystalline cylindrical ingots and cut into very thin, flat discs called wafers, less than a millimeter thick and up to 300 mm in diameter. These wafers are polished to extreme smoothness and then coated with thin films of conductive, insulating or semiconducting materials (the deposition step), including a photosensitive layer called photoresist. This is followed by lithography, a crucial step in the chip manufacturing process, which transfers the complex chip design patterns onto the wafers, followed by etching and ion implantation (doping). Finally, the wafers are cut into individual chips (some wafers can contain thousands of chips), tested, and packaged. Hundreds of tests and measurements are performed to ensure the functionality of the products (Ruberti, 2023; Cerutti & Nardo, 2023; ESIA, 2025a).

In general, four major stages are distinguished within the semiconductor industry: research and development, design, manufacturing and assembly, testing and packaging. Only large players are integrated device manufacturers (IDM), which design and manufacture using their own intellectual property: Intel, Micron and Texas Instruments in the US or Samsung and SK Hynix in South Korea. There are many companies that specialize only in design, called fabless (Nvidia, Broadcom, Qualcomm or Apple, all in the US, MediaTek, Novatek and Realtek in Taiwan), and those that carry out only manufacturing activities are known as foundries (TSMC and UMC in Taiwan, GlobalFoundries in the United States or SMIC in China). Some companies specialize in manufacturing equipment (such as ASML in the Netherlands or Applied Materials and Lam Research in the USA), assembly, testing and packaging (Amkor in the USA, ASE in Taiwan, JCET in China or UTAC in Singapore), electronic design automation (Cadence and Synopsys in the USA and Siemens EDA in Germany) or Core Intellectual Property (Arm in the UK)(Poitiers & Weil, 2021; Bown & Wang, 2024; Huggins et al., 2023).

Semiconductors are essential components for numerous electronic products in various fields: consumer electronics, transportation, healthcare, renewable energy, communications, modern infrastructure, industry or defense (Bown & Wang, 2024; European Council, 2025a).

This research aimed in particular to analyse the European semiconductor ecosystem from the point of view of its regional development. The research also aimed to identify Europe's strengths in semiconductor manufacturing (such as holding key positions in the manufacturing process), as well as to compare it with other regions of the world. It also aimed to identify measures taken to reduce dependence on external markets and to implement them in order to achieve the assumed strategic objectives.

1.1. Historical context

The foundations of semiconductors were laid in the 19th century and the first half of the 20th century. In 1833, Michael Faraday discovered that the electrical conductivity of silver sulfide crystals increased with temperature, suggesting the properties of semiconductors. In 1874, Karl F. Braun discovered the rectifier effect at the point of contact between metals and certain crystalline materials, which allowed the conversion of alternating current to direct current. In 1901, Jagadis C. Bose patented a point-contact semiconductor rectifier for detecting radio waves. In December 1947, John Bardeen and Walter Brattain invented the germanium-based point-contact transistor, improved in 1948 by William Shockley, who developed the junction transistor (Computer History Museum, 2025).

The invention of the transistor led to the development of modern electronics. The introduction of the integrated circuit by Jack Kilby and Robert Noyce in the late 1950s marked another turning point. The miniaturization of electronic components enabled the mass production of increasingly complex devices (chips), leading to the subsequent microelectronics revolution (Tolasa, 2025). Today, innovation focuses on adding more and more components to smaller and smaller areas to increase processing performance and reduce power consumption. This is expressed in terms of “node size”, with smaller nodes indicating more advanced chips (Poitiers & Weil, 2021).

American companies have long dominated the semiconductor industry. Texas Instruments, National Semiconductors, Motorola, and Intel were among the top global players in 1980 (by revenue). While in Europe Philips has long been a major player in the sector, in Asia the first companies in the field emerged in Japan in the 1970s and 1980s, and then in Taiwan and South Korea. Taiwan Semiconductor Manufacturing Corporation (TSMC) emerged in 1987 as the world's first manufacturer of chips designed by other companies. The emergence of the foundry-less model profoundly changed the structure of the industry, with some companies focusing exclusively on chip design (Bown & Wang, 2024).

1.2. Geopolitical context

The semiconductor industry is undergoing a historic transformation, moving from a model based on global efficiency to one defined by national security and geopolitical competition. The geopolitical framework is marked by trade tensions between the US and China. Tariff policies and trade tensions between the US and China have forced a restructuring of supply chains, and US exports to China have declined sharply. Overall, in 2025, US exports of goods were 26% lower than in 2024. As a share of total US production, sales of goods and services to China had fallen to almost half of their 2017 levels (Bown, 2026). Europe has also faced more Chinese imports and higher US tariffs (Devesa et al., 2026). In the semiconductor sector, competition between the two countries has been manifested through US sanctions and export controls to limit China's role in the global chip supply chain. China has thus set out to create a fully Chinese semiconductor supply chain (Sharma, 2025). Directly affected, Europe's strategy has aimed to build a resilient semiconductor ecosystem, with the aim of increasing economic security by reducing dependence on external actors and ensuring a competitive advantage in the field.

2. LITERATURE REVIEW

The scientific literature on semiconductors is vast and addresses a wide range of issues, from technological and economic to geopolitical and sustainability. Some authors examine the influence of European policies on the development of the semiconductor industry and argue that the European semiconductor industry is at a crossroads due to the long-term decline in competitiveness and industry size (Johnston & Huggins, 2023). Others consider digital sovereignty as a tool for legitimizing trade, economic and research policies and assert the need for a strong semiconductor industry in the EU and the globalized nature of supply chain threats (Monsees, 2025). There are authors who have tried to identify the determinants and barriers to building resilience in the semiconductor supply chain, proposing possible scenarios for the year 2050 (Ejdys & Szpilko, 2023). The decline of the European semiconductor industry is also explained by the dominance of demand for consumer electronics, the structure of demand being one of the main factors affecting the rate and direction of technological change and the evolution of high-tech industries (Malerba, 1985).

Aspects targeting the sustainability of the semiconductor industry have also been widely addressed (Song & Dong, 2024; Liu et al., 2024; Qi et al., 2024; Narayanaswamy & Muthusamy, 2011). For example, some authors have focused on understanding how semiconductor research and technology organizations promote sustainability and sustainability-oriented innovations, as the semiconductor industry consumes large amounts of energy, electricity, and water and generates hazardous waste and greenhouse gas emissions (Konstari & Valkokari, 2025).

Many authors analyze the semiconductor industry in a geopolitical context (Bown, 2020; Miller, 2022) and emphasize the dominance of the global value chain and strong extraterritorial control of the United States (Malkin & He, 2024). The fact that states seek to expand their control over the semiconductor value chain, while reducing their dependence on foreign production, is emphasized by some authors (Malkin & He, 2024; Kim & Rho, 2024). Wong et al. (2024) examined the changing landscape of global value chains and competition in the semiconductor industry as the United States implements chokepoint measures to limit the growth of semiconductor production in China. The authors found that these measures will have significant impacts, particularly on three types of memory (HBM, DRAM, and NAND) and logic chips, and will slow down the speed and process of China's catch-up. Another study addresses the threats posed by geopolitical and climate risks that are undermining the resilience of the global semiconductor supply chain, noting that companies' profits have declined significantly due to disruptions and delays in chip supply. The study provides theoretical and managerial insights for resilient supply chain management (Zhang et al., 2024).

3. DATA AND METHODS

In the current geopolitical context, the development of the European semiconductor system is defined by the transition from global dependence to strategic autonomy. Spatially, the research focuses on the European space, but highlights the relationship with other geographical areas, such as East Asia and the SAU. The temporal framework follows the situation of the European semiconductor ecosystem from the relatively recent past (2020-2023), marked by the semiconductor crisis and the implementation of the European Chips Act, to the present.

This research uses quantitative and qualitative methods to collect and analyze data on the European semiconductor ecosystem. Data on the composition of the European semiconductor ecosystem was compiled from various sources, mainly the official websites of research institutions and companies operating in the field. The documentation aimed to identify the main actors involved in the semiconductor field in Europe and group them according to the activity carried out: research and development, production of basic materials, production of equipment used in the chip manufacturing process or production of semiconductor devices. The data obtained were summarized in the form of tables.

In identifying the main players in the semiconductor field, technological performance (such as the ability to design or manufacture chips at advanced nodes), market dominance (control of market segments, such as essential equipment or devices) or financial (such as revenue and market share) were taken into account. In research and development, those research institutions or companies that have a clear commitment to innovation, are distinguished by technological capabilities, financial investments and influence within the global ecosystem were targeted. In general, key players are those that have the ability to drive the industry, control a significant market share or provide essential technologies.

For regional differentiation, the research followed the geographical location of research or production units. Other data used in the research come from international sources and databases (Semiconductor Industry Association, European Council, European Commission, European Semiconductor Industry Association), but also from consulting a specialized bibliography and other sources. To highlight the regional distribution of the European semiconductor ecosystem or the evolution of some indicators, graphical methods were used and the results were subsequently interpreted.

4. RESULTS

Within the global semiconductor ecosystem, Europe has significant R&D capabilities, is a major supplier of chip manufacturing equipment and has a highly specialised semiconductor device industry, such as chip production for the automotive, aerospace, defence and security, and industrial sectors. Europe has a top-notch education system that produces talent and a robust R&D ecosystem, including Imec in Belgium, the Fraunhofer Institutes in Germany, and CEA-Leti in France. Also, the British company Arm designs the chip architecture (the structural design and organization of integrated circuits within a chip) for the world's largest computing ecosystem (over 325 billion devices contain Arm-based chips). Their architecture is prevalent in most smartphones, but is also present in many other areas (Arm, 2025).

European companies are world leaders in the production of highly sophisticated equipment needed to manufacture chips. For example, ASML (Netherlands) is the world's only manufacturer of extreme ultraviolet (EUV) lithography machines, essential for manufacturing the world's most advanced chips. Their lithography systems offer the highest resolution in high-volume production, allowing chipmakers to include more transistors on a single chip (ASML, 2026). Other European companies are leaders in areas such as vacuum technology (Edwards Vacuum), optics (Carl Zeiss) or wafer bonding equipment (EV Group, SÜSS MicroTec).

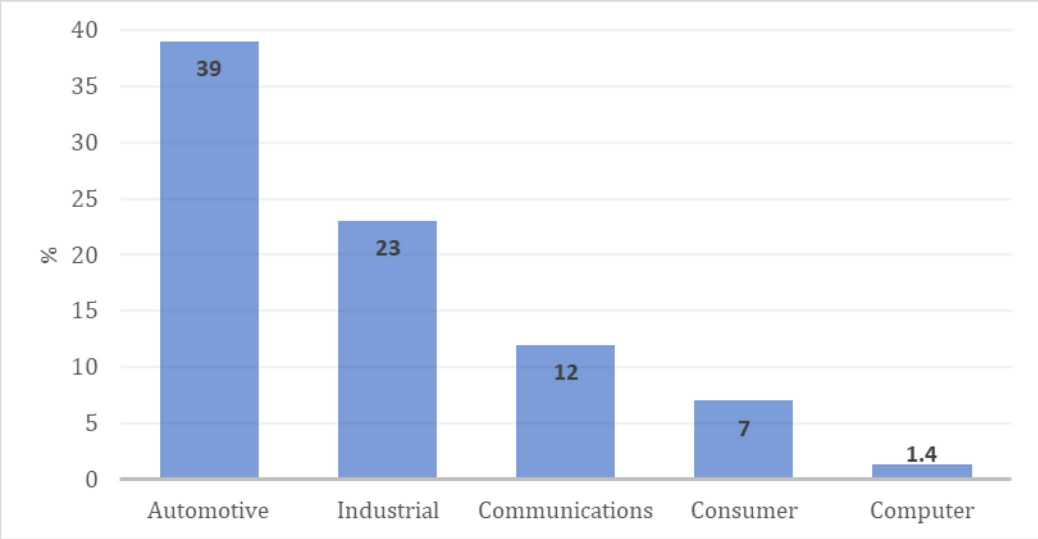

Figure 1. EU end-user semiconductor device market share in 2023.
Source: European Council (2025b).

In the production of semiconductor devices, Europe excels in specialized areas that require high reliability and unique engineering. The automotive sector is the main destination for chips produced in Europe (European Council, 2025b) (Figure 1). Infineon Technologies and STMicroelectronics are major players in the field of power electronics, sensors and microcontrollers. Europe is also important in the design and production of "More than Moore" components (sensors, power and telecommunications components), crucial for the automotive industry, defense, healthcare and other emerging technologies (Dauvé, 2025). Among the leading European companies in the production of "More than Moore" components are STMicroelectronics, Infineon Technologies, NXP Semiconductors or Robert Bosch GmbH, which are also the major European integrated device manufacturers (IDM).

It is difficult to estimate the total size of the European semiconductor ecosystem. It is estimated that there are at least 2000 companies active in the processes, development and production of semiconductors (Huggins et al., 2023). In general, there are few large companies in the semiconductor industry, and most of them are American (Nvidia, Broadcom, Intel, Qualcomm, Micron Technology, AMD, Applied Materials, Lam Research, Texas Instruments, Analog Devices) or Asian (Samsung Electronics, TSMC, SK Hynix, ASE Group, MediaTek, KLA, TEL, Sony). Among the European companies, the most important are: ASML, Infineon Technologies, NXP Semiconductors, STMicroelectronics or Arm (Table 1).

Table 1. Major companies in the semiconductor industry in Europe.

Company	Headquarters	Locations in Europe	Areas of activity
ASML	Veldhoven (Netherlands)	Veldhoven, Delft, Oirschot, Berlin, Dresden, Erlangen, Leuven, Crolles, Avezzano	Lithography systems for chip production
Infineon Technologies	Neubiberg (near Munich, Germany)	Dresden, Regensburg, Warstein, Augsburg, Duisburg, Erlangen, Ilmenau, Langen, Soest, Villach, Cegléd, Graz, Klagenfurt, Linz, Le Puy-Sainte Réparade, Zurich, Stockholm, Cork, Dublin, Padua, Pavia, Bristol, Redhill, Brașov, Bucharest, Iași, Belgrad, Budapest, Cegléd, Lviv	Automotive, power & sensor systems, green industrial power, connected secure systems
NXP Semiconductors	Eindhoven (Netherlands)	Nijmegen, Delft, Dresden, Munich, Hamburg, Gratkorn, Leuven, Toulouse, Caen, Mougins, Milan, Catania, Glasgow, Southampton, Stockholm, Rožnov pod Radhoštěm, Bucharest, Sibiu, Budapest	Automotive, IoT, and secure connectivity chips.
STMicroelectronics	Geneva (Switzerland)	Crolles, Rousset, Tours, Rennes, Agrate Brianza, Catania, Marcianise, Kirkop, Norrköping	Automotive, Industrial & Power, IoT & Communications.
Arm	Cambridge (United Kingdom)	Cambridge, Manchester, Bristol, Sheffield, Sophia Antipolis, Aschheim, Lund, Galway, Oslo, Trondheim, Budapest, Sentjernej	Semiconductor intellectual property (IP) and architecture licensing.

ASM International	Almere (Netherlands)	Almere, Leuven, Helsinki	Wafer processing equipment (ALD/Epitaxy)
BE Semiconductor Industries (Besi)	Duiven (Netherlands)	Duiven, 's-Hertogenbosch, Steinhausen, Radfeld	Advanced packaging and assembly equipment
Technoprobe	Cernusco Lombardone (Italy)	Cernusco Lombardone, Agrate Brianza, Osnago, Vimercate, Catania	Wafer testing and probe card technology.
Soitec	Bernin (France)	Bernin, Grenoble, Besançon, Hasselt, Le Bourget-du-Lac	Engineered substrate materials (SOI wafers)
Melexis	Ypres (Belgium)	Ypres, Tessenderlo, Sofia, Erfurt, Dresden, Düsseldorf, Sophia Antipolis, Corbeil-Essonnes, Courbevoie, Bevaix, Kyiv	Mixed-signal automotive sensor ICs

Source: ASML, 2026; Infineon, 2024; NXP, 2026; STMicroelectronics, 2026; Arm, 2025; ASM International, 2022; BESI, 2026; Technoprobe, 2025; Soitec, 2026; Melexis, 2026.

4.1. Semiconductor research and development in Europe

The main component of the European semiconductor ecosystem is research and development, including advanced chip design, which aims to: achieve technological sovereignty, stimulate innovation in artificial intelligence, IoT or 5G, improve manufacturing processes, secure supply chains and build a skilled workforce. The achievement of these goals is strongly supported by initiatives such as the European Chips Act and the Chips JU (CjipsJU, 2025).

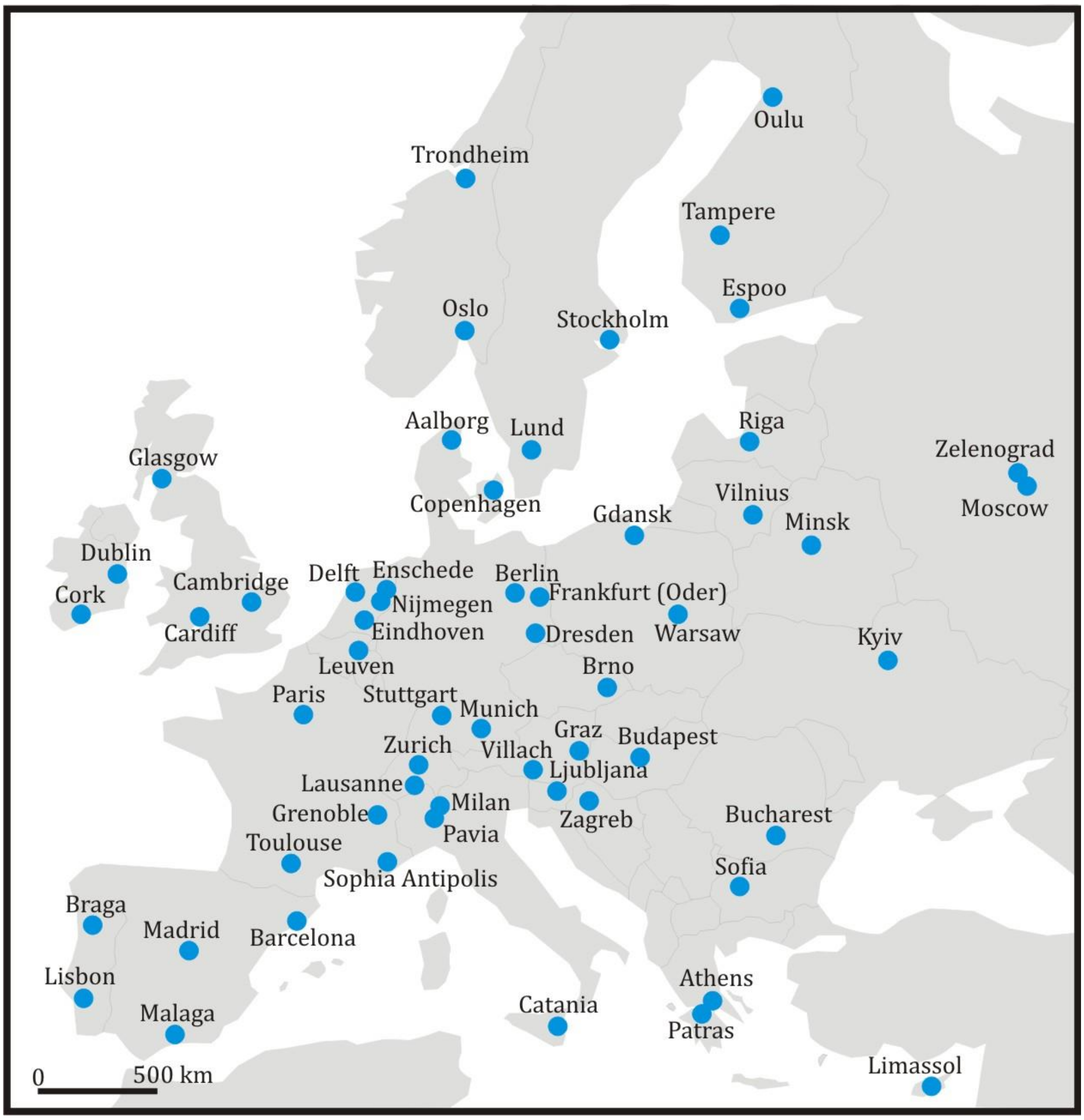

Figure 2. Main centers in semiconductor R&D in Europe.

The research and development component in the field is distributed throughout Europe (Figure 2), but is better developed in some countries such as Germany, Belgium, the Netherlands, France or the United Kingdom. The world's largest independent research and innovation center for nanoelectronics and digital technology is located in Leuven (Belgium). This is Imec (Interuniversity Microelectronics Centre), which has state-of-the-art facilities, including a 300 mm semiconductor pilot line, clean rooms and laboratories, essential for innovation, and collaborates with industrial partners, startups and numerous universities. Although headquartered in Leuven, Imec operates globally, with a presence in Europe in the Netherlands, the United Kingdom, Spain, Germany and Italy (Imec, 2026).

Germany stands out for its large number of R&D players in the semiconductor industry, particularly in the city of Dresden, also known as Silicon Saxony. The region is home to many key players, including the Dresden University of Technology, several Fraunhofer institutes (such as the Fraunhofer Institute for Photonic Microsystems) and major companies such as Infineon Technologies, GlobalFoundries, Bosch, X-FAB, NXP or Carl Zeiss SMT (Silicon Saxony, 2023). Infineon, the most powerful company in the field in Germany, had over 13,200 R&D employees worldwide at the end of 2024, in 71 R&D centers in 27 countries. In Europe, there were 30 centers, of which 10 were in Germany, 4 in Austria, 3 in Romania, two each in Ireland, Italy, Hungary and the United Kingdom and one each in France, Sweden, Switzerland, Serbia and Ukraine (Infineon Technologies AG, 2024).

A strong R&D ecosystem in the field is also located in the Netherlands. The Brainport Eindhoven region, which includes the Eindhoven University of Technology (with the Casimir Institute), the ASML campus in Veldhoven and the headquarters of NXP Semiconductors, is noteworthy. Also important are the University of Twente (MESA+ Institute for Nanotechnology) in Enschede and TU Delft and QuTech in Delft (NFIA, 2024). France also makes an important contribution in this field, with the Grenoble region being the most prominent. It is home to CEA-Leti (Laboratoire d'électronique des technologies de l'information), one of the world's largest organizations for applied research in microelectronics and nanotechnology. CEA-Leti has created numerous startups and laid the foundations for the microelectronics sector in France (CEA-Leti, 2026). STMicroelectronics and Soitec also have R&D facilities in Grenoble.

Significant semiconductor R&D activities are also taking place in the UK, Italy, Sweden, Poland, Austria, Finland, and others (Table 2). The UK has major initiatives focused on compound semiconductors (in Cardiff), photonics and chip design, and the University of Cambridge is a leading centre for semiconductor design, being the headquarters of Arm (techUK, 2025). In Italy, important centres are in Lombardy, including Fondazione Chips-IT and Politehnico di Milano. The Franco-Italian company STMicroelectronics has R&D facilities in Catania and Agrate Brianza (The Italian House of Business, 2026). In Poland, Pomerania is emerging as a critical centre for semiconductors, hosting major companies such as Intel, SK Hynix and Synopsys. Intel has the largest R&D technology centre in Europe in Gdańsk, with around 3000 employees, and one of the largest of its kind in the world, with a main focus on software development (Tek.info.pl., 2025). Kista Science City is a major technology center in Stockholm, home to universities, research institutes and technology companies, including Stockholm University, the Royal Institute of Technology, the Research Institutes of Sweden and the Swedish Defence Research Agency (Kista Science City, 2026).

Table 2. Major players in semiconductor research and development in Europe.

Country	Main locations	Major players	
		Academic and research institutes	**Companies with R&D activities**
Austria	Villach, Graz, Linz	Silicon Austria Labs (SAL), Graz University of Technology	Infineon, NXP, Lam Research
Belgium	Leuven, Ghent, Louvain	Imec (Interuniversity Microelectronics Centre), Ghent University, UCLouvain	Melexis, NXP, X-FAB, Keysight
Czech Republic	Brno	Brno University of Technology	Onsemi, Codasip, Elmos Semiconductor, TESCAN
Denmark	Copenhagen, Aalborg	DTU Nanolab (Technical University of Denmark), Niels Bohr Institute (University of Copenhagen), Aalborg University	Samsung, NVIDIA, Lotus Microsystems
Finland	Espoo, Tampere, Oulu	InstituteQ (The Finnish Quantum Institute), VTT Technical Research Center of Finland, Aalto	IQM Quantum Computers, SemiQon

		University, Micronova, University of Tampere	
France	Grenoble, Sophia Antipolis, Paris, Toulouse	CEA-Leti (Laboratoire d'électronique des technologies de l'information), Minatec (Grenoble), C2N (Centre for Nanosciences and Nanotechnology), Paris-Saclay University, Laboratory for Analysis and Architecture of Systems (Toulouse)	STMicroelectronics, Soitec, MACOM, NXP, Microchip Technology
Germany	Dresden, Munich, Frankfurt (Oder), Stuttgart	Fraunhofer Institutes, Leibniz Institute for High Performance Microelectronics (Frankfurt an der Oder), Max Planck Semiconductor Laboratory (Munich), Dresden University of Technology, University of Stuttgart, TU Berlin	Infineon, GlobalFoundries, Bosch, X-FAB, NXP, Carl Zeiss SMT, Siltronic, AIXTRON
Ireland	Cork, Dublin	Tyndall National Institute, University College Dublin	Infineon, Qualcomm, Broadcom, Microchip Technology
Italy	Pavia, Milan, Catania	Fondazione Chips-IT in Pavia, Politecnico di Milano, Institute for Microelectronics and Microsystems of the National Research Council	STMicroelectronics
Netherlands	Eindhoven, Nijmegen, Enschede, Delft	Eindhoven University of Technology (Casimir Institute), University of Twente (MESA+ Institute), Delft University of Technology, Holst Centre, OnePlanet Research Center	ASML, NXP, BESI, Imec
Norway	Trondheim, Oslo	Norwegian University of Science and Technology, SINTEF MiNaLab (Oslo)	Nordic Semiconductor
Poland	Gdańsk, Warsaw	Gdańsk University of Technology, Łukasiewicz Research Network	Intel, SK Hynix, Synopsys
Portugal	Braga, Lisbon, Porto	International Iberian Nanotechnology Laboratory din Braga INESC Microsistemas e Nanotecnologias (Lisbon)	Synopsys, Amkor Technology
Romania	Bucharest	National Institute for Research and Development in Microtechnologies (hosts IMT-MINAFAB), POLITEHNICA Bucharest	Infineon, Microchip Technology, NXP
Russia	Zelenograd, Moscow, Sankt Petersburg	Molecular Electronics Research Institute (Zelenograd), Moscow Center for SPARC Technologies, Scientific Research Institute of Electronic Technology	Mikron Group (JSC Mikron), Angstrem, Baikal Electronics, GS Nanotech
Spain	Barcelona, Madrid, Malaga	Institute of Microelectronics of Barcelona, Institute of Micro and Nanotechnology of Madrid	Imec, Intel, Cisco
Sweden	Stockholm, Lund, Linköping	Stockholm University, Royal Institute of Technology, Research Institutes of Sweden, Electrum Laboratory, Lund University	Ericsson, STMicroelectronics, Silex Microsystems, SweGaN
Switzerland	Zurich, Lausanne, Neuchâtel	Swiss Federal Institute of Technology in Zurich, École Polytechnique Fédérale de Lausanne, Swiss Center for Electronics and Microtechnology in Neuchâtel	STMicroelectronics, IBM Research, U-blox, Sensirion, EM Microelectronic
United Kingdom	Cambridge, Cardiff, Glasgow	University of Cambridge, Cardiff Compound Semiconductor Centre, University of Glasgow, University of Sheffield, University of Southampton	Arm, NVIDIA, Qualcomm, NXP, Infineon, Pragmatic Semiconductor, etc.

Source: ABA, 2023; Imec, 2026; CSIS, 2024; CSC, 2025; Silicon Saxony, 2023; Infineon, 2024; GTAI, 2024; NFIA, 2024; CEA-Leti, 2026; techUK, 2025; CC-NorChip, 2026; España Digital, 2023; POEMS, 2026; Semiconductor Sweden, 2026; Kista Science City, 2026; Tek.info.pl., 2025; DTN, 2026.

4.2. Production of wafers and other basic materials

In general, the semiconductor industry uses hundreds of materials. Semiconductor wafers, usually made of high-purity monocrystalline silicon, are the fundamental material (substrate) for the entire semiconductor industry, acting as the basis on which integrated circuits (chips) are made. Major European companies producing wafers from monocrystalline silicon ingots include Siltronic, Okmetic, Soitec, Topsil or MEMC Electronic Materials. Siltronic, a German company headquartered in Munich, is one of the world's leading producers of hyperpure silicon wafers, supporting the semiconductor supply chain in

Europe. It develops and produces wafers in Burghausen (large diameter wafers, up to 300 mm) and Freiberg (state-of-the-art 300 mm wafers) (Siltronic, 2026). Okmetic of Finland is the world's seventh largest supplier of customized 150 and 200 mm silicon wafers for MEMS sensors, radio frequency applications and power semiconductors, produced in its Vantaa plant (Okmetic, 2026).

In Bernin (near Grenoble), Soitec produces advanced semiconductor materials, in particular silicon-on-insulator (SOI) and silicon carbide (SiC) wafers, used in applications from smartphones to electric vehicles (Soitec, 2026). High-purity silicon ingots and wafers, including 200 mm wafers (used in power electronics, renewable energy and quantum computing), are produced in Frederikssund by Topsil (part of the GlobalWafers Group), the largest semiconductor company in Denmark. It is one of the few companies in the world capable of producing hyperpure silicon obtained by the Float Zone method (Topsil, 2026). The Italian company MEMC Electronic Materials (part of GlobalWafers) produces high-quality single crystal silicon ingots in Merano and polished and epitaxial wafers in Novara, used in the automotive, consumer electronics, telecommunications and defense sectors (GlobalWafers, 2026).

Other materials used in the semiconductor industry are also produced in Europe: high-quality silicon metal (key raw material for creating hyperpure silicon), silicon carbide (SiC) powders and granules, or high-purity gases and chemicals (Table 3).

Table 3. European semiconductor ecosystem – wafer production and other basic materials.

Company	Production centers	Products
Siltronic	Burghausen, Freiberg (Germany)	Monocrystalline silicon wafers
Okmetic	Vantaa (Finland)	Customized silicon wafers
Soitec	Bernin (France)	Silicon-on-Insulator (SOI) and Silicon Carbide (SiC) wafers
Topsil	Frederikssund (Denmark)	High purity silicon ingots and wafers, including 200 mm wafers
MEMC Electronic Materials	Merano, Novara (Italy)	Monocrystalline silicon ingots and polished and epitaxial wafers
X-FAB Silicon Foundries	Dresden (Germany)	Gallium nitride-on-silicon (GaN-on-Si) wafers
SweGaN AB	Linköping (Sweden)	GaN-on-SiC (gallium nitride on silicon carbide) epitaxial wafers
Littelfuse	Dortmund (Germany)	200 mm wafers
SiCrystal (part of Rohm)	Nuremberg (Germany)	Monocrystalline silicon carbide semiconductor wafers
Kepp EU	Riga (Latvia)	High purity silicon ingots
Wacker Chemie AG	Burghausen, Nünchritz (Germany)	Hyperpure polysilicon (world market leader)
Fiven ASA (part of Kymera Int.)	Lillesand, Arendal (Norway)	High purity silicon carbide (SiC) powders and granules (global leader)
SICREATE (part of EBNER Group)	Leonding (Austria)	High purity SiC powders
ESK-SIC GmbH	Frechen (Germany)	High purity SiC powders and granules
Elkem	Bremanger, Salten, Fiskaa (Norway), Roussillon, Saint-Fons (France), etc.	Advanced silicon-based materials
Zadient	Chambéry (France), Leipzig (Germany)	High purity source materials made by the chemical vapor deposition (CVD) process
PCC BakkiSilicon	Husavik (Iceland)	High-quality silicon metal (key raw material for creating ultrapure silicon)
BASF	Ludwigshafen (Germany)	High purity chemicals (including sulfuric acid, ammonium hydroxide) for wafer cleaning and etching processes
Air Liquide	Dresden (Germany)	Ultrapure gases (nitrogen, oxygen, hydrogen, helium, etc.) and advanced electronic materials (special molecules for nanoscale deposition) essential for the manufacture of semiconductors
Merk	Darmstadt (Germania)	High purity gases for deposition, etching, cleaning and doping processes

Source: GTAI, 2024; Siltronic, 2026; Okmetic, 2026; Soitec, 2026; Topsil, 2026; GlobalWafers, 2026; Wacker, 2026; INSIDE Magazines, 2025; Kymera Int., 2026; Elkem, 2026; Semiconductor Sweden, 2026; EBNER, 2026; BASF, 2025; Air Liquide, 2025; Merk, 2026.

4.3. Production of equipment needed in chip manufacturing

Chip production requires sophisticated equipment (deposition systems, lithography machines, etching systems, metrology and inspection instruments, assembly and packaging equipment), automated, housed in specialized clean rooms. High-precision instruments measure physical/electrical properties (metrology) and detect defects (inspection) at the nanoscale of the chips, ensuring quality control. Assembly and packaging equipment takes silicon chips and transforms them into usable components, covering processes such as die attachment, wire bonding, encapsulation or dicing.

The Netherlands is a major contributor to the design and production of advanced chip manufacturing equipment. Approximately 85% of chips manufactured globally use technology from the Netherlands. Brainport Eindhoven is the main semiconductor hub in the Netherlands and is home to ASML (with a production center in Veldhoven). ASML is the leading manufacturer of extreme ultraviolet (EUV) lithography machines, which are needed to manufacture the world's most advanced chips, with a market share of 90%. It is the largest semiconductor company in Europe by market value (275 billion euros) and employs around 39,000 people worldwide. The company also produces various key components for lithography systems in Berlin (wafer tables and clamps, reticle chucks and mirror blocks). BESI, headquartered in Duiven, is a global leader in semiconductor assembly and packaging solutions. It has four design and development centers in Europe, but series production has been outsourced to Asia (Malaysia and China). ASM International, another major equipment manufacturer, has 55% of the market for advanced atomic layer deposition technologies, but its volume production facilities are in Asia (ASML, 2026; NL Netherlands, 2025; ASM International, 2022). Also in the Netherlands, in Enschede, the American company Lam Research produces advanced pulsed laser deposition (PLD) technology and equipment for critical components used in 5G, MEMS and photonics applications (Lam Research, 2025).

Other important equipment manufacturers are Carl Zeiss SMT, TRUMPF or AIXTRON from Germany, Technoprobe SpA from Italy or EV Group from Austria (Table 4, Figure 3). Carl Zeiss SMT is the only manufacturer in the world of optics used in extreme ultraviolet lithography machines, and TRUMPF is the only manufacturer of lasers required for EUV lithography (Zeiss, 2020). AIXTRON also produces metal-organic chemical vapor deposition (MOCVD) equipment in Herzogenrath (near Aachen), Cambridge and Turin (AIXTRON, 2024). Technoprobe SpA specializes in the design and development of probe cards (high-tech devices that facilitate chip testing), with production facilities in Cernusco Lombardone, Agrate and Osnago (Technoprobe, 2025).

Table 4. European semiconductor ecosystem - equipment manufacturing.

Company	Production centers	Equipment type
ASML	Veldhoven (Netherlands), Berlin (Germany)	Extreme ultraviolet (EUV) lithography machines
Carl Zeiss SMT	Oberkochen (Germany)	Optics used in extreme ultraviolet lithography machines
AIXTRON	Herzogenrath (Germany), Cambridge (UK), Turin (Italy)	Metal-organic chemical vapor deposition equipment (MOCVD) (global leader)
SÜSS MicroTec	Garching, Sternenfels (Germany)	Versatile wafer bonding equipment
TRUMPF	Warsaw (Poland)	Laser systems (essential in semiconductor manufacturing machines)
Technoprobe SpA	Cernusco Lombardone, Agrate Brianza, Osnago (Italy)	Probe cards (chip testing devices)
SPEA	Volpiano (Italy)	Automated testing equipment for electronic devices
LPE (part of ASM Int.)	Baranzate (Italy)	Epitaxy equipment
EV Group	St. Florian am Inn (Austria)	Wafer bonding equipment (a global leader)
Lam Research	Enschede (Netherlands), Villach (Austria)	Advanced Pulsed Laser Deposition (PLD) equipment; Spin Clean Technology (for wafer cleaning, etching and stripping)
VIGO Photonics	Ożarów Mazowiecki (Poland)	Infrared photonics (plays a vital role in various stages of the semiconductor manufacturing and testing process)
AIUT	Gliwice (Poland)	It provides specialized equipment and solutions for

		automation, robotics and IoT
Edwards Vacuum	Clevedon (UK), Lutín (Czech Republic)	Abatement systems and integrated vacuum and purification systems
Oxford Instruments	Bristol (UK)	Plasma etch technologies and wafer processing
KLA	Newport (UK)	Specialized etch and deposition equipment
UnitySC	Grenoble (France)	Metrology and inspection (tools for detecting defects that can cause chip damage)
RIBER	Bezons (France)	Molecular beam epitaxy (MBE) systems and components
SET (Smart Equipment Technology)	Saint-Jeoire (France)	World leading supplier of High Accuracy Flip Chip Bonders and versatile Nanoimprint Lithography (NIL) solutions
VAT Group	Haag (Switzerland), Arad (Romania)	Vacuum valves (world leader)
Mycronic	Täby/Stockholm (Sweden)	High-precision production equipment (photomask production, advanced packaging and testing)
MSTECH Europe	Barcelona (Spain)	Back-end automation solutions, particularly depaneling equipment used in final assembly stages
ThermoFisher, Tescan	Brno (Czech Republic)	Advanced metrology and process control tools, such as electron microscopes

Source: NL Netherlands, 2025; ASML, 2026; ASM International, 2022; GTAI, 2024; Lam Research, 2025; Zeiss, 2020; AIXTRON, 2024; Technoprobe, 2025; Semiconductor Sweden, 2026; TRUMPF, 2026; VAT Group, 2026; LPE, 2022; Tek.info.pl., 2025; MSTECH Europe, 2026; CSC, 2025.

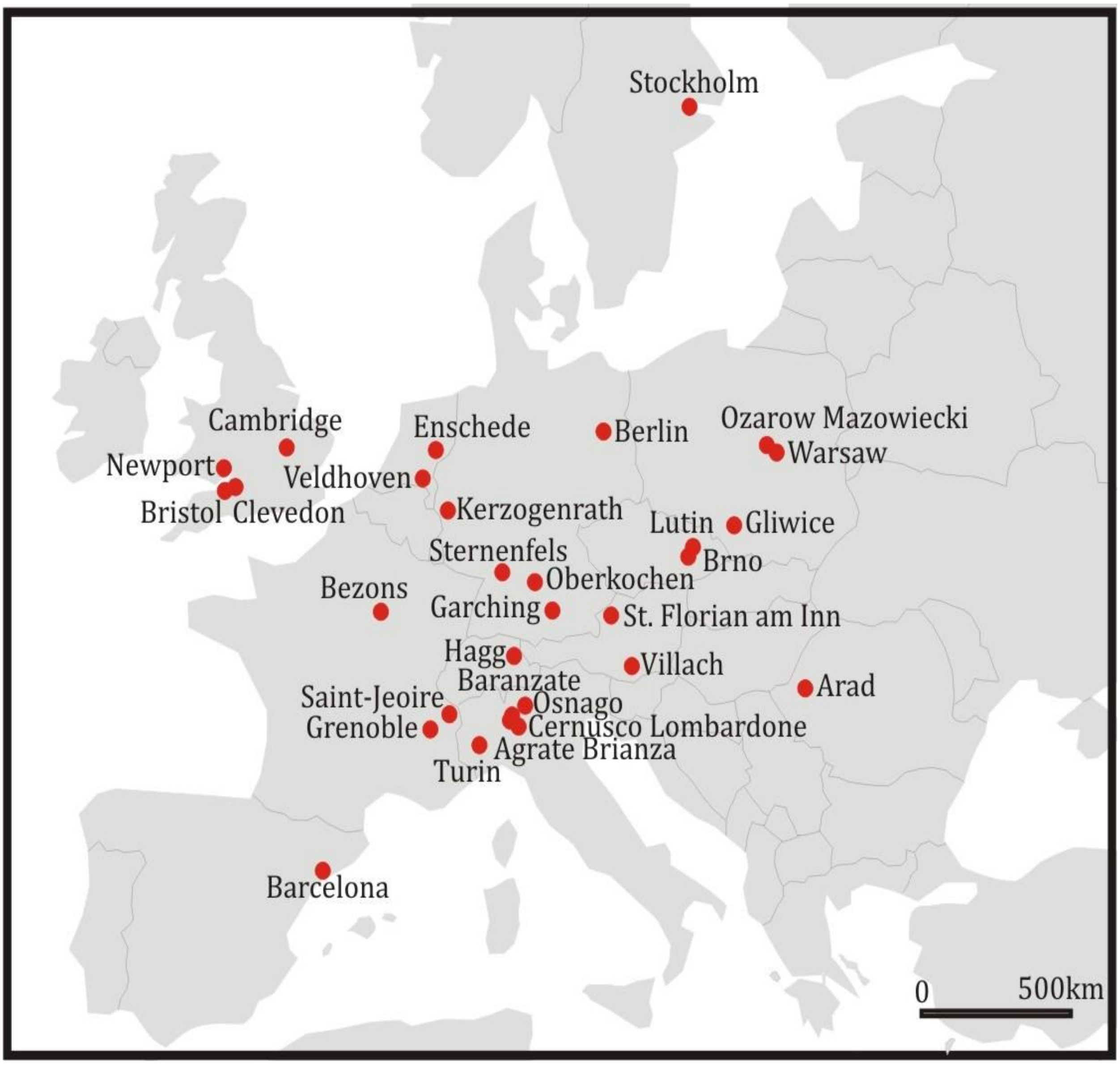

Figure 3. Equipment production centers for the manufacture of semiconductor devices.

4.4. Semiconductor device production

Semiconductor devices are electronic components found in almost all modern electronics. These devices are classified into two main types: discrete devices and integrated circuits. Discrete devices are individual components with a single dedicated function, such as transistors, diodes, or thyristors. Integrated circuits (ICs) are semiconductor devices that integrate multiple electronic components onto a single chip: microprocessors, memory chips, logic ICs, or analog ICs. Integrated circuits can contain millions or billions of transistors and other components packaged on a single piece of semiconductor material. There are also optical devices, such as LEDs (essential in communication systems), sensors and display technologies, microwave devices (used for radar applications, wireless communications or satellite transmissions) or sensors (detect changes in environmental conditions and convert them into electrical signals, being essential for applications in automotive systems, healthcare, industrial automation and consumer electronics (Takahashi, 2005; AIUT, 2025).

The European semiconductor device industry is mainly concentrated in Germany, followed by the Netherlands, France, the United Kingdom and Italy. European players such as NXP, Infineon and STMicroelectronics are recognised as leaders in semiconductor technology, particularly for automotive and industrial automation applications. Germany is a major global semiconductor manufacturer and the largest EU chip exporter, accounting for over a third of the total. Germany's strengths lie in the production of chips for automotive and industrial automation applications, with leading companies such as Infineon and Bosch. Germany is home to several semiconductor factories, particularly in the states of Saxony, Bavaria and Baden-Württemberg. Silicon Saxony is the largest semiconductor hub in Europe, with numerous industrial players: GlobalFoundries, Infineon Technologies, Bosch, X-FAB or SAW Components (Silicon Saxony, 2023; GTAI, 2024). For example, GlobalFoundries' Dresden factory (Fab 1) produces many different types of chips for a wide range of applications, including automotive, smartphone, 5G and IoT. It is one of the largest and most modern production facilities of its kind in Europe, a foundry that produces chips based on designs from its customers, such as Bosch, Infineon and NXP (GlobalFoundries, 2022).

In the Netherlands, NXP Semiconductors stands out, with around 11% of the global automotive semiconductor market. In 2023, it reported revenues of $13.2 billion and around 31,000 employees worldwide. In Nijmegen, it has one of the largest automotive chip factories in Europe (NL Netherlands, 2025). The Grenoble region is the main center of the French semiconductor industry, with a manufacturing ecosystem dominated by the Franco-Italian company STMicroelectronics. It produces a wide range of semiconductor devices, including microcontrollers (MCUs), RF (Radio Frequency) components, MEMS (Micro-Electro-Mechanical Systems) sensors and advanced integrated circuits for automotive and Internet of Things (IoT) applications in its factories in Crolles (northeast of Grenoble) and Rousset (STMicroelectronics, 2026). The UK has a strong expertise in compound semiconductors. South Wales is home to the world's first and only dedicated compound semiconductor cluster, known as CSconnected, which focuses on high-value manufacturing for electric vehicles, 5G, healthcare and defence (GOV.UK, 2025). Semiconductor devices are also manufactured elsewhere in Europe (Table 5, Figure 4).

Table 5. European semiconductor ecosystem – semiconductor device production.

Company	Production centers	Semiconductor devices
Infineon	Dresden, Regensburg, Warstein (Germany), Villach (Austria)	A wide range of semiconductor products, focusing on power semiconductors, analog/mixed-signal technologies, and sensors
NXP	Nijmegen (Netherlands)	Chips for the automotive sector
STMicroelectronics	Crolles, Rousset (France), Catania, Agrate Brianza (Italy)	It produces a wide range of semiconductor devices, including microcontrollers (MCUs), RF (Radio Frequency) components, MEMS (Micro-Electro-Mechanical Systems) sensors and advanced integrated circuits
X-FAB Silicon Foundries	Dresden, Erfurt, Itzehoe (Germany), Corbeil Essonnes (France)	Specialized semiconductors, focusing on MEMS and CMOS technologies, but also analog/mixed-signal integrated circuits (ICs); high-voltage chips, sensors and RF technologies

GlobalFoundries	Dresden (Germany)	Chips on 300 mm wafers
Bosh	Dresden, Reutlingen (Germany)	Advanced semiconductors, specializing in silicon carbide (SiC) power chips, MEMS and Application-Specific Integrated Circuits (ASICs)
Ams OSRAM	Regensburg (Germany), Premstätten (Austria)	Optoelectronic semiconductors (including LED chips, laser diodes and infrared components), advanced sensor technologies and analog semiconductors
SAW Components	Dresden (Germany)	Surface Acoustic Wave (SAW) devices, including filters, resonators, delay lines, and sensors for RF engineering and identification (RFID)
Semikron Danfoss	Nuremberg (Germany)	Power modules and semiconductor components
Texas Instruments	Freising (Germany)	Chips on 200 mm wafers
United Monolithic Semiconductors	Ulm (Germany)	High-performance chips
TRUMPF	Ulm (Germany)	It mainly produces photonic components and laser diodes.
Diotec Semiconductor	Heitersheim (Germany), Trbovlje (Slovenia)	A wide range of semiconductor devices (diodes, rectifier bridges)
TDK-Micronas	Freiburg (Germany)	Hall effect sensors
Nexperia	Hamburg (Germany)	Discrete semiconductors, specifically small-signal diodes, transistors, and MOSFETs
Swissbit	Berlin (Germany)	Industrial-grade flash memory products and secure storage and digital identity solutions
Smart Photonics	Eindhoven (Netherlands)	Indium phosphide (InP) based photonic chips
MACOM	Limeil-Brévannes (France)	Monolithic microwave integrated circuits and Millimeter-Wave Technologies
Vishay	Itzehoe, Heilbronn (Germany), Borgaro Torinese (Italy)	Semiconductor devices (diodes, transistors, rectifiers, power modules)
INEX Microtechnology	Newcastle-upon-Tyne (UK)	Compound semiconductors (such as GaN, SiC) and MEMS systems
Littelfuse	Chippenham (UK), Kaunas (Lithuania)	High-power semiconductors, advanced electromechanical products including sensors and switches
Pragmatic Semiconductor	Durham (UK)	Ultra-thin and flexible chips called FlexICs
Diodes Incorporated	Oldham (UK)	Advanced semiconductor components
Intel	Leixlip (Ireland)	Advanced chips
Analog Devices	Limerick (Ireland)	High-performance analog chips and MEMS systems
Hitachi Energy	Lenzburg (Switzerland), Prague (Czech Republic)	High-power semiconductors
Onsemi	Piešťany (Slovakia)	Low-voltage MOS power devices and various semiconductors for power management
Silex Microsystems	Jarfalla (Sweden)	Advanced MEMS systems
Brolis Semiconductors	Vilnius (Lithuania)	Infrared laser diodes and electro-optical systems
RD Alfa Microelectronics	Riga (Latvia)	High reliability and radiation hardened microelectronics components for aerospace and defense equipment
Mikron, Angstrem	Zelenograd (Russia)	Various semiconductor devices
Integral	Minsk (Belarus)	Chips widely used in the Russian military-industrial complex

Source: GTAI, 2024; STMicroelectronics, 2026; NL Netherlands, 2025; GlobalFoundries, 2022; GOV.UK, 2025; IDA Ireland, 2026; Hitachi Energy, 2021; onsemi, 2026; IDA Ireland, 2026; MACOM, 2026; INSIDE Magazines, 2025; Semiconductor Sweden, 2026; BROLIS, 2026; iSANS, 2025.

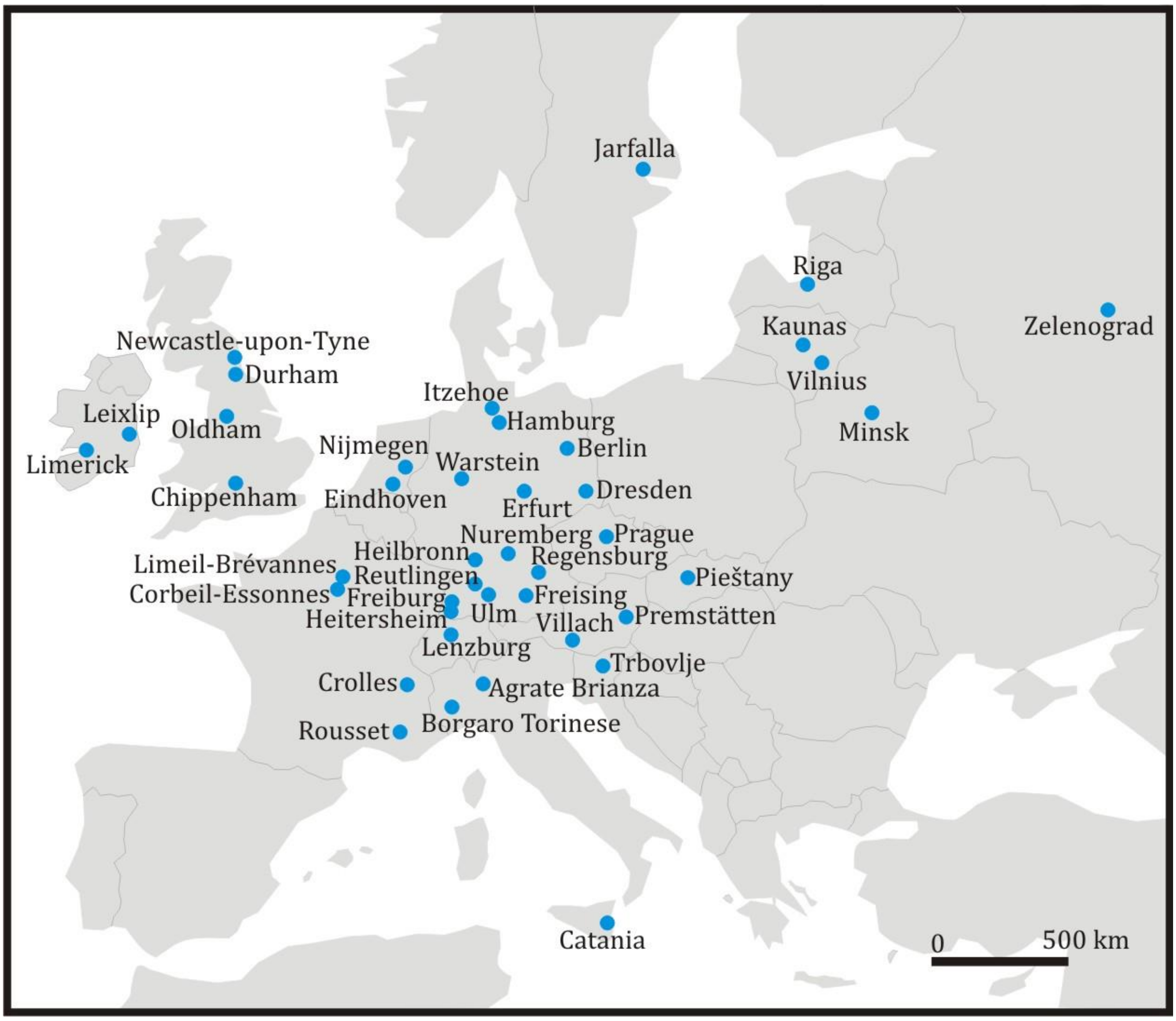

Figure 4. Semiconductor device manufacturing centers.

5. DISCUSSIONS

Global demand for electronics has grown significantly in recent years, driven by the digitalization of life and business. In 2015, global electronics sales were nearly US$2 trillion, exceeding US$2.5 trillion in 2021 and expected to reach US$3.5 trillion in 2027 (Cerutti & Nardo, 2023). In terms of semiconductors, global sales reached around US$630 billion in 2024, an increase of over 19% compared to 2023 and almost double compared to 2014 (US$336 billion). The market was dominated by the Asia-Pacific region, including Japan (US$384 billion), the Americas (US$195 billion), while Europe accounted for only US$51.2 billion. The market was dominated by sales of integrated circuits (nearly US$540 billion), mainly Logic and Memory, driven by applications related to artificial intelligence, computing infrastructure and data centers. November 2025 saw the highest monthly sales in history, with demand increasing month-on-month across all major product categories. The global chip market is expected to grow substantially in 2026 as well, reaching nearly US$1 trillion in annual sales, with growth across all regions and product categories (ESIA, 2025b; SIA, 2026).

The main problem facing Europe in this area is its dependence on external markets for the supply of various products in the semiconductor value chain, due to the complexity, geographical specialization and deep interdependencies that characterise the supply chain. In general, the United States dominates the design side, Japan the production of wafers and process gases, China the supply of key materials (gallium, tungsten, magnesium, silicon) and Taiwan and South Korea, through the foundries TSMC and Samsung, dominate chip production. TSMC is the only company that masters the most advanced nodes (2 nm), which are highly innovative and in high demand (Dauvé, 2025). Asia holds a dominant share (around

75%) of global semiconductor manufacturing capacity, with Taiwan (92%) and South Korea (8%) leading in advanced nodes (below 10 nm), while around 90% of chip assembly and testing is also concentrated in Asia, particularly in China and Taiwan (Bown & Wang, 2024; BCG-SIA, 2021; Deloitte, 2024). In terms of memory chips, which accounted for around 23% of the industry's global sales in 2022 (the most traded of all semiconductor technologies), Samsung, SK Hynix and Micron dominate almost the entire lucrative DRAM (Dynamic Random Access Memory) market (Bown & Wang, 2024).

Over the years, EU chip production has increased, but its share of global production capacity has declined significantly. In the 1990s, Europe produced over 20% of the world's chips. This decline is largely due to the rise of the fabless production model, lower manufacturing costs in Asia, and a historical focus on the needs of the automotive sector rather than on the development of high-end chips. Today, Europe accounts for around 10% of global semiconductor production (Dauvé, 2025; Meyer, 2025).

In chip production, the EU is competitive only in the DAO (discrete, analogue and optoelectronic devices) segment, with Infineon, Bosch and Osram, while for logic chips, Europe plays a minor role, with STMicroelectronics and NXP. European semiconductor companies rely heavily on suppliers and customers outside the EU. On average, in the EU supply chain, almost 80% of raw material suppliers and 63% of companies' customers are located outside the EU. Of these suppliers, the majority are based in the United States, followed by Taiwan, China, South Korea and Japan (9%) (Cerutti & Nardo, 2023). This makes the supply chain vulnerable to disruptions such as natural disasters, health crises or geopolitical tensions. Global events, such as the COVID-19 pandemic and the war in Ukraine, have exposed the weaknesses of the semiconductor supply chain and Europe's heavy dependence on foreign suppliers. About a year after the start of the COVID-19 pandemic, chip shortages have deeply affected industries around the world. In Germany, France and other countries, chip shortages have temporarily paralyzed parts of the automotive industry (Bonnet et al., 2025).

In 2013, the EU adopted a strategy to strengthen the micro- and nanoelectronics sectors (EC, 2013). Although microchip production capacity has increased substantially since 2013, it has not kept pace with global growth, so the EU's share of the global market has declined. To boost the digital transformation and Europe's sovereignty in areas such as artificial intelligence, cybersecurity and digital skills, the Digital Europe and Horizon Europe programmes (the EU's main funding programme for research and innovation) were launched in 2021 for the period 1 January 2021 to 31 December 2027 (EC, 2025a; EC, 2025b).

On 25 July 2023, the EU officially adopted a new chip law (EU Chips Act), which aims to double the EU's global semiconductor market share from 10% to at least 20% by 2030. The EU Chips Act aims to improve the EU's security of supply, resilience and technological sovereignty in chips by investing in the supply chain and by strengthening its strengths in research, design and equipment manufacturing. To support these objectives, the EU Chips Act includes public and private investments worth €43 billion, around half of which is provided by the German government (Germany Trade & Invest, 2024; ECA, 2025). Most of these funds come from industry's own resources or from Member States' budgets, with the Commission responsible for only a small part of the total, around 10% of public funding (ECA, 2025).

To boost the semiconductor sector in Europe, on 30 November 2023, the European Commission officially launched the Chips Joint Undertaking (Chips JU), a pioneering initiative dedicated to catalysing research, development and manufacturing capacities across Europe. The Chips JU programmes include the Chips for Europe initiative, which funds strategic actions such as pilot lines, design platforms and competence centres, and the ECS Research and Innovation programme, which addresses a wide range of technology areas, including artificial intelligence hardware, edge computing, cybersecurity, 6G technologies, energy efficiency, advanced packaging or photonics (CjipsJU, 2025). The Digital Europe and Horizon Europe programmes closely align with the objectives of the Chips JU, in particular through a new specific objective dedicated to semiconductor technologies.

In March 2025, nine EU Member States (Austria, Belgium, Finland, France, Germany, Italy, Poland, Spain and the Netherlands) launched the Semicon Coalition, marking an important step towards deepening cooperation in the semiconductor ecosystem in Europe, to strengthen Europe's competitiveness and strategic autonomy in the semiconductor sector by supporting research, expanding production capacity and promoting a highly skilled workforce (ESIA, 2025c).

An important step in strengthening Europe's semiconductor manufacturing capacity was the granting by the European Commission, in October 2025, of Integrated Production Facility (IPF) and Open EU Foundry (OEF) status under the EU Chips Act to four semiconductor projects across the Union. The Ams-OSRAM AG (Austria), MEGAFAB-DD of Infineon Technologies Dresden (Germany) and Catania Campus of STMicroelectronics S.r.l. (Italy) projects were granted IPF status, and the ESMC project (Germany) was granted OEF status (EC, 2025c). Both categories are essential for the EU's ambition to reduce dependence on supply chains outside the EU and increase strategic autonomy in semiconductor technologies. They will receive priority administrative support, simplified authorization processes and advanced access to pilot lines under the Chips for Europe Initiative.

Overall, the European Commission has approved state aid for several projects under the EU Chips Act until December 2025, representing a combined public and private investment of over €31.5 billion (Table 6) (EC, 2025d). These subsidies are essential for the development of the European semiconductor industry, as many steps in the production process require considerable costs. For example, building a new factory (fab or foundry) costs around $20 billion (Bown & Wang, 2024). One of the major investments is made with the involvement of Taiwan Semiconductor Manufacturing Company (TSMC), the world's largest chip manufacturer. The new company, known as the European Semiconductor Manufacturing Company (ESMC), is a joint effort between TSMC, Bosch, Infineon and NXP and aims to establish a large factory in Dresden, specializing in chips for the automotive and industrial sectors. The groundbreaking ceremony for the works took place in August 2024 (Germany Trade & Invest, 2024).

Table 6. Projects that have benefited from state aid approved by the European Commission under the EU Chip Law.

Company	Project location	Date and aid approved	Project type
STMicroelectronics	Catania (Italy)	October 5, 2022 (€292.5 million)	Construction of a silicon carbide (SiC) wafer facility using 150 mm technology
STMicroelectronics & GlobalFoundries	Crolles (France)	April 27, 2023 (€2.9 billion)	A new 300-mm FD-SOI microchips manufacturing facility
STMicroelectronics	Catania (Italy)	May 31, 2024 (€2 billion)	Building an integrated production facility for high-performance silicon carbide chips
ESMC (TSMC, Bosch, Infineon, NXP)	Dresden (Germany)	August 20, 2024 (€5 billion)	A high-performance 28/22nm and 16/12nm FinFET microchip plant
Silicon Box	Novara (Italy)	December 18, 2024 (€3.2 billion)	Advanced semiconductor packaging and testing facility
Infineon	Dresden (Germany)	February 19, 2025 (€920 million)	MEGAFAB-DD project, which can switch between discrete power and analog-mixed signal technologies
ams OSRAM	Premstätten (Austria)	February 25, 2025 (€227 million)	A CMOS - integrated production facility
Ephos	Milan (Italy)	July 25, 2025 (€41,5 million)	Development of the world's first glass-based photonic chip manufacturing plant
Onsemi	Rožnov pod Radhoštěm (Czechia)	November 20, 2025 (€450 million)	An integrated SiC manufacturing plant
GlobalFoundries	Dresden (Germany)	December 10, 2025 (€495 million)	Expanding 300mm wafer capacity for dual-use applications (aerospace and defense)
X-FAB	Erfurt (Germany)	December 10, 2025 (€128 million)	Building a new open foundry combining MEMS with innovative packaging for automotive and AI sectors (Fab4Micro)

Source: European Commission (2025d) (with additions).

Other examples demonstrate the will of European states to reduce dependence on foreign supply chains and stimulate domestic production and innovation, aligning with the EU Chips Act. Thus, the semiconductor industry in France is supported by government investment plans, such as the Electronique 2030 plan, worth around 6 billion euros. The most important investment belongs to STMicroelectronics and GlobalFoundries Fab for a jointly operated 300 mm FD-SOI microchip production facility in Crolles, which should reach full capacity by 2028 (Duncan, 2024). Also, an investment of 830 million euros, supported by the European Commission and the French state, for the FAMES pilot line, i.e. the construction of 2000 m^2 of clean rooms and the purchase of approximately one hundred new industrial equipment, was inaugurated in January 2026 in Grenoble and operated by CEA-Leti (Dauvé, 2025; EC, 2026).

In Italy, the government announced billions of euros in investments to strengthen its chip ecosystem. In 2022, it established a national chip fund (Chips Fund) for the period 2022-2030 to support R&D and industrial activities (The Italian House of Business, 2026). In the Netherlands, the government allocated 2.5 billion euros to strengthen the business climate in Brainport Eindhoven through investments in education, infrastructure and housing (NL Netherlands, 2025). Also, in 2023, the Spanish government approved the Strategic Project for the Recovery and Economic Transformation of Microelectronics and Semiconductors (PERTE Chip), with a budget of 12.2 billion euros until 2027 (financed mainly with European funds), with the aim of developing the design and production capacities of the Spanish microelectronics and semiconductor industry, covering the entire value chain (España Digital, 2023).

Despite increasing government support, in some cases very substantial, many European countries face challenges including skills shortages, intense global competition for talent or a lack of large-scale domestic manufacturing facilities. There are many views that the EU Chips Act is unlikely to be sufficient to achieve the very ambitious Digital Decade target of a 20% share of the global market value chain. This target is believed to be too ambitious, given the Commission's limited mandate and resources, the lack of coordination between countries, the reliance on Member State action, private sector investment and other factors such as energy costs (Meyer, 2025; ECA, 2025; Green, 2025).

It is estimated that Europe would need an initial investment estimated at over $300 billion to create the entire supply chain. The total development cost of a new front-edge chip (SoC) could exceed $1 billion. Additional annual costs would also be required to maintain self-sufficiency. Such additional investment would cause an increase in semiconductor prices, estimated at between 35% and 65%, which would reduce final demand and harm companies and R&D, if not supported by public subsidies (BCG-SIA, 2021).

At the same time, major players involved in the semiconductor industry (USA, China, South Korea or Taiwan) have implemented their own policies to support the semiconductor industry. In July 2022, the United States passed a historic law (CHIPS and Science Act) that provides for spending of $280 billion to stimulate scientific research and advanced semiconductor manufacturing capacity to increase US competitiveness vis-à-vis China. The bill allocated $52 billion in subsidies and tax incentives for chip manufacturing companies and $200 billion for research in artificial intelligence, quantum computing and robotics, among other areas (HAI Stanford University, 2022). In December 2022, China announced investments of approximately $143 billion over a five-year period to support domestic chip production, in response to US sanctions (Zhu, 2022). South Korea also passed legislation known as the "K-Chips Act" in March 2023, designed to boost the domestic semiconductor industry by expanding investment tax credits available to manufacturers such as Samsung and SK Hynix (Noh et al., 2023).

6. CONCLUSIONS

It is certain that human society is increasingly dependent on electronic devices, and in recent years the global demand for them has increased considerably as a result of the digitalization of life and business. In the future, this demand is expected to increase. Electronics production is heavily dependent on semiconductors, especially increasingly advanced chips, and their manufacturing is a very complex process involving hundreds of sophisticated steps and many actors.

Within the global semiconductor ecosystem, Europe stands out for its R&D capabilities, its production of chip manufacturing equipment and its highly specialized industry, such as automotive chip production. Regionally, the R&D component, including chip design, is found in almost all European countries, while the production of semiconductor equipment and devices is present in a few countries, most notably Germany.

Europe is dependent on external markets for the supply of various products in the semiconductor value chain, accounting for only 10% of global semiconductor production. The EU Chip Law aims to increase the EU's market share in semiconductors to at least 20% by 2030. Although significant funds have been allocated, achieving this target is not certain. Even so, European countries need to continue their efforts to reduce dependence on external supply chains and boost domestic production and innovation.

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Use of AI tools declaration
The author declares they have not used Artificial Intelligence (AI) tools in the creation of this article.

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The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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